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Czestochowa, Poland

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Preface

Stating that health is paramount only seems as a truism. Every person may suffer from a disease which could be either somatic or psychological, or both. It is difficult to understand why most messages relate in wide circulation only to one dimension of health, i.e. a somatic one. There is almost no discussion about the third dimension of health – social health.

Its level has a profound impact on the quality of life of a family, of towns and villages, regions, countries and finally of global society. Spiritual and material poverty, concerns about economic situation but also fear of violence and aggression expressed against other people (by individuals, criminal groups, countries and their coalitions) are a major factors of degradation of social health. On the level of public health, however, it depends how nations or social groups can overcome unauthorized violence and overt aggression.

This raises the elementary question about the methods and measures which can be used to prepare people to effectively and decently counteract violence and aggression.

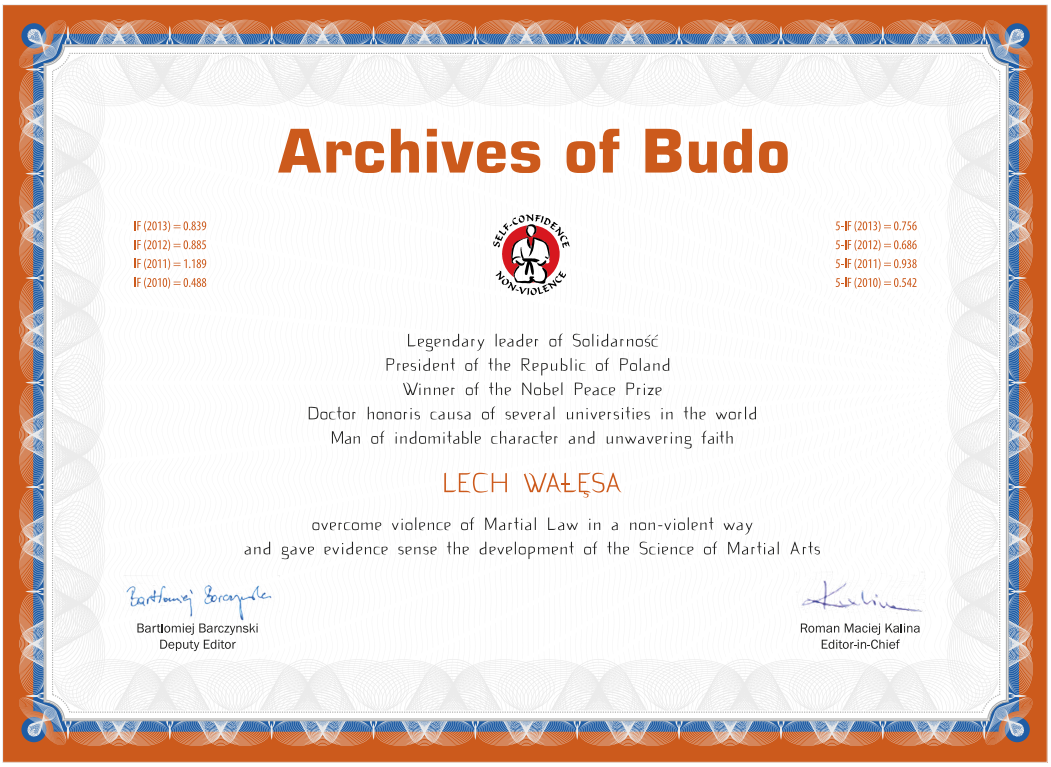
Agreement between the Jan Długosz University in Częstochowa and Archives of Budo concerning organization of the 1st World Congress on Health and Martial Arts in Interdisciplinary Approach (2014 Oct 22).

In opinion of many reasonable people, the right way consists in moral and patriotic education, responsible physical education, shaping respect for other nations and cultures. Many nations developed various forms and types of martial arts (some of them function as combat sports with Olympic status) which serve to enhance somatic and psychological health as well as to develop intellectual potential of a human being. Each martial art teaches self-defence, thus increasing personal safety. When a martial art is practiced as a combat sport, two more significant elements of moral and civic education became active, i.e. respect for human dignity and responsibility for their security. Martial arts and combat sports as a show have, on the other hand, substantial impact on the level of social health.

Bloody fights of neo-gladiators closed in cages deny healthy and educational values of martial arts and combat sports. With time, such show would escalate to become the method which degrades social health even more. Due to electronic media, such shows have global reach and are available 24 hours a day.

Lech Wałęsa, the winner of the Nobel Peace Prize, former Polish President, Doctor Honoris Causa of several universities in the Word standing at the forefront of a multimillion community of the “Solidarity movement” gave the world an example that even the most sophisticated violence may be overcome without violence.

Lech Wałęsa (on the right) together with Roman Maciej Kalina



Archives of Budo

IF (2013) = 0.839
IF (2012) = 0.885
IF (2011) = 1.189
IF (2010) = 0.488

SELF-CONFIDENCE NON-VIOLENCE

5-IF (2013) = 0.756
5-IF (2012) = 0.686
5-IF (2011) = 0.938
5-IF (2010) = 0.542

Legendary leader of Solidarność
President of the Republic of Poland
Winner of the Nobel Peace Prize
Doctor honoris causa of several universities in the world
Man of indomitable character and unwavering faith

LECH WAŁĘSA

overcome violence of Martial Law in a non-violent way
and gave evidence sense the development of the Science of Martial Arts

Bartłomiej Barczynski
Deputy Editor

Roman Maciej Kalina
Editor-in-Chief

Special certificate from Archives of Budo to Lech Wałęsa

The world is changing. Methods related to educational activities and the offer of physical activity for everyone also change. The idea involving such practice of martial arts to serve to strengthen all dimensions of health among the greatest number of people wherever they live, regardless of their beliefs, wealth, etc. is possible for implementation. One condition has to be fulfilled – to the millions of potential adepts to make available in appropriate manner the appropriate knowledge and proper motor patterns. The simplest way is the modern electronic media. However, in media dominates a pathology such as a show in which contemporary gladiator covered in blood mutilates lying and bloody opponent accompanied by the applause of the audience.

Częstochowa Declaration "HMA against MMA" is an offer to overcome this barrier of absurd. The participants of the 1st World Congress on Health and Martial Arts in Interdisciplinary Approach (2015 Sep 17-19), during the Summary of Congress adopted it unanimously. Initiative group committed to continue regular, annual congress in a symbolic acronym – HMA 2016 World Congress. The meeting will be held at the University School of Physical Education in Wrocław, Poland, October 20-22, 2016.

Prof. Roman Maciej Kalina

Czestochowa Declaration 2015:
HMA against MMA

continuous improvement of health through martial arts
as one of the most attractive form of physical activity for a human,
accessible during entire life should constantly exist in public space,
especially in electronic media,
to balance permanent degradation of mental and social health
by enhancing the promotion of mixed martial arts
– contemporary, bloody gladiatorship,
significant tool of education to aggression in a macro scale

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1st World Congress on Health and Martial Arts in Interdisciplinary Approach, HMA 2015

Long way to the *Czestochowa Declarations 2015: HMA against MMA*

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Abstract

The main questions raised in our paper regarding the following issue which is very embarrassing for global society: why there are so many people who tolerate numerous pathologies related to people fighting, including to neo-gladiators? why neo-gladiators' fights are considered equivalent with sport by media, in particular electronic ones, even though they clearly contradict the idea of "sport"? which side does the spectators of neo-gladiators' fights identify themselves with – a winner or defeated, or does it even matter as bloody show is the most important thing?

The aim of this review paper (partially falling into the category of *research highlights*) does not include full answers for the questions raised. On the contrary. We discuss a few premises, assumptions and hypothesis as well as several open questions. We believe that the issue is so important that, on one hand, it should be called into question in a broad perspective by scholars and various social entities and on the other hand it requires the necessary intensification of research and implementation into educational practice.

This brief overview of the papers published in the last 10 years mainly in *Archives of Budo*, the only one in the global space science, which is dedicated to the science of martial arts, highlight health and utilitarian potential of martial arts, combat sports and arts of self-defence. Thus, it is justified to conclude that this is a sufficient reason to spread Czestochowa Declaration „*HMA against MMA*" of 2015.

Key words: agonology • arts of self-defence • combat sports • *homo agonisticus* • neo-gladiators • science of martial arts

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Contributors: Roman Maciej Kalina, Bartłomiej Jan Barczyński conceived the study design. Roman Maciej Kalina, Bartłomiej Jan Barczyński collected the data. Roman Maciej Kalina analysed the data. Roman Maciej Kalina, Bartłomiej Jan Barczyński prepared the manuscript. Roman Maciej Kalina, Bartłomiej Jan Barczyński secured the funding.

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Introduction

The main questions raised in our paper regarding the following issue which is very embarrassing for global society:

why there are so many people who tolerate numerous pathologies related to people fighting, including to neo-gladiators?

why neo-gladiators' fights are considered equivalent with sport by media, in particular electronic ones, even though they clearly contradict the idea of "sport"?

which side does the spectators of neo-gladiators' fights identify themselves with - a winner or defeated, or does it even matter as bloody show is the most important thing?

There are no simple answers to those questions. Agonist nature of a human may only partially explain these phenomena. The awareness itself that we are *homo agonisticus* [1] is not enough. The answers require not only an interdisciplinary approach but also sensitivity, courage and certain methodology. New detailed science , i.e. science of martial arts [2-4], is an ally. The most important factor linking specialists of martial arts from the entire world (of this unique knowledge) turned out to be the journal *Archives of Budo*, which emerged in the global science space in 2005 and has been awarded with a *5-year Impact Factor* dating from the starting year [4].

It is astonishing that science about struggle (*agonology*) is a deeply esoteric science [5-7]. Five complete, but different, theories of struggle, were published in Polish between 1938 and 2000 by four Polish scientists [8-12]. It would be naive to explain that it is the language which constitutes the fundamental barrier limiting the access to agonology in a global scale. In-depth analysis of such theories indicates the possibilities of using knowledge about fighting and many practical forms of a fight between two people in a humane way with benefit for positive enhancement of all dimensions of health (somatic, mental, social) and survival abilities. There are few but important empirical evidence confirming authenticity of this statement [13-15].

Perhaps, the cause of limited access to agonology in the Society of Knowledge is more prosaic. This knowledge is in strong opposition to the interests of the people and institutions for which bloody fighting are the basis for lucrative business.

The aim of this review paper (partially falling into the category of *research highlights*) does not include full answers for the questions raised. On the contrary. We discuss a few – in our opinion significant – premises, assumptions and hypothesis as well as several open questions. We believe that the issue is so important that, on one hand, it should be called into question in a broad perspective by scholars and various social entities and on the other hand it requires the necessary intensification of research and implementation into educational practice.

Two special layers of homo agonisticus nature – destructive (toxic) and creative ones

There are enough historical facts as well as theoretical and empirical arguments to formulate the following hypothesis – agonistic nature of a human being is determined by two competitive layers: destructive (toxic) and creative. This means that one of the inherent features of *homo agonisticus* is a permanent internal struggle, i.e. a fight with oneself [6]. This relation was accurately formulated by Mahatma Gandhi in his maxim: *"Good and evil must exist side by side, a man should make a choice"*. Professor Rudniański has quoted this maxim in his fundamental work entitled *A Compromise and a Struggle* [10]. The authors of the Saint Books (especially *The Old Testament* and the *Bhagavad Gita*), historians, philosophers, writers, and poets point out to the possibility of overcoming the toxic layers and activate the creative potential of agonistic human nature for thousands of years [6].

If the hypothesis is true, if Mahatma Gandhi and the authors of the Saint Books are right and if it is true that people pathologically predisposed to extreme destructive measures constitute a margin in the popular, then what are the reasons that this issue has still been ongoing for thousands of years. One of them certainly includes susceptibility of homo agonisticus for activating toxic layer on certain circumstances, even on a large scale. Totalitarian regimes would not be created. It would be difficult to recruit terrorists, create conflicts between social and ethnic groups and effectively merchandise aggression on unprecedented scale, etc. It is impossible to escape the conclusion that the algorithm "*aim – fire – forget*" widespread in computer games is a product of homo agonisticus with very high toxicity index. Computer players prone to activating this layer of their agonistic nature are likely to become ideal candidates for operators of modern destruction measures over long distances.

There is, however, another side of this phenomenon – the human right to a dignified, happy life and to protect these values. It is, therefore, counterproductive to ignore judicious defensive education and to base defence on multiplied aggression. This principle is

universal as it fills action from micro to macro scale. However, the consequences crossing the criteria of self-defence by an individual may be suffered only by the perpetrator of this act (although it is opposite in many cases). The nuclear retaliation may result in complete annihilation.

For thousands of years, people used to settle fights for death and life through direct struggle. Regardless whether they fought one against another or thousands against thousands, each person directly experienced emotions related to injuring and killing the opponents or subordinating them. Furthermore, the one who survived, either as a winner or defeated, gathered experiences which are difficult to unambiguously define and classify from contemporary perspective.

Three assumptions are, however, justified:

preferred martial arts, combat sports and arts for self-defence indicate indirectly that either destructive (toxic) or creative layer of real and potential fighters are activated in given culture;

legal gladiators' games based on severe fighting measures (strikes, etc.) stimulate destructive layer, while those based on mild and relatively mild measures (tying the opponent up, i.e. specific control over violence) stimulate the creative layer;

restrictions imposed by authorities on close-contact fights (leaving aside wars and military training) reflect the attempts to mitigate the pathology in a culture born out of repeated viewing of violent and bloody battles.

Respect for human dignity, physicality and following the rules which are to protect mental and somatic integrity of all participants in exercises and fights are a proof of educational and healthy values of martial arts and arts for self-defence

John Harasymowicz very aptly defined the essence of learning martial arts: "Struggle reveals different sides of human nature – fear, aggression, pride, vanity, skills, physical predispositions, knowledge and interdependence between those features. Learning of martial arts allows to conclude that fear of being defeated paralyses human ability for proper, intelligent action, that aggression obscures cognition and that vanity, lack of physical predispositions, knowledge, perseverance and skill are suicidal. Such learning develops the attitude of vigilant observer and skills to act in accordance with the laws of nature, highlights own weaknesses and necessity to cooperate with the others to overcome them. Training develops human predisposition, allows for overcoming fear and anxiety which generate aggression towards other people. It is, in spite of appearances, a way to non-aggression" [16, p.10].

Harasymowicz does not classify martial arts either in terms of preferred fight measures or of cultural and geographical context. Prophylactic and therapeutic potential of martial arts is a universal property. Although there is enough evidence that health training of Buddhist monks is based on martial arts and that the phenomenon of *Japanese Budo* [17] is closely associated with the busido culture (physical and ethical education of Samurais) but it may also easily be argued that enlightened people were aware of the educational and therapeutic value of martial arts (advantages of chivalrous education) everywhere where the rational society emerged.

Nitobe Inazō (1862-1933), the author of *Bushido: The Soul of Japan* shows similarities of education through martial arts in European and Japanese cultures in different periods [18]. Nitobe Inazō (economist, author, teacher, diplomat and politician of Japanese epochs: Meiji, Taishō and the beginnings of Shōwa) published this book in 1900 at first in English and afterwards it was translated into Japanese. In the final recommendation, he outlines in bold the perspective of universal application of busido „(...) **school of martial prowess or civic honour** (...)" [18, p. 303].

In Greece during Homer era (8 c. BC) and during times he describes, the following combat rules were applied: save anyone who humbles oneself and asks for mercy; respect the messenger; maintain truce; allow to bury the dead; refrain from boasting over a dead body [19,20]. Homer [21] provides excellent descriptions of fights conducted during Olympic games in honour of Patroclus, the leader of one of the Achaean tribes, killed at Troy (12 c. BC). Over one third was constituted by fights which nowadays may be qualified as combat sports (boxing, wrestling, fighting in armour, which would be analogous to fencing and *kendo*, although *kendo* has different cultural roots).

Descriptions of these fights reveal their educational and therapeutic nature for the fighters but also for spectators, mainly other warriors. The most prominent leaders, the bravest, most experienced and fairest ones, were the judges. During wrestling fight, Odysseus tripped Aias up with one sneaky strike which however astounded the crowd (it showed disapproval of this

Figure 1A. Light punch with right fist in fingers.

Figure 1B. Left hand diverge it at least few centimetres in the direction of the force.

act). When Achilles, eminent leader, saw Odysseus' struggle with Aias and understood that it would not be settled with fair methods and that it turns into tricky fight, he said: "Stop the fight and refrain from hardship that destroys power. You are both winners. The prize belongs to both of you" [21, p. 547].

When during fight in armour aimed to pierce competitor's armour and "draw blood drop", Diomedes tried to hit Aias in the neck with a spear, terrified spectators cried to stop the fight and award the prize to both fighters. The fight was stopped and Diomedes received first prize for the advantage he had over his competitor.

Homer described also effective and decent behaviours during tournament battles. During boxing fight, Epejos with his own hand hold Euryale, falling to the ground, after the strike. The principle of being "*effective and decent*" thus stems from the times prior to ancient Olympism. This is an important message that clever use of martial arts may stimulate constructive layer of agonistic nature of human being for the benefit of certain unit and the entire population.

There are two issues governing reasoning, which are related to education and health values of sport and not just a specific martial art of art of defence.

First of all, "*The Olympic motto „«Citius, Altius, Fortius» expressing the aspirations of the Olympic Movement*" [22, p. 23] is flawed in the sense that it prefers the so-called energetic sports (athletics competitions, swimming, triathlon etc.) and is an incentive for illegal support of training to satisfy these aspirations. There are many examples justifying the hypothesis that failures in the Olympic movement and sport in general should only be seen in literal sense and not in a metaphoric one by many entities. It is difficult to count on success without respecting fundamental ethical norms in martial arts and games.

Secondly, boxing and each combat sport in which a knockout is an acceptable way of winning excludes both the health recommendations and statement that such provision contradicts respecting human (opponent) dignity. The statistics are clear. According to data from October 2011, since 1890 1,865 boxers have died during the fight [23].

Nevertheless everyone can perform a simple experiment that demonstrates the scale of health risks faced by the boxer, taekwondo athletes, etc. in comparison to neo-gladiators. Light punch with right fist in fingers (from the outer side) of vertically positioned left hand will diverge it at least few centimetres in the direction of the force – this discloses natural amortisation (Figure 1A and 1B). Repeating this activity with right hand resting on the table (supination) will cause pain during strike, because the laws of physics are objective (Figure 2). The third principle of dynamics is applicable here. While assessing the opponent's dignity and a sense of self-respect by the participants in such fight, we rely on imagination, sensitivity and sense of aesthetics of each reader.

What is the greatest attraction for the spectator of neo-gladiators games? Watching bloodied neo-gladiator lying in a cage who is effectively constrained by the opponent and is unable to either avoid or cushion the blows to the head? Admiration for the opponent covered with blood who delivers the strikes? Or perhaps both?

The genius of Professor Jigoro Kano (1860-1938) made him create at the end of 19th c. a martial art which was modern but at the same time deeply rooted in the tradition of samurai combat fighting. In 1882, he officially established the institute of *Kodokan*, which still functions under the name of *Kodokan Judo Institute*. The ideals of judo include personality development, health improvement,

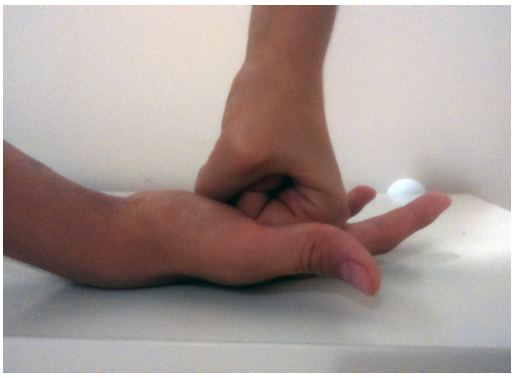

Figure 2. Light punch with right hand resting on the table.

respect for the dignity of every human being, effectiveness of actions but also respect for universal values. Forty years after founding the *Kodokan*, Kano decided to make public the most general ethical principles of judo: "maximum efficient use of energy" (*seryioku-zenyo*) and "mutual prosperity for self and others" (*jita-kyoei*) [24]. Nowadays, there are numerous *departments of judo therapy* at Japanese universities. Promotion of healthy aspects of judo dominates in sport. Nevertheless, in the view of global society, judo is known as one of the Olympic disciplines among other combat sports (the first of the Far East origin).

Jigoro Kano started to restore traditional martial arts. Experts and promoters of other martial arts followed his steps in Japan (***karate, kendo***), in Korea (***taekwondo***) and in China (***kung-fu, wu shu***), etc. This trend fell on fertile ground in many countries after the dissolution of the Soviet Union. The turn of 20th and 21st c. also revived interests on the border of arts of self-defence and dance: Indian ***kalaripayattu*** [25, 26], Brazilian ***capoeira*** [27].

A separate issue is raised by establishment of the arts of self-defence in 20th c. which are not rooted in the traditional military training: ***aikido*** of Morihei Ueshiba (1883-1969) based on gentle and relatively gentle counteractive measures; ***hapkido*** of Yong Shul Choi (1904-1986), a combination of gentle, relative gentle and heavy counteractive measures; ***krav-maga*** of Imi Lichtenfeld (1910-1998), a combination of aggressive defence with offensive techniques.

Unfortunately, Olympic champions of judo and other combat sports, representatives of many restored and established martial arts engage in bloody fights in cages. This is no longer a sport. Thus, their presence in neo-gladiators group by no means negates the health and educational values of the majority of martial arts, combat sports and arts of self-defence.

Milestones

Apparently the oldest description in writing of hand-to-hand fighting comes Babylonian-Assyrian poem of Gilgamesh [28,29] from the third millennium BC [30]. According to the legend, Chinese martial arts originated during the semi-mythical Xia Dynasty more than 4,000 years ago [31]. However, the earliest references to Chinese martial arts are found in the 5th century BC (which mentions a hand-to-hand combat theory, one that integrates notions of "hard" and "soft" techniques).

According to Godlewski, it was in ancient Egypt where the skill of hand-to-hand fighting was considered as art. Traditionally, heir to the throne was raised with a group of boys born on the same day. Together with future pharaoh, they participated in military exercises, such as archery, weapon use and hand-to-hand fighting. The most valuable source is the painting of the burial chamber in Benni-Hassan dating back to the twelfth dynasty (1950-1900 BC) – it shows 400 pairs of wrestlers practicing [31]. This is a kind of first substantive collection of wrestling techniques. Painting from the Amonnos' chamber (approx. 1550 BC) showing warriors fighting with sticks and hand-to-hand has also substantial cognitive value. This proves that martial arts were based on gentle and relatively gentle fighting measures most likely as a part of military training of that times. Similar scene is presented on the bas-relief in the temple of Ramses III in Medinet Habu (1180-1170 BC) [28].

Hand-to-hand fighting and fights with weapons performed by ancient Greek warriors (described by Homer [21]) may be considered as idealisation of the future ancient Olympism. First documented Olympic Games were held in 776 BC. Wrestling were included in the programme of 18th Olympic Games (688 BC). The winner had to knock the opponent down three times. The sources also recall second type of wrestling (fight in horizontal posture – *acrochirismos* [28]), in which surrender was signalled by raising a hand. Competition in *pentathlon* was conducted during 18th Olympic Games. The one who had defeated two opponents in two various disciplines and in wrestling could become the winner.

Fist fight was also included in the 23rd Olympic Games (688 BC). It eventually became the most bloody show during the event. *Pancratium* (derived from *pan* – total, omni and *krátos* − strength, power, authority) was very popular among the spectators. This was a combination of boxing and wrestling. This discipline was introduced to the programme of the

33rd ancient Olympic Games (648 BC). Defeated competitor signalled surrender by raising one hand (there were only three principles – no one could attack opponent's eyes, genitals and bite them). According to the historical records, most of the fighting in *pancratium* ended with surrender and fatal accidents were extremely rare. More gentle form of Olympic *pancratium* was intended for young boys.

Paintings from the sixth century BC discovered in Tarquinia prove that Etruscans had passed on extremely bloody show to Rome – fights with wild animals supervised by specialists called *bestiarii* [32]. These were not gladiators.

At the time when European civilisation gradually degraded martial arts and hand-to-hand fighting in frame of ancient Olympic Games, in India there was a martial art established which actually shares properties of arts of self-defence and dance [25, 26]. Sabellian paintings (4th century BC) present gladiators' fights. Bas-reliefs which showed gladiator's struggles appeared on the burial urns from Etruria in the third century BC. It is not certain whether Romans took over the concept of "gladiator" from the Etruscans. Until the first century BC, Romans believed that the terms "gladiator" and "Sabellians" are synonymous. Long before the Colosseum, the largest amphitheatres (Gladiator centres) were located in Campania – in Capua and a smaller town of Puteola [32].

In 200 AD, Emperor Septimius Severus prohibited the fights of female gladiators. Emperor Constantine the Great issued an edict abolishing the gladiatorial games (326 AD), while Constantius (357 AD) enacted edict forbidding, under pain of penalty, soldiers and officials in Rome to participate in gladiatorial shows. In turn, Emperor Honorius abolished the existence of gladiators' schools in Rome (399 AD). However, gladiators' games were finally banned in 681. This precedence was not stopped by heroic deed of Telemachus (holy Almachius), a monk from Asia Minor, who in 404 threw himself into the arena to separate the fighting gladiators and was torn to pieces by an angry mob [32].

Previously, the Olympic Games were abolished by emperor Theodosius the Great (393 AD). The reason was their pagan character and lots of violations of competition rules and principles – including a ceasefire or participation of only Greeks in the competition [33, p. 430].

According to Japanese legend, *sumo* fights (type of Japanese wrestling and in fact combination of ritual and sports elements [34]) were performed (mainly at the courts of feudal lords) at the turn of old and new era. They were however more brutal and often ended with death of one of competitors. First historically proven *sumo* fight took place in 642 AD at the court of Empress Kōgyoku (642-645) [Wikipedia]. In 734, *sumo* became part of the court tournament and from 824 court competitions were held since 16th day of the month. In 1185, *sumo* was trained at military training in Japan [35]. Some sources report that the first Japanese *sumo* championships were held in 1630.

The end of 16th century resulted in the decline of popularity of *sumo*. Spectacular *sumo* (*kenjin-sumo*), but also illegal street fights, were established. Edict issued in Edo (1648 AD) prohibited *sumo* street fights, *sumo* fights of women in the light entertainment houses and women's fights with the blind. After a show of samurai Ikazuki Gondaiyu, ban of street fights was revoked but approval of the authorities, a kind of "licence", was required each time [35]. Popularity of street fights in Japan has a long tradition. Pursuant to Article 13 of *Goseibai-shikimoku* (1232 AD), the samurai could be banished or his goods could be confiscated for public beating of any person [36].

In Europe, the first handbooks (with drawings) for wrestling and fencing emerge at the end of 14th century. The oldest ones include: *The Code of Johann Lichtenauer* (1389) *and the Code of Thalhofer*. *The Code of Wallerstein* is published in the 15th century [28, 37]. Mister Lion (Lewen-Luwen) recommends "fencing wrestling" [31,37,38]. In his work Messerfechten (fencing with knives), Leckchner encourages the pooling of skills of knife fighting with wrestling. Meister Ott (Master Otto), also known as a master of Austrian wrestling, developed the wrestling manual [37].

As a healthy exercises and optimal means of physical education, wrestling is recommended by: Geronimo Cardano (1501-1576), a mathematician and physician of the Italian Renaissance; Łukasz Ogończyk Górnicki (1527-1603), humanist of the Polish Renaissance, poet, political commentator, secretary and chancellor of Sigismund August of Poland; Girolano Mercuriale (1530-1606), Italian physician; Michel Eyquem de Montaigne (1533-1592), moralist and humourist of French Renaissance.

However, Church was opposed to wrestling. It issued orders, edicts and bulls in 1588, 1611 and 1655 which contain directives prohibiting participation of plebeian adolescents in wrestling fights

[37]. Church was also an adversary of the fights, similar to enlightened Europeans and the people of Pennsylvania in the United States. Tournament fights with blunt weapon and often with blade weapons were popular in medieval Europe. At the beginning of 17th century, it is estimated that approx. 30,000 persons lost their life in fights in France, that is more than in any war of the times. The quick-tempered ones could not be stopped by church curses, infamies, banishments or even death penalty for killing the opponent. In 19th century, duels with pistols (which can no longer be classified as hand-to-hand fighting) became popular which resulted in higher mortality [39].

The year 1719 may be considered as symbolic rebirth of boxing. James Figg (1684-1734) opened than *English School of Arms and Art of Self-Defence Academy* in London, proclaimed himself master of boxing and until 1730 he fought against candidates (he lost one of them and this was the only one in 250 that he had lost). In 1726, Catherine I introduces rules to fist fights common in Russian towns. First world championships for professionals were held in 1816 in St. Luis, USA. Boxing has been present in the programme of modern Olympic Games already from 1904 (Saint Louis). However, it was not included in the Olympic Games held in 1912 in Stockholm, because boxing was prohibited in Sweden.

Momentous initiation of the revival of martial arts by professor Jigoro Kano in healthy and educational dimensions as well as positive followers were described in the previous chapter.

The fights of the Olympic Champion in boxing (1960) Muhammad Ali (born Cassius Marcellus Clay Jr.) with the legendary master of Japanese martial arts, Antonio Inoki [40] may be considered as symbolic moment initiating compilation of the fights between representatives of various martial arts and combat sports (fight took place in Tokyo on June 26th, 1976).

The word “compilation” is to clearly distance the message from semantic and actual abuse of the term martial arts combined in expression *mix martial arts*. Judo Olympic Champion, Siergiej Novikov (1976), developed the concept which meets both educational and healthy criteria, that is a *unifight* which is an authentic compilation of various combat sports and martial arts. In 2000, he registered the *International Unifight Federation* in Paris. While describing *Unifight* (Universal Fight), Wikipedia mentions *Parenthood – Modern martial art*. Sport competition in *unifight* consists in:

a) overcoming special obstacle course, which also includes shooting pneumatic or laser gun and throwing to the target (adults - a special sport knife, children - tennis ball);

b) hand-to-hand on the ring (or mat) which may be performed in several ways:

during *light* formula, only overthrows and throws are permitted,

semi-light formula allows also throws, locks and chokehold,

during *classic* formula, struggle is performed in special gloves and with protectors on their heads; in addition to throws, overthrows, locks and chokeholds, strikes with hands and legs can be used only in vertical posture (children formula does not allow strikes);

Winter Universal Fight – obstacle course was replaced with in cross-country skiing (at a distance of 2 x 200 meters) combined with shooting to the goal and fighting in the ring – fight on the snow limited to throws and overthrows [41].

According to Wikipedia, the first documented use of the name *mixed martial arts* was in a review of Ultimate Fighting Championship (UFC 1) by television critic Howard Rosenberg, in 1993. Proponents of MMA list ancient *pancratium* as its ancient archetype. Thus, they prove that they consciously distance themselves from humanistic and healthy values of martial arts. It is, therefore, difficult to count on the fact that most of them ever take the trouble to explore the meaning of the rules formulated by Jigoro Kano, which nowadays may be combined with every responsible practice of martial arts: “mutual prosperity for self and others” (*jita-kyoei*).

Figure 1 illustrates this combination of facts with key importance for the purpose of this paper in a synthetic way.

Conclusion

Unfortunately, media perpetuated the caricature and pathology of martial arts. The knowledge that within 20 years (1990-2010) a fall rose high in a global scale in the rankings comprising causes of years lived with disability as well as years lost to premature death, does not reach ordinary citizen. Among 25 causes of those negative phenomena the fall is ranked tenth [42]. Safe fall exercises are the basic training element in may martial arts, combat sports,

Table 1. Milestones of martial arts, combat sports, arts of self-defence (shaded fields), gladiator games and restrictions on the principles of hand-to-hand or their legality – schematic layout of the main facts.

Basic on soft or/and relatively soft means	Date	Basic on acute means
	Alternative: **date** [basic on soft and acute means] V {restrictions} V important information	
	second half **3000** BC [**hand-to-hand fighting** in Babilon]	
	c. 2000 BC [**kung fu** in China]	
wrestling in Egypt	**1950-1170** BC	
fight on sticks in Egypt	**1550-1170** BC	
	12th – 7th century BC [in Greece occasional **Warriors games** – see Homer *Iliad*]	
wrestling since 18 ancient Olympic Games	**708** BC	
	688 BC	**fist fight** (**boxing**) since 23 ancient Olympic Games
	648 BC [**pankratium** (compilation wrestling and boxing) since 33 ancient Olympic Games]	
	6th century BC	Etruscans had passed on extremely bloody show to Rome – **fights with wild animals**
	4th century BC	**gladiatorial fighting** Samnites
	3th century BC	**gladiatorial fighting** in Rome
kalaripayatt in India (border of arts of self-defence and dance)	**c. 3nd** century BC	
	200 AD	{Emperor Septimius Severus prohibited the **fights of female gladiators**}
	326 AD	{Emperor Constantine the Great issued an edict abolishing the **gladiatorial games**}
	357 AD	{Constantius enacted edict forbidding, under pain of penalty, soldiers and officials in Rome to participate in **gladiatorial** shows}
	393 AD {Olympic Games were abolished by emperor Theodosius the Great}	
	681 AD	**gladiators' games** finally banned
	642 AD [first historically proven ***sumo*** fight in Japan]	
	1185 AD [***sumo*** was trained at military training in Japan]	
	AD {pursuant to Article 13 of *Goseibai-shikimoku* the samurai could be banished or his goods could be confiscated for public beating of any person}	
	Medieval Europe [tournament fights with **blunt weapon** and often with **blade weapons** were popular]	
	14th century in Europe, the first handbooks (with drawings) for **wrestling** and **fencing**	
as a healthy exercises and optimal means of physical education, **wrestling** is recommended by poets, physicians, humanists, moralists etc.	second half **16th** century AD	
orders, edicts and bulls which contain directives prohibiting participation of plebeian adolescents in **wrestling** fights	**1588, 1611, 1655** AD	
	1630 AD [the first Japanese ***sumo*** championships]	
	1648 AD {Edict issued in Edo prohibited *sumo* street fights, *sumo* fights of women in the light entertainment houses and women's fights with the blind]	
	1684 AD [after a show of samurai Ikazuki Gondaiyu, ban of **street fights** was revoked but approval of the authorities, a kind of "licence", was required each time]	

cd. Table 1. Milestones of martial arts, combat sports, arts of self-defence (shaded fields), gladiator games and restrictions on the principles of hand-to-hand or their legality – schematic layout of the main facts.

Basic on soft or/and relatively soft means	Date	Basic on acute means
	1719 AD [symbolic rebirth of boxing] James Figg opened than *English School of Arms and Art of Self-Defence Academy* in London]	
	1726 AD	{Catherine I introduces rules to **fist fights** common in Russian towns}
	1816 AD [first world **boxing** championships for professionals in St. Luis, USA]	
	1904 AD [**boxing** has been present in the programme of modern Olympic Games in Saint Louis, USA]	
	1912 AD {**boxing** was not included in the Olympic Games held in Stockholm, because boxing was prohibited in Sweden}	
capoeirain in Brazil (border of arts of self-defence and dance)	**18**th century AD (first descriptions [27])	
Professor Jigoro Kano create ***judo*** and officially established the institute of *Kodokan*, which still functions under the name of *Kodokan Judo Institute*	**1882** AD	
	20th century AD restore traditional **martial arts**	
aikido of Morihei Ueshiba (1883-1969)		
	hapkido of Yong Shul Choi (1904-1986)	
		krav-maga of Imi Lichtenfeld (1910-1998)
	26 Jun 1976 the fights of the Olympic champion in **boxing** (1960) Muhammad Ali vs. legendary master of **Japanese martial arts**, Antonio Inoki	
	1993 AD	the first documented use of the name ***mixed martial arts*** was in a review of Ultimate Fighting Championship by television critic Howard Rosenber NEO-GLADIATORSHIP
	2000 AD [Siergiej Novikov , **judo** Olympic Champion (1976), registered the *International Unifight Federation* in Paris] He developed the concept which meets both educational and healthy criteria, that is a ***unifight*** which is an authentic compilation of various combat sports and martial arts	

arts of self-defiance. There are empirically verified programmes to diagnose susceptibility to injuries during the fall [43-48] and prevention of body injuries based on safe falling exercises [14,15,49], especially people belonging to high risk groups of balance loss and fall or collision with vertical obstacle – the blind and people with eye diseases [49,50], people after limb amputation [50,51], elderlies [49,52,53], patients with mental impairments [54], etc.

Perhaps, a relatively large number of people can associate the effects of training combat sports and martial arts as a preparation for self-defence. But the majority of them agree with the opinion that self-defence based on gentle measures to deal with aggression [55,56] is ultimately more effective than responding to aggression with multiplied aggression (MMA model). Therapeutic and preventive effect of the first model has been proven. As a result, aggression and sense of fear are reduced and indicators related to life quality increase [13-15]. Leaving aside *neo-gladiatorship* model and understandable effectiveness of preparing soldiers, policemen, anti-terrorists, body guards and prevention workers to fight in close contact [57-62], there are many empirical proofs that aggression and aggressiveness in sport and training of intervention forces are counterproductive in terms of both expected effectiveness and health effects [14,63-67].

Interdisciplinary research under the new sub-discipline – science of martial arts [4] – provides a lot of empirical arguments related to diagnosing of functional capacity of combat sports athletes [68-71], their structure and composition of the body [72-75],

coordination [76-78] etc. which is closely linked with prevention of somatic health. Thus, during 10-year edition *Archives of Budo* provides reliable review of the health effects on people practicing different combat sports and martial arts around the world.

It is difficult to find direct evidence that there is a relationship between the level of physical health and social health and martial arts, combat sports, arts of self-defence preferred in given society. These preferences should be treated in comprehensive manner and not just based on indicators of crime, robberies, suicides [79], etc. It is necessary to analyse educational systems, entertainment offer provided in the media, to assess similarity of interpersonal behaviours and models imposed by the heroes (positive and negative) of the virtual world of media, everyday reports about events full of emotions and brutality (violence and aggression are attractive commodity for the media), behaviours of celebrities and sports stars in conflict situations and, unfortunately, the settlement patterns of hand-to-hand fighting by neo-gladiators.

There are, however, positive signs of social interest in humanistic and healthy values of martial arts which gives hope for effective development in the future as a *martial arts bibliotherapy*. Scientific work of Alexander Dolin *Kempo – die Kunst des Kampfes* [80] became a bestseller in Germany. Works of Carl De Crée dedicated to unknown or little-known aspects of judo, published in the *Archives of Budo* in three cycles (in 2009 and 2011 co-author Jones LC) [81-89] support the phenomenon of Dolin's publications. The phenomenon of *budo* as an effective system of education system in all types of schools in Japan and a very popular form of recreation is another matter [17]. This perspective is supplemented by perpetuated tradition of cyclical *World* Scientific *Congress of Combat Sports and Martial Arts* and available knowledge gathered in the subsequent proceedings [90-92].

This brief overview of the papers published in the last 10 years mainly in *Archives of Budo*, the only one in the global space science, which is dedicated to the science of martial arts, highlight health and utilitarian potential of martial arts, combat sports and arts of self-defence. Thus, it is justified to conclude that this is a sufficient reason to spread Częstochowa Declaration „*HMA against MMA*" of 2015.

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1st World Congress on Health and Martial Arts in Interdisciplinary Approach, HMA 2015

Budo practice for post-stroke patients – reflections on historical and scientific issues

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Abstract

Background and Study Aim. While many persons who participate in Budo-based rehabilitation profess improvements in functional ability, and self-efficacy in daily life, it has been extremely difficult to collect quantitative scientific data on the effectiveness of Budo-based rehabilitation. This difficulty is due in part to the wide variety of disabilities. The aim of this present study, therefore, is the scientific data on the effects of Budo rehabilitation targeting post-stroke patients.

Material and Methods. The six post-stroke patients were subjected to a period of 4-months Budo practice. Participant data was measured according to Single Subject Experimental Design guidelines. The following tests were used to gather data: 5 repetitions of the sit-to-stand test, 6 meter timed walk test, and Test of Dynamic standing balance. Data was also collected through interviews and self-report regarding: fear of falling and general health.

Results. Data showed that post-stroke patients experienced improved muscle strength, balance, postural control, walking ability and performance of daily activities as a result of the Budo-based rehabilitation in this experiment. Patient self-reporting revealed a reduced fear of falling and indications of a healthier self-image as a result of Budo practice. Patient interviews suggest that the sociality and culture of Budo had a powerfully positive psychological effect aiding the rehabilitative process.

Conclusion. Data clearly showed that Budo-based rehabilitation effectively delivered general quantitative improvements as reported by post-stroke patients. Not only could the patients perform daily-life tasks better, they exhibited less fear, more self-efficacy, and a healthier self-image.

Key words: jodo • judo • karate/karatedo • kendo • person who with disabilities/the disabled • physiotherapy/physical therapy/PT • SSED/Single Subject Experimental Design

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Contributors: Kantaro Matsui, Agneta Larsson, Annika Näslund conceived the study design. Kantaro Matsui, Agneta Larsson, Annika Näslund collected the data. Agneta Larsson, Annika Näslund analysed the data. Kantaro Matsui, Agneta Larsson, Yoshimi Yamahira, Annika Näslund prepared the manuscript. Agneta Larsson, Annika Näslund secured the funding.

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Introduction

The body movements of Budo were made for the techniques in battlefields. On the battlefield in ancient Japan, there was no referee to say "Yame (= Stop) !". When someone sustained an injury, that person had to keep fighting on the battlefield. For instance, in the situation when a warrior injured his arm he had to fight using the other. This way of thinking was an important consideration when Budo originally developed. Japanese warriors developed their techniques considering what would happen if they got injured and thenceforth what they could do to survive. This means that Budo has, from its early origins, been an open system for persons with limited body motor control - the disabled.

The Budo Charter [1], Budo kensho, said "*Seeking the perfect unity of mind and technique, Budo has been refined and cultivated into ways of physical training and spiritual development. The study of Budo encourages courteous behaviour, advances technical proficiency, strengthens the body, and perfects the mind*".

When able-bodied people start to practice Budo, no one asks about the existence of the scientific evidence for these claims that Budo practice encourages courteous behaviour, advances technical proficiency, strengthens the body, and perfects the mind. But when people with disabilities start to practice Budo, many people start questioning the existence of scientific evidence. For detractors and sceptics, like coaches or the families of disabled persons, spreading this message required scientific evidence.

For the last fourteen years, I, professor Matsui have organized over 70 lectures on the topic of Budo for the disabled, and I have worked with over 3000 participants in workshops and demonstrations. I have collected many personal testimonies from disabled participants regarding the rehabilitative benefits of Budo practice. While many persons who participate in rehabilitation treatments based on Budo practice profess improvements in functional ability, coordination, and self-efficacy in daily life, it has been extremely difficult to collect quantitative scientific data on the effectiveness of Budo-based rehabilitation.

In order to provide scientific evidence that Budo is good for the disabled, it is necessary to increase the number of the disabled who practice Budo. Initially I had envisioned a study which compared two large groups of disabled persons-those who practiced Budo and those who did not. However, this experiment was never realized.

These failures occurred due to 3 research problems: 1) The number of disabled people willing to subject themselves to Budo-related scientific studies is quite low.

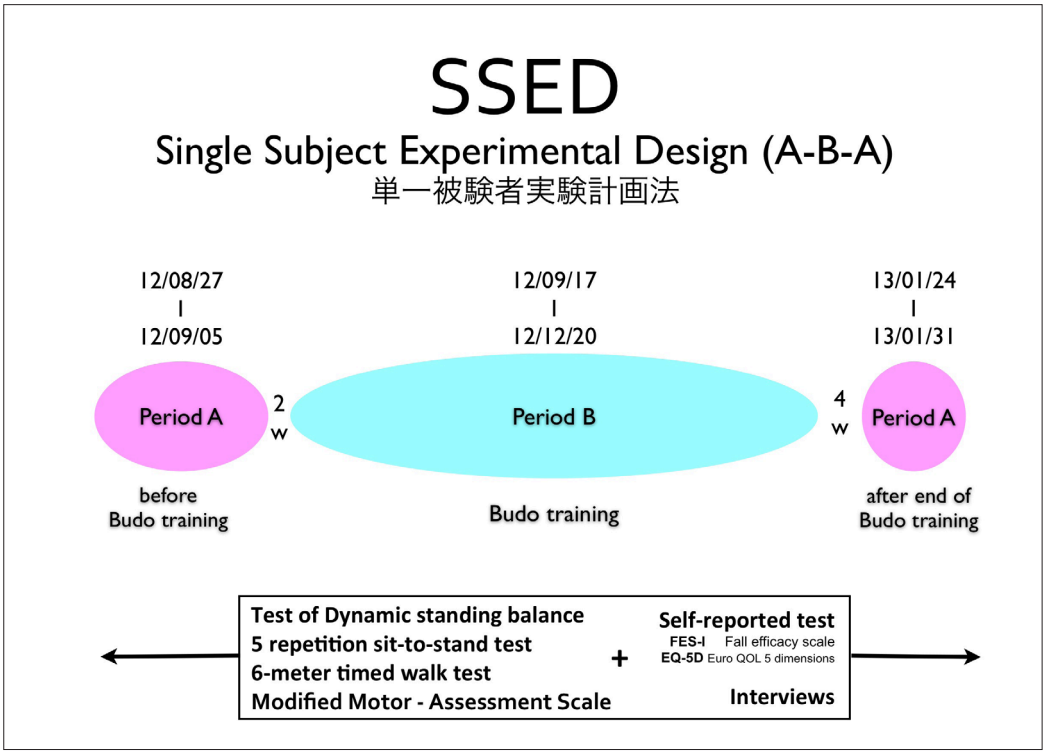

Figure 1. Single Subject Experimental Design

2) There is such a range of symptoms, conditions, and needs even for people suffering from the same disability. This makes designing large studies, which usually require certain homogeneity, practically impossible.

3) It can take a very long time for people with disabilities to see rehabilitation results. For instance, it took 6 years for one young man to learn how to raise his left arm [2].

Material and Methods

In collaboration with my two colleagues who have long experience in clinical physiotherapy research, Dr. Naslund, expert in motor control for disabled people [3] and Dr. Larsson, expert in clinical tests [4], from the department of Health Sciences, Luleå University of Technology, Sweden, a single subject experimental design (or SSED for short) was designed [5]. This research design makes it possible to analyse only one participant and we used a standard "A-B-A" experimental structure to collect our data (figure 1). That is, tests procedures were performed twice a week during the experiment's three general phases: before (period A), during (period B), and after (period A) the Budo-based rehabilitation.

Period A, before the Budo practice phase, provides us with a lot of data on just a few willing participants. With less participants needed, it was possible to find subjects with the same kind of disability- in this case, all six of our participants were post-stroke survivors. Though the severity and nature of stroke varied considerably even amongst these 6 subjects, the benefit of SSED-type experiments is that we were able to modify the design of the experiment to address the progress of motor function of each subject.

Using this kind of experiment, we were able to identify and implement the optimum treatment for each research subject while also providing objective evidence regarding the effect of the Budo-based rehabilitation.

Baseline measurements were taken two weeks before the Budo intervention, during the 3-month Budo rehabilitation intervention, and then, final measurements were taken one month after the conclusion of the intervention. Tests included: "6-meter timed walk" test, "5 repetition sit-to-stand" test and "dynamic standing balance" or "step" test. This testing was supplemented with a few self-reported tests (for "Fear of Falling" and the "Health Status" of our subjects) as well as subject interviews[6,7].

The Budo-based rehabilitation in a facility in Northern Sweden was instructed by Mr. Pontus Johansson, a former Swedish Paralympic swimmer, who suffers from cerebral palsy. The Budo-based rehabilitation in this experiment incorporates three kinds of Budo practices on rotation. Because stroke symptoms vary considerably from person to person, group exercises (based on judo, jodo, karate and kendo) were adapted on both the group and individual levels in order to meet every patient's individual abilities and rehabilitation objectives. So that, for instance, the first day's rehabilitation session is a jodo (kendo) style practice; the second day is a jodo style practice; the third day is karatedo practice; the fourth day, returns to jodo; and so on. In this experiment, the participants had a 45-minute practice, twice a week, (every Monday and Thursday). Two physiotherapy students assisted the participants during the Budo rehabilitation sessions.

The variety of different practice kept participants' motivation engaged and allowed participants to work on different muscles and motor challenges from session to session. At the beginning of each practice session, the physical progress of all participants was tested by a team of physiotherapists.

The experiment was approved by the Ethical Board, Umeå University, Sweden, Dnr:2012-261-31M.

Results

The diagram below (figure 2) features the combined results of all six patients for the sit-to-stand test. The numbers at the bottom of the graph indicate weeks of the experiment. During baseline measurements, some participants took up to 30 seconds to complete just five repetitions of standing and sitting. From the baseline to the end of the 3-month rehabilitation, the time was at least halved for almost all of the participants. These good results persisted, but reduced slightly after a month from the end of Budo-based training (figure 2).

The diagram (figure 2) illustrates the large individual differences between the stroke participants in their ability to perform the repeated tests. The intra-individual variation in the test results emphasise the importance of several baseline measurements. Keep in mind all participants did not reach steadiness in their baseline measurements.

Let's take an in depth look at one of the subjects, represented by the blue line. Subject 5 was a 69 years old man. Four years ago, he suffered from a cerebral infarction which affected the right side of his body.

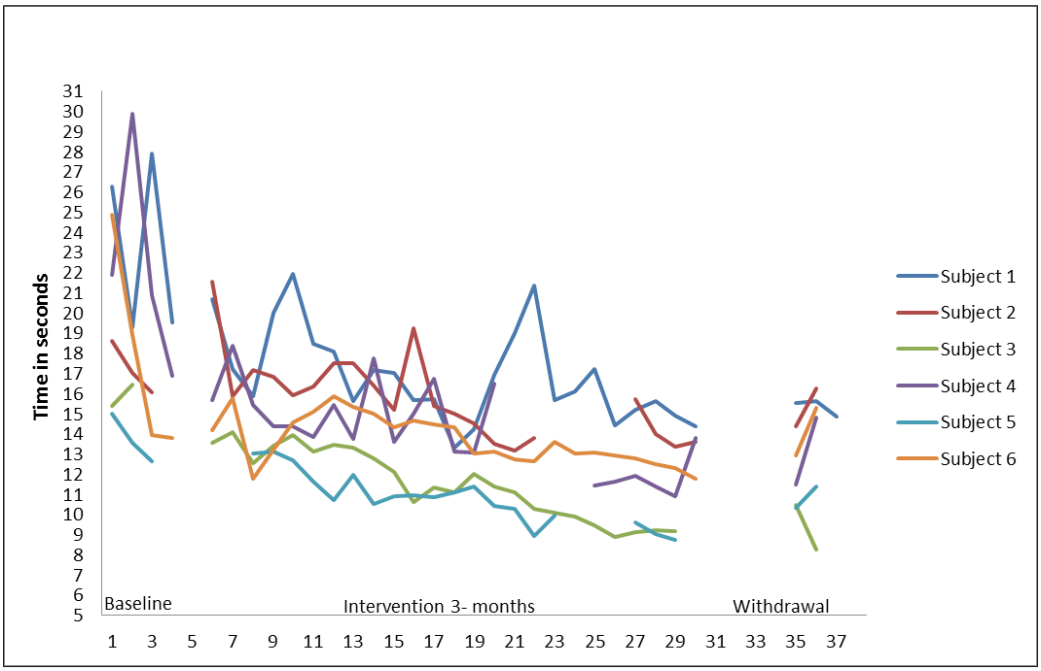

Figure 2. 5 repetition sit to stand test for the six participants

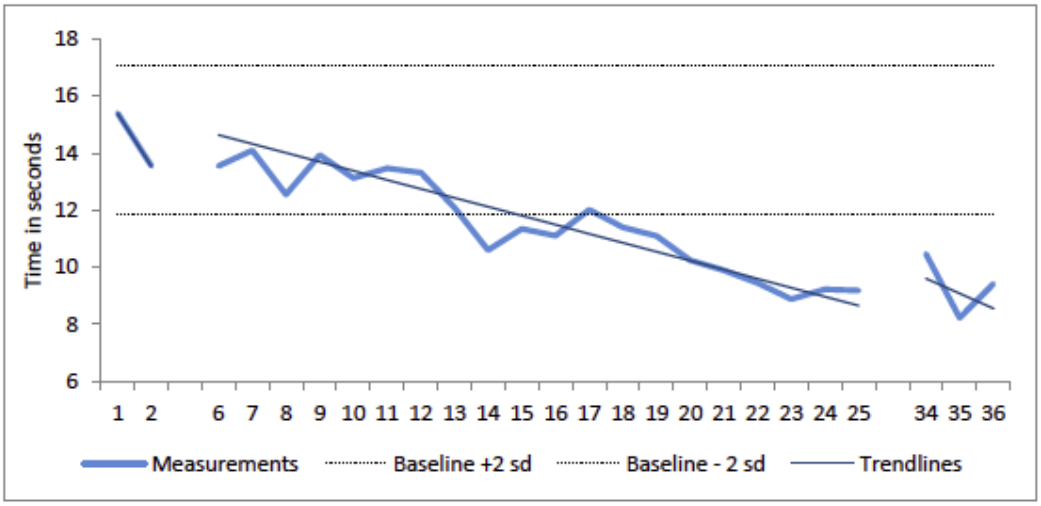

Figure 3. 5 repetition sit to stand test

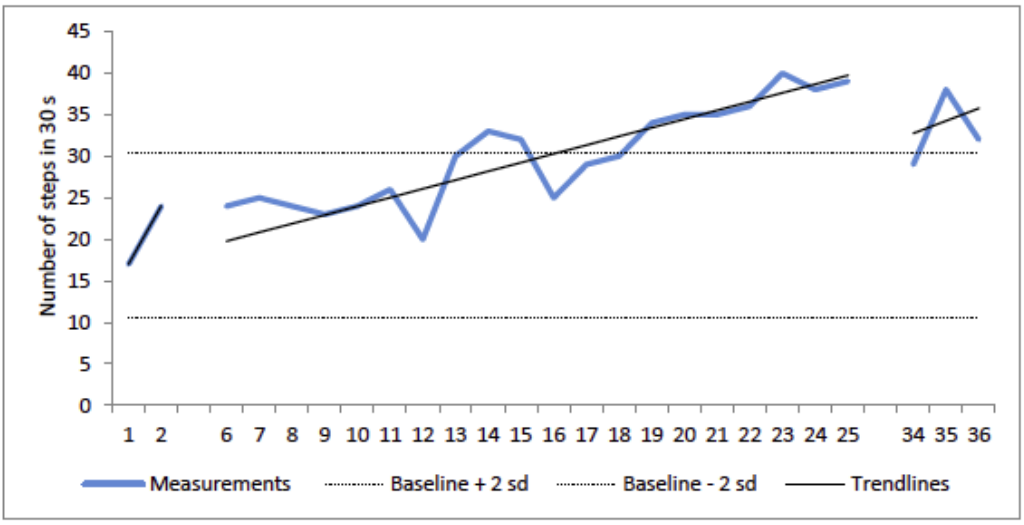

Figure 4. Test of dynamic standing balance (step test) standing on affected leg

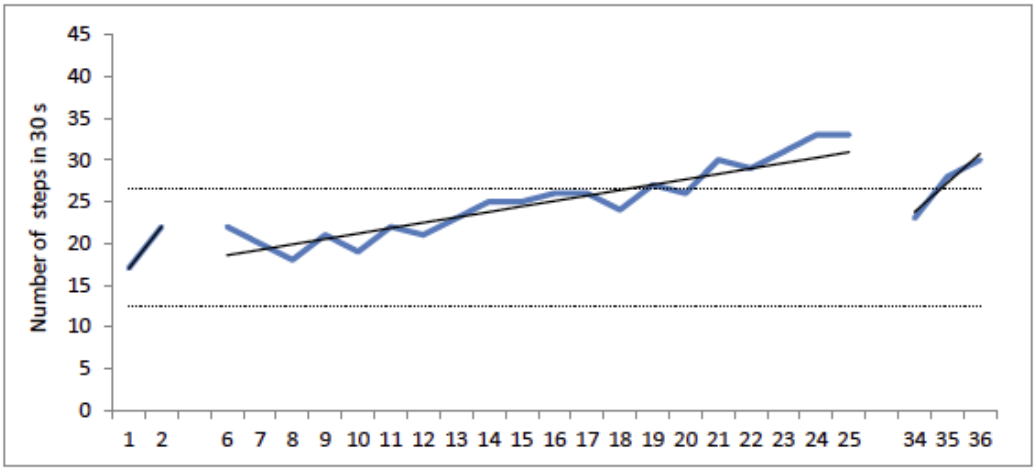

Figure 5 .Test of dynamic standing balance (step test) standing on unaffected leg

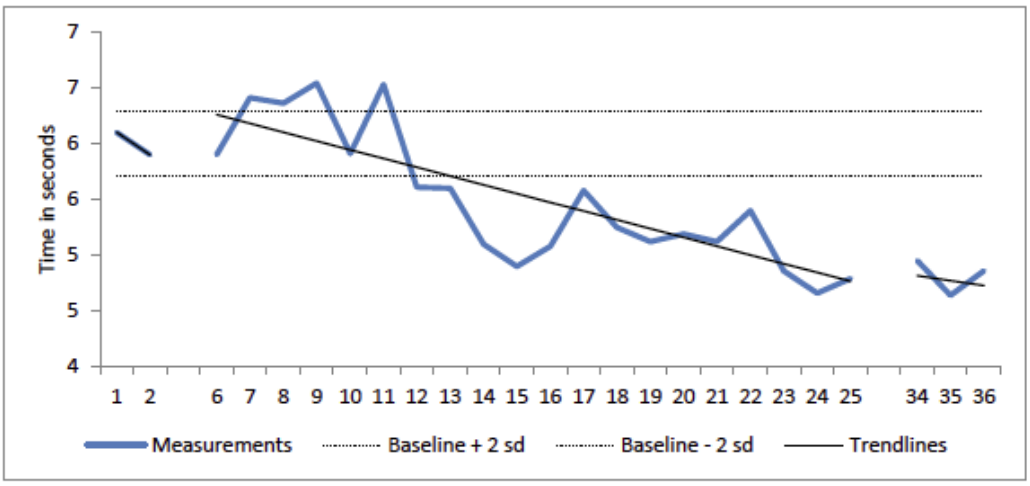

Figure 6. 6-meter timed walk test

The diagram above (figure 3) illustrates the subjects results for 5 repetitions of the sit-to-stand test. His baseline average for the test was 14 seconds. By the end of the experiment, he was completing the test in 9 seconds.

The above diagrams (figure 4 and 5) illustrate his results for the test of dynamic standing balance. In this test, the subject was standing on one leg and asked to move his other foot from the floor to the top of a box as many times as possible during a 30 second time period. The test was performed separately for each leg.

Before the Budo-based intervention, he could only step up on the box a total of 21 times in a 30 second period with his unaffected leg (figure 4). By the end of the intervention, he could step up on the box 38 times - an improvement of 55%. Lifting his affected leg showed similar improvement, from 19 steps to 34 steps in a 30-second period – also an improvement of 55% (figure 5).

In the 6-meter timed walk test (figure 6), the subject was timed walking a short distance. He began the experiment with a baseline average of 14 seconds. By the end of the experiment, his 6-meter walking time improved by 5 seconds.

Data showed that post-stroke patients experienced improved mobility, balance, muscle control, and walking ability and performance of daily activities as a result of the Budo rehabilitation.

Data was also collected by patient self-report: fear of falling (FES-I) and general health status (EQ5D). Interviews conducted with participants were designed to judge the psychological, social, and cultural qualities of improvement. According to FES-I tests, patients self-reporting revealed a reduced fear of falling after the Budo intervention. According to EQ5D, index improved self-reported health status indicates a healthier self-image as a result of Budo practice. Patient interviews suggest that the sociality and culture of Budo had a powerfully positive psychological

effect aiding the rehabilitative process. Interviews show that patients were intrigued and inspired by the cultural image of the Samurai, Japanese warrior, associated with Budo traditions. Furthermore, patients identified with the metaphors of combat and struggle in Budo. This identification improved the overall quality of rehabilitation.

In the interview, subject 5 expressed that before the Budo practice he couldn't get up from the floor into a standing position without someone's assistance or a crutch and was not able to walk without them as well. Budo-based rehabilitation was fun for him. The image of being a Japanese worrier encouraged him and drove his motivation for training. After the intervention he could stand up from the floor to a standing position by himself. He no longer felt frightened to go outside or move independently. So he could also walk 1500 meters without any support. He eventually even took up swimming again.

Discussion

It is incredible that these participants showed such improvement long after they had suffered a stroke. In the case of two subjects: 6 months to a year had passed since their stroke, for three subjects 3 - 4 years, and in the case of one subject, 15 years had passed since he suffered stroke. We can argue that there is a reason that Budo has been shown to be so remarkably effective in Sweden.

If the stroke victims don't show improvement in rehabilitation, they may believe that they will probably never improve. As a consequence, stroke survivors begin to fall into routines which reinforce these poisonous misconceptions regarding the limitations of their bodies.

The strength of Budo as rehabilitation method lies in the fact that it represents a new cultural context, outside Western people's experience. It is a new opportunity for people with disabilities to reassess and redefine what they can do. Every tyro who starts to practice Budo, must learn new movements. For disabled persons with poor motor control, this can be particularly challenging, and also enlightening, as they discover the abilities they never knew they had by being put in a context of a Samurai in a battle.

Falling is very scary for people with disabilities. Not only is it dangerous, it is a distressing moment of weakness and helplessness. Practicing Budo gives practitioners a familiarity with the floor, which, for the disabled, imparts an enormous feeling of self-efficacy and self-reliance. In Sweden, the common rehabilitation does not include extensive practice moving on the floor and moving up and down from the floor. But for instance, in Judo, new students spend days and days practice "ukemi", falling technique, learning how to twist their bodies in order to fall correctly. Disabled Judoka, a person who practices Judo, must learn this too.

Those people with disabilities might look at this exercise and say: "I can't do that." However, this simple, repetitive falling exercise is incredibly helpful. It stimulates new muscles activities and improves coordination. More importantly, it reduces fear of falling by teaching disabled Budoka, a person who practices Budo, an essential life skill: how to get up again. The Budo concept of "Be a Samurai warrior" drive the patients' motivation.

Rehabilitation is not just a physical challenge but a mental one as well. Budo practice teaches us that the body and mind are one. For any physical improvement to take place, a person must learn to believe that such improvement is possible. Because the Dojo is a place removed from those habits and routines of everyday life that reinforce disempowering and debilitating ideas. Budo practice becomes an opportunity to develop a new mental paradigm to confront one's preconceptions. In the Dojo, Mr. Johansson, coach of Budo-based rehabilitation in this experiment, always said "Don't think about what you can't do, think about what you can do." This mental shift is a powerful rehabilitative tool.

The fact that Budo, from the perspective of the Swedish, is a Japanese cultural product also plays an important part in the success of Budo-based rehabilitation methods there. Not only does Budo practice share similar body movements and exercises to standard physical therapy and rehabilitation, it re-contextualizes the rehabilitation in a very powerful way. Unlike standard rehabilitations, the Budo Practice is through the Dojo context not a reminder of one's infirmity. The Dojo context challenges the disabled to push themselves in ways they did not think possible, but only if participants are sincere and respectful to Budo, to the Sensei (master of Budo), and to each other.

Of course, the Japanese have a more complicated understanding of Budo. Japanese people know Budo as exhausting, painful, and smelly... But to the Swedish, the Budo-based rehabilitation has none of these connotations. To them, (at least in the beginning, perhaps) practicing Budo means you can pretend to be a Samurai warrior. For the purposes of rehabilitation, identifying with such a figure, like a

Samurai, for instance-associated with self-reliance, resilience, danger, and mystery-can prove to be a powerful and helpful guiding motivation for the disabled in rehabilitation.

Conclusions

Data clearly showed that an individually-tailored Budo rehabilitation effectively delivered general quantitative improvements with reported post-stroke patients. Not only could the patients perform daily-life tasks better as a result of a Budo rehabilitation, they exhibited less fear, more self-efficacy, and a healthier self-image. Interviews suggest that Budo-based rehabilitation is qualitatively different from other exercise-based rehabilitation. This is so because Budo uses a metaphysical approach in its holistic Budo tradition.

We conclude that adapted Budo practice, the Budo-based rehabilitation in this experiment, proved to be effective for post-stroke participants in Sweden. A similar system could be implemented as a rehabilitation method for other kinds of disabilities that have similar symptoms.

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Acceptance and sublimation of aggressiveness and violence in Japanese martial arts: from a view-point of the history of the techniques and equipment used in *budo*

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Meji University, Japan

Abstract

Japanese martial arts have been developed and passed down under the proposition of 'sublimating the violence inherent in the martial arts while accepting it.' Let me cite a few examples of this from my perspective as a researcher with a focus on the history of the techniques and equipment used in the martial arts. In kendo, the Japanese art of fencing, a shinai (bamboo sword) and several pieces of protective armour—men (face guard), kote (hand and forearm protectors), dou (breastplate), and tare (groin and leg protectors)—have been developed, which allow a kendoka (kendo practitioner) to make direct full-contact blows and thrusts that were impossible to make in Kata Kenjutsu (traditional swordplay). Through the use of this armour, we can ensure safety and give consideration to avoiding fatal injury while accepting—to an extent—the violence inherent in martial arts. The main purpose of the art of grappling in jujutsu or judo is to gain a victory by holding down, 'pinning' or otherwise restraining an opponent, not by delivering a death blow. Such a proposition can also be seen in binding techniques where the knots and lashings used to tie up an opponent are designed so that the opponent can be released at any time. As can be seen from the above, the concepts inherited by Japanese martial arts are effective measures by which to explore the theme of the HMA Congress.

Key words: injury • jujutsu • judo • kendo • sword

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Introduction

First of all, I would like to express my respect to the mission of the Congress, 'a scientific argument justifying the permanent strengthening of all dimensions of health through rational practice of martial arts as a counterweight to the expansion of a culture of violence'. My believe is that the legacy that Japanese martial arts have inherited can contribute to the mission of the Congress to a certain degree. In my opinion, since the late Muromachi period, Japanese martial arts have been developed and passed down under the proposition of 'sublimating the aggressiveness and violence inherent in the martial arts while accepting it'. As the field of my research is the history of the techniques and equipment used in the *budo*, especially *kendo*, I will explain my position by presenting a few examples from my perspective.

Examples in swordplay and *kendo*

Rites relating to swords date back to the age of Gods and ancient times, and the techniques used to make a warped sword—called *wantou*, a characteristic sword of Japan—to the middle of the Heian period (10th Century). The origin of today's *kendo* (an athletic sport in which a practitioner wears four pieces of protective armour—*men* (face and head guard), *kote* (hand and forearm protector), *dou* (breastplate) and *tare* (groin and leg protector)—and delivers blows and passes to an opponent with a bamboo sword called a *shinai*) can be found in *shinai uchikomi geiko* (practice striking and thrusting with *shinai* and protective gear) that had been established in the middle Edo period (1710's).

Artifice of *shinai* in the *Shinkage-ryu* School and its significance

In chronological order, the *hikihada shinai* was devised by Nobutsuna Kamiizumi in the late Muromachi period (around 1550's). The leather wrapping on a sword scabbard is called the *hikihada*, and a *hikihada shinai* is a piece of bamboo measuring around 38-39 inches (97-100 cm) in length inserted into a *hikihada* with a split from the centre to the front. It also is known as a *fukuro shinai*. In a practice or a match (duelling) of that time, a practitioner usually used a wooden sword, but it was not uncommon for real swords to be used, which might occasionally result in wounds or death. With the invention of the non-painful and non-lethal *fukuro shinai* by Kamiizumi, practitioners of the school of Kamiizumi (the Shinkage-ryu School) could practice direct full-contact blows against each other, and were no longer limited to *sundome* (non-contact) blows.

Kamiizumi was the lord of Ohgo Castle in Kohzuke Province (present-day Gunma Prefecture). After losing a battle with the Hohjo Clan, Kamiizumi surrendered the castle. During his time with the Nagano Family, whom he served thereafter, he suffered misery due to the fall of castle. Eventually, he embarked on a training tour around all of Japan with his disciples, and mastered swordsmanship and the art of war. Kamiizumi was the master of three key origins of swordsmanship: the Nen-ryu, Shinto-ryu and Kage-ryu schools. His most important act was to extract *kimyo* (a secret distinct from other schools) from the Kage-ryu School and established the Shinkage School.

Specifically, *kimyo* means the techniques and theory known as *marobashi*. This is a smooth circular and free motion conducted according to an opponent's action without deviating to any of the four dimensions—*ken* (attack), *tai* (defence), *hyo* (front), *ri* (back)—and resembling a round ball rolling on a board in body, mind and sword (Ref. *Seiden Shinkage-ryu* by Toshinaga Yagyu). This marked a conversion from *setsunintou*, sword to kill people by overwhelming an opponent by power and speed; to *katsuninken*, sword to take advantage and control of opponent's attack (the terms *setsunintou* and *katsuninken* are derived from *Zen* words).

The time during which Kamiizumi lived (1508? – 1577?) was the middle of a turbulent warring period in the Age of Civil Wars. Why then did Kamiizumi dare to devise the *fukuro shinai* and the theory of *marobashi* in such times? From the age of his maturity to his later years, the production, distribution and use of guns increased in Japan and the gun played the major role on the battlefield. It is presumed that Kamiizumi was aware of the limitations of battles among individuals armed with the Japanese sword, and looked to a way of keeping swordsmanship alive in such times. The techniques and the theories created by Kamiizumi were handed down to the Hikitakage-ryu School and the Yagyu Shinkage-ryu School which were derived from the Shinkage-ryu School.

Kagetomo Hikita (1537? – 1605?) was one of the early disciples of Kamiizumi. Hikita served the Hosokawa Family. When he was on the verge of turning 60, Hikita asked for leave and left on a training tour (knight errantry) around all of Japan from 1595 to 1601. During his training tour, the Battle of Sekigahara—the biggest battle in Japanese history—took place in 1600. What drove Hikita in his golden years to go on a training tour around Japan in such turbulent times was a sense of crisis that the Shinkage-ryu School established by Kamiizumi had

split into several sects in which the instructions and the understanding differed among students.

According to *Hikita Bungoro Nyudo Seiunsai Kaikokuki*, which described the training tour of Hikita, he faced 24 opponents in matches during the training tour. The breakdown of weapons that the opponent used in the matches was: wooden sword 10 people; *fukuro shinai* 5 people; stick 2 people; cane 1 person; either a stick or a cane 1 person; and unknown weapons 5 people. No opponents used a real sword, and the majority of opponents used a wooden sword in the match. Furthermore, no description appeared in the book of Hikita killing or injuring an opponent or of he himself being injured.

The savage atmosphere that was seen in the matches of Musashi Miyamoto who walked across the provinces of Japan in later years was not felt in *Hikita Bungoro Nyudo Seiunsai Kaikokuki*. Of course, even a wooden sword has lethal potential and some of Hikita's opponents used a metal-reinforced wooden sword or a stick measuring 152 to 182 cm in length. Hikita's courage in fighting his opponents with a *fukuro shinai* measuring just 100 cm in length and his ability to gain victories in all the matches is deserving of admiration [1].

During Kamiizumi's tour, one opponent, Munetoshi (or Muneyoshi) Yagyu, who was the leading swordsman in the *Goki* (five provinces closely to the Emperor Home City Kyoto, an area to the south of Kyoto, Osaka and Nara prefectures), lost his match with Kamiizumi and became a disciple of Kamiizumi. Kamiizumi presented Munetoshi with a challenge to devise ways of achieving a state of *mutou-no-kurai*, and Munetoshi eventually reached that stage. *Mutou* means, in one aspect, a *jujutsu* technique in which one captures an armed opponent using one's bare hands. According to Heiho Kadensho, *mutou* means putting one's self at an advantage by utilizing timing and spacing with an opponent, even under an unfavourable situation in which an opponent uses a spear or *naginata*, in contrast to the defender's sword of normal length, or where an opponent uses a sword of normal length in contrast to the defender's knife.

It is a secret principle and the essence of the Yagyu Shinkage-ryu School that in a relative relationship with an opponent, the first step is to give scope to the opponent's force; and the second step is to take control of that force using a small weapon or even with one's bare hands. Paradoxically, the Shinkage-ryu School took the position that masters such as Kamiizumi, Hikita and Munetoshi Yagyu—who had reached a state of *mutou-no-kurai*—could fight sufficiently well with just a *fukuro shinai*—regardless of how strong the opponent's weapon was.

A son of Munetoshi, Munenori Yagyu (the author of the *Heiho Kadensho*) who served the Tokugawa Family as a sword instructor, applied the concept of *setsunintou* and *katsuninken* to politics in his understanding. Force is violence, and a weapon is an unfortunate and ominous instrument in the first place (the concept of *setsunintou*). However, Munenori developed a theory that stated that killing a bad person (*setsunintou*) could save the lives of many people (*katsuninken*). In other words, the use of a weapon for building peace changes the unfortunate and ominous *setsunintou* into *katsuninken*. His way of thinking was reflected during the reign of Iemitsu Tokugawa, the third shogun of the Tokugawa Family, who adored Munenori as a mentor or father figure.

The foundation of the Tokugawa shogunate, which lasted for 260 years, was said to be established during the reign of Iemitsu, to which the Yagyu Shinkage-ryu School made a substantial contribution. Iemitsu frequently held cavalry battle games called *shinai-uchi* in the fields near Edo as training for samurai. Samurai who attended *shinai-uchi* training used a *fukuro shinai* as a weapon, not a sword or a wooden sword. It is presumed that *shina-iuchi* were held to release the pent-up energy (violence) of *samurai*. However, Iemitsu's plan was actually to limit the weapons that could be used in offensive and violent scenes to the *fukuro shinai*, which was a symbol of peace.

Improvement in protective armour and establishment of *shinai uchikomi geiko* in the Jikishinkage-ryu School

Based on the findings of the research into the history of swordplay, training armour was used in the late 1600s. However, this armour was fairly primary the face guard (*men*) made of bamboo strips not metal strips, and there was no padded cap inside—it was simply placed on the head. In the same manner, the hand and forearm protector (*kote*) was created based on the glove for the right hand that was used in Japanese archery (*yugake*). Those were also in a primary form, and had the purpose of minimizing injury during practice with wooden swords [2].

Sword practice at that time consisted mainly of practicing forms (*kata*) and, except for the schools such as the Shinkage-ryu School that used *fukuro shinai*, most schools used wooden swords and practitioners practiced *sundome* (non-contact) blows. Additionally, by virtue of the stable feudal system, opportunities to fight in the battlefield had decreased in the extreme,

which reduced the fighting spirit of samurai. Thus swordplay came to respect the beauty of style, including accomplished form and elegant action, which was called *kaho*.

In the 1710s, Mitsunori Yamada and his son Kunisato Naganuma, who belonged to the Jikishinkage-ryu School—which was part of the lineage of the Shinkage-ryu school, improved the training armour to depart from the *kaho* trend and establish sword training that was genuinely useful and effective. The *men* was fitted with a padded cap and the *dou* was made from bamboo based on battle armour (*takegusoku*). With a *fukuro shinai* of 3 feet (91 cm) in length added, *shinai uchikomi geiko* was established so that practitioners could make full contact blows [2]. In other words, they sought to replicate battle while freeing practitioners from concerns about injury while allowing the aggressiveness and violence inherent in swordplay, and also to attain the purpose of training for educating *samurai*.

Development of *shinai uchikomi geiko*

In the 1750s, *shinai uchikomi geiko* that used training armour—*men*, *kote* and *takegusoku* —was encouraged also in the Nakanishiha Itto-ryu School. Each school in the domain started to adopt the practice of disciplinary training using training armour. In the 1780s, Sadanobu Matsudaira, the lord of the Shirakawa Domain (later *roju*—the shogun's council of elders), urged the inclusion of elements of actual battle and discipline in all martial arts including sword and spear. Sadanobu ordered the domain to do so saying "The logical school is popular in recent swordplay as is the case with *Zen*. However, swordplay is supposed to study victory or defeat in the course of nature by striking each other without thinking logically. We should learn from schools teaching the art of the spear and the swordplay involving thrusting and striking while wearing training armour."

Around the same time, Yasuchika Matsudaira, who was the lord of the Mimasaka/Tsuyama Domain and had a deep friendship with Sadanobu, unified the equipment to be used in sword and spear training. Students in swordsmanship schools were required to wear *men* and *kote* and use a *fukuro shinai* regardless of the school. Likewise, students in spearmanship were required to wear *men*, *kote* and *takegusoku* (*dou*), and use a *tanpoyari* (spear with a cotton or leather tip stuffed with crumpled cotton) that was made by each school. Yasuchika encouraged matches with other schools inside and outside the domain and integrated the schools based on the results of the matches (a school whose winning percentage fell below 50% was disbanded).

The background to the use of such disciplinary training and the encouragement of matches with other schools in the Shirakawa and Tsuyama domains was that both domains were relatives of the Tokugawa Family (*Shinpan*), although they were located on opposite sides of Japan, and geographically stood at the forefront in confronting outside feudal lords of powerful domains (Tozama Yuhan). Therefore, both domains placed importance on these policies as measures to educate *samurai*.

The encouragement of *shinai uchikomi geiko* missed the original purpose (secure the elements of actual battle and disciplinary training) over the course of time, which increased the number of those who participated simply seeking the amusement and fun of the swordplay wearing training armour. That was a remote cause of swordplay uniting with competition performances in the later times [3].

After the establishment of the feudal system, training tours around the country (knight errantry) or matches with other schools were prohibited in public because they might cause trouble. However, from the 1790s onwards, some people went on training tours pretending to go on pilgrimages to places such as Ise or Konpira shrine, and positively exchanged information on sword techniques and how to make training armour. In the 1830s, the training armour had a close performance to that of the today's armour, and a *shinai* or called *wari-shinai*, was employed that was made of a large piece of bamboo split into 4 or 5 parts, nearly the same as today's *shinai*.

A particularly strong fighter was Susumu Ohishi, who was a feudal retainer of the Yanagawa Domain in Chikugo. Standing 2.12 m tall, Susumu was a master of the spear, and he would come uninvited to training halls in Edo and defeat everyone in sight using a *naga-shinai* of 5 feet 3 inches (about 161 cm) in length. Therefore, each training hall had a *naga-shinai* as a countermeasure when fighting against Ohishi. Additionally, foot movements called *okuri-ashi* or *fumikomi-ashi* (stepping-in) were frequently used that had the same footwork as the foot movements used in today's *kendo*.

As seen from the above, although *shinai uchikomi geiko* was developed to attain the elements of real battle and disciplinary training in the beginning, it improved to using nearly the same equipment and techniques as today's *kendo* and united the technique that deviated from a real battle with the use of sword,

in other words, competitive techniques (a major example being *fumikomi-ashi*).

Subsequently throughout the 1850s, the techniques of swordplay were divided into two types; techniques to be used in *kata* or a fight with a real sword, and techniques for competition. As a major example, we note Shusaku Chiba, who was the founder of the Hokushin Itto-ryu School (lineage of the Nakanishiha Itto-ryu School). Shusaku systematized techniques unique to swordplay using a *wari-shi-nai*, including *fumikomi-ashi* stepping, and used them separately from the techniques for *kata* or fighting with a real sword.

On the other hand, Nobutomo Odani who belonged to the Jikishinkage-ryu School and served as a chief of the *shogunate* military academy (Bakufu Kobusho) aimed to find a compromise between the elements of real battle and disciplinary training and the equipment and techniques unique to the swordplay with the use of a *shinai*. As a representative example of his efforts, Odani set the length of *shinai* as 3 feet 8 inches (about 115 cm) as a rule at the academy, which was nearly the same length as the *shinai* used in today's *kendo* of 3 feet 9 inches (about 118 cm).

Judging from the equipment and the technique, *kendo* had already been provided with the completeness and the same content as today's *kendo* by the end of the Edo period. It can be said that *kendo* is a physical exercise culture in that it avoids deviation from the elements of real battle and disciplinary training as far as possible, while allowing the aggressiveness and violence inherent in swordsmanship to a certain extent and, at the same time, generates and passes on the competitive techniques unique to swordplay using a *shinai*. These characteristics of *kendo* have allowed it to be passed down until today as a measure for recreation or education based on the safety secured from the use of training armour and a *shinai*.

Examples of *jujutsu*, *judo* and *hojojutsu* (art of the arresting rope)

Since the area of my research is *kendo*, I have given long description of *kendo*. I will now introduce some examples of *jujutsu*, *judo* and *hojojutsu* in the following limited space.

The techniques of *jujutsu* and *judo* in Japan were originally derived from the techniques of grappling with an opponent in battle whilst wearing armour. Among the techniques of grappling, the art of grappling (so-called *katamewaza*, including holding down, choking and joint-locking) is effective in one-on-one fighting on the battlefield, but not always effective for a fight against numerous opponents. Rather, throwing or striking and kicking might be more effective in that case. Striking and kicking techniques may have killing power, but the main purpose of their use is to make an opponent wince once when they are used in fighting or the art of self-defence.

The art of grappling, particularly choking, likewise has killing power—depending on the manner of use; however, it is an effective technique to exercise temporal control over an opponent who resorts to force. As seen from the above, its not an exaggeration to say that most techniques used in *jujutsu* and *judo* consist of those that exert temporal control over an opponent or that make an opponent wince.

Jujutsu and *judo* have had the thoughts of killing manner (*sappou*) and restoring manner (*kappou*) since old times. Striking and kicking techniques are called *sappou* (killing manner), as they can deliver a blow to vital parts that nearly correspond to the meridians in Oriental medicine (*keiraku*). By contrast, although it involves vital parts in a similar manner, the manner of restoring an opponent is called *kappou* [4].

Fainting caused by choking, known as *ochi*, is loss of consciousness caused by transient functional disorder. During a *judo* match, after an umpire declares the conclusion of a match, prompt treatment helps quicken the natural awaking from *ochi*, which is commonly known as "resuscitation" (*katsu*). *Kappou*, which has been inherited by *jujutsu*, is said to have a wide variety of contents. *Kappou* as used in today's *judo* has several types of restoring breathing that are used to aid recovery from fainting caused mainly from choking, and there are several types of restoration techniques for testicles that have been pushed up into the abdominal cavity by kicking them [5].

The Takenouchi-ryu School is one of the oldest schools of *jujutsu* in Japan, and was formally known as Takenouchi-ryu Jujutsu Koshinomawari Kogusoku, which was a comprehensive martial art with grappling with an opponent in the Age of Civil Wars called "*torite koshinomawari kogusoku*" as a core and said to be the origin of *jujutsu* (Ref. Website of Old Martial Arts of Japan). As you can see in demonstrations by the Takenouchi School, the style employed *kappou* and *hojojutsu* in addition to the techniques of *jujutsu*. Furthermore, the knots and lashings used are designed to permit the easy release of an opponent.

Hojojutsu is said to be come from China along with arresting tools in the middle of the 1500s. The art was improved and developed during the course of its

dissemination to various places in Japan, and handed down, and dozens of schools were derived over time. The principle of the art in each school is based on *hajakensho* (manifest the correct path by destroying false doctrine). A truncheon (*jitte*) is likened to the sharp sword that can drive off Satan (Goma no Riken) that is held in the right hand of Acala (Fudo Myoo), and the arresting rope to a rope for binding evil and rescuing people (Fudo no Kensaku) that is held in the left hand of Acala.

In the Edo period, use of an arresting rope was deemed to be an act of divine mind. The art of the arresting rope has two types: one is called *haya-nawa*, and the other is called *hon-nawa*. *Haya-nawa* means to capture a criminal at the time of arrest by winding the rope around a wrist or the neck to overcome resistance and prevent escape on a temporary basis. The technique needs to be completed in as short time as 10 seconds for both winding and releasing, efficiently and without causing injury or neuropathy.

Haya-nawa uses no knots after winding the rope around a subject in contrast to *hon-nawa*. This was intended to avoid disgracing a suspect by tying her/him at the time, when whether the suspect was a real culprit had not as yet been determined, and to avoid the possibility of dispute. *Hon-nawa* means to tie a criminal with a rope so that she/he cannot free her/himself from a rope, taking into account her/his gender, position, occupation, circumstances and other conditions. There were hundreds of types of *hon-nawa* from dozens of schools [6]. In any case, speed—without causing injury or neuropathy and speed of easy release—are noted as characteristics of the Japanese art of *Hojojutsu*.

Conclusion

As mentioned above, Japanese martial arts and military arts have, since the late Muromachi period inherited the undercurrent spirits and thoughts of *setsunintou*, *katsuninken* that has been handed down by the Shinkage-ryu School. That can be found in the following:

1) The thoughts and the techniques of the Shinkage-ryu School is to give scope to an opponent's attack (force) as a first step and to take control over this force by *muto-no-kurai*;

2) Sublimate and inherit aggressiveness and violence for educational purposes by securing safety through the use of a *shinai* and training armour (examples of swordplay and *kendo*); and

3) Technical composition aiming to take control of an attack or violence temporarily, rather than to deliver a death blow (examples of *jujutsu*, *judo* and *hojojutsu*).

I hope that my opinions will provide some useful references to the argument in the Congress.

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Influence of aikido exercises on mobility of hip joints in children

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Abstract

Background and Study Aim. From biomechanical point of view adequate action on muscles responsible for mobility of hip joints can bring about changes in muscles affecting position of pelvis. Pelvis, on the other hand, as a link in a biokinematic chain can cause changes in the position of spine, especially in its lumbar section. The purpose of the present article was the knowledge about the effect of the selected aikido exercises on the angle of hip joint rotation in the transverse plane.

Material and Methods. The experiment involved 107 boys from 7 to 10 years of age, pupils of the 1st-4th grade of primary school. They were divided into two groups, namely the experimental E one and control C0. The E group consisted of 66 pupils and C0 of 41 boys. The research groups comprised boys exhibiting scoliosis of first degree according to Gruca, as well as boys with threatening scoliosis due to a slanting pelvis position in frontal plane.

The measurements of hip joint mobility in the transverse plane were taken with Posturometre- S. The angle of internal and external rotation was determined. In the C0 group there were children who had never participated in any corrective gymnastics classes, but only attended sports classes prescribed by the curriculum. The children from the control E group performed the selected aikido exercises. The measurements were taken three times during the school year.

Results. In the experimental group the increases of internal and external rotation of hip joints were bigger than in the control group. The results of the total angle of rotation in the left and right hip joint obtained in the third test differed statistically between the groups. A statistical difference between the groups concerning the results obtained for the angle of internal rotation in the left hip joint was also found in the second and third test.

Conclusions. Aikido exercises applied increased the range of the angle of rotation of hip joints in the transverse plane.

Key words: hip joint • scoliosis • pelvis • aikido • martial arts

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Prepared the manuscript and secured the funding.

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Introduction

Numerous articles on aikido [1-3] support the statement, that aikido exercises increase mobility of hip joints. However, the articles available do not provide any data illustrated by empirical investigations with the use of adequate diagnostic methods in order to justify this statement. From biomechanical point of view adequate action on muscles responsible for mobility of hip joints can bring about changes in muscles affecting position of pelvis. Pelvis, on the other hand, as a link in a biokinematic chain can cause changes in the position of spine, especially in its lumbar section and thus bring about changes in spinal curvatures. Slanting pelvis position in transverse plane can create a force rotating vertebra as well as cause asymmetric femoral bone load [4,5]. In case of a child this can lead to an incorrect bone growth. Some researchers reported [6-9] that aikido offers stretching exercises that may prevent formation of lateral spinal curvatures. It is very often that progression of scoliosis comes together with restricted mobility of hip joints.

The purpose of the present article was the knowledge about the effect of the selected aikido exercises on the angle of hip joint rotation in the transverse plane.

Material and Methods

The experiment involved 107 boys from 7 to 10 years of age, pupils of the 1st-4th grade of primary school. They were divided into two groups, namely the experimental E one and control C0. The E group consisted of 66 pupils and C0 of 41 boys. The boys came from primary schools in Konin and Koło. In the C0 group there were children who had never participated in any corrective gymnastics classes, but only attended sports classes prescribed by the curriculum. The children from the control E group performed the selected aikido exercises. Aikido classes were conducted three times a week outside the regular curriculum in the afternoon. Children actively participated in the classes for about 60 minutes. The research groups comprised boys exhibiting scoliosis of first degree according to Gruca, as well as boys with threatening scoliosis due to a slanting pelvis position in frontal plane. The experiment participants were members of the experimental groups E and C0 referred to in the papers by Mroczkowski and Jaskólski [7,8].

Research organization and methods

The assessment of the angle of lateral spinal curvature and the asymmetry of pelvis position in the frontal plane was made following Śliwa method [10] with the use of Posturometer- S device determining location of anthropometrical body points in three-dimensional space, similarly to Ortelius 800 [11]. This method as well as the organization of the measurements aiming at assessing a degree of lateral spinal curvature and pelvis position asymmetry in the frontal plane have already been elaborated by Mroczkowski and Jaskólski [7,8]. The present paper describes measuring of hip joint mobility in the transverse plane with the use of Posturometer S. The angle of internal and external rotation was determined. The examination was carried out following the generally accepted rules of measurement [12-14]. The person examined was lying face down on the floor with the lower limb bent at 90 ° in a knee joint. The pelvis during examination was immobile and controlled by the person taking measurement. The measurements were taken three times during the school year 2002/2003. The first was conducted in September, the second in the beginning of March and the third one in the end of June. The children of the two groups had never attended any corrective gymnastics classes. All the examinations were carried out in morning hours.

Method of exercises

The method of exercises applied did not differ from the ones referred to in previous papers [7,8]. Using the same set of exercises it was examined what influence they had on the angle of lateral spinal curvature, the value of the asymmetry of pelvis position and additionally in this paper on the changes in hip joint rotation. The selected aikido exercises were employed, which to a great extent comprised both stretching as well as bending-rotation exercises. The exercises focused much on walking on knees which is often referred to as “Samurai walk”; [1]. The exercises offered during the experiment were of a play and game character in order to adapt the activity to the needs of a child. These forms are used not only in aikido but in other martial arts as well [15,16]. The important part of the training was the initial phase, the so called warm-up. This phase included numerous stretching-relaxation exercises, which, however, were not very intensive, aiming at, for example, doing the splits.

Results

In order to analyze the research material methods of mathematical statistics were used including the programme Statistica 6.1. The following statistical tests were applied: test F Snedecora (in ANOVA), test Student test for dependent variables. The following abbreviations were used for the values measured c1, c2,…, c6.

The abbreviations used in the table mean:
c1 – total angle of rotation in the left hip joint
c2 – angle of external rotation in the left hip joint
c3 – angle of internal rotation in the left hip joint
c4 – total angle of rotation in the right hip joint
c5 - angle of external rotation in the right hip joint
c6 - angle of internal rotation in the right hip joint

Table 1. The value of t-Student test for the differences between test 1 and test 2 and test 1 and test 3 means the difference of the average, whereas SDR stands for standard deviation for the difference, t means the value of t-Student statistics and p is probability.

Quality	Group E				Group C0			
	r	SDR	t	p	r	SDR	t	p
c1								
2	–6.80	10.85	–5.0937	0.0000	–3.13	5.32	–3.3226	0.0023
3	–8.39	11.89	–5.7351	0.0000	–3.94	7.08	–3.1461	0.0036
c2								
2	–0.59	8.89	–0.5401	0.5910	1.13	4.28	1.4874	0.1470
3	–1.12	8.14	–1.1193	0.2672	0.69	5.37	0.7238	0.4746
c3								
2	–6.52	7.53	–7.0282	0.0000	–4.34	4.71	–5.2188	0.0000
3	–7.61	8.22	–7.5140	0.0000	–4.81	5.99	–4.5477	0.0001
c4								
2	–6.80	11.33	–4.8785	0.0000	–4.69	8.51	–3.1160	0.0039
3	–9.80	12.39	–6.4290	0.0000	–4.97	9.06	–3.1034	0.0041
c5								
2	–3.76	6.59	–4.6312	0.0000	–0.94	5.41	–0.9811	0.3342
3	–3.58	6.99	–4.1544	0.0001	0.34	6.40	0.3039	0.7632
c6								
2	–2.85	10.09	–2.2944	0.0250	–3.88	7.56	–2.8997	0.0068
3	–5.44	11.47	–3.8543	0.0003	–5.44	9.33	–3.2960	0.0025

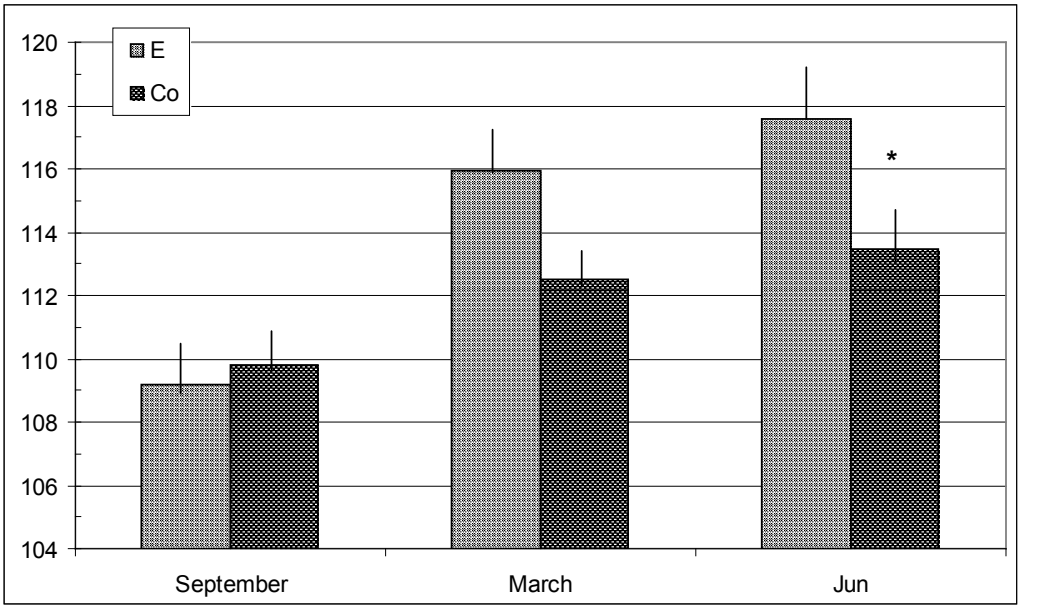

Figure 1. Change of the total angle of rotation (c1) in the left hip joint in successive tests for each group separately. (The differentiation between the groups was marked - * for p < 0.05, ** for p<0.01)

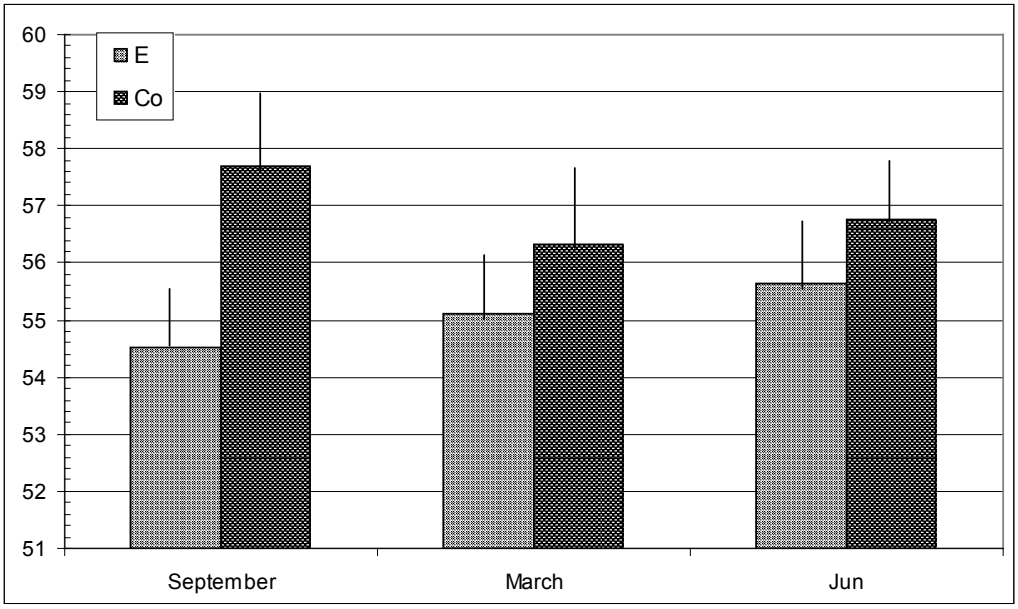

Figure 2. Change of the angle of external rotation (c2) in the left hip joint in successive tests for each group separately.

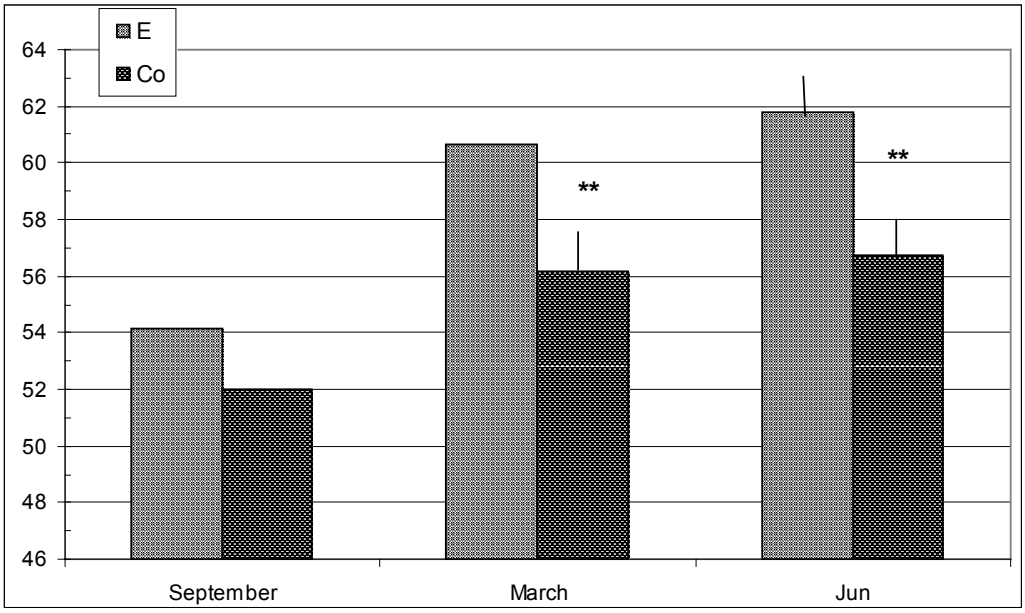

Figure 3. Change of the angle of internal rotation (c3) in the left hip joint in successive tests for each group separately. (The differentiation between the groups was marked - * for $p < 0.05$, ** for $p<0.01$)

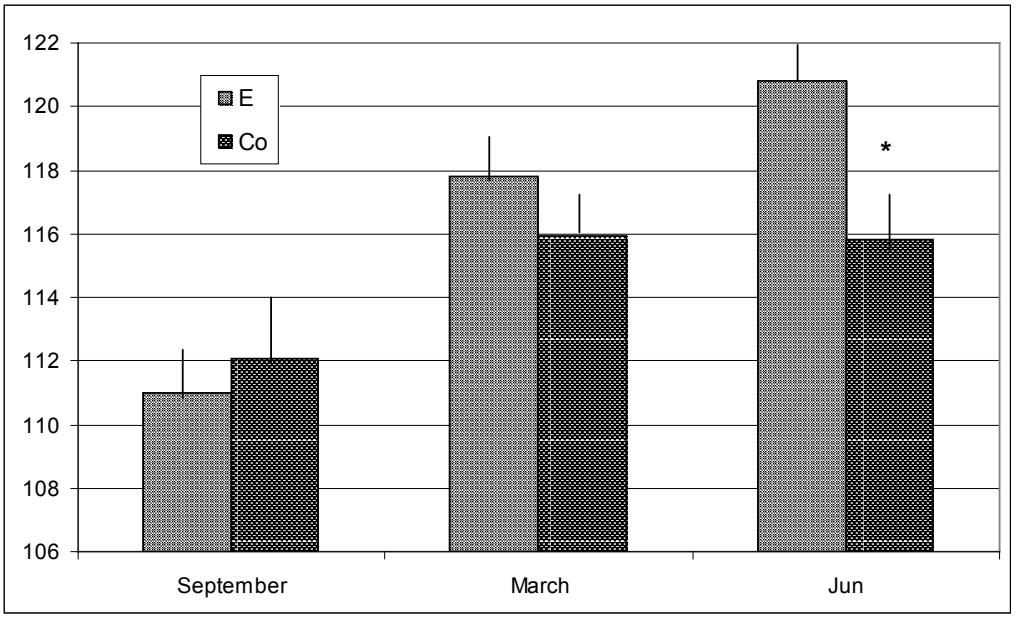

Figure 4. Change of the total angle of rotation (c4) in the right hip joint in successive tests for each group separately. (The differentiation between the groups was marked - * for p < 0.05, ** for p<0.01)

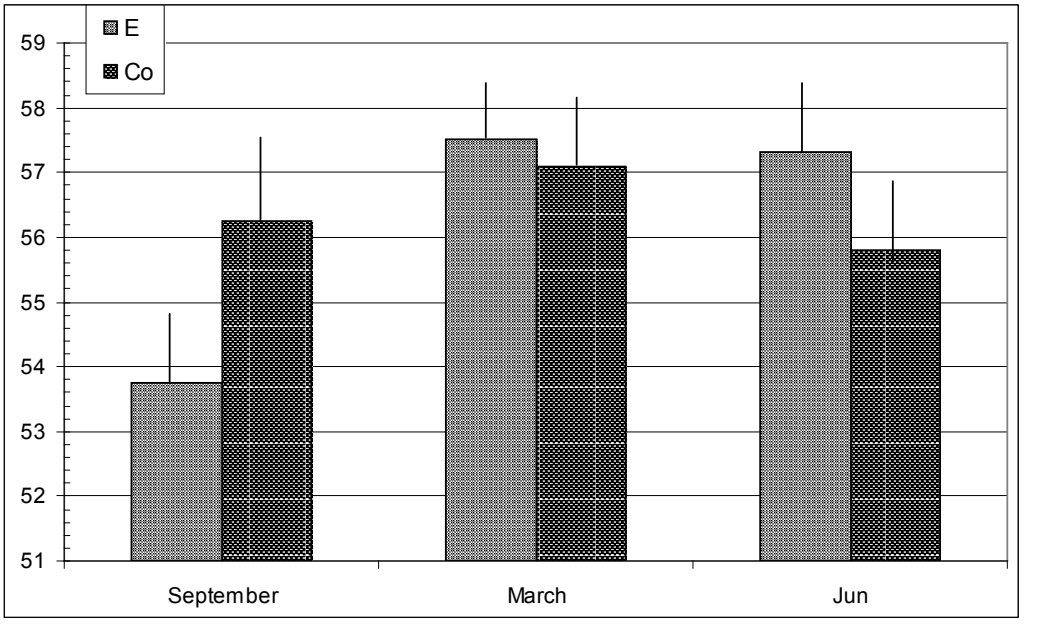

Figure 5. Change of the angle of external rotation (c5) in the right hip joint in successive tests for each group separately.

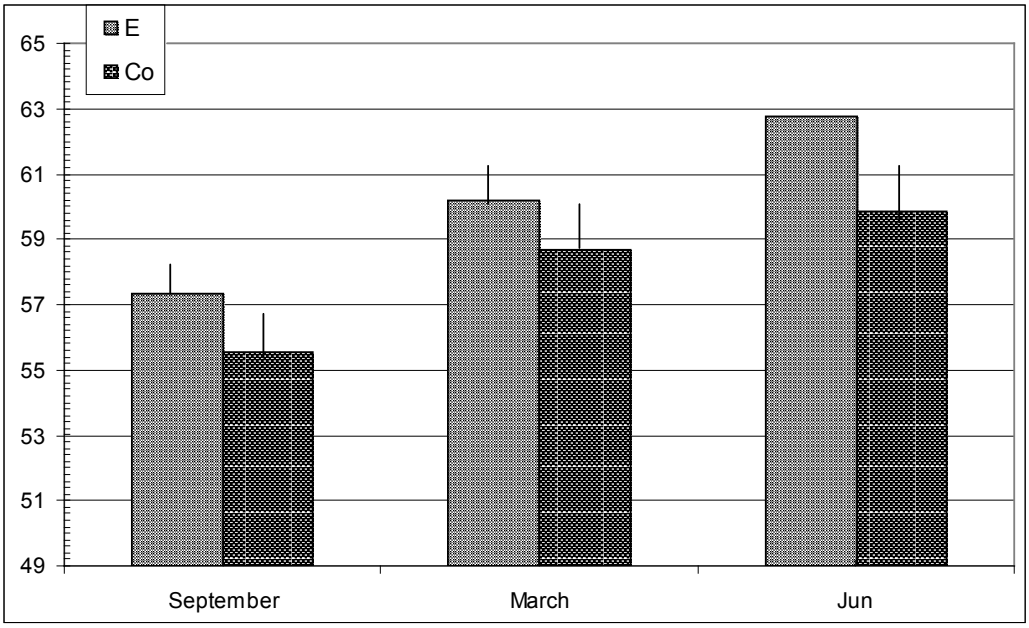

Figure 6. Change of the total angle of rotation (c6) in the right hip joint in successive tests for each group separately.

Statistical results show that for the total angle of rotation in the left hip joint (figure 1) there is a diversity in the significance in successive tests applied to group E and C0, however with a greater significance in group E (the smallest p value – table 1). The analysis of the variance showed a diversity in the significance between the groups only with respect to test 3 ($p<0,05$). No significant differences between the tests carried out in particular groups were found while examining the angle of external rotation in the left hip joint (c2). The type of the group did not influence the value of this feature. However, in group E (figure 2) an increasing tendency of the average value of this angle was noted. Analysis of the changes in the value of internal rotation angle (c3) showed significant statistical differences in both groups. In group E there was a bigger increase in the average value of this angle in comparison with the C0 group (figure 3). Analysis of the variance showed that type of the group had an influence on the value of this feature in test 2 and 3. Analysis of changes in the value of the total angle of rotation in the right hip joint (c4) showed significant differences between the results of tests applied to group E and C0, with a bigger significance in group E. In the test 3 the value of this quality differed significantly in group E and C0. The group type had an influence on the value of this quality in test 3. For the angle of external rotation (figure 5) the type of the group did not effect the value of this quality. Statistical analysis showed in successive tests significant increase in the angle value only in group E (table 1). For the angle of internal rotation (figure 6) the type of the group did not effect the value of this quality as well. A significant statistical increase in this angle value was obtained for both groups in test 2 and 3.

Discussion

Occurrence of restrictions of the mobility of hip joints along with the progression of scoliosis has already been analyzed by many researchers. The restriction of mobility concerning hip joint rotation in the transverse plane [17] is frequently found, the same as asymmetry concerning internal and external rotation of this joint [18]. Karski and et al claim that the main reason for the occurrence of idiopathic scoliosis are the progressing contractures of hip joints including abduction contracture [19]. Cole et al [20] in their research claimed that there was a relationship between the range of internal and external rotation of hip joints and the Cobb angle of scoliosis. The research carried out and referred to in this paper, according to its author, does not allow to conclude about the existence of such a relationship. This is because the analysis concerned boys with a small angle of lateral spinal curvature or just with an asymmetry in pelvis position in the frontal plane.

The exercises applied to the experimental group resulted in a much bigger increase of the angle of rotation of hip joints in the transverse plane than in a control group. The increase of the hip joint mobility was most probably affected by changes occurring in muscles that act on this joint. This may entail some changes in pelvis position. The research material used

for the experiment referred to in this paper is the material used for describing a part of the research results obtained. Analyzing the results obtained Mroczkowski and Jaskólski [7.8] came to the conclusion that by applying the selected aikido exercises it is possible to decrease the angle of lateral spinal curvature as well as to correct pelvis position in the frontal plane. It may be assumed that the exercises applied actively affect the muscles responsible for mobility of hip joints and through a biomechanical chain can influence position of pelvis as a base for correct development of a child's spine.

In the experimental group there was a bigger increase of the angle of rotation in hip joints in the cross section than in the control group.

A bigger increase of the angle of internal rotation than of external rotation of hip joint was observed in the experimental group.

In the control group C0 the increase in the angle of rotation was observed only in case of internal rotation of the hip joint.

Conclusions

Aikido exercises applied increased the range of the angle of rotation of hip joints in the transverse plane.

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Fun forms of martial arts in positive enhancement of all dimensions of health and survival abilities

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Abstract

The world is changing, and apparently Japanese youth are more likely to choose American baseball than the native martial arts. The aim of our work is arguments to justify the benefits of *fun forms of martial arts* as a universal means of enhancement of all dimensions of health and survival abilities, developing intellect, building an ethical attitude, breaking down the barriers of inability, etc., which are available to anyone with only limited professional intervention. The most general division of *fun forms of martial arts* includes two aspects: the utilitarian and the health one. Dividing *fun forms of martial arts* according to the health aspect first of all applies to relationships with three manifestations of health (somatic, mental, social), and within each manifestation there is a diagnostic and adaptive factor (this one divided into the prophylactic and therapeutic one). For example, part of *fun forms of martial arts* of the category "1 –avoiding a collision" and "8 – comprehensive settling of close combat" is useful both for diagnosing aggressiveness (it is one of the most popular indices of mental health) and for reducing it (the therapeutic factor). These categories of *fun forms of martial arts* also have a prophylactic significance in the sense of preventing injuries to the body as a result of a collision with an object in motion. It is clear how extensive can be applications of specific *fun forms of martial arts* – the known ones and those that can only be invented.

Key words: counter effectiveness • difficult situations • non-aggression • nonviolence • preventing injuries • self-defence skills • safe falling skills

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Introduction

Jan Harasymowicz very aptly notes that during a fight various aspects of human nature are revealed – anxiety, aggression, pride, vanity, skills, physical dispositions, knowledge, and interdependence between these characteristics [1]. This directly corresponds to various forms of hand-to-hand fighting.

Contemporary sport has developed many varieties of team games where some of these features characterising all or most team members determine the success – pride marked by modesty, high skills and physical dispositions, knowledge and harmonious interdependence between these traits. If team members are characterized by anxiety, aggression, pride (understood as the lack of modesty), vanity (unjustified pride), then success can only be accidental, usually as a result of an even greater intensification of these negative characteristics in the opponent.

In every type of hand-to-hand fighting as well as in a non-sport confrontation (one against one or one against a group) success is determined by an accumulation of positive characteristics and their interdependence. Conflict with oneself is deadly. A single warrior can only count on himself. The opponent's mistake can prove to be an ally, but to use such circumstances, one needs to be optimally prepared.

Harasymowicz goes on to say that learning martial arts (or arts of self-defence) allows recognising that a fear of failure cripples the human capacity for proper, intelligent action, that aggression obscures understanding, that vanity, a lack of physical disposition, knowledge, perseverance and skills are suicidal. Such learning shapes an attitude of a watchful observer and acting skills in accordance with the laws of nature; it highlights one's own weaknesses and the need to cooperate with others in overcoming them. Training develops human disposition and allows him/her to overcome anxiety and complexes that trigger aggression towards others. So it is – contrary to appearances – a path to non-aggression (non-violence) [1,p.10].

Since a single warrior can only count on himself and possibly on a favourable combination of circumstances, then what need for cooperation with others does Harasymowicz mean? Clearly, he means the learning process rather than the acquisition of skills and experience by fighting to the death. Therefore, in 1978 (three years before the introduction of the martial law in Poland and in the initial period of the expansion of Japanese, Korean, and Chinese martial arts to Central and Eastern Europe) Harasymowicz formulated a general pedagogical (humanistic) principle of modern training of primarily arts of self-defence and only then in a wider perspective of martial arts (assuming that any martial art is also an art of self-defence).

The world is changing, and apparently Japanese youth are more likely to choose American baseball than the native martial arts. Many coaches of the so-called energetic sports and sports games lack an awareness that the repetition of the usual training schemes, typical of specific disciplines and events, actually slows the progress. Athletes are sometimes unmotivated to intensify efforts, and soon they succumb to fatigue. The few who reach for *fun forms of martial arts* are discovering new opportunities of a creative influence on individuals and the whole team.

With such generally depicted premises, the aim of our work is arguments to justify the benefits of *fun forms of martial arts* as a universal means of enhancement of all dimensions of health and survival abilities, developing intellect, building an ethical attitude, breaking down the barriers of inability, etc., which are available to anyone with only limited professional intervention.

Inspirations and warnings straight from the Antiquity and the Middle Ages

In different cultures of the Ancient times, in the short periods of rest between wars, many forms of hand-to-hand fighting were among some basic entertainment for courtiers and the commoners. In the Antiquity and the Middle Ages duelling was a plague [2].

In ancient Greece, wrestling was the mildest form of hand-to-hand fighting. Brutalisation came with combining wrestling with boxing (*pancratium*), which quickly gained popularity among viewers.

In Japan the most popular was *sumo* – a type of wrestling, but in fact a combination of ceremonial and sport elements. At the turn of the old and the new era fights were brutal; very often they ended in the death of one of athletes. Since year 734 *sumo* became part of the court tournament, and since year 824 court tournaments began to be played from the 16th day of the month. The fall of popularity of *sumo* at the end of the 16th century revived illegal street fighting (banned by the edict in Edo in 1648), which had nothing to do with gentleness [3,4]; revived, because already four centuries earlier a Samurai risked exile or confiscation of goods for publicly beating a person (article 13 of the *Goseibai-shikimoku*, 1232) [3].

During knights' tournaments, fighting with the use of dull weapons was a relatively mild form of fighting in close contact, aside from wrestling. The introduction of firearms revolutionised the formula of duels [2], although still for a long time decisive moments of battles and skirmishes were settled in direct confrontation, including hand-to-hand fighting. Tournament fighting had the advantage of increasing survival abilities on a battlefield for both the victors of the tournaments and the defeated ones.

Viewers have been an important part of tournament fighting till today. It is astonishing that some rulers tolerated brutality, and they even inspired bloody spectacles themselves, while others banned them [5]. Also Church authorities opposed the practice. Speaking in the modern language, opponents of the practice were aware of the pernicious impact of watching extreme violence and aggression, including the public killing of people, on the mental and social health status.

It is remarkable that in the 16th and 17th centuries ecclesiastical authorities issued ordinances, edicts and bulls prohibiting young commoners to participate in wrestling bouts [6]. At that time, wrestling was recommended by outstanding European thinkers, doctors, mathematicians, and humanists as health exercises and optimal physical education means.

This dilemma is still valid. There are numerous interest groups promoting neo-gladiatorship. There are also many kind-hearted people who lack, however, interdisciplinary knowledge, personal experience and courage to oppose the practice, although probably for many violent, bloody fighting in cages is unacceptable mainly for aesthetic reasons.

For the creators of *fun forms of martial arts*, regardless of their cultural background, no violent form of combat constitutes a model. Yet one fundamental conclusion comes from this brief review. The fact that an individual or even a very large community does not accept any form of violence, even more so extreme aggression, does not mean that others adhere to this principle to a similar extent. We appeal here to the elemental principle of responsibility for one's own actions and the safety of the circle of the closest people (family, friends, a cultural or religious community, etc.). To dispense with an opportunity to optimally prepare oneself and the loved ones to defend the principal values, including health, life and dignity, means a conscious withdrawal to the position of a potential victim.

Pessimistic empirical arguments

Recent empirical studies of young Polish women studying physiotherapy [7], tourism and recreation [8], physical education [9], and nursing [10] provide results which indicate important drawbacks of the educational system, considered from the perspective of preparing a person to function in difficult situations. The studies regarded the profile of a sense of positive health indices and survival abilities. The profile was based on the subjective sense of various positive health indices covering three dimensions: somatic A, mental B, social C (these letters and "D" symbolize these variables in a special protocol SEPSA) and D dimension, which represent a sense of indices and assessment reflecting an individual's survival abilities.

The studied women (declaring either occasional physical activity OPA or daily physical activity DPA) on a five-grade scale assess their own survival abilities the lowest (except nursing students) (mean OPA: **2.956** to **3.920**; DPA: **2.828** to **3.895**). Two specific indices are symptomatic: safe falling skills and self-defence skills (Table 1).

Nursing students' results are, however, surprising as, despite the declared occasional physical activity, they assessed their self-defence skills the highest among the tested groups. Yet declarations of physical education students concerning their safe falling skills (4.258 points) are not astonishing. Everyone participated in a basic judo course. One has to agree then

Table 1. Indices of safe falling skills and self-defence skills declared by Polish female students differing in their physical activity (daily – DPA; occasionally – OPA)

Female students & [references]	Cardinality [number]		Safe falling skills [points]		Self-defence skills [points]	
	OPA	DPA	OPA	DPA	OPA	DPA
Physiotherapy [7]	100	22	2.79	2.600	2.420	2.400
Tourism & recreation [8]	34	24	3.147	3.792	3.059	3.208
Physical education [9]	21	31	3.700	4.258	3.150	3.484
Nursing (including 2 males) [10]	52	-	3.810	-	3.920	-

with conclusions of the authors of these papers that it would be the most interesting cognitively to confront such declarations with the diagnosed indices. Pilot studies (yet regarding the somatic dimension) indicate a significant discrepancy. There is no clear trend. Some declarations are overrated, others understated and some are characterized by high compatibility with the fairly diagnosed result [11,12].

Universal assumption of self-defence training

The premises presented in the Introduction and the next two sections directly lead to a reflection on the formulated by Kalina [13, p. 43] universal assumption of self-defence training: "*if you have learned to act effectively, wisely and nobly in a situation, in which the goal of someone's actions would be harming or killing you, each different situation would be incomparably easier and you will certainly solve it*".

The ability to decipher this assumption and implement it into practice means stimulating a pupil to act in every situation in an efficient and dignified manner.

Mental bridge with the tradition of fighting on the border of fun

People of different ages and cultures who in a certain way were enslaved, threatened and, above all, were highly motivated to gain or regain freedom could camouflage defence education on the border of fun and dance. Indian *kalaripayatt* [14] or Brazilian *capoeira*, which is assigned African roots [15], are good examples.

In Poland, during the period of lost independence due to partition made by the three neighbouring empires, the first one in 1772 by Russia, Prussia, Austria; the second one in 1793 (by Russia, Prussia); the third one in 1795 (again by Russia, Prussia, Austria), fighting with riding crops was very popular. The **riding crop** was a shaft weapon, a form of baseball bat, (with a length of 80 centimetres to 1 meter, with a diameter of approx. 2.5 cm, made of hard wood, often equipped with a basket made of wicker) used as a training weapon when learning sabre fencing. The riding crop fight was also a popular form of recreation among young people until World War II [16].

Fighting with sticks was popular in many cultures and countries (e.g.: Zulu fighting with sticks in South Africa, different styles of *wushu* in China, the Philippine *arnis*, *Balintawak*, *kali*, *escrima*, *estocada*, *doce pare*, *grand canne* in France, *bo-jutsu*, *jo-jutsu (Jōdō)*, *aikido (aikijo)* and some karate schools in Japan, *shim gum do* in Korea; Portuguese stickfighting *jogo do pau*).

Systems of fighting without weapons created by Buddhist monks, masters of Okinawan karate or Korean taekwondo [17-22] had a similar defensive purpose, but also a clear link with health training and moral education. Szymankiewicz and Śniegowski [19, p. 29] reiterate that martial art training, whatever it is, caters primarily to two human needs: getting rid of fear in everyday life and experiencing thrill and discharging aggression in a safe way. It can be added that it is an important factor for group integration, although its essence is to develop individuality.

In the traditionally understood martial arts training, whatever it is, there is no place for *fun forms*. Harsh discipline of formal exercises *(kata, poomse, etc.)* is one of the basic canons, just as the need to respect the rules and fight ethics in *randori*, *kumite*, *etc.* There is still a significant factor in the one-man leadership and absolute subordination to the teacher (master).

Fun forms of physical activity and fun forms of martial arts in different cultures

It is difficult to clearly indicate the reason why fun forms of physical activity and especially *fun forms of martial arts* have developed in some cultures and not in others, and why it is not easy to adapt them to educational systems of particular countries.

All *fun forms* of activity exclude violence somehow by definition. If a hypothesis about the camouflaged defence education of people who in the past were enslaved in some way, who did not have legal access to weapons and formal opportunities to learn martial arts is true, it seems obvious that training destructive fighting would be counter effective for a number of reasons. This means that instead of the goal, neophytes of such a solution would achieve its negation. Such is the meaning of the term "counter effectiveness" (counter productive) in the language of praxeology [23].

Interpretation of this phenomenon among nomadic herding peoples seems easier. For shepherds responsible for the safety and the quality of the herd, various forms of wrestling were, on the one hand, a form of daily or occasional entertainment, on the other hand, a form of defence training, and thirdly – a way to enhance their health. Probably children spontaneously imitated these fights naturally giving them a fun character. Fights based on aggressive measures would be counter effective in the sense that with time the herd

minders would lose their ability to protect it and the ability to attain economic goals.

Perhaps the above argument explains the phenomenon of a relatively large interest of scholars and trainers from countries of the former Soviet Union (Georgia, Russia, Ukraine, etc.) not so much in *fun forms of martial arts* as in the use of games and motion amusements in training, especially youth, combat sports: judo [24-27], wrestling [28], kickboxing [29]; and in physical education [30].

Also in Poland, the popularity of motion games and amusements in physical education, sport and recreation has a long tradition [31-34]. Bondarowicz belongs to precursors of teaching team sports in the form of fun [35]. Jaskólski recommends both judo and games (mainly in the form of fighting) as optimal measures in achieving the objectives of physical education [36]. Together with co-authors he recommends *fun forms of martial arts* in a monograph devoted to biological and pedagogical basics of the system of sports training [37]. Głaz and Kuźmicki advocate fun and games in judo and wrestling training [38], while Cieplicki and Witkowski are the authors of a unique set of exercises with a skipping rope and a rope to use in judo training [39].

The only known work dedicated to *fun forms of martial arts* was published in Polish in 2000 by Kalina and Jagiełło [40]. Published three years later in English and Polish *Combat sports propedeutics – basics of judo* [41] was implemented in educational practice.

Divisions and classifications of fun forms of martial arts

The most general division of fun forms of martial arts includes two aspects: the utilitarian and the health one. This logical division arises from the adopted assumptions [40, p. 9] which are presented in this work in a shortened version with some modification.

The first assumption is that the complementary nature of the influence of combat sports and hand-to-hand fighting exercises on the human system, with a clarification that it is used by a competent teacher, is mainly manifested in the fact that in one, so to say, stream of time (special exercises and training or tournament fights) there is an accumulation of stimuli of both a biological and a cognitive nature in the broad sense of the word. The essence of close combat lies in the need to activate both those biological mechanisms and functions of the body that are responsible for controlling the motor system and the use of energy resources and those that control the psyche, including the intellect and the heuristic sphere. In general, very large dynamics of events of close combat and the diversity of undertaken actions (the need to predict the opponent's movements, making optimal choices and processing them into motor actions adequate to the changing situation [42]) requires courage to adopt creative and non-standard solutions, to overcome the fear of failure or injury, to have faith in one's own abilities.

The second assumption accentuates the peculiar value of combat sports and hand-to-hand fighting exercises in moral education of a human being. Unlike most sport disciplines where performance evaluation (*effective – ineffective*) dominates almost exclusively, here there is also ethical assessment (*fairly – shamefully*). In fact, combat sports are based on mixed effective–ethical evaluations (when training fights, and especially tournament fights are subject to evaluating). Basically, an objective compilation of *effective – shamefully* assessments is possible to some extent – when in the course of a bout the winner received statutory penalties, except for disqualification, but ultimately won as a result of a greater number of collected points. However, in many cases (not necessarily ending in disqualification), the ethical assessment *shamefully* paradoxically takes the value of performance assessment. The one who breaks the rules loses (penalty points), despite the fact that the opponent has not documented his advantage with necessary points or in any other way.

These assumptions fully refer to *fun forms of martial arts*. An external entity (judge) who would settle the outcome of each bout in any *fun form of martial arts* becomes unnecessary. Self-assessment of one's own and the opponent's actions (according to the above explained criteria of mixed assessments) and an awareness that the opponent also makes such self-evaluation has the largest educational value.

Regardless of the adopted assumptions, a zealous critic would find the division of *fun forms of martial arts* according to the utilitarian and the health aspect crippled in the theoretical and the purely practical sense. Learning safe falls, whether it is based on the methodology of formal exercises or in accordance with a fun formula, only seemingly has the same health and utilitarian meaning. An adept reduces the likelihood of injury in a situation of a loss of balance and fall (the health aspect), which in the course of hand-to-hand fighting additionally does not diminish his chance of ultimate victory (the utilitarian aspect). That critic can make similar argumentation with regard to the effects of self-defence skills. An

aggressor's efficient attack can cause not only the victim's physical injury but even lead to his/her permanent disability or death.

A thorough analysis of the issue will dispel doubts. Formal exercises of safe falls and self-defence allow repeating only certain sequences of movements, but not situations that will surely happen at a predictable time and place. A track and field athlete specialising in long jump or triple jump knows what actions he has to repeat, how many times and in what intervals in order to succeed, and he knows the exact dates and places of the most important competitions.

Fun forms (of falls and the necessary prevention of aggression) are always a certain simulation of events that only in some respects are similar to situations that can happen unexpectedly sometime in the future. A person preparing to self-defence will increase the likelihood of survival if in the course of many simulations of events which cannot be excluded he/she can not only make relevant decisions but also perform appropriate motor actions. To avoid hitting or any other form of attack, one time this may be a jump backward, another time sideward or forward. The question is not about the record time, but the appropriate reaction time, coordinated movements of the body segments which are the most vulnerable and those that, in the circumstances, should be used to thwart another attack.

Kalina and Jagiełło [40] adopted objectives of actions as the main frame of reference for the classification of *fun forms of martial arts*. They distinguished 8 groups of *fun forms of martial arts*: 1) avoiding a collision; 2) putting the opponent out of balance; 3) releasing oneself from grips; 4) restraining the opponent's movements; 5) removing the opponent from the area; 6) putting the opponent in a specified place; 7) defending the territory and property; 8) comprehensive settling of close combat.

Almost every *fun form of martial arts* attributed to a specific category (set) occasionally repeated can be used as a specific test of an ecological type (a diagnostic property); repeated many times, it becomes a means of modifying the body in a motor, energy and/or mental sense (a preventative or therapeutic property).

Dividing *fun forms of martial arts* according to the utilitarian aspect applies to 2 categories of properties: diagnostic and adaptive ones. Another division distinguishes, as part of diagnostics, the possibilities of applications in sport, self-defence training, military training, training of emergency and security personnel, and within the framework of adaptive expectations – specific motor effects (skills) associated with all, some or one of the 8 distinguished categories of actions.

Dividing *fun forms of martial arts* according to the health aspect first of all applies to relationships with three manifestations of health (somatic, mental, social), and within each manifestation there is a diagnostic and adaptive factor (this one divided into the prophylactic and therapeutic one). For example, part of *fun forms of martial arts* of the category "1 –avoiding a collision" (Figure 1) and "8 – comprehensive settling of close combat" (Figure 2) is useful both for diagnosing aggressiveness (it is one of the most popular indices of mental health) and for reducing it (the therapeutic factor). These categories of *fun forms of martial arts* also have a prophylactic significance in the sense of preventing injuries to the body as a result of a collision with an object in motion. It is clear how extensive can be applications of specific *fun forms of martial arts* – the known ones and those that can only be invented.

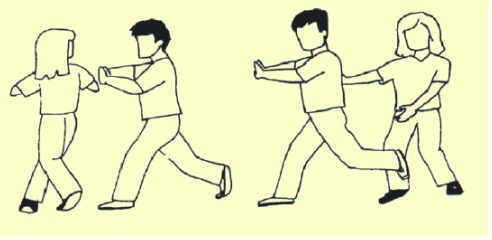

Figure 1. "Matador" example, *fun forms of martial arts* of the category "1 –avoiding a collision" [40]

Figure 2. "Mischievous fox" example, *fun forms of martial arts* of the category "8 – comprehensive settling of close combat" [40]

Optimistic empirical arguments

In the ongoing for over twenty years own research (or in cooperation with researchers from different centres in Poland and abroad) on the application of the *fun forms of martial arts* for utilitarian and health purposes, almost all of the issues covered here have been empirically verified.

The diagnostic and adaptive value of *fun forms of martial arts* for a use in sport [43-45], military and police training [13,46-50], intervention services, bodyguards, security and emergency services [51-53], as well as self-defence training [42,54] is high.

The use of specific *fun forms of martial arts* in the health aspect proved especially effective. The possibility to diagnose aggressiveness [13,40,55,56] and therapy aimed at reducing it [13,54,57] were verified the earliest. Declarations of nearly 60% of animators of sport for children and youth from all over Poland interested in obtaining such qualifications are a significant social effect. In 2014 and 2015 they participated in one-day courses and workshops dedicated to this issue [58,59]. One cannot overestimate the importance of this achievement, since violence and aggression at school are still an open problem [60,61].

No less promising is the prospect of application of *fun forms of martial arts* on a larger scale in diagnosing the vulnerability of people of all ages to injuries during a fall [62-66] and in prophylaxis. Unique preventive effects concern healthy elderly persons, but also those classified in different risk groups [67-69]. Practising safe falls in forms of play proved to be important means of prevention and kinesiotherapy of patients diagnosed with moderate or high mental impairment and intercurrent mental disorder (schizophrenia, anxiety-depressive disorder or abnormal behaviour) [70].

Conclusion

Each day, all over the world, the primary recommendation of doctors concerning clients' (patients') physical activity for health purposes boils down to three words: walking, running, gymnastics. The more affluent ones are recommended additionally or alternatively: aerobics, cycling, golf, swimming, tennis, yoga etc. or training under the guidance of a professional personal trainer. Those from the first category of recommendations after some time of systematic exercises usually achieve a cardiological effect and a periodic improvement in muscle strength. Those who can afford the second variant, in addition, improvement in coordination, body balance, and flexibility. Still many of the former and the latter will be helpless when suddenly they lose balance, collide with the hard ground or a vertical obstacle, or even without losing their balance they collide with an object that is in motion (a vehicle, a thrown object, etc.). The listed forms of movement do not prepare a human being to these events optimally or at all. The more so they do not prepare people for the necessary *self-defence.*

The cardiological and all other effects will be achieved by a person who is able to rationally use *fun forms of martial arts* in his/her systematic physical, intellectual and mental activity. Moreover, with a limited professional intervention he/she can diagnose not only aggressiveness of those from the closest circle in advance, but also become aware of their weaknesses and other traits (anxiety, shyness, vanity, etc.) which they cannot overcome by themselves. Such an animator of family activity or of a group of friends can play a role of a volunteer of rational prophylaxis or even therapy.

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Different approach analysis of self–defence for people with physical disability

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Abstract

In some countries it has been shown that individuals with disabilities are three times more likely to become victims of crime, and that crime is the biggest concern for people with physical disabilities. The aim of the study is the knowledge about the current state of self-defence for people with physical disabilities in the world. Using meta-analysis we draw on previous research looking for common elements to create new patterns of self-defence for people with physical disability. The major threat and challenge in this area seems to be vulnerability, abuse and sexual assault of women with disabilities. The topic of self-defence for people with physical disabilities is a serious problem which needs to be addressed in further research, especially by using exploratory methods.

Key words: abuse • crime • disabled persons • secure • vulnerability

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Introduction

The term 'disability' has been much discussed in recent years [1]. Many advocate groups for people with disabilities have shunned the use of the adjective 'disabled' because they argue that many, perhaps most disabled people are quite 'able' but are forced by external circumstances into situations that do not allow them to function to their full potential. Other specialists [2], and indeed some of the biggest European advocate groups, accept the term as it is defined again by the WHO [3]: "*Disabilities is an umbrella term, covering impairments, activity limitations and participation restrictions. An impairment is a problem in body function or structure; an activity limitation is a diffi culty encountered by an individual in executing a task or action; while a participation restriction is a problem experienced by an individual in life situations. Thus disability is a complex phenomenon, reflecting an interaction between features of a person's body and features of the society in which he or she lives*".

Violence and disability: two simple nouns that, in reality, represent some very complex concepts. Together, they reflect a sinister but sadly very real problem that faces all regions of the world, including Europe [1].

It is often mentioned that people with disabilities are "more vulnerable" to violence than able-bodied people[4,5], but vulnerability is also a contentious concept. In fact, vulnerability is not a 'characteristic', but rather a phenomenon related to how violent people, exploiters or other abusers perceive the person they victimise. In this sense some impairments are likely to be perceived as making a person more 'vulnerable'. The main point here, as in so many other areas relating to violence and disability, and certainly also for people who do not have a disability, is to ensure that people have the knowledge, tools and means to protect themselves to the full extent of their capacity [1]. The higher risk of victimisation in the disabled is highlighted by Čírtková [5]. These risks can negatively influence the degree of independence as described by Válková [4]. To prevent this problem there is a way to accept our vulnerability [6].

The aim of the study is the knowledge about the current state of self-defence for people with physical disabilities in the world. The analysis based on available data from the four countries (Czech Republic, France, Germany, USA).

Material and Methods

Using meta-analysis we are looking for common elements to create new patterns of self-defence for people with physical disability.

Results

USA

In The USA there is The International disabled Self-defense Association (IDSA), which has been focusing on self-defence for disabled persons since 1996. The Defense Ability system based on combat hapkido was developed by Jurgen Smidt. Jurgen Schmidt, who is a paraplegic, has used the art to defend himself against muggers. He said the skills based on dynamics and balance are easily adaptable to fit his special needs. Advanced training includes defences against weapons as well. The official website is available from: www.defenseability.com. There is also a demo on youtube [7,8].

On the other hand, Ronald van de Sandt claims that some attacks are similar to those experienced by anyone sitting on a chair or bank. Other attacks are unique for people with physical disability. While the period of time he has been confined to a wheelchair he adapts some defence technique from American Kempo, Shorin Kempo, Karate and Aikido for self-defence on wheelchair. Van de Sandt uses the wheelchair as an always present weapon as well. He teaches how to employ different parts of the wheelchair, in particular handles, breaks or footboard in self-defence. A good level of ability to manipulate with the wheelchair is essential [9–11].

Another umbrella organization for self-defence of specific groups in the USA is a non-profit organization „NOT-ME!". Its primary objective is to promote, advance and unify self-defence education and training for at-risk populations. These populations that are traditionally considered vulnerable or have been historically targeted for violence, include but are not limited to people with physical disabilities, women, the elderly, the gay and lesbian population, and ethnic minorities. A key person and founder of this organization is Erik Kondo, who became disabled at the age of 19 after a motorcycle accident. NOT ME! strategy is elaborated into details. It is grounded on 5D – decide, deter, disrupt, disengage and debrief. [12] Also many videos are available on youtube as „Paraplegic Self-Defense" [13–23].

France

In France we can find „Self defense en Fauteuil", an infant working group of 5 members (3 on wheelchair), who apply Krav Maga concept to self-defence for people with physical disability. The official website is available from http://www.sdfworld.org. [24]. Another French judoka Adrien Marcone focused his classes of self-defence for wheelchairers on prevention of bad habits in the field of self-defence [25].

Germany

In German speaking countries Hermes [26,27] and others [28] point out the higher risk of sexual assault in women with physical disability. They are often placed in various organizations, where they are dependent on orderly or other often male employee of organization. Because of this, a female trainer of self-defence is mostly required by German women on the wheelchair. This requirements is met naturally in wendo, where only women are in the position of trainer for other women with or without impairments [29]. Hermes [26] also highlights a necessity of barrier-free entrance and presence of assistants on the self-defence courses. The possibility to express their feelings, concerns and experience with every kind of violence is for disabled participants important too.

Patric Hummer, policeman and trainer who organized self-defence courses for various groups of people on the wheelchair, emphasizes the usage of strong and self-confident voice, which every participant should adopt to discourage attacker in the first phase of conflict. When it comes to physical defence he teaches where sensitive nervous endings on body are and how to take advantage from that knowledge as well as using improvisational weapon including the wheelchair. He encourages participants to lower attacker to them [30].

Another German self-defence possibility for people with physical disability is in Bremen, where Nils Thate applies wing tsun and escrima to self-defence [31]. Rollstuhlsportmenainschaft (RSG) Langenhagen (a community of wheelchair sport in Langenhagen) organizes regular seminars of self-defence for children and youth on wheelchair with Nils Thate as the main instructor [32]. A condition training, body language or usage of voice is included in the self-defence seminar as well as various defence techniques and recognition of the coming threat [33].

The Czech Republic

There is a need to create a concept of self-defence for people with physical disabilities in the Czech Republic. No association offers regular courses for disabled people. There was just one attempt in 2014 in Brno, where Self Defence Brno club held a four hour seminar for people on mechanical wheelchair. Marian Komrska, the head instructor of the course had been using a wheelchair for 3 month to find out what kind of problems people with physical disability could face. Other self-defence instructors do not see the physical disability as an insuperable obstacle but they do not offer a course for disabled people either [34,35].

During creation of self-defence concept we draw on Wagner [36] and Cooper [37] with baring in mind specific needs and limitations of people with physical disability.

Conclusion

The self-defence concept for physically disabled people should meet their requirements, which can be formulated by disabled people only. Their needs can be specific for each group of participants according to their experience and concerns. General research of disabled people´s security threats should be done for the first proposal of the concept. Then the same should be done for every group of participants before each course.

Each individual participant of the self-defence course for people with physical disability needs specific approach with accord to the type of their disability. Only this way leads to making use of the full extent of their capacity. It is better to work with a group of participants of similar diagnosis.

The course should include every aspect of self-defence: physical, mental, tactical preparation for conflict solution such as prevention and communication strategies, physical defence and postconflict acting, which is always a big challenge while teaching self-defence for people with any kind of disability.

Because of movement limits the defence strategy should focused on the pre-conflict phase, prevention and communication, as well as on asking for help and using security aids such as personal alarm or lacrimatory spray.

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Dynamics of Judoka´s foot arch

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Abstract

Background and Aim of the study. Many health problems are caused by a poor condition of foot arch. Foot arches of athletes are influenced by injuries. Barefooted walk is recommended as a prevention of foot arch problems. That is why we chose judoka as tested persons because their performance and training is always barefooted.

Materials and Methods. We used drop test to assess the dynamics of judoka´s foot arch. Our control group consists of nonathletic population (25 judoka, 25 nonathletes). We measured the length of the sole, height of os navicular in a sitting and standing position.

Results. The dynamics of Judoka´s right foot (average result of drop test 6.64 mm) is bigger than their left foot´s (6.0 mm). Foot arch´s drop of nonathletes is less than half of judoka´s (2.62 mm of right foot, 3.54 left foot).

Conclusions. Practicing judo formulates the feet arches. There is a difference between right and left foot arch dynamics depending on the preference guard in judo.

Key words: tarsal bones • martial art • drop test • dexterity • barefooted activity

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Contributors: Zdenko Reguli conceived the study design. Jan Šenkýř collected the data. Jitka Čihounková analysed the data. Jan Šenkýř, Jitka Čihounková prepared the manuscript. Zdenko Reguli secured the funding.

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Introduction

Many athletes suffer from pain of lower limbs´ joints. Apart from pain caused by injuries [1] doctors locate the root of the trouble in a foot, foot arch or position of ankles. As a therapy it is recommended to use orthopedic footwear, specific insoles and other secondary methods of foot arch support. Martial artists, in our case judoka, can follow these recommendations only with difficulties because they practice barefoot.

The present study is focused on the dynamics of judoka foot arch. Judoka´s performance and training is always performed on tatami and barefoot. It is generally known that the root of the trouble with foot arches lies in an inadequate maximal physical demand as well as in inactivity. In judo the maximal physical demand is increased by barefoot performance [2]. The results of the experimental group is compared to the results of the control nonathletic group.

Materials and Methods

Research sample

Our research sample consists of 25 male judoka aged between 18 and 32, whose results are compared to the group of the nonathletic male group of the same size. Selection criteria is specified in the Table 1. The age variance was determined based on the average age of judoka in the Olympic games. [3]

The cross-sectional method of data selection was applied. Data was collected at the end of 2014.

We measured the anthropological extends of foot such as the length of the right foot, the length of the left foot as well as body height, body weight, body mass index and the age of the tested persons.

Methods

Similarly to Gardin [4] we used navicular drop test which gives evidence of foot arch dynamics, shortening of muscles and ligaments of the sole. After palpation and marking, the height of the navicular bone was measured twice (Figure 1). First while sitting without any pressure on the foot then while standing with legs apart and with the body weight distributed equally to both legs.

We monitored other variables such as age, height, weight and the length of foot, whose extremes could interfere with the results. The length of the foot was measured with a ruler (Figure 2). We measure the absolute length of the sole from the heel to the longest toe with no pressure on foot.

All measurements were done in the morning hours, when the feet were relaxed after sleeping period. The tested persons were asked about the medical history of their feet to prevent the influence of injury or other foot issues on the results and the usage of medication which could influence muscular tonus.

We use Statistica Cz software to analyze the data as well as Calculator of Cohen d.

Research questions

RQ1: Is there any difference of navicular bone drop between judoka and nonathletic population?

RQ2: Is there any difference of navicular bone drop between judoka´s right and left foot?

Results

In table 2 you can see average results with its standard deviation for all measured variables. The most important variables are differences between the heights of navicular bone while sitting and standing at the bottom of the table.

Table 1. Specification of the research sample

Judokas		Nonathletes	
Age (years)	18-32	Age (years)	18-32
Sex	male	Sex	male
BMI	18-25 kg/m^2	BMI	18-25 kg/m^2
Time of training	min 10 years	Time of training	No regular physical activity
Technical degree	min 1. KYU		
Training hours a week	min 6 hours a week	No health issues with feet	

Figure 1. Measurement of the height of the navicular bone

Figure 2. The measurement of the length of the foot

The effect size (using Cohen d) of the differences between the heights of navicular bone while standing and sitting was 1.19 for the right feet, 0.75 for the left feet while comparing judoka and nonathletes. Judoka´s differences between the heights of navicular bone while standing and sitting comparing their right and left foot was not statistically significant (p = 0.440) but there was the effect size of 0.21.

Judoka right foot´s dynamic (average result of drop test 6.64 ± 3.33 mm) is bigger than their left foot´s (6.0 ± 2.77mm) with small size of effect (d = 0.21).

Foot arch drop of judoka (6.64 ± 3.33mm for right foot, 6.0 ± 2.77mm for left foot) is bigger than in nonathletic group (2.62 ± 3.33mm for right foot, 3.54 ± 4.61mm for left foot). These differences are statistically significant (p = 0.001 for right feet,

Table 2. Results of measurements

	Judokas (n = 25)	SD	Nonathletes (n = 25)	SD
Age (years)	24.64	3.91	30.38	6.74
Height (cm)	177.10		180.10	
Weight (kg)	81.35		82.46	
Length of the right foot (mm)	261.30	14.8	259.90	11.76
Length of the left foot (mm)	264.50	14.65	264.50	10.6
Height of navicular bone while sitting – right foot (mm)	52.08	8.35	52.00	9.26
Height of navicular bone while sitting – left foot (mm)	53.62	5.86	51.69	9.56
Height of navicular bone while standing – right foot (mm)	45.46	9.82	49.38	10.67
Height of navicular bone while standing – left foot (mm)	47.62	7.08	48.15	9.69
Differences between the heights of navicular bone while standing – right foot (mm)	6.64	3.33	2.62	3.33
Difference between the heights of navicular bone while sitting – left foot (mm)	6.00	2.77	3.54	4.61

p = 0.047 for left feet). The effect size of the differences between the heights of navicular bone while standing and sitting was 1.19 for the right feet, 0.75 for the left feet, which means that both differences (left and right foot) are significant.

Discussion

Foot arch dynamics and foot architecture in association with judo or other martial arts seems to be a neglected topic in research. We dealt with the condition of judoka´s foot but only by using plantogram [5], which did not give evidence of foot arch dynamics. That is why we have used drop test in this paper.

We can assume that selection of tested persons was successful. Both groups, judoka as well as nonathletic, consisted of similar tested persons, whose BMIs were between 18 and 25 kg/m^2. It means that no extreme influenced the results. Similarly Kim [6] is comparing athletes with results of nonathletic population.

During measurements we noticed a big difference of navicular bone drop between right and left foot in two tested persons. The difference between their right foot navicular bone drop and their left foot navicular bone drop was 8.0 mm. A medical examination was recommended to these tested persons.

Foot arch drop of judoka (6.64 ± 3.33mm for right foot, 6.0 ± 2.77mm for left foot) is bigger than nonathletic group´s (2.62 ± 3.33mm for right foot, 3.54 ± 4.61mm for left foot). Nonathletic population spends most of time provided with shoes, which influences movements of foot, toes, foot arch and sometime ankles as well [2]. The dynamics of foot arch can also be influenced by judo itself with its characteristic movement patterns. Judoka use their legs not only for locomotion. They use it actively during ashi waza such as for hitching the opponent's leg by heel, sweep or push with a sole, lifting opponent with feet and others [7,8]. These movements are important for maintaining the proper condition of plantar muscles [9].

We were also looking for differences in navicular bone drop between the left and right foot in judoka. All judoka in the research sample were right-handed. The difference in navicular bone drop between the left and right foot in judoka was 0.62 mm in average, which was a small size of effect. The bigger drop of navicular bone was found in the right feet. The preferred guard in right-handed judoka is mostly with the right foot forward. The forward foot in judo performance is employed by fine movements, sweeps or pushes over. The left foot is usually the stronger one. Its task is body support and keeping balance during techniques [10].

Conclusions

We can conclude that at minimum 6 hours a week training on tatami may cause better dynamics of foot arch. Judoka´s front foot dynamics is bigger than their left foot´s. This can be caused by specific techniques of front foot, which requires the work of plantar muscles. It would be worthy

to verify our results in a larger sample of tested persons.

The differences between judoka and nonathletic population are notable as well as the differences between left and right foot of each individual person. The border of foot arch drop in the context of physiological extent is another issue [11].

Judo performance is based on moving with opponent using one´s own strength, staying in a steady position with lowered center of gravity which is connected with a solid support by lower limbs. In other martial arts in particular karate or kick boxing there are much quicker changes of position without an interpersonal physical contact. These changes are made by dynamic push to feet. A comparison of foot arch dynamics and foot condition among different martial arts is a challenge for future research.

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Why can a little lady throw down a strong man using only a finger? The mechanism of soft *atemi-waza*

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Abstract

Background & Study Aim: There is a picture that was sketched where a little lady controls a big man who breaks his balance with a forefinger. The three explanations in previous documents are not always clear or complete by the interpreters. The first technique of the Itsutsu-no-kata and the lady's skill were considered to include the soft type of atemi-waza. The aim of this study is to clarify the mechanism of the soft type of atemi-waza that Kenji Tomiki had studied since 1942.

Material & Methods: This study examines a few points that are made in three explanations from the perspective of Seiryoku Zenyo of judo after introducing them precisely, while referring to the Itsutsu-no-kata and Tomiki's theory.

Results: (1) The woman's technique shown in the picture has a close relationship with a kind of soft type of atemi-waza. (2) The big man who puts his weight onto his right foot temporarily retreats with his left foot as a result of her continuation of the push and then will retreat his right foot in an attempt to compensate for the acceleration, causing him to fall down. (3) When the big man recovers stability, it is necessary for her to break the man's balance onto the heels of both feet while maintaining the power to push her palm even if the man's feet have adapted to his movement.

Conclusion: This study shows that the skill of the lady's postures of right and left, unsoku, tegatana, balance breaking, and soft type of -atemi are indispensable for her to continue to control the big man, and is acquired by a relative exercise and accomplished depending on the movement of the partner, because fighting forms of the exercise vary greatly.

Keywords: Kano Jigoro • Kenji Tomiki • *Itsutsu-no-kata* • Yoshizo Matsumoto

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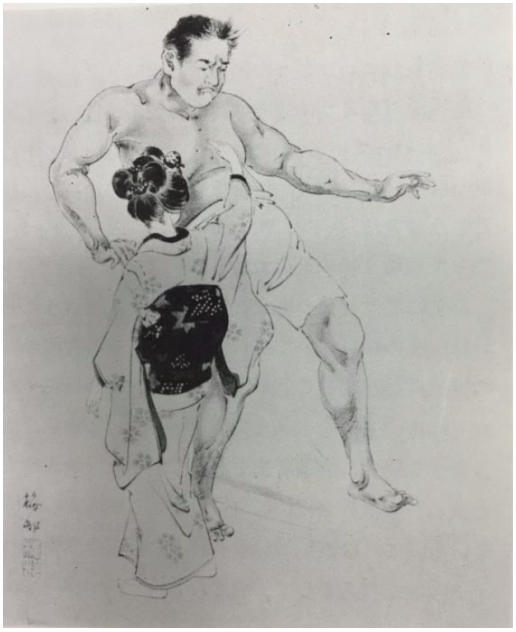
Introduction

There is a picture (Picture 1) that was sketched where a little lady, wearing a Kimono or Japanese traditional clothes, controls a big man who breaks his balance with a forefinger. This picture was sometimes quoted in books of judo in post war Japan. The creator of the work is mentioned in the picture but no one has explained who drew it because of an indecipherable signature. One of the main reasons why this picture attracts interest is because the picture symbolically expresses the idea that "Softness overcomes hardness" through the little lady's action. But the explanations in those documents that introduced this picture are not always clear or complete by the interpreters who are described below. So this author supposed that the interpreters, though they were first class researchers, might not have been familiar with the wide range of skills of jujutsu. Because 1) ordinary judokas mainly practice randori techniques by grabbing the sleeve and collar of each other and incidentally they practice kata, which includes techniques various forms of fighting, less than in randori, 2) they often have difficulty to improve their skills because the contents of various methods in various katas are not classified or systematized like randori. Jujutsu includes not only various forms of combat where techniques include grabbing the sleeve and collar but also techniques from wrist grabs, striking of vital points, kicking, attacking with various weapons, etc. According to Kenji Tomiki [1], Tomiki suggests that there is a soft type of atemi-waza based on the principle of the throwing techniques in jujutsu/judo, which means that there are two types of atemi-waza, namely a striking type and a soft type.

Thus this author will first examine questionable points of three explanations of the picture from the perspective of *Seiryoku Zenyo* of judo after introducing them precisely, while referring to the *Itsutsu-no-kata* and Tomiki's theory, and will then clarify the mechanism of the soft type of atemi-waza. The results may show the existence of a new martial art that comprises the idea of "Health Martial Arts".

1. The examination of the explanations so far

Yoshizo Matsumoto, prominent theorist of the Kodokan and professor of the Tokyo University of Education, briefly explains the picture in two books; "A hundred year history of judo explained in photos and figures" [2] (Hereafter, HHJ) and "Coaching of Judo" [3] (Hereafter, CJ). According to the colophon of HHJ, it is considered that the explainer was Matsumoto because he was a representative of the editors such as Ichiro Abe (Chief of the International division), Teizo Kawamura (Assistant professor of Tokyo Gakugei University), Masaru Hayakawa (Managing director of the Japan Business Federation), Yoshizo Matsumoto (Professor of Tokyo University of Education), and Isamu Morishita (Director of All-Japan Judo Federation). Matsumoto wrote CJ by himself, which has been highly evaluated for a long time by its comprehensive and detailed contents described from historical and biomechanical aspects.



Picture 1. A little lady overcomes a big man

HHJ: "Even if you have a small amount of strength, you can win a man who has a large amount of strength if you use it efficiently. [小力も有効に使えば大力に勝てる]" [2]

It is clear to understand that this explanation shows two basic propositions, "Softness overcomes hardness [柔よく剛を制す]", and "Maximun efficiency with minimum efforts" or *Seiryoku Zenyo* [精力善用]. But no concrete explanation is given.

CJ: "If you use both mental and physical strength efficiently, even a small amount of power can have a big effect. The ground object that is compressed by the gathering of absolute strength [into a single point] has its balance broken and defeated without any resistance being permitted. ［心身の力を最も有効に使用すれば小さい力でも大きな効力を働かすことができる--。絶対の力を結集して加えられた地上の物体はいかなる抵抗も許されず、崩し倒されていく］[3]

This explanation includes two propositions described above and also shows that a HHJ had progressed at a point of concreteness, namely, in the representation of

the absolute strength is gathered in the lady's forefinger in order to push a big guy's chest. But Matsumoto doesn't refer to the question that many people may believe that the forefinger may be broken when she pushes against the big guy's chest by it.

Interestingly, an explanation of the picture entitled "About the practical application of *Seiryoku zenyo*" in a book "The Kodokan Judo explained by photo" [4] (Hereafter, KJ) shows more detailed contents. But it is difficult to determine who wrote it. Many editors were appointed (Japanese syllabary order) as follows.

- Uzawa Takashi [Chief of Women's Division in 1934] (Encyclopedia of Judo, in 1999, p.155)
- Shigekuni Eguchi [7th dan in 1948] (Raisuke Kudo ed., Judo yearbook, the publishing association of the Judo yearbook, 1965, p.81)
- late Tsunetami Oda [9th dan in 1952, famous leader of techniques on the ground] (Editorial board of the Encyclopedia of Judo, Encyclopedia of Judo, in 1999, p.146)
- Yoji Kikuchi [8th dan in 1952] (Editorial board of the Encyclopedia of Judo, Encyclopedia of Judo, in 1999, p.146)
- Kazuzo Kudo [8th dan in 1952] (Editorial board of the Encyclopedia of Judo, Encyclopedia of Judo, in 1999, p.146)
- late Masao Koyasu [8th dan in 1952] (Editorial board of the Encyclopedia of Judo, Encyclopedia of Judo, in 1999, p.146)
- late Kaichiro Samura (10th dan in 1948) (Editorial board of the Encyclopedia of Judo, Encyclopedia of Judo, in 1999, p.184)
- late Itsuyo Sawa [8th dan in 1952] (Editorial board of the Encyclopedia of Judo, Encyclopedia of Judo, in 1999, p.146)
- Toshio Daigobou,
- late Saburo Takahiro [Graduate of Waseda University Judo Club]
- Shigenori Tashiro [Head of the International division of the Kodokan in 1951] (Editorial board of the Encyclopedia of Judo, Encyclopedia of Judo, in 1999, p.13)
- late Isao Nagahata [8th dan in 1952] (Editorial board of the Encyclopedia of Judo, Encyclopedia of Judo, in 1999, p.146)
- Masaru Hayakawa [8th dan in 1952] (Editorial board of the Encyclopedia of Judo, Encyclopedia of Judo, in 1999, p.146)
- Tatsuo Hisatomi [8th dai in 1959] (Publishing association of the Directory of Judo, Directory of Judo, Japan judo newspaper company, p.51)
- Teisuke Masuko [1885-1979] (managing director of the Taisei Yasuda Fire & Marine Insurance. http://id.ndl.go.jp/auth/ndlna/00518361, accessed) 12/7/2015)
- Yoshizo Matsumoto [7th dan in 1952] (Editorial board of the Encyclopedia of Judo, Encyclopedia of Judo, in 1999, p.146)
- late Kyuzo Mifune [10th dan in 1952] (Editorial board of the Encyclopedia of Judo, Encyclopedia of Judo, in 1999, p.146)
- Kou Yamada [member of the society of medical affairs in the Kodokan] (Editorial board of the Encyclopedia of Judo, Encyclopedia of Judo, in 1999, p.148)

Matsumoto might have been one of most notable academic writers, but the explanation in KJ is much more concrete than HHJ and CJ. Risei Kano, president of the Kodokan, described historical comments in its preface entitled "Judo to go to the world" in the first edition, 1956: "I visited Paris taking [Shigenori] Tashiro, [Yoshizo] Matsumoto and [Toshiro] Daigo with me in November, 1950,…In December of 1952, I was nominated as the president of the International Judo Federation.…As an editing committee, I covered all each authority such as late Nagaoka 10th dan, Mifune 10th dan and others….I believe that for an authentic text suitable for the reliable public of the judo lover, there is no book that is superior to this book. (March, 1956)" [4: iii]. Judging from the above, this author temporarily decides the author with Mr. X.

KJ: "If the weak woman uses power effectively as this picture shows it, she can control the power of a big man. Even if the man tried to shift his weight to his foot while retreating to regain balance, I use the power effectively as if chasing him while controlling or suppressing him and can still extinguish his balance. You cannot learn this fundamental, which can be used for every purpose, by the normal method, but can completely acquire it by learning the effective techniques and methods concerning the mind and body of judo, which is higher than the normal method." [4]

［この絵の示す通り、か弱い女も力を効果的に使用すれば、巨人の力をも制御出来る。退いた方の足に体重をかけて均衡を取り戻そうと男がした時でも、彼を押さえたまま追うようにして力を効果的に使って男の均衡を失わすことができる。/ あらゆる目的に使用出来るこの基礎原理は普通の方法では学べないが、柔道の精神と肉体のより高い効果的な技術と方法を身につけることによって完全に会得することが出来る。］

This commentary is different from the former two books in mentioning a concrete method of "the balance breaking (*Kuzushi*)" to extinguish the balance of ones partner. However, the point that is hard to understand appears within the indistinctness of the

picture. Primarily it is not shown clearly what mechanism the woman uses effectively and how she uses it. Because it is difficult to push it down only with a forefinger in common-sense terms, this explanation is still insufficient. Second what do you mean "to use the power effectively as if chasing him while controlling him?" It is thought that it is impossible with the posture drawn on the picture, to control the big man with a forefinger. Then how is it possible "to chase him?" Third, "this fundamental which you can use for every purpose" (way using mental and physical power most effectively) is considered be same as Kano's *Seiryoku Zenyo* which Kano calls. Then why you cannot learn it by the normal method? In the first place what is "the normal method?" Fourth, on earth, what is "the effective technique" that is higher than the normal method?

The method that this author used in this study to clarify the above-mentioned questionable point is as follows. According to a written turn, this author considered it every possibility of the meaning while thinking about the connection with the above sentence sequentially as follows.

(1) About the question of "it is not shown clearly what mechanism the woman uses effectively and how she uses it."

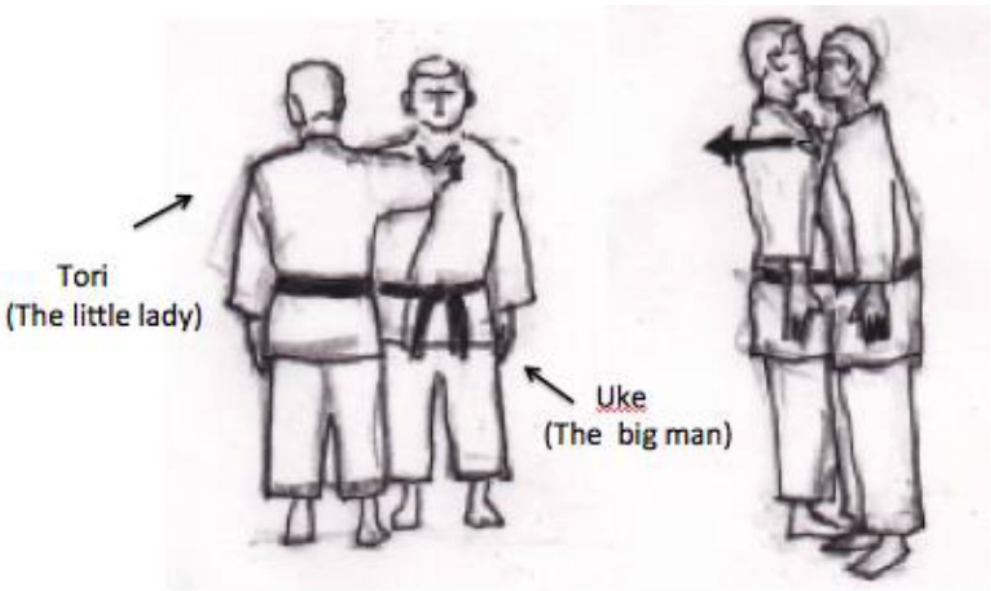
If you try to break the balance of a big man who is standing by a forefinger, the finger is more likely to be damaged. You may defeat him if you can touch his body with a finger along the direction where he falls down by himself. You don't have to attach a finger when he falls down by himself. But, judging from the experience of this author, when he strongly attempts to restore his balance you sometimes cannot disturb his movement by attaching a palm on a part of the guy's body. So the picture may be an exaggeration except when the big man falls down by himself, by a technique of the lady's balance breaking.

(2) What do you mean "to use the power effectively as if chasing him while controlling him?"

This sentence shows that the woman can break the man's balance if she has strong legs that is possible to chase and can compress him by using power efficiently, even when the man tries to regain balance by putting weight on his one leg that retreated. This suggests that this woman, who is unlike the appearance that seems to be weak, is a martial artist who has well-trained legs and hips, body movement, and footwork or *Unsoku*.

The questions refer to the direction and method of chasing the man, who tries to regain balance, while suppressing him by her forefinger. The man will try to retreat with a leg to regain balance. How does the woman chase him? In the first technique of the *Itsutsu no kat*a (Hereafter, Itsutsu-1) that Kano created, you can find that the positional relationship of the *uke* (a person receiving a technique) and *tori* (a person performing a technique) is similar to this picture (See, Picture 2:).

The main difference between the picture and Itsutsu-1 are showed in Table 1.



Picture 2: *Istutsu-no-kata*-1

Table 1: The main difference of the explanation between the picture and Itsutsu-1

	The uke's posture at the beginning position	The measure of touching	Details of the explanation
The picture	Uke's balance is broken	A forefinger	Just a suggestion by X
Itsutsu-1	Uke stands with natural posture	A palm	A detAailed explanation by Kotani & Otaki

Kotani & Otaki [5] describe how to perform Itsutsu-1 in details as follows:

Tori, raising his right hand high enough, advances quietly toward *Uke*, starting with his left foot and then right foot alternately. When both *Tori & Uke* come close enough to touch their shoulders, *Tori*, with his stance of basic natural standing posture, touches *Uke*'s chest center with his right hand palm.

Tori, then, advances slowly with his right foot first, keeps pushing *Uke*'s chest continuously with his right hand palm, putting strength on and around his little finger. *Uke*, being pushed, retreats slowly with his left foot, resisting falling down, trying to keep his balance.

Tori, this time, advances with his left foot first, keeps pushing *Uke*, with his right hand palm, putting strength on and around his thumb. *Uke* retreats with his right foot first, as he is pushed, and tries to keep his balance.

Tori still advances, without lessening his power, gains his power to push, walks faster, and keeps pushing *Uke*'s chest, with his right hand palm, putting strength on and around his thumb and little finger alternately. *Tori*, by so doing, deprives *Uke* of his chance to recover, and keeps pushing continuously. *Uke*, being pushed and pushed, retreats with his left foot first and then right foot alternately, with shorter steps, losing his balance, and finally becomes unable to recover his balance.

Tori, at this moment, keeping his balance, makes a long step with his right foot to give *Uke*'s chest the last push. *Uke*, being unable to recover his balance, falls down supinely in a manner of *Jizo-taoshi*.

Shishida & others' study about Itsutsu-1 in 2014 [6] pay attention to the direction of the palm that works one direction against one point (一点一方向) like a strike while changing direction, and explains that the tori can make the uke fall down by placing uke's weight on both heels by alternating pressure between the thumb and little finger and by continuing tori's movement. It is sure that the uke continues to lose balance as a result of the tori's chasing his body movement.

(3) Why can't you learn the fundamentals, which can be used for every purpose, by the normal method?

To understand this explanation above, you need to clarify the meaning of "the normal method" and the fundamental (基礎原理). It will be appropriate to think that the former is how to practice randori by grabbing the sleeve and collar and the latter (基礎原理) means *Seiryoku Zenyo*. In the same page where the picture and its explanation were inserted, the editor quoted Kano's sentence that, Judo is "the way of using physical and mental power most effectively, which is also considered the fundamental principle (根本原理)". The reason why Mr. X replaced the fundamental principle (根本原理) with the fundamental (基礎原理=精力善用) is just an expression.

Then, what is the reason that you can't learn this fundamental by the normal method? Mr. X might feel there is a reason, but referred to no concrete explanation.

(4) What is "the more effective technique" that is higher than the normal method in order to understand her technique?

Mr. X finished this remark with "You can gain it completely by acquiring the more effective technique and method of the spirit and body in judo. But there is also no description of "the more effective technique". This commentary is strange. Because this picture in the chapter 2 "The essence and a purpose of Kodokan Judo" of the book accompanies one of the commentaries that provides a concrete example where the lady applied *Seiryoku Zenyo*, namely, about three techniques that are not to be used in normal judo.

The first example is the secession method when a wrist is grabbed, which is the same technique as "Onikobushi" of "Tehodoki" in Tenjinshinyo-ryu jujutsu [7], where a very careful commentary is done. In the second example is a technique when you are held from behind, and which is also a technique to be seen in katas of "The art of self-defense for women (女子護身法)" [8] established in the times of the Jiro Nango scheme in Kodokan. Here a relatively careful commentary is done. On the other hand, the commentary in this picture is not given concrete explanation though the author referred to another "techniques that is more effective"

2. The proposal of a new commentary

This author thinks that the woman's techniques reside in the picture has a temporarily retreats close relationship with a kind of the soft type of atemi waza. As mentioned above it was 1942 that Kenji Tomiki already referred to this type of atemi-waza with ate-waza (=atemi-waza) "based on the principle of the throwing technique" [1]. In 1977, 35 years later, Tomiki briefly explained the soft type of atemi-waza in the history of atemi-waza.

"In many of the scrolls of jujutsu, authors illustrate vital points through a diagram based on the theory of acupuncture points that comes from the Asian Continent, and emphasize the effect of killing power. But, when we see the later history, the contents of the atemi-waza as a kata and a practice method is poor, and the documents of being worth seeing is not handed down. Atemi-waza was almost forgotten until "The Karate", which developed in the special historic environment created by the martial arts prohibition policy in Okinawa, and was transmitted in inland in 1923. Often mentioned above, there were a great variety of techniques in ancient jujutsu. But the essence of jujutsu, which was arose from *kumi-uch* (grappling), is in throwing and holding an opponent down.

In a sentence in the scroll of *Kakugo* (resolution) of Yoshin-ryu jujutsu, which was learned from the art of swordmanship on the Continent, there is a sentence: "My techniques has no killing one". The thought to deny murder is a fundamental idea of the martial arts in Japan, and some pioneers eventually realized *Muto* (e.g., a state to be particular in a fight) even in kenjutsu where the art of killing appears. We can understand that the original atemi-waza of jujutsu developed in this way. In most *nage-waza* (throwing techniques) [in normal judo], a practitioner throws an opponent by the application of bidirectional opposite forces upon two points, such as the function of the hand and waist.

But you can also topple him by applying power to a single point if you can break the opponent's balance skillfully. The skill that you can topple him is called "atemi-waza". For example, even a gentle application of power that was increased by one point can topple an opponent as shown in the *Koshiki-no-kata* and *Itsutsu-no-kata* in case that it works as the endurance. The "atemi-waza" of this meaning is an "atemi-waza" indicating power as applied as *nage-waza* rather than the "atemi-waza" with a physically powerful effect that causes injury due to impact. We can find a model and the character of atemi-waza in the jujutsu in the *Koshiki-no-kata* and *Itsutsu-no-kata*." [9]

Judging from the materials of Tomiki's speeches, a short film of Itsutsu-no-kata and his many writings, it is clear that he studied all kata of judo carefully in for these 35 years, and deepened conviction in his theory of the two types of atemi-waza through historic and practical consideration. This author refers to them in here as a hard type of atemi-waza and a soft type of atemi-waza (Hereafter, s-atemi).

Tomiki does not refer to the *Koshiki-no-kata* or *Itsutsu-no-kata* of judo in the article in 1942. On the other hand, Tomiki gives concise comments about the first 14 techniques of the *Koshiki-no-kata* in section 6 of the article, "The essence of judo" [9]. In Tomiki's comments about "*Hikiotoshi*, "*Kodaore*, and *Taniotoshi*, he pointed out that these three techniques "became the origin about of the various functions of the hand blade or *tegatana* (wide sense). Namely, the technical principle of atemi-waza is developed from here." But a detailed explanation of the reasons has not been provided. Hence, this author will clarify the concept of s-atemi below by explaining the mechanism of the skill of the woman of this picture. The movement of the first technique of the *Itsutsu-no-kata* was used as an authoritative reference as defined in the book "Saishin Judo no kata" (All the latest Forms of the Judo), written by Sumiyuki Kotani & Tadao Otaki. The reason for this choice is because it is considered that commentary is the best in seven commentaries in seven documents [6].

Glossary: *Tegatana:* In a narrow sense, a *tegatana* (hand blade) means a hand that is an upper part from the root of the little finger. You should stretch out five fingers enough and meet willpower on each tip of a finger. In a wide sense, it is the upper part from an elbow. *Tegatana* can be applied in a fight.

(1) The situation (Overall composition of the picture)

The woman, bending her knees a little, lines up on the side of the big man who took area of the width of the shoulders and stands with a natural posture. The relative positions of both are not parallel. For the straight line that links both heels of the big man, the woman is located so that she faces to the left at an angle of approximately 18 degrees. The direction of the woman's big toe is hidden, but is understood when the direction of both legs is about the same. Because the forefinger of woman's right hand touches the big man's chest or the fourth intercostal and controls it in the diagonal lower left direction, the big man's weight gets on the right foot.

Five toes of the left foot of the big man are given above and the big toe of the right foot is given on the top. Judging from these facts, the big man's weight does retroversion in a state that hung over the right edge a little of both heels. On the other hand, the big man bends both knees and lets his head bend forward and the man supports the weight of the upper part of the body who does retroversion by raising both hands, particularly by the left hand forward and maintain his posture.

There seem to be a recovery movement of the posture break by the big man's movement of his knee, head and both hands. However, this entire movement becomes invalid by being touched on the chest, and being controlled by a finger, and there seem to be a state of irretrievability in it. It may be said that this is a state similar to the balance breaking in *Kosotogake* (See, Picture 3) [10]. This picture makes two meanings of "A man who has lost his balance is hard to move" and "you don't need power if you can break an opponent's balance" a symbol and is drawn.

Picture 3: *Kosotogake*

A man can escape when he does not truly lose his balance or when he recovers from an attempt to break his balance even if he seems to have lost his balance. The case that the big man steps back a foot behind and escapes, as written by Mr. X "to use the power effectively as if chasing him" is rightly assumed. So we will think about chasing while putting a palm to the opponent's chest. This is because a palm is used in the Itsutsu-1.

(2) A consideration of the movement

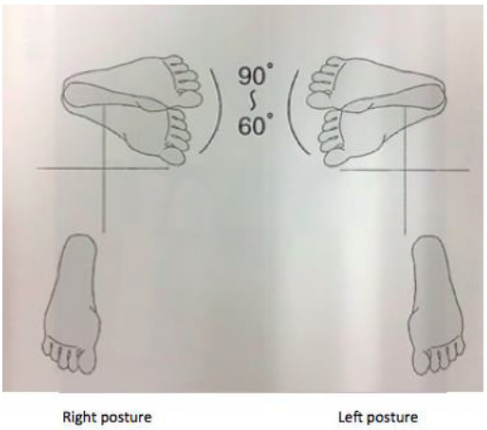
It is fixed whether a big man, who wants to gain stability, sends either the right or left foot backward by following two points: 1) which foot takes the body's weight?; 2) which foot is his dominant foot?. The direction of the push due to the finger affects the decision. If the direction that the woman continues to push is to her lower left, the big man will send his left foot backward because he is required to sprinkle his weight to the right foot. Namely, the following things are expected that: the big man who puts his weight onto his right foot temporarily retreats with his left foot as a result of her continuation of the push and will lower the foot in an attempt to compensate for the acceleration, causing him to fall down.

Then when the big man recovers stability by unexpected tenacity in the same situation and bounces against the push of the woman, how should the woman deal with this? In that case, it is necessary for her to break the man's balance onto the heels of both feet while maintaining the power to push her palm even if the man's feet have adapted to her movement. The foot movement of the woman is judged from the existing state of her partner. One of the important thing is *unsoku-ryoku* (the power of *unsoku*, the leg power that can move freely in all directions), which can follow the change in direction of the partner without weakening the power that the woman uses to push with a palm. *Unsoku* means the physical movement in all directions using the legs without breaking the natural posture.

Glossary: *Unsoku*: The meaning of words, *un* and *soku*, means to move a body with the foot. Accrding to Tomiki [11: 41], *tsugiashi* and *ayumiashi* are basic methods of *unsoku* in a fight.

Generally, because power increases and decreases with the increase and decrease of the speed and weight of the human body, the maintenance of quick locomotion is effective. However, it may be blocked by a partner who stays and/or tries to resist, even if a lightweight person puts a palm on a heavy person's chest and pushes it quickly. In this case, it is necessary for the lightweight person to look for the direction where the heavy person is easy to have his balance broken while he gradually breaks the heavy person's balance by putting his weight against the heavy person. The moment when the lightweight person realizes the direction of movement, he moves with agility in that direction. If he pushes the heavy person in that same direction, it will be effective. As an application, it is also effective if the lightweight person retreats once, and pushes again quickly with the palm when the heavy person resists.

Then what method do you use to cope with it? In case of the situation of Picture 1, the lady cannot cope with the movement of the man only by the conventional natural postures or *Shizentai* of right and left, because these two *Shizentai* are effective to move when taking hold of a collar and sleeve, but makes it difficult to move quickly back and forth. According to a series of Tomiki's study of the techniques while maintaining distance in judo, you can perceive that the right posture and the left posture (See, Picture 4) are important as well as the three *Shizentai* [1, 11]. *Tsugi-ashi* and *ayumi-ashi* are also one of important methods of movement in *jujutsu* and judo (as a normal method), and the skill of these methods in both right/left postures is also important.



Picture 4: *Kamae* / a right posture and a left posture

Glossary: *Tsugi-ashi* : In case you stand in *Shizentai*, when you move to the right foot by 20 cm, the left foot moves to it with the same distance by a nimble step.

Glossary: *Ayumi-ashi*: How to walk everyday.

Glossary: *Jujutsu*: "*Jiujutsu* is an art of fighting without weapons and sometimes with small weapons much practised by the Samurai." (Jiujutsu, T.LINDSAY AND J. KANO, 1888, p.200)

Tomiki additionally introduced *Tenkai* [11], a footwork of turning that no one seems to have introduced in the judo books so far. This is, for example, a method to change a right posture for the front into a left posture for the rear promptly. In the practice of *Tenkai*, a student practices how to maintain a strong posture while changing the direction of the left foot by pivoting on the ball of the right foot. If you apply this and change the direction of the tip of the right foot, and the left foot changes in the same manner, you can follow an escaping partner. This is a method to chase the partner who escapes while being far away, or by curving to the right or left.

Why is a chase enabled by the right/left posture? We consider the right posture for an example. The right posture is the posture that has a crossing angle of approximately 60 degrees (up to 90 degrees) to a straight line, which is the one between the tip of the foot and its heel, and the same straight line of the left foot. Each of these straight lines is drawn between the tip of the foot and the heel and extended. When pushed from the front, this posture has durability and stability in comparison with the natural posture. The reason is because the left foot, which was put backward with the crossing angle, becomes a point of action of the power to resist the partner's power when it is pushed, while becoming the point of application that gives driving force to a foot that tries to take a step. In addition, this posture is quicker than the natural posture for movements to the front. If permitted to say from experience, it is said that the right posture is superior to use the right arm (a palm or forefinger) as an application of the right *tegatana* (wide sense), and is also superior at the point, triggering the right arm and both legs cooperatively.

Other than books by Tomiki, there may be no judo books that introduced the right posture and the left posture. It may be because Kano did not introduce such a posture, or such a posture may be because they fall prey to foot techniques in the state of "the normal method" of grabbing a collar and a sleeve in judo. The former reason may be Kano's limit in the study because of his very busy life, and the latter reason may make judoka overconfident to disturb a study except the normal method. *Shizen-hontai* or the natural main posture is a basic posture for standing positions. *Migi-shizentai* or the right natural posture and *Hidari-shizentai* or the left natural posture are the basic moving postures that come from the natural main posture. The right natural posture and the left natural posture particularly are the postures that are assumed when two practitioners grab each other's collar and a sleeve. For example, it is difficult to chase someone moving with the right or left natural posture in all directions when the opponent is at a distance and attempts to strike and stab you. Therefore Tomiki thought that the posture of right and left was necessary.

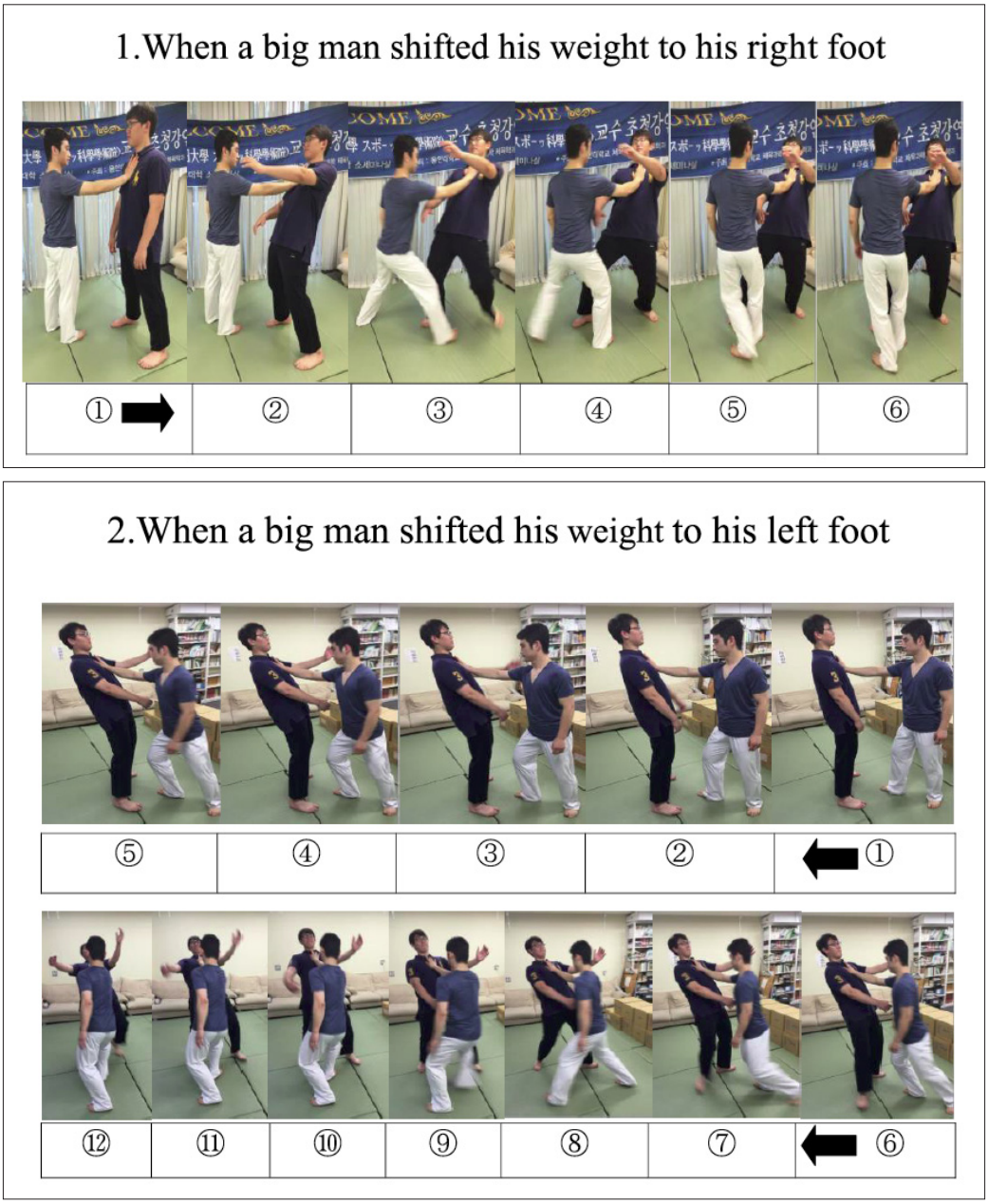
Then how does the woman maintain stability when a big man sends back a foot? The answer is in two kinds of Serial Photographs that was taken at the moment the big man steps back with his left foot because he was pushed so that the right foot takes the weight. The little man moves a palm from the right foot in a right posture to the right side, and the little man (woman side) does not let the big man recover his balance after it is broken (See, no. 1 of Serial Photographs). It

is a similar case as the big man sends back the opposite foot. (See, no. 2 of Serial Photographs)

Conclusion

In this study, this author easily explained the possibility and the meaning of the action of the woman, assuming that the big man lost balance. The power of *unsoku* provides one condition where a short man can maintain the balance breaking of the big man. In other words the power of *unsoku* is necessary to practice the maxim "Softness overcomes hardness". However a woman cannot really defeat a big man when she does not master concrete methods to break one's balance. The skill of balance breaking, the postures of right and left, *unsoku* with *tsugiashi* and *ayumiashi*, and s-atemi are indispensable for her to continue to control the big man, and is acquired by a relative exercise and accomplished depending on the movement of the partner, because fighting forms of the exercise vary greatly.

By Tomiki's study the basic posture becomes five, and the mutual relations in this way become the Trinity. In addition, this posture system will cover all domains that jujutsu includes from a grappling attack using a collar and sleeve to an attack by atemi-waza maintaining distance. The posture of right and left is not drawn in this picture. However, if this painting shows the spirit of



Picture 2: Istutsu-no-kata-1

"Softness overcomes hardness" and you want to explain that it is an example of *Seiryoku Zenyo*, which is a way of life in judo, you need to give an explanation such as the theories of s-atemi and the skill of maintaining distance. S-atemi is the technique with a Health-like character, the intention is not to injure the healthy body of the partner. This author watches here the existence of the old culture of martial arts that is not yet well known to the world.

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The assessment of the anterior and posterior spine curvatures in taekwon-do practitioners and the socially unadjusted from Juvenile Detention Centres

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Abstract

Background and Study Aim. Daily physical activity prevents from a number of changes in the body posture such as the anterior and posterior spine curvatures. Training hand-to-hand combat as a form of physical activity when following the rules of Taekwon-do can contribute to the improvement in body posture. Children and adolescents from Juvenile Detention Centres are presumed to use hand-to hand combat to resolve conflicts. The question arises: does the range of curvatures differ between the groups. The objective of the work is thoracic kyphosis and lumbar lordosis in the groups of Taekwon-do practitioners and the socially unadjusted.

Material and methods. The research material included 39 children and adolescents aged 10-18 (20 Teakwon-do practitioners and 19 subjects from Juvenile Detention Centres in the region of Silesia). The Saunders inclinometer was used to measure the angle of lumbar lordosis and the angle of thoracic kyphosis. The variations between the groups were assessed on the basis of $\chi 2$ Pearson's test at the significance level of $p<0.05$.

Results. Kyphotic curvatures deviating from the norm were observed mostly in the group of children and adolescents from Juvenile Detention Centres where thoracic curvatures occurred in 42.1 % of the subjects. In the group of Teakwon-do practitioners the figure was apparently higher (65%). Lordotic curvatures, within the norm, occurred in 60% of the Teakwon-do practitioners and 52,63% of the subjects from the other group.

Conclusion. Despite some variations in spine curvatures, the test did not confirm the statistical significance between the groups of Teakwon-do practitioners and the socially unadjusted, which can result from a high level of physical activity of the members of the two groups.

Key words: thoracic kyphosis • lumbar lordosis • body posture • taekwon-do

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Introduction

The procedures aiming at improving motor skills and people's personality date back to ancient times. Physical activities were usually an element of military training and a means of building up courage and self-discipline for an individual. Plato as an Athenian soldier emphasized a positive influence of physical activities and referred to them as 'an older sister of spiritual education' [1]. Today's civilization development boosts sedentary lifestyle and thus, contributes to the muscular system deterioration. As a result, the system cannot function properly and loses its dynamic stability of the spinal column.

In the world of the socially unadjusted adolescents, the efficiency of sports as an educational and moral means was emphasized by a number of researchers [2]. S.C. Miller and B.J.L. Bredemeier, Shields indicate a close link between the programs of motor activities for the socially unadjusted and the activities promoting moral development [3]. Hence, the educational effect is achieved through the positive approach towards motor activities adopted even by those who do not like school or other formal education classes.

Despite technical skills, martial arts improve moral and ethical behaviour. Taekwon-do, being an example of combat sports, places an emphasis on improving self-discipline, self-control, mental endurance, mental acuity, as well as body and mind balance [4-6]. Moreover, Taekwon-do training encompasses a wide range of stretching exercise improving agility and spinal mobility, which has a positive effect on a proper development of the spine. However, it is important to consider the fact that the tendency to improve body posture and particularly spinal curvatures in young people who practise sports depends on the training specification and its frequency [7].

The objective of the work is to assess thoracic kyphosis and lumbar lordosis in the groups of Taekwon-do practitioners and the socially unadjusted. The following questions were addressed:

Are there any essential differences in forming the anterior and posterior spine curvatures between the Taekwon-do practitioners and the socially unadjusted?

What variations in the anterior and posterior spine curvatures occur in particular groups?

Material and methods

Subject

The research material included 39 boys aged 10-18 (13.78 ± 2.67 years old) from the region of Silesia: 20 Taekwon-do practitioners (13.2±2.6 years old) and 19 boys from Juvenile Detention Centres (14,36 ± 2.62 years old).

Protocol

The physiological spine curvatures analysis was performed by means of the Saunders inclinometer in accordance with the manufacturer's instructions. The angle of lumbar lordosis and the angle of thoracic kyphosis were determined. According to the norms accepted by Panjabi and White [8]., the norms of lumbar lordosis and thoracic kyphosis were established at 20-45 degrees. Furthermore, the occurrence of hypokyphosis, norm kyphosis and hyperkyphosis as well as hypolordosis, norm lordosis and hyperlordosis was evaluated. The tests were performed by an experienced physiotherapist and the records-taking person.

Human Subjects Research Committee of the University scrutinized and approved the test protocol as meeting the criteria of Ethical Conduct for Research Involving Humans. All subjects in the study were informed of the testing procedures and voluntarily participated in the data collection.

Statistics

Descriptive statistics were calculated for the studied parameters, i.e. the mean value and standard deviation. The differences between the compared groups were obtained on the basis of Person's test of statistical significance $\chi 2$. The statistical significance was put at the level of $p<0.05$. All the measurements were obtained with the use of MS Excel.

Results

The achieved chosen results were plotted in Tables 1 and 2.

Table 1. The recorded kyphotic curvatures in the group of Taekwon-do practitioners (TKD) and the socially unadjusted (P)

Spinal curvatures	TKD	P	Test results $\chi 2$
Hypokyphosis	7	9	0.432
Norm kyphosis	13	8	0.203
Hyperkyphosis	0	2	0.059

Table 2. The recorded lordotic curvatures in the group of Taekwon-do practitioners (TKD) and the socially unadjusted (P)

Spinal curvatures	TKD	P	Test results $\chi 2$
Hypolordosis	6	4	0.928
Norm lordosis	12	10	0.525
Hyperlordosis	2	5	0.087

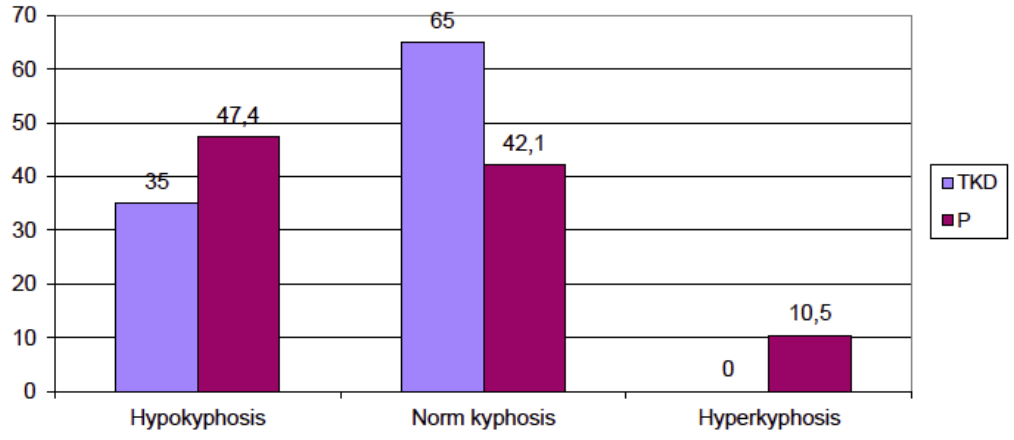

Figure 1. The percentage distribution of kyphotic curvatures occurrence in the studied groups (TDK – Taekwon-do practitioners, P- the socially unadjusted group)

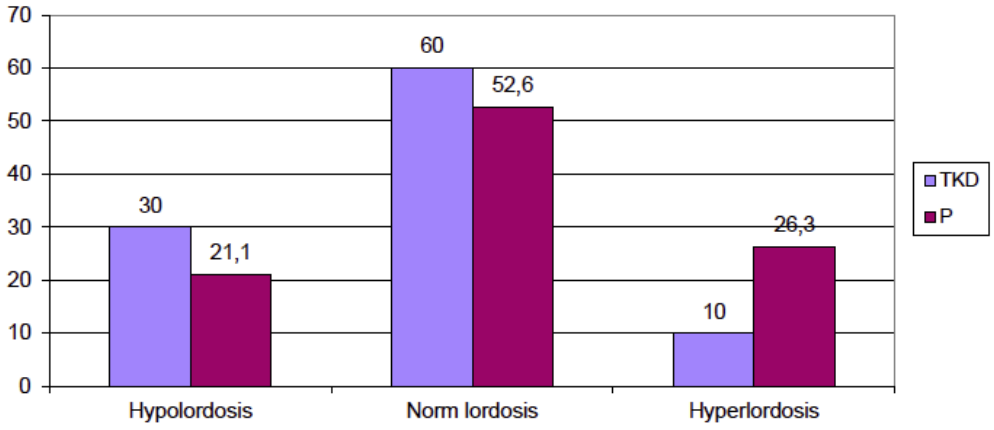

Figure 2. The percentage distribution of lordotic curvatures occurrence in the studied groups (TDK – Taekwon-do practitioners, P- the socially unadjusted group)

Discussion

Scientific literature comprises a few publications concerning the influence of martial arts on the body posture. [9,10]. However, it is extremely difficult to find similar literature on the same topic relating to the socially unadjusted group.

The analysis suggests no statistically significant variations in the anterior and posterior spinal curvatures between the two groups. It is assumed that the lack of the variations can be the result of using hand-to-hand combat techniques, but still more data is required. In the group of the Taekwon-do practitioners hand-to-hand combat technique is used as a form of sports competition. On the other hand, in the group of the socially unadjusted, it is used to regulate conflicts, which is an ethical issue. However, certain variations expressed in percentage are observed.

More than a half of the Taekwon-do practitioners remain the norm where the occurrence of norm kyphosis is observed in 65% of the studied subjects and norm lordosis is observed in 60 % of the studied subjects. In the control group the occurrence of the curvatures is estimated at the level of 42% and 52.6% respectively (figure 2). The similar results were achieved by other researchers. Balanced types of body posture defined as extremely correct and correct occurred more often in Taekwon-do practitioners [11]. Moreover, their kyphotic posture remained within the norm [12].

It is proved that there is a close link between the occurrence of lordotic spinal curvatures and a kind and intensity of the trained physical activity [13-16]. Judo practitioners are a good example of sportspeople with kyphotic postures [17]. The same refers to female handball players [18].

The research proves less occurrence of body posture deformities in the group of Taekwon-do practitioners. Hypokyphosis was observed in 35% of the subjects. There were no cases of hyperkyphosis. Hyperlordosis was observed in only 10% of the subjects. However, in the group of the socially unadjusted hypokyphosis was observed in 47.4% of the subjects while hyperkyphosis occurred in 10.5% and hyperlordosis was observed in 26.3% of the subjects (figure 1,2). On the contrary, hypolordosis was observed in 30% (TKD group) and in 21.1% of the subjects (P group).

The study is just a portion of the whole issue as it constitutes a preliminary phase of an in-depth study. The presented data and the following discussion provide other researchers with the comparative data and pave the way for further studies.

Conclusions

On the basis of the collected data, the following assumptions were made:

1. Despite different conditions of physical development in the subjects of the groups of Taekwon-do practitioners and the socially unadjusted, distinctive variations in the anterior and posterior spinal curvatures are absent.

2. In most of the studied Taekwon-do practitoners, there is no evidence of a pathology in body posture. Norm kyphosis and norm lordosis were observed in more than 60% of the studied subjects of the group.

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Questioning the Concept of General Falling Techniques (GFT)

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Abstract

Background and Study Aim. Many martial artists and some scholars point out that acquiring martial arts and combat sports falling techniques can prevent injuries in daily life. They have articulated that historical experience and tradition in falling led to the advancement of safe falls. However, safe falls are an inseparable part of many non-combative sports like games or gymnastics. Movement patterns for falling techniques differ from one sport to another, while they are still safe and serving the purpose.

Material and Methods. Athletes fall quite often in lot of sports, but research in this area is scarce. In some sports, falling techniques is a part of basic curriculum. Can we presume, that knowledge of falling can be easily transferred from sports to everyday life? Is there any diagnostic tool for that?

Results. In this theoretical essay we will clarify terms fall and falling technique as two different movements. Next we will go through the current research about falling in sports. We will find out what the danger of falling is and what benefit we can gain from falling techniques in sports. At the end of the article a look to possible transfer of falling techniques to general physical activities from children to elderly will be given. The scope is to give suggestion for basic principles for General Falling Techniques (GFT).

Conclusion. In general, falls and falling techniques can be recognised in sports as well as in everyday working or leisure time. Respect the nature of respective sport, falling techniques differ. This is way it is not possible to use them as general skill to avoid injury.

Keywords: safe falls • biomechanics of falls • injuries in sports • falling in sports • injury prevention

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Contributors: Zdenko Reguli conceived the study design. Zdenko Reguli, Jan Šenkýř collected the data. Zdenko Reguli analysed the data. Zdenko Reguli, Michal Vít prepared the manuscript. Zdenko Reguli secured the funding.

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Introduction

We can encounter falls in many areas of life. Not only in sport and physical education, but also in everyday situations. Despite the fact that the concept of fall is intuitively clear for every human being, its definition is not clear. Even in the Holy Bible, according to Christian theology, the fall of man is connected to original sin. Fall is perceived as something evil. Falling down, loss of balance is a metaphor to all unhappy things, when no hope can be seen as far as a man can rise up. What is the difference between that who remain on the ground and that who could rise again and again?

In the ontogenesis, ground movement and falling are necessary for future standing and walking. On other side, failing causes many injuries and can cause death. People, especially elderly, but also athletes, can feel fear of falling. This is also frequent topic for researchers, as physical and psychological health is part of quality of life.

Athletes fall quite often in lot of sports, but research in this area is scarce. In some sports, falling techniques is a part of basic curriculum. Can we presume, that knowledge of falling can be easily transferred from sports to everyday life? Is there any diagnostic tool for that?

Material and Methods

In this theoretical essay we will clarify terms fall and falling technique as two different movements. Next we will go through the current research about falling in sports. We will find out what the danger of falling is and what benefit we can gain from falling techniques in sports. At the end of the article a look to possible transfer of falling techniques to general physical activities from children to elderly will be given. The scope is to give suggestion for basic principles for General Falling Techniques (GFT).

Results

It is necessary to distinguish between the concepts of the fall in its various semantic meanings in the area of physics, philosophy, medicine, political science, and of course, in sport. Multiple meanings of the concept of fall assures us that it is necessary to distinguish the concepts of the fall and the falling technique.

Multiple meanings of the concept of fall (as well as the movement of the human body) assures us that it is necessary to distinguish the concepts of:

- the fall: any movement of the body as a whole and its segments in the direction of the gravitational force
- falling technique: acquired movement skill

Based on theoretical analyses of the problem [1], as well as findings from practice, we propose to define the falling technique as a sudden change of the movement structure caused by the loss of balance in the direction of the gravitational force. The movement structure of the falling technique is an acquired movement skill, which is demonstrated by a safe balance restoration by creating a new support area by other parts of the body than feet.

The biomechanical structure of falling techniques is based on the biomechanical structure of falls in particular according to Straus [2] and Carter [3], who examined falls from the forensic and biomedical point of view. In our point of view, the phases landing and landing position are the most emphasized ones at falling technique.

Here we have to think about four stages of the falling technique. At first it is a violation of the balanced state that from the mechanical point of view occurs by the impact of gravitational forces, eventually other forces until the fall itself. Furthermore, it is a phase of the contact with the ground and the phase of stopping the motion, which is terminated when the falling one stands up or stops in the landing position. Even though the falling technique is a complex phenomenon, in which the individual phases relate to each other, each phase is caused by the previous one. The reason of the fall, imbalance, is phase of initiation, which can be caused by endogenous or exogenous factors. At the stage of initiation, there is external or internal stimulus to fall, or their combination. Intentional fallings are initiated by inner impulse to fall. Unintentional fallings are accidental, caused through a fault of a person, or due to another person or an object. Falling, as second phase, is accelerated one. One can fall in controlled or uncontrolled way. Next phase, is the most dangerous one. Contact with the ground is called impact. This phase is characterised by quick deceleration. Impact seems to be crucial, because this is the phase in which the falling one is vulnerable to injuries. We distinguish the impact, and thus also a traumatic injury, as primary and secondary. The primary impact arises in the first contact of the body with the mat at the moment of impact (interaction). Secondary impact arises by the subsequent impact of other parts of the human kinematic chain after the primary impact. The last phase, after-impact position is often underestimated. Fallen person usually stay in a lying position till checking possible injuries. Balance restoration can be made also in a standing position when using kinetic energy of fall.

In different sports, falls are not only an important physical skills affecting the sports performance, but also a means to make the sports discipline more attractive. For example, in volleyball considers Roque [4] falls as part of the game and the most exciting part of the game. As an example of a team sport Reguli [5] analysed potential danger of falls in volleyball and highlighted falling techniques as necessary skill in it. Falls are not the basic skills in volleyball. However, they allow to manage game situations in which would have been otherwise granted a point to the opponent. The most important part of the technique is considered to be the ability of the players to maintain the momentum gained by the fall and use it to roll the body away and to get back to the standing position. Complete season for one of the best Czech men's volleyball team was examined. The monitored situations were as follows: a) what falling was performed; b) the post of the player who performed the falling or combative activity. Authors found that average frequency of fall was one per 81 seconds. The number of particular combative activities out of ten monitored matches was 65.4 in one match, which is one falling technique in every 1 min 21 sec. Players successfully received ball in the number of 36.1 in one match with using falling down. But only half of receiving ended with scoring a point. The character of a volleyball game is created by sport rules that allow to use falling techniques as collapse, sprawl, dive, shoulder or barrel roll, etc. Falling techniques have an irreplaceable position in volleyball nowadays and their mastering is an important part of team performance. The team that is not fully prepared for physically and mentally demanding active style of volleyball has a worse position in contrast to teams that mastered falling and combative techniques well. Well performed falling techniques are crucial for scoring a point in a danger situation. Similar results were found in football [6], where falling techniques are in close connection with other combative activities as pushing.

After-impact position in falling techniques used in games allow to continue in a game successfully and without an injury. When the speed is quick, falling can lead to injure, which is main acute and concludes chafing, cataclasis, sprain and contusion. Hua and Hua [7] examined basketball and learned that falling and spraining (due to collision with other player) injures are common in this game.

As for individual sport, Philippe et al. [8] give example answering question "How frequent and why are skiers and snowboarders falling?" in 1436 recreational male and female skiers and snowboarders from all age groups. For last decade the incidence of falls among skiers and snowboarders was substantially lower. But still, injuries in winter sports are mainly caused by falls. It confirms previous findings of Vives [9]. The incidence of falls among skiers was in Philippe et al. study (8) 0.076 ± 0.21 per hour and that among snowboarders was 0.429 ± 0.70 per hour. Age (OR: 0.96; CI: 0.95 - 0.97), soft snow conditions (OR: 4.1; CI: 1.9 - 8.8) and poor skiing skills (beginners and intermediates) (OR: 2.6; CI: 1.2 - 8.1) were predictive for falls during skiing. Poor snowboarding skills (beginners and intermediates) (OR: 8.3; CI: 3.1 - 27.4), wearing a helmet (OR: 2.3; CI: 1.2 - 4.6) and alcohol consumption (OR: 2.1; CI: 1.2 - 3.9) were predictive for falls during snowboarding. We can assume, that in competitive skiing and snowboarding a fall leads to failure in competition. For safety reasons skiers and snowboarders should perform in good conditions, with good protective equipment, but they also should learn how to fall down and how to stabilise the body after the impact to avoid secondary fall and secondary injuries.

It is believed that martial artists and combat sports athletes mastered falling techniques [10]. Especially in competitive combat sports like judo or wrestling. On other site, even practising combat sports can make an serious injury, or can cause a death [11] The ultimate aim in combat sport is to win competition according to the rules. We assume that the structures of the falling techniques taught in competitive combative sports are based on this goal. The falling technique used in combat sports influenced the understanding of the falling technique as a prevention against injury. The fact that the decisions of the referees on the evaluation of the tossing ones is indirect by nature of the fall of the tossed opponent naturally developed in the effort to learn how not to fall according to the rules, so that the rivals aren't given positive assessment. The judoists started at first informal and later a targeted repeat training of such a physical structure of falls that prevented a positive evaluation of the tossing opponent. If an athlete falls on his back, his opponent is announced to be winner. In judo this effort culminated especially in the second half of the eighties of the twentieth century.

Some coaches even went so far as not to teach correct falling techniques at all, so that the trainees did not learn wrong habits for the competition. In training they use only physical structures disturbing the control of the tossing one over the tossed one, the so-called unorthodox falls, turnouts [12], which include turns, handstands, flips on the elbows, and flips on the head to avoiding contact with the back.

Lafon next state there are several reasons why a training process should contain turns instead of the classic falling technique. They are based on the premise that today's judo is primarily a competitive sport discipline modified by rules and does not fulfil the self-defensive or other functions. Even when the sportsmen are specifically preparing for performing turns for a long time, some authors doubt the correctness of their inclusion in training instead of the falling technique. Lee [13] refers to many cases of injury (exceptionally even death), which were caused by an intentional or unintentional fall on one's head. He objects to training of turns:

- turns can be dangerous and cause serious injuries
- turns contradict to the principles of judo, which can be punished by the referees according to the competitive order of judo
- judo is also a martial art (not only a competitive sport) and carries traditions that should be kept

Despite these objections the turns are constantly used in sports fighting.

Position in the bridge with a support on the head is common even in wrestling according to the United World Wrestling (FILA). Head bridge is an often trained position in wrestling and the wrestlers practice development of various specific exercises for strengthening of all muscle groups involved in this position, particularly the muscles of the neck and back. In addition, in judo and wrestling, injuries can be prevented by mats. Soft surface partially absorbs the impact of a fall.

The analysis of the usage of techniques in judo and wrestling implies that the falling techniques that are now used in competitive combative sports, are not suitable as models of general falling techniques. Falling techniques practiced by wrestlers and judo players extensively changed motion patterns because of the rules of sports. The examination of falling techniques in combative sports leads to state that sports rules specify that the winner is that who throws the opponent. The falling technique is, therefore, the secondary, often overlooked skill. These sports are practiced on a soft surface. It prevents injuries and allows athletes to fall in such a way that it could have fatal consequences in a situation outside of the sport. To do a correct falling technique means to loss a fight. Correct falling techniques are undesirable in a sports fight.

Indirectly, we can learn a lot about unsuccessful falls from research about injuries in sports. More than half injuries is caused by falls in some Olympic sports [14]. Injuries are typical for any particular sport. If there is no proper falling technique, small joints as wrists can be easily injured. If that injury is not treated, even serious can occur [15]. Also other joint injuries are caused by falling down as acromioclavicular joint or elbow, as Tauber [16] state.

Athletes are applauded for their courage when returning to the game after fall. Podell [17] pointed out that even if there is no injury of movement apparatus, sports-related concussion is one of the biggest health concerns today for athletes. Prevention and education are discussed as well as wearing protective device or teaching falling techniques.

There is no doubt that falling techniques help to prevent injury. Falling technique is a skill that should be tested or evaluated. The question here is what criteria limits the good falling technique. Simply, we can consider that correct falling technique performed who felt down without causing an injury. But it is not possible to test anybody like that, or with some possible errors as it can be demonstrated in evaluation of susceptibility to injuries during fall (STBIDF) [18]. This indirect method uses controlled task of lying down from standing position, which can be considered as no fall. Also it must be used in safe environment (using mats), precluding the real injury.

There are also various evaluation methods for falling techniques. Traditionally, evaluation of falling techniques is an element of lower kyu tests in various Japanese budo, for example. More sophisticated way to various motor abilities and skills related to falls was developed and used by Kalina and Michnik [19–22] as well as effects prognosis of safe falls education (predictive validity. Some specific scales were developed by Zvonar and Reguli [5,23]. These scales were built on the basics of biomechanics of respective falling techniques. This is way it is not possible to use them for evaluation any other falling technique. Nor traditional, not modern methods of evaluation are answer to the structure of General Falling Techniques.

Conclusions

In general, falls and falling techniques can be recognised in sports as well as in everyday working or leisure time. Respect the nature of respective sport, falling techniques differ. This is way it is not possible to use them as general skill to avoid injury.

In accordance with previous research [1], we propose unifying principles of General Falling Techniques as follows:

- The distribution of the impact force largest possible surface area of the body. Only that parts protected by a layer of muscles should be in the contact with the ground.
- Convert sliding friction, eventually a direct impact, to rolling friction (rolling motion) to avoid bruises, especially when falling on abrasive ground.
- Dampening of the fall in the longest possible time. Striving for gradual deceleration.
- The use of kinetic energy of a fall to retake the standing position.
- The use of natural/functional movement allowing to utilize developed motor abilities according to functional anatomy of the human body.

Each falling technique should follow as much principles of General Falling Techniques, as possible. However, some situations do not allow the use of all principles. The causes may be different, endogenous and exogenous depending on their nature. Endogenous factors include especially contra motivation, tactical behaviour, and exogenous the terrain, equipment, another person, and so on.

It is necessary to practice the technique of the falls with regard to its future use. It is not advantageous to practice for example, judo falls in football players, volleyball players, or the general public to avoid injuries. It is necessary to adapt the falling technique for each group. Due to the nature of suddenness, and unpredictability of the fall, it is necessary to master the falling technique perfectly, which will be eventually maintained lifelong. We suggest falling technique as one of three component in avoiding injury as partly Gerrard indicated [23]:

- Proper falling technique in the meaning of GFT;
- Strength training to develop motor abilities and protective layer of muscles;
- Injury prevention as inseparable part of education.

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Philosophy of kendo: killing sword and life living sword. Reconsider the meaning of the culture of kendo in connection with the ideas of *setsunintou* and *katsuninken*

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Abstract

This paper is intended to make the philosophy of kendo clear on two themes: the first is about martial arts, which were originally a culture of destruction—one that specifically denied the lives of others for the sake of one's survival—and which were thus developed as techniques to kill and maim others, and which then became a measure to educate people to realize the importance of living together and one that has since been developed as a culture of creation; the second is about when and by whom battle techniques were converted into an apparatus to promote awareness of life. Author present theme from the viewpoint of body-and-mind relations, namely the philosophy of *setsunintou* (sword to kill people) and *katsuninken* (sword to restore people to life)—one of concepts in Zen, that was introduced into swordsmanship. The philosophy changed swordsmanship from killing techniques into techniques to restore and foster people.

To consider the issue, author focus on the relationship among military commanders, masters of martial arts and Zen priests, who lived from the latter half of the 16th century—when firearms were introduced from Europe into Japan, to the first half of the 17th century—when swordsmanship was systematized and written records about swordsmanship were compiled, focusing on: Nobutsuna Kamiizumi (1508-1582?), Muneyoshi Yagyu (1527-1606), Ieyasu Tokugawa (1542-1616), Munenori Yagyu (1571-1646), Soho Takuan (1573-1645) and Musashi Miyamoto (1584-1645). The spirit of these people, who lived through the Warring States Period of Japan and built a peaceful time, has been handed down as the spirit of swordsmanship.

Keywords: philosophy of kendo • sword to kill people • sword to restore people to life

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INTRODUCTION

This paper is intended to make the philosophy of kendo clear on two themes: the first is about martial arts, which were originally a culture of destruction—one that specifically denied the lives of others for the sake of one's survival—and which were thus developed as techniques to kill and maim others, and which then became a measure to educate people to realize the importance of living together and one that has since been developed as a culture of creation; the second is about when and by whom battle techniques were converted into an apparatus to promote awareness of life.

All people who are born into this world are destined to struggle with how to survive this world until they depart their lives. The challenge of how to live a given life is a fundamental and compelling issue for those of us who have lived "right here and now" through different countries, regions and generations. People have made many and varied efforts to seek an answer to that question in various places around the world in various times. These efforts have been embodied today in the forms of religions, ideas, philosophies, and literatures. On the other hand, people have continuously killed each other in battles and wars throughout history. How can we understand and overcome the biggest contradiction embraced by humankind? There is a contradiction between two sides of human nature: to commits murder each other and to persist in life. That can be considered one of the most difficult question among many difficult questions.

In 2000, 15 years ago, a book titled "Why War? – An exchange of letters between Freud and Einstein" was published in Japan. In 1932, Albert Einstein (1879 – 1955), who was then 53 year old and who had been awarded the Nobel Prize in Physics that year, was asked by the League of Nations to deal with a theme that Einstein deemed most important to human beings and to exchange letters with the person with whom he most wanted to exchange opinions concerning that theme. The title of the book come from a theme selected by Einstein. The correspondent selected by Einstein was Sigmund Freud (1856 – 1939), a psychoanalyst who was then 76 years old. Einstein asked Freud whether we could free ourselves from the constraints of war and whether we could lead our minds to a specified direction so that we would not be touched with the mental diseases of hatred and destruction. In reply, Freud sought to answer the questions by using the words of *eros* (life drive) and *thanatos* (death drive). Freud placed his last glimmer of hope on the 'development of culture', saying that it didn't seem likely that we could rid people of aggressiveness.

How then can we find a clue to solve this old-but-new difficult question from our standpoints as practitioners who belong to a sports group and who have placed ourselves in the world of fighting sports? In daily life, the actions of hitting, kicking, throwing and grappling an opponent are prohibited as wrongful acts. However, in sports in which practitioners confront and compete against each other, the integrated operation of all mental and physical functions to strive for victory—including rational mind, emotion and physical sense—is valued. As a result, the victor is praised. What is prohibited in daily life is permitted in the fictitious space of sports. This can be seen notably in fighting sports including martial arts. In fighting sports, what do people utter from the movement *sensuos*[1] that can be recognized through the fictitious space of a match? In particular, this paper will focus on the words of *kendo* that were generated based on the worst possible situation for human beings in which people pointed swords at each other in a struggle for life or death.

THE WORLD OF *KENDO*

Fifty-three years has passed since I started practicing martial arts, and forty-three years has passed since I became interested in the culture of martial arts and started to explore what the martial arts are, while having a glimpse into the world of martial arts and Zen in old times and their historical backgrounds.

In the world of martial arts, we practice what is prohibited in daily life as a matter of course. Moreover, defeating an opponent in an excellent way is praised. *Kendo* was originally developed as a training method for killing and wounding others with one stroke of a Japanese sword (*ittou*) for self-defence or in a battle. *Kendo* has since evolved in its own right as an athletic sport to compete for *ippon* with *shinai* while wearing armour. Thus a world in which we previously sought to kill each other was placed into an athletic event called *kendo* in the framework of sports and practiced by many devotees. By the way, the 16th World Kendo Championships was held on May this year at the Nippon Budokan and practitioners from 46 countries and regions participated. The number of devotees of *kendo* are increasing not only in Japan and also throughout the world.

As I said, *kendo* started from the idea of killing and wounding each other with a Japanese sword. Although

1. Movement sensuous, the conscious mind feeling sense of movement. The movement sensuos Kinaesthese which Husser says.

the Japanese sword was replaced by a *shinai*, there was no change in the structures of the motions in delivering passes and blows. Even although *kendo* assumes acceptance of what we are prohibited from doing in 'normal life', the number of *kendo* practitioners is increasing. If I may explain the sensuous movement to be felt as a practitioner, I might be attracted by the strong pressure and sense of release by throwing an explosive *ippon* generated from the pressure.

In *kendo*, the concepts of facing each other and never retreating are valued. In a normal environment without psychological pressure, people are supposed to process information properly, make a level-headed judgment and act in a prompt manner. However, in *kendo*, practitioners are required to behave normally in an abnormal environment in which they come close to one another and put psychological pressure on each other. *Kendo* training aims to foster an ability to convert pressure into more energy. That ability is considered to correspond to an ability to convert trouble into an opportunity.

The culture of *kendo* has twice faced the threat of extinction in Japan. The first time was during the Meiji Period (1686-1911), a time when Japan ranked with the Great Powers of the West and had started out on its voyage as a modern state. The second time was in 1945 when Japan surrendered unconditionally in the Pacific War. Despite the two threats to its existence stated above, *kendo* has survived and gained popularity among women and overseas devotees. What was the strong energy of *kendo* that enabled it to survive?

To answer that question, it is essential to consider *kendo* from a historical viewpoint.

To understand the culture of *kendo*, we have to look back to the 10th century when *samurai* appeared as a class of rulers in society. In the 12th century, *samurai* held the reins of government and invited many Zen priests to Kamakura, the capital at the time, from China. These priests came to be spiritual support for the *samurai*. Zen priests metaphorically applied the sword function of 'cutting' to saving souls and healed the distress of *samurai*. Zen priests used the words *setsunintou* and *katsuninken* as means to heal distress of *samurai*. On the other hand, *samurai* felt something similar to belief towards swords which were used as means.

What are *setsunintou* and *katsuninken*?

The words *setsunintou and katsuninken* can be found in Rules 12 and 15 of "*Hekiganroku*," a collection of sayings compiled in the early 12th century that indicated education methods for a master of the Zen sect to instruct disciple in achieving the state of mental detachment (*mushin*). A good master observed his disciples and, while being opposed to each other, uses the two methods of *setsunintou* and *katsuninken* flexibly— according to time and occasions—without placing too much weight on either method to instruct his disciples in how to achieve the state of *mushin*. *Setsunintou* means to deprive a disciple of and disallow worldly thoughts. *Katsuninken* means to accept and approve the words of a disciple. Sogen Omori, who succeeded as master of the swordplay school called the Jikishinkage School established in the Edo Period was also a Zen priest, and he explained *setsunintou* and *katsuninken* in his book "*Hekiganroku*" as follows: *setsunintou* is the function of denial and is synonymous with deprivation. *Katsuninken* is, in opposition, the function of affirmation and is synonymous with giving. Affirming and giving are not always good, and denying is not always bad. Using two swords properly, according to time and occasion, eventually resulted in one sword. This was a discipline of Zen priests, in other words, a practice and an example from old times to master the double-edged sword that can kill and spare others as one likes freely without interference.

I would like to call your attention to this by pointing out that using two swords (*nitou*) properly according to time and occasion eventually result in one sword (*ittou*). In this case, *ittou* means the ability of a master to read the state of mind of his disciples intuitively and determine which sword to use. This ability is referred to in Zen as a function to seize an opportunity (*ki wo miru kokoro*). For that purpose, a master is confronted by a disciple with seriousness and wields two swords when the opportunity comes to make his disciple understand the function of *mushin*.

In the 13th century, the philosophy of Zen as stated above was imported from China by Chinese Zen priests and accepted by the *samurai* during the Kamakura Period (1192-1333) when the *samurai* obtained political power. In course of time, prominent Japanese Zen priests appeared and brought relief to the wavering minds of *samurai* and many other people. In particular, the *samurai* who handled administration and military affairs in society formed a closer relationship with Zen priests. One of the reasons for this is that the spirits of the *samurai* and the Zen sect has the common theme of looking at life from the viewpoint of death and also has a common point in addressing a challenge on one's own.

The social roles of *samurai* and Zen priest alike are, for the sake of principle, to give relief to all living things.

Although it tends to be thought that a *samurai* carried a sword or a spear, as a matter of fact, Ieyasu Tokugawa (1542-1616) made the most of firearms to suppress the country. In 1615, Ieyasu destroyed the Toyotomi Family and brought the long-standing and war-torn country to an end. However, Ieyasu then imposed strict restrictions on the production of firearms that had yielded the military victories, and restored swordplay with the use of sword that was not as effective as a military weapon. The system established by Ieyasu built a period of peace that lasted for about 260 years until 1868. What was his intention?

Unfortunately, no description as to his intention appeared in Japanese literature. However, a description was identified in "Giving up the Gun: Japan's Reversion to the Sword" written by the American author Noel Perrin in 1979, 36 years ago. That book had anti-war and anti-nuclear themes, and was translated into Japanese by Heita Kawakatsu and published in 1991 [1], and said:

Only a few years after firearms were introduced to Japan in 1543, Japan started to produce guns and created the best weapons in the world by improving their function and became the leading country in terms of possessing guns. However, as Noel Perrin said, Japan relinquished that position for five reasons.

I. Many *samurai* felt that control over the country was not working effectively;

II. The Japanese were tough soldiers and the islands of Japan were difficult to invade due to natural conditions;

III. A sword had far more symbolic meaning in Japan than in Europe;

IV. The background factor to the downgrading of the role guns was a reactionary trend that the attitude of Western people toward the Christian religion and commerce was unacceptable; and

V. The sword as a weapon is connected to a graceful movement of the person wielding it. The reason, therefore, is simple as a sword is more dignified than a firearm.

Although all the above reasons are persuasive, in my opinion, there were more important factors. That was the fact that military commanders who had fought with pride and honour in facing an opponent and fighting fairly were killed by a gunshot from an unknown shooter in confrontations with gun-bearing troops consisting of foot soldiers (*ashigaru*), which were organized and delivered an intense attack. As a result, military commanders in each region who had possessed military and political powers since the 12th century felt a sense of crisis that wisdom, courage and ethics as *samurai* might be instantly dispelled. Therefore, Ieyasu Tokugawa—who brought together military commanders in each region—took the measure to refrain from using firearms and keep swordplay alive, not as a technique to kill and wound an opponent in war, but as one for creating a new era of peace that incorporated wisdom, courage and ethics to be passed on to offspring.

People who changed swordplay (*kenjutu*) into swordway (*kendo*)

To discuss this issue, I would like to focus on the relationships among military commanders, masters of the martial arts, and Zen priests who had lived from the late 16th century when guns were introduced into Japan from Europe, to the early 17th century when swordplay was systematized and written records were compiled.

The people whom I would address are Nobutsuna Kamiizumi (1508-1582), Muneyoshi Yagyu (1527-1606), Ieyasu Tokugawa (1542-1616), Munenori Yagyu (1571-1646) and Soho Takuan (1573-1645). They were all lived in the Age of Civil Wars in Japan and sought to establish peace. How were their spirits reflected in swordplay?

From Nobutsuna Kamiizumi to Muneyoshi Yagyu

Kamiizumi employed *setsunintou* and *katsuninken*, the educational methods of Zen Buddhist, as the philosophies of swordplay. Kamiizumi defined *setsunintou* as defeating an opponent by attacking through to the end, and *katsuninken* as defeating an opponent by moving according to an opponent's action.

Kamiizumi decided neither to acknowledge nor destroy other schools, and extracted the principle of *kimyou* from various techniques of many schools including the Kage School. To correspond to a new era, he created and systematized a technique to convert an attack according to an opponent's action, which was a simple and sole technique against techniques manipulated in various manners. That was the Shinkage School. The main point of the Shinkage School was the training in putting oneself at risk and

seizing the opportunity to move oneself beneath the sword of an opponent and perform a technique. The school was proud of its training as not only a technique for a warrior in one-on-one battle but as a technique of a great and wise military commander for battle against a group of opponents.

Kamiizumi taught all his techniques to Muneyoshi Yagyu and imposed on Muneyoshi the challenge of developing a specific technique to express the idea of *mutou* [2].

From Muneyoshi Yagyu to Ieyasu Tokugawa

Relationship between Muneyoshi and Ieyasu through swordplay

In 1594, Muneyoshi demonstrated to Ieyasu the techniques of *marobashi* and *tsutomete eiyu no kokoro wo shiru zegoku ittou* (the most important thing is to look at an opponent's action, taking efforts to understand his mind), which was a technique of *mutoudori* that represented a way of using a long sword (*tachi*) to change one's stance freely according to an opponent and indicate one's pride as a military commander. At that time, Ieyasu was in the second highest position in the whole country. Ieyasu was so impressed by the demonstration of Muneyoshi that he not only immediately became a disciple of Muneyoshi but employed Muneyoshi as an instructor for the Tokugawa Family. The thinking of Ieyasu can be analogized by the following statements.

Statements of Ieyasu [3]

I could rule the whole country thanks to both Shingen Takeda and Mitsunari Ishida. (*Roudanki*) Ieyasu was defeated overwhelmingly in the battle of Mikatagahara by Shingen Takeda, a general of the enemy, and decided to kill himself. After the death of Shingen, Ieyasu respected Shingen and learned from him as a master. Then, in the fateful battle of Sekigahara, Ieyasu narrowly defeated his rival Mitsunari Ishida. In later years, Ieyasu even felt gratitude toward Mitsunari. Hero knows hero's mind.

A general does not want to kill people. He thinks solely of avoiding having to face difficulty. (*Gyokuonsho*)

A good commander recognizes a reason for victory or defeat before avoiding a battle. (*Tootoumi Kenbun Ryakki*)

From Ieyasu Tokugawa to Munenori Yagyu (son of Muneyoshi)

Statements of Ieyasu to those who take a position of leadership

The whole country is for the people of the whole country. You should not consider the whole country as being for you yourself. Likewise, a country is for the people of the country, not for yourself. Home is also a home for the family, not for yourself. Nothing can be formed by yourself. (*Buyashokudan*)

Utensils will not avail you in the hour of danger, no matter how valuable they are. A treasure among treasures is a person. (*Iwabuchi Yawa Besshu*)

Every leader of a region should dispel the worries of the people with a merciful heart. (*Koroushodan*)

Statements of Munenori who accepted Ieyasu's will

Zegoku means to capture the essence of a subject. *Ittou* means to seize the opportunity of an opponent, not a sword. (*Heiho Kadensho*) [4] Munenori put stress there on fostering the ability to seize the opportunity. Munenori also explained using the words *setsunintou* and *katsuninken* employed by Kamiizumi that the blade that kills people should become the sword that brings people to life, and that if we use *setsunintou* in order to calm a disordered society and society becomes calm as the result, *setsunintou* is exactly *katsuninken*. Munenori proposed the idea that in on ordered society, a sword must be something that can contribute to the development of the personality of a *samurai*, not a practical technique for fighting.

Relationship between Munenori Yagyu and Soho Takuan

The Zen priest Takuan explained to Munenori that in order to seize the opportunity accurately, the ego in one's mind (*ga*) should be discarded—but not by stopping the function of the mind.

Munenori put stress on a state of mind that could totally accept and respond freely to the approach of an opponent, while explaining the methods of manipulating a sword. Accordingly, it was acknowledged that the art of war was consistent with Buddhism and had many common points with Zen. The concept of the sword and Zen are one (*ken zen icchi*) widely spread and had a lot of influence in the Edo Period, due as well to the authoritative position of Munenori as a master of the art of war for the Shogun Family.

Conclusion

As seen above, it can be recognized that a place where people killed each other was transformed into a place of live and death (actual fighting) →a place of real sword (accomplishments of art) →a place of confrontation (athletic sport)=a place of recovering from mental disorder.

Kamiizumi and Muneyoshi who were involved in the above transformation were not only swordsmen, but also military commanders who ruled regions. Their challenge was to create and hand down sword techniques from the viewpoint of such techniques being a necessary qualification that, as a *samurai*, the leader of a group should have. They established the Shinkage School to represent an awareness that the true enemy was not an opponent but within oneself, and to build the pride of *samurai*.

It is said that Ieyasu was so impressed by the technique called *muto-dori* created by Muneyoshi Yagyu that Ieyasu acknowledged the technique as one worthy of securing the qualification as *samurai* in the peaceful age to come. Then, what is the *muto-dori*?

I interpret this question that *Mutou*, as intended by Yagyu, was exactly the same as a *samurai* becoming a Japanese sword that did not fold nor bend, was sharp and which had a beautiful figure. Regarding this thoughts, Tenshin Okakura (1862-1913) who was taught by Ernest Francisco Fenollosa, similarly to Jigoro Kano, and served as the principal of the Tokyo Fine Arts School and the director of the Museum of Fine Arts, Boston, USA, referenced that ideal of *samurai* living in the late middle age, the Muromachi Period (1392-1573), was to be a sword, not to use a sword. “A Japanese sword that did not fold nor bend” means flexibility or the principle of flexibility (*Ju*), “to be sharp” means distinguished strength, and “a beautiful figure” means a natural posture that can apply a technique to convert an attack according to an opponent’s action. On the other hand,Tenshin said that being a sword meant that *samurai* became like a sword that was pure, clear, steadfast and always pointing to the pole star[2].

Here, I want to note a statement by Daisetsu Suzuki, a Buddhism scholar (1870-1966): In answer to the proposition “how can you forget yourself on the very eve of killing each other?” is that continuing effort to deepen the emotional function and the spiritual perspective through practice can lead to a universal truth beyond a mere individual activity (“The Eastern Way of Seeing Things”, Iwanami Bunko). This remark can be interpreted as the mental condition of a samurai who can reach after he become a Japanese sword.

The spirit built by the pioneers as described above has been inherited in the spirit of modern *kendo*. I am extremely desirous that the world of the martial arts can lead to a universal truth beyond a mere individual activity as explained by Daisetsu.

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The conflicts in modernization of wushu – By the case of Japanese Wushu Taijiquan Federation oppose the *Rules for Wushu Taolu Competition*

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Abstract

Background and Study Aim: Wushu Taolu (武術套路) means the routine performance in competitive Chinese martial arts. In 2003, the International Wushu Federation (IWUF) published the new version of Rules for Wushu Taolu Competition. The new rules approve difficulty and add music in performance, just like rhythmic gymnastics. Japanese Wushu Taijiquan Federation (JWTF), the second influential member in IWUF, insist the new rules raised the risk of injury and cannot be sufficiently represented the feature of wushu.

Material and Methods: This study analyzed related material including the official journal published by JWTF, main changes of the new rule, and the details of the proposed amendment draft by JWTF.

Results: JWTF disagree with the new rules in contents of difficulty. In back of this opposition lies that JWTF attaching importance to the combative aspect of martial arts.

Conclusions: The conflict of modernization of Wushu Taolu exists in the relationship of combative aspect and aesthetic aspect of martial arts. Japanese association solves this conflict by dividing Taolu into two parts: the Olympic style of Taolu and the original style of Taolu. But this kind of solution needs further researches.

Keywords: aesthetics • body performance • globalization • localization

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Introduction

Wushu (武術) means Chinese martial arts. It is mainly divided into two parts, the traditional Chinese martial arts and the newly or modern Chinese martial arts [1,2]. Newly or modern Chinese martial arts also known as the competitive Chinese martial arts, it consists of Sanshou (Chinese boxing or Chinese kicking boxing) [1] and Taolu (the routine performance). Compared to Sanshou, Taolu pays more attention on the body performance (the aesthetic aspect of martial arts) instead of practical combat (the combative aspect of martial arts).

Currently, the International Wushu Federation (hereafter "IWUF")[3] has 146 members. Among the member countries, Japanese Wushu Taijiquan Federation (hereafter "JWTF")[4] was established in 1987. It is second influential member following China in IWUF.

This study aims to analyze the conflict exist in the modernization of Wushu, especially Taolu. The way from traditional ethnical sport to the modern competitive sport can be understand as the modernization. Taolu appears as a competitive sport since 1959 when the first *Wushu Taolu Competition rule* was published. There were 8 times that the rules of Taolu have changes [5,6]. The biggest change made in recent year was in 2003. In that year, the IWUF published a new version of rules, the *Rules for Wushu Taolu Competition* (hereafter "*the new rule*"). But JWTF insist *the new rules* raised the risk of injury and cannot be sufficiently represented the feature of Wushu.

Based on these facts, this study wants to reveal the conflicts in modernization of Wushu through analyzing the changes of Wushu's rule and the altitude of Japanese association. The study aims to solve the following two questions: (1) the main changes in the new rule from the former rules; (2) how and why JWTF opposed the new rule.

Material and Methods

This is a historical research based on the related documents and materials. In order to reveal the question (1), the study summarizes the related papers and analyzes the rules published after 1959. As for question (2), this study analyzes the official journal published by JWTF, and the details of the proposed amendment draft by JWTF.

Result

1. The main changes of the new rule.

After the first *Wushu Taolu Competition rule* was published in 1959, this rule was revised in 1960, 1973, 1979, 1984, 1991, 1996 and 2003. Table 1 shows the main changes of each version of rules.

Table 1. Main changes of rule of Wushu Taolu (1959-2003)

Year	Main changes
1959	Decided the competition events; The evaluation method (full score is 10 points); The amount of movements of each event (each performance should have 50-60 movements); Set the upper limit of performance time (105-150 seconds); Set the standard of some movements;
1960	Divided the man and women event; Set the detail of scoring (deduct 0.1-0.2 points for minor mistake, 0.3-0.5 points for obvious mistake, 0.6-1 points for severe mistake);
1973	Add bonus points when competitor complete the new movement or difficulty; Set the lower limit of performance time (80 seconds);
1979	Cancel the bonus points for difficulty; Unified the term and points in evaluation; The apparatus should be checked before performance;
1984	Add some competition events; Limit the size and weight of apparatus; Deduct the points if performance include the vulgar movements; The national competition should set camera to record competitor's performance;
1991	Change deduction points of minor mistake from 0.1 to 0.05; Allow two decimal places appear in the score. The second decimal places should be "0" or "5".
1996	Divided the full 10 points into several parts: evaluation of quality of movements (6.8 points); evaluation of overall performance (3 points); there are 3-5 referee responsible for each part. Add the point for innovated movements (0.2 points); Listing the detail of the mistake and deduction criteria of quality of movements and overall performance.
2003	Add the part of evaluation of difficulty. Simplify the deduction criteria for mistake in performance. Change the point of each part: evaluation of quality of movements (5 points); evaluation of overall performance (3 points); evaluation of degree of difficulty[1] (1.4 points for the "Difficult movements". 0.6 points for "Difficult connections"); Allow the competitor to choose the music (conducted to melodies without words) to match their choreography. Add the contents of anti-doping test.

The early rules (published in 1959, 1960) mainly decided the general contents of competition. Most of the contents are abolished in today's rule. But some

1. Evaluation of degree of difficulty divided into two parts: "Difficult movements" (1.4 points) and "Difficult connections" (0.6 points). The points of "Difficult movements" are added when competitor completes the movements with acrobatic technique like jump and spin. There are three classes in the "Difficult movements", A (+0.2); B (+0.3); C (+0.4). The points of "Difficult connections" is added when competitor complete two or more "Difficult movements" continuously. There are four classes in the "Difficult connections", A (+0.05); B (+0.1); C (+0.15); D (+0.2).

of the contents are still used, such as the full score is still 10 points. In 1973, the rule adds bonus points to encourage competitor to perform new or difficult movements. But this change let meaningless or dancing movements appearing in Taolu and drew some criticism. Therefore, the bonus points for difficulty were canceled in 1979. The version published in1979, 1984 and 1991 focus on the limitation of apparatus and the evaluation system. In 1990, Wushu became one of the events of the Asian Games aims. Therefore the more objective judging system was needed in the development of Taolu competition.

The huge changes made in the version published in 1996 and 2003. In prior version of rule, one referee should judge the competitor's whole score. The final score of competitor is the average of each referee. But since 1996. The final score were divided into several parts and each part responses by special referees. In 2003, *the new rule* adds the part of evaluation of difficulty and clearly defined the standard of the difficulty clearly. Obviously, these kinds of changes improve the objectivity of Taolu competition.

But every coin has two sides. *The new rule* does make the evaluation of Taolu competition more objective. But it also drives Taolu, as a kind of martial arts lose its combative aspect and draw some criticism and opposition from the member of IWUF like Japan.

2. The opposition of JWTF

In 18th-20th July 2003, JWTF invited Chinese Martial Arts Delegation to Japan to demonstrate their routine performances. The situation of the final day was recorded on the official website of JWTF (http://www.jwtf.or.jp/taichi/taichi02.html).

"The performances of the delegation are just as what we worried about. Each performer focused on the difficulty, which leads the result that the original style of Wushu was losing."

JWTF did a survey immediately on that day (20th July 2003) to the audience and Japanese competitors about whether you agree with this kind of difficulty added in Taolu or not. As the result, 2020 votes are against the new changes while only 332 people agree with that. JWTF showed this result to the IWUF and Chinese Wushu Association (hereafter "CWA") and applied to modify the new rule.

In December 2003, the 10th IWUF technical committee was held in Macau, in order to manipulate *the new rule*. In the committee agree with the following terms:

1) Increase the amount of difficulty, especially the amount of easier difficulty;

2) Increase the point of "Difficult connections";

3) Increase the amount of "Difficult connections" in Taiji quan;

4) Add flexibility to the referee operation with computer, in order to meet the various competitions.

5) The throw and catch apparatus is not belongs to "must do" movements, therefore it can`t be deleted from *the new rule*;

6) Competitor have right to choose add music with performance or not.

CWA was responsible for modifying *the new rule* after 10th IWUF technical committee. CWA proposed a modified version in late December. Although the modified version of *the new rule* solved some issues on above, there are still some problems lefts. Such as, modified version added some easier difficulty in Chang quan, but as for Taiji quan and Nan quan there are no changes. What's more, the point of "Difficult connections" is also not increased.

JWTF beliefs these unsolved problems related to the foundation of *the new rule*. It will infect the future development of Taolu. Because there is a large disparity exists in the technique level of each athlete of country and area. Most of the foreign athletes can't complete the high classes difficulty (C or D of "Difficult connections" or C of "Difficult movements"), therefore it will lead the result that most countries can't participate the 2005 world championship in Moscow.

In considering of these facts, JWTF applied to hold 11th IWUF technical committee as soon as possible. In February 2004, the committee was held in Beijing and JWTF proposed an amendment draft with four main proposals [7]:

1) Only allow to use A and B classes of "Difficult movements" in 2005 world championship;

2) Increase 0.05 point of each classes of "Difficult connections" (A=0.1; B=0.15; C=0.2; D=0.25);

3) Increase the amount of difficulty in Taiji quan and Nan quan (JWTF even designed the movements of difficulty and attached picture and description).

4) Delete the dangerous and unreasonable movements.

The committee totally accept the 1) and 2) terms of JWTF's amendment. About term 3), the committee agreed to add 2 "Difficult movements" and 5 "Difficult connections" into Taijiquan. For Nan quan, 3 "Difficult connections" was added. Also, some movements was changed its classes. For term 4), JWTF proposed to delete 5 dangerous or unreasonable movements. As the result, the committee finally did not delete these movements but modified the description or reduce the classes of these movements.

As the result, most of proposals of JWTF were accepted. Ishihara (2004), a member of the IWUF technical committee, wrote in JWTF's official journal:

The new rule was provided with the appropriate content for the Olympic, but it lays particular stress on the difficulty. If this phenomenon goes on, Taolu will become the gymnastics and will impede the development of Taolu.

From now on (Japanese proposals was accepted by IWUF) in Japan, Wushu will divide into the Olympic style and the original style. From my point of view, since the Olympic style of Wushu was created, the evaluation of original style should be reconsidered. Also the standard of evaluation of original style should emphasize characteristic and traditional style of each event. The Olympic style aims to the high technical performance. On the other hand, the original style aims to recover the traditional techniques.

Discussion

Like figure skating or rhythmic gymnastics, Taolu belongs to evaluation sports [8]. Since Taolu is an evaluation sports, the final score is related on the performance of competitor. Before *the new rule* was published, competitors are able to pay more attention on their performance. They will also have enough energy to think how to perform better by using body through traditional Wushu techniques. Those Wushu techniques are abstracted from practical combat and organized by Chinese thinking of beauty. Although such Wushu techniques may not be able to used in practical combat, they come from practical combat directly.

Adding difficulty and stressing the body performance (even accompany with music) means IWUF value the aesthetic aspect of Wushu. This is a big step for Taolu to becoming the modern competitive sports. Because by doing this, the process of evaluation will be more precise and objective. But the problem is the movements like jump and spin are useless in practical combat. And it is hard to say such acrobatic movements have close relationship with traditional Wushu techniques. Competitors have to spend much time and energy that originally used for shaping performance to practice difficulty.

In other words, *the new rule* drives Wushu far away from traditional Wushu techniques. It weakens the combative aspect of Wushu and shaped Taolu into a new kind of martial arts. This may be why the JWTF said the original style of Wushu was losing.

Taolu has several aspects. Two of them are aesthetic aspect and combative aspect. If Taolu focus on stressing the aesthetic aspect then the combative aspect will be weaken. While if Taolu focus on combative aspect, then it is hard for referee to evaluate competitor through the performance objectively. JWTF opposed the new rule because they worried that Taolu will lose its original style. But the amendment draft proposed by JWTF did not deny adding difficulty into the Taolu, and even request for increase the amount of difficulty. Why does this happen?

From Ishihara's saying, it is easy to find that the JWTF's way to solving the dilemma is to divided Taolu into two parts: The Olympic style and the original style. This seems to be a good idea. But what this author worried is, the original styles of Taolu will "degeneration" under the wave of modernization. Most of the sport events want to become official Olympic events. Competing with each other under the same situation (the same rules) can be a strong motivation for practitioner. The original style of Taolu is more depends on the experiences and personal aesthetic of a referee. Therefore, the evaluation of the original style is relatively lacks of objectivity. Thinking in this way, the changes in *the new rule* is not made by IWUF deliberately, but pushed by the wave of modernization.

Another interesting things is the original style of Taolu is not leaded by Chinese (CWA) but by Japanese (JWTF). Sogawa in 2004 said [9], International sport is leaded by the international society, which is beyond the country and ethnic group. The goal of international sport is global understanding and world peace. While on the other hand, the ethnic sports are leaded by the ethnic group. The goal of ethnic sport is brew the identity of the ethnic group. The Olympic style of Taolu can be classified as international sport, and the original style of Taolu can be classified as ethnic sport. That means the identity of Chinese ethnic group

is not shaped by their own but another ethnic group (Japan or JWTF) through Wushu Taolu. How can we evaluate such phenomenon?

Future researches should focus on whether we should divide Taolu in two ways (the Olympic style of Taolu and the original style of Taolu). If we should, how can we develop both of them. If we shouldn't, then what we have to do?

Conclusion

The conflict of modernization of Wushu Taolu exists in the relationship of combative aspect and aesthetic aspect of martial arts.

Japanese association solves this conflict by dividing Taolu into two parts: the Olympic style of Taolu and the original style of Taolu. But this kind of solution needs further researches.

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Educational background of security bodies identification in self-defence: study programme *Special Education of Security Bodies*

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Abstract

Background and Study Aim. Special Education of Security Bodies (SESB) is a unique study programme at Masaryk University in Brno. The aim of this paper is the knowledge about theoretical background for self-defence competency, which is one of the learning outcomes in SESB.

Material and Methods. The methods of content analysis, learning objectives analysis, external evaluation and exploration were used for this study. External evaluation was done by both graduates and employers of graduates. Information are reported in Evaluation and Self-evaluation reports.

Results. Although there are many approaches to reality-based self-defence, the starting-point in SESB is in moral values of martial arts and combat sports. Self-defence is incorporated into a broader idea of self-protection and it is understood as a part of education in security bodies. Extensive research in graduate students shows a high ratio of employment in the area of security, and confirms that moral values of martial arts and combat sports can have a considerable impact on self-defence in security bodies.

Conclusion. The theoretical background in SESB comes from taxonomy of combatives, cycle of conflict and educational principles of martial arts. Although there are many approaches to reality-based self-defence the starting-point in SESB is in moral values of martial arts and combat sports. Self-defence is incorporated into a broader idea of self-protection and it is understood as a part of education in security bodies. Extensive research in graduate students shows a high ratio of employment in the area of security and confirms that moral values of martial arts and combat sports can have a considerable impact on self-defence in security bodies.

Key words: martial arts • academic degree • self-protection • safety education • combat sports

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Introduction

Security bodies training include various combative techniques and special physical preparation. In the International Perspectives on Police Education and Training edited by Stanislas [1], self-defence training is described as important part of preparation for Police work. Security bodies training is also a part of their organisational culture as an internal identifier of the force together with other external identifiers as uniform, or police badge. Special education of Security Bodies (SESB) is a unique study programme at Masaryk University in Brno. The aim of this paper is to analyse theoretical background for self-defence competency, which is one of the learning outcomes in SESB. We comes out from the situation in the Czech Republic where various types of security bodies operates. Table 1 show various state and local government security bodies in the Czech Republic with different superior unit. Among them there are private agencies making their business in both of personal and corporate security.

Table 1. The list of Security forces in the Czech Republic

Security force	Superior unit
Czech Police	Ministry of the Interior
Czech Security Information Service	Government o the Czech Republic
Municipal Police	Mayor
Czech Army	Ministry of Defence, Commander-in-Chief is the President of the Czech Republic
Army Police	Ministry of Defence
Customs Service	Ministry of Finance
Prison Service	Ministry of Justice

According their acts, every security body has the right to use restrain measurable to force the law. Initial and continuous training in the Police of the Czech Republic is a good example of standard education in security bodies. Initial training provides the police officer with knowledge and skills develops their abilities and attitudes and teaches them to accept values necessary for police service. The basic professional training is divided into practical and theoretical part of professional practice.

Continuous training is a system of specialized courses that enable to gain qualification for performance of particular function, eventually they are a condition for service in special units.

Both initial and continuous training contain self-defence and using of restrain measurable. They focus on effectiveness of maintaining the law and general moral values in the democratic society.

Police Academy of the Czech Republic is a state university. It is established by the Ministry of the Interior of the Czech Republic. Currently the Academy offers its undergraduate students an accredited Bachelor's and continuing Master's and Doctor's degree study programme. Study programmes can be realized in a full-time study mode or combined form (part-time form) of study. In the combined form there are 3 1-week trainings with lectures at school in every term; except for this students prepare for examinations at home studying scholarly literature, alternatively they can consult with teachers individually.

In the Czech Republic the primary mission of the University of Defence as a state university is propagation of literacy, development of thinking and independent scientific research in the issues vital for Czech Republic security or accomplishment of its Alliance obligations. Physical preparation is also part of curricula but not as independent study programme, but rather as integral part of army training. For that purpose, Physical Training and Sports Centre was created as independent unit within the University of Defense.

Masaryk University is with the Faculty of Sports Studies (FSpS MU) the second largest university in the Czech Republic. FSpS MU provides various bachelor's, master's and doctoral studies [2]. Although Masaryk University is a public university there are special programmes for security bodies among offered study programmes. Standard length of bachelor's study programme study is 3 years. Study is completed by state final examination and thesis defence. Graduates are bestowed the Bachelor academic degree (abbreviated to Bc.). Study programme Special Education of Security Bodies is offered for full time and part time students. Master's degree study programme continues Bachelor's degree study programme. The condition for enrolling in the study programme is completed Bachelor's degree study programme. Standard length of study is 2 years. Study is completed by state final examination together with diploma thesis defence. Graduates are bestowed the Master academic degree (abbreviated to Mgr.). The study programme Applied Sport Education of Security Bodies is offered for full time and part time students. Doctor's degree study programme Kinanthropology follows Master's degree study programme. Standard length of study is 4 years. Study is completed by state final exam together with doctoral thesis defence. Graduates are bestowed the Doctor academic degree (abbreviated to Ph.D. stated behind one's name). In this study, only bachelor study programme of Special Education of Security Bodies will be analysed.

Material and Methods

For this study the methods of content analysis, learning objectives analysis, external evaluation and exploration were used.

At the Masaryk University ECTS Label is fully implemented which is not common at every Czech university [3]. European Credit Transfer and Accumulation System (ECTS) allows to compare the amount of student performance and the impact of particular subject in the study programme. Among others, learning outcomes are defined for study programmes at whole as well as for every single subject. ECTS label standardise education at the university level through clear study structure. Study catalogue at the Faculty of Sport Studies of Masaryk University enables analysis of ECTS and the weight of combative subjects in the Special Education of Security Bodies study programme.

Learning objectives at all three of psycho-motoric, affective and cognitive dimensions are defined. Analysis of learning objectives was done from accreditation documents as well as from public information at Information System of Masaryk University (IS MU), which was developed to manage and share system information about the study [4].

External evaluation was done by both graduates and employers of graduates. Information are reported in Evaluation [5] and Self-evaluation [6] reports.

Results

From 2002 Special Education of Security Bodies is a unique bachelor study programme built on the base of physical education and sport aimed to prepare professionals theoretically and practically. Table 2 shows a shortened profile of the graduate, learning outcomes and methods of evaluation. From the combative point of view second and fourth learning outcome is most important. Students are led to achieve not only motor skills at the level of application into self-defence model situations, but they should show deep understanding of moral values leaning behind self-defence systems, which are martial arts virtues. Eastern martial arts lead more to violence prevention then to violence itself [7]. Prevention is also the basic concept of self-defence [8].

In the half of 20th century Bloom pointed out that student centred teaching should look on learning objectives. From the start cognitive domain was fairy developed [9] till two other domains started to be less used. While Karthwohl continued on affective domain Harrow worked on psychomotor domain. Theory of learning objectives is based on the simultaneous effect of all domains [10]. This is way of SESB - all three domains are incorporated in the graduate profile.

A structure of the study programme in its combat/martial part comes out from the theory of taxonomy of combatives. The taxonomy of combatives is modernised educational system of combatives anchored in Czech tradition of the Sokol movement [11]. There are three level of combat: pre-requisites (preparatory combatives), combat systems (combat sports and martial arts) and combat applications (self-defence). In the Table 3, all 18 compulsory combat/martial subjects of SESB study programme are structured according the taxonomy of combatives.

Table 2. Graduate profile, learning outcomes and evaluation methods in SESB

Graduate profile	Learning outcomes After successful fulfilling the study, the graduate:	Evaluation methods
The aim of bachelor's study of SESB is to prepare qualified professional for wide range of security bodies. Graduates will be prepared in theoretical subjects of jurisprudence, social, bio-medical, and kinesiology sciences. Graduates are prepared physical in combat sports, self-defence, martial arts, and climbing, swimming, gymnastics and track and fields. They gain also communication skills to cope conflict and extreme situations.	Is able to perform practical skills in particular sports, is capable to watch as a repeat new skills.	Practical test of movement skills, performing the movement by task
	Naturally (without thinking about) apply practical skills in self/defence model situations. Graduate is able to join single movements, or change them to solve the movement problem.	Solving self-defence model situation
	Has basic knowledge in theoretical disciplines of kinesiology, security and jurisprudence. Graduate is able to reproduce and explain particular terms and relations among them.	Written test, oral exam, seminar work
	Accept moral backgrounds of self-defence, respect legal norms, positively distinguish between personal and social needs.	Essay, case study
	Has basic knowledge of research methodology in kinesiology and apply them in the research project, is able to analyze the data, summarize and draw general conclusions	Doing research project, developing and defending bachelor's thesis

The first term is dedicated to combat pre-requisites. The second, third and fourth term are dedicated to combat systems, and the last third year to combat applications in self-defence. Almost all courses are practical exercises. Only three courses are pure theoretical (History of combat sports, Martial arts, and Theory and didactics of SESB). Two courses integrate both lectures and exercises (Preparatory combatives and Self-defence for special groups). In SESB student starts with combat prerequisites in first term, then continues with combat systems from second to fourth term, and finishes with combat applications in fifth and sixth term.

No doubt, combative and martial courses are core of SESB. Not to mention other practical courses as swimming, track and fields, gymnastics, or climbing, average amount of practical combative lectures is 5.3 hours per week (lecture per 45 minutes) during three years of study. Student have to attend two or more exercise sessions per week. High performance of all male and female students is expected. As the student's performance is given in ECTS we can analyse the ratio of ECTS gained from combative and martial courses. Although amount of study hours per one ECTS is not standardised in the Czech Republic 26 hours are usually counted per one ECTS.

Combative and martial courses rate is 39.4 % ECTS from 180 ECTS compulsory to finish SESB study programmes successfully. This shows that graduate identity is highly influenced by martial practice. Number of lectures or exercises per week and ECTS are clearly shown in the Table 4.

According to the self-evaluation of the study programme six experts were asked in the years of 2009 and 2013 to evaluate curricular quality, personal quality, equipment and facilities, competitiveness, employability of graduates (5, 6). Expert sampling included two independent scholars, two employer of graduates and two graduates employed in the security bodies' management. As the result experts states that:

Curricular quality is at high level, focused on combat sports, martial arts and self-defence. As an improvement some lectures in firearms use and police administration are recommended

Personal quality is based on academic persons with deep and broad experiences in martial arts

Equipment and facilities meet current technological and educational standard

There is not any other study programme of specialised education for security bodies

Employability is very high, as SESB provides both theoretical and practical education

Table 3. Compulsory subjects according to levels of Taxonomy of combatives

Level in the taxonomy	Term	Practical course	Theoretical course
Combat pre-requisites	1	Preparatory combatives	
		Falling techniques	
Combat systems	2	Boxing I	
		Wrestling I	
			History of combat sports
	3	Boxing II	
		Wrestling II	
		Judo I	
		Karate I	
			Martial Arts
	4	Judo II	
		Karate II	
Combat applications		Aikido	
		Self-defense preparatory exercise	
	5	Self-defense I	
		Self-defense for specific groups	
	6	Self-defense II	
			Theory and didactics of SESB

Table 4. List of combative/martial lectures and exercises at the study programme

Term	Course	Lectures per week	Exercises per week	ECTS
1.	Preparatory combatives	1	1	4
	Falling techniques	0	1	3
2.	Boxing I	0	2	4
	Wrestling I	0	3	4
	History of combat sports	1	0	3
3.	Boxing II	0	2	3
	Wrestling II	0	2	3
	Judo I	0	3	4
	Karate I	0	3	4
	Martial Arts	1	0	4
4.	Judo II	0	2	3
	Karate II	0	2	3
	Aikido	0	3	5
	Self-defense preparatory exercise	0	1	3
5.	Self-defense I	0	3	6
	Self-defense for specific groups	1	1	4
6.	Self/defense II	0	3	6
	Theory and didactics of SESB	2	0	5

Employability of graduates was confirmed by independent research of National Educational Found [12]. They gained information from employers (n=10), job offers at employment offices (n=4680) and graduates (n=69).

Employment rate was 88 % and only 6 % is searching for job. The most frequent job is policeman (51 %), then soldier, close combat instructor, and others, which is exactly in accordance with the study programme concept. Graduates can see tight relationship in experiences, physical skills and theoretical knowledge. Combat and martial education (self-defence, physical preparation, programming) as well as theoretical knowledge in social sciences and law was rated very high, too. Combat sports, self-defence and other practical skills are useful in their profession providing also general background in moral values and coping with extreme situations. On other side graduates consider lack of specialised activities, as firearm shooting, police administration, languages and cooperation with security forces.

Conclusion

The theoretical background in SESB comes from taxonomy of combatives, cycle of conflict and educational principles of martial arts. Although there are many approaches to reality-based self-defence the starting-point in SESB is in moral values of martial arts and combat sports. Self-defence is incorporated into a broader idea of self-protection and it is understood as a part of education in security bodies. Extensive research in graduate students shows a high ratio of employment in the area of security and confirms that moral values of martial arts and combat sports can have a considerable impact on self-defence in security bodies.

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Rationale for mental training of elite wrestlers

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Abstract

Background and Study Aim. Ways of coping with stress and emotional intelligence are significant psychological variables which co-determine good health and effective functioning in various situations. Defining the level of these variables and their correlations will make it possible to get to know the psychological profile of wrestlers and formulate guidelines for mental training. The aim of the research presented in this work was the knowledge about the level of two variables (their dimensions and correlations between them), i.e. emotional intelligence and styles of coping with stress.

Material and Methods. The research included 40 Greco-Roman wrestlers aged 18-22 with training experience from 6 to 12 years. A questionnaire and two psychological examination methods, i.e. Coping Inventory for Stressful Situations (CISS) and Two-Dimensional Emotional Intelligence Inventory (DINEMO) were used in the research. An average level of the measured variables in wrestlers was noted. The distribution of proportions of the categories of low, average and high results as well as correlations between the variables suggested the necessity to undertake directed psycho-educational activities in the training process. Improving these characteristics will let wrestlers function more effectively in sports situations, especially in a sports fight, but also in non-sports situations, such as the period after they have retired from sport.

Results. Relatively lowest results were obtained in the scale measuring emotion-oriented style (the result lower than in the SSZ scale – $Z=-2.15$, $p=0.3$ and lower than in the SSU scale – $Z=-4.02$, $p=0.00$). Every fifth wrestler represented a high level of results in GEN scale, including one person who got the highest result of a sten of 10. In turn, ca. ¾ of the examined group obtained average results. Within OTHERS scale 3 participants obtained high results (at the level of a sten of 8), while the majority (i.e. 8 out of 10 participants) obtained average results. Two wrestlers obtained low results within ME scale, while nearly 30% of the participants had high results.

Conclusion. It is relevant to implement directed corrective, educational and prophylactic activities from the field of sports psychology into a training cycle. It is significant for wrestlers to be aware of the role of emotional intelligence and of the process of coping with stress. Equipping wrestlers with indispensable knowledge and mastering appropriate abilities will, in consequence, develop the desired competences. It will also improve the efficiency of functioning in sport as well as health and quality of life.

Key words: mental training • psychological profile • coping with stress

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Introduction

In recent years both in theory and in psychological practice attempts at explaining mechanisms connected with the process of coping with stress have been observed. According to the current definitions, coping with stress serves a regulative function and refers to sustaining a balance between the experienced requirements and the capabilities of an individual. Every person has a particular style of coping with stress which is understood as a relatively constant disposition for a definite and conscious way of reacting in difficult situations. Recognising the style of coping with stress and a detailed analysis of this phenomenon makes it possible to verify the adequacy of actions undertaken in difficult situations [1,2].

In this context the correlation between variables responsible for coping with stress and various dimensions of emotional intelligence has become an interesting issue. It has been proved that emotional competences correspond with the effectiveness of functioning in difficult situations and, as a consequence, with good health and higher quality of life [3-5]. Emotional intelligence serves an adaptive role[1], i.e. makes it possible to adapt to coping with stress, and its level is connected with the aforementioned individual style of coping with stress [6,7]. In order to define emotional intelligence fully, it must be added that it is a range of abilities which regulate processing various types of emotional information. As a result, these abilities influence the creation of the complex of socio-emotional competences later developed during social training [6,8].

The two aforementioned psychological variables correspond with each other. Both separately and together they influence the effectiveness of functioning in sport and in other life activities, and are mainly connected with holistically-perceived good health[2]. Therefore, the aim of the research presented in this work was the knowledge about the level of two variables (their dimensions and correlations between them), i.e. emotional intelligence and styles of coping with stress. The obtained results may generate application forms at the stage of creating programmes of mental training of elite wrestlers.

Material and methods

The research included 40 Greco-Roman-style elite wrestlers aged 19.42.8 with the training experience of 8.13.3 years. They were the finalists of the Polish Junior and Senior Championships in 2015. While selecting the participants the classification of the Polish Wrestling Federation was applied [10].

In the research the following two methods of psychological examination were used:

1. Coping Inventory for Stressful Situations (CISS), which examines the following styles of coping with stress (2):

- task-oriented style (SSZ scale) – in which the problem is dealt with by action-based approach or by cognitive appraisal,
- emotion-oriented style[3] (SSE scale) – in which the focus is on negative emotional states and the tension connected with a difficult situation is dealt with through, inter alia, fantasising or wishful thinking,
- avoidant style (SSU scale) – which can be divided into distraction seeking (ACZ scale) and social diversion (PKT scale); such behaviours help to avoid experiencing or even thinking of a stressful situation.

2. Two-Dimensional Emotional Intelligence Inventory (DINEMO), which makes it possible to determine a general level of emotional intelligence (GEN scale) as well as two dimensions of this variable measured with the following scales [6]:

- OTHERS – the scale makes it possible to verify the accuracy of recognising emotions in others and judgements connected with it, and to assess the ability to influence emotional states of other people;
- ME – this scale helps to analyse the level of being aware of one's own emotions, their reasons and consequences as well as their influence on one's decisions or actions.

1 The possibility to adapt is connected with the realisation of basic regulative functions of emotions, i.e. "informative function (owing to emotions, people get to know the value or significance of stimuli and events), stimulating function (emotions stimulate thinking and acting) and communicative function (expressed emotions inform the surroundings about the state of the individual, owing to which they may activate adequate reactions, e.g. help)" [6: p. 9]

2 Health is perceived as a complete physical, social, mental and noetic wellbeing but also as a condition for optimal functioning as well as realising one's own needs and aspirations and satisfactory quality of life. Contemporary definitions of health assume its constant improvement, which corresponds with this work [9]

3 Task-oriented style is thought to be the most adaptive style of dealing with stress. However, there are opinions that emotion-oriented style may also be profitable, especially in situations when increased agitation motivates a person to make additional effort in a difficult/stressful situation [1,11].

The research was conducted and the results were analysed according to the suggestions of the authors of the applied methods. Raw data (obtained directly after the application of the answer key) and calculated data (referred to sten norms and categorised[4]) were analysed with the use of SPSS software taking into account the location measurements (means), significance of differences and correlations.

Results

the analysis of the CISS questionnaire results made it possible to conclude that all the styles of coping with stress noted in wrestlers and included in the research were on an average level (table 1). Relatively lowest results were obtained in the scale measuring emotion-oriented style (the result lower than in the SSZ scale – Z=−2.15, p=0.3 and lower than in the SSU scale – Z=−4.02, p=0.00).

Table 1. The results of CISS questionnaire

CISS scales	RD	CD
SSZ	59.35 ± 6.72	6.02 ± 1.59
SSE	41.67 ± 7.33	5.17 ± 1.28
SSU	56.02 ± 9.13	6.80 ± 1.96
ACZ	21.45 ± 5.67	5.50 ± 1.96
PKT	18.42 ± 3.64	5.42 ± 1.81

Key: CISS – Coping Inventory for Stressful Situations; RD – raw data; CD – calculated data; SSZ – task-oriented style; SSE – emotion-oriented style; SSU – avoidant style; ACZ – distraction seeking; PKT – social diversion

Categorising the calculated results obtained by the participants helped to collect the following information[5]: in the group of participants one wrestler had a low result in SSZ scale (a sten of 3), while nine participants had high results (including only one person at the highest level, i.e. sten of 10) (figure 1). In turn, in SSE scale, nine out of ten participants obtained average results. One wrestler obtained the result of a sten of 8 which qualifies him for the category of high results. Nearly half of the wrestlers obtained high results in the SSU scale. Three participants had low results. The distribution of the category of results referring to ACZ and PKT scales was the same, i.e. nearly ¾ of the participants obtained average results, while six participants had high results.

The results obtained during the test carried out with the use of DINEMO inventory and referred to appropriate norms revealed that a mean level of emotional intelligence in the participants (measured in each of the three scales) has average values. Comparing the calculated results provided additional data, i.e. the wrestlers obtained relatively highest result in the area of emotional intelligence referring to their own emotions (the result in ME scale is higher than in OTHERS scale – Z=−3.57, p=0.00).

Table 2. The results of DINEMO Inventory

DINEMO scales	RD	CD
OTHERS	10.75 ± 2.67	5.20 ± 1.49
ME	9.00 ± 2.14	6.42 ± 1.57
GEN	18.50 ± 3.70	6.00 ± 1.69

Key: DINEMO – Two-Dimensional Emotional Intelligence Inventory; OTHERS – emotional intelligence referring to the emotions of others; ME – emotional intelligence referring to one's own emotions; GEN – general level of emotional intelligence

Similarly to the analysis of the results of CISS questionnaire, the calculated results obtained from DINEMO inventory were categorised. Every fifth wrestler represented a high level of results in GEN

4 A sten of 1-3 – low results, 4-7 – average, 8-10 – high

5 The results presented in figure 1 and 2 are expressed in percentage. The authors are aware of the fact that the groups of participants were relatively small, and therefore, they treat the aforementioned sets of results as data facilitating orientation in the proportions of the categories of low, average and high results.

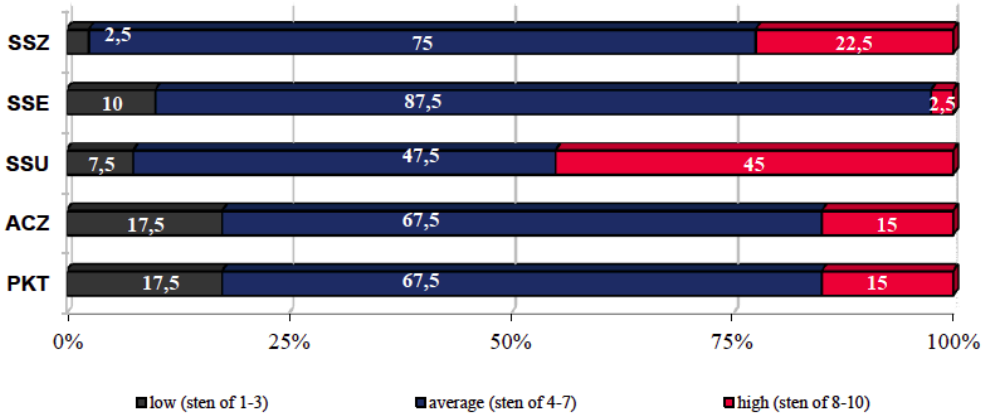

Figure 1. Styles of coping with stress – CISS calculated results (percent)

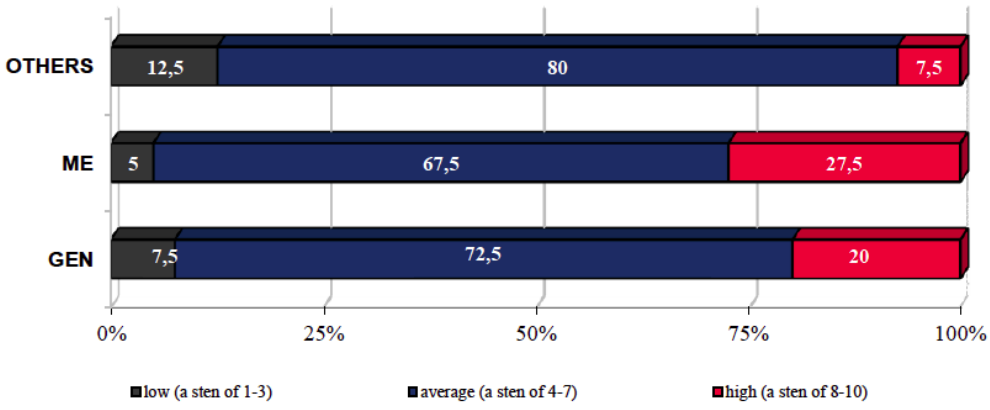

Figure 2. Emotional intelligence – percentage distribution of the calculated DINEMO results

scale, including one person who got the highest result of a sten of 10. In turn, ca. ¾ of the examined group obtained average results. Within OTHERS scale 3 participants obtained high results (at the level of a sten of 8), while the majority (i.e. 8 out of 10 participants) obtained average results. Two wrestlers obtained low results within ME scale, while nearly 30% of the participants had high results.

The analyses of Spearman's correlation coefficients of the results of CISS questionnaire and DINEMO inventory (table 3) confirmed the existence of correlations between a task-oriented style and general emotional intelligence and emotional intelligence referring to "myself".

Table 3. Correlations between results obtained in CISS and DINEMO scales

Scales		DINEMO		
		OTHERS	ME	GEN
CISS	SSZ	0.27	0.33*	0.44**
	SSE	−0.11	−0.41**	−0.31
	SSU	−0.25	−0.12	−0.21
	ACZ	−0.34*	−0.13	−0.30
	PKT	−0.23	−0.02	−0.16

* p≤0.05 ** p≤0.01

Discussion

Wrestling and other combat sports particularly highlight the necessity to understand the relation between body and mind not only with regard to oneself but also with regard to an opponent. They require specific starting readiness. Excellent knowledge and control of one's own emotions is required from wrestlers both during the whole sports career and after it. The knowledge and ability to use emotional information concerning oneself and others and an ability to adapt to changing conditions (including difficult situations) contribute to holistic mastership. It is expressed by the highest and repeated sports results, a natural tendency to care about the quality of life and development as well as satisfaction with the undertaken activity [12]. The literature of the subject includes interesting suggestions of reinforcing various psychological abilities of athletes. Formulas of psychological training are constantly improved and adapted to the requirements of particular sports, including wrestling [13-19]. The authors' aim is to draw attention to the necessity to create and realise such procedures in Poland.

Despite the fact that all the measured styles of coping with stress were on an average level, two styles dominated in the examined group of wrestlers, i.e. a task-oriented and avoidant style. They significantly prevailed over an emotion-oriented style. Such a conclusion is indirectly confirmed by the analyses of the distribution of proportions of categorised results. Nearly half of the participants obtained high results referring to avoidant style, while nearly ¼ obtained results which prove a high tendency to focus on a task. In the group of athletes these strategies occurred relatively often. A task-oriented and/or avoidant style of coping with stress dominate especially among athletes doing combat sports[6]. A lower tendency to use emotion-oriented strategies of coping with stress can be noted in males doing sport. As it is suggested by the research [20-23], the problem of coping with stress must be analysed additionally with regard to other psychological dimensions.

The results of the tests carried out with the use of DINEMO inventory indicated an average level of

6 In the literature of the subject which the authors quoted, other opinions (apart from these cited while describing CISS questionnaire) may be found which suggest that avoidant style of dealing with stress perceived as non-adaptive may be profitable for athletes since it lowers the level of fear in certain situations.

general emotional intelligence of wrestlers but also an average level of emotional intelligence regarding an ability to deal with information concerning one's own emotions (ME scale) and emotions of others (OTHERS scale). However, it is worth highlighting that the wrestlers obtained the highest result (but still among average results) in the ME scale. It means that abilities influencing self-awareness of one's own emotional states (and understanding their causes and consequences) are best developed and they can be adequately expressed. This conclusion can be confirmed by the analysis of the distribution of categories of calculated results. Every third examined wrestler obtained high results in ME scale, while only two wrestlers obtained low results.

The obtained results referring both to the level of emotional intelligence and to the styles of coping with stress may be insufficient in order to function optimally in sport and in other areas. Being aware of one's own emotions is treated as one of key elements of mental preparation [24-26]. Moreover, it is mentioned as one of the most significant psychological variables whose level corresponds with the quality of the organisational climate. According to the results of research by Huseinagić et al. [27], the higher the level of emotional intelligence of coaches and sports managers, the higher the tendency to cooperate in good atmosphere. Although the research was carried out among coaches, it might be expected that high emotional intelligence of athletes will also contribute to a better way of functioning in the closest sports environment (relations with coaches or other wrestlers).

Currently engagement in a sports activity is connected with an absolute necessity to meet high requirements which are in many cases beyond the control of wrestlers themselves. Therefore, analyses of individual predispositions to cope with stress should be carried out with regard to the realities of wrestling, to the dynamic changes occurring in a broadly-understood sport management and to the subjective assessments of these changes made by wrestlers and their level of fear connected with it [28-33]. The authors of this work perceive it as an inspiration to continue the research in a broader range taking into account the specificity of wrestling in Poland. An analysis comparing the results of wrestlers with other untrained males could be the next step of analysis which would certainly provide interesting conclusions. The research by Mitić et al. [34] conducted among judo competitors revealed that they have higher emotional competences and they apply task-oriented style of coping with stress more often than their untrained counterparts. Generally, a higher level of emotional intelligence is diagnosed in athletes. However, it should be specified especially with longitudinal research. Currently there is no certainty whether it is sport that develops psycho-social abilities and competences such as intelligence, or whether sport is chosen by individuals with specific psychological features [35]. The research by Rutkowska and Gierczuk [36] regarding the youth training wrestling and untrained youth may serve as pilot study.

Interesting conclusions were provided by the analyses of correlations between the results of CISS questionnaire and DINEMO inventory. A general level of emotional intelligence is connected with a task-oriented style of coping with stress. This style is also correlated with emotional intelligence concerning oneself (positive correlations). However, this dimension of emotional intelligence and emotion-oriented style correlate negatively. The third analysed dimension of emotional intelligence referring to the accuracy of recognising emotions in others is negatively correlated with avoidant style, i.e. with engaging in distracting activities. Such tendencies are also suggested by Strelau et al. [1]. Generally, research has shown that a high level of emotional intelligence corresponds with a more efficient way of coping with stress [37]. The correlation between emotional intelligence and psychological abilities (i.e. coping with stress, controlling/regulating emotions, perceiving successes and failures) was also noted in the research carried out among athletes doing other sports. Lane et al. [38,39] drew attention to the necessity to specify the direction of this correlation more precisely. It may be an interesting direction of further research.

Combat sports are sports with tradition and their system of training also takes into account the necessity to care about health, i.e. develop and improve specific mental competences. They are to assure a better cooperation between body and mind. This, in turn, makes it possible to properly understand the relation between emotions, thoughts and behaviour. As a consequence, it enables the control of thoughts, regulation of emotions and improvement in the quality of movement, i.e. speed and ease [15,17,19,40,41].

The presented research results may be a starting point in a discussion regarding the level of psychosocial competences or, more broadly, mental preparation of athletes. The conversations with wrestlers and coaches revealed that none of the examined athletes had any professional experiences of cooperation with a sport psychologist. However, the research revealed the need for developing and improving mental sphere. The results may be used for preparing initial guidelines useful in constructing mental training programmes dedicated to the group of elite wrestlers.

Athletes should develop the awareness of relations between emotions, thoughts and actions, and through this they should be able to manage themselves in a stressful situation. Depending on individual needs of a wrestler, on an accepted model of cooperation with a psychologist and a range of other factors (e.g. the moment in the training cycle when the cooperation with a psychologist starts, sports career or a wrestler's age), the formula of a mental training may differ. It should take into account improving emotional intelligence and the most adaptive styles of coping with stress, mainly task-oriented style, but also emotion-oriented style. The results of this research and conclusions drawn from it are confirmed in the literature of the subject [18,42].

The correlation between body and mind which is naturally realised in sport should be developed towards higher awareness of functioning in stressful situations. It results in a better quality of life and good health. The programmes of the postulated training of psychological abilities or mental trainings should be created in cooperation with coaches in order to increase their effectiveness and possibility to realise (within coaching). The engagement of coaches and good climate for co-realised aims may bring additional profits, positively influence the course of the whole sports training and use the philosophy of wrestling more fully [42-44].

Conclusions

the research needs to be continued and the obtained results indicate the need for undertaking new directed studies in the future. However, at the present stage it is justified to formulate the following conclusions. Emotional intelligence and the ability to cope with stress of the participants need to be improved. They are, to a large extent, flexible abilities which can be changed during psychological training. Therefore, it is relevant to implement directed corrective, educational and prophylactic activities from the field of sports psychology into a training cycle. It is significant for wrestlers to be aware of the role of emotional intelligence and of the process of coping with stress. Equipping wrestlers with indispensable knowledge and mastering appropriate abilities will, in consequence, develop the desired competences. It will also improve the efficiency of functioning in sport as well as health and quality of life.

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The effect of hand strengthening techniques in martial arts on bone mineral density – pilot study

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Abstract

Background and Study Aim. Hand strengthening techniques were used in most traditional Asian martial arts as preparatory exercise for hardening of striking areas, as injury prevention and a method for developing powerful striking techniques. They were also used for passing knowledge and tradition down to other practitioners. According to the Wolff's law, loading on a particular bone leads to remodelling of the bone overtime to become stronger and more resistant. The aim of the paper is the knowledge about the effect of 100-day lasting intervention programme of strengthening techniques on both hands of one tested person.

Material and Methods. For examination of the tested person three non-invasive methods were employed. X-ray apparatus, ultrasonography and densitometry were used for the description of physiological changes. Examination by X-ray, ultrasound and densitometer were conducted in a pre-test, during which the condition of the upper limbs before the workout was assessed. After completion of the intervention programme a post-test was conducted in which the condition of the upper extremities after exercise was described, assessing the difference between measurements. Assessment was done by doctors working in the field of radiology.

Results. The research showed an increase in bone mineral density in both hands after the intervention (right upper limb with BMD increased by 2.1%, the left upper limb with BMD increased by 1.6%). A stronger effect in the right hand was traced.

Conclusion. The research could not be considered as final evidence but as a pilot study for further more in-depth investigation of health benefits of the strengthening techniques witch should be conducted with larger number of tested persons.

Key words: combative • healthy lifestyle • self-defence • security • sports

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Introduction

The theory of Asian martial arts describes special training methods aimed for strengthening of striking areas of human body and preparing the practitioner for combative performance. Roots of such strengthening techniques can be traced back to Shaolin temple were six hand techniques were used for strengthening fingers and other parts of a striking hand [1]. Kennedy & Guo [2] state that some of the best known special training methods are various forms of iron hand training. These training procedures were aimed for strengthening of hand striking areas to increase fighter's ability to strike with maximum impact without damaging their hand [2]. The purpose of this exercise was therefore not only to develop effective striking techniques, but also prophylaxis of hand injury, which, due to the further development of combat situations, could have fatal consequences. Current definition of combatives by Reguli [3] mentions that combative activities comprise also specific exercise which prepares a participant to overcome a partner by physical contact. Strengthening techniques are a good example of this definition.

In the past in Chinese martial arts not only methods of strengthening hands but also forearms, shins, the whole body, or even the head would occur. Kiew [4] reports that such specialized training should be performed daily, i.e. in the morning, afternoon or evening in the length of half an hour or longer. Martial artists perform striking rice, beans, peas, sawdust, sand, gravel, and in the last stages steel balls [5]. Some students show their level of strengthening their striking areas by breaking bricks, stones, or desks just using those strikes that were practiced in training. The shift from strengthening striking surfaces to breaking techniques is possible within a few months. Students are able to apply the proper striking mechanics and lead the strike in a faster and harder way. Shaolin monastery is also mentioned as a source of qinna techniques. Chinese word „qin" means „to grasp" and the word „na" means „to control". Qinna is the art of controlling the opponent with grasping techniques, whose main purpose is to block breathing, arteries, and to strike and press on acupressure points [5]. Due to the need of leading strikes on very small vital points of the human body not only large striking areas of hands but also fingertips are being strengthened during qinna training. Qinna techniques are not a separate fighting style but to a lesser or greater extent, according Balner [5], the vast majority of Chinese styles are involved.

Also in Japanese martial arts strengthening techniques are very popular. Typical example of them is practice on the makiwara striking post. The makiwara is a Japanese word meaning forging post. In metaphorical meaning the use of makiwara is a process of forging fist like a blacksmith, which should lead to creating iron-like tool for raw punching power [6]. There is empirical evidence about the effect of strengthening techniques using makiwara or other tools in martial arts on the human body. Egami [7] describes that training on makiwara will lead to forming blisters on the areas of the hand that come into contact with it and calluses will form on the knuckles with further practice. Egami [7] also states that cartilage will have formed around the bone, which was confirmed by x-ray apparatus. Black [6] affirms that makiwara training may be of benefit to the karate practitioner, causing greater bone density in the areas of impact referring to the Wolff's law. The effect of mechanical stress on bones and their re-modelling is described in literature as follows. The direction and thickness of trabeculae in cancellous bone are related to regional stress trajectories. According to the Wolff´s law the architecture and mass of the skeleton are adjusted to withstand the prevailing forces imposed by functional need or deformity [8]. Bone constantly adapts to the stresses imposed upon it and at any particular site cortical and trabecular thickness will be greatest in the trajectories of highest stress [9]. Bone´s structural adaptation to mechanical usage was dealt by Frost [10] who also refers to the Wolff's law which says: „Every change in the form and function of bone or of their function alone is followed by certain definite changes in their internal architecture, and equally definite alteration in their external conformation, in accordance with mathematical laws" [11]. We can conclude that according to the Wolff's law loading on a particular bone will lead to remodelling of the bone overtime to become stronger and more resistant.

Influence of martial arts training on the musculoskeletal system was dealt by many authors from different aspects [12–17]. Eckert & Lee [13] identified anatomical principle of nikkyo techniques in aikido which leads to acute pain and long-term pathological changes. Shin et al. [14] suggested that taekwondo training during growth significantly improved bone health of young female athletes in all weight groups. The influence of karate training on the health of hands was dealt in the study by Crosby [12]. In his study 22 hands and wrists of 22 karate instructors who had practiced karate for a minimum of five years were reviewed. Seventeen tested person regularly trained on the makiwara and all 22 performed between fifty and

one hundred push-ups on the knuckles every day. Radiological evidence of a total of ten fractures was found. Apart from revealing evidence of previous fractures, X-ray film of the hands showed none of the features of osteoarthritis at the metacarpophalangeal joints or carpometacarpal joints, and the radiological density of the metacarpals was normal. Crosby [12] concludes that long term and routine practice of karate does not appear to predispose to the early onset of osteoarthritis or tendonitis in the hands and wrists. Hsu et al. [16]Tai chi group and control group. The exercise program consisted of 60 min of exercise three times per week for 12 weeks. The circuit exercises were carried out with intensity controlled by heart rate (60-80% of work investigated the impact of circuit exercise and Tai chi exercise on body composition in middle-aged and older women. As the same author [15] reported earlier there is positive correlation between basal metabolic rate (BMR) and bone mineral density (BMD). Lip et al. [17] examined the effect of Ving Tsun (VT) Chinese martial art training on radial bone strength in elderly participants. VT involves repetitive upper limb striking movements that continually load high peak forces and impacts on the forearm bones. Lip et al. [17] state that the bone strength of the distal radius, therefore, increases to accommodate these mechanical demands. In present research the radial bone strength of the VT group improved by 28.9 % over time, whereas the no-training control group improved by only 11.3%. This improvement can be explained by the constant upper limb striking movements three months of VT intervention. Lip et al. [17] also refer to the Wolff´s law and conclude that the repetitive forces and impacts on the forearm bones during sticking-hand drills should enhance distal radial bone strength to accommodate the increased mechanical demands.

There are some assumptions and evidence about the effect of martial arts training, especially strengthening techniques on the human body, which should lead to re-modelling of bones and hardening the striking areas [5–7,14,17]. That is why we decided to examine the assumption about prophylactic purpose and health benefit of these exercises. The article focuses on testing the hypothesis that practice of strengthening techniques in martial arts leads to increase of bone mineral density.

Material and Methods

Tested person

For selection of a test person the following criteria were set: a man or woman with at least 5-year-experience in the martial art that uses the technique of striking without medical contraindications for strengthening techniques, e.g. previous hand injuries. On the basis of these criteria was for the purpose of the pilot study chosen a man of white ethnicity aged 24.3 years, height of 175 cm, weight of 84.5 kg having 10-year-experience in martial arts and combative sports (kyoukushinkai karate, kick boxing, K1, aikijujutsu, aikido, taekwondo, wing tsun) in good health condition without previous injuries of his hands. Tested person was informed about procedures during the experiment. All examination methods of the tested person used in experiment are non-invasive. Strengthening techniques programme is commonly used in martial arts. That is why no objective risk was present in experiment and all procedures were in accordance with the ethical standards of the responsible institutional committee.

Selection of strengthening techniques programme (STP)

Intervention programme (STP) was selected on the basis of literature research so that it was especially gentle to the body, possible to be involved in a daily program of the tested person and with proclaimed effect that should occur within months. For the selection method the following criteria were set:

1. STP should be implemented using the indirect method (using fabric between hands and striking materials);

2. STP should be performed twice a day;

3. STP should begin with a warm-up;

4. STP should be based on the hypothesis of bone remodelling after intervention within hundred days;

5. STP should be accompanied by treatment of striking areas by traditional herbal preparations.

For research purposes, the iron palm method by Balner was chosen [5]. This method meets all the criteria and is described in detail in the literature. According to this method the hand bone remodelling occurs after exercising twice a day for a hundred days.

Description of strengthening techniques programme (STP)

The intervention programme included training according to the method of iron hand which is

described in detail by Balner [5]. The method is based on strikes led on a bag 40 cm long, 25 cm wide and 8-14 cm thick, which is in the beginning filled with rice, later with beans or peas, and in the subsequent stages of training with gravel or steel balls. In the case of our research the time was divided as follows: 33 days of strikes to the apparatus filled with rice, further 33 days of strikes to the apparatus filled with gravel with a weight of shot size (4.46 mm), and finally 34 days of strikes to the apparatus filled with pellets. When selecting methods and materials, the emphasis was put on safety, loading sequence and a target of interventions, while persevering in the STP for one hundred days. Therefore, in the initial phase of the programme rice was selected as, in terms of subjective feelings of pain, it is the simplest material. Gravel is comparable to coarse sand, and for that reason the shift from the preceding material should be continuous. Shots were chosen as the last and hardest material. Sequential loading of the organism from the finest to the hardest material is also advantageous because in case of complications during the experiment, it is possible to go back to the previous striking material, which in the case of one striking material or technique performed on makiwara would be impossible.

Each session started with warming up shoulders, elbows, wrists and fingers. Strikes were performed by the palm, the back of the palm, fingertips, knife-hand and fist. Each time two series of thirty repetitions of each hand by all striking surfaces were performed. Before and after each exercise herbal preparation called Dit Da Jow was applied and hands were massaged.

Methods

For examination of the tested person three non-invasive methods were employed. X-ray apparatus, ultrasonography and densitometry were used for the description of physiological changes. Examination by X-ray, ultrasound and densitometer were conducted in a pre-test, during which the condition of the upper limbs before the workout was assessed. After completion of the intervention programme a post-test was conducted in which the condition of the upper extremities after exercise was described, assessing the difference between measurements. Assessment was done by doctors working in the field of radiology.

Ultrasound examination is used for examination of soft tissues, and it could detect damage to muscles, tendons, and tendon sheaths or tendonitis. For examination of the tested person GE Logiq 400 ultrasound system were employed.

The radiograph shows the position of the bones and joints. This investigative method can detect eventual deformity, micro trauma or post-traumatic changes. It may also be used to detect point indicative of bone density in the skeleton of both hands. But X-ray signs of bone loss are late and unreliable. Densitometry is much more accurate way of measuring bone mineral density (BMD) and bone mass [9]. That is why we used DXA GE Prodigi densitometer. Bone densitometry measures in grams per square centimetre the amounts of bone minerals in the monitored section of the bone. Test results of the densitometer examination are expressed as a T-score or Z-score. T-score reflects the number of deviations of the result of the examination from the table values of bone mineral density of young and healthy individuals of the same gender. Z-score expresses the same figure, but compares the test results with average values in people of the same gender and age. The score SD +2.5 to –1 SD is considered normal. Densitometry is considered to be an optimal diagnostic method for detecting the effect of an intervention programme on bone mineral density. To increase the security and control of the experiment complementary methods of data collection such as photographs and a diary of the tested person were used. The diary recorded the dates and times in which the exercise was carried out, the materials used for STP and subjective exercise soreness. Although the pain is subjective, individual perception, which cannot be objectively measured, verbal scale of pain is used in examination. In our research a five-point scale was employed, the purpose of which was to monitor the progress of STP and feedback of the tested person. Description of the scale is as follows: 0 = no pain, 1 = little pain, 2 = moderate pain, 3 = severe pain, 4 = excruciating pain. There is also a note in the diary with description of further exercise that was carried out on that day or problems and events related to the strengthening training.

Results

Pre-test

During the X-ray examination no abnormalities, micro trauma or other contraindications that would make it impossible to launch STP were found. Sonography examination showed no damage to muscles, tendons, tendon sheaths or tendinitis.

The densitometry examination conducted on 21st August 2014 revealed BMD of 1.031 g/cm^2 of the right upper limb using 33% radius examination. The T-score was determined by + 0.4 SD. The densitometry examination revealed BMD of 1.127 g/cm^2 of the left upper limb using 33% radius examination. The T-score was determined by +1.4 SD. Result of the densitometry: the values are within normal limits.

Post-test

A control X-ray examination revealed that there is no increased occurrence of any symptoms of osteoarthritis, deformity or post-traumatic changes on the skeleton of hands including small interphalangeal joints. On the contrary, adequate increase in point bone density on the skeleton of both hands including the carpals was identified, which corresponds to densitometry of both forearms. The sonography examination showed no apparent changes in the area of tendons, fingers and forearms.

Densitometry examination showed that after 100 days of continuous intervention there was an increase of BMD. On the right upper limb BMD of 1.053 g/cm^2 was measured in 33% of radius. The T-score was determined by + 0.6 SD. On the left upper limb BMD of 1.145 g/cm^2 was measured in 33% of radius. The T-score was determined by + 1.6 SD. The result of the densitometry: the values are within normal limits.

Based on the set design of the research the hypothesis was confirmed. In comparison to the results of the pre-test and post-test it was revealed that BMD in the right upper limb increased by 2.1%, and BMD on the left upper limb increased by 1.6%.

Discussion

Measurements conducted on one person before and after a 100-day intervention brought interesting findings pointing to an increase in BMD on both arms of the test person (right upper limb with BMD increased by 2.1%, the left upper limb with BMD increased by 1.6%). During the exercise, only minor changes to striking areas such as blistering and peeling of hard skin appeared. The pain was assessed according to the degree of 0 (no pain) of a selected range. The exception was the period of four days, when a blister on the left hand appeared and that gradually ruptured. During these four days, the pain was assessed at level 1 (small pain).

Before we set a conclusion, we have to consider some limitations of the research. In particular, this is a pilot study conducted on one subject aimed to select and validate the feasibility of implementing a particular method of strengthening exercise. The research results cannot be generalized or compared with other research of the same design that uses the same pre-test, intervention lasting 100 days and a post-test, because during the search no study on BMD measurements on tested persons of comparable age was found. Moreover, it is also necessary to take into account the deviation of measurement of whole body DXA densitometer. Mazess et. al. [18] state that the deviation of the GE device of Prodigy series on which measurements were performed should be in partial and whole body BMD measurement on the level of 0.5% in vitro and 1% in vivo. With respect to the deviation of the measurement it is possible to infer a significant difference especially on the right upper extremity. The left upper limb is less significant considering the deviation. More significant difference in BMD values of the right upper extremity shows the fact that the tested person is right-handed and strikes during STP were performed stronger by right than left hand. Higher loads should therefore, according to Wolff's law, lead to greater adaptation and remodelling of bone. Another variable that could affect the measurement results is exercise performed parallel during the experiment (martial arts and self-defence training, kettlebell, powerlifting and crossfit training). However, this exercise is not of great significance, as it had been done a long time before the experiment. Thus affecting the results during the ongoing 100 days intervention is not probable. Also, it is important to mention, that 98% of the body´s calcium and 85% of its phosphorus is tightly packed in bone and can be released only by resorption of the entire tissue. Calcium absorption is mediated by vitamin D metabolites and inhibited by excessive intake of phosphates (common in soft drinks), oxalates (found in tea and coffee) and fats. Vitamin D, through its active metabolites, is principally concerned with calcium absorption and transport and (acting with parathyroid hormone) bone remodelling [9]. Vitamin D intake could be influenced by sunlight exposure or diet. We have to consider that eating habits of tested person were not taken into account during the research. The last factor to be discussed is the use of Dit Da Jow herbal medicine. Chemical analysis of the product and its possible influence on BMD was not a part of the research.

Except for objective data obtained from the measurement we consider also subjective feelings of

the tested person to be valuable. According to him thanks to STP there was significant strengthening of his wrists and improvement of strike techniques. Strikes carried out in combat activities have thus become stronger mainly because of right strengthening of the hand just before they strike the target. Physical performance is also affected by mental condition. Improvement of strike technique was caused by a decreased fear of possible injury. Thus STP also contributed to positive changes in cognitive areas, i.e. understanding of leading the strike without protective means.

Conclusions

The research showed an increase in bone mineral density in both hands after intervention. In the selected person appeared after the intervention programme of strengthening exercise increase of BMD in both hands (right upper limb with BMD increased by 2.1%, the left upper limb with BMD increased by 1.6%). Bigger difference in BMD values of the right upper extremity shows the fact that the tested person is right-handed and right-hand strikes performed during strengthening techniques programme were stronger than left-hand ones. This corresponds to Wolff‘s law according to which the higher load should lead to greater adaptation and bone remodelling. Although the results of measurements showed an increase of BMD in both hands, with regard to the above discussed factors such as deviation of DXA densitometer, diet etc., conclusions are not unambiguous. The research could not be considered as final evidence but as a pilot study for further more in-depth investigation of health benefits of the strengthening techniques witch should be conducted with larger number of tested persons.

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Physiological aspects of post-training adaptation in martial arts

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Abstract

Background and Study Aim. Dependent on the character and intensity, sports training results in specific adaptive changes in the organism that can occur at different pace. In order to study the post-training adaptation of the organism, a group of martial arts athletes and a group of untrained students were tested. The aim of the study was morphofunctional characteristic of the person practicing martial arts and untrained youths.

Material and Methods. 8 Brazilian jiu jitsu athletes, 4 taekwondo athletes (SG) and 10 students (CG) performed an anaerobic Wingate test (WT) and then a cycle ergometer aerobic test (ET) during which the circulatory and pulmonary variables were recorded.

Results. The study has shown that the SG group in comparison to the CG group achieved higher anaerobic work (Wt) and average power during WT, whereas during ET they achieved higher values of power at anaerobic threshold (APAT), higher values of aerobic power at maximal load (APML), with a simultaneous higher energy expenditure (EE) and significantly higher values of VO_2max, maximum pulmonary ventilation (VE) and oxygen debt (OD), without the occurrence of other significant changes in the pulmonary and circulatory systems.

Conclusions. The obtained results suggest that the applied training loads lead to gradual adaptive changes in the organism that started with the increase of aerobic and anaerobic power, and with initial increase in exercise metabolism.

Key words: Brazilian jiu jitsu • taekwondo • aerobic power • anaerobic power • training adaptation

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Introduction

Martial arts represent an individual form of physical activity where taekwondo (TKD) and Brazilian jiu jitsu (BJJ) may be included among many other styles. The functional profile of TKD athletes that can be described by physiological changes taking place during training, simulated and real competition include: heart rate (HR) during simulated combat that ranged from 148±2 bpm [1] to 197±2 bmp [2], blood lactate concentration after combat simulation ranged from 2.9±2.1 mmol x L^{-1} [1] to 10.2±1.2 mmol x L^{-1} [2], whereas during the real competition the concentration ranged from 7.0±2.6 mmol x L^{-1} [3] to 11.9±2.1 mmol x L^{-1} [4]. On the basis of this data Campos et al. [5] suggest, that TKD is a sport that is largely based on the development of anaerobic capacity, because during the competition 2-3 rounds lasting 2 minutes each are played and during that time the athlete performs as fast as possible mostly punches and kicks [6].

BJJ is a martial art in which the goal is to project or take your opponent down and continue fight in this position. This form of combat is similar to the kind of fight performed in judo, where the round lasts for 5 minutes, mainly in upright position. BJJ is a form of combat that is performed mainly in recumbency, during which different techniques are used to affect the opponent. Once on the ground, the athletes must seek to control their adversaries using different techniques, including immobilizations, chokes and joint locks. During almost the entire combat that lasts for 5-10 minutes the BJJ athletes remain in direct contact with the opponent, maintaining a firm grip and trying to engage in active combat [7]. As a consequence of participation in competitive or training activities adaptive changes occur, which lead in BJJ and judo to the enhancement of the aerobic capacity, strength and physical endurance of the athletes [8, 9]. The maximum oxygen consumption (VO_2max) in judo reaches 50-60 ml×kg^1× min^{-1} [10] and this value is higher than the value reached in TKD [11]. It is only during short periods of time that determine the score of the combat, where explosive muscle power is developed [12].

The physical loads during training and competition in both TKD and BJJ modify the body composition in a similar fashion [13]. Comparison study of TKD and judo athletes performed by Tabben et al. [11] has shown that the TKD athletes achieved better results in speed tests, similar results in the developed power of legs and significantly lower results in the ranges of VO_2max compared to the judo athletes. This kind of post-training adaptation is similar to the changes that occur during endurance training and this adaptation should lead to better adaptive changes in the circulatory and pulmonary systems of the BJJ athletes in comparison to the TKD athletes, where these changes are visible to a lesser extent [14].

Taking into consideration the difference in adaptation of TKD and BJJ athletes, it was decided to join these athletes into one group (SG) in this paper and present their post-training changes compared to a group of untrained males (CG). The aim of the study was morphofunctional characteristic of the person practicing martial arts and untrained youths.

Material and methods

The study was approved by the Bioethics Research Committee of Jan Dlugosz University in Czestochowa, Poland.

Subjects

Twelve martial arts athletes (SG) (4 TKD athletes and 8 BJJ athletes) and ten untrained students (CG) with comparable age were studied. The martial arts athletes had an average training experience of 3.65±2.44 years and the frequency of training sessions was 3-5 times per week each of 1.5 h duration.

Procedures and calculations

The study began with the recording of age, body height (BH), and other somatic variables, i.e. body mass (BM), body fat (BF), total content of water (TBW), fat-free mass (FFM), and body mass index (BMI), which was obtained by using a body composition analyzer, the Tanita BS 418 - MA. In the next stage of the research, an anaerobic Wingate test (WT) was performed using legs. During the test the following parameters were obtained: total work performed during 30s (Wt), maximal power (Pmax), mean power (Pmean), minimal power (Pmin), total power slope (Ts) and rate of fatigue (Rf). After 4 hours of rest and 10 minutes in a sitting position, the systolic blood pressure (SBP) and diastolic blood pressure (DBP) were measured on the arm. Heart rate (HR) was also measured in rest position (R). Based on these values the mean arterial pressure (MAP), pulse pressure (PP) and the rate pressure product of systolic pressure x heart rate (RPP=SPB × HR ×1000^{-1}) were calculated. Then while a face mask was tightly secured in place and connected with quick breath analyzer (Ergo Card), the following pulmonary variables were recorded: maximum pulmonary ventilation per minute (VE), oxygen consumption per minute (VO_2), carbon dioxide output per minute (VCO_2),

respiratory exchange ratio (RER), cardiac output (CO). Based on these values, the ventilatory equivalent for oxygen (EQO_2), the ventilatory equivalent for carbon dioxide ($EQCO_2$), the factor of oxygen consumption and heart rate ($VO_2 \times HR^{-1}$) and stroke volume (SV) were calculated. Cardiac output (CO) was calculated by Ergo Card from the Fick formula, based on a non-invasive method for determining the size of the absorbed oxygen by the body [15].

Afterwards the participants have performed a cycle ergometer aerobic test (ET), which consisted of pedaling at a rate of 60 rpm with an initial load of 60W. Thereafter every 3 minutes the load has been increased by 30W, until the individual maximum load was reached (ML). At each load all the previously mentioned physiological parameters were recorded and calculations were performed and at AT and ML aerobic power (AP) was recorded. Using the changes of VE during test, the anaerobic threshold (AT) was calculated by the method proposed by Beaver et al.[16] and expressed it in watts [W]. Energy expenditure per minute (EE) during ET was calculated according to the modified Weir equation [17]: EE = (3.94 x VO_2) + (1.1 x VCO_2); where EE is energy expenditure (kcal/min), VO_2 is the volume of the oxygen uptake (l/min), VCO_2 (l/min) is the volume of carbon dioxide excretion. In the statistical analysis, apart from the R values, only the values obtained at AT and during the maximum individual load (ML) were taken into consideration. After the test was terminated, the oxygen debt (OD) was measured during a period of 5 minutes.

Statistical analysis

Data is presented as the mean ± standard deviation for each variable. "t" Student test was applied to determine the statistical differences of the intra-group and the two-factor analysis of variance was used to simultaneously determine the inter and intra-group differences of the applied variables (SPSS software, version Statistics 20). The level of significance was set at 0.05.

Results

There was no difference in the age and somatic parameters of the both groups (Table 1).

The study of the anaerobic power performed with WT has shown that the trained athletes reached higher values in the ranges of: Wt and Pmean (W) ($p<0.01$) as well as Pmean ($W \times kg^{-1}$), ($p<0.001$) in comparison to the CG (Table 2).

Table 1. Somatic characteristic of subjects

Variables	Groups	X	SD	T	p<
Age [years]	SG	24.08	4.72	1.973	0.071
	CG	21.30	1.16		
Body height [cm]	SG	173.59	7.66	–0.761	0.456
	CG	175.72	4.62		
Body mass [kg]	SG	72.87	8.75	0.759	0.457
	CG	69.83	10.09		
BMI [$kg \times m^{-2}$]	SG	24.18	2.56	1.326	0.200
	CG	22.60	3.04		
BF [%]	SG	15.15	3.80	0.569	0.576
	CG	14.05	5.25		
BF [kg]	SG	11.26	3.82	0.521	0.608
	CG	10.27	5.14		
FFM [%]	SG	84.82	3.82	–0.571	0.575
	CG	85.93	5.24		
FFM [kg]	SG	61.61	5.90	0.846	0.408
	CG	59.56	5.33		
TBW [%]	SG	62.08	2.80	–0.578	0.570
	CG	62.90	3.82		
TBW [kg]	SG	45.09	4.33	0.840	0.411
	CG	43.60	3.92		

Table 2. Results of anaerobic power reached during Wingate test

Variables	Groups	x	SD	t	p<
Wt [kJ×30sec^{-1}]	SG	16.95	2.53	2.973	**0.008**
	CG	13.99	2.05		
Pmax [W]	SG	930.22	166.89	1.599	0.125
	CG	160.76	319.49		
Pmax [W×kg^{-1}]	SG	12.72	1.40	0.836	0.413
	CG	12.07	2.21		
Pmean[W]	SG	569.36	85.70	2.945	**0.008**
	CG	470.27	68.91		
Pmean [W×kg^{-1}]	SG	7.79	0.46	3.687	**0.001**
	CG	6.77	0.82		
Pmin[W]	SG	368.77	61.09	1.892	0.073
	CG	325.78	41.20		
Ts [W×s^{-1}]	SG	19.54	8.21	0.188	0.853
	CG	18.94	6.33		
Rf [%]	SG	55.26	18.43	−0.785	0.442
	CG	60.14	7.34		

APAT in both groups were significantly lower than APML. The subjects from SG reached higher values of APAT ($p<0.01$) and APML ($p<0.05$) in comparison with the subjects from CG (Table 3). During ET VE was significantly higher ($p<0.05$) in SG than in CG both at AT and ML. The parameter VO_2 (l×min^{-1}) was also significantly higher in SG in comparison to CG at AT and ML ($p<0.01$) and the same difference was observed in EE only at ML (Table 3).

The range of differences of each physiological variable measured at R, AT and ML was lowest at R for both studied groups, significantly higher at AT and the highest at ML. The statistically significant differences ($p<0.001$) between R, AT and ML were found in the following parameters: VE, VO_2 (l×min^{-1}), VCO_2, HR, VO_2 (ml×min^{-1}×kg^{-1}), EE and CO (Table 3 and 4). SV in both groups differed between R and AT as well as R and ML ($p<0.001$). SBP, MAP, PP and RPP were lower at R compared to values obtained at AT and ML in both groups ($p<0.001$) and in CG at AT lower values of SBP ($p<0.05$), PP ($p<0.05$) and RPP ($p<0.001$) were observed with relation to values obtained at ML. In SG at AT, MAP and RPP, were significantly lower ($p<0.05$; $p<0.01$) than at ML. However TPR was significantly higher at R than at AT and ML in both studied groups ($p<0.001$), at the same time it was also lower at ML than at AT in SG (Table 3).

The changes in the RER coefficient (Table 4) showed significant differences in SG between R and AT as well as at R and ML ($p<0.01$), and additionally between R and AT, R and ML, AT and ML in CG ($p<0.001$). EQO_2 was higher at ML than at AT in SG group, whereas in CG group significantly lower values of this variable were observed at AT in comparison to the values at R and ML ($p<0.001$). Also $EQCO_2$ in SG was significantly lower at AT with regard to R and ML, whilst in CG the differences at R, AT and ML were shown to be statistically significant. The significant differences were found in case of the VO_2 ×HR^{-1} coefficient; they were present in the comparison of R and AT as well as R and ML ($p<0.001$) and at AT and ML ($p<0.01$) in both groups. SaO_2 was higher in SG at R conditions in comparison to AT and ML ($p<0.001$) and in CG it was also higher at R than at ML ($p<0.01$).

It was also observed that the value of the oxygen debt recorded in the 5 minute post-exercise recovery, was significantly higher ($p<0.05$) in SG (4.68±1.02 l × 5min^{-1}) than in CG (3.75±0.86 l × 5min^{-1}).

Discussion

The studied athletes in SG were characterized by higher values of Wt performed during the 30s WT and higher Pmean (expressed in W and W×kg^{-1}) compared to CG. The increase of anaerobic power of the legs after TKD training sessions was confirmed by Bridge et al. [18] and Moreira et al. [19]. In BJJ an increased explosive power of legs muscles is also required [8, 12]. This motoric conditioning in BJJ is formed with the simultaneous development of strength endurance

Table 3. Variables characteristic of cardiovascular function and applied workloads

Variables	Groups	R		AT		ML		Group		Intensity of exercise		Interaction (group vs intensity)	
		x	SD	x	SD	x	SD	F	p<	F	p<	F	p<
HR [bpm]	SG	80.10[aaa]	14.75	158.80[ccc]	11.52	180.70[bbb]	6.55	2.829	0.127	692.766	**0.001**	1.377	0.306
	CG	80.30[ddd]	6.11	169.00[fff]	11.71	188.20[eee]	7.24						
CO [l×min^{-1}]	SG	5.00[aaa]	1.15	17.90[ccc]	2.38	19.90[bbb]	2.02	0.001	1.000	894.702	**0.001**	0.390	0.689
	CG	5.40[ddd]	0.70	17.80[fff]	1.62	19.60[eee]	1.71						
SV [ml]	SG	68.00[aaa]	21.85	113.50	14.37	110.00[bbb]	12.86	0.830	0.386	384.360	**0.001**	0.651	0.547
	CG	68.60[ddd]	12.01	105.10	9.21	104.36[eee]	10.07						
SaO_2 [%]	SG	96.80[aaa]	0.92	92.70	0.95	93.10[bbb]	1.10	0.175	0.686	71.355	**0.001**	1.667	0.248
	CG	96.00	2.71	93.40	2.76	92.30[ee]	2.26						
SBP [mmHg]	SG	124.50[aaa]	13.01	185.50	7.24	195.00[bbb]	17.79	0.148	0.710	81.808	**0.001**	0.074	0.929
	CG	128.00[ddd]	8.56	186.50[f]	22.37	196.50[eee]	21.48						
DBP [mmHg]	SG	80.50	4.97	82.50	4.25	84.00	4.59	0.022	0.885	5.456	**0.032**	0.655	0.545
	CG	79.50	3.69	83.50	4.74	83.50	4.74						
MAP [mmHg]	SG	95.17[aaa]	6.21	116.83[c]	3.46	121.00[bbb]	6.67	0.074	0.792	58.356	**0.001**	0.167	0.849
	CG	95.67[ddd]	3.35	117.83	9.03	121.17[eee]	8.05						
PP [mmHg]	SG	44.00[aaa]	12.43	103.00	8.88	111.00[bbb]	18.38	0.184	0.678	95.054	**0.001**	0.302	0.747
	CG	48.50[ddd]	10.01	103.00[f]	21.24	113.00[eee]	21.63						
RPP [mmHg×min^{-1}]	SG	10.08[aaa]	2.63	29.44[cc]	2.23	35.22[bbb]	3.34	1.260	0.291	242.372	**0.001**	0.735	0.509
	CG	10.27[ddd]	0.99	31.64[fff]	5.29	37.05[eee]	4.98						
TPR [mmHg×L^{-1}×min^{-1}]	SG	19.32[aaa]	4.08	6.63[cc]	0.90	6.14[bbb]	0.67	0.286	0.606	279.816	**0.001**	0.500	0.624
	CG	18.01[ddd]	2.66	6.64	0.49	6.42[eee]	0.99						
AP [W]	SG			186.00[ccc,hh]	23.66	240.00[i]	28.28	17.190	**0.002**	245.000	**0.001**	0.060	0.811
	CG			159.00[fff]	20.25	210.00	20.00						

[a]-difference between R and AT in SG; [b]-difference between R and ML in SG; [c]-difference between AT and ML in SG; [d]-difference between R and AT in CG; [e]-difference between R and ML in CG; [f]-difference between AT and ML in CG; [h]-difference between SG and CG at AT; [i]-difference between SG and CG at ML; [a a a, bbb, ccc, ddd, eee, fff] – p < 0.001. [cc, hh, ee, hh,] – p < 0.01. [.c, ,f, i] – p < 0.05;

[8]. The development explosive power ability reached only average level because it requires simultaneous enhancement of an aerobic power [12]. It has been suggested that in BJJ an elevated level of explosive power of arms is also required and it should also be characterized by an enhanced hand grip strength. This would make possible to maintain constant level of strength for an extended period of time, so that it is viable to overcome the resistances of the opponent [20]. However the development of the explosive power and strength of the arms in BJJ must be treated with caution because the values reached in this case are only moderately elevated in comparison to other sport disciplines or compared to untrained people [21]. The combined adaptable changes in TKD and BJJ were the reason of the higher value of anaerobic power in SG than in CG.

It was also shown that in SG significantly higher values of aerobic power reached at AT and ML during ET than in CG. The more significant development of aerobic power in SG is confirmed by a higher absolute value of VO_2max (p<0.001), higher VO_2 at AT (p<0.01), higher VE reached at AT as well as at ML (p<0.05) in comparison to CG. Although in the presented results the reached VO_2max values in SG were higher than in CG, they belong to the lower ranges in relation to trained individuals. In the research Tabben et al. [11] highly trained judo athletes reached high values of VO_2max = 60.6 ml× kg^{-1} ×min^{-1} and for highly trained TKD athletes these values were significantly lower and reached the level of 57.8 ml× kg^{-1} ×min^{-1}. In our study the relative values of VO_2max did not differ between both groups and were significantly lower than those determined by Tabben et al.

Table 4. Variables characteristic of respiratory function and metabolism

Variables	Groups	R		AT		ML		Group		Intensity of exercise		Interaction (group vs intensity)	
		x	SD	x	SD	x	SD	F	P<	F	P<	F	P<
VE [l×min^{-1}]	SG	10.61$^{aaa.}$	3.19	68.81$^{ccc.h}$	17.62	122.08$^{bbb.i}$	28.86	9.323	**0.014**	153.742	**0.001**	7.162	**0.016**
	CG	10.70^{ddd}	1.64	55.77^{fff}	9.06	96.70^{eee}	13.34						
VO_2 [l×min^{-1}]	SG	0.36^{aaa}	0.09	2.62$^{ccc.hh}$	0.54	3.35$^{bbb.ii}$	0.34	8.978	**0.015**	512.770	**0.001**	8.121	**0.012**
	CG	0.38^{ddd}	0.05	2.39^{fff}	0.37	3.00^{eee}	0.39						
VO_2 [ml×min^{-1}×kg^{-1}]	SG	5.10^{aaa}	0.99	36.90^{ccc}	6.30	47.40^{bbb}	3.66	2.228	0.170	1210.326	**0.001**	2.462	0.147
	CG	5.40^{ddd}	1.17	34.60^{fff}	6.20	43.40^{eee}	5.62						
VCO_2 [l×min^{-1}]	SG	0.31^{aaa}	0.08	2.58^{ccc}	0.41	3.58^{bbb}	0.40	3.701	0.087	578.065	**0.001**	1.745	0.235
	CG	0.32^{ddd}	0.05	2.36^{fff}	0.38	3.35^{eee}	0.44						
RER	SG	0.85^{aa}	0.08	0.99	0.06	1.08^{bb}	0.15	0.104	0.755	49.885	**0.001**	1.023	0.402
	CG	0.84^{ddd}	0.09	0.99^{fff}	0.03	1.12^{eee}	0.09						
EQO_2	SG	29.48	4.64	26.08^{ccc}	1.56	36.08	6.19	0.286	0.606	108.066	**0.001**	15.296	**0.002**
	CG	33.70^{ddd}	1.36	23.35^{fff}	0.86	32.55	5.05						
$EQCO_2$	SG	34.67^{aaa}	4.11	26.37^{c}	3.02	34.57	10.21	3.647	0.088	160.329	**0.001**	0.972	0.419
	CG	33.70^{ddd}	1.36	23.66^{fff}	0.65	28.96^{ee}	2.88						
VO_2×HR^{-1} [ml×beat^{-1}]	SG	4.67^{aaa}	1.58	16.44^{cc}	3.04	18.59^{bbb}	2.08	9.991	0.012	355.683	**0.001**	3.467	0.082
	CG	4.72^{ddd}	0.90	14.11^{ff}	1.80	15.87^{eee}	2.04						
SaO_2 [%]	SG	96.80^{aaa}	0.92	92.70^{cc}	0.95	93.10^{bbb}	1.10	0,175	0.686	71.355	**0.001**	1.667	0.248
	CG	96.00	2.71	93.40	2.76	92.30^{ee}	2.26						
EE [kcal×min^{-1}]	SG	1.75^{aaa}	0.44	13.15^{ccc}	2.55	17.15$^{bbb, ii}$	1.45	9.883	**0.012**	616.399	**0.001**	4.793	**0.043**
	CG	1.83^{ddd}	0.24	12.00^{fff}	1.87	15.47^{eee}	1.99						

^{a}-difference between R and AT in SG; ^{b}-difference between R and ML in SG; ^{c}-difference between AT and ML in SG;^{d}-difference between R and AT in CG; ^{e}-difference between R and ML in CG; ^{f}-difference between AT and ML in CG; ^{h}-difference between SG and CG at AT; ^{i}-difference between SG and CG at ML; $^{a\,a\,a,\ bbb,\ ccc,\ ddd,\ eee,\ fff}$ – $p < 0.001$. $^{aa,\ bb,\ cc,\ ee,\ ff,\ hh\ ,ii,}$– $p < 0.01$. $^{.c,\ i}$– $p < 0.05$;

[11]. That is why the aerobic capacity of the athletes from SG must be considered as low.

Taking into account the fact that the TKD training leads to insignificant increase in VO_2max while BJJ training has the stronger influence; this paper shows a significant increase of the absolute value of this variable, whereas relation variable (to body mass) does not show any difference between both groups. Despite the average increase of VO_2max, the increase of aerobic power reached at AT and at ML in SG was more pronounced, which suggests that in the studied martial arts group the increasing rate of both variables is different. This can be a result of a definite improvement of the aerobic and anaerobic metabolism and their mutual interactions in trained individuals [9]. The credibility of this hypothesis is reinforced by the fact that a higher anaerobic power was reached in SG in relation to CG. Such discrepancy of reaching higher values of aerobic and anaerobic power, with a simultaneous limited rise of VO_2max, is also supported by the observation that during training an increase of the exercise capacity precedes other functional changes in the organism [22]**.** Sale [23] had shown earlier that during the first stage of strength and power development training, nervous improvement is more pronounced than metabolic effects. The necessity of obtaining high values of VO_2max in judo athletes is also negated by Franchini et al. [9]. On the other hand it has been shown that individuals with higher VO_2max are capable to resynthesize faster phosphocreatine resources [24], remove faster lactates and they maintain appropriate pH level during 5 minutes of combat [25].

The EE per minute reached during ET was higher in SG only at ML compared to CG ($p<0.01$), which should be linked with the higher power level at maximum loads in the first group. The reached values of EE in both groups was very high already at AT and at ML because it exceeded 15 kcal × min^{-1}. Such values can be seen only during exertions in extreme sports or extremely intensive professional work [26]. In the presented study only the "global" EE was calculated during ET, without specifying the energetic components of the expended energy. Campos et al. [5] described that during a 2 minute round of simulated combat in TKD 66±6%, 30±6%, 4±2% of the energy is generated by the aerobic, non-lactate anaerobic and lactate anaerobic system, respectively. Also in Matsushigue et al. study [27] point out the significant importance of anaerobic, non-lactate metabolism to safeguard energy levels during TKD combat (and due to this fact, the importance of a diet high in carbohydrates). In the presented paper the energetic components of EE were not determined, however the OD was measured and it corresponds in a stated degree to anaerobic potential of the organism [28]. The OD expressed in l × $5min^{-1}$ was higher in the SG than in the CG, which confirms differences observed between both groups in the range of anaerobic power.

In the present study training did not lead to any somatic differences between SG and CG**,** despite the adaptive changes in the capacity of physical exertion. In our opinion this is either an effect of too short period of training (or/and its low intensity) experience of the studied athletes (3.65 ± 2.44 years) or a specificity of somatic adaptation to applied workloads in martial arts. The later assumption has been confirmed by Diaz-Lara et al. [29], who did not record any changes in fat content in experienced (9.5±4.6 years of training), and much less experienced (3.0±1.1 years of training) BJJ athletes. It has been observed in our study that the body fat content (measured also using the bioelectrical impedance method) in both groups was similar and ranged averagely between 14 and 15 %, but these values were significantly higher than presented by Diaz-Lara et al. [29] in BJJ group. To complement the above mentioned arguments, it is important to underline, that Moreira et al. [19] has listed low body mass, low body fat content, high relative non-fat body mass as predictive factors in development sports level in TKD.

Many of the variables presented in Table 3 and Table 4 that characterize the functioning of the circulatory and pulmonary systems were similar in both groups and did not differ statistically between them. Some of them (HR, SV, EQO_2, $EQCO_2$, $VO2 \times HR^{-1}$, RPP) have shown only a tendency to a post-training increase [30-34]. Such changes suggest that: 1) in martial arts only a small enhancement of circulatory and pulmonary functions can be observed, 2) the training loads either were too low (may be period of training was too short) and did not lead to specific adaptive changes, typical for trained individuals or 3) applied workloads were optimal and did not lead to the improvement of these systems but also did not lead to their overtrained failure. Only intergroup differences were registered in the range of the circulatory and pulmonary variables between R, AT and ML, which is well documented in literature and does not shed any new light on the research aspects of the presented paper.

Conclusion

In conclusion, it has to be stated, that the applied martial arts training caused an increase in aerobic and anaerobic power, combined with the occurrence of higher OD. In consequence of these changes, an average increase of VO_2 occurred at different applied loads, without the incidence of somatic, circulatory and pulmonary changes. The range of these changes seems to be dictated by the specificity of post training adaptation in TKD and BJJ.

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Determinant factors of aerobic and anaerobic power in martial arts

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Abstract

Background and Study Aim. The body's ability to undertake physical effort is highly variable and depends on many factors. Therefore, the aim of present stady was knowledge about factors what determine the development of anaerobic power (AnP) and aerobic power (AP) in people practicing martial arts and in untrained persons.

Material and Methods. At the commencement of this study a dietary composition of 8 Brazilian jiu jitsu athletes, 4 taekwondo athletes (SG) and 10 students (CG) was recorded. Then both groups performed Wingate test (WT) to determine AnP and later a cycle ergometer test (ET) was performed during which AP, pulmonary and circulatory variables were recorded. Afterwards a correlation between AP and AnP indicators was performed. Then AP and AnP indicators were also correlated with the oxygen consumption (VO_2), oxygen debt (OD), the value of energy expenditure (EE), the ingredients of the diet (UD) and somatic indicators (SP) separately in each group.

Result. The AP reached at anaerobic threshold (APAT) and aerobic power at maximal load (APML) correlated with numerous indicators of AnP indicators in the SG group, whereas in the CG group the correlations were few and concerned APML and AnP variables such as total work (Wt) and mean power (Pmean). Additionally AP and AnP showed more frequently significant correlation with VO_2, OD, EE, UD and SP in the SG group than in CG group.

Conclusion. Studies have shown that training in martial arts not only causes specific adaptation changes in the body but also improves the functional interdependence.

Key words: diet • correlations

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Introduction

The best indicator of physical performance is the amount of performed work or the size of power output during a specific physical effort whether it will be at work or in certain types of sports. Such specific tests of physical performance evaluation may be: Cooper test evaluating specific running performance [1], cycle ergometer trial evaluating specific physical performance of cyclists [2], a specific test for judo competitors developed by Sterkowicz [3], or the height of a volleyball player jump (in two jumping capacity tests) [4]. Such specific evaluation is not always technically feasible or it is not necessary to perform and then overall physical performance is evaluated. Usually these physical performance tests assess aerobic capacity, which outside competitive sport are often used for evaluation in medicine (cardiology, pulmonology, physiotherapy). In elite sports through not proper sports training or in extreme ambient conditions may occur chronic or acute damage to the body. An example of overburdening the cardiovascular system may be too intense weight training, during which a trained bodybuilder has recorded increase in blood pressure up to 480/350 mm Hg [5]. Dysfunctions were also observed in the respiratory system in case of endurance athletes, where intense breathing took place under different temperature conditions [6]. Such repetitive and excessive burden may lead to a gradual or sudden reduction of physical capacity and tracking its changes may be an indication of health recovery and in the case of active sports training shows increase in physical capacity, helping in achieving satisfactory results in sport. Decreasing physical performance in sport's training indicates overtraining, which can change into fatigue and be the basis for upcoming diseases.

It is known that the overall physical performance is determined by factors such as the efficiency of the various body systems, physical, mental and environmental variables and the nature of training [7]. Taking into account the above suggestions the aim of present stady was knowledge about factors what determine the development of anaerobic power (AnP) and aerobic power (AP) in people practicing martial arts and in untrained persons.

Material and methods

The study was approved by the Bioethics Research Committee of Jan Dlugosz University in Czestochowa, Poland.

Subjects

Twelve martial arts athletes (SG) (4 TKD athletes and 8 BJJ athletes) and ten untrained students (CG) with comparable age were studied. The martial arts athletes had an average training experience of 3.65±2.44 years and the frequency of training sessions was 3-5 times per week each of 1.5 h duration.

Procedures

For a period of three days prior to the study participants wrote down their diets, which were later analyzed by a computer program Dieta-5. The program details the value of the caloric content of proteins, fats, carbohydrates, water, minerals and vitamins. After determining the age of the respondents, body height (BH) was measured, and body weight (BW) and its composition was recorded using the body composition analyzer, Tanita BS 418 - MA. The body composition included fat (BF), lean body mass (FFM) and the body water (TBW). In addition, weight-height indices such as BMI, Quetelet, Rohrer and Slim index were calculated. In the next stage of research the Wingate anaerobic power test (WT) was performed and the following variables were determined: total work performed during the 30s (Wt), maximal power (Pmax), mean power (Pmean), minimal power (Pmin), total power slope (Ts) and rate of fatigue (Rf). Then, after a four-hour break and after 10 minutes seating, heart rate (HR) was measured during rest (R) in all subjects. Further on, while a face mask was tightly secured in place and connected with quick breath analyzer (Ergo Card), the following pulmonary variables were recorded: maximum pulmonary ventilation per minute (VE), oxygen consumption per minute (VO_2), carbon dioxide output per minute (VCO_2), respiratory exchange ratio (RER) and cardiac output (CO).

Afterwards the participants have performed a cycle ergometer test (ET), which consisted of pedaling at a rate of 60 rpm with an initial load of 60W. Thereafter every 3 minutes the load has been increased by 30W, until the individual maximum load (ML) was reached. At every load change all previously mentioned parameters were recorded and calculations were performed.

An anaerobic threshold (AT) was calculated using the VE dynamic stress changes method proposed by Beaver et al. (1986) and it was expressed in watts (W). The statistical analyzes has taken into account those parameters recorded during R, AT and with individual maximum load (ML). During the first 5 minutes after the completion of ET volume OD was measured and it was calculated in a

traditional way as the difference between total oxygen uptake during 5-minute recovery period and total resting oxygen uptake at 5 minute rest before the exercise. Minute's EE during ET at R, AT and ML was calculated according to the modified Weir [8] equation, EE = (3.94 × VO_2) + (1.1 × VCO_2); wherein EE is energy expenditure (kcal×min^{-1}), VO_2 is the size of the oxygen uptake (l×min^{-1}), VCO_2 (l×min^{-1}), is the volume of carbon dioxide excretion.

Statistical Analysis

The statistical significance of differences between the two groups in terms of body weight and body composition, VO_2max, OD, EE-ML and the ingredients of UD was calculated using the "t" Student test. Pearson linear correlation coefficients "r" was calculated between the aerobic power reached during ET, at AT and ML, and anaerobic power indices assessed during WT. Further the AP and AnP indices were correlated with: VO_2 determined at rest (VO_2-R), VO_2 determined at AT (VO_2-AT), and VO_2 determined at ML (VO_2-ML), OD, EE, SP, and ingredients of UD. The level of significance was set at 0.05.

Results

The competitors did not differ with age and somatic variables (Table 1). In SG were observed significantly higher values of: APAT, APML, Wt, Pmean, VE, VO_2-AT, VO_2max-ML (l×min^{-1}), OD, EE-ML in comparison to CG. Comparison performed between both groups has shown that in the diet of SG was higher content of animals protein and magnesium, but in the diet of CG was observed higher content of sodium and vitamin E.

It has been shown that the APAT and APML in SG correlated with the following anaerobic

Table 1. Somatic characteristic of- subjects; SG, n=12; CG, n=10

Variables	Groups	x	SD	t	p<
Age [years]	SG	24.08	4.72	1.973	0.071
	CG	21.30	1.16		
Body height [cm]	SG	173.59	7.66	–0.761	0.456
	CG	175.72	4.62		
Body mass [kg]	SG	72.87	8.75	0.759	0.457
	CG	69.83	10.09		
BMI [kg×m^{-2}]	SG	24.18	2.56	1.326	0.200
	CG	22.60	3.04		
Quetelet idex [g×cm^{-1}]	SG	419.47	44.18	1.058	0.303
	CG	397.18	54.67		
Rohrer index [g×cm^{-3}]	SG	1.40	0.17	1.447	0.164
	CG	1.29	0.18		
Slim index [cm^3×$\sqrt{}$kg^{-1}]	SG	41.65	1.72	–1.513	0.146
	CG	42.83	1.92		
BF [%]	SG	15.15	3.80	0.569	0.576
	CG	14.05	5.25		
BF [kg]	SG	11.26	3.82	0.521	0.608
	CG	10.27	5.14		
FFM [%]	SG	84.82	3.82	–0.571	0.575
	CG	85.93	5.24		
FFM [kg]	SG	61.61	5.90	0.846	0.408
	CG	59.56	5.33		
TBW [%]	SG	62.08	2.80	–0.578	0.570
	CG	62.90	3.82		
TBW [kg]	SG	45.09	4.33	0.840	0.411
	CG	43.60	3.92		

performance indicators: Wt, Pmax, Pmean [W, W×kg^{-1}], and Pmin (Table 2), on the other hand in CG these correlations occurred less frequently and dealt with APML vs. Wt and vs. Pean [W, W×kg^{-1}] (Table2).

Table 2. Pearson correlation coefficients "r" between mechanical indices of aerobic power and anaerobic power; SG, n=12; CG, n=10

Aerobic power	Groups	Wt [KJ]	Pmax [W]	Pmean [W]	Pmean [W × kg^{-1}]	Pmin [W]
APAT [W]	SG	0.843^{xxx}	0.622^{x}	0.844^{xxx}	0.583^{x}	0.763^{xx}
	CG	NS	NS	NS	NS	NS
APML [W]	SG	0.893^{xxx}	0.609^{x}	0.893^{xxx}	0.711^{xx}	0.755^{xx}
	CG	0.751^{xx}	NS	0.752^{xx}	0667^{x}	NS

x-p<0.05; xx-p<0.01; xxx-p<0.001;

Such AnP indicators as: Wt, Pmax, Pmean [W, W×kg^{-1}], Pmin and AP indicators, i.e. APAT and APML in SG correlated with VO_2-R, VO_2-AT, VO_2-ML, OD, EE-ML. However, among these correlations were several insignificant dependencies, i.e.: Pmax vs. VO_2-AT, Pmax vs. OD, and Pmean [W×kg^{-1}] vs. OD, as well as Pmin vs. OD (Table 3). The CG correlations in this regard were much less frequent and concerned only Pmin vs. VO_2-ML, OD, EE and APAT vs. VO_2-R, VO_2-AT, VO_2-ML, OD, EE-ML.

Table 4 illustrates dependencies of AP and AnP with SP. AnP variables such as: Wt, Pmean [W] Pmin have correlated with numerous somatic parameters in SG and CG. On the other hand Pmax, APAT and APML have correlated with BW, FFM [kg], TBW [kg], Quetelet index, and additionally Pmax correlated with FAT [kg] only in SG.

There was also a statistically significant correlation coefficients of Wt vs. animal protein in the diet - r = 0.619 (p <0.05), APML vs. the amount of magnesium in the diet – R=0.740 (p<0.01) in SG and APAT vs. the amount of potassium in the diet r = –0.638 (p <0.05) with respect to CG.

Discussion

This study has shown that APAT and APML indicating aerobic power in SG correlated with Wt, Pmax, Pmean [W, W × kg−1] and Pmin have characterized anaerobic power, while in the untrained CG group these correlations were less frequent and concerned only the APML from Wt, Pmean [W, W × kg−1]. This suggests that in case of trained group of athletes aerobic and anaerobic pathways resynthesis of energy are coordinated to a greater extent than in untrained persons. A similar lack of correlation between the anaerobic power of upper and lower extremities in the group of swimmers observed Stanula [9], which indicates a different degree of post-exercise adaptation of various parts of the body. This evidence suggests that post-training power changes are a complicated process, that training improves them and that in order to determine changes in the body's physical performance, it is necessary to make a lot of physical capacity tests of as many body part as possible.

Linear relationship between the oxygen uptake and developed power output is a fundamental

Table 3. Pearson correlation coefficients "r" between mechanical indices of aerobic power and: anaerobic power, VO_2, oxygen debt and energy expenditure; SG, n=12; CG, n=10

Mechanical variables	Groups	VO_2-R l × min^{-1}	VO_2-AT l × min^{-1}	VO_{2max}-ML l × min^{-1}	Oxygen debt l – 5min^{-1}	EE-ML kcal × min^{-1}
Wt [kJ]	SG	775^{xx}	0.697^{xx}	0.775^{xx}	0.626^{x}	0.900^{xxx}
	CG	NS	NS	NS	NS	NS
Pma× [W]	SG	0.553^{x}	NS	0.579^{x}	NS	0.590^{x}
	CG	NS	NS	NS	NS	NS
Pmean [W]	SG	0.777^{xx}	0.697^{x}	0.880^{xxx}	0.626^{x}	0.900^{xxx}
	CG	NS	NS	NS	NS	NS
Pmean [W×kg^{-1}]	SG	0.584^{x}	0.712^{xx}	0.616^{x}	NS	625^{x}
	CG	NS	NS	NS	NS	NS
Pmin [W]	SG	0.767^{xx}	0.594^{x}	0.699^{xx}	NS	0.686^{xx}
	CG	NS	NS	0.682^{x}	0.610^{x}	0.639^{x}
APAT [W]	SG	0.752^{xx}	0.848^{xxx}	0.765^{xx}	0.666^{xx}	0.680^{xx}
	CG	0.695^{x}	0.908^{xxx}	0.790^{xx}	0.624^{x}	0.806^{xx}
APML [W]	SG	0.733^{xx}	0.782^{xx}	0.891^{xxx}	0.602^{x}	0.874^{xxx}
	CG	NS	NS	NS	NS	NS

x-p<0.05; xx-p<0.01; xxx-p<0.001;

Table 4. Pearson „r" correlation coefficients between aerobic and anaerobic variables and somatic indices; SG, n=12; CG, n=10

Variables	Groups	BW [kg]	BF [%]	BF [kg]	FFM [%]	FFM [kg]	TBW [%]	TBW [kg]	BMI [kg×m²]	Quetelet Index [g×cm⁻¹]	Rohrer Index [g×cm³]	Slim Index [cm×³√kg⁻¹]
Wt	SG	0.930^{xxx}	NS	0.704	NS	0.922^{xxx}	NS	0.923^{xxx}	0.644^{xx}	0.861^{xxx}	NS	NS
[kJ]	CG	0.631^{x}	0.687^{x}	0.673^{x}	−0.687^{x}	NS	−0.687^{x}	NS	0.701^{x}	0.687^{x}	0.698^{x}	−0.691^{x}
Pmax	SG	0.797^{xx}	NS	0.610^{x}	NS	0.786^{xx}	NS	0.784^{xx}	NS	0.707^{xx}	NS	NS
[W]	CG	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Pmean	SG	0.930^{xxx}	NS	0.703^{xx}	NS	0.923^{xxx}	NS	0.924^{xxx}	0.643^{xx}	0.861^{xxx}	0.698^{xx}	−0.691^{xx}
[W]	CG	0.653^{x}	0.686^{x}	0.673^{x}	−0.686^{x}	NS	−0.686^{x}	NS	0.701^{x}	0.689^{x}	NS	NS
Pmin	SG	0.698^{xx}	NS	NS	NS	0.689^{xx}	NS	0.689^{xx}	0.635	0.723^{xx}	NS	NS
[W]	CG	0.750^{xx}	0.699^{x}	0.715^{x}	−0.696^{x}	0.725^{x}	−0.699^{x}	0.723^{x}	0.742^{xx}	0.757^{xx}	0.705^{x}	−0.707^{x}
APAT	SG	0.783^{xx}	NS	NS	NS	0.861^{xxx}	NS	0.862^{xxx}	NS	0.684^{x}	NS	NS
[W]	CG	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
APML	SG	0.790^{xx}	NS	NS	NS	0.840^{xxx}	NS	0.841^{xxx}	NS	0.675^{xx}	NS	NS
[W]	CG	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

x-p<0.05; xx-p<0.01; xxx-p<0.001

concept occurring in applied physiology. However it turns out that this basic correlation can be modified, because Beaven et al. [10] showed that VO_2 changes at 88.93% (R^2 = 0.8893) are explained by the increasing power output during the graduated cycle ergometer test performed with concentric work of arms, while for the eccentric working of the upper limbs R^2 = 0.5923, and the correlation was significantly weaker than the previously cited. The surveyed subjects have performed concentric work every day and the eccentric test was performed only for experimental purposes. Therefore we must assume that they performed eccentric test with much poorer technique and with lower mechanical efficiency as it was shown in the cited paper. These data therefore indicate that a change in the nature of work and the deterioration of exercise techniques affect the strength of the correlation between oxygen uptake and power output. Our data indicate that the volume of VO_2-R, VO_2-AT, VO_2-ML correlated significantly more frequently with indicators of AP and AnP in a trained SG than in untrained CG. Beaven et al. [10] further suggests that the level of training of muscles can modify this relationship. Applying this comment to the results of our study, we can conclude that indeed both groups did not differ in somatic variables but the SG was better trained, because it reached higher values APAT, APML during the ET and Wt as well as Pmean while doing WT. Thus, correlations between oxygen uptake and power output during exercise can be reasonably explained by the better trained SG and the resulting higher mechanical efficiency of the subjects in Beaven et al. [10] study (the coefficient of work's mechanical efficiency was not calculated in our study). This also may have a significant impact on the incidence of correlation between AP and AnP. Significant correlations occurring in SG between AP as well as AnP and EE-ML were almost identical to the relationships appearing between AP as well as AnP with VO_2max-ML, while in the CG significant correlations of EE-ML were observed only with Pmin and with the APAT. It can be assumed that martial arts training led to stimulate both aerobic and anaerobic metabolism.

Analysis of relationships between somatic variables and AP as well as AnP showed that body weight had a significant impact on the size of AnP because in both groups analyzed Wt, Pmax, Pmean, Pmin were significantly correlated with it. Similarly in earlier studies Pilis et al. [11] found in a group of weight lifters a significant correlation between body weight and aerobic maximum power and Pmax, which was assessed with Margaria et al. [12] test. Relatively expressed Pmax showed no relation to body weight. However, in the presented studies size of aerobic power expressed as the APAT and the APML only in the training group correlated significantly with body weight and body composition. Therefore it is concluded that both AP and AnP (regardless of the method of its definition) to a greater extent are determined by the weight size and not by the level of training. In another study Mikkola et al. [13] showed that after 6-12 months endurance-strength military service training and standard diet (3200-3600 kcal × day^{-1}) there was a significant linear relationship between change in AP and changes in body weight, fat mass, fat free mass, waist circumference and visceral fat area and these relationships

have become more substantial if training period of the overweight and obese people was lengthening compared with normal-weight subjects. [13]. Cited studies show that body weight and body composition change themself in the coaching process of people trained in varied degree and determine the development of physical fitness and power capacity. Although direct measurements of somatic variables in our study showed no difference between SG and CG, however numerous correlations existing between somatic variables and AP only in SG confirm, that there is an effect of somatic determinants on the power output in this group of athletes. The observed differences of the described correlations of trained individuals in relation to untrained subjects may also be the result of a stronger stimulation of the nervous system that appears in the early stages of the training process and occurring much later, or poorly outlined muscle hypertrophy, affecting the development of muscle strength [14]. These phenomena did not occur in untrained people.

AP and AnP correlations occurring with OD in SG and much less likely to appear such relationships in CG have a theoretical basis corresponding to the fact that the oxygen debt during exercise and size of the anaerobic energy release are closely interrelated. It is true that oxygen deficit is strongly connected with AnP and represents the smaller part incurred oxygen debt [15]. In our study the size of oxygen debt turned out to be predictive not only in relation to the anaerobic power output but also to aerobic output in SG. The strength of such correlations in the non-trained group was far lesser than in SG, what once again shows that the hydrolysis and re-synthesis systems of energy in trained people is more efficient than in untrained.

Only three statistically significant correlations between power output and the diet ingredients among many more possibilities suggest that a type of diet does not always directly influence human physical performance.

Conclusion

Greater AP and AnP, and closer correlation between AP and AnP were observed in a group of athletes, who train martial arts, while in case of untrained persons with the lower power's values this correlation appeared to be weaker. The reasons for the differences in these relationships of both groups are believed to be the body modifications resulting from training, and manifesting an increase and improvement of aerobic and anaerobic metabolism, as well as of the energy expenditure system. The somatic changes that influence the size of the power output can be caused only by the improvement of transduction nervous-muscle system without apparent skeletal muscle hypertrophy.

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Recording process of judo training

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Abstract

Background & study aim: The judo training is highly complex and recording methods should help coaches to a better understanding of what is in fact been trained. The purpose of this study was recording the exercises performed by judo athletes during fourteen training sessions.

Material and Methods: During fourteen days a digital camera video recorded the training of a judo team. The exercises were posteriorly analysed according to the magnitude, structure and dynamic through the time spent to perform each exercise.

Results: 1422 minutes were recorded and the *randori* was the exercise more performed along the fourteen days training. The *randori* was always executed at the end of the training session with only two days exception. Specific exercises were more executed than general and special exercise.

Conclusion: The recording process is an efficient method to analyze the magnitude, structure and dynamic of the exercises and can help to a better understanding on the adaptations caused by the training practice.

Key words: dynamic • magnitude • structure

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Introduction

Judo is a combat sport which requires effective physical preparation [1]. To achieve high levels of physical conditioning, the fighters must be undertaken to a rigorous process of training [2]. The judo trainers are responsible to organize and elaborate this training process [3]. Eventually, trainers use a periodization model to structure the distribution of the training load along a microcycle, mesocycle and macrocycle [4]. However, although trainers may find different scientific sources to substantiate the judo periodization [5-6], seem the recording of training load performed has been neglected by coaches [7].

The recording of the training load may help to visualize some important aspects of the training process [7]. During a training session, coaches may switch exercises for other, or they can just eliminate an exercise [8]. Different reasons can justify this changing, such as injury what forces coaches to reprogram the training load; lack of motivation by the athletes, in this case, coach has to eliminate an exercise because the athletes group was not motivated enough for it in that time. Since the adaptations are responses directly related to the training process [9], it's expected that chronically the changing on the daily training program may influence on the athletes adaptations [8]. To facilitate the understanding of the adaptations occurred in athletes, is necessary to record exactly what was in fact trained by the athletes during the training session [8, 10].

Brink et al [7] monitored the training load practiced by soccer players during a training period using a recording method. This method consists in recording in minutes all time spend to practice the exercises of the training day and also the eventually matches. These authors were interested in analyzing the relation of injury and the training volume and the recording of the training load helped to identify a high likelihood risk of injury due the high training volume noticed. However, for a greater understanding of the training load response, other aspects should be taken on account. Szmuchroswki and Couto [8] proposed the training load should be recorded under three indicators: *magnitude*, *structure* and *dynamic*.

The *magnitude* represents the time spent to perform a unique type of exercise or a group of similar exercises. This recording may help to identify how much time the athletes spent by training a determined exercise along a macrocycle, mesocycle or microcycle [8]. The *structure* represents the order in which a determined exercise or a group of similar exercises was utilized along the cycles of training [8]. Since the order of the exercise can influence the adaptive response, the analyzes of the *structure* is very important [11]. The indicator *dynamic* represents a perspective that evidence when an exercise stopped to be practiced [8]. To access this analyze, is necessary to record the date and the *magnitude* in what an exercise was practiced [8]. These three indicators are very important for the planning, and need to be duly recorded and noted [8].

Pedrosa et al. [12] aiming to contribute for the judo training planning and also for the training record, elaborated a catalog with seventy six judo training means. These exercises were divided in three groups: general, special and specific training means according to the level of specificity. Exercises which reproduce the pattern of movement and the physical demand required during a judo combat were classified as specific. Exercises which reproduce only the pattern of movement but not the physical demand of a judo combat were classified as special and the exercises that not reproduce the judo movement and the judo demand were classified as general training means.

This catalogue can be used as a tool of reference to record the exercises performed during the judo training program [12]. As the exercises are numerically coded, the insertion of the exercise code on a training sheet, such the one designed by Kalina [13], could be an alternative for the training recording process. Thus, the objective of this study was to record the exercises and the time spent to each exercise performed during fourteen judo training sessions and analyze the indicators of *magnitude*, *structure* and *dynamic* of the exercises practiced during the fourteen training days.

Material and methods

This study was approved by the Ethic Committee of the Federal University of Minas Gerais, under the number 26568314.3.0000.5149 and all volunteers were informed about the methods, risks and benefits and all gave written consent to participate in this research.

The recording method adopted in this study is presented in Szmuchrowski and Couto [8] when both researches contextualized the training system named Planning, Recording and Analyzes of Sports Training Load (PRACTE).

Fourteen judo training session, corresponding to two microcyles of training (accumulation) were entirely video recorded by camera (Sony®, Digital HDR – XR150, United States). This microcycles are at the

initial period of a mesocycle of training (preparatory). However, only the first fourteen days were recorded. The judo team was formed by twenty fighters and four staff members. The characteristics of the fighters and the staff members are present in Table 1. The training session occurred in an appropriate place to develop judo (mat area) and the researchers of this study have no influence on the training program. The training programs were previously elaborated by the staff members and the training days started on Monday and went straight the following days (excepted on weekends). The camera was placed at the corner of the mat and all exercises were recorded in high definition. The training session lasted around 150 min per day.

After each training session, one of the researches watched the video recorded and through the software

Table 1. Judo team characteristics

Athletes			
Age (years)	Time of experience (years)	Weight (kg)	Height (cm)
18 (±4)	3 (±2)	60 (±8)	172 (±10)
Staff members			
Function	Time of coaching (years)	Title as coach	Graduation in judo
Main Coach	12	Pan-American	Black Belt
Secondary Coach	8	Brazilian	Black Belt
Physical trainer	-	-	Brown Belt
Cooperator	5	State	Black Belt

Table 2. Transcriptions of the codes

Code	Transcription
7	Aerobic running. e.g. Running on treadmill.
9	Warm up exercise. e.g. Jogging.
12	Competitive recreational activities. e.g. Captor flag and dodge ball.
13	Circuit exercises for the general motor skills development.
14	Sprints running. e.g. running very intense short distances.
15	Classics weight exercises. e.g: Bench press, squat and rows.
17	Strength resistance exercise to improve gripping.
45	Tandoku-renshu.
48	Exercises aiming improvement of the submission technique
49	Static *uchi-komi*. e.g. Performing *uchi-komi* statically.
51	Exercises to improve time decision making and time reaction in a fight.
52	Linear *uchi-komi.*
53	*Ukemi* exercise. e.g. Front rolling and back rolling.
54	Exercises to develop *Fusegi.*
55	Uchi-komi on ground. e.g. On ground, performing *uchi-komi* for any *ne-waza*.
65	*Uchi-komi* performed in free direction
67	Exercises aiming the technique of *kaeshi-waza. Tori* applies a blow against *uke* who defends and applies a counterblow.
69	*Renraku-henka-waza.* Sucessive technique blows application.
70	*Randori* on ground.
71	*Nage-komi.* e.g. Successive throws.
73	*Randori* without blows, aiming of *kumi-kata* supremacy.
74	*Randori.* e.g. fight.
76	*Tokui-waza*.

Note: Codes from the catalog of judo training means elaborated by Pedrosa et al. [12]

Handycam® Camcorder (Sony, United States), the time spent to each exercise (including the resting time between sets) were calculated and noted in a spreadsheet (Microsoft Excel, 2010). The exercises from the catalogue of training means developed by Pedrosa et al. (12) have all a number code. The codes were typed on the same spreadsheet and whenever an exercise was performed, one of the researchers recorded the code (with the time spent).

To former graphically the indicator *magnitude*, the time spent to each exercise was summed along fourteen days. To former graphically the indicator *structure*, the order in which every exercise was executed and its respective duration (time spent) was registered daily in the spreadsheet. To former graphically the indicator *dynamic*, the exercises performed were registered according to the day of the training session.

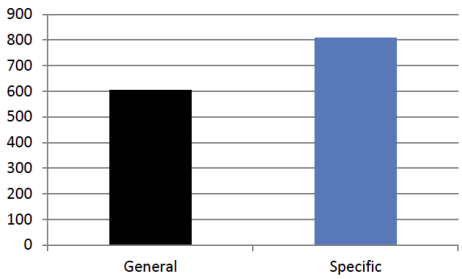
The indicator of *magnitude*, of each level of specificity (general, special and specific exercises) were also performed by the summed of time spent in exercise that belong the same specificity.

Results

The exercises are presented in code number. The transcription of each code can be found in Table 2. During fourteen training sessions none special exercise were used, only general or specific exercise were performed in this microcycle.

Magnitude

During the fourteen training session, 1.422 minutes (min) of exercises were performed. The *magnitude* for specificity demonstrated a higher predominance of time spent in specific exercises where the exercise code 74 was the exercise most performed. Figures 1 and 2 shows the *magnitude* for specificity and for each exercise respectively.

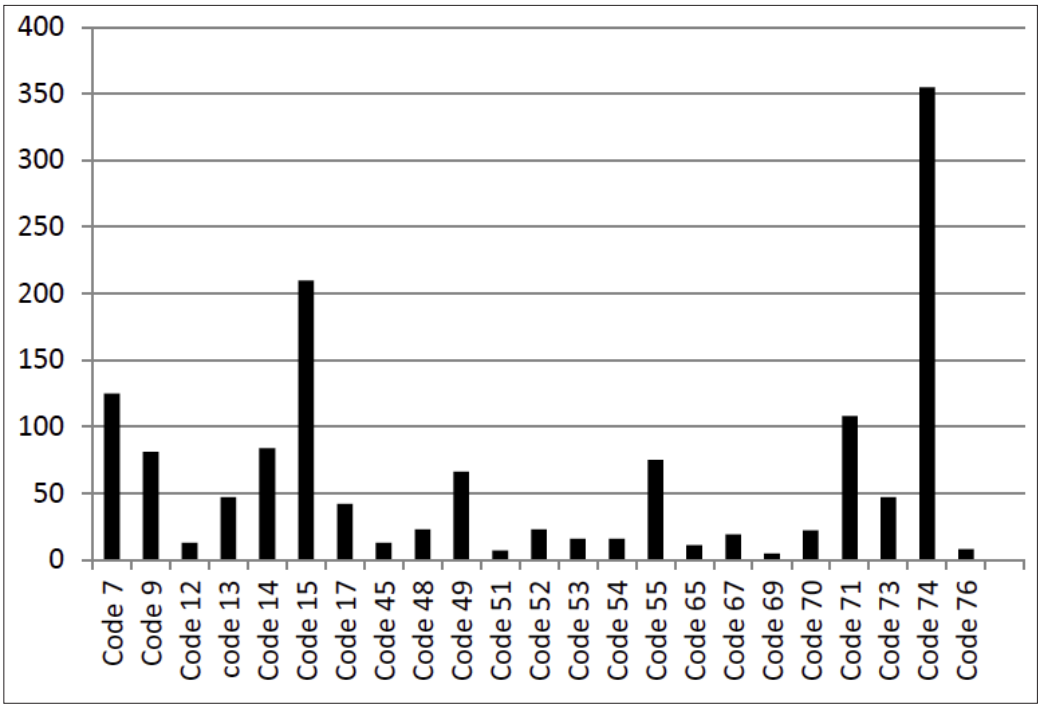


Note: 606 min for general exercises x 816 min for specific exercises

Figure 1. Magnitude per specificity in minutes

Structure

The *structure* for specificity revealed that always a general exercise starts the training session and a specific exercise was always performed as the last



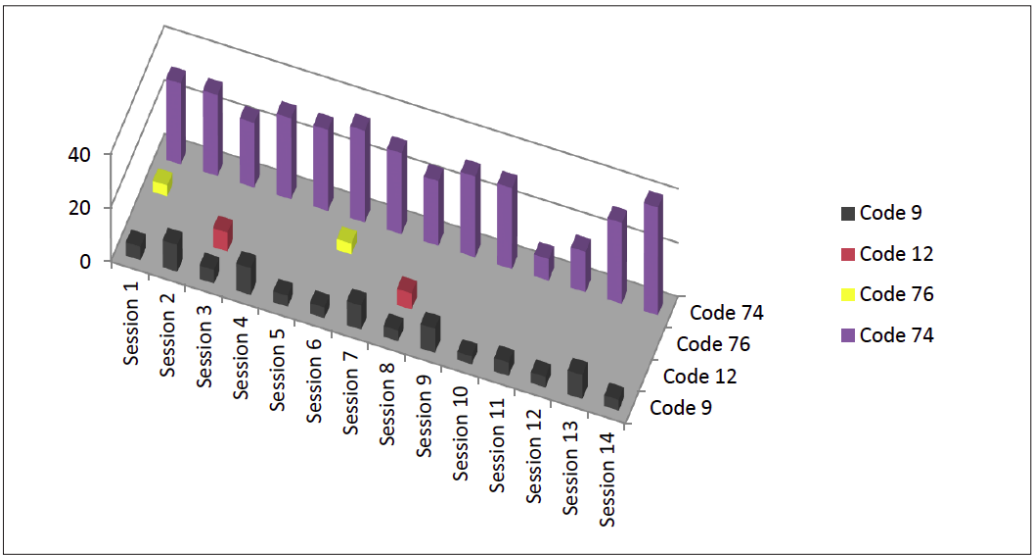
Note: Minutes spent in each exercise. The transcriptions of the codes are presented in Table 2

Figure 2. Magnitude of each exercise along fourteen training sessions

Table 3. Structure of the exercises during the training sessions

Session number	Order of how the exercises were performed (1-12) – Recording according to the code proposed by Pedrosa et al. [12]											
	1	2	3	4	5	6	7	8	9	10	11	12
1	9	15	14	17	49	45	73	71	74	76		
2	9	7	55	48	54	71	70	74				
3	9	17	30	12	14	53	73	71	74			
4	9	7	55	48	54	71	70	74				
5	9	17	15	14	13	53	51	52	73	74		
6	9	14	15	17	49	45	71	73	74	76		
7	9	7	48	54	71	70	74					
8	9	12	17	15	12	53	73	71	74			
9	9	7	48	55	54	70	71	74				
10	9	13	15	14	17	54	51	52	67	65	73	74
11	9	49	69	71	74							
12	9	17	15	14	13	45	52	73	71	70	74	
13	9	7	48	55	54	71	70	74				
14	9	17	15	14	49	45	71	74				

Note: The transcriptions of the cods are shown in Table 2



Note: The transcriptions of the four codes are present in Table 2
Figure 3. Dynamic of the five exercises during fourteen training sessions

exercise of the day training. The *structure* for exercise shows that exercises code 9 and code 74, most of time, started and finished the training sessions respectively. Table 3 presents the *structure*.

Dynamic

The *dynamic* for specificity revealed that in all training sessions a general and specific exercise was performed, however none special exercise was performed during the fourteen sessions. The Dynamic for exercise shows that exercises code 12 and 76 were practiced only two times and the exercises code 9 and 74 were performed in all training sessions but the amount of time performed on the exercise code 74 was greater than any other exercise. The *dynamic* of four exercises (codes 12, 76, 9 and 74) is shown in Figure 3.

Discussion

The objective of this study was to record the exercises performed during fourteen days and show the

indicators *magnitude, structure* and *dynamic* of these exercises.

During the fourteen days training, none special exercise was performed by the judo fighters. According to Baker [14] and Nunez et al. [15] special exercises are more used when competition is approaching. As we recorded only the first fourteen days of periodization, maybe if we had continuing recording, the special exercises should be recorded. Tota et al. [10] recorded the exercises performed by mixed martial arts fighters during ten microcycles. At the beginning of the periodization, short time was spent for special exercises in comparison with the end of the periodization, leaving no doubt those special exercises are more important from the middle to the end of the periodization.

The total time spent for training during the fourteen days was 1.422 min. Every training session lasted 150 min. Thus, it would be expected to record 2.100 min of training. However, 678 min was spent to explain the exercises, water time and for extra resting between the exercises. The judo team that participated in this study is formed majoritarian by judoist with less than 3-4 years of experience. This fact may impose to trainers spend more time in resting to avoid injuries.

The catalogue of training means elaborated by Pedrosa et al. [12] was very accurate once all exercises performed during the recording phase could be located in the catalogue. The indicator *magnitude* showed that specific exercises were more performed than general exercises during the fourteen days. The construction of the training planning was conducted by the staff members of the judo team and they divided the training session into two phases: the first one aimed to develop the physical fitness and the second one aimed to develop specific aspects related to the judo fight with prevalence in time to the second phase. As this judo team is not formed by professional athletes and the judo requires many different specific skills [16-18], perhaps the short time (150 min per day) of daily training obligate the coach to train more specific demands even at the beginning of the periodization.

The *magnitude* also revealed that exercise code 74 (*randori*) is the exercise most performed along the fourteen days. *randori* is considered by experts as one of the most important exercise of judo training [12] once it symbolize a competition between two fighters [19].

The *structure* presented in Table 3 shows that the training session always started with a general exercise. This exercise in question was the code 9 (warming up). According to Smith [20] the warm up is an important mean to prevent injury and increase the performance of the athletes during the training session. The *structure* has also demonstrated the exercise code 74 (*randori*) was always practiced at the end of all training day with two exceptions (session 1 and session 6). As mentioned earlier, the *randori* is a very important exercise for judo, however, maybe the performance of fighters during the *randori* may have suffer influence of the fatigue accumulated earlier through the exercises performed before. As the order of exercises may influence the performance acute and also the chronically adaptations [11], perhaps should be more interesting perform the *randori* at the beginning of the training session sometimes with the fighters less fatigued.

What refers to the *dynamic*, Figure 3 shows the exercises code 12 (ludic warming up) and 76 (*tokui waza*) were practiced only two times and the exercises code 9 (warming-up) and 74 (*randori*) were practiced in all training sessions. As the trainer have only 150 min to train daily and ludic warm-up may consume long time for playing, maybe this is the reason that why this exercise was not more explored. The *tokui -waza* is related to the practice of the *toris´*best technique [12], and it is more recommended for experienced fighters and some judoist in this study are still on formation. On the other hand the warming-up and *randori* was present in all training sessions due they importance in preparing the training session [20] and the development of specific demand required for judo [19] respectively.

Conclusion

The recording of fourteen training days, permitted the analyzes of the *magnitude, structure* and *dynamic* of exercises performed. This process can be very utilized by coaches to prevent injuries and to achieve better results. We strongly recommend the recording and the analyzes of *magnitude, structure* and *dynamic* of the entire periodization.

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Correlation analysis between Special Judo Fitness Test and Uchikomi Shuttle Run Rest

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Abstract

Background and Study Aim. Since 1995 (Sterkowicz), Special Judo Fitness Test (SJFT) has been validated and is widely used in order to measure Judo competitors' Judo specific stamina. The purpose of this study was the knowledge about the correlation between the SJFT and the USRT (Uchikomi Shuttle Run Test that integrates Judo specific movements into shuttle run test) in order to seek for a possibility to employ the method practically at physical education class settings in Japan for examining Judo specific abilities.

Material and Methods. Eighteen Judo competitors (means and SD: age = 20.3±1.2; height: 171.6±6.2cm; weight: 76.2±12.2kg) volunteered to complete both the SJFT and USRT. We specifically measured frequencies of the USRT and calculated the indices for SJFT. The USRT involves a 10m interval with one uke and another uke. First, a tori sets in the middle of the interval and reach to lift one uke and another, respectively and repeatedly (the tori has to ippon seoi nage, at least lift the uke). A tori attempts to accurately synchronize the beep sounds that starts at the speed of 17km per hour and increases 1km per hour in thirty seconds. A point the tori fails to follow the beeping tempo is the end. We counted the frequencies that the tori did ippon seoi nages within the time.

Results. Pearson correlation analysis revealed that the frequencies of USRT were significantly associated with the index of SJFT ($r = -0.56$; $p = 0.015$).

Conclusions. The results indicated that the USRT is a possible measure that can evaluate a combined abilities of physical education students' Judo specific and general endurance capacities.

Keywords: performance test • science of martal arts • training

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Introduction

Judo competitions are the best opportunity to evaluate multidimensional athletic performance such as technical, tactical, motor, psychological and theoretical aspects [1]. Previously, Sogabe A, Maehara K, Yamasaki S. [2] examined the composite time of each game element such as tachiwaza, newaza, and mate, when Japanese national judo athletes were in the selection. The researchers found the average duration of competition for male was 5 minutes and 20 seconds (SD = ± 2 minutes 47 seconds), and in turn, considering the case until championship stage, an athlete possibly compete 5 or 6 competitions, which indicates that the athlete compete ranges from 26 minutes 40 seconds to 32 minutes per day. In addition, they reported the average frequency for waits (mate) was 8.67 times (SD = ±5.64 times) as well as the average duration for waits (mate) was 9.09 seconds (SD = 4.67 seconds). If simply calculated the average timing in acquiring waits (mate) by using the total competition durations, an athlete acquire a wait (mate) per 30.9 seconds for 9.09 seconds by some reasons (e.g., giving a point, instruction, and warning). Thus, as is often the case with judo competitions, 5 or 6 times of intermittent exercise occur and in turn, judo athletes perform multiple offensive and defensive techniques such as kumite, tachiwaza, and newaza continuously for approximately 30 seconds. Taking the uniqueness into account, Sterkowicz introduced Special Judo Fitness Test (SJFT) in 1995 as a unique performance evaluation procedure for judo athletes. The measurement consists of nagekomi and 6 meters dash, which are evaluated in frequencies of nagekomi and heart rates which are both immediate and 1 minute later. As a result, SJFT index is calculated as a standard (a small index indicates better performance) [3]. The SJFT is currently prevailed as a useful and reliable measurement method for judo specific athletic abilities all over the world [4].

In Japan, on the other hand, running ability based evaluation methods such as 400 sprint [5,6] and 800 meter run [6], 20 meter shuttle run test [7], were used for measuring judo athletes' physical abilities, which judo specific exercises and skills are not specifically included. Nevertheless, majority of Japanese adolescent students have experienced the 20 meter shuttle run test since the Japanese ministry of education recommends physical education teachers to evaluate students' overall physical endurance. Moreover, the Japanese ministry of education made budo compulsory at junior high schools in 2012. Responding to the order, many junior high schools choose to teach judo, which raises many cases that junior high school students are first being exposed to practice judo at the age. Therefore, we proposed an easy and safe alternative evaluation method namely Uchikomi Shuttle Run Test (USRT) that combines uchikomi and the 20 meters shuttle run test. We carefully selected uchikomi component because novice judo students are assumed not necessarily to be skilled at ukemi, so uchikomi is more protective against injuries at physical education classes. The current study hypothesizes that the frequencies of USRT are negatively correlated to the SJFT index.

Material and Method

Participants

Eighteen Judo competitors (means and SD: age = 20.3±1.2years; height: 171.6±6.2cm; weight: 76.2±12.2kg, judo history; 11.0±1.2years) volunteered to complete both the SJFT and USRT at two different dates because of a consideration for their fatigue. The criterion for inclusion into the study group was previous participation in tournament bouts and no injuries/ body damages that would limit normal performance of judo exercises.

The study protocol was approved by the Human Ethics Committee of Konan University (No.14-14). Prior to participation, the risks and benefits of the study were thoroughly explained to all participants and written informed consent was subsequently obtained.

Special Judo Fitness Test

Special judo fitness test was carried out following the standardized warm-up procedure according to the instruction described by Franchini et al. [8]. The cards of individual experiments contained the number of throws performed within the 15-second segment A, 30-second segment B, and 30-second segment C. Duration of the rests between the segments was 10 s. The measurements of a minute heart rate (bpm) were recorded directly after the exercise and after a 1-minute rest using a heart rate monitor (Polar, RS800CX, Finland).

The SJFT index was calculated according to the following formula:

$$\text{SJFT Index} = \frac{\text{Final HR (bpm)} + \text{HR 1 min (bpm)}}{\text{Throws in total (N)}}$$

where:

Final HR – heart rate recorded immediately after the test.
HR1 min – heart rate obtained 1 minute after test.
Throws – number of throws completed during the test.

Lower index represented better results.

Furthermore, the participants answered to the question of the similarity between the effort perceived in the SJFT and during real competition. They used a 5-point forced-choice scale (1 minimum; 5 maximum).

Uchikomi Shuttle Run Test

The USRT involves a 10m interval with one uke and another uke. First, a tori sets in the middle of the interval and reach to lift one uke and another, respectively and repeatedly (the tori has to ippon seoi nage, at least lift the uke) (Figure 1). A tori attempts to accurately synchronize the beep sounds that starts at the speed of 17km per hour and increases 1km per hour in thirty seconds. A point the tori fails to follow the beeping tempo is the end. We counted the frequencies that the tori did ippon seoi nages (in uchikomi form) within the time (Figure 2). The measurements of a minute heart rate (bpm) were recorded directly after the exercise and after a 1-minute rest using a heart rate monitor (Polar, RS800CX, Finland). Furthermore, the participants answered to the question of the similarity between the effort perceived in the USRT and during real competition. They used a 5-point forced-choice scale (1 minimum; 5 maximum).

Statistics

First, means and standard deviations for each variable were computed. In order to test the main hypothesis for this study (i.e. the frequencies of USRT are negatively correlated to the SJFT index), a Pearson product-moment correlation analysis was conducted. Lastly, a paired sampled T Test was conducted to evaluate participants' perceived exertion for both USRT and SJFT.

Results

Descriptive statistics for all the variables were shown in Tables 1 and 2. Pearson product-moment correlation analysis was used to determine a significant correlation between USRT and SJFT. As hypothesized, the frequencies of USRT were negatively and significantly associated with the indices of SJFT ($r = -0.56$; $p = 0.015$; two-tailed). Next, a paired sampled T Test was conducted to examine if the participants' perceived exertion are significantly different or identical. As a result, the participants' perceived exertion on USRT ($M = 3.11$) and SJFT ($M = 3.00$) were not significantly different ($t = 0.316$, $df = 17$, $p = 0.756$ two-tailed).

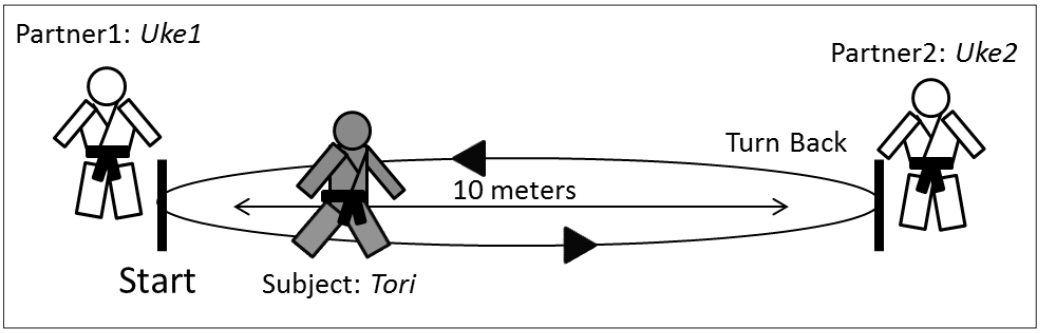

Figure 1. Method of The USRT

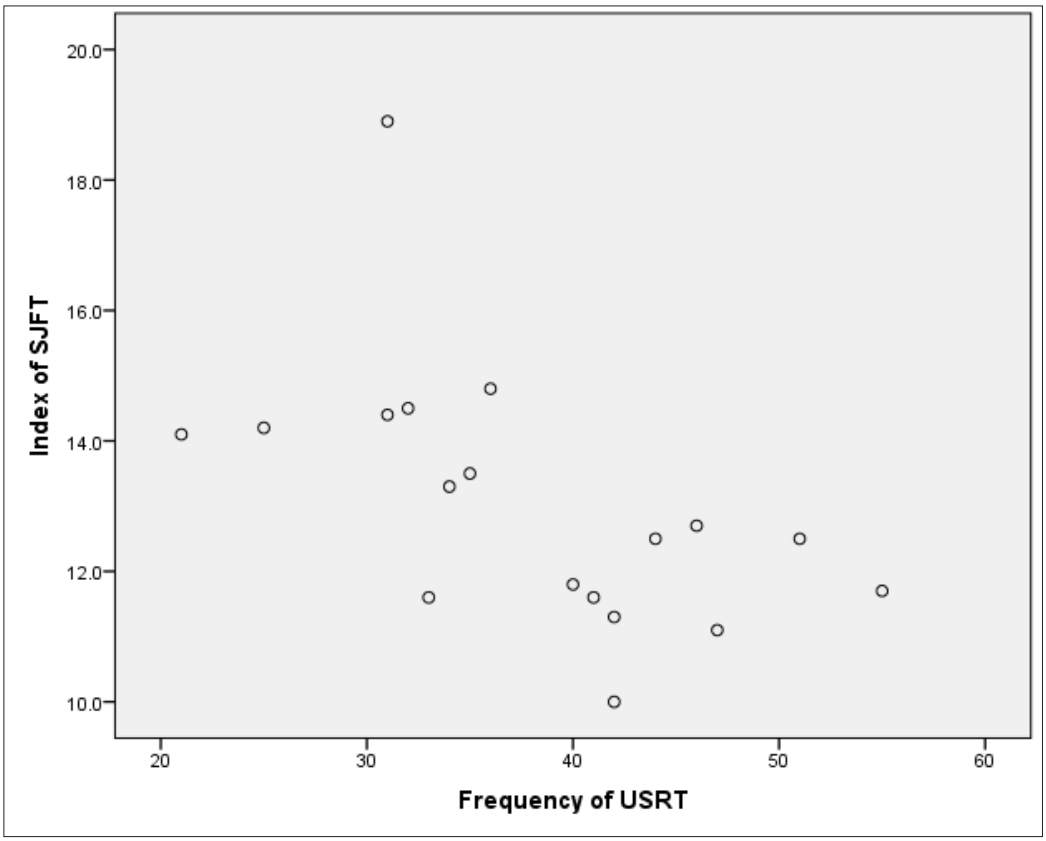

Figure 2. Scatter plot of the Index of SJFT and Frequency of USRT

Table 1. Mean and Standard deviation of the SJFT

SJFT	A	B	C	Total	HR immediately	1HR 1minute	index	Rating of Perceived Exertion
Mean	5.8	10.6	9.7	26.1	180.6	151.7	13.0	3.0
SD	0.9	1.7	1.5	3.9	7.0	12.3	2.0	0.9

Table 2. Mean and Standard deviation of the USRT

USRT	Number	HR immediately	1HR 1minute	Rating of Perceived Exertion
Mean	38.1	182.1	145.0	3.1
SD	8.8	7.1	16.2	1.1

Discussion

The purpose of this study was to evaluate the USRT and examine the relationship between USRT and SJFT. Results revealed that the frequencies of USRT and the indices of SJFT were significantly and negatively correlated and deemed participants' perceived exertion on both USRT and SJFT fell in the similar spot. Additionally, significant correlations between pairs of testing dimensions were found: Number of Throws performed during SJFT and Number of Throws performed during USRT ($r = 0.62$, $p=0.007$), Final HR (bpm) in SJFT and Final HR (bpm) in USRT ($r=0.67$, $p=0.002$), HR 1 min (bpm) SJFT and HR 1 min (bpm) USRT ($r=0.79$, $p<0.001$).

Moreover, participants' immediate HRs from both USRT and SJFT did not differ, which indicates an equivalence of exercise level from these two evaluation methods. Taken together, the results support our proposed evaluation method can be useful to measure judo athletic abilities

A uniqueness of judo competition is that judo athletes repeat both aerobic such as trials of nage waza and kumite and anaerobic exercise of continuous body movements in 5 minutes (the length of judo competitions) [2]. Because judo requires both aerobic and anaerobic exercises, evaluation method should be adequate to measure the complex of judo performance. Although 20 meter shuttle run test [7] was designed to evaluate individuals' aerobic ability and Wingate Anaerobic Test (WAnT) [9] was designed to measure individuals' anaerobic abilities, both evaluation methods are independent and were not designed to capture both individuals' aerobic and anaerobic abilities at a time. Moreover, laboratorial evaluation methods in aerobic, anaerobic, lactate, and VO2 max levels are not practical for judo instructors and teachers. Therefore, this proposed method i.e., USRT can be useful for teachers at schools because they do not necessarily possess devices such as heart rate monitors and pedometers.

Our intention was to propose a reliable non-device dependent judo specific athletic ability evaluation method. One existing reliable evaluation method to measure judo specific athletic ability is the SJFT [3]. Previous research demonstrated that the results of SJFT were frequently and significantly associated with judo performance because the SJFT can capture an essential metabolic element that judo athletes need [10]. However, previous studies [11, 12] reported the WAnT were not consistently associated with the SJFT which can be a significant judo performance indicator. This inconsistency probably make sense because the WAnT does not cover the aerobic facet. On the other hand, 20 meter shuttle run test could be a consistent predictor of judo performance. According to the report that examined 20 meter shuttle run abilities of Japanese woman judo national team, those who were in 48 kg – 70 kg demonstrated higher frequencies (100 ± 5.4 times) of the test than the average frequencies (88 times) on the list of evaluation among the population in Japan [13]. Nevertheless, this 20 meter shuttle run test might not be an adequate evaluation method since it does not consider judo specific athletic abilities which might be necessary to add anaerobic aspect. In that regard, this proposed USRT covers both aerobic and anaerobic components to be evaluated, which might predict individuals' judo performance closer than simply evaluating the results of WAnT and/or 20 meter shuttle run test.

Despite these findings, this study has some limitations. First, the sample was restricted to a small college student sample. Future researchers should employ more diverse and larger population in order to support this USRT as a reliable evaluation method. Second, more studies are needed employing test-retest procedure, which can add more reliability of the USRT. Lastly, measuring more judo performance related variables and examining their associations with the USRT will provide further evidence. Future researchers should consider these criteria of limitation.

Conclusions

Overall results suggested the USRT can be a substitute of SJFT. Thus, the USRT which does not require any biomarker device, can be useful for physical education classes at schools and judo novices in order to test judo specific athletic abilities.

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Effect of muscle torques ratios and age category on judo fight

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Abstract

Background and Study Aim. The review of the studies that have examined fitness preparation of judokas shows that both dynamic and static strength testing protocols have been in use in judo. Therefore, it can be assumed that strength is an important component of athletes' motor preparation. The principal aim of the present study was to find proportions between relative muscle torques at each stage of athletes' development.

Material and Methods. The examinations involved e.g. biometric measurements (BH – body height,BM – body mass) and evaluation of body composition (LBM – lean body mass, FM – fat mass, PF – percentage fat content [12]. Body height was measured with Martin type anthropometer.

Results. The authors found that the ratios of relative muscle torques that define the position of the elbow, arm and trunk joints correlated with age of the judokas. We also observed a specificity of the judo fight and demonstrated the differences in the level of the indices of activity and effectiveness of attack depending on the age category. Ratios of the muscle torques measured under static conditions correlated with the indices of the course of the fight to different extent and they were in correlation with the age category. The level of achievement in judo tournaments in junior and cadet categories correlated mainly with the ratio of muscle torques in knee extensors to flexors. Lean body mass was calculated by deducting fat mass.

Conclusions. The obtained information might help coaches modify strength training regimes in cadet judokas in order to match model levels of ratios of relative muscle torques observed in seniors under static conditions. Biomechanical characteristics of professional athletes might be of importance to both coaches and scientists in the field of robotics.

Keywords: age • kinesiology • torque • martial arts

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Introduction

The review of the studies that have examined fitness preparation of judokas shows that both dynamic and static strength testing protocols have been in use in judo [1]. Therefore, it can be assumed that strength is an important component of athletes' motor preparation. Most previous studies [see review in reference 2] have used static handgrip test because handgrip is a key factor in transfer of forces to the opponent's body when performing throwing techniques or blocking these techniques. However, no correlations have been found to date between the level of achievement and static strength in the hand [2]. It was demonstrated that topography of muscle torques measured under static conditions correlated with the preferred technique used during the fight (hand or foot and leg techniques) [3].

A comprehensive diagnosis of judokas [4], which included testing of physical capacity, found the relationship between the athletes' age and the static strength in handgrip tests, arms and back. In cadets, total value of static strength was higher than in the untrained peers but it was significantly lower compared to juniors and seniors who were similar in these terms. In reference [4] no results relative to body mass were presented, which is particularly important since these athletes are divided into weight categories. Differences between the values of relative muscle torques measured under static conditions in judo cadets compared to the untrained peers were presented in e.g. reference [5]. It was observed that the frequency and effectiveness of technical and tactical actions that affect the score in the judo fight depend on weight category [6] and sports level [7,8]. Level of indices which characterize the course of cadets' fight correlated with physical capacity [9]. Although these findings seem to be significant for theoretical fundamentals of training, seeking correlations between the indices that characterize the course of the judo fight and ratios of relative static muscle torques might be even more interesting as they might determine the level of achievement of an athlete in a particular tournament [5]. Knowing these proportions might not only improve the course of the fight but they also help prevent knee joint injuries [10], which are a common occurrence in judokas, who are particularly exposed to sprains [11].

The principal aim of the present study was to find proportions between relative muscle torques at each stage of athletes' development and provide answers to the following questions:

Are there differences in ratios of relative muscle torques between athletes from different age groups?

Are there relationships in individual age groups between the ratios of relative muscle torques and the fighting method and between these ratios and the level of achievement?

Material and Methods

The experiment meets the requirements with the 2008 revision of the Helsinki Declaration on the Experimental setup and procedures for the use of human subjects in research. The athletes and their legal guardians were also informed about the benefits of obtaining the results of examinations and limited risk during performance of non-invasive tests in the laboratory. The coaches expressed their interest in the experiment and agreed for participation of the athletes. The examinations involved e.g. biometric measurements (BH – body height, BM – body mass) and evaluation of body composition (LBM – lean body mass, FM – fat mass, PF – percentage fat content [12]. Body height was measured with Martin type anthropometer with accuracy of 1 mm, whereas body mass was evaluated by means of Sartorius F 1505 – DZA scales (Germany) with the accuracy of 1 g. Lean body mass was calculated by deducting fat mass from

Table 1. Characteristics of chronological age and training experience and basic indices of somatic build in study participants (mean, min, max, SD).

	Seniors (n=9)		Juniors (n=10)		Cadets (n=8)	
	$\bar{x} \pm$ SD	min-max	$\bar{x} \pm$ SD	min-max	$\bar{x} \pm$ SD	min-max
Age (years)	21.9± 0.99	20-24	17.4±0.73	16-18	15.4±0.55	15-16
Experience (years)	12.6±1.76	10-14	8.5±1.18	8-11	6.0±0.81	4-7
Body Height (cm)	180.2±5.39	171-188	180.5±3.70	172-185	177.1±6.25	170-186
Body Mass (kg)	82.9±6.62	71.0-92.1	85.4±10.45	72.1-101.1	71.6±7.50	56.4-82.0
Lean Body Mass (kg)	74.1±6.20	65.6-82.5	72.3±5.49	64.6-78.9	65.3±6.25	52.2-73.0

Table 2. Characteristics of standard measurement positions for maximal muscle torques [5].

Measured Muscle Group (Fmax)	Measurement Position	Angles in Joints Between Adjacent Segments		
SF & SE	Standing	Shoulder joint – 0°	Elbow joint – 0°	Radiocarpal joint – 0°
EF & EE	Standing	Shoulder joint – 90° (flexion)	Elbow joint – 90° (flexion)	Radiocarpal joint – 0°
HF & HE	Lying on back	Hip joint – 90° (flexion)	Knee joint – 90° (flexion)	Talocrural joint – 0°
KF & KE	Standing	Hip joint – 90° (flexion)	Knee joint – 90° (flexion)	Talocrural joint – 0°
TF & TE	Standing	Hip joint – 90° (flexion)	Knee joint – 90° (flexion)	Talocrural joint – 0°

Fmax – maximal strength; F – flexors; E – extensors; S – shoulder joint; E – elbow joint; W –radiocarpal joint; H – hip joint; K – knee joint; TC – talocrural joint (0° means that a foot of the measured extremity was in neutral position, i.e. at right angle to the lower leg); T – trunk.

body mass. Percentage fat content was calculated according to the formula for white postpubescent boys and adult males [12]. This information was then used for evaluation of fat mass.

Table 1 presents the characteristics of chronological age, training experience and basic parameters of somatic build in 25 judo contestants. All of them were in the middle of their competitive season and had scored places from 1st to 5th in Polish National Tournaments.

Measurements of muscle strength in hip, knee, shoulder and elbow extensors and flexors for the left and right body sides were carried out in the Department of Biomechanics. Based on these measurements, the authors calculated muscle torques. Muscle force was recorded during isometric contraction in test stands in standard positions in consideration of the relative position of body segments (Table 2). Before maximum isometric contractions were performed, the subjects were immobilized in the test stand by means of special holding devices in order to prevent using the muscles other than those measured in the study and to ensure reliable measurement conditions.

The force was recorded in a measurement circuit which featured Hottinger strain gauges, an analogue/digital (A/D) card and a PC. Data were stored and analysed by means of an Analog Digital Acquisition (ADA) application, licensed for the Department of Biomechanics. Based on the values of registered forces, maximal muscle torques were obtained for the measured muscle groups according to the formula (1):

$$\text{Mmax} = \frac{F\,\max}{d} \qquad (1)$$

where: Mmax [N·m] – maximal muscle torque in the measured muscle group, Fmax [N] – maximal force developed during isometric contraction in the measured muscle group, d [m] – lever arm of external force (distance from biomechanical rotation axis in the joint to the line of dynamometer's operation).

Furthermore, relative values of developed muscle torques were calculated based on the formula (2):

$$\text{Mw} = \frac{M\,\max}{m} \qquad (2)$$

where: Mw [Nm•kg^{-1}] – relative muscle torque, m [kg] – body mass of a subject.

Dividing the relative values of muscle torques in extensors by the respective values of torques in flexors yielded ratios which characterize strength abilities in antagonistic pairs in lower extremities. In the case of upper extremities, relative values of muscle torques in flexors were divided by the respective values in extensors. This allowed for obtaining values over 1 in both cases, which reflects different topography of dominance of antagonistic muscle groups in lower and upper extremities.

Observations of the technical and tactical actions were carried out during sports competitions. Video analysis carried out in the Department of Theory and Methodology of Combat Sports (now Department of Theory of Sport and Kinesiology) consisted in calculation of the indices of the course of 175 fights (51 fights in senior group, 58 fights in junior group and 66 fights in cadet group). 373 technical actions which scored points for these contestants (3 to 10 points) and attacks without points (0 points) were recorded in total. Based on the collected data, indices which determine the activity and effectiveness of actions among

Table 3. Torque ratios in five main muscle groups in seniors, juniors and cadets (mean, min, max, SD)

	Senior (n=7)				Junior (n=10)				Cadet (n=8)				Significance of differences	
Ratios	$\bar{x}$	Min	Max	SD	$\bar{x}$	Min	Max	SD	$\bar{x}$	Min	Max	SD	test	p
EF/ EE	1.63	1.18	2.23	0.35	1.48	1.28	1.70	0.15	1.11	0.76	1.56	0.27	F=8.37	0.002
SF/ SE	0.99	0.71	1.48	0.30	1.50	1.08	1.89	0.30	1.32	0.84	1.60	0.24	F=7.08	0.004
TE/ TF	2.00	1.83	2.19	0.12	2.63	2.26	3.20	0.32	1.83	1.26	2.81	0.61	H= 11.85	0.003
KE/KF	2.67	2.18	3.58	0.61	2.40	2.05	3.33	0.38	2.25	1.87	2.96	0.38	H= 3.88	0.144
HE/HF	2.39	1.84	2.70	0.28	2.09	1.37	3.15	0.54	2.77	1.22	6.96	1.86	H=1.14	0.567

F – flexors; E – extensors; S – shoulder joint; E – elbow joint; H – hip joint; K – knee joint; T – trunk.

the study participants were calculated. Activity index (WA) was calculated from the formula (3):

$$WA=\frac{\Sigma A}{NW} \qquad (3)$$

where: ΣA is a total of the attacks, NW – is the number of fights the contestant fought. The activity index calculated for phase 1 was WA1, with WA2 for phase 2. Another index, RWA (difference in the activity index), was also calculated to reflect variability of activity during competition. It was calculated as follows (4):

$$RWA=WA1-WA2 \qquad (4)$$

The effectiveness index (WS) is an arithmetic mean of the notes for attacks (WS1 as calculated for phase 1 of the match and WS2 for the second phase) (5):

$$RWS=WS1-WS2 \qquad (5)$$

Level of sports achievement was differentiated according to the following point scale:

preliminary fights: 1st place 3 points, 2nd place 2 points, 3rd place 1 point, 5th place 0.5 points; and

central competition: 1st place - 7 points, 2nd 5 points, 3rd 3.5 points, 5th 1.5 points, and 7th 0.5 points.

The indices of the course of the fight were calculated for the first three minutes (1) in seniors and the first two minutes in juniors and cadets (1). If extra time was used, it was included in the phase 2 of the fight (2).

Statistica package software was employed for the analysis of the results. The descriptive statistics were calculated and the comparison was made between the groups of cadets, juniors and seniors. ANOVA (F) or non-parametric ANOVA Kruskal-Wallis test (H) for ranks was used, depending on the fulfilment of the condition of normal distribution by variables. Tukey's multiple comparison test was used where ANOVA F-values were significant. Spearman rank correlation coefficient (R) was also employed for the analysis. Statistical significance level was set at $p \leq 0.05$.

Results

a) Differences in torques across age group

Table 3 presents the descriptive statistics for the ratios of torques in five main muscle groups in seniors, juniors and cadets.

The results of comparison of mean torque ratios were statistically significant ($p<0.01$) for elbow joint, shoulder joint and body trunk. A characteristic pattern of means was observed in EF/EE ratio, where the advantage of flexors over extensors was the highest in seniors, medium in juniors and the lowest in cadets. Tukey's multiple comparison test demonstrated that cadets differed significantly from juniors ($p<0.05$) and seniors ($p<0.01$). The ratio of flexors and extensors of shoulder joint (SF/SE) in seniors was balanced (≈1.0), whereas distinct advantage of flexors was found in younger contestants. The difference between seniors and juniors was statistically significant ($p<0.01$). Mean muscle torque ratios in extensors and flexors differed statistically significantly ($p<0.01$) and were significantly higher in juniors compared to seniors ($p<0.001$). Juniors

Table 4. Indices of the course of the fights of seniors (S), juniors (J) and cadets (C) (mean, min-max, SD)

	Senior (n=7)				Junior (n=10)				Cadet (n=8)			
Ratio	$\bar{x}$	Min	Max	SD	$\bar{x}$	Min	Max	SD	$\bar{x}$	Min	Max	SD
WA	2.63	1.60	3.80	0.72	2.13	1.00	3.50	0.63	1.73	0.60	2.60	0.76
WA1	1.80	0.90	2.50	0.60	1.03	0.33	2.00	0.45	1.16	0.40	2.40	0.61
WA2	1.37	1.00	1.80	0.28	1.56	0.67	2.20	0.56	0.94	0.33	2.00	0.59
RWA	0.43	−0.70	1.00	0.67	−0.53	−1.67	0.49	0.73	0.22	−0.64	2.07	0.85
WS	2.84	1.64	4.77	1.00	3.42	2.42	6.83	1.37	4.51	3.26	6.25	1.05
WS1	3.10	0.00	5.86	1.77	4.04	2.17	7.00	2.02	5.25	3.29	8.50	1.76
WS2	2.11	0.00	3.50	1.24	3.24	0.75	6.75	2.06	2.96	0.00	7.00	2.71
RWS	1.00	−2.60	3.90	2.14	0.81	−3.19	6.25	2.95	2.30	−3.00	8.50	4.20
PO	4.00	0.00	14.00	5.07	3.30	1.00	6.00	1.51	2.88	0.00	9.00	3.01

also dominated in this respect compared to cadets ($p<0.05$). Nearly twice higher muscle torques were observed in extensors compared to flexors in knee and hip joints across all the three age categories. Intergroup differences were not statistically significant ($p>0.05$).

b) Indices of the course of judo fight in relation to muscle torques ratios

Table 4 presents the levels of indices characterizing the course of the judo fights fought during competitions by the athletes included in the study.

A strong rank correlation was observed in seniors between RWA and the ratios of muscle torques: TE/TF ($R=0.84$, $p<0.05$) and HE/HF ($R=0.72$, $p=0.07$, i.e. insignificant tendency). A strong positive correlation existed between the value of the effectiveness index in attack in the second part of the fight WS2 and SF/SE ratio ($R=0.75$, $p=0.05$). In juniors, the value of activity indices correlated moderately ($p<0.05$), either positively or negatively, within the following pairs: WA with TE/TF ratio ($R=-0.68$), WA1 with KE/KF ratio (0.64), WA2 with SF/SE ratio (−0.70). RWA depended on SF/SE ratio ($R=0.65$). Level of effectiveness index WS correlated negatively with EF/EE ratio (−0.64), WS2 with KE/KF ratio ($R=0.63$) and with RWS ($R=-0.64$).

In cadets, the effectiveness of attack (WS and WS1) showed strong correlation with EF/EE ratio (0.79 and 0.77, respectively, $p<0.05$).

Level of sports level (PO) in the group of seniors did not correlate with ratios of the measured muscle torques. The most numerous correlations between the muscle torque ratios and indices of the course of the fight were observed in the junior group. The rank of the sports level depended on the KE/KF ratio, with strong statistically significant correlation ($R=0.79$; $p<0.01$). In the group of cadets, correlation between the rank PO and KE/KF ratio was negative ($R=-0.74$).

Discussion

We previously stated that "Although judo contestants exhibit similar relative strength to untrained peers, many-year training causes that they demonstrate higher strength in the muscles which are active when pulling or lifting the opponent during performing throws. Antigravity muscles are capable of developing particularly high force in these persons and play an essential role when throws are performed." [5]. In this study we have verified how proportions of relative muscle torques measured in static conditions correlate to age and the course of the judo fight. The biomechanical approach to judo performances can be fruitful for both biomechanics specialists and judo coaches [13]. The results obtained in this study might be used in the practice of judo training, where the athletes must maintain balance and perform complex movements (throwing techniques in particular). They might also be of much interest to the scientists who investigate human-robot interactions and attempt to define the principles of robot construction in order to create even more perfect machines that utilize biological relationships observed in athletes (judokas). This empirical work is relevant for better understanding of the regularities in proportionality of torques across different age groups. It shows the relation between strength indices and performance level during the course of judo tournament fights. The

collected data might be used in construction of training aids and provide a model for the design and construction of the equipment based on biofeedback principles.

Conclusions

In conclusion, the value of muscle torque ratios which determine the position of the elbow, shoulder or trunk joints correlated with judoka age. The specific method of fighting was found for each age category, reflected by the differences in the level of activity indices and the effectiveness of attack. The level of achievement in judo tournaments in the categories of juniors and cadets depended mainly on muscle torque extensor/flexor ratio in knee joints. Further research should be conducted in the field of the effect of isokinetic strength on judo performance. Investigations of the relationships between the parameters characterizing the level of physical and tactical preparation in senior groups might be particularly valuable for the theory and practice of training.

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Correlation between the performance of taekwondo athletes in an Adapted Anaerobic Kick Test and Wingate Anaerobic Test

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Abstract

Background & Study Aim: To characterize the energy demands of taekwondo, researchers have verified the relevant contribution of anaerobic energy supply to athletes during fights. To evaluate anaerobic capacity, the Wingate Anaerobic Test (WAnT) was developed, which is based on the use of the lower limbs. For assessing anaerobic power using a more specific taekwondo technique, an adapted test was created, Adapted Anaerobic Kick Test (AAKT), which consists of a repeated execution of the kick technique *banda chagui*. A comparison between the results of these tests allows a verification of the validity of the utilization of WAnT as a task for assessing performances in taekwondo. The aim of this study was to correlate the results between WAnT and AAKT for the lower limbs.

Material and Methods: The study included 15 individuals (10 males and 5 females), all of them Brazilian taekwondo athletes from UFMG Sports Training Center (mean age 20.17 ± 1.89 years), mean body mass (63.82 ± 9.22 kg) and mean height (170.08 ± 9.87 cm).

Results: A significant correlation was founded in the comparison between the WAnT and AAKT results. It was founded a strong correlation between three parameters, the relative peak power and higher kick frequency, index fatigue WAnT and index fatigue AAKT, and relative average power and average kick frequency.

Conclusion: These findings identified the WAnT is appropriate for assessing peak anaerobic power and capacity of taekwondo competitors.

Key words: anaerobic • exercise • martial arts • sports performance

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Contributors: Leszek Antoni Szmuchrowski, Cristiano Arruda Gomes Flor, Bruno Pena Couto conceived the study design. Mariana Paulino Oliveira, Cristiano Arruda Gomes Flor, Bruno Pena Couto collected the data. Reginaldo Gonçalves, Bruno Pena Couto analysed the data. Mariana Paulino Oliveira, Leszek Antoni Szmuchrowski, Cristiano Arruda Gomes Flor, Reginaldo Gonçalves, Bruno Pena Couto prepared the manuscript. Leszek Antoni Szmuchrowski, Cristiano Arruda Gomes Flor, Reginaldo Gonçalves, Bruno Pena Couto secured the funding.

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Introduction

Taekwondo is a Korean martial art sport, became a full-medal sport at the 2000 Summer Olympics in Sydney and has been an Olympic sport since then [1]. The athletic performance in taekwondo may be determined by a competitor's technical, tactical, psychological, and physical characteristics. The actions in the sport are characterized by short durations, high intensity and require specific fast, high and spinning kicks [2]. Hence of this intermittent characteristic [3] the energy demands of taekwondo include the relevant contribution of both aerobic and anaerobic power. However is the anaerobic power the determinant fitness for the success in the fight [4].

The taekwondo championship matches are typically structured across three 2-min rounds with a 1-min interval separating each round [5]. Thus Taekwondo athletes repeatedly perform brief periods of high intense exercises, such as fighting attacks (1 to 5 seconds) alternate with periods of low intense exertion (non-fighting or pause). Consequently, in the fighting attacks the primary energy system is the phosphagen system. This system supplies energy for high-intensity exercises that last up to approximately 10 seconds in the form of adenosine triphosphate (ATP) and creatine phosphate (CP) [6]. In high-intensity exercises, such as kick, the most used technique in taekwondo competition draw a rapid decrease in the ability to generate power, possibly as a result of a depletion of PCr and an production of lactic acid [7].

Training effectiveness in sport is measured with the best possible performance in the most important competitions [8]. Therefore understand the specific characteristics of taekwondo is essential to develop an adequate training program and for choose the best methods for assessing fitness. In selection of the tasks of training evaluation, for a particular sport, the focus should be on those actions and abilities which have the most significant influence on sport performance [9], and on those which are predominantly under prevailing influence of energy demands [10].

The Wingate Anaerobic Test 30s (WAnt) constitutes the most common method of assessing peak anaerobic power and capacity of taekwondo competitors [4]. While this test assess the anaerobic power from the lower limbs, it is not a specific test to evaluate the physical condition of taekwondo athletes. Although, WAnt constitutes a universal method of assessing peak anaerobic power and capacity and it is the most used method for taekwondo competitors, the WAnt is done in a cycle ergometer and, consequently the technique used is very different for the specific technique required for taekwondo match. However, no studies have been compared the results from the WAnT to the results from a similar composition to WAnt, but with specific taekwondo gestures. Thus, the proposal of this study was to correlate the results between the WAnt test and Adapted Anaerobic Kick Test.

Material and methods

Subjects

The study included 15 individuals (10 males and 5 females), all of them Brazilian taekwondo athletes from UFMG Sports Training Center, mean age 20.17 ± 1.89 years, mean body mass (63.82 ± 9.22 kg) and mean height (170.08 ± 9.87 cm). All volunteers were aware of the procedures of the study and gave their consent for participation before undergoing the tests. The study was submitted to the Ethical Committee of the Federal University of Minas Gerais (Belo Horizonte, Brazil).

Procedures

In addition to measuring the anthropometric variables, the athletes performed the Adapted Anaerobic Kick Test (AAKT) and the Wingate Anaerobic Test (WAnT) for lower limbs. The tests were carried out at different meetings. At the first meeting, the volunteers performed the AAKT and at second meeting, the taekwondo athletes performed the WAnT for lower limbs.

Adapted Anaerobic kick Test (AAKT) Protocol

To perform the Anaerobic Kick Test, athletes were placed with the foot would kick standing on a contact mat. The volunteers were instructed to kick, with the preferred member, the taekwondo targe pad positioned at the height of the iliac crest of the individual as soon as possible, so they were allowed (Figure 1). The test was performed in 30 seconds with the highest possible frequency of *banda chagi* technique. The athletes were also instructed to perform the movement as quickly as possible and a verbal encouragement was given during the 30-second test. The first kick was done with the preferred member in the back. Starting from the second kick, the preferred member was positioned on a contact mat and forward throughout the remaining time of the test. A contact sensor was coupled in the target pad for measuring the kick time, which corresponded to the loss of contact of the kicking foot to the mat until contact with the targe pad.

Only kicks performed with the front leg were considered for the analysis, the parameters were: higher kick frequency (higher frequency of kicks performed

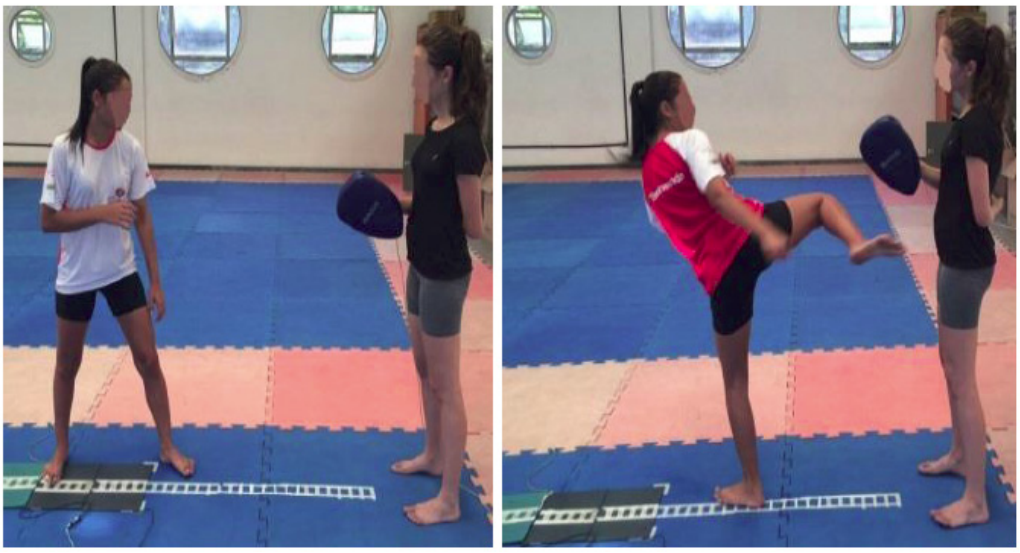

Figure 1. *Banda chagi* kick

during 3 seconds: kicks/s); lower kick frequency (lower frequency of kicks performed during 3 seconds: kicks/s); average kick frequency (average frequency of kicks performed during 30 seconds: kicks/s); fatigue index (percentage reduction of the maximum frequency kick to minimum frequency kick: %); time to higher kick frequency (time from start to the higher frequency of kicks performed during 3 seconds).

Wingate Anaerobic Test (WAnT) Protocol

Before beginning the WAnT for lower limbs, the athletes performed a specific warm up protocol. The Hidrofit Maxx cycle ergometer was utilised. The athletes executed a 2-minute warm up, and the test was executed in 30 seconds with the highest possible frequency of pedalling. In the warm up, the load utilised was 1.5% of the athlete's body mass. After the warm up, a 2-minute recovery interval was performed. After this interval, the athletes executed the WAnT for lower limbs with load fixed in 7.5% of the athlete's body mass for 30 seconds. The athletes were instructed to spin the cycle ergometer at the highest possible speed and a verbal encouragement was given during the 30-second test. The test data were obtained by a computer connected to the cycle ergometer with the MCE 5.1. Software (JBA Zb. Staniak, Poland). After the end of the test, the load was removed, and the volunteers continued to spin the cycle ergometer for 60 seconds more in a moderate rhythm.

Instrumentation

Contact mat fixed to the ground was used. There was one computer connected to mat and contact sensor, containing the Multisprint Full program version 3.5.7 (Hidrofit Ltda. Brazil). The mat used the AAKT was marked with the footage in centimeters between the mat positions and the place where the target pad would be positioned.

An armored inertial sensor was inside to a specific taekwondo target pad (Figure 2). The sensor, in its interior, has a mass in form of coil spring that in the moment of the feet contact with the target pad closed the electric circuit.

Statistical Analysis

Were performed data descriptive analysis and the results are presented in mean and standard deviation. To verify the normality of the data was performed the Shapiro-Wilk Test was realized. The correlation between the results of WAnt and the AAKT was done by the Pearson Correlation Coefficient. The significance level was 0.05. Statistical tests were performed on SPSS statistical package.

Results and discussion

All the analyzed data showed normal distribution according to Kolmogorov-Smirnov test. The Table 1 presents the mean values, and it respective standards deviations from the values obtained from AAKT and the Table 2 values obtained from WAnt.

Table 1. Mean and standard deviation of the variables from AAKT

Variable	Mean	SD
Higher Kick Frequency (kicks.s^{-1})	2.47	0.25
Lower Kick Frequency (kicks.s^{-1})	1.52	0.24
Average Kick Frequency (kicks.s^{-1})	2.09	0.25

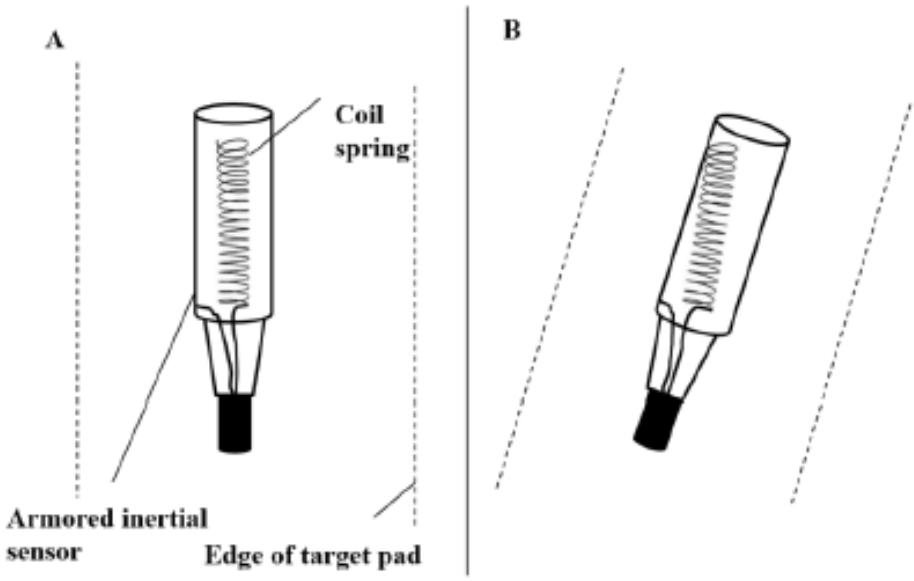

Figura 2: Coupled inertial sensor inside the target pad: (A) – before the kick contact; (B) – after the kick contact (closed eletronic circuit between the coil spring and the

Variable	Mean	SD
Time to Higher Kick Frequency (s)	3.751	0.888
Fatigue Index (%)	37.57	10.49

Table 2. Mean and standard deviation of the variables from Want

Variable	Mean	SD
Absolute Peak Power (W)	649.67	92.35
Relative Peak Power (W/Kg)	10.29	1.28
Time To Peak Power (s)	5.68	1.07
Index Fatigue (%)	37.32	9.30
Average Absolut Power. (W)	546.80	80.14
Relative Average Power (W/Kg)	8.80	0.92

A significant correlation between the results of AAKT and the results of WAnT for lower limbs was found (Table 3). A strong correlation was obtained between the relative peak power and higher frequency (r = 0.851), index fatigue in WAnT and AAKT (r = 0.863) and relative average power and average kick frequency (r = 0.865). A moderate correlation was obtained between the absolute peak power and higher frequency (r = 0.543). The only two low correlations were between the time to peak power and time to higher frequency (r = 0.307) and average absolut power and average frequency (r = 0.412).

The aim of the study was to correlate the results between the WAnT and AAKT. A significant correlation was founded in the comparison between the WAnT and AAKT results. It was founded a strong correlation between three parameters, the relative peak power and higher kick frequency, index fatigue WAnT and index fatigue AAKT, and relative average power and average kick frequency. These results indicate use of a non-specific test not compromised the assessing peak anaerobic power and capacity of taekwondo competitors. Thus, the WAnt is adequate for this purpose.

Table 3. Results on the Pearson's correlation coefficients of the variables of WAnt and Anaerobic Kick Test

Variables	r
Absolute Peak Power X Higher Kick Frequency	0.543
Relative Peak Power X Higher Kick Frequency	0.851
Time To Peak Power X Time To Higher Kick Frequency	0.307
Index Fatigue WAnT X Index Fatigue AAKT	0.863
Average Absolut Power X Average Kick Frequency	0.412
Relative Average Power X Average Kick Frequency	0.865

Szmuchrowski et al. [10] proposed a comparison between the lower and upper limb results between the WAnT and a judo specific test, Special Judo Fitness Test. These authors found no significant correlation between the results of WAnT for upper limbs and the results of WAnT for lower limbs and Special Judo Fitness Test indicators. They concluded WAnT most likely does not have enough specificity to adequately evaluate the anaerobic capacity in judokas. Despite, in the presente study the unique difference between the WAnt and the AAKT was the used exercise. In Szmuchrowski et al. [10] research, were two differences, the used exercise and the intermittent caractheristic of the Special Judo Fitness Test.

More studies are needed to investigate the results from WAnT to the results from anaerobic test that uses not only taekwondo techniques, such as kicks, but also induces changes in the intensity similar to a taekwondo combat. Based on these results, the parameters of the WAnt relativized by body mass demonstrated a high correlation with the results from the WAnt. The possible explanation of these finding is the WAnt was carried out in a cycle ergometer, so the body mass was relativized.

Conclusion

These findings identified the WAnT is appropriate for assessing peak anaerobic power and capacity of taekwondo competitors. As a final point, more studies are needed to compare the results from WAnT to results from anaerobic test that uses taekwondo techniques and induces changes in the intensity similar to a taekwondo combat [10].

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Flexibility measured by Fingertips-to-Floor test among groups practicing yoga, Brazilian jujitsu, tricking and tai chi in comparison to non-active group

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Abstract

Background & Study Aim: Flexibility is considered as significant component human physical activity, defined as ability to perform high amplitude movements conditioned by functional-anatomical factors. Paper aim is the knowledge about flexibility level among physically active people in comparison to sedimentary one and confirming the following hypothesises: the youngest one have better flexibility than the oldest in non-active group. Physical activity in which stretching techniques play an essential role, have positive influence on flexibility.

Material & methods: Ninety-six men between ages 22-69 were examined. Sixteen research objects were divided to four practicing groups; *tricking*, *Brazilian jujitsu*, *yoga*, *tai chi* and Non-active group consisting 80 people. As an evaluation method of the flexibility FTF (*Fingertips-to-Floor*) test was used before and after training in sequence of four consecutive weeks.

Results: In case of non-active people physical decrease of flexibility was noticed. The biggest decreasing values were observed between the youngest to the second test subject group and in case of the oldest group. In case of any physical activity group, improvement of flexibility was recorded after the training, which was the biggest in the *tai chi* group. Despite advanced age, the biggest difference in result occurred in *yoga* and *tai chi* to respect of non-active group.

Conclusion: The results of our experiment indicate that flexibility measured with FTF test demonstrate decreasing tendency with age. Physically active people have better flexibility. The biggest results are shown in *tai chi* and *yoga* group that corresponds with dominance of stretching practice.

Keywords: body elasticity • martial arts • non-apparatus test • physical activity • sport activity • stretching

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Contributors: Henryk Knapik conceived the study design. Henryk Knapik, Andrzej Szuszkiewicz, Szczepan D Mateja, Grzegorz Rzetecki, Agata Niewiadomska-Matuła collected the data. Henryk Knapik, Szczepan D Mateja, Grzegorz Rzetecki analysed the data. Henryk Knapik, Andrzej Szuszkiewicz, Szczepan D Mateja, Grzegorz Rzetecki prepared the manuscript. Henryk Knapik, Andrzej Szuszkiewicz secured the funding.

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Introduction

Flexibility (movement range in joints) is acknowledged as essential and important component of human physical activity. Being defined as ability to perform high amplitude movements and is conditioned by functional-anatomical factors. Movements range depends on shape articular surface, their distance from rotation axis, skeletal limitation, ligament elasticity along with joint capsule, length together with elasticity of tendons, as well as the antagonist muscles extending over particular joint. On flexibility also influence the excited state of central nervous system [1]. As well as in all sport disciplines, as in the martial art, crucial role play stretching exercises [5]. The aim of this study was to investigate the effect of practicing various forms of physical activity on flexibility, compared to those not engaged in any physical activity including sport disciplines and leading sedentary lifestyle.

The aim of the paper is to investigate flexibility level among physically active people in comparison to sedimentary one and confirming the following hypothesises: the youngest one have better flexibility than the oldest. Positive influence on flexibility play a significant role using stretching techniques in physical activity. The aim of the study is also to confirm the following hypotheses:

The youngest one have better flexibility than the oldest in non-active group.

Physical activity in which stretching techniques play an essential role, have positive influence on flexibility.

Material and Methods

The study consisted in using non-apparatus test (*Fingertips-to-floor test*) [1-4] which determines the mobility and flexibility entire spine as well as its individual segments, hip joints, ankle joint and mobility of the pelvis [1].

Participants

The research material was a group consisting 96 men in age range between 22 to 69 years old. The main object of study included four groups of people exercising; *tricking* (age; 22, 23, 23, 25), *Brazilian jujitsu* (age; 26, 28, 30, 34), *yoga* (age; 42, 47, 50, 57) and *tai chi* (age; 60, 65, 66, 69) in various ages, of 4 people in each group. Control group consisted of 80 individuals declaring themselves as non-active and leading a sedentary lifestyle was purposely selected in a way that 5 non-active individual of the same age were matched with one practitioner, since there are no standard values for that test and published data refers to people in age range from 18 up to 51 years without specifying the trend results correlated with age [1,4] Individuals were examined within four consecutive weeks, right before (Test 1) and after training (Test 2)

Inclusion criteria

At least three years of practice in the above-mentioned physical activity.

The exclusion criteria

In study groups – practice other types of physical activity (sports).

For all tested – surgical procedures in the spine and joints, spine and joints ailment furthermore lower limb muscle injuries in the last 6 months. In control group – practice of any regular physical activity.

The tests were carried out at the club “Gracie Barra” in Sosowiec, in the gym AWF Katowice, in the sport center “Bażantowo” and *Wing Chun Academy* in Cracow. The research was conducted from November 2014 to March 2015. Each training group was tested in four consecutive weeks.

FTF test is not only the most popular test evaluating flexibility, but also a clinical test for assessing inter alia bending of the spine, which is used in healthy individuals and patients.

This test consist of measuring the distance from the longest fingertip to the edge of the platform. The subject is standing on 30 cm high platform with feet joined together, then performs maximum down flexion with straight knees and is asked to touch the edge of the platform, where at the end of flexion measuring being done. The edge threshold corresponds to the level 0, results below that level were positive, and negative above it. [2, 3]

Results

Results presented in table and figure 1 shows that the values obtained in the test by non-active group in average age of 23.25 years are the highest and are 8.35 cm. In the next age group (29.5 years) test result shows the greatest tendency to decline by 6.9 cm. In the next age group decline is now only 2.5 cm. Further significant reduction in test results observed in individuals in the oldest age group (65 years), which is 4.10 cm reaching its lowest level –5.05 cm. Analyzing the results obtained by people

who practice different types of physical activity is stated by better results compared to those non-active. The smallest result difference exists between non-active and *tricking* trainees after training maximally amounts to 2.78 cm. In another group B that practices *Brazilian jujitsu* test results are higher than in A group of 6,37 cm and difference in relation to non-active people is 16.05 cm. *Yoga*, C group achieve even better results in comparison to non-actives, the difference is 20.01 cm. The best results are achieved by *tai chi* practitioners 19.06 cm, where non-active group amount to –5.05 cm, and so the difference reach up to 24.3 cm. It should be noted that the results obtained after training (Test 2) are higher in all groups. The smallest difference (0.63 cm) was observed in the case of the youngest people practicing Tricking, however the biggest difference states for practicing *tai chi* (5.25 cm) who are at the same time the oldest training group.

Discussion

Stretching techniques (also auto stretching) are important elements exercises of yoga, in other groups are the key elements of the warm-up and training, and thus flexibility [5]. Stretching exercises improve range of motion in the joints, which has been proven in many scientific studied [6-8].

Physical activity has positive effect on the flexibility of the human body. Performed flexibility studies measured with FTF test made on a group of 155 healthy volunteers aged from 18 to 51 years have shown that people who are physically active (aged 19-46 years) had better flexibility(x = 10.56) than physically inactive people (aged 18-51 years) for which the values were on average 6.29 [4]. Studies involved both men and women, the results were analyzed together without correlation trend with age, which does not allow for identification of normative values.

Table 1. Average values of age and results in FTF test in examined groups.

Average Age	Non active group	Group	Test 1	Test 2	Δ(T1,T2)	Δ(NAG,T1)	Δ(NAG,T2)
23.25	8.35	A	10.50	11.13	0.63	2.15	2.78
29.50	1.45	B	14.63	17.50	2.87	13.18	16.05
49.00	–0.95	C	17.44	19.06	1.62	18.39	20.01
65.00	–5.05	D	14.00	19.25	5.25	19.05	24.3

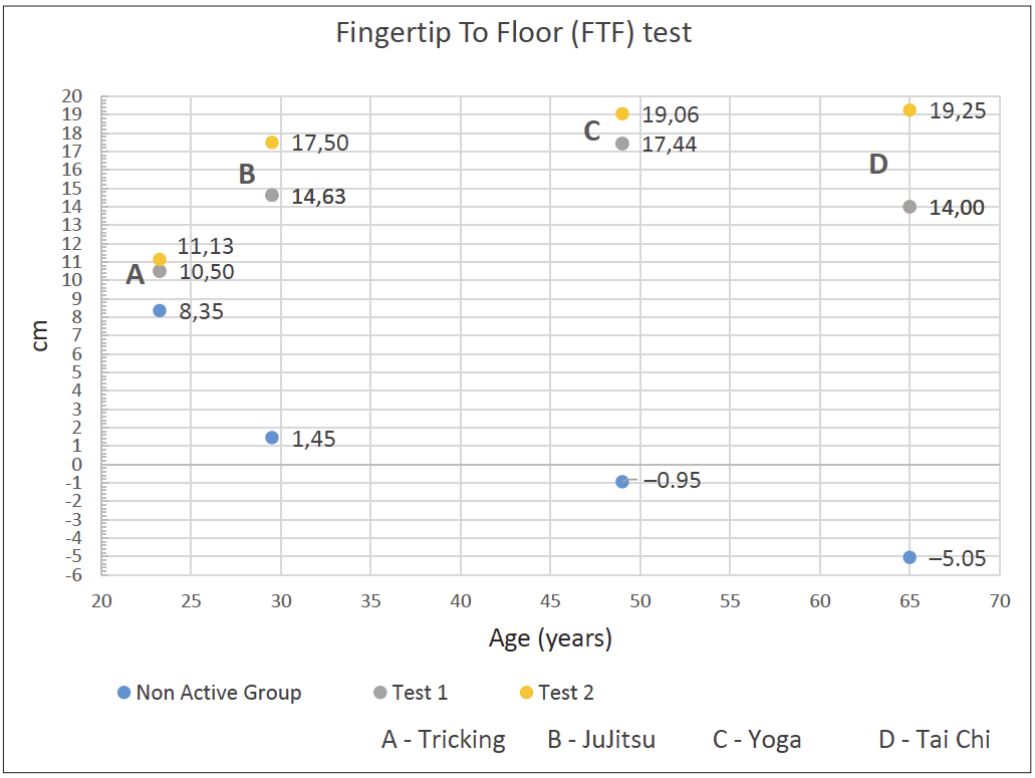

Figure 1. Chart of average values of age and results in FTF test in examined groups.

It is not entirely clear how the individual structure of bio kinematical chain affect the flexibility of the human body. A study by Li et al. [9] have shown that the flexibility test results depend on the mobility in the hip joints and lumbar spine.

Much more detailing research on the impact of various structures on the flexibility have been done by Kuszewski, Knapik, Saulicz et al. [1], studying 190 people between the ages of 18 to 51 years, have shown that the FTF test results correlate with the mobility of the upper (r = 0. 79) and lower (r = 0.70) level of lumbar spine. In addition, there was a significant correlation with the results of both hip joints flexion (r = 0.34 and r = 0.36), straighten hocks (r = 0.33 and r = 0.25) and significant negative correlation with the shortening of hamstrings (r = –067 for both limbs) [1].

This allows to conclude that TFT test is not only a quick and simple test, but also is a reliable way to assess the movement ability of the lower spine, pelvis and lower extremities and thus it is a good indicator of the flexibility [1]. Research Guissard and Duchateau showed a decrease in the stiffness of the tissue after use of stretching exercises [10]. Hence the conclusion that stretching decrease the risk of injury and musculoskeletal disorders [11,12].

However stretching exercises should not be used with mobility restrictions in the joints resulting from abnormal anatomy structure, damage to tendons and muscles and also pain in the joints resulting from excessive compression. On the other hand, excessive mobility sometimes may suggest hypermobility of the joints and then usage of stretching techniques is not recommended.

The biggest increases during the training are observed in the case of people practicing *thai chi* on the one hand indicate the possibility of obtaining excellent results using this technique, but on the other hand are confirming the fact stated by Magnusson et al. about impermanence effects of stretching methods [8].

Conclusion

The results of our experiment indicate that flexibility measured with FTF test demonstrate decreasing tendency with age. Physically active people have better flexibility. The biggest results are shown in *tai chi* and *yoga* group that corresponds with dominance of stretching practice.

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Anthropometric indicators and motor abilities of university students performing various types of physical activities (martial arts, volleyball, bodybuilding/fitness, jogging followed by sauna, golf, general PE classes)

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Abstract

Background and Study Aim. The aim of this study was to evaluate the relationship between various forms of physical activities undertaken by students of the University of Warmia and Mazury in Olsztyn and their body height, body mass, BMI scores and motor abilities.

Materials and Methods. Anthropometric measurements and motor ability tests were performed twice in 2010, at the beginning and at the end of the summer semester, and they involved 337 first-year full-time male students. At the beginning of the academic year, students selected the type of activity they would be involved in during physical education classes. The participants' body height, body mass and BMI were determined. Thirteen tests were carried out in the PE facilities of the University of Warmia and Mazury in Olsztyn to assess the students' motor abilities.

Results. Taller students opted for volleyball. Students with high body mass and high BMI scores chose less intensive forms of physical activity (golf) and strength-building workouts (bodybuilding, fitness). Slimmer students selected high-intensity activities, including general PE, martial arts, jogging followed by sauna, and volleyball.

Conclusions: The choice of physical activity was correlated with body height, body mass, BMI and motor fitness. Differences in the students' body mass, BMI and motor abilities at the beginning and at the end of the semester were influenced by the type of performed activity. In most motor ability tests, a significant improvement in results was observed in students who had opted for general PE, martial arts, jogging followed by sauna, and volleyball, which suggests that those activities had the most profound influence on the participants' motor fitness.

Keywords: male students • physical activity • motor fitness • anthropometric features • BMI

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Introduction

There exists vast scientific evidence that physical activity (PA) plays an important role in disease prevention and promotion of a healthy lifestyle. Children and adolescents should be provided with high-quality physical education (PE) and positive PA experiences that will encourage them to be physically active over a lifetime [1, 2]. A sedentary lifestyle increases the risk of serious chronic diseases, including heart disease, high blood pressure, stroke, certain types of cancer, diabetes and osteoporosis [3, 4]. Regular PA improves exercise capacity and motor fitness [5], and it delivers a variety of health benefits [6]. There is evidence to suggest that regular exercise improves immune function and alleviates symptoms of arthritis, asthma and fibromyalgia [7, 8]. Quality PE programs in high school contribute to higher levels of physical activity [9, 10], they improve self-esteem [11], self-efficacy [12], motor abilities and skills [13], enjoyment [14] motivation [15], PA levels in the long-term [16], and reduce sedentary behavior after graduation [17]. Over decades, physical activity has been gradually eliminated from most aspects of daily life, which is why PE plays a very important role in promoting an active lifestyle [1].

Most students are required to participate in some form of physical education in school, which is why PE classes make a significant contribution to public health [18]. The process of advocating for daily PE involves significant effort, cost and political strategy, but considerable success has been reported recently at elementary and middle levels. A high level of physical activity should be maintained until late in life, and an active and healthy lifestyle significantly contributes to the quality of life. Despite the above, the role of PE in promoting a pro-active attitude is marginalized at university. In Polish universities, the number of PE hours has been decreasing steadily in recent years, and in most countries in the world, PE is not an obligatory part of university curricula. The required number of PE credit hours was reduced from 165 in the 1998/1999 academic year to only 60 in the 2010/2011 academic year [19].

In accordance with a new regulation of the Ministry of Science and Higher Education, the number of PE credit hours at university can be reduced to thirty 45-minute classes during the entire degree program or obligatory PE classes can be eliminated entirely. Pursuant to the provisions of Art. 13 §7 of the Higher Education Law, Polish universities are merely required to *create a favorable environment for promoting students' involvement in physical activities* [20]. This provision is highly declarative, and it does not entail specific measures or legal sanctions. The global negligence towards the role played by PE in the promotion of an active and healthy lifestyle stems from the misapprehension that university students have developed healthy habits during earlier stages of education, therefore, this area of education can be disregarded at university. According to research, students' PA levels decrease significantly during the transition from high school to university [21] and in the first years of university [22]. Polish university students are characterized by low daily levels of physical activity [23-25], and the creation of daily opportunities for participation in PE classes is not always feasible. Physical activity levels of university students are low in most highly developed countries [3, 21, 26-28].

There is mounting scientific evidence to indicate that physical activity is indispensable to health and that people who remain physically active into old age derive significant health benefits. For this reason, physical education should not end in high school, but it should be continued at university. Health is not a given, and it has to be advanced and protected over a lifetime. The elimination of PE classes in university and the continuous reduction in PA levels is, therefore, unreasonable and highly detrimental to public health. There is no logic in the fact that young people are first taught to exercise for health, but are then deprived of the opportunity to participate in PE classes at university.

In most Polish universities, the number of PE credit hours has been reduced to thirty 45-minute classes during the academic year (two semesters). According to scientists and PE practitioners, such low PA requirements may not contribute to a noticeable improvement in the students' motor abilities [29], but this hypothesis has not yet been tested. In view of the above, the aim of this study was to analyze the relationship between the types of physical activities undertaken by the students of the University of Warmia and Mazury in Olsztyn (UWM) and their body mass, body height, BMI and motor abilities.

Materials and Methods

Ethics

The research was carried out upon the prior consent of the Ethical Committee of the UWM. The study involved male student volunteers who signed a written statement of informed consent.

Participants

The study was conducted in 2010, at the beginning and at the end of the summer semester, in physical

education facilities of the UWM in Olsztyn, Poland. It involved 337 first-year full-time male students who were chosen from 260 groups of students attending obligatory PE classes with the use of a random selection method and statistical tables [30]. A total of 25 PE groups were randomly selected, and only those students who were absent, for whatever reason, on the day the tests and measurements were performed, were excluded from the study. More than 94% of students aged 19-20 from the selected groups were examined. The participants could choose from the following types of physical activities: martial arts, bodybuilding/fitness, volleyball, jogging followed by sauna, golf and general PE. teachers teaching basketball, soccer and swimming classes refused to participate in the study. The vast majority of participants resided permanently in the Region of Warmia and Mazury (NE Poland). First-year male students were specifically chosen as a particularly valuable research group because their motor habits can still be modified. In the UWM, obligatory PE classes take place mainly in the first year, and this study constitutes the sixth stage of cross-sectional research that has been conducted biannually since 2000 [31]. The participants were selected from among students who: did not take any medication or nutritional supplements, were in good health, had no record of blood diseases or diseases affecting biochemical and biomechanical factors, and did not participate in any physical activity programs other than the obligatory PE classes (fifteen 90-minute classes), conducted once a week during the summer semester (5 months). The students' physical activity levels were evaluated with the use of the Polish version of the standardized and validated International Physical Activity Questionnaire (IPAQ) [32]. The participants' energy expenditure did not exceed 600 METs per week, and none of the volunteers were included in the "sufficient physical activity" category. Questionnaire results revealed that the analyzed male students were characterized by low levels of physical activity and sedentary behavior. IPAQ was used only to select a homogenous sample, and its results are not presented in this study.

Instruments and procedures

The participants' body mass and body height were measured using the Radwag scale, and the results were used to calculate their BMI. Volunteers participated in thirteen motor ability tests: standing long jump [cm], 4×10 m shuttle run [s], skipping with hand clapping 8 s [number of claps], zig-zag run [s], sit-ups 30 s [number of sit-ups], medicine ball (4 kg) forward throw [cm], medicine ball (4 kg) backward throw [cm], pull-ups on bar [number of pull-ups], standing forward bend [cm], barbell overhead trunk rotation [cm], 1-minute and 3-minute Burpee tests [number of cycles], and 12-minute Cooper test on a rowing ergometer [m]. The accuracy and reliability of motor ability tests was confirmed by numerous studies on the subject [33-35]. In each student group, motor ability tests were conducted in the same order, beginning from coordination tests, through speed, agility, flexibility and strength tests, and ending in endurance and strength tests. Every student was shown how to perform the tasks in PE classes before the test and was given ample time to practice them. The participants warmed up for 10 minutes before performing the tests [36].

Statistical analysis

The results of every trial were averaged and standard deviation was computed using descriptive statistics. Maximum and minimum values were also given to classify the participants into the applicable ranges for every test. The differences in the motor abilities of students participating in different types of physical activities were determined by an analysis of variance (ANOVA). The mean values of the "physical activity factor" were compared by Duncan's test. Calculations were performed at a significance level of a = 0.05. Mean values and significant variations between participants attending different PE classes were shown in tables. Data were processed and the results were analyzed in the Statistica PL v. 10 software package [37].

Results

Body mass, body height and BMI of participants from different activity groups, measured at the beginning and end of the semester, as well as the significance of differences in the measured parameters between the analyzed groups are presented in Table 1. The significance of differences between the results of motor ability tests reported in each activity group at the beginning and end of the semester is shown in Tables 2-4.

The body mass of students attending bodybuilding/fitness classes increased significantly (p = 0.0000) between the beginning and the end of the semester. No significant increase was observed in the body mass of participants involved in martial arts, jogging with sauna, golf and general PE, whereas the body mass of volleyball players decreased significantly (p = 0.0000). Similar trends were noted in BMI values. The BMI scores of bodybuilding/fitness students increased significantly (p = 0.0000). No significant changes in BMI values were reported in students involved in martial arts, jogging with sauna, golf and general PE, whereas a significant drop in BMI scores was noted in volleyball players. The BMI values of students enrolled in bodybuilding/

Table 1. Body mass, body height and BMI values of students at the beginning and end of the summer semester.

Activity	Anthropometric indicators	Beginning of semester	End of semester	(p)
		x̄ *SD* (min÷max)	x̄ *SD* (min÷max)	
Martial arts	Body mass (kg)	76.47 ± 6.99 (63÷103)	76.66±6.92 (63÷103)	0.0865
	Body height (cm)	180.39 ± 5.87 (164÷193)	180.29±5.12 (168÷193)	ns
	BMI (kg/m^2)	23.68 ± 2.33 (18.99÷35.43)	23.62±2.40 (18.70÷36.49)	ns
Bodybuilding /fitness	Body mass (kg)	82.81 ± 9.24 (72÷119)	83.36±8.99 (72÷121)	0.0000
	Body height (cm)	181.51 ± 7.12 (167÷196)	181.51±7.05 (167÷196)	ns
	BMI (kg/m^2)	25.20 ± 3.07 (20.78÷37.22)	25.37±2.99 (20.78÷37.22)	0.0000
Volleyball	Body mass (kg)	74.96 ± 6.80 (63÷91)	75.73±6.72 (63÷93)	0.0000
	Body height (cm)	182.60 ± 6.16 (168÷195)	182.60±6.09 (168÷195)	ns
	BMI (kg/m^2)	22.96 ± 1.86 (19.58÷27.47)	22.73±1.89 (18.99÷27.47)	0.0000
Jogging followed by sauna	Body mass (kg)	71.16 ± 3.83 (63÷81)	71.15±4.13 (60÷81)	ns
	Body height (cm)	179.68 ± 4.08 (174÷192)	179.68±4.03 (174÷192)	ns
	BMI (kg/m^2)	22.04 ± 0.98 (19.87÷24.45)	22.03±0.93 (19.37÷24.45)	ns
Golf	Body mass (kg)	80.44 ± 5.06 (73÷93)	80.60±4.88 (73÷93)	ns
	Body height (cm)	180.56 ± 5.97 (165÷189)	180.56±5.89 (165÷189)	ns
	BMI (kg/m^2)	24.71 ± 1.59 (22.12÷29.38)	24.75±1.55 (21.84÷29.38)	ns
General PE classes	Body mass (kg)	78.56 ± 7.25 (63÷107)	78.72±7.33 (63÷110)	ns
	Body height (cm)	178.67± 6.60 (146÷176)	178.67±5.63 (164÷194)	ns
	BMI (kg/m^2)	24.63 ± 2.18 (19.44÷33.77)	24.68±2.17 (19.44÷33.77)	ns

Key: x̄ – arithmetic mean, ± – standard deviation, max – maximum value, min – minimum value, *ns* – no significant difference, (p) - probability that the calculated chi-square value will be exceeded.

fitness classes were in the overweight range (BMI ≥ 25.0) both at the beginning and at the end of the semester. BMI scores were within the norm in the remaining activity groups (martial arts, volleyball, jogging with sauna, golf and general PE). The highest body mass and BMI values at the beginning and end of the semester were reported in the bodybuilding/fitness group, and the lowest – in the group of participants who jogged and used a sauna. The tallest students played volleyball, and the shortest participants attended general PE classes.

At the end of the semester, students performing martial arts improved their results in 5 motor ability tests: medicine ball forward throw (p = 0.050), pull-ups on bar (0.0137), 1–minute and 3-minute Burpee tests (p = 0.0090 and p = 0.0005), and 12-minute Cooper test on a rowing ergometer (p = 0.0416). No significant differences between the results noted at the beginning and end of the semester were observed in the remaining 8 tests: standing long jump, 4×10 m shuttle run, skipping with hand clapping 8 s, zig-zag run, standing forward bend, barbell overhead trunk rotation, sit-ups 30 s, and medicine ball (4 kg) backward throw. In the bodybuilding/fitness group, an improvement in results was reported in the medicine ball (4 kg) forward throw test (p = 0.0033), whereas negative changes were observed in the following 6 trials: 4×10 m shuttle run (shorter time is a better result, p = 0.0275), skipping with hand clapping 8 s (p = 0.0118), standing forward bend (p = 0.0012), 1-minute and 3-minute minute Burpee tests (p = 0.0000 for both) and 12-minute Cooper test on a rowing ergometer (p = 0.0009). No significant differences in results were reported in the following tests: standing long jump, zig-zag run, barbell overhead trunk rotation, sit-ups 30 s, medicine ball backward throw, and pull-ups on bar (Table 2).

At the end of the semester, volleyball players improved their results in 5 motor ability tests: skipping with hand clapping 8 s (p = 0.0035), medicine ball (4 kg) backward (p = 0.0017) and forward (p = 0.0000) throw, and 1-minute and 3-minute Burpee tests (p = 0.0018 and p = 0.0007, respectively). No significant differences were reported in 7 tests: standing long jump, 4×10 m shuttle run, zig-zag run, barbell overhead trunk rotation, sit-ups 30 s, pull-ups on bar, and 12-minute Cooper test on a rowing ergometer. A significant deterioration in results was noted only in the standing forward bend trial (p = 0.0137). Students who jogged and used a sauna significantly improved their results in 4 tests: 4×10 m shuttle run (shorter time is a better result, p = 0.0169), zig-zag run (shorter time

Table 2. Average results of motor ability tests scored at the beginning and end of the semester by students enrolled in martial arts and golf classes.

Activity	Motor ability test	Beginning of semester	End of semester	(p)
		x̄ ± *SD* (min÷max)	x̄ ± *SD* (min÷max)	
Martial arts	Standing long jump	221.32 ± 17.70 (187÷265)	221.49±18.33 (180 ÷ 270)	ns
	4×10 m shuttle run	10.65 ± 0.72 (9.28÷12.84)	10.65±0.71 (9.28 ÷ 12.84)	ns
	Skipping with hand clapping 8 s	27.72 ± 3.13 (20÷34)	27.80±2.86 (20 ÷ 34)	ns
	Zig-zag run	25.35 ± 1.43 (21.45÷28.43)	25.34±1.48 (21.20 ÷ 28.60)	ns
	Standing forward bend	9.96 ± 5.46 (0÷24)	10.07±5.92 (-2 ÷ 26)	ns
	Barbell overhead trunk rotation	85.41 ± 11.24 (60÷112)	85.64±10.87 (60 ÷ 112)	ns
	Sit-ups 30 s	25.04 ± 2.88 (19÷34)	25.13±2.67 (19 ÷ 34)	ns
	Medicine ball backward throw	1038.10 ± 155.80 (720÷1550)	1038.67±163.87 (700 ÷ 1600)	ns
	Medicine ball forward throw	848.73 ± 153.18 (550÷1200)	854.46±142.41 (550 ÷ 1200)	0.0050
	Pull-ups on bar	5.75 ± 3.72 (0÷18)	5.95±3.51 (0 ÷ 18)	0.0137
	1-min Burpee test	25.39 ± 3.12 (20÷34)	25.68±2.78 (19 ÷ 34)	0.0090
	3-min Burpee test	53.38 ± 6.20 (43÷67)	53.87±5.75 (43 ÷ 69)	0.0005
	12-min Cooper test on rowing ergometer	2481.39 ± 241.87 (1900÷2950)	2487.28±231.58 (1900 ÷ 2950)	0.0416
Bodybuilding /fitness	Standing long jump	216.43 ± 15.77 (161÷245)	216.54±15.20 (161 ÷ 245)	ns
	4×10 m shuttle run	11.48 ± 0.99 (9.78÷14.45)	11.49±0.98 (9.78 ÷ 14.52)	0.0275
	Skipping with hand clapping 8 s	25.26 ± 2.54 (21÷30)	25.54±2.31 (20 ÷ 30)	0.0118
	Zig-zag run	25.94 ± 1.32 (23.79÷30.28)	25.92±1.30 (23.22 ÷ 30.28)	ns
	Standing forward bend	3.49 ± 3.35 (-3÷10)	3.11±3.98 (-6 ÷ 11)	0.0012
	Barbell overhead trunk rotation	93.70 ± 8.33 (79÷110)	93.94±8.67 (78 ÷ 112)	ns
	Sit-ups 30s	23.89 ± 3.95 (14÷31)	24.05±3.62 (14 ÷ 32)	ns
	Medicine ball backward throw	1107.92 ± 198.53 (100÷1550)	1122.03±181.19 (100 ÷ 1610)	ns
	Medicine ball forward throw	920.00 ± 155.71 (600÷1360)	928.02±145.57 (600 ÷ 1360)	0.0033
	Pull-ups on bar	3.92 ± 2.35 (0.00÷10)	4.08±2.21 (0 ÷ 11)	ns
	1-min Burpee test	24.04 ± 2.92 (14÷28)	23.42±3.28 (11 ÷ 29)	0.0000
	3-min Burpee test	45.60 ± 4.90 (37÷58)	44.16±5.07 (33 ÷ 58)	0.0000
	12-min Cooper test on rowing ergometer	2129.25 ± 209.03 (1650÷2500)	2117.45±218.27 (1550 ÷ 2500)	0.0009

Key: x̄ – arithmetic mean, ± – *SD* – standard deviation, max – maximum value, min – minimum value, *ns* – no significant differences, (p) - probability that the calculated chi-square value will be exceeded.

is a better result, p = 0.0133), and medicine ball (4 kg) backward (p = 0.0201) and forward (p = 0.0000) throw. No significant differences were observed in the remaining 9 tests: standing long jump, skipping with hand clapping, standing forward bend, barbell overhead trunk rotation, sit-ups 30 s, pull-ups on bar, 1-minute and 3-minute Burpee tests, and 12-minute Cooper test on a rowing ergometer (Table 3).

In the group of golf players, a significant deterioration in results was noted in the following tests: zig-zag run (shorter time is a better result, p = 0.0029), standing forward bend (0.0460), barbell overhead trunk rotation (p = 0.0094), sit-ups 30 s (p = 0.0138), medicine ball (4 kg) forward throw (p = 0.0105), pull-ups on bar (p = 0.0419) and 1-minute Burpee test (p = 0.0005). No significant variations in results were observed in the 6 remaining trials: standing long jump, 4×10 m shuttle run, skipping with hand clapping 8 s, medicine ball backward throw, 3-minute Burpee test, and 12-minute Cooper test on a rowing ergometer.

Students attending general PE classes significantly improved their results in 6 motor ability tests: standing long jump (p = 0.0413), medicine ball (4 kg) backward (p = 0.0000) and forward (p = 0.0006) throw, pull-ups on bar (p = 0.0000), and 1-minute and 3-minute Burpee tests (p = 0.0001 and p = 0.0041, respectively). No significant

Table 3. Average results of motor ability tests scored at the beginning and end of the semester by volleyball players and joggers.

Activity	Motor ability test	Beginning of semester	End of semester	(p)
		x̄ *SD* (min÷max)	x̄ *SD* (min÷max)	
Volleyball	Standing long jump	226.21 ± 14.69 (200÷256)	226.49±15.11 (193 ÷ 260)	ns
	4×10 m shuttle run	10.70 ± 0.68 (9.61÷12.87)	10.70±0.67 (9.61 ÷ 12.87)	ns
	Skipping with hand clapping 8 s	26.68 ± 2.18 (20÷32)	27.00±2.01 (20 ÷ 32)	0.0035
	Zig-zag run	25.69 ± 1.56 (21.12÷28.70)	25.66±1.50 (21.12 ÷ 28.70)	ns
	Standing forward bend	4.72 ± 2.84 (-2.00÷11.00)	4.47±3.19 (-5 ÷ 11)	0.0137
	Barbell overhead trunk rotation	87.38 ± 7.96 (74÷102)	87.66±7.54 (74 ÷ 102)	ns
	Sit-ups 30 s	22.47 ± 3.60 (13÷30)	22.66±3.2 (13 ÷ 30)	ns
	Medicine ball backward throw	1036.17 ± 171.70 (630÷1750)	1046.28±158.50 (630 ÷ 1750)	0.0017
	Medicine ball forward throw	824.68 ± 112.75 (590÷1070)	836.97±110.44 (590 ÷ 1100)	0.0000
	Pull-ups on bar	3.00 ± 2.10 (0÷7)	3.12±1.84 (0 ÷ 7)	ns
	1-min Burpee test	24.36 ± 3.48 (18÷34)	24.79±3.00 (18 ÷ 34)	0.0018
	3-min Burpee test	50.28 ± 7.19 (32÷67)	50.93±6.62 (32 ÷ 67)	0.0007
	12-min Cooper test on rowing ergometer	2302.34 ± 272.86 (1800÷3000)	2302.77±259.54 (1800 ÷ 3000)	ns
Jogging followed by sauna	Standing long jump	219.19 ± 25.52 (172÷265)	219.24±25.13 (171 ÷ 268)	ns
	4×10 m shuttle run	10.44 ± 0.82 (9.02÷12.06)	10.42±0.80 (9.02 ÷ 12.06)	0.0169
	Skipping with hand clapping 8 s	25.22 ± 3.88 (16÷38)	25.53±4.14 (16 ÷ 38)	ns
	Zig-zag run	25.38 ± 2.18 (22.06÷30.72)	25.31±2.19 (21.53 ÷ 30.80)	0.0133
	Standing forward bend	3.59 ± 3.75 (-3÷10)	3.80±3.66 (-3 ÷ 10)	ns
	Barbell overhead trunk rotation	82.59 ± 6.03 (72÷98)	82.78±6.46 (70 ÷ 99)	ns
	Sit-ups 30 s	24.14 ± 4.52 (10÷31)	24.12±4.55 (10 ÷ 31)	ns
	Medicine ball backward throw	995.81 ± 164.35 (580÷1240)	998.24±162.26 (580 ÷ 1260)	0.0201
	Medicine ball forward throw	856.49 ± 155.05 (520÷1200)	861.08±153.95 (520 ÷ 1220)	0.0000
	Pull-ups on bar	4.35 ± 2.45 (0÷9)	4.36±2.50 (-1 ÷ 10)	ns
	1-min Burpee test	25.76 ± 3.39 (18÷30)	26.07±3.24 (18 ÷ 30)	ns
	3-min Burpee test	56.24 ± 7.47 (28÷65)	56.34±6.80 (28 ÷ 66)	ns
	12-min Cooper test on rowing ergometer	2631.08 ± 222.16 (2200÷3100)	2637.16±224.79 (2150 ÷ 3150)	ns

Key: x̄ – arithmetic mean, ± – standard deviation, max – maximum value, min – minimum value, *ns* – no significant differences, (p) - probability that the calculated chi-square value will be exceeded.

differences were observed in 6 drills: 4×10m shuttle run (p=0.5348), skipping with hand clapping 8 s, zig-zag run, standing forward bend, sit-ups 30 s, and 12-minute Cooper test on a rowing ergometer. The students' results deteriorated significantly in the barbell overhead trunk rotation test (p = 0.0295) (Table 4).

Discussion

The observed differences in anthropometric indicators (body mass and body height), BMI scores and motor ability test results between the beginning and end of the semester varied across the evaluated activity groups and relative to the results for the entire analyzed population [24]. The results describing the entire population (without accounting for the type of physical activity) indicate that the participants' average body mass and BMI scores increased during the experiment. After attending PE classes for one semester, students performed significantly worse in 8 motor ability tests (sit-ups 30 s, skipping with hand clapping 8s, downward forward bend, 1-minute and 3-minute Burpee test, 12-minute Cooper test on a rowing ergometer, medicine ball (4 kg) forward throw, and pull-ups on bar). No significant differences in results were observed in the 5 remaining trials (standing long jump, zig-zag run, medicine ball (4 kg) backward throw, 4×10 m shuttle run and barbell overhead trunk rotation) [24].

Table 4. Average results of motor ability tests scored at the beginning and end of the semester by students enrolled in golf and general PE classes

Activity	Motor ability tests	Beginning of semester	End of semester	(p)
		x̄ ± *SD* (min÷max)	x̄ ± *SD* (min÷max)	
Golf	Standing long jump	212.28 ± 16.84 (180÷240)	211.60±17.60 (176 ÷ 245)	ns
	4×10 m shuttle run	11.49 ± 1.04 (10.12÷13.74)	11.52±1.01 (10.12 ÷ 13.79)	ns
	Skipping with hand clapping 8 s	23.14 ± 3.59 (13÷30)	23.22±3.81 (13 ÷ 30)	ns
	Zig-zag run	26.40 ± 1.49 (24.00÷31.03)	26.44±1.49 (23.97 ÷ 31.15)	0.0029
	Standing forward bend	4.14 ± 2.67 (-2÷10)	3.89±2.77 (-2 ÷ 10)	0.0460
	Barbell overhead trunk rotation	87.03 ± 10.97 (60÷102)	87.81±11.54 (60 ÷ 110)	0.0094
	Sit-ups 30 s	22.75 ± 3.95 (16÷30)	22.17±3.68 (16 ÷ 31)	0.0138
	Medicine ball backward throw	1006.94 ± 128.84 (780÷1270)	997.99±165.85 (100 ÷ 1270)	ns
	Medicine ball forward throw	878.06 ± 108.94 (640÷1110)	875.69±107.14 (640 ÷ 1110)	0.0105
	Pull-ups on bar	2.31 ± 1.74 (0÷8)	2.07±1.87 (0 ÷ 8)	0.0419
	1-min Burpee test	23.11 ± 3.71 (16÷30)	22.42±3.39 (16 ÷ 30)	0.0005
	3-min Burpee test	43.67 ± 4.50 (32÷51)	43.33±4.25 (32 ÷ 51)	ns
	12-min Cooper test on rowing ergometer	2149.72 ± 269.29 (1550÷2650)	2144.31±259.69 (1550 ÷ 2650)	ns
W-F	Standing long jump	211.10 ± 25.19 (156÷260)	212.55±24.87 (156 ÷ 270)	0.0413
	4×10 m shuttle run	10.83 ± 1.01 (9.34÷14.56)	10.86±1.00 (9.32 ÷ 14.58)	ns
	Skipping with hand clapping 8 s	26.65 ± 3.35 (16÷36)	26.66±3.38 (16 ÷ 38)	ns
	Zig-zag run	25.86 ± 2.13 (21÷30.07)	25.86±2.13 (21.00 ÷ 30.10)	ns
	Standing forward bend	3.83 ± 5.50 (-15÷16)	4.00±5.41 (-15 ÷ 17)	ns
	Barbell overhead trunk rotation	86.77 ± 12.04 (60÷120)	86.84±12.57 (60 ÷ 127)	0.0295
	Sit-ups 30 s	22.23 ± 4.06 (9÷29)	22.45±4.28 (9 ÷ 30)	ns
	Medicine ball backward throw	997.82 ± 177.55 (550÷1400)	1004.04±176.21 (550 ÷ 1430)	0.0000
	Medicine ball forward throw	831.15 ± 142.22 (510÷1300)	834.10±141.01 (510 ÷ 1310)	0.0006
	Pull-ups on bar	3.99 ± 3.51 (0÷12)	4.42±3.36 (0 ÷ 14)	0.0000
	1-min Burpee test	22.92 ± 4.27 (13÷30)	23.53±4.29 (13 ÷ 31)	0.0001
	3-min Burpee test	46.08 ± 8.70 (30÷62)	46.47±8.74 (30 ÷ 62)	0.0041
	12-min Cooper test on rowing ergometer	2270.51 ± 416.89 (1400÷2850)	2271.47±412.67 (1350 ÷ 2900)	ns

Key: x̄ – arithmetic mean, ± – standard deviation, max – maximum value, min – minimum value, *ns* – no significant differences, (p) - probability that the calculated chi-square value will be exceeded.

An analysis of results scored in various groups indicates that body height, body mass and BMI scores influenced the students' choice of physical activity. The tallest students had a preference for volleyball, whereas the shortest participants attended general PE classes. The heaviest students with the highest body fat percentage preferred bodybuilding/fitness, and the lightest participants with the lowest body fat percentage decided on jogging followed by sauna. Students with the highest BMI scores opted for bodybuilding/fitness workouts which are characterized by simple, isolated movements with added resistance. Participants in the upper limit of normal BMI chose golf and general PE classes which involve recreational activities of low (golf) and varied (general PE) intensity. Students with the lowest BMI scores (mid-range) had a preference for martial arts, volleyball and jogging with sauna, which are high-intensity activities [38]. Morphological fitness measures are often related to metabolic fitness components and body composition is often recognized as a component of health-related fitness [39]. A similar dependency is noted in motor fitness – individuals with higher motor ability levels may find it easier to be physically active and may be more inclined to engage in physical activity than their peers with lower levels of motor competence [40]. Our results validate the general rule that overweight or obese individuals

are less physically active and, consequently, choose less intensive and less time-consuming activities, whereas slimmer subjects are more physically active and able to engage in high-intensity activities [39, 41, 42].

Strength-building exercises contribute to an increase in body mass [43], whereas aerobic workouts help burn adipose tissue and improve circulation and respiratory function [44]. Similar observations were made in our study where a significant increase in body mass between the beginning and end of semester was reported in students participating in bodybuilding/fitness activities, whereas a decrease in body mass was noted in volleyball players who, together with students involved in martial arts and jogging with sauna, where characterized by the lowest BMI scores.

The changes in motor ability levels observed during the summer semester were correlated with the type of physical activity. In the group of students performing martial arts, a significant improvement in results was observed in endurance tests (12-minute Cooper test on a rowing ergometer), strength-building tests (medicine ball forward throw), endurance and strength-building tests (1-minute and 3-minute Burpee tests) [45], whereas no significant changes were noted in speed, agility and flexibility drills. It should be noted, however, that martial arts students generally scored highest in motor ability tests at the beginning of the semester, therefore, the improvement noted at the end of the experiment was not as striking as that reported in the remaining groups. Volleyball players significantly improved their results in speed and agility tests (skipping with hand clapping 8 s), endurance and strength-building drills (1-minute and 3-minute Burpee tests) and strength-building trials (4 kg medicine ball backward and forward throw), whereas their sagittal spinal flexibility markedly deteriorated (standing forward bend). Joggers significantly improved their results in strength-building tests (4 kg medicine ball backward and forward throw) and speed and agility drills (zig-zag run). Only a minor improvement was noted in their endurance performance (12-minute Cooper tests on a rowing ergometer), but they clearly outpaced students from the remaining groups.

The motor abilities of students enrolled in golf and bodybuilding/fitness classes deteriorated in the highest number of trials. Golf players' results deteriorated significantly in 7 tests: sit-ups – 30 s, pull-ups on bar (strength-building), 1-minute Burpee test (endurance and strength-building), standing forward bend, barbell overhead trunk rotation (flexibility) and zig-zag run (speed and agility). The results scored by bodybuilding/fitness students deteriorated significantly in 6 trials evaluating endurance, speed, agility and flexibility. Strength-building exercises contributed to a significant improvement in results only in the medicine ball forward throw, whereas no significant changes were observed in the remaining trials of this category. The above results could indicate that golf and bodybuilding/fitness programs had been poorly designed or executed. Despite their specificity, golf and bodybuilding/fitness curricula should promote overall physical development and should include exercises targeting all motor abilities. Endurance exercises contribute to cardiorespiratory fitness, and they should be a part of every PE program, regardless of the chosen type of physical activity [46-48]. Despite the above, a drop in endurance test results was noted in several types of activities undertaken by the UWM students.

During the summer semester, students attended only fifteen 90-minute PE classes, held once a week, which could explain their low levels of physical activity. According to physical activity recommendations formulated by the World Health Organization (WHO) for aircrew members aged 18-64 years, moderate-intensity activities should be performed for minimum 150 minutes per week, and they can be replaced by high-intensity activities (which increase the heart rate, respiratory rate and precipitation levels) performed for minimum 75 minutes per week [48]. In an attempt to maximize the health benefits of physical activity, fitness experts recently suggested that the volume of moderate-intensity activities should be increased to 300 minutes and the volume of high-intensity activities – to 150 minutes per week. Exercises of the recommended length and intensity level improve muscle strength, respiratory and circulatory system function, and they reduce the risk of non-infectious chronic illnesses and depression [49].

In this study, the number of PE classes was insufficient to promote a significant improvement in test results, but other research has demonstrated that rowing for 500 m on an ergometer only once a week delivered numerous benefits for sedentary male students [50]. Interestingly, the cited study demonstrated that the participants were able to improve their rowing times only up to a certain level (5-6 training sessions), after which, their results ceased to improve. Twelve-station high intensity interval training (HIIT) consists of jumping jacks, wall sits, push-ups, abdominal crunches, chair step-ups, chair tricep dips, high-knee planks/running in place, lunges, push-ups with rotation, and side planks, were each exercise is performed for 30 seconds with 10 seconds of transition

time between stations. The entire circuit is completed in approximately 7 minutes, and it can be repeated 2-3 times a day to lower body fat, increase insulin sensitivity, improve maximal oxygen consumption (VO_{2max}) and muscular fitness [44].

Practical applications

Despite a limited number of PE classes during the academic year (thirty 45-minute classes), university students can participate in various types of physical activities, some of which contribute to a significant improvement in motor abilities, whereas others do not result in any significant differences or even lead to a clear deterioration in motor abilities. Physical education teachers can strive to improve the students' motor fitness levels by encouraging them to participate in high-intensity workouts as part of general PE, martial arts, jogging and volleyball classes. The physical activity levels of university students have been deteriorating steadily in recent years, and PE teachers can influence students' self-determination through motivational strategies [51]. The results of this experiment indicate that a professionally guided university-level PE program can significantly improve the students' agility, endurance, strength, coordination, flexibility, and lower their body fat percentage (BMI). Workouts that produce poor results or lead to a deterioration in general motor ability levels should be carefully revised and improved. Our results can be used to design a new PE program within the allocated number of class hours, where the rigid system of fifteen 90-minute weekly classes can be replaced with more flexible and attractive options. High-intensity workouts could be split into 30- to 60-minute training sessions held more than once a week, whereas 90-minute classes could be held at the end of the semester when the participants' motor fitness levels have improved. The results of this study can also be used to develop motor fitness standards for university students.

Limitations

International classification standards have not been developed for several tests in the applied battery of 13 motor ability tests, therefore, the students' average fitness levels in all tests (total T-score) or selected drills could not be evaluated. An extended number of tests was designed for a more reliable assessment of specific motor abilities. The study was performed on the assumption that fifteen 90-minute PE classes per semester (5 months) are not sufficient to induce not only a significant improvement but an adequate improvement in the students' motor fitness levels. Coordination abilities were evaluated in only one test, skipping with hand clapping [52], and additional coordination trials could not be incorporated into the study due to time constraints. The study was performed only in the UWM in Olsztyn, and the evaluated population included only male students performing six types of physical activities because the instructors teaching basketball, soccer and swimming classes refused to participate in the study.

Conclusions

In this study, sedentary male students' choice of physical activity was correlated with their body height, body mass, BMI and motor fitness. Participants with higher body mass and higher BMI scores opted for less intensive forms of physical activity (golf, bodybuilding/fitness), whereas slimmer students selected activities characterized by a higher level of intensity (general PE, martial arts, jogging followed by sauna, and volleyball). Differences in body mass, BMI and motor abilities at the beginning and at the end of the semester were determined by the type of performed activity. In most motor ability tests, a significant improvement in motor abilities was observed in students who had participated in general PE classes, martial arts, jogging with sauna, and volleyball, which suggests that those physical activities had the most profound influence on the participants' motor fitness. Future research should incorporate other types of physical activities as well as students from other Polish and foreign universities. The results can be used to develop international motor fitness standards for university students.

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Influence of different versions of the straight forward punch on the obtained force, energy and power – measurements of taekwon-do ITF athletes' performance

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Abstract

Background and Study Aim. The aim of the study was the knowledge about the values of force, energy and power obtained during performance of the straight punch in two different techniques.

Material and Methods. 15 taekwon-do ITF (International Taekwon-do Federation) athletes were asked to participate in the study. They were asked to perform the traditional and sports version of the punch three times each. The research was carried out with the use of Smart-D system manufactured by Italian BTS Spa company and used for complex analysis of movements.

Results. The research shows that the average delivery time of 0.170 ± 0.007 s of the sports version punch is significantly shorter than that of its traditional version whose average is 1.060 ± 0.142 s ($p<0.01$). The kinetic energy of 2299 ± 320 J and force of 3284 ± 555 N were obtained in the traditional technique of the punch. The force of this strike is comparable to the force obtained in the roundhouse kick. The other technique (i.e. the sports one) obtained only 916 ± 60 J and 1308 ± 173 N ($p<0.01$). Thus, a greater force and a greater energy were obtained in the traditional technique. However, the calculated power of 5630 ± 247 W is considerably higher for the sports technique of the strike, which signifies a high pace of energy production (the traditional strike achieved only 2598 ± 283 W).

Conclusions. Having analyzed the obtained results it can be stated that the aim of a strike determines the way the strike is delivered. The traditional taekwon-do punch is used to perform mechanical work and produce a maximum kinetic energy, which is necessary for breaking, whereas the sports punch requires a short time of delivery, which gives great power, i.e. high rate of energy production. That is the reason why it is used in combat.

Key words: taekwon-do • analysis of movement • kinetics of punch • biomechanics of combat sports

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Introduction

Biomechanical optimisation of the combat sports' techniques can enhance the ability to learn and perform the fastest and most powerful strikes. That is the reason why many researchers attempt to find and identify the factors which influence efficient strike performance. Choi [1] put forward his "Theory of Power", in which he emphasized the role of the mass, velocity, balance, concentration and control of breathing in gaining force. Vos & Binkhorse [2], Blum [3] and Walker [4] analysed the kinematic aspect of the strikes and process of breaking hard objects with bare hands. A continuation of that research was noted in the following years [5-8], when an attempt at describing a dynamic theory of strikes occurs together with a more comprehensive registration of strike kinematics.

Taekwon-do practitioners have a wide range of kicks at their disposal, thus most of the research is concerned with this kind of techniques [9-17]. However, some of the research on biomechanics of taekwon-do practitioners concentrates on the technique used by the upper parts of the body. For instance, Pieter and his colleagues [18] compared a straight forward punch performed from two different starting positions and suggested that a quantitative research was needed so as to obtain a better understanding of that particular technique. The punch executed from the front stance was examined with respect to the mechanical work being performed and the force obtained [19].

Efficient execution of strikes in combat sports is affected by a number of factors, including their force, energy, power, etc. However, it does happen that the terms of mechanical work, energy and power are not always appropriately understood by many specialists in the world of sport. For example, great *power* does not necessarily translate into a greater *force* of the strike, doing more harm to the opponent or breaking a higher number of boards. These effects are produced by *kinetic energy* and not *power*. Confusing these terms happens to lead to misunderstandings.

The terms of *mechanical work* and *energy* are closely connected with each other. It is rather apparent as these two have the same unit in the International System of Units (SI), which is [J]. In order to obtain energy, a certain amount of work needs to be done, or in other words, performed work provides energy. This relation is shown in equation (1) [20,21]:

$$W = mgh + \frac{mv^2}{2} \quad (1)$$

where: W – mechanical work, m – mass, g – gravity, h – height, v – velocity, mgh – potential energy, $1/2mv^2$ – kinetic energy

Equation (1) shows that the velocity of a fist, for example in a taekwon-do strike, at the very moment of making contact with its target is generated by work (W). If the direction of the thrown strike is horizontal (parallel to the floor), then the fist does not have gravitational potential energy, but only the kinetic energy. In such case equation (1) takes on the form of equation (2):

$$W = \frac{mv^2}{2} \quad (2)$$

This energy acts on an opponent or the target object. The right side of equation (2) shows that the kinetic energy, and thus the amount of the work done depends on the mass of the body (m) put in motion and the fist velocity (v) at the moment of making contact with the target. In order to present the force produced at the moment of an impact equation (2) can be rewritten in the form of equation (3):

$$F = \frac{m \times v^2}{2s} = \frac{E_k}{s} \quad (3)$$

where: E_k - kinetic energy, s – distance

Equation (3) shows that the force of the strike is directly proportional to the kinetic energy of the fist and inversely proportional to the distance, over which the kinetic energy will be absorbed. The acting force, which translates into potential damage done to the opponent or the object being broken might be increased by an appropriately adjusted distance for the intended impact aimed at an opponent or a target object.

According to the definition of power it is possible to illustrate it by dividing both sides of equation (1) by time t during which the work is done:

$$P = \frac{W}{t} = \frac{mgh}{t} + \frac{1/2mv^2}{t} \quad (4)$$

where: P – power, t – time.

In special circumstances equation (4) will take the following form (the strike being executed is parallel to the floor):

$$P = \frac{E_k}{t} \quad (5)$$

In a number of situations in taekwon-do or in karate efficiency is indicated by kinetic energy production, which is expressed in the right side of equation (4) [19]. As far the amount of kinetic energy is concerned it needs to be taken into account that it can be produced quickly or that it can also be produced slowly. The key assumption is that the power

is determined how fast kinetic energy is produced (equation 5). Hence, the greater the velocity is, the greater the power is obtained, which can be clearly seen in equation (4). Equations (3), (4) and (5) show that a given amount of kinetic energy can be produced by a great force acting over a shorter distance or a smaller force acting over a longer distance. Using force over a longer distance usually requires more time so that the rate of kinetic energy transfer could be lower. However, according to formula (4) it will have less power.

The aim of this paper is to evaluate the values of force, energy and power obtained while executing a straight punch in two attempts and performed with the use of a different technique in each of the attempts. Having adopted commonly used criteria for sports technique biomechanical analyses [22], and the techniques used in taekwon-do in particular [23, 24], the following research questions have been addressed:

How do different punch patterns affect the kinematics of the strike?

Do the techniques used have biomechanical foundations for using them?

The answers to the above questions may contribute to selecting a more efficient method of executing this kind of strikes in taekwon-do sports events as well as in self-defence.

Material and Method

The study was based on 15 taekwon-do ITF (International Taekwon-do Federation) athletes comprising 5 female athletes and 10 male athletes whose average age was 16.5 ± 0.8 year, average weight was 64.1 ± 9.0 kg and average height was 176.5 ± 6.0 cm. The researched group included European Junior Champions, Polish Junior Champions and other athletes who had practised taekwon-do for a minimum of 3 years. Athletes and their parents agreed to take part in this study voluntarily. For the purpose of this study each of them adopted the same starting position and performed the straight forward punch three times in the traditional version and three times in the sports version, which gave a grand total of 60 strikes – 30 strikes in each of the two versions. Figure 1 presents the structure of those punches.

In the traditional version each athlete adopted the L-stance forearm guarding block (in taekwon-do terminology referred to as *niunja sogi palmok debi maki*) with the front right foot and performed the punch by throwing the left fist forward (in taekwon-do terminology referred to as a*p joomok jirugi*) [25,26].

In the sports version each athlete standing in a fighting posture with the front right foot executed a boxing-type punch with their left fist.

The study relied on an Italian system called Smart-D, made by BTS S.p.A., used for complex movement analysis. The system comprised six cameras reflecting infrared rays, which in real time located the markers fixed to the athlete's body. The system made it possible to record the picture of the athlete's moving body and evaluate the kinetic parameters obtained. The movement was recorded with the accuracy of 0.3-0.45 mm and the frequency of 120 Hz.

The parameters, which were obtained from the markers located on the athletes' wrists, defining the space and time structure of the athlete's movements were analysed. This enabled the author to calculate the total punch duration, time needed to develop the maximum velocity and the maximum fist velocity. For all the values obtained mean values and standard deviation were calculated. The analysis of the differences between the mean values for the punches executed in the traditional and sports versions was done on the basis of t-test for two mean values at the significance level of $p<0.01$. The values of force, energy and power were computed on the basis of equations (1), (3) and (5). The errors for these values were computed with the use of exact differential. Statistical analysis was done with the use of MS Excel 2000.

Results

Figure 2 shows example curves reflecting the changes in fist velocities in time obtained for two types of the taekwon-do straight punch for one punch delivery of a given athlete: the punch in the traditional version (broken line) and the punch in the sports version (solid line). The punch in the sports version obtained the maximum velocity of 5.48 s and time of 0.175 s. The punch in the traditional version obtained the maximum velocity of 7.20 m/s and time of 1.392 s. Table 2 shows the mean values of the kinematic parameters affecting efficiency of the punch while Table 3 presents the computed dynamic parameters of the strikes.

Discussion

The research results confirm the theoretical expectations. The data presented in Table 1 indicate that the mean values of velocity and time for different variants of the straight punch execution are statistically

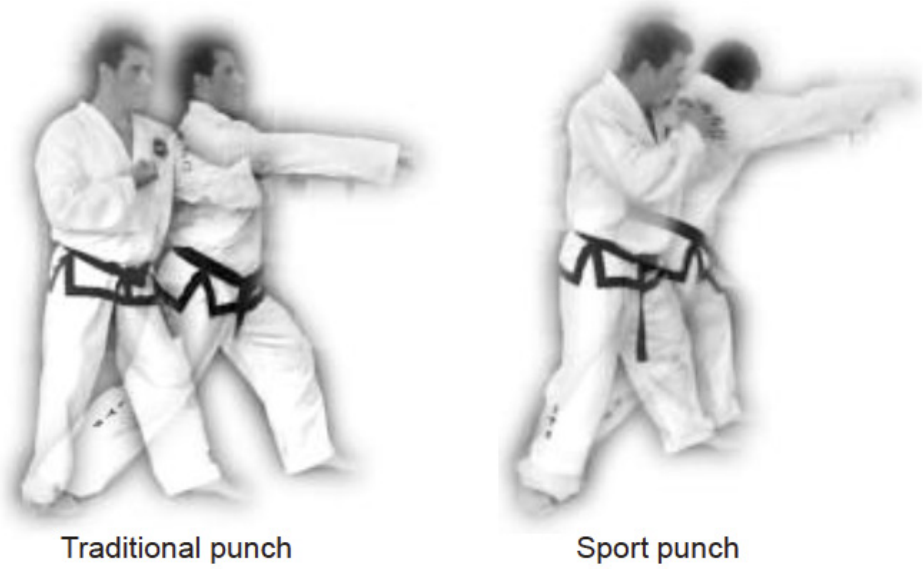

Figure 1. The structure of the movement in the traditional and sports versions of the punch in ITF Taekwon-do

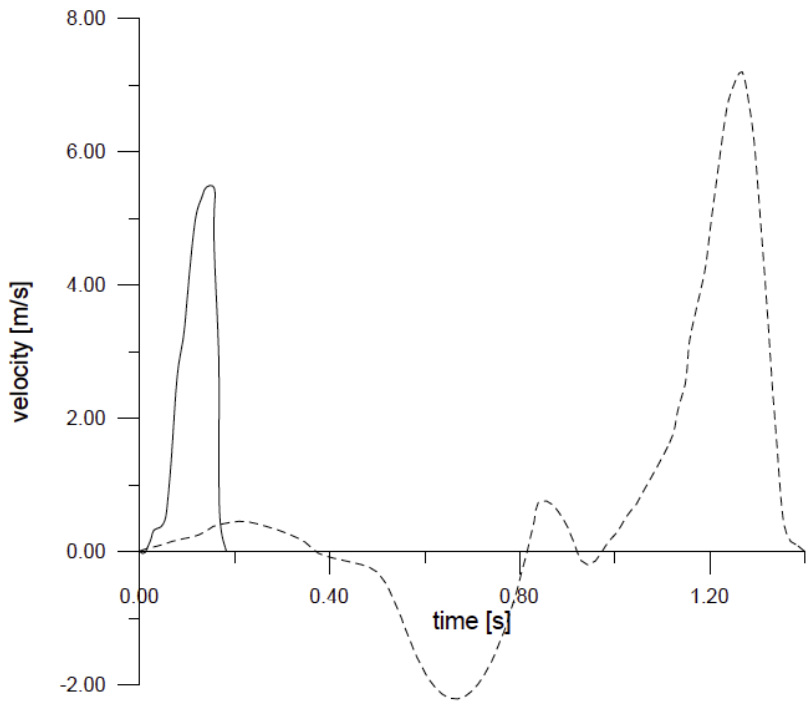

Figure 2. Example graph of fist velocity changes during execution of the straight punch: boxing style (solid line) and traditional one (broken line)

Table 1. Kinematic variables and indicators affecting efficiency of the punch

Variables and indicators	sports punch SD	Range	traditional punch SD	Range	p
Total punch duration [s]	0.170 ± 0.007	0.1590.182	1.060 ± 0.142	0.8301.330	p<0.01
Time needed to develop the maximum velocity [s]	0.162 ± 0.007	0.1521.75	0.884 ± 0.081	0.711.030	p<0.01
Velocity [m/s]	5.34 ± 0.32	4.895.92	8.46 ± 1.14	6.7110.52	p<0.01

Table 2. Calculated dynamic variables and indicators of the strikes

Variables and indicators	sports punch ± Dx	traditional punch ± Dx
Force [N]	1308 ± 173	3284 ± 555
Energy [J]	916 ± 60	2299 ± 320
Power [W]	5630 ± 247	2598 ± 283

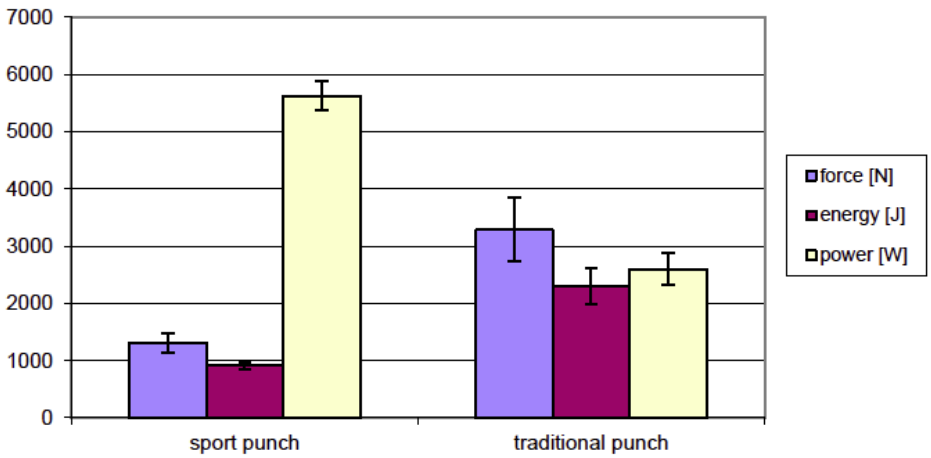

Figure 3. Dynamic parameters for the two versions of the straight punch execution

Figure 4. Athletes' opposite priorities

different (p<0.01). This makes it possible to draw a conclusion that the traditional version of the punch used in Taekwon-do ITF allows an athlete to achieve greater maximum velocities with an average of 8.25 ± 1.30 m/s than its sports version with the velocity of 5.38 ± 1.24 m/s. However, the duration of the sports strike proved to be shorter and its mean value was 0.170 ± 0.007 s, whereas the time of the traditional one was 1.060 ± 0.142 s.

The velocity values obtained in this research can be compared to the results obtained in other research studies. The sports version punch achieves velocities comparable to the ones obtained in the side kick [5], and the velocity of the traditional punch is comparable to the velocities obtained in traditional strikes delivered by karate athletes [6]. Moreover, it is greater than the velocity of the spinning kick and smaller than the velocity of the roundhouse kick performed by taekwon-do athletes [13].

Figure 2 shows the theoretical values of energy, force and power obtained in the two different versions of the straight punch execution. The traditional punch developed kinetic energy of 2299 ± 320 J and force of 3284 ± 555 N. The force of this strike can be compared to the force obtained in the roundhouse kick [9]. The other version of the punch obtained only 916 ± 60 J and 1308 ± 173 N. Thus, it was the traditional strike than managed to develop greater force and energy. However, the calculated power of 5630 ± 247 W is significantly greater in the sports version of the punch, which means a high rate of energy transfer (the traditional punch obtained only 2598 ±283 W).

The two punch versions discussed herein have biomechanical foundations for using them in Taekwon-do ITF sports events, namely in sparring and power tests involving breaking boards [25, 26]. In light contact sparring the objective is to score points. In order to

increase one's efficiency it is imperative for an athlete to react as quickly as possible as the objective is not to knock-out an opponent, but to "touch" him/her and score a point. This is connected with producing strikes having great power. On the other hand, breaking boards or other objects is a situation in which reaction time is not of a great importance as the priority involves delivering the maximum kinetic energy to the object at the moment of the strike so that the greatest amount of the work is done on the object being struck.

These two versions of the punch reflect the opposite priorities of sports combat practitioners, which is shown in Figure 4. The priority of obtaining the greatest force is on one end and the priority of the reaction time on the other. The force priority is important when there are no time limitations and the action is aimed at producing the maximum kinetic energy. The reaction time priority results from a strict time limit, when the action is aimed at producing an immediate response.

In many self-defence situations or in full contact sparring these two priorities are often confused. The main dilemma usually faced is whether to strike once with a maximum force according to once-only-opportunity rule [27] and take the risk of losing control over the body in case of a block or a dodge, or whether to reduce the energy of the strike at the cost of an immediate response. In such situation the dilemma of developing the maximum energy at the cost of a short response time might become the very difference between life and death.

The research results and considerations presented in this paper can be used for comparison in other research papers or become a springboard for further research.

Conclusion

Summing up it can be concluded that the set objectives determine the strike movement patterns. They confirm that different versions of the straight punch execution must be analysed in terms of the set priority of a strike. The traditional taekwon-do strike is meant to produce the maximum kinetic energy, which is necessary for breaking objects, whereas the sports strike needs a very short reaction time, but it generates great power, i.e. the rate of energy production; thus it works best in combat situations.

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Comparison of body hydration status before and after training in male rugby seven players in cool and warm environment

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Abstract

Background and Study Aim. The impact of natural alternation of seasons on hydration status in athletes is not known, but it is a factor influencing efficiency of the training. The aim of our investigation was to compare pre- and post- training body hydration status, a body mass (BM) changes and sweating rate in male rugby seven players in early spring and summer.

Material and Methods. Twenty four male rugby seven players participated: 13 players in March (air temperature: +4**°C,** humidity 65%), 13- in June (air temperature: +19°C, humidity 70%). The pre- and post-training urine samples were collected. Players with urine specific gravity (USG) ≤1.020 were "euhydrated", with USG 1.021-1.030 "hypohydrated", with USG >1.030 "seriously hypohydrated". Sweating intensity was calculated from the BM changes, consumed water mass, urine volume and the duration of training.

Results. The mean pre-training USG in cool environment was in norm: 1.019±0.008, but in warm conditions exceeded the boundary of norm: 1.021±0.005. The mean USG after training indicated similar hypohydration in spring and summer. The mean BM did not significantly decreased after training in cool and warm environment. Decrease of the BM >2% was observed in two athletes and for 1.5-2 % in six players only in cool conditions.

Conclusion. Fluid consumption in cool conditions was insufficient in preventing the body hydration status worsening and a decrease in BM for more than 1.5-2% in some players. The fluid consumption in warm environment better allows prevent the body hypohydration and keep the BM decrease below 1.5%.

Key words: rugby seven • sweating intensity • urine specific gravity

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Contributors: Inese Pontaga, Lilita Voitkevica conceived the study design. Inese Pontaga, Lilita Voitkevica, Liepiņa Jekaterina collected the data. Inese Pontaga, Lilita Voitkevica analysed the data. Inese Pontaga, Lilita Voitkevica, Liepiņa Jekaterina prepared the manuscript. Inese Pontaga Klimczak secured the funding.

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Conflict of interest: Authors have declared that no competing interest exists

Ethical approval: The experiments reported in the article were undertaken in compliance with the current laws of the Latvia. The study was performed in accordance with the standards of the Ethics Committee of the Latvian Council of Sciences.

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Introduction

The level of body hydration determines the aerobic capacity and psychomotor performance of athletes [1]. For example, a moderate dehydration (water loss that causes the body mass decrease by 1.5–2%) significantly reduces the physical performance and psychological condition of soccer players [2]. Pre-exercise hypohydration may result in a lower sweat rate, a more rapid rise in core body temperature and higher heart rate during workout [3, 4]. Therefore keeping the degree of dehydration within the acceptable limit lower than 2% of the body mass loss during a play match or training session may be not possible if the sport games players begin exercise in a hypohydrated state. Hence, pre-training body hydration status in rugby players should considered an important factor potentially influencing efficacy of training.

The performance of athletes is remarkably influenced by dehydration of body, which is especially important in sports where the performance lasts longer than an hour, including sports games, for example, in summertime about 0.99 – 1.93 litres of fluid (mean 1.46 litres) are lost by every soccer player during a training, whereas during a training in winter 0.71-1.77 (mean 1.13) litres of fluid are lost [5]. Loss of fluid during the training or a game is significantly influenced by the environmental factors, especially in case of outdoor sports activities (soccer, rugby) which take place in an open stadium. Therefore the sweating intensity of soccer and rugby players changes according to the weather: the air temperature, humidity and wind flow velocity. The studies providing direct comparison of pre-and post- practice body hydration status in sport games players training in different environmental conditions due to natural alternation of seasons are investigated only in limited number of investigations. For example [5], investigated and compared fluid loss by sweating in soccer and basketball players in summer and winter.

Fluid intake cannot be based solely on the subjective thirst sensation of athletes because thirst appears only after the body mass loss by 1-2% by sweating from pre- training mass. So, if fluid consumption is based only on thirst sensation, large body mass decrease will appear and considerably influence the performance of athletes [6].

Therefore it is necessary to choose method for determination of body hydration status that can be used in field conditions and give opportunity to describe body hydration status sufficiently precisely. Determination of urine specific gravity fits those criteria. It has been widely recognised that urine specific gravity (USG) over 1.020 is associated with hypohydration and USG over 1.030 is associated with seriously hypohydration of the body, referring to data provided by the American Medical Society for Sports Medicine [5] and National Collegiate Athletic Association [7]. Urine specific gravity can be determined by using three methods of fast evaluation: hydrometry, refractometry and reagent test strips. Stuempfle & Drury [8] compared the accuracy of these methods by testing representatives of wrestlers before and during competition and found refractometry to be the only accurate method to determine the urine specific gravity; in case of hydrometry 28% of results were false positive, 2% – false negative, but in case of reagent test strips (15% of results were false positive, 9% – false negative).

The aim of our investigation was to compare pre- and post- training body hydration status, a body mass changes and sweating rate in well trained male rugby seven players in early spring and summer.

Material and Methods

Participants

Twenty four male rugby seven players from the same team of the Premium League voluntary participated in our study. Two athletes from 24 participated in our investigation in moderate (early spring) and in warm (summer) environment. The investigation protocol was approved by the Ethics Comity of Latvian Academy of Sports Education. The players mean age was 26.19 ± 4.95 years. They had the mean training experience in rugby seven of 11.7 ±7.8 years and had regular trainings or play matches with duration of 2,0 ±0.7 hours four times per week (8.2 ±3.4 training hours per week).

Study design

We determined usually pre- and post- training body hydration status in well trained male rugby seven players in cool and warm environment. Therefore we asked the participants to consume the fluid as they usually do according to their subjective thirst sensation and not change their drinking habits before training and during it. The training duration was 1.5 hours in cool and in warm environment. All water bottles of every player were weighted before and after training by using of special scales Midrics1 (Sartorius, Germany) with precision of 0.01 kilogram. The urine produced by athletes after training was weighted by the same scales. The pre- and post-training urine samples of rugby seven players were collected within one day at the fourth week of March (the air temperature in that day was +4°**C, humidity 65%, without rain**

and the speed of wind 2 meters per second) and in the end of June (the air temperature in that day was +19°C, humidity 35%, without rain and wind).

Sweating intensity of every rugby players was calculated from the data of the body mass changes, consumed water mass, urine volume produced after training and the duration of training, taking into account that 1kg of water = 1 liter of water [9]:

Sweat rate (l/h) = {[pre-practice mass (kg) – post-practice mass (kg)] – post-practice urine volume (l) + fluids consumed during practice (l)}/ length of practice session (h).

Anthropometry and body composition analysis

Athlete's height was measured by Ultrasound Height Measuring Unit MZ10020 (ADE, Hamburg). Body mass was measured wearing briefs by special scales Midrics1 (Sartorius, Germany) with precision of 0.01 kilogram before and after training. Body fat percentage and total body water content in percents were measured using Body Composition Analyzer BC-418 manufactured by Tanita Corporation, Japan. Rugby players' body surface area (BSA) was calculated using the equation [10]:

BSA (m^2) = 0.20247 · height (m) $^{0.725}$ · body mass (kg) $^{0.425}$.

Urine sampling and analysis

Before and immediately after training, participants provided a midstream urine sample into a sterile polyurethane container (15 ml, Sarsted Aktiengesellschaft & Co, Germany). USG was measured within two hours after collection of the samples using digital hand held refractometer PAL-10S (Atago, USA). USG measuring range of this device is 1.0000-1.060, resolution 0,001 and accuracy ± 0.001 units.

Some discrepancy exists in the literature regarding the definitions of euhydration and hypohydration based on USG values. In particular, USG values of 1.010–1.020, which are considered consistent with euhydration according to American College of Sports Medicine [5] and National Collegiate Athletic Association [7] criteria, indicate minimal hypohydration compared with the National Athletic Trainers' Association's (NATA) more detailed classification system [6]. In the current paper, we classify our rugby players with USG ≤1.020 "euhydrated", those with USG 1.021-1.030 "hypohydrated", and those with USG >1.030 "seriously hypohydrated".

Statistics

The SPSS version 20 programs were used for statistical analysis of the data. The mean values and standard deviations were calculated for all characteristics. A dependent *t*-test for paired data groups was employed to determine differences between the characteristics before and after training, and *t*-test for unequal data groups to detect differences between the same characteristics in cool (early spring) and warm (summer) environment. The linear correlation analysis was used to determine relationships between various characteristics. Statistical significance was set at $p<0.05$.

Results

The anthropometric and body composition data of the participants are summarized in Table 1. The mean body mass index exceeded the norm 25 kg/m^2 (Table 1), its value was increased in 18 players from 24, in two players the obesity was observed: their body mass index was greater than 30 kg/m^2 (32.37 and 35.28 kg/m^2, respectively) and body fat 25.7% and 24.5%. The body fat percent above 20 % was determined only in these two athletes. The significant relationship between the age of rugby players and the body fat content in percents was not detected ($p>0.05$). The significant linear relationship was determined between the body fat content and the body mass index ($r = 0.88$, $p<0.001$). This means that the increase of the body mass index was determined by the body fat growth.

Table 1. The mean anthropometric and body mass composition data of well-trained rugby seven players before training

Characteristics of rugby seven players	Mean value ±	Variation range
Age (years)	26.19 ± 4.95	18-33
Height (cm)	186 ± 6	174-197
Body mass (kg)	92.61 ± 13.58	64.05-112.59
Body mass index (kg/m^2)	26.79 ± 3.60	18.92-35.28
Body fat content (%)	13.84 ± 5.40	5.0-25.7
Total body water (%)	63.38 ± 4.00	54.2-69.7

The mean pre-training urine specific gravity in rugby players in cool environment was 1.019 ± 0.008 (Table 2), which was in norm. Euhydration (USG ≤1.020) was observed in seven rugby players from 13 or 54 %, which was more than half of all athletes (Figure1). Hypohydration was observed in five athletes or 38% of players (USG 1.021-1.030). Only one rugby player or 8% was seriously hypohydrated (USG > 1.030).

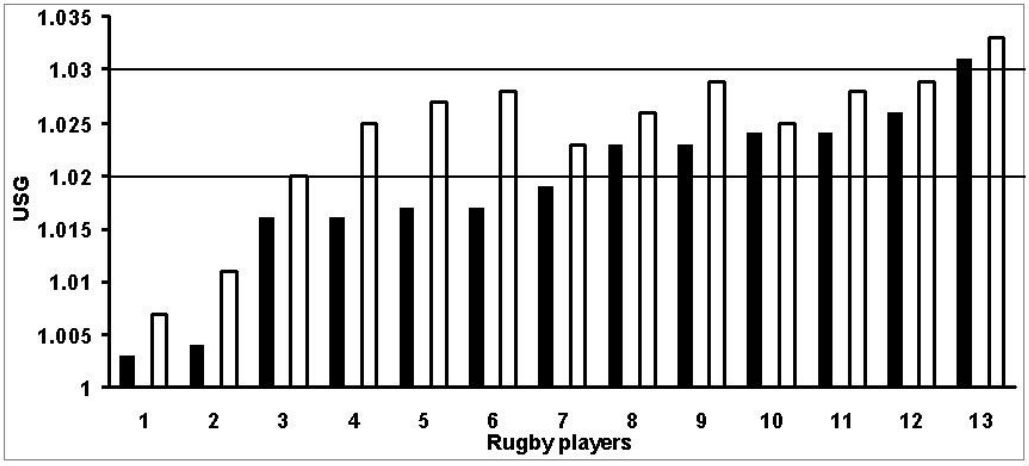

Figure 1. Individual values of pre- (■) and post-training (□) urine specific gravity in rugby seven players in cool environment (spring). Horizontal lines at 1.02 and 1.03 indicate cut-off values for hypohydration and serious hypohydration, respectively

USG varied in wide range in subjects: from 1.004 to 1.031 (Table 2).

The body hydration degree worsened after training. The mean urine specific gravity after training 1.024±0.007 (hypohydration) was significantly greater than USG before training in cool environment ($p<0.001$) (Table 2). Euhydration (USG ≤1.020) was observed only in three rugby players or 23 % from players (Figure 1). Hypohydration was detected in nine athletes or in 69 % of players or more than two thirds of rugby players (USG 1.021-1.030). Only one player who was seriously hypohydrated before the training remained seriously hypohydrated (USG >1.030) after training too. USG variation among the players was slightly smaller than before it: from 1.007 to 1.033 (Table 2).

The mean pre-training urine specific gravity in rugby seven players in warm environment was 1.021 ± 0.005 (Table 2), which exceeded the boundary of norm. Euhydration (USG ≤ 1.020) was observed in five rugby players from 13 or 38%, which is more than one third part of athletes (Figure 2). Hypohydration was observed in eight athletes or close to two thirds or 62% of players (USG 1.021-1.030). Nobody was seriously hypohydrated (USG > 1.030). USG varied in subjects in the range from 1.011 to 1.027.

The body hydration state none significantly worsened after training ($p>0.05$). The mean urine specific gravity after training was 1.023±0.006 (hypohydration) (Table 2). Euhydration (USG ≤1.020) was observed only in three rugby players or 23% (Figure 2). Hypohydration was detected in nine athletes (69 %) or more than two thirds of rugby players (USG 1.021-1.030). Only one rugby player (eight percents) was seriously hypohydrated (USG > 1.030). USG variation among the players was smaller: than before the training from 1.017 to 1.036 (Table 2).

Table 2. The mean pre- and post-training body mass and USG in well trained male rugby seven players in cool and warm environment

Characteristics	Pre-training	Post-training	Mean difference	Statistical significance of difference
Body mass (kg) in cool environment	90.75 ± 18.13	89.68 ± 17.82	−1.07 ± 0.84	Not significant, $p>0.05$
Body mass (kg) in warm environment	94.46 ± 6.92	94.08 ± 6.78	−0.37 ± 0.30	Not significant, $p>0.05$
Stat.sign.of mean body mass difference in cool and warm environment	Not signif., $p>0.05$	Not signif., $p>0.05$	Significant, $p<0.01$	-
USG in cool environment	1.019 ± 0.008	1.024 ± 0.007	0.005 ± 0.003	Significant, $p<0.001$
USG in warm environment	1.021 ± 0.005	1.023 ± 0.006	0.002 ± 0.004	Not significant, $p>0.05$
Statistical significance of USG difference in cool and warm environment	Not signif., $p>0.05$	Not signif., $p>0.05$	Not signif., $p>0.05$	-

The positive linear relationships were determined between the pre- and post-training USG in rugby seven players (Figure 3): This equation in warm environment was:

$$USG_{after\ training} = 0.166 + 0.842 \cdot USG_{before\ training};$$

where r = 0.92, p<0.001, the standard error of the equation is 0.003.

The relationship in cool environment was:

$$USG_{after\ training} = 0.039 + 0.964 \cdot USG_{before\ training};$$

where r = 0.81, p<0.001, the standard error of the equation is 0.004. This proved that the athletes' body hydration status more worsened after training if they were hypohydrated before the training.

The mean body mass of the players did not significantly decreased after one and half hour of training in cool, as well as, in warm environment (Table 2). The greatest decrease of the body mass in rugby players was 3.08 kg or three percents from the pre-training body mass which was observed in cool environment. Decrease of body mass (>2%) which could impair performance was observed only in two athletes and only in cool conditions, body mass diminishing between 1.5% and 2% was detected in six players also only in spring (Figure 4). Body mass decrease exceeded 1 % of the pre- training body mass only in two players in warm environment, in other athletes the post- training body mass decrease was <1%. Increase of the body mass for 0.38 kg in cool and for 0.33 kg in warm environment or <0.5% after training was observed only in one player in spring and one – in summer, respectively. The mean body mass decrease after training in kilograms in cool environment was statistically significantly greater in comparison with the mean body mass diminishing in warm environment (p<0.01) (Table 2). The mean body mass decrease after training in percents from pre- training body mass in cool conditions (–1.15 ± 0.83%) was significantly greater in comparison with the body mass decrease after training in warm environment (–0.39 ± 0.31%), p<0.007.

The correlation between the body fat content in percents and the body mass changes due to training was not significant (p>0.05). The correlation between the body total water content and urine specific gravity was not determined in the rugby players (p>0.05).

The mean water consumption during training in warm environment 1.169 ± 0.313 litres was statistically significantly greater in comparison with water uptake in cool environment 0.167± 0.025 litres (p<0.0001itres). Water uptake in summer varied from 0.887 to 1.288 litres, but in early spring variation of water uptake was smaller – from 0.160 to 0.250 litres.

The mean sweat loss by every player during training in cool environment was 1.25 ± 0.805 litres, but in

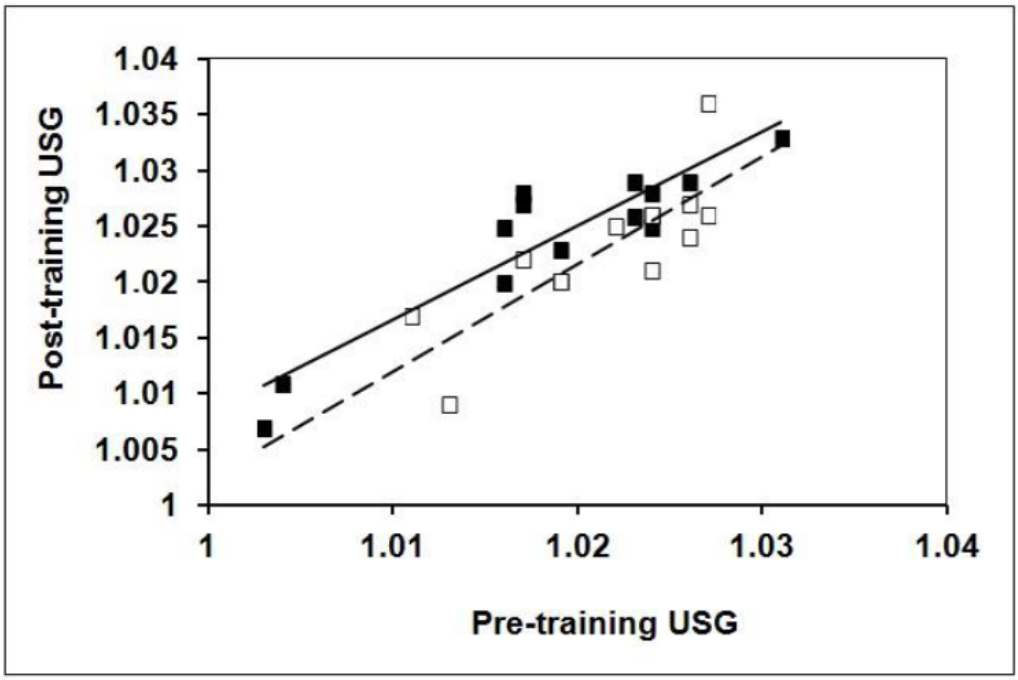

Figure 3. Relationship between pre- and post-training USG in well trained male rugby seven players: in cool environment (–□–); r = 0.92, p<0.001; in warm environment (--■--); r = 0.81, p<0.001

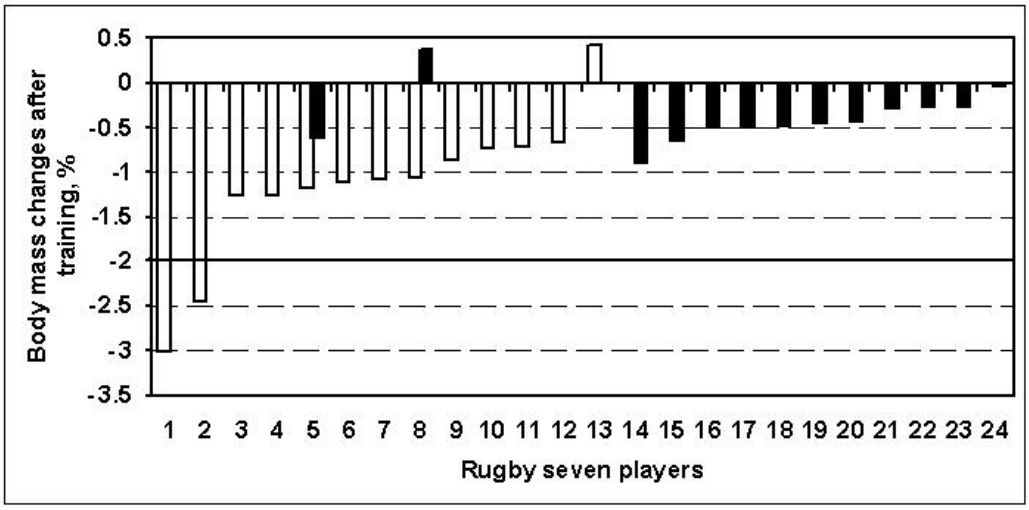

Figure 4. Individual values of body mass changes after training in well trained male rugby players in moderate (□) and warm (■) environment. Horizontal line at –2% indicate cut-off value for decrease in physical performance [19]

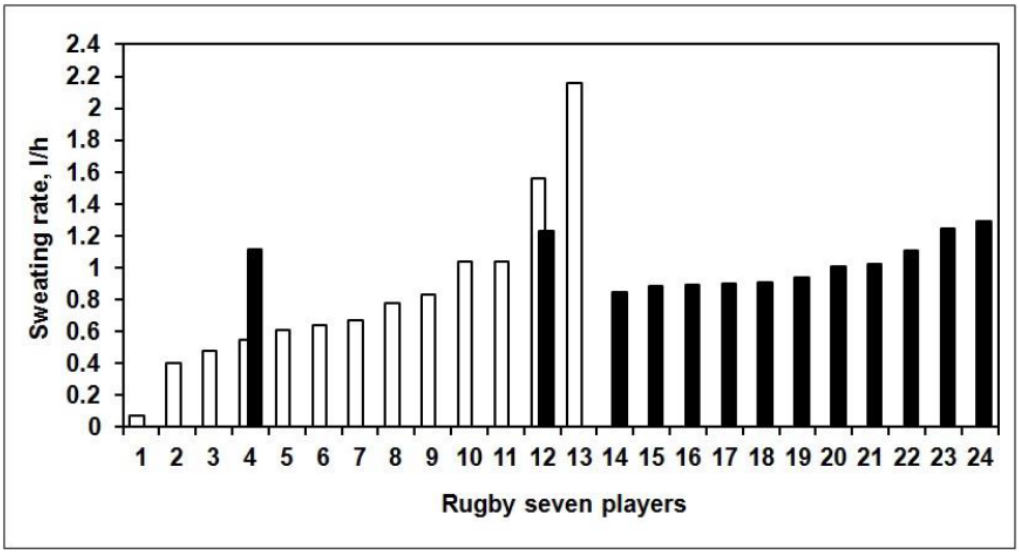

Figure 5. Individual values of sweating rate during training in well trained male rugby players in cool (□) and warm (■) environment

warm conditions 1.513 ± 0.205 litres. The mean sweating rate in cool conditions was 0.883 ± 0.537 litres per hour (l/h), but in warm environment – 1.030 ± 0.152 l/h, the difference between the mean values was not statistically significant ($p>0.05$). The sweating rate in spring varied in wide range from 0.07 l/h to 2.16 l/h, but in summer only from 0.847 l/h to 1.288 l/h (Figure 5).

The relationship between sweating rate and body mass changes during training was very close in cool environment and characterized by the equation (Figure 6):

$$BM_{changes}\ (kg) = 0.225 - 1.560 \cdot \text{Sweating rate (l/h)};$$

where $r = 0.99$, $p<0.001$ and standard error of the regression equation was 0.090 kg. The correlation between sweating rate and body mass changes during training in warm environment was not determined ($p>0.05$). The correlation between water consumption during training and sweating rate of rugby players was not significant in cool and warm environment ($p>0.05$). The correlation between water consumption and body mass changes during training was not significant in cool conditions (in spring) ($p>0.05$), but statistically significant in warm environment (Figure 7):

$$BM_{changes}\ (kg) = 0.691 \cdot \text{water consumption (l)} - 1.184;$$

where $r = 0.72$, $p < 0.005$ and standard error of the regression equation was 0.216 kg.

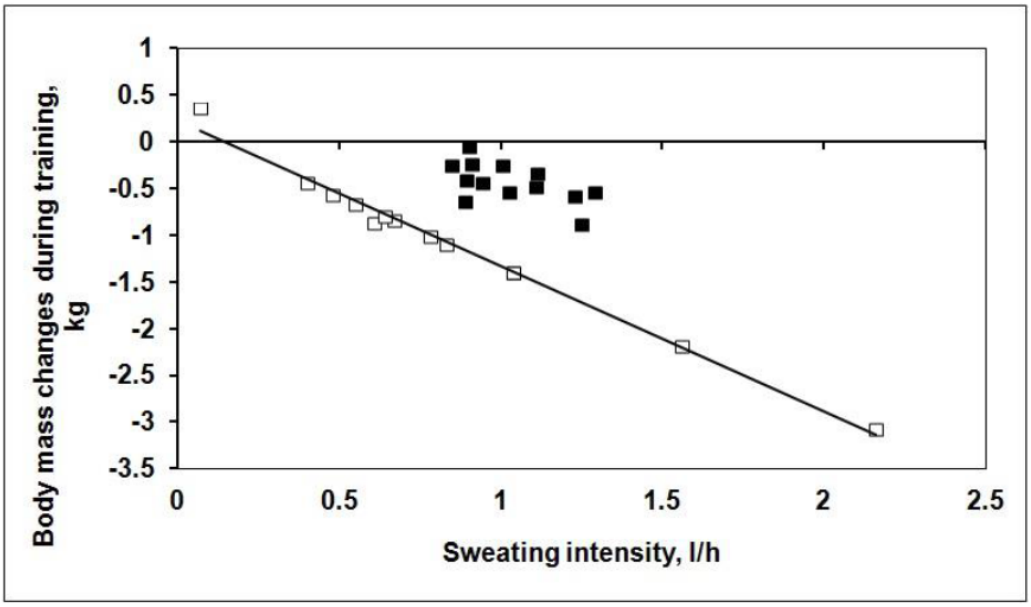

Figure 6. Relationship between sweating rate and body mass changes during training in well trained male rugby seven players in cool environment or early spring (–□–), r = 0.99 and p<0.001. This correlation did not exist in warm environment or summer (■), p>0.05

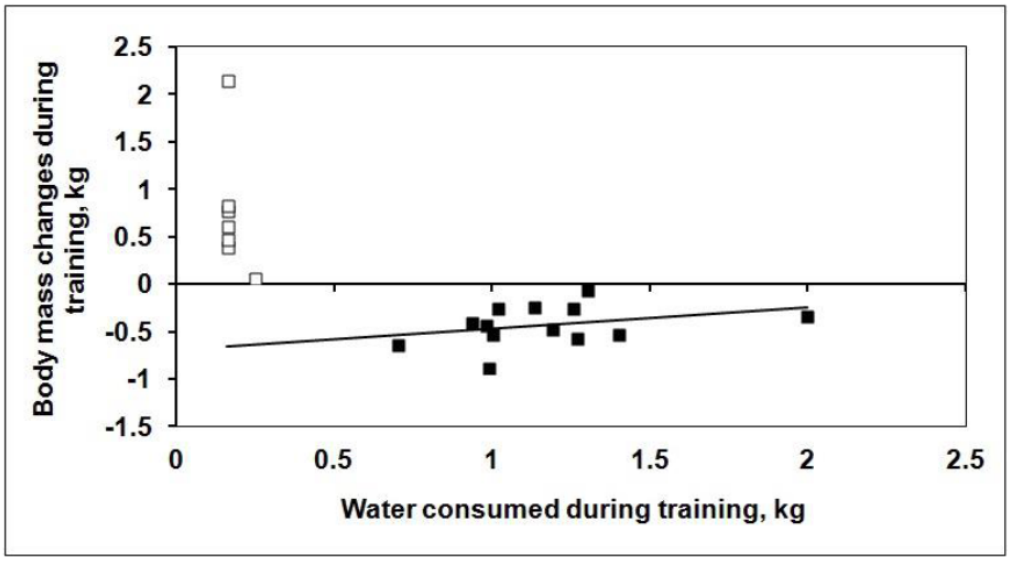

Figure 7. Relationship between water consumption and body mass changes during training in well trained male rugby seven players in warm environment or summer (–■–), r = 0.72 and p < 0.005. The correlation was not significant in cool conditions or spring, p>0.05

The mean BSA of rugby players participated in the investigation in cool conditions was 2.174±0.276 m^2, but BSA of players participated in the training in warm environment 2.202±0.102 m^2, the difference between the mean values was not statistically significant (p>0.05). The relationship between the BSA of athletes and sweating rate was statistically significant in cool environment (Figure 8):

Sweating rate (l/h) = 1.456 · BSA (m^2) – 2.334;

where r = 0.75, p<0.003 and standard error of the regression equation was 0.373 l/h. The correlation between BSA and sweating rate was not significant in warm conditions (p>0.05).

Discussion

Mean pre- practice urine specific gravity of Latvian national rugby seven team players in cool environment was 1.019±0.008 (norm), but in warm

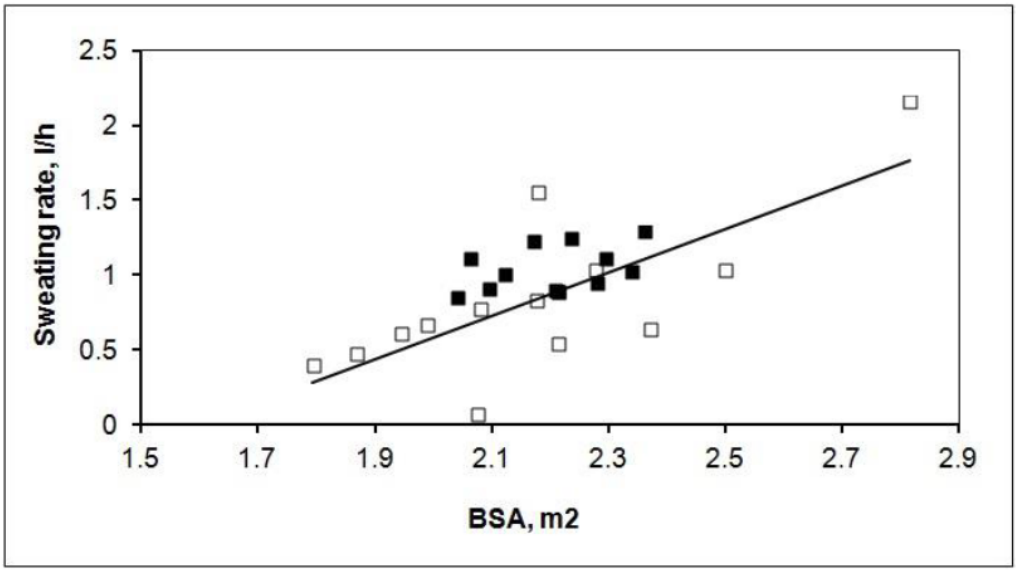

Figure 8. The relationship between the BSA of athletes and sweating rate in moderate environment (–□–), r = 0.75, p<0.003 and standard error of the regression equation was 0.373 l/h. The correlation between BSA and sweating rate was not significant in warm – environment (■), p>0.05

environment 1.021±0.005 (hypohydration), the difference was not statistically significant (p>0.05). In both: cool and warm environment the mean hydration of rugby players is close to the lowest boundary of hypohydration – USG 1.020. Controversially, in the studies of Lee et al. [11] the mean pre-training urine osmolality was 423±157 mOsmol/kg and in the investigations of Jones et al. [12] –423±157 mOsm/kg. In both cases urine osmolality indicates adequate levels of athlete's body hydration.

From our data half or more from all rugby players were hypohydrated before training from the results of USG: 46% of rugby players were hypohydrated in cool environment and 62% of rugby players – in warm environment. These results are in a good agreement with the data about high prevalence (47–60%) of pre-training hypohydration in semiprofessional soccer players [13] and in approximately half of basketball players before the play match from the data of USG [14]. Stover et al. [15] reported similar mean pre-training USG values in two big groups of recreational exercisers living in Chicago and Los Angeles, where the ambient temperature during the study averaged –5**°C** and 20.6 °C, respectively. In the pooled sample from the two cities the prevalence of pre- training hypohydration was 49%.

Insufficient fluid intake for athletes training in cold and moderate temperatures can be explained by reduced thirst sensation [16]. For example, the fluid intake volume among elite football players in a cold environment (5°C) was much smaller than the sweat loses [17]. Despite their accurate intake of fluid, runners also underestimate their sweating intensity in cool weather conditions [18]. These data are in good agreement with our results obtained in rugby seven players: fluid consumption according to the thirst sensation in cool conditions was insufficient in preventing the body hydration status worsening and a decrease in BM for more than 1.5-2% in some players, which can negatively influence the performance [19]. From our data the fluid consumption based of the thirst sensation in warm environment better allows prevent the body hypohydration and keep the BM decrease below 1.5 %.

Perrella et al. [20] detected that body hypohydration and the mean post-training BM loss of 1.5±0.7% was enough to provoke the thirst sensation. So large mean BM loss during training was not found in the rugby players tested in our study in summer and in greatest number of athletes in early spring. Therefore there was no additional stimulation to the thirst sensation in these players, which does not provoke fluid consumption during the training.

O'Hara et al. [21] determined that the mean BM loss during the rugby game was 1.28 ± 0.7 kg or 1.3% from the pre-training body mass (the mean air temperature 12.1±5.3°C, the relative humidity 70.5±11.4%). These data are in good agreement with our results obtained in early spring in similar environment (the mean air temperature +10°C, the relative humidity 65%): the mean BM loss –1.07±0.84 kg or 1.15% from the pre-training body mass. The BM decrease of our rugby players after training in warm environment

0.37±0.30 kg or 0.39% was significantly lower than in cool environment (p<0.001)). This suggests better sweat loss compensation by fluid consumption before training and during it in warm environment in comparison with cool conditions.

From the data of O'Hara et al. [21] the mean volume of consumed fluid by every rugby player during training 1.64±0.5 liters was greater in comparison with our data of the mean fluid consumption of 0.167±0.025 liters during training in cool conditions (air temperature +10°C, the relative humidity of 65%) and 1.170±0.300 liters in warm environment (air temperature +27°C, the relative humidity of 35%).

O'Hara et al. [21] observed the mean loss of sweat of every player during the training 2.0±0.7 liters, and it was greater than observed in our study 1.25±0.805 liters in cool and 1.513±0.205 liters in warm environment. This could be explained by suggested smaller load intensity and insufficient fluid consumption during trainings in our players. O'Hara et al.[21] estimated the body hydration state of rugby players from the data of urine osmolality as athletes arrived to the stadium, before the game, in the game half-time break and after the game: 396±252 mOsmol/kg, 237±177 mOsmol/kg, 315±133 mOsmol/kg and 489±150 mOsmol/kg, respectively. All these data correspond to norm.

Contrary to this we determined hypohydration of our rugby players from the mean pre-practice USG of 1.021±0.005 in summer and the highest boundary of norm 1.019±0.008 in early spring, but post-practice USG in summer (1.023±0.006) and spring (1.024±0.007) showed hypohydration in both environments. This proves insufficient fluid consumption in our rugby players in comparison with the athletes from the study of O'Hara et al. [21].

Hydration status in athletes is a factor influencing efficiency of the training. The body hypohydration observed in many rugby players especially worsen the cardiovascular system functions and aerobic performance of athletes. For example, Aldridge et al. [22] tested the influence of hypohydration on the aerobic workload capacity of rugby players in moderate environment (20°C). They found statistically significant heart rate differences between euhydrated and hypohydrated rugby players (78.4±12 and 84.9±9.4 beats per minute, respectively). These differences increased after cycle ergometry testing with duration of 30 minutes: the mean heart rate was 115.6±12.4 beats per minute in euhydrated and 123.8±12.9 beats per minute in hypohydrated rugby players (p<0.01).

Conclusions

1. Mean pre- practice urine specific gravity of Latvian national rugby seven team players in cool environment was 1.019±0.008 (norm), but in warm environment 1.021±0.005 (hypohydration), the difference was not statistically significant (p>0.05). More than half of rugby players were hypohydrated before the training: 46% in cool conditions and 62% in warm environment.

2. After 1.5 hours of training in both: cool and warm environment the hydration state of players worsened: nine from 13 rugby seven players or 69% were hypohydrated and only one player was seriously hypohydrated. The positive linear relationships were determined between the pre- and post-training USG in rugby seven players both: in cool (r = 0.92; p<0,001) and warm environment (r = 0.81; p<0,004).

3. Decrease of body mass (>2%) which could impair performance was observed only in two athletes and only in cool conditions, body mass diminishing between 1.5% and 2% was detected in six players also only in early spring. Body mass decrease exceeded 1 % of the pre- training body mass only in two players in warm environment, in other athletes the post-training body mass decrease was <1%.

4. The relationship between sweating rate and body mass changes during training was very close in cool environment (r = 0.99; p<0.001), but in warm environment the correlation between sweating rate and body mass changes during training was not determined (p>0.05). This can be explained by better body rehydration based on the thirst sensation during training in summer.

5. The correlation between water consumption and body mass changes during training was not significant in cool conditions (p>0.05), but positive statistically significant in warm environment (r = 0.72; p<0.005). Therefore increase of fluid consumption during training in summer cause diminishes the body mass decrease.

Highlights

The results indicate that in well-trained rugby seven players pre-training hydration status evaluated on the basis of USG does not differ in cool temperature early spring and warm summer. The mean USG coincides with the highest boundary of norm or lower border of hypohydration. High prevalence (46-62%) of pre-training hypohydration confirms that daily fluid uptake is not enough and the players need

evidence-based recommendations and qualified guidance for adequate fluid replacement. The results also suggest that individual-related factors such as pattern of voluntary fluid intake may have stronger impact on hydration status than environment-related factors like natural alternation of seasons.

The positive linear relationships between the pre- and post-training USG in rugby seven players both: in cool and warm environment proves, that starting the training in hypohydrated state, a player's hydration during the training and at the end of it most likely will become worse and fluid uptake during the training will not compensate fluid loss and the worsening of the body hydration status.

Decrease of body mass (>2%) which could impair performance was observed only in some athletes and only in cool conditions. The relationship between sweating rate and body mass changes during training was very close only in cool environment. This can be explained by lowered thirst sensation and therefore decreased the fluid consumption and body rehydration during training in cool environment in comparison with warm.

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Fatigue resistance of thigh muscles in sport games players

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Abstract

Background and Study Aim. Changed thigh muscles action balance can cause sports injuries. The aim of our investigation was the knowledge about effect of thigh muscles fatigue resistance on the knee flexor (Fl)/ extensor (Ext) muscles mean work (W) and power (P) ratio.

Material and Methods. Fourteen amateur male handball players participated The tests were carried out by a dynamometer system using the knee isokinetic flexion–extension movements at angular velocity of 90°/s (five repetitions) and 240°/s (20 repetitions) by the concentric contractions. The mean thigh muscles W, P and Fl/Ext muscles mean W and P ratios were calculated for the first ten and last ten repetitions. The correlation between the thigh muscles peak torques (τ_{max}) at the velocity of 90°/s, 240°/s and W, P at the first and last ten repetitions was determined.

Results. Mean W produced by the knee Fl in the last ten movements was smaller than in the first ten motions ($p<0.02$). The knee $W_{Fl}/W_{Ext}=0.69$; $P_{Fl}/P_{Ext}=0.65$ in the last ten motions were lower than in the first ten movements: $W_{Fl}/W_{Ext}=0.73$; $P_{Fl}/P_{Ext}=0.71$ ($p<0.002$). Therefore the knee joint trauma may occur more probably after fatigue appearance. The positive correlation between thigh muscles τ_{max} and W, P in the first ten and last ten knee movements ($p<0.01$) confirms that strength training of muscles will improve not only the maximal strength but also the fatigue resistance.

Conclusion. The significant positive correlation between thigh (hamstrings and quadriceps femoris) muscles peak torques and the mean work and power of the same muscles in the first ten and last ten knee *flexion–extension* movements ($p<0.01$) confirms that the strength training of these muscle groups will improve not only the maximal strength but also the fatigue resistance of these muscles.

Key words: *flexion–extension* movement • handball • knee • strength and power balance

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Introduction

The influence of knee flexor (hamstrings) and extensor (quadriceps femoris) muscles fatigue resistance on knee muscles strength ratio during *flexion–extension* movements is not investigated in wide scale. Only few authors are investigated a relationship between the knee flexor and extensor muscles strength balance and an occurrence of injuries for healthy athletes. For example, Knapik et al. [1] revealed that the thigh muscles strength imbalance measured at fast velocity of movements by isokinetic dynamometer is associated with injuries. The predisposing factors to injury are [2]: changed muscles agonists/antagonist's strength, work and power balance, lack of flexibility in the joint, insufficient warm-up before exercises and fatigue of muscles.

An investigation method of the thigh muscles strength (torques produced by the muscles agonists and antagonists) balance and the same muscles mean work and power balance is the isokinetic dynamometry. A mean value for the knee flexor/extensor (hamstrings/ quadriceps femoris) muscles peak torques ratio in concentric contraction of the muscles is approximately 60% at slow angular velocity of movement of 30º-60º/s [3-5]. The value of this ratio increases with the growth of the velocity of movements, and it is close to 80% at the fast velocity of 240º-300º/s [6-9]. Pontaga I. [10] determined that the mean knee flexor/ extensor muscles peak torques ratio of male students trained in sport games (the mean age 24,3 ± 4,5 years) at the medium angular velocity of movements of 100º/s is 61% ±7%, but at the high velocity of 200º/s this ratio is 70% ±9%. These results agree with the data of Calmels et al. [3], they obtained the ratio 55-60% at the slow velocity of 60º/s and 63% at fast angular velocity of movements of 240º/s. Changes of the knee flexor/ extensor muscles peak torques, mean work and power ratio due to repeated knee *flexion–extension* movements and caused by training or play match are not known.

If the hamstrings muscles are too weak in comparison with the quadriceps femoris muscle, it can change the muscles action balance and to create additional mechanical stresses on the knee anterior cruciate ligament (ACL) [11]. These muscles partially compensate the knee ACL ligaments functions: they restrict the anterior movement of a tibia relative to a femur and provide resistance to valgus and varus deformations of the leg in the knee joint, as well as, to rotation of the tibia [2]. Therefore weakness of the hamstring muscles can promote the knee joint trauma occurrence in sport activities.

Isokinetic muscle endurance is the capacity of a muscle to perform work, and fatigue is measured as a decline in work production over a series of consecutive contractions [12]. Total work performed over several isokinetic contractions is a valid indicator of the endurance capacity of a single muscle group. Kannus [13] showed that the total work performed during a 25 repetition isokinetic test and the total work performed for the final five of the 25 repetitions were as significant and consistent as peak torque for the measurement of muscle endurance capacity.

The aim of our investigation was the knowledge about effect of thigh muscles fatigue resistance on the knee flexor/ extensor muscles mean work and power ratio.

Materials and Methods

Participants

Fourteen amateur male athletes played in Premium league team were informed of possible test risks and voluntarily participated in the investigation. Their training experience in team handball ranged from seven to ten years. These athletes trained five times per week and played regularly on the weekends. The study was performed in accordance with the standards of the Ethics Committee of the Latvian Council of Sciences. All knee joints of the athletes were injury free and painless during the investigation. The mean age, body height, body mass and body mass index of the tested athletes equaled: 19±2 years, 187±5 cm, 79±7 kg and 22.52 ±1.51 kg/m^2.

Procedures

The tests were performed using the dynamometer system REV-9000 (Technogym, Gambettola, Italy) in the isokinetic knee *flexion–extension* movements at the medium angular velocity 90º/s (degrees per second) and high velocity 240º/s. The range of movements was from 10º in the knee extension to 90º in flexion. The person was placed in the positioning seat with the hip at an angle of 120º of flexion. The hip and trunk were fixed by stabilizing straps. The support lever was attached at the point between the upper two thirds and the lower third of the shin. The athlete was fixed in position after adjustment of the depth of the seat, the height of the dynamometer and the length of support lever to be aligned with a prolonged virtual rotation axis of the knee. The rotation axis of the knee joint was determined as a line passing through the femoral condyles. The measurements were corrected for the effects of gravity.

Passive *internal–external* rotation motions in the knee joint were performed for 90 s at an angular velocity of 120°/s just before the investigation. The athletes were given detailed verbal instructions of the procedures and performed five submaximal warm-up repetitions before the test.

The test began with the knee extension from 90º of the range of movements – extreme flexion position. The knee isokinetic concentric *flexion–extension* movements were tested at angular velocity values of 90°/s and 240°/s. The movements were repeated five times at the velocity of 90°/s and 20 times at the velocity of 240°/s. Subjects were verbally encouraged to maximally move the extremity "as hard and as fast as possible" during concentric testing. The passive *flexion–extension* motions in the knee joint were performed for 90 s at the angular velocity of 120°/s between tests of different velocities.

Peak torque (τ_{max}) values (N·m) of the knee flexor and extensor muscles were obtained from the best repetition (greatest peak torque). The mean work (W) and mean power (P) of the knee flexor and extensor muscles of the both legs were determined for the first ten and last ten repetitions of knee *flexion - extension* movements at an angular velocity of 240°/s. The mean work and power ratios of the knee flexor/extensor muscles were calculated for the first ten and last ten repetitions of movements.

Statistic

Mean values and standard deviations for all characteristics were calculated. A dependent t-test for paired data groups was employed to determine differences between the mean W, mean P, and mean W and P ratios of the knee flexor/extensor muscles in the first ten and last ten repetitions of the knee *flexion–extension* movements at the velocity of 240°/s. The differences were considered statistically significant at $p<0.05$. The linear correlation analysis was used to determine the relationships between the peak torques of knee flexor and extensor muscles at both velocities (90°/s and 240°/s) and the mean work and power of the same muscles in the first ten and last ten repetitions of movements at the fast angular velocity of 240°/s. Microsoft Excel 2007 was used to perform all statistical procedures.

Results

The mean work and power of the knee extensor muscles in the first ten and last ten flexion – extension movements did not differ significantly (Table 1). The mean power of knee flexor muscles in the first ten and last ten movements did not differ significantly. The mean work of knee flexor muscles in the last ten movement repetitions was significantly smaller than in the first ten movements ($p<0.02$).

Table 1. The mean work (W) and power (P) of knee extensor (Ext) and flexor (Fl) muscles in the first ten and last ten repetitions of the knee flexion – extension movements at the velocity of 240°/s

Repetitions	First ten	Last ten	Sign. of difference
W_{Ext} (J)	127 ± 19	128 ± 17	$p>0.05$
P_{Ext} (W)	235 ± 47	240 ± 36	$p>0.05$
W_{Fl} (J)	92 ± 11	88 ± 9	$p=0.02$
P_{Fl} (W)	161 ± 31	156 ± 24	$p>0.05$

The knee flexor/extensor muscles mean work and power ratios were lower in the last ten movements in comparison with the first ten, $p<0.002$ (Table 2).

Table 2. The mean work (W) and mean power (P) ratio values of knee Fl/Ext muscles in the first ten and last ten repetitions of the knee flexion – extension movements at the velocity of 240°/s

Repetitions	First ten	Last ten	Sign. of diff.
W_{Fl}/W_{Ext}	0.73 ± 0.11	0.69 ± 0.10	$p=0.002$
P_{Fl}/P_{Ext}	0.71 ± 0.11	0.65 ± 0.09	$p=0.001$

Positive significant correlations were determined between the τ_{max} and mean W or P of the knee flexor and extensor muscles developed by the same muscles in the first ten and last ten repetitions of knee *flexion–extension* movements at the angular velocity of 240°/s (correlation coefficients varied from 0.49 to 0.81, $p<0.01$) (Table 3).

Table 3. The correlation coefficients between the peak torque (τ_{max}) and mean work or power of knee extensor (Ext) and flexor (Fl) muscles developed by the same muscles in the first ten and last ten repetitions of knee flexion – extension movements at the velocity of 240°/s ($p < 0.01$)

Velocity of movement	Peak torque	Mean	Work (J)	Mean	Power (W)
	(N·m)	First 10 repetitions	Last 10 repetitions	First 10 repetitions	Last 10 repetitions
90°/s	$\tau_{max\ (Ext)}$	0.65	0.56	0.65	0.56
	$\tau_{max\ (Fl)}$	0.62	0.62	0.59	0.47
240°/s	$\tau_{max\ (Ext)}$	0.49	0.63	0.76	0.81
	$\tau_{max\ (Fl)}$	0.49	0.55	0.62	0.67

The correlation coefficients between τ_{max} of the knee muscles measured at the medium (90°/s) or fast (240°/s) angular velocity and mean work of the same muscles was similar (r varied from 0.49 to 0.65). The correlation coefficients between τ_{max} of the knee muscles at the angular velocity of 240°/s and mean power of the same muscles were closer (r varied from 0.62 to 0.81) in comparison with the correlations between the τ_{max} of these muscles measured at the angular velocity of 90°/s and mean power produced by the muscles (r varied from 0.47 to 0.65).

Discussion

From our data training in team handball causes better strength and fatigue resistance development in the knee extensor muscles (quadriceps femoris) in comparison with the knee flexors (hamstrings) in many players. Fatigue of the knee flexor muscles appears faster than of the extensor muscles because the mean work produced by the knee flexors in the last ten flexion – extension movement repetitions was significantly smaller than in the first ten motions ($p<0.02$). This causes significant decrease of the knee flexor/ extensor muscles mean work and power ratios in the last ten motions ($W_{Fl}/W_{Ext} = 0.69$; $P_{Fl}/P_{Ext} = 0.65$) in comparison with the first ten knee *flexion–extension* movements (($W_{Fl}/W_{Ext} = 0.73$; $P_{Fl}/P_{Ext} = 0.71$), $p<0,002$. Due to the hamstrings muscles lower fatigue resistance and relative weakness in work and power production in comparison with the quadriceps femoris muscle after many repetitions of the knee *flexion-extension* movements, the thigh muscles action balance is changed, additional mechanical stresses on the knee anterior cruciate ligament (ACL) are created and this can be a reason of the injury of ACL [11]. Therefore the knee joint trauma may occur more probably after many knee *flexion–extension* movement repetitions or in the end of the game or training in handball players.

The hypertrophy of hamstrings can appear as a compensatory reaction to knee injuries. For example, the greater knee flexor/ extensor peak torques ratio (60-70%) is observed in the operated leg of male sport games players six to 13 months after the knee ACL reconstructive operation in comparison with the contralateral legs' muscles ratios without special training exercises of hamstrings [14], as well as, in comparison with the average ratio value of uninjured people 61% ±7% in the concentric/ concentric contractions of the thigh muscles [10]. This can be explained by the quadriceps femoris muscle relative weakness and the hamstrings hypertrophy to compensate partially the ACL functions to restrict the anterior movement and rotation of the tibia in the operated leg.

One commonly held belief is that muscle hypertrophy induces increased strength at the expense of fatigue resistance or strength endurance, which is not confirmed by research data [15]. Rube and Secher [16] determined that a five-week program of static training using maximal isometric knee extensions increased fatigue resistance as tested by maximal extensions every fifth second. When the test was performed bilaterally, improvements were observed only in groups that had trained bilaterally, but improvement in unilateral fatigue was evident only in the group that had trained unilaterally with that leg. This investigation supports the positive effect of static strength training on fatigue resistance. These results agree with our data that the increase in the τ_{max} values of the knee flexor and extensor muscles at medium (90°/s) and fast (240°/s) velocity of movements positively correlated with the mean W and P of the same muscles in the first ten and last ten isokinetic knee *flexion–extension* movements at the velocity of 240°/s. Therefore, preventive knee flexor muscle strength training programs for handball players are recommended. This training would cause increase the knee flexor/extensor muscles peak torques, mean work and power ratios not only in the first to tenth repetition of the knee flexion – extension movements, but also in greater amount of movements or improve the fatigue resistance of hamstrings.

Conclusions

Fatigue of the knee flexor muscles (hamstrings) appears faster than of the extensor muscles (quadriceps femoris) because the mean work produced by the knee flexors in the last ten *flexion–extension* movement repetitions was significantly smaller than in the first ten motions ($p<0.02$). The knee flexor/ extensor muscles mean work and power ratios in the last ten motions ($W_{Fl}/W_{Ext} = 0.69$; $P_{Fl}/P_{Ext} = 0.65$) were significantly lower in comparison with the first ten knee *flexion–extension* movements ($W_{Fl}/W_{Ext} = 0.73$; $P_{Fl}/P_{Ext} = 0.71$), $p<0,002$. Therefore the knee joint trauma may occur more probably in the end of the game or training.

The significant positive correlation between thigh (hamstrings and quadriceps femoris) muscles peak torques and the mean work and power of the same muscles in the first ten and last ten knee *flexion–extension* movements ($p<0.01$) confirms that the strength training of these muscle groups will improve not only the maximal strength but also the fatigue resistance of these muscles.

Highlights

The knee flexor/extensor mean work and power ratios decrease due to faster fatigue of hamstrings in comparison with quadriceps femoris is observed in sport game players. This can cause knee joint trauma. Strength training of hamstrings will improve the fatigue resistance of these muscles.

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An invitation to study Budo for the disabled – Is Budo good for the disabled? Is Budo for the disabled good for Budo?

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Abstract

Nowadays, a majority of people thinks that a person with disabilities can practice Budo. However most people believe that Budo teachers have to prepare some special care and overall privilege for the disabled students. Indeed it may be so, but it should not be a matter that burdens the Budo instructor: through practicing with the disabled persons the teacher becomes aware of the original intention of Budo techniques. The body movements of Budo were made for actual battlefield combat, in ancient Japan. This means that Budo had, since it originated, been an open system for persons with disabilities. Indeed, Samurai had to think about how to fight after receiving injuries on the battlefields. From that point of view, we are confident that we can share the Budo training methods with disabled people and others. For instance, the coaching methods used for the mentally challenged can be benefic for the beginners and the elderlies as well.

I have collected many testimonies from disabled participants regarding the rehabilitative benefits of Budo practice. However I could not get scientific evidence through the comparison of two large groups of disabled - those who practiced Budo and those who did not. The main reason is there are only a few people with disabilities who practice Budo. In order to increase the number of disabled people practicing Budo, I would like to invite you to consider this research field. There is such a wide range of symptoms, conditions, or needs, even for people who suffer from the same disability. This makes designing large studies (which usually require a certain homogeneity) practically impossible. Therefore, this field is very rich in term of study possibilities. There are many opportunities for single case studies and they all help forge the future of the disabled and Budo.

Keywords: body movements • injuries • rehabilitative benefits

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Why Japanese *budo* enthusiast study foreign martial arts? By the case study of the Chinese martial arts pioneer Ryuchi Matsuda's works and his thought based on Japanese traditional *budo* thought

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Abstract

Background and Study Aim. There are many forms of traditional martial arts in Japan, however, among all martial arts enthusiasts, only some dare to choose to receive the training of foreign traditional martial arts. Why they chose to practice these martial arts? And based on what kind of *budo* thought that led them to such choices? The purpose of this study is the relationship between localization of foreign martial arts and domestic *budo* thought by the case of traditional kung fu (Chinese martial arts) in Japan. Specifically, this study intends to clarify the introduction of kung fu to Japan was led by critical thoughts based on Japanese *budo* thought through Matsuda's life history and his concepts of *budo*.

Material and Methods. Ryuchi Matsuda (1938-2013) is one of the most influential pioneers of kung fu in Japan. This historical study mainly based on Matsuda's writings since 1970s. More specifically, this study analysis his autobiography "Nazo no kenpo wo motomete" (A quest for mysterious kung fu) [1], "Matsuda Ryuchi no kenyuki" (The journal of Matsuda Ryuchi 's travels to quest a fist) [2] and "Matsuda Ryuchi no zoku kenyuki" (The sequel journal of Matsuda Ryuchi 's travels to quest a fist) [3] , and "Kenji" which is a series of comic books written by him as well [4-7].

Results. 1) Under the influences of his father, who is a kendo teacher, Matsuda was exposed to many classics about traditional swordsmanship masters in his childhood. Though with deep admiration toward these masters, he thought it is impractical to carry a real sword in modern society, thus "replacing sword with fist" and developing a strong *atemi* (attack without any weapon) into sword-like is the only solution to reach the achievement of those masters. To master the art of *atemi*, he received various kinds of trainings, including wado, shotokan, goju school of karate, and he also travelled to find kobudo (ancient styles of Japanese martial arts) masters in his school days. Among all experiences, the training of Gigen School left him with a strong impression. It was strict and rough swordsmanship training for a week in the last of high school days. After this experience, it became his lifework to master powerful *atemi* such as this school without sword. This could said to be a decisive experience that makes him determine to master his *atemi* to be powerful as Gigen, only without sword.

2) Meanwhile, as karateka, Matsuda gradually realized that only young and strong bodies could withstand the training modernized *budo*. Thus, he indulged into kobudo trying to find out skills and abilities without depending on youth power and strong physicality after graduated from high school. However, kobudo could not satisfy his need to master in *atemi*, since many kobudo mostly use throwing and submission skills. He started to study kung fu in Taiwan and mainland China from the 1970s. After contacting with kung fu, he firmly believed that kung fu has a set of skills and training methods could help to achieve the "best *atemi*". Finally finding an appropriate training method to master "best *atemi*" in the late 1990's, he thus started to practice *atemi* 3,000 times every day, with a goal of 10 million times in total. On a morning in 2013, he suffered an acute myocardial infarction, and 2 days later he passed away at the age of 75 years old. He was still practicing his *atemi* few hours before his heart attack. The number of *atemi* he achieved was estimated around 2,917,200 times.

3) Matsuda introduced the history, custom and skills of kung fu through articles in martial arts magazines and other writings. In addition, he was concerned with comics "Kenji" as writer. The story mainly develops around the protagonist "Kenji" and his journeys of searching for famous masters and the following trainings, in Taiwan, Hong Kong and China. The story is generally based on Matsuda's life history and his lifelong devotion in questing for the "best *atemi*". For Japanese martial arts enthusiasts, this series of comics not only introduces the knowledge of kung fu, but also creates a reference model for them, demonstrates that being Japanese, how to learn kung fu.

Conclusion. 1) The studying and practicing traditional foreign *budo* by Matsuda has established him as the pioneer of kung fu in Japan. However, his original intention was to master the "best *atemi*" interest in order to replace sword in modern society. Such concept was based on typical Japanese *budo* thought, and with the aspiration to become a traditional Japanese *budo* master.

2) Based on Japanese *budo* thought, Matsuda established a new style through his studying foreign traditional martial arts. He also criticized the sportization of *budo* and the losing of original spirits. The embodiment of his ideas towards Japanese *budo* could be found in the protagonist of the comic, which based on his own life story.

Keywords: Hirokazu Kanazawa • Masutatsu Oyama • Liu Yun Quao • Yukiyoshi Sagawa • Su Yuzhang

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Table 1. Matsuda's life and martial arts history

Year	Life history	Martial arts history (learning experiences are "☆" and related important persons are "◯")	Publication and Mass Media
1938	Born in Aichi		
1945	His family suffered a great airstrike and moved to their grandfather's house	Encountering with the book "Musashi Miyamoto" by Eiji Yoshikawa in grandfather's house and the admiration towards traditional great swordsman began to grow	
	Elementary school days	Began practicing Karate by his own style	
	Junior high school days	☆Wado Ryu Karate in Aichi	
	High school days	☆Goju Ryu Karate (Masutatsu Oyama, Seigou Yamaguchi) in Tokyo during summer and winter vacation ◯Kenichi Sawai (Taiki-ken) ◯Tatsuo Yamada (Nihon kenpo) ◯Hiroshi Kinjyo (Okinawa Karate) ◯Kotaro Yoshida (Daito Ryu) ◯Seiko Fujita (Ninjyutu) ◯Gentyo Yagyu (Sinkage Ryu)	
	Moved into a temple due to involving into a fighting his final year of high school	☆Gigen Ryu Ken Jyutsu (Shigemasa Togo)in Kagoshima ☆Kenbukan Karate in Wakayama	

Year	Life history	Martial arts history (learning experiences are "☆" and related important persons are "◯")	Publication and Mass Media
1957	Began his work in Toyota Company, but resigned after 4 months, and working part time after	☆Boxing in Aichi	
1959		☆Daito Ryu (Yukiyoshi Sagawa)	
1961		☆Basic skills of Xing Yi Quan (Wang Shu Jin) in Meiji Jingu ◯Shimazu Kenji (Yagyu singan Ryu)	
1964	Got married		
1967	Moved to Tokyo	☆Basic skills of Xing Yi Quan and Ba Gua Zhang (Kinbei Sato) in Tokyo	"The study of Chinese martial arts" in *Modern Karate* (newspaper of Kyokushin kaikan)
1969		☆Shosho Ryu in Morioka (Kyozo Takahashi) ☆Xing Yi Quan (Hong Yi Xiang) in Tokyo	
1970		☆Xing Yi Quan (Hong Yi Xiang) in Taiwang ☆Bajiquan (Su Yu Zhang) in Taiwang	
1971	Became a Buddhist and given his Buddhism name as "Ryuchi"		"The note about Shaolinquan" in *Tyuo koron*
1972		☆Yan Qing Quan and Ba Ji Quan (Liu Yun Quao), Chen style Tai Ji Quan (Xu Ji in Taiwang	· The Oriental Secrecy of making a Strong Body · Chinese Martial Arts: Shaolinquan and Taijiquan
1973	He work in Buddism temple till 1974. The movie "Enter the Dragon" was released on December in Japan.	☆Ba Gua Zhag(Liu Yun Quao)	· *The Introduction of Tai Ji Quan* · *The Chinese Secret Method of Making a Tough Body* · *The Introduction to Shao Lin Quan*
1974		◯Hirokazu Kanazawa (Karate) ☆Double sickle and chain	· Comic "Otoko Gumi", Supervisor (1979)
1975		Established „Orient Traditional Martial Arts Study Group" in Waseda University	· *Quest for Mysterious Martial Arts*
1976	Travel to India and Nepal for Buddism Study		· *Introduction of Chinese Martial Art by Picture* · *The Illustration and History of Chinese Martial Arts*
1977	Travel to India and Pakistan for Tibetan esoteric Buddhism study	Changing the name of „Orient Traditional Martial Arts Study Group" into „Chinese Martial Arts Study Group" in Waseda University	· *Introduction of the secrecy of Chen Style Tai Ji Quan* · *Introduction of Mi Men Tang Lang Quan* · *Introduction of Chinese martial Arts*
1978	First visit to People's republic of China		· *The Secret of Japanese Jujyutu*
1979		☆Chen style Tai Ji Quan (Xu Ji) in San Francisco	· *The Chinese Martial Arts for Illustration of Real fight situation through photographs* · *Introduction to Xing Yi Quan* · Martial arts instructor in special TV series „Megaro Man" (Fuji TV)
1980		Visited Beijng, Zhengzhou, Luoyang, Xi'an, Shaolin temple. ◯Chen Xiao Wang(Chen style Tai Ji Quan) ◯Hou Chun Xiu(Zhao Bao style Tai Ji Quan)	· Acting in Children's programs „Open ! Ponkikki" (Fuji TV), „Here is Information Section" (NHK)
1981	Participated "Pan-Asia culture centre"		· *The World of Chinese Martial Arts* (The first special volume of kung fu)
1982	The movie "Shao Lin Temple" was released on November in Japan	Visited Shanghai, Xi'an, Zhengzhou, Baoding, Cang xian, Chen Jia Gou, ShaoLin temple, Beijing ◯ Ma Xian Da, Ma Ming Da (Tong Bei Quan) ◯Wang Xi'an, Zhu Tian Cai (Chen style Tai Ji Quan) ◯Wu Lian Zhi (Wu style Ba Ji Quan) ◯Zhang Shi Zhong (Li style Ba Ji Quan) in Tokyo.	· The Introduction of Northern Chinese Martial Arts illustrated by sequence photographs. · Martial arts instructor in *The Story of a Police Detective* (movie ,Vol. 1 to 5, ~1987) Supervising editor in *Wu Shu* (First Kung-Fu magazine)
1983		☆Wu style Ba Ji Quan (Wu Lian Zhi), Yin Yang Ba Pan Zhang (Xu Yong Xiang), Ying Zhao Fan zi Quan (Chen Zheng Hui) in Shi Jia Zhuang ☆Tong Bei Quan (Ma Xian Da) in Xi'an	

Year	Life history	Martial arts history (learning experiences are "☆" and related important persons are "◯")	Publication and Mass Media
1984	Became executive committee in "Japan traditional Martial Arts Convention"	Visited Beijing and Xi'an and meet Ma Xian Da and Chen Li Qing for arrangements of *Japan and China Martial Arts Friendly Demonstration Exchange Convention*	· *Qi Xing Tang Lang Quan by sequential photographs* · *The mysterious Kung-Fu, Instruction to Ba Gua Zhang*
1985	Part-time lecturer in Tokyo University. He became a formal pupil of Ma Xian Da in Xi'an	An executive committee in *Japan and China Martial Arts Friendly Demonstration Exchange Convention* ☆Chen style Push Hand (Chen Li Qing, Chen Xiao Wang, Wang Xi An)	· *Jiao Men Chang Quan*
1986	Visited China as Japan *budo* representative. Special lecture of All Japan Tai Ji Quan Association.		· *Luo Han Quan, Shao Lin Kung-Fu, From Basic to Fighting techniques.* · *Traditional China, Kai Men Ba Ji Quan.* · *Poem of Fighter (Video)*
1987	Experimentation on the power of "one inch punch"	◯ Zhu De Bao (Qiang style Ba Ji Quan) in Cang Zhou.	
1988		☆Qiang style Ba Ji Quan(Zhu De Bao), Mi Zong Quan in Cang Zhou	· The Soul of Art (Collection of conversation) · "Kenji" (Comics, writer, ~1992)
1991		☆Xin Yi Ba, An Hui style and Luo Yang style Xin Yi Liu He Quan in China	
1992		Study of Dai style Xin Yi Quan in Shan Study of Xin Yi Ba in Shao Lin temple	"Traditional Training of Chinese Martial Arts" in *Sports sciences*
1993		☆Xin Yi Liu He Jian in He nan. Study of Tang Ping Seven Style ◯Huo Wen Xue, Fan Chuan Yi (Chang Chun style Ba Ji Quan) ◯Xu Cai, Kang Ge Wu in Beijing	
1994	Received Mantra from a Tibetan eminent priest		
1996	Participated Tai Ji Quan International Competition in He Nan	Study Xin Yi Ba in Shao Lin temple	
1997		☆Qiang style Ba Ji Quan (Zhu De Bao) in Cang Zhou	
2000			"Cosmic Dance, Ba Gua Zhang" in *Tonpa*
2003	Began his practicing of 1 million repetition of Peng Quan (Xin yi Quan) from December		
2004	Achieved his one million goal in April. Started practicing 1 million repetition of Chong chui (Ba Ji Quan) from July	☆He start to practice Wu style Ba Ji Quan at Wu Lian Zhi's Training session in Japan	Kung-Fu magazine "Wu Shu" publication terminated
2005	Finished 1 million times at February. Started practicing Chong Chui with the aim of 10 million times.	☆Wu style Ba Ji Quan (Wu Lian Zhi)	The journal of Matsuda Ryuchi,s travels to quest a fist
2006		☆Wu style Ba Ji Quan (Wu Lian Zhi)	The serial journal of Matsuda Ryuchi,s travels to quest a fist
2007		☆Wu style Ba Ji Quan (Wu Lian Zhi)	
2008		☆Wu style Ba Ji Quan (Wu Lian Zhi)	
2009		☆Wu style Ba Ji Quan (Wu Lian Zhi)	
2010		☆Wu style Ba Ji Quan (Wu Lian Zhi)	
2011			The innermost secrets, Fa Jin and basic techniques
2012			The innermost secrets, lethal technique and practical usage
2013	Passed away at 24, July	Visited Wu Lian Zhi in Japan in April	
2015			Quest for Mysterious Martial Arts, augmented edition

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Dealing with anger by taekwondo practitioners of a different level of advancement and age

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Abstract

Background and Study Aim. There are data revealing that effective dealing with anger, frustration and irritation has an adaptive meaning. In the light of literature, the dominance of these feelings is connected with a long-lasting stimulation of a sympathetic system. Due to many researchers, experiencing severe anger and fury is a skew in perception that exaggerates the negative qualities of things.

The main aims of the study was: 1) the methods of dealing with anger among adolescents and adults who practice taekwondo and 2) the dependencies between dealing with anger, age and the level of advancement in taekwondo.

Material and Method. *Group:* The sample group was composed of 70 people who practice taekwondo, average age 21.34 (age range: 10-45 years), median 17, standard deviation 9.82. *Research tools:* Questionnaires used in psychology and health promotion were applied in the research (Novaco Anger Scale and Anger Expression). Sufficient psychometric value is attributed to them. Data were also collected by means of an independently developed survey. *Statistical analysis:* Due to the fact that the obtained data are of a self-descriptive character (they derive from surveys and questionnaires), the analysis was performed with the application of the methods that are recommended for proceeding "non-acute", imprecise data that frequently appear in the humanities, health science and economics. Explorative techniques that aim at identifying subgroups within multidimensional data collection were applied. Among others, cluster analysis with the use of k-means clustering was done. Thanks to the above, clusters, that possibly differ from one another, were identified (minimizing variations inside clusters- maximizing between clusters).

Results. Data concerning expression of experienced anger i.e. targeting anger – to inside and outside (suppressing/extinguishing and revealing anger) were obtained. The information refers to general situations and reactions that are usually revealed, typical for a particular person. The second type of the obtained data covers information about intensification of experienced negative feelings in typical situations- from very little irritated, though little irritated and moderately upset, to very angry. In the sample group clusters were identified on the basis of *F* values and levels of relevancy. The practitioners that characterize of a higher level of advancement can tackle anger to a higher degree. They possess a wider spectrum of reactions in the situations that provoke crossness, irritation and anger.

Conclusion. Through practicing taekwondo a mental factor is increased. Self-control, self-assurance and the ability of maintaining the balance between manifesting and controlling anger are increased.

Key words: psychometric value • self-control • self-assurance • dealing with anger • level of advancement • age.

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Rates of injuries in martial arts and combat sports on the example of two taekwon-do styles

Zbigniew Bujak, Dariusz Gierczuk, Mirosław Zalech

University of Physical Education in Warsaw, Branch in Biała Podlaska, Poland

Abstract

Background and Study Aim. The objective of this study was to describe the characteristics and rates of injuries during the martial arts, self-defense and combat sports competitions on the example of two types of taekwon-do: ITF and WTF.

Materials and Methods. Different kinds of sports competitions in which 4000 competitors participated and were exposed to injuries, have been examined. The records of 15 medical reports from ITF competitions in Poland and scientific studies (taekwondo WTF) have been used in this research. The rate of injuries was calculated by means of the following formula: # of injuries / # of athletes exposed to injury x 1000 = # of injuries per 1000 athletes exposed to injury (A-E).

Results. The average rate of injuries during ITF taekwon-do competitions was 111.6/1000 A-E (95%CI 91.8-131.3), however, for WTF it was (men and women) 82.8/1000 A-E (95%CI 76.3-89.3) and 87.0/1000 A-E (95%CI 76.8-97.2). A bigger number of injuries occurred during ITF junior competitions 117.7/1000 A-E (95%CI 106.6-128.8). When compared to other sports disciplines, the injuries rates in both taekwon-do styles were on an average level.

Conclusions. The age and the level of influence on the number of injuries during competitions, however, the power of punches and kicks limited by competition regulations does not decide about the rate of injuries. There is no homogenous method of recording and assessment of injuries in martial arts and combat sports.

Key words: Rates of injuries • ITF taekwon-do • WTF taekwondo

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New judo rules impact in the fight dynamics – 2013 and 2014 world championships data preliminary exploratory analysis

Jorge Gonçalves, Luís Monteiro, Luís Chambel, Margarida Cardoso

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Abstract

Background and Study Aim. Following previous changes, new rules are applied to Judo competition since January 1, 2014. Some of the new rules may impact Judo fight dynamics. Among the new set of rules, the female fight time decreases from 5 to 4 minutes and new penalties (Shidos) are introduced. This study is a preliminary exploratory analysis of that impact based on the 2013 and 2014 World Championships fights. The 2015 World Championships will also be included in future work.

Material and Methods. The 2013 World Judo Senior Championships involved 673 senior judokas (415 male, 258 female) from 123 nations in 715 matches. The 2014 edition involved 637 athletes (386 male, 251 female), 110 countries, 679 matches. Each match was videotaped. Two separate databases resulted from the analysis of the of fights:

Fight structure database with time spent standing (with and without grips), in the floor and with the fight paused, classified by minute of the fight.

Fight action database, each attack or pause (due to shido) being characterized by its effect (score, shido or no result), cause for shido, gripping (kumikata) positions, ne waza and ne waza score, all classified by minute.

Results. The preliminary exploratory analysis presented (based solely on the Fight structure database) suggests that there is a total time (includes pauses) decrease in the female fights (all weight categories) from 273 to 233 seconds. There is also a decrease in the real time (no pauses included) from 199 to 179 seconds (again considering all categories). There are marked differences in the that pattern when the analysis is further refined, with the lighter (-48 kg) category showing no difference in total fight times before and after the rule changes.

Conclusion. In what concerns male fights, having no time rule changes, fight times were globally similar in both years. However, when weight category is considered, there are some variations, possibly explained by an evolution of the referees' interpretation of rules introduced in 2013 (with a larger or smaller influence on fight times depending on the diverse fight dynamics in the different weight categories).

Keywords: judo • new match rules • world championships • impact assessment

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Martial arts bibliotherapy – the prospect of support of Aggressiveness therapy based on cognitive-behavioural methods

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Abstract

Introduction. The term *bibliotherapy* has appeared for the first time in *Atlantic Month* journal in 1916 and was defined in *Oxford English Dictionary* in 1920. In 1923, American Library Association (ALA) published the first in the world instruction about selection of book collections for patients [1]. From 1966 ALA has accepted, that bibliotherapy is an usage of selected reading materials as a therapeutic support in medicine and psychiatry, and also guidance in solving personal issues through dedicated reading [2]. Bibliotherapy is a form of mental support and has application in psychotherapy.

The objective of this work is an argumentation justifying the creation of support's patterns for people susceptible of learning aggressive behaviour (preventive aspect) and for people with diagnosed aggressiveness (therapy aspect).

The objectives of bibliotherapy. The objectives of bibliotherapy are mostly connected with RJ Rubin's division [3] for three categories: institutional, clinical and developmental. The main objective of institutional bibliotherapy is an application of didactic literature and an assurance of appropriate recreation. The objective of clinical bibliotherapy is a treatment of disorders and developmental bibliotherapy is focused on correction of an attitude, compensation and self-fulfillment.

Recipient – theory – practice. There are at least six target groups for bibliotherapy: ill persons, impaired persons, antisocial persons, students of various types of schools, parents and teachers, adults above 60 years old [1].

Theory and practice of bibliotherapy include following spheres of human: mental, intellectual, social and emotional. Because of its wide influence on human, it could be helpful in modification of his behaviour. These are important aspects connected with quality of life, fulfillment of needs (including personal and loved ones safety in view of escalation of violence and aggression), personal identity and creative attitude. Methodology of bibliotherapy is based on literary, psychological and increasing influence of praxeological principles. In the area of interest primal specific means of influence on reader such as text, plot and characters remain unchanged.

Clinical effects. Results of clinical studies from last 15 years has given us evidences of high effectiveness of bibliotherapy in various kinds of mental disorders [4-11] (Table 1).

Table 1. Results of bibliotherapy in various kinds of mental disorders (selected clinical studies from last 15 years)

Authors	Mental disorder	Applied form of bibliotherapy	Result
Wright J et al. [4] 2000	panic attacks, panic cognitions, anticipatory anxiety, avoidance, and depression	relapse prevention (RP) program delivered via bibliotherapy in the treatment of individuals with panic attacks	"clinically significant change" in status on both panic-free status and level of avoidance
Naylor E et al. [5] 2010	depression	*Feeling Good* (Burns DD,1999 [11]	behavioural prescription for *Feeling Good* may be as effective as standard care, which commonly involves an antidepressant prescription.
Högdahl L et al. [6] 2013	bulimia nervosa (BN) and similar eating disorders (EDs),	cognitive behavioural therapy based on guided self-help (CBT-GSH) via the Internet	results showed that both groups attained significant improvements in core- as well as related ED symptoms in both instruments.

Authors	Mental disorder	Applied form of bibliotherapy	Result
Rohde P et al. [7] 2014	self-assessed depressive symptoms	*Feeling Good* (Burns, 1980),	Condition differences in major depression onset were nonsignificant but suggested support for CB interventions
Sharma V et al. [8] 2014	stress, anxiety	effectiveness of a self-directed Stress Management and Resil- iency Training (SMART) program delivered using only written material	A statistically significant improvement in perceived stress, resilience, mindfulness, anxiety ,and quality of life was observed
Lewis K et al. [9] 2015	children's nighttimes fears	The treatment protocol involved parents reading Uncle Lightfoot, Flip that Switch: Overcoming Fear of the Dark, Academic Version	clinically significant change in anxiety severity. In addition, decreases in child-reported nighttime fears were observed
Rus-Makovec M et al. [10] 2015	alcohol addiction	comprised two texts without reference to alcohol dependence ('Der Panther', Siddhartha), two displaying a critical attitude to alcoholism, by describing its negative aspects (John Barleycorn, L'Assommoir) positive approach to alcoholism (The Pickwick Papers, 'In Taberna Quando Sumus')	Even short passages from literary works, appropriately and expertly differentiated, served to trigger or reinforce mentalisation-based reflective processes in addiction psychotherapy

Perspectives Interdisciplinary of bibliotherapy (culture therapy) and its broad connections with medicine, psychiatry, pedagogy, mass culture etc., paradoxically could be one of the most effective means of *catharsis* for a men stunned by electronic media that shows virtual and real destructive fights, neo-gladiators games and aggressive competition in many sports [12-14]. Meanwhile mass (global) education did not provide knowledge and there is lack of development of skills necessary to opposing effectively those highly destructive actions for human personality.

Elaborated methodology of bibliotherapy can be a foundation of general principles of counteraction in this difficult situation, where main means of acquiring knowledge of this phenomena are description of struggle of characters in belles-lettres, didactic and scientific literature. Some people may find interest in exploration of knowledge about struggle in literary descriptions about foiling an alien invasion, and others – in studying scientific papers from the field of agonology (science of strugle [15,16]) or science of martial arts [17].

Keywords: agonology • clinical studies • theory and practice of bibliotherapy

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The study on educational property of japanese budo –based on the formation of the *Bushi* status in the early modern period

Kentaro Tai

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Abstract

Background and Study Aim: Against the backdrop of the increasing expectations placed on budo instruction, many of the basic concepts behind the traditional Japanese martial arts are unclear. Therefore, by focusing on the early modern period, which was a time of reform in the Japanese martial arts' culture, this paper aims to clarify the process through which bugei, from the early modern period, became enmeshed in the educational qualities that are fundamentally connected to budo in the present day.

Material and Methods: In concrete terms, I use Heihosho – a book about military tactics that can be called a text on thought, the art of war, and politics – to consider the process through which the Bushi formed a sense of self in early modern times.

Results: The process of forming the warrior's status through physical techniques in the early modern period, to consider the process through which the Bushi formed by: 1) The Yamaga-Ryu Heiho thought as the ideal bushi, 2) The kind of physical training in the Heiho practice, 3) The process of forming the warrior's status through Physical Techniques.

Conclusions: In *Heihosho*, the *Bushi's* ideal daily actions include both etiquette, derived from classic Confucian writings, and manners, derived from fighting techniques in the civil war period. Thus, the idealized images of the fighting warrior and the statesman coexisted in the early modern period. With regard to the characteristics of the fighter and the statesman, their theoretical compatibility was also required in the *Bushi* class. In this context, warrior training involved teaching these characteristics as the process of making (or remaking) warriors who possessed both sets of qualities. This duality was likely embodied in actual lessons focusing on *bugei*, or fighting techniques. The early modern *bugei* features seen here were the prototypes for the methods of teaching values through the martial arts, which can be found in present-day *budo*.

Keywords: *bugei* • *Yamaga-Ryu Heiho* • the warrior's status • Japanese martial arts

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Introduction

Various Japanese budo have evolved into their modern form since the Meiji era (1868–1912). The brutal early modern martial arts have been transformed into a combination of skills acquisition and the cultivation of personal moralistic values. Several recent studies have indicated that combat techniques in the early modern period (1603–1868) were not necessarily focused mainly on killing or inflicting injury. This is perhaps because of the clear break in this period from the violence and upheaval in the medieval world. Considering the historical and cultural essence of Japanese martial arts as a combative sport, and questioning the established wisdom surrounding this topic until now, this poses an important problem. We cannot fully understand contemporary *budo* without a clear grasp of the meaning of "*bu*" ("martial") in the early modern times and how it connects to Japanese martial arts in the late modern era.

Against the backdrop of the increasing expectations placed on *budo* instruction, many of the basic concepts behind the traditional Japanese martial arts are unclear. I will discuss the establishment of the concept of Japanese *budo* and its origins as a physical art in the early modern times, which is when its core elements are thought to have arisen. Therefore, by focusing on the early modern period, which was a time of reform in the Japanese martial arts' culture, this paper aims to clarify the process through which *bugei*, from the early modern period, became enmeshed in the educational qualities that are fundamentally connected to *budo* in the present day [1].

As the material for this study, I use *Heihosho* – a book about military tactics that can be called a text on thought, the art of war, and politics in the early modern period. The concrete aims of this study are to clarify (1)the *Yamaga-Ryu Heiho* mindset (military strategy) as the ideal *bushi* , (2) the kind of *Heiho* practice and (3) the process of forming the warrior's status through physical techniques in the early modern period, to consider the process through which the *Bushi* formed a sense of self in early modern times.

The *Yamaga-Ryu Heiho* thought as the ideal bushi

"*Bukyo-Honron*", the *Yamaga-Ryu* military strategy textbooks, contain ideas about the *Yamaga-Ryu Heiho*. On this textbooks, Soko Yamaga [2] said that bushi should first study the chapters on the laws of nature (*Taigen*) and the foundations of the liberal arts (*Shuyo*) as a form of literary education (*Bun-Kyo*). Next they should study the chapter on miltary theory (*Senryaku*) as a form of military education (*Bu-Kyo*). If bushi are brave but not educated then they will not rise above the level of common thugs. The basis of *Yamaga-Ryu Heiho* thought was that the ideal bushi is both a statesman and a warrior.

The kind of physical training in the Heiho practice

"*Bukyo-Shogaku*", the *Yamaga-Ryu* military strategy textbooks, on how to instruct beginners in combat techniques has instructions for students, which they have to observe at all times as a statesman/warrior, before receiving instructions from the textbook on combat techniques.

These are organized into instructions for a Bushi as a statesman and instructions for the bushi as a combatant. In acting as a statesman, the objective is to be rigorously loyal and pious by acting in accordance with the customs at all times. Among the general warrior class, becoming a student of martial arts provided an opportunity to learn how to conduct oneself and act morally.

Moreover, in the teaching content for acting as a combatant, we can see that students honed their skills as combatants not only in terms of battlefield elements such as understanding topography and commanding troops, but also in training their own bodies and sharpening their individual combat techniques. Even in the techniques of horseback combat, students were required to master practical techniques with little regard for their outward visual appeal. Such standards for training combatants were the same as those used for Bushi during the war-torn Sengoku period.

The process of forming the warrior's status through Physical Techniques

As the world grew stable in early modern period, a Confucian view of the warrior grew popular, and the combat techniques known as the *Heiho* were redefined as the "art of government." [3]. However, the premises of the warrior as a combatant were also retained, and many promoted the view that a warrior can be a statesman and a combatant at the same time. "*Bukyo-shogaku*", the *Yamaga-Ryu* military strategy textbook, on how to instruct beginners in combat techniques has instructions for students, which they have to observe at all times as a statesman/warrior, before receiving instructions from the textbook on combat techniques. These are organized into instructions for a warrior as a statesman and instructions for the warrior as a combatant.

It is the role of the bushi as the governing classes to learn the civil and the military. The reproduction of the bushi with the both character of a statesman and a combatant sides , was carried out through the practice of everyday act and military arts. In the practice to be thought to be the cultivation as a combatant, the creation of the ideal bushi to keep as a statesman was fixed its eyes on. This is one of the forms to acquire thought or an ethic in experience by a practice of physical techniques. It is thought that I will form one of the characteristics of the traditional physical arts culture that the practice of the military art forms the thought of the practitioner [4].

Conclusions

In *Heihosho*, the *Bushi's* ideal daily actions include both etiquette, derived from classic Confucian writings, and manners, derived from fighting techniques in the civil war period. Thus, the idealized images of the fighting warrior and the statesman coexisted in the early modern period. With regard to the characteristics of the fighter and the statesman, their theoretical compatibility was also required in the *Bushi* class. In this context, warrior training involved teaching these characteristics as the process of making (or remaking) warriors who possessed both sets of qualities. This duality was likely embodied in actual lessons focusing on *bugei*, or fighting techniques. The early modern *bugei* features seen here were the prototypes for the methods of teaching values through the martial arts, which can be found in present-day *budo*.

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Augmented reality (AR) in teaching and developing judo techniques – project assumptions

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Abstract

This paper describes the role and meaning of AR technology in teaching and developing judo techniques. The aim of this research is an model of a AR implement in judo teaching techniques – perspective of biomechanics of movement, psychology and sports pedagogics. The subject of this research is the process of judo techniques teaching and the AR system functionality.

The material of research are children learning judo and adults improving themselves individually (master level). We verify the hypothesis that "illustrating reality" with the use of AR increases learning attractiveness, deepens the effect of mental and imagination training.

Key words: fighting sport • injuries • male and female competitors

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Karate and its attitude to life

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Abstract

Karate is not only a martial art but, first and foremost, a life philosophy. Therefore, this study attempts to look closer at the problem of practising martial arts from the socio-pedagogical standpoint. The focus of the study was on the attitude of karate practitioners to life, their life aspirations, sense of responsibility, their attitude to the problem of "to be or to have" and the role of practising karate in feeling satisfaction from life. The examinations were carried out in Braslaw, Belarus among over 60 people who are actively involved in karate.

Adoption of the socio-pedagogical standpoint allowed for evaluation of the role and importance of martial arts in living a satisfactory life, particularly in difficult socio-economic conditions present today in Belarus. Being involved in sports, especially martial arts, helps develop personality and outlook on life of a person, substantially affects perception of the reality and is useful in development of self-discipline and responsibility for what we do. Therefore, martial arts might offer a powerful tool to support education of young people and prevent social maladjustment and demoralization of the youth.

Keywords: karate • life • threats to family functions • unemployment social opinions • young people

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Contributor: Arkadiusz Marzec conceived the study design. Arkadiusz Marzec, Elena Karpuszenko collected the data. Arkadiusz Marzec, Elena Karpuszenko analysed the data. Arkadiusz Marzec, Elena Karpuszenko prepared the manuscript. Arkadiusz Marzec secured the funding.

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Fun forms of martial arts in diagnosing and reducing aggressiveness – mental effects of a one-day course for Polish animators of sport

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Abstract

Background and Study Aim. During a fight, various aspects of human nature become apparent – anxiety, aggression, pride, vanity, skills, physical dispositions, knowledge and interdependence between these characteristics [1]. Only in few countries martial arts are part of universal education: in Japan school youth practice *judo, kendo and sumo* as part of the *budo* module [2]; in South Korea *taekwondo* [3]. In Poland these are covered only as original curricula, for example. *hapkido* [4] or as *fun forms of martial arts* [5,6].

The purpose of the research is the knowledge of mental effects (associated with the perception of the phenomena of violence and aggression and a possibility to diagnose and modify human violent behaviours) for sport animators participating in one-day specialist courses.

- Detailed research questions:
- does training change the perception of the phenomena of "aggression", "aggressiveness" and "violence" (courses I and II)?
- is aggressiveness desirable in sport (course II)?
- is a one-day course enough to convince the most creative participants to take effort to specialize in diagnosing and therapy of aggressiveness based on cognitive-behavioural methods, including *fun forms of martial arts* (courses I and II)?

Materials and Methods. Total 1,076 and 618 sports animators, recruited mainly from among Physical Education teachers and sport coaches, participated in two one-day courses (in 2014 and 2015, respectively), 237 of them (38%) also participated in course I. Women accounted for (23% and 13%), men (77% and 87%). Persons with work experience of over 10 years dominated (67% and 70%).

Results and Discussion. Prior to training (course I) it was obvious only for 50% of the teachers that the notions of "aggression", "aggressiveness", "violence" mean various phenomena related to each other in substance, but for almost half (48%) these terms were synonyms of the same phenomenon (Figure 1), which is a clear lack of understanding of the essence. After the training these proportions already diversified: 56% and 37%, respectively. However, this seemingly positive trend was a result of three-fold increase (from 2% to 6%) in the declaration of those who believed that these concepts were unrelated, which is another proof of the lack of understanding of the essence of the differences, but also of the substantive ties between the phenomena thus named. This is an indirect evidence that the issue of aggression (with which the key concepts of "aggressiveness" and "violence" are related and are often distorted in the media) is not easy. Hence a valid directive for future trainings – to pay more attention to the semantic aspect of the taught content.

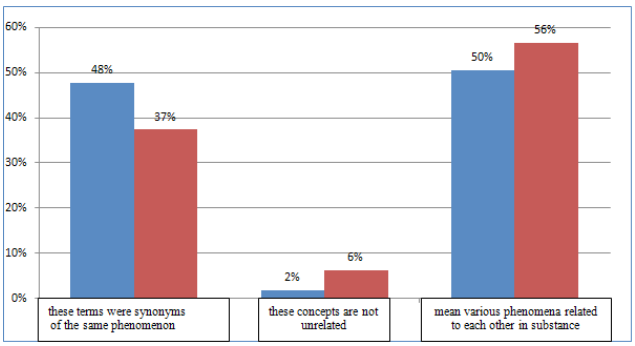

Figure 1. Changes in teachers' perception of the relationship between the concepts of "aggression", "aggressiveness", and "violence" (course I) before the training, blue colour (n = 1046) and after the training, maroon colour (n = 842).

The result of course II shows a positive, long-lasting educational effect. From among persons who participated in the course for the second time, 62% declared that the concepts of "aggression", "aggressiveness", "violence" mean various phenomena related to each other in substance, but 34% still thought that they were synonyms of the same phenomenon. This significant positive effect can be hypothetically connected with studying the coursebook [7], which each participant received. Similar declarations, however, were made by those participating in the course for the first time (60% and 37%, respectively). The conclusive result whether aggressiveness in sport is desired is an argument reinforcing the authenticity of this hypothesis: 47% of newcomers believed "yes" and 7% said "strongly yes", while those attending for the second time 37% and 5%, respectively ($p<0.01$). Only 29% of newcomers said "never", but 46% of those participating for the second time in the course ($p<0.01$) (Figure 2).

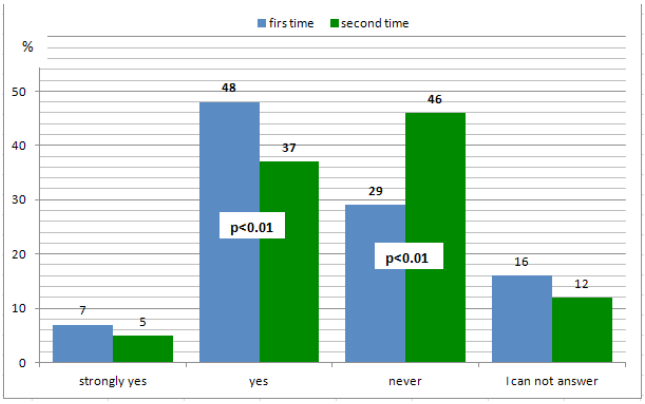

Figure 2. The structure of answers of 618 participants of course II to the question: "*Is aggressiveness in sport desirable?*"

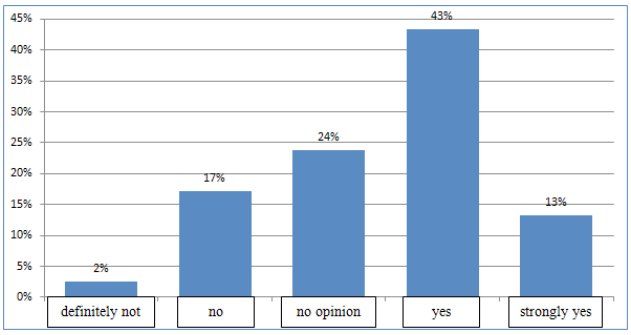

Figure 3. The structure of answers of 846 sport animators after course I when asked about taking the trouble to specialize in the diagnosis and therapy of aggressiveness based on cognitive behavioural methods.

Clearly the most positive training effect shows in the structure of answers to the question about taking the trouble in the future to specialize in the treatment of aggressiveness based on cognitive behavioural methods. The majority (56%) want to gain such qualifications (Figure 3). The result after the second course is similar.

Conclusion. Aggression and violence in school [8] and in the area of sport activity [9] are growing phenomena on a global scale. A large percentage of sports animators working with Polish youth who are determined to take the trouble to specialize in the treatment of aggressiveness based on cognitive behavioural methods gives optimistic educational prospects and expected social effects. The result of the study also indicates a possibility of a successful promotion of widely understood *martial arts* in the prevention and therapy of aggressiveness, positive education and health promotion defying the expansion of neo-gladiatorship.

Keywords: cognitive behavioural methods • physical education teachers • social effects • specific courses

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Contributors: Jarosław Klimczak, Roman Maciej Kalina conceived the study design. Jarosław Klimczak, Roman Maciej Kalina collected the data. Jarosław Klimczak, Roman Maciej Kalina, Władysław Jagiełło analysed the data. Jarosław Klimczak, Roman Maciej Kalina, Władysław Jagiełło prepared the manuscript. Jarosław Klimczak, Roman Maciej Kalina secured the funding.

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Ethical approval: Not required

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Combat sports and martial arts as an element of health-related training

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Abstract

Background and Study Aim. As far as mission and goals of health-related training are concerned [1], body load with physical effort is the most significant health-stimulating factor. Nevertheless, an important criterion allowing for the use of a particular form of physical activity (sport) in health-related training is to reduce to a minimum the risk factors to the health or life of its participants [2]. Therefore, may forms of physical activity consisting in direct struggle of competing parties (units or teams) be applicable here if we assume that development of assurance habits, e.g. safe falling skill, control over fall of a person which was thrown off balance, are an important part of all combat sports and martial arts [3]?

There are reports of beneficial rehabilitation effects [4] as well as positive impact of such actives on the mental sphere [5]. There is also a scientific basis for using combat sports and martial arts in counter acting aggression among children and adolescents [6,7] and in stimulating their development through use of fun forms of martial arts in sports training and physical education [8]. The aim of this study was to resolve the issue whether combat sports and/or martial arts may be, according to the self-defence instructors, recommended as elements of health-related training?

Material and Methods. The study involved participants of self-defence course (n=30, including men n=28 and women n=2). The studied group consisted of 22 people who are teachers or students of physical education. The average age of respondents amounted to 26 years. All participants had experience in combat sports and/or martial arts and they have been practising such forms of physical activity on average for 4.5 years. They represented various types of combat sports and martial arts (Fig.1). This study uses the method of diagnostic survey with anonymous questionnaire as a research tool.

Results The majority of respondents (63%) preferred recreational types of combat sports or martial arts (Fig. 2). However, their reasons to undertake such physical activity included self-defence skills and high sports results (Fig. 3). From the perspective of several years of experience, they believe that combat sports and martial arts had impact on maintaining high physical fitness and shaping personality (Fig. 3). The majority of respondents (93%) think that combat sports and martial arts are an appropriate form of physical activity which may be used in health-related training (Fig. 3).

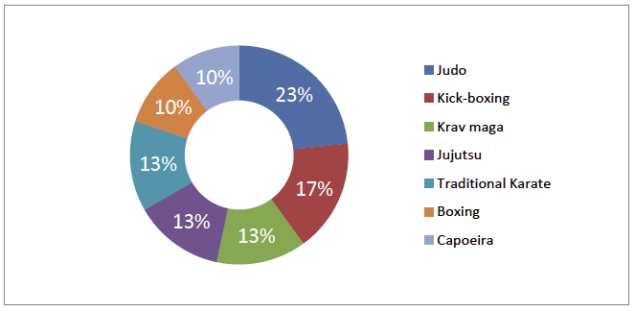

Figure 1. Types of combat sports and martial arts preferred by the respondents.

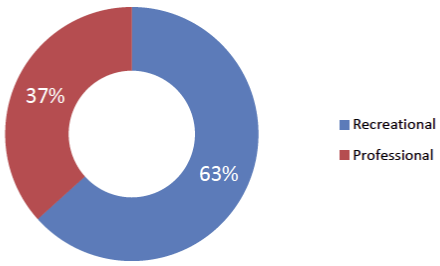

Figure 2. Forms of combat sports and martial arts preferred by the respondents.

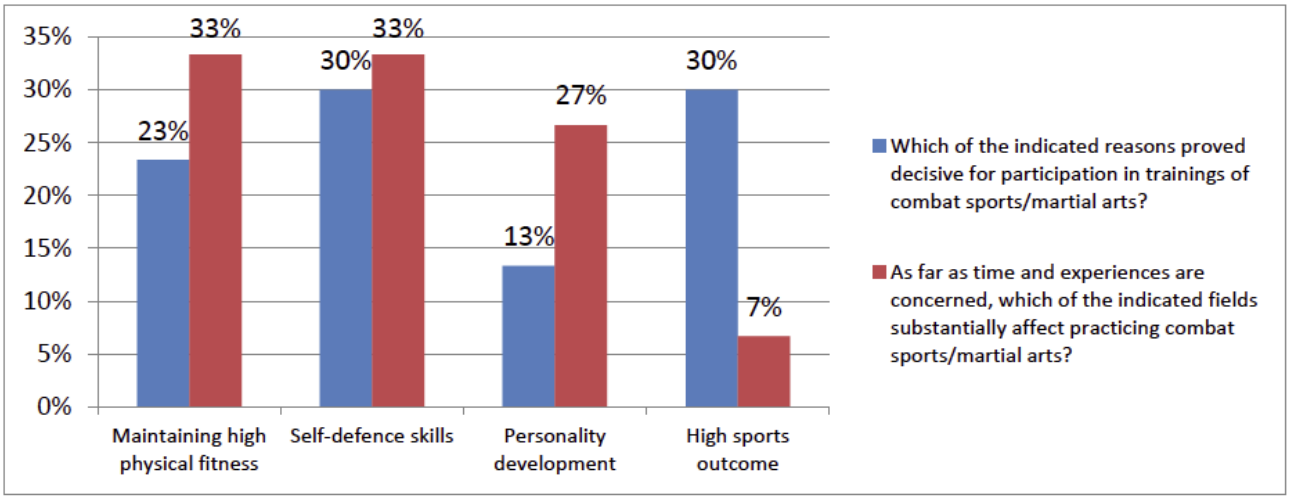

Figure 3. Respondents' opinions about reasons for choosing combat sports or martial arts as well as fields which in their belief are affected by these forms of physical activity.

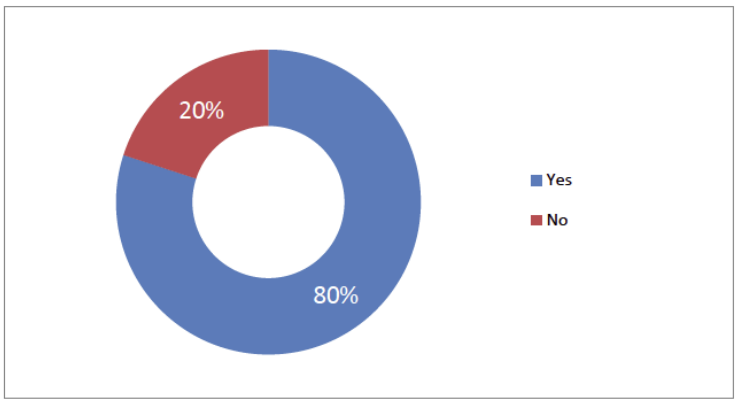

Figure 4. Respondent's opinions about possibility of using recreational forms of combat sports and martial arts in health-related training.

Conclusion. There are substantial grounds for recommending forms of physical activity considered as combat sports and martial arts as parts of health-related training with properly selected loads and the risk factor to health or life reduced to a minimum.

Key words: assurance • health • safe falling • recreation • training

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Contributor: Robert Bąk conceived the study design, collected and analysed the data, prepared the manuscript and secured the funding.

Funding: The study was conducted within the research project Faculty of Physical Education, University of Rzeszów: „Selection and prepare people to work in extreme conditions" (Resolution No. 5/12/2010 Bioethics Committee at the University of Rzeszów, Poland).

Conflict of interest: Author has declared that no competing interest exists

Ethical approval: approval of the Local Ethical Committee

Provenance and peer review: Under responsibility of HMA Congress

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Susceptibility of body injuries during a fall of people after amputation or with abnormalities of lower limb

Bartłomiej Gąsienica Walczak [1,2], Artur Kalina[3]

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[2] University of Rzeszów, doctoral student of a faculty of medicine
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Abstract

Background and Study Aim. In the world every 20 seconds he/she is reaching amputation of a lower limb because of diabetes [1]. However they in Poland are making amputation on average hourly [2]. Amputees within lower limbs are included in a group of the increased risk of the fall and traumas associated with fall [3]. These people are exposed especially to fractures within upper limbs and to injuries of the head [4-6].

The purpose of this study was the knowledge about susceptibility of body injuries during a fall of people after amputation or with abnormalities of lower limb

Material and Methods. Way of managing body parts (head, hands, hips, leg) during simulated fall were measuring susceptibility test of body injuries during a fall – STBIDF [6]. During each of three task that test is composed of, correctness of motor control of hips, hands and head (additionally legs in third task) were assessed during simple simulation of collision with the ground (on a signal, on soft ground subject is ought to change posture from vertical to horizontal – lying on back). The test was carried out without orthopaedic bullets and without the prosthesis on soft base. Results of observations: "0" lack of error, "1" first grade error, "2" second grade error. Total number of points is general indicator of SBIDF: low (0), average (1-3), high (4-8) and very high (9-14). The measure of susceptibility of the predetermined parts of the body to injuries (SBPIDF) is the sum of the points from all tasks analyzed separately for the each parts of the body: low (0), average (1), high (2–6). Marginal values of SBPIDF (as a result of adding errors made during the tasks) for the different parts of the body include between: legs 0–2; hips 0–3; hands 0–6; head 0–3. However the marginal values of adding points estimated after completing the Task 1 and 2 are in the range of 0 and 4 points, and Task 3 in the range of 0 and 6 points. For this reason a comparative analysis (for the parts of the body and each tasks) takes into account the indicator of proportion of errors (expressed in percentage) applied to the possible maximal value of estimated points (SBPIDF%max). For example, for the hands this value is 6 points and 2 points for legs.

The surveys included seven men in age from 14 to 37 (= 26.4) with the different level of amputation of a lower limb (n = 5) or with abnormalities of lower limb (n = 2). They are involved in a Cracow Amputee Football squad, some of them are representatives of Poland in this sports discipline. Trainings take place once during the week on the court with the artificial surface. Cardinal variable for result presentations is SBIDF indicator. AF letters are a prefix of the given Amputee Footballer code, digits from 1 to 6 are marking his position in the ranking, and in case of the same result next small letters of the alphabet were assigned: a, b, c etc.

Results. Two persons (AF5, AF6) revealed very high level of susceptibility of body injuries caused by loss of the balance and collision with the ground (SBIDF indicator from 9 to 12 points). Five remaining footballers (AF1a, AF1b, AF2, AF3, AF4) revealed high level (SBIDF indicator from 4 to 8 points) (Figure 1).

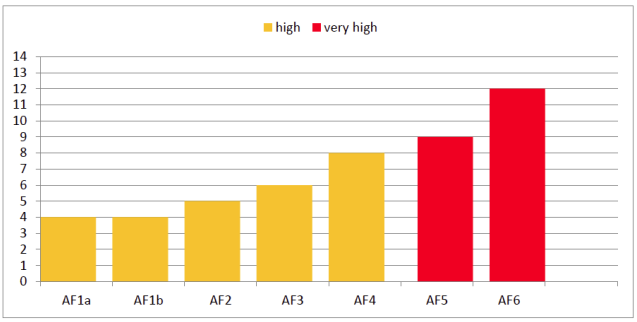

Figure 1. Indicator of susceptibility of body injuries during a fall (SBIDF) examined Amputee Footballers (n = 7).

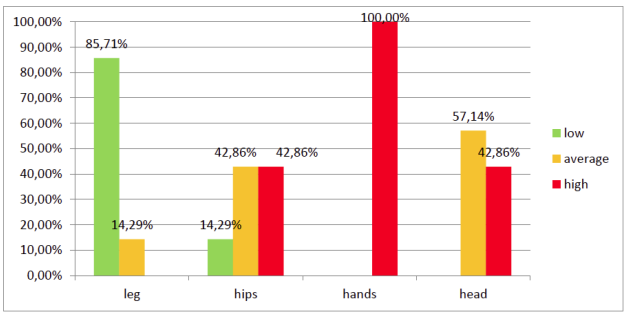

Figure 2. Susceptibility of body injuries during a fall (SBIDF) examined Amputee Footballers (n = 7).

Footballers with abnormalities of lower limb (AF1b, AF3), and footballers after amputation with respect to the average result they revealed high susceptibility (appropriately SBIDF = 5, SBIDF = 7.6). Body part with the most exposed to damage (SBPIDF) are hands (100% examined persons reveled high susceptibility) next the head and hips (43%). The leg is a least exposed body part (86% footballers reveled low susceptibility) (Figure 2 and 3).

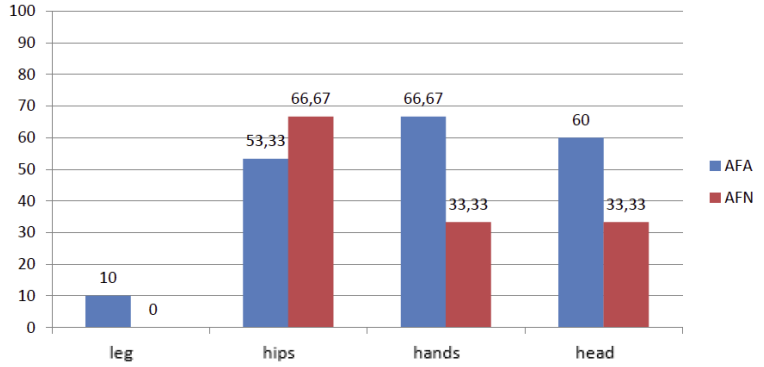

Figure 3. Susceptibility of the predetermined parts of the body to injuries during a fall (SBPIDF) examined Amputee Footballers after amputation (AFA, n = 5) and Amputee Footballers with abnormalities of lower limb (AFN, n = 2) described with indicator PUCCPU%max.

Conclusions. Mistakes of managing individual body parts during simulated fall by examined footballers let to predict their body injuries caused by the fall in different circumstances of their everyday motor activity, particularly during the training or the match.

Since exercises of safe falling were involved in the weekly practice of examined footballers (Figure 4 and 5) (a supervision of the doctor and the coach is ensured, and for a specialist part is responsible a physiotherapist, specialist in theory and methodology of safe falling), so there will be assessed effects of increasing cyclically (of stabilization) of their **motor safety** (which is the consciousness of the person undertaking to solve a motor task or consciousness the subject who has the right to encourage and even enforce from this person that would perform the motor activity, who is able to do it without the risk of the loss of life, injuries or other adverse health effects [7]).

Figure 4. Cracow Amputee Football squad.

Figure 5. Amputee Footballers during the match.

Keywords: abnormalities of lower limb • amputee footballers • body injuries • loss of the balance • collision with the ground

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Contributors: Bartłomiej Gąsienica Walczak conceived the study design. Bartłomiej Gąsienica Walczak, Artur Kalina collected the data. Bartłomiej Gąsienica Walczak, Artur Kalina analysed the data. Bartłomiej Gąsienica Walczak, Artur Kalina prepared the manuscript. Bartłomiej Gąsienica Walczak, Artur Kalina secured the funding.

Funding: The study was conducted within the research project URWWF/S/04: “Motor, methodological and mental effects of educating students in safe falling of blinds and/or after limbs amputations” (Resolution No. 03/02/2011 Bioethics Committee at the University of Rzeszow, Poland).

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Ethical approval: Not required

Provenance and peer review: Under responsibility of HMA Congress

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Changes of susceptibility of body injuries during a fall of patients with mental impairment participating for several months in special cognitive-behavioural therapy

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2 CALMFIT Dariusz Mosler , Poland

Abstract

Background and Study Aim. People with intellectual impairment are especially vulnerable to fall due to cognitive dysfunctions, taking inadequate or danger actions in certain situations while being unaware of consequences [1,2]. Study results shows impaired ability to learn new motor skills by patients with intellectual disabilities and intercurrent mental disorders [3].

The purpose of this study was the knowledge about efficiency of cognitive-behavioural therapy with exercises designed to reduce susceptibility of body injuries during a fall and collision with the ground.

Material and Methods. Patients were tested using susceptibility test of body injuries during a fall (STBIDF) [4] at the beginning of therapy with safe fall method exercises and after every six months. During each of three task (Figures 1-3) that test is composed of, correctness of motor control of hips, hands and head (additionally legs in third task) were assessed during simple simulation of collision with the ground (on a signal, on soft ground subject is ought to change posture from vertical to horizontal – lying on back).

Figure 1. First task of STBIDF

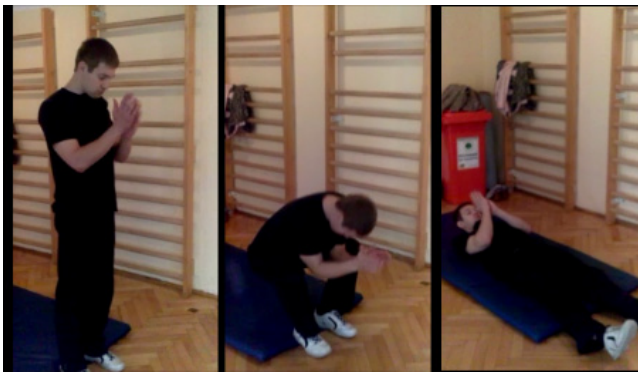

Figure 2. Second task of STBIDF

Figure 3. Third task of STBIDF

Figure 4. Presentation of forced simulated fall conducted by therapist.

Results of observations: “0” lack of error, “1” first grade error, “2” second grade error. Total number of points is general indicator of SBIDF: low (0), average (1-3), high (4-8) and very high (9-14). Same criteria of STBIDF were used during testing performance in forced simulated falls (FSF) conducted by therapist (Figure 4).

Five people (two women and three men) in age from 34 to 56 (=45.8) with diagnosed moderate or high mental impairment and intercurrent mental disorder (schizophrenia, anxiety-depressive disorder or abnormal behaviour) were participating in therapy sessions. They are attending to Environmental House of Self-Help for People with Mental Disorders in Oswiecim. Criteria of choice were similar level of disability and lack of somatic contraindications for individual kinesiotherapy. For cardinal variable (referred to patient code P1 etc.) for result presentations is SBIDF indicator assessed before therapy.

Results Patients reduced considerably motor control errors during a fall after every six months blocks of therapy sessions. Before therapy patients showed high and very high SBIDF (indicator form 6 to 14 points, . After six months they reduced motor control errors during a fall (SBIDF indicator from 3 to 9 points). After next 6 and 12 months they reduce SBIDF even further (indicator from 1 to 6 points). 6 weeks after end of therapy sessions STBIDF indicator remain reduced (Figure 5).

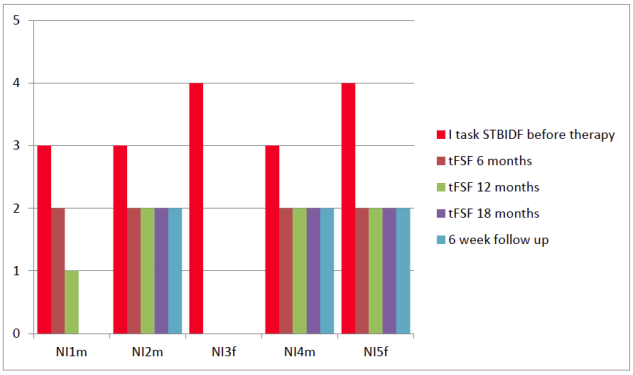

Figure 5. Changes of susceptibility of body injuries during a fall before and after every six months of therapy measured in STBIDF (f – female, m – male)

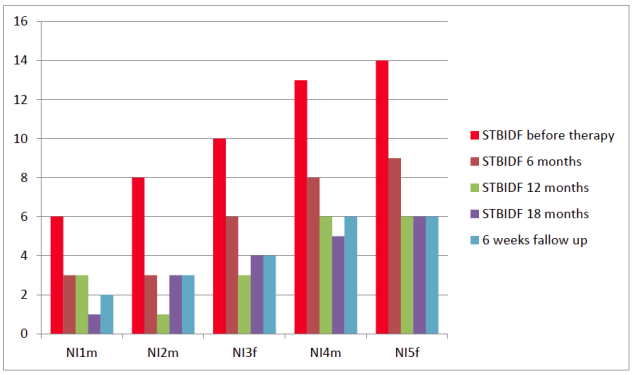

Figure 6. Changes of susceptibility of body injuries during a fall before therapy (measuring using I task of STBIDF) and after every six months of therapy measured in FSF test

SBIDF’s indicator value for each of six months block of therapy sessions correlated on low level with attendance on therapy sessions (0.241). In forced simulated fall test after first six months of therapy tested subjects reduced motor control errors in comparison with first task of STBIDF before therapy, making only one or two hand errors or making none. During next block of therapy they made the same errors (Figure 6). Indicator of susceptibility of body injuries during a fall in FSF test correlated on high level with attendance for specific block of therapy sessions (0.838).

Conclusions Applied innovative cognitive-behavioural kinesiotherapy allow to suppose, that inclusion of systematic (2-3 times a week) safe fall exercises could increase motor safety (*which is the consciousness of the person undertaking to solve a motor task or consciousness the subject who has the right to encourage and even enforce from this person that would perform the motor activity, who is able to do it without the risk of the loss of life, injuries or other adverse health effects* [5] of people with mental impairment and intercurrent psychical disorders during their daily physical activity. Differences in progress in reducing SBIDF may be connected not only with neurological aspects of motor control, but also with specificity of mental disorders. Specificity of those disorder justified opinion, that inclusion of safe fall exercises only at adult age makes reducing susceptibility of body injuries during a fall to low level impossible in applied time frame of therapy. All aspects of this therapy require cooperation of specialist from field of kinesiotherapy, neurology and psychiatry.

Keywords: cognitive-behavioural kinesiotherapy • mental disorders • safe fall method exercises

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The risk of passion, a comparative analysis of the injuries based on judo and wrestling

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Abstract

Background and Study Aim. A sport is a contending with your weaknesses, but essentially, it is a pursuing your passions. Sometimes it is possible that pursuing your sport passion is connected with the occurrence of the injuries. The objective of this paper was the analysis of sport contusions among male and female competitors concerning 2 sport disciplines as judo and wrestling. The following hypotheses were formed: judo is sport with a greater number of contusions than the wrestling; there are more injuries of the upper extremities in comparison to lower extremities injuries which occur more likely in wrestling; in both sports disciplines the injuries take place mostly during the sports competitions.

Material and Methods. The following research referred to 117 male and female competitors including wrestling (58 people) and judo (59 people). The information concerning the past sport injuries was gathered by the questions presented in the survey. The provided results were subject to the analysis.

Results. According to judo, a main cause of injuries, indicated by surveyed people, was: improper warm-up 41%, uncompleted treatment of previous injuries 37%, direct fight 22%. With reference to wrestling, a main cause of injuries was: direct fight 44%, improper warm-up 29%, uncompleted treatment of previous injuries 27%. The vast majority of competitors answered that despite the appearance of aches and pains, they continue a training/the competitions. As based on competitors' answers,from 117 surveyed people, 97 (83%) had at least one injury within their sports career. The examined sportspeople had 44 injuries in judo and 80 injuries in wrestling. The mostly occurred contusions were the injuries of lower extremities: judo 27, wrestling 33.

Conclusions: Fighting sports refer to the disciplines with increased degree of injuries. The majority of examined people were injured within their sports career. A lower extremity was most often injured, next an upper extremity and head injuries. More injuries were noted in wrestling.

Key words: fighting sport • injuries • male and female competitors

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Assessment of body build diversity of taekwondo female and male contestants

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Abstract

Somatotype is a definite type of genetically determined traits of physical build, overlapped by an impact of external environment, climate, economics and motor activity.

Morphological diversification of contestants practising different sports disciplines is a well known phenomenon. Studies describing morphological diversification and body build profile of taekwondo contestants have been sparse so far.

The purpose of the study was determination of a body build profile of taekwondo male and female contestants practicing in Czestochowa clubs.

The study was carried out in spring 2014 in Czestochowa and involved 15 men and 15 women. Anthropometric measurements of somatic traits were made in compliance with the Martin technique and and with the use of Martin instruments (Drozdowski 1985). The measurements wer used as basis for determining: body height, length of: an upper limb and foot, width of: shoulders, hips and knees, size of: a forearm and shin, fat deposition on the shoulders, under a shoulder blade and on the stomach, as well as body mass.

Body build was assessed with the use of the Percal method of natural indicators. Results of the study were statistically processed. Mean values of somatic traits of the participants were standardized to an arithmetic average and standard deviation of the sample group, which consisted of students of physical education. Next, three body build factors were calculated: the height factor, stoutness and fat deposition factors and the body build profile was determined.

The examined female contestants were significantly taller than female PE students. They had longer upper limbs, lower widths of shoulders, hips and knees and higher sizes of forearm and shin. In relation to other students, the examined male contestants were characterized by significantly lower size of shoulders and hips, higher sizes of forearm and shin, and higher fat deposition. Body build of the examined females is dominated by the length factor, whereas the stoutness factor shows the lowest value. Body build of the examined males is dominated by the fat deposition factor, whereas the stoutness and length factors are at the same level.

Key words: assessment of body build • contestants • women • men

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Hormonal responses to sambo exercise in women

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Abstract

The main aim of this study was to compare the hormonal status between top-level female sambo athletes and sedentary controls; in addition, we analyzed hormonal response to sambo exercise in top-level athletes. Salivary hormones were measured in 59 female sambo fighters of the Russian national team and 31 sedentary females. Participants provided saliva samples in the morning, with a second sample taken only in athletes after a sambo exercise session. This session consisted of 5 simulated fights of 5 minutes each one with 10 minutes of recovery between combats. Baseline salivary testosterone was significantly higher in sambo athletes compared with sedentary controls (37.4 ± 24.1 pg/mL vs. 14.3 ± 6.9 pg/ml; P <0.001), while estradiol levels were lower (2.4 ± 1.5 pg/mL vs. 11.3 ± 7.0 pg/mL; P <0.001). A significant decrease in both salivary testosterone (for 19.5%P = 0.007) and cortisol (for 22.2%, P = 0.014) was reported in female athletes as a response to sambo exercise session. It seems that sambo exercise affects hormonal status both chronically and acutely in female athletes.

Key words: sport • training • motor function • injury • muscles

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Rotating training simulator as an assessment tool measuring susceptibility of the body injuries during the fall caused by an external force – validation procedure

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Abstract

Background and Study Aim. The aim of present study was verification of rotating training simulator (RTS) as an assessment tool of susceptibility of the body injuries during the fall caused by an external force.

Material and Methods. A Group of 68 students of physical education from University of Zielona Góra were tested. Appropriateness was determined by comparing results of RTS's test for different frequencies (from 0,16 Hz to 0,3 HZ) with results of I task from STBDIF test designed by Roman Maciej Kalina, adopting the same criteria and grading scale. Reliability of RTS's test results was evaluated by retesting subjects after one week, and also comparing grades given by two observers with those given by authors.

Results. Current results show significant correlation between STBDIF test and RTS's test for each frequency. There are very high correlations between first test and retest after one week results of RTS's test. For 31 subjects obtained results show good and excellent reliability defined by intraclass correlation coefficient (ICC).

Conclusions. Obtained results show that rotating training simulator is a valid and reliable tool to diagnose susceptibility of the body injuries during the fall caused by an external force and exhibits significant repeatability of results.

Key words: simulating falls • safe fall • motor safety• biomechanics• rotational movements

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A comparison between physical fitness of children practicing judo and non-practicing children based on International Physical Fitness Test

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Abstract

Background and Study Aim. The ongoing technological development as well as negative effects of environment pollution which are noticeable for a common human, constitute the phenomena which have an impact on the development of civilization diseases. The objective of research was the knowledge about the general physical fitness of teenagers who practice judo and those who do not. It was wondered whether in the young age of 10-11 years old the judo trainings may have the impact on increased level of physical fitness. The authors also formed the question whether the people who practicing judo have the increased physical fitness in comparison to the boys who do not practice any sport.

Material and Methods. The group of 44 children in the age of 11-12 years old was taken to the analysis, including 22 people who practice judo and 22 people who do not practice any sport discipline. International Physical Fitness Test S. Pilicza was used to the research. The arithmetic average, the standard deviation, the coefficient of variation and student's t-test for independent samples were calculated.

Results. In all samples people who practice judo, achieve better results. According to the results of research, the majority of people having the increased physical fitness, refer to judo group (14 people), which constitutes 63.63%of those who train, while in the non-practicing group 36.36% of people is at the high level of physical fitness, what should be considered as a very good result. In the non-practicing group the majority of people qualify to the average level of the physical fitness (11 people), what constitutes a half of the primary school group. Those who practicing judo, are at the following physical fitness levels: high and average, no one has been at the low level. Among non-practicing children, 3 people are at the low level which is 13.64% of non-practicing people.

Conclusions The boys who practice judo, had better results in all samples. The judo training comprehensiveness leads to the development of all motor skills. The results indicated the significant differences in flexibility, strength and power tests. Practicing boys are at the high level of strength. People who do not practice any sport, besides school classes, achieved good tests results.

Key words: judo • fighting sports • martial arts • physical fitness

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Functional evaluation of Olympic competitors practicing boxing using the FMS

Damian Kuźma, Dariusz Górka, Krzysztof Suszyński, Magdalena Dąbrowska-Galas, Grażyna Dura-Nowaczyk, Łukasz Toborek

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Abstract

Background and Study Aim: Problem of postural stability, balance and motor function deregulation in fighting sports as boxing is well known. In this study we conducted boxers motor analysis, which could help do reduce the occurrence of injury and overloading of the movement Among the competitors. The aim of this study was clinical assessment of motor function in competitors and verification, whether training experience or other factors has an impact on the results of functional tests.

Material and Methods: Address 32 fighters study, two groups of age. The average age of the players from Group 1 was 14 ± 0.94, while in group 2: 24 ± 1.78 years. The research tool was a functional traffic system (FMS) - Test is used to make international assessment of functional mobility, which includes 7 Different tests evaluated on a scale Bu 0-3. The results were statistically analyzed.

Results: Research results showed that participants with greater training experience (11 ± 1.62) received fewer points in each FMS test, which indicated a decreased mobility of the shoulder girdle.

Conclusions: Longer training experience will contribute boxers do to reduce the mobility of the shoulder girdle, while a positive effect on the length of the sciatic-tibial muscles.

Key words: sport • training • motor function • injury • muscles

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Role and influence of Chinese martial arts on human body and mind

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Abstract

Main permission One of the oldest martial arts in the world is *Tai Chi Ch'uan* (太极拳 /*chin. Tàijíquán*; 太极*Tàijí* – supreme ultimate 拳*quán* – fist, box), which have roots and rose in Chinese civilization. Philosophical and health aspect was based on the experience gained during many years of war, which had always took place in Chinese history until World War II. Between the wars, people stopped fighting with each other, however they haven't parted with martial arts, still continuing training the *wǔshù* (武術 *wǔshù – chin*. Art of war). In preparation for any subsequent wars, they perceived the advantages of this type of training, adding health (healing) and prophylactic (health benefits) aspect. That way, *Tàijí* was created. People have observed that motion helps to improve physical health as well as mental one, because training this martial art led to development not only the body but health of a man and his spirit.

Tàijí combines elements of self-defence with understanding human inner energy and uses Chinese philosophies such as Taoism and Confucianism. In *Tàijí* power describes *Yin* and *Yang* energy as the primary forces, opposite, which complement one another, being in harmony with each other. *Yin* literally means cloudy, it is meant as negative force, passive, while *Yang* meaning is bright, positive force and active. Both of these forces are all around us, where they are constantly transforming and human lasts between earth and the universe. The interaction of universe, earth and surrounding nature on man means constant flow of energy. The gravity force on earth, electromagnetic waves or black matter in outer space that pervades everything, all the physical and chemical phenomena constantly taking place on the ground, are nothing more than just penetration of the two opposing elements. Practicing *Tàijí* teaches how to use this energy.

Training assimilate use of internal energy (from birth), elements of self-defence, external energy along with physical and chemical, such as food or warmth. One of the main *Tàijíquán* training is development of nervous system through flexibility training, concentration, and above all – coordination by maintaining control of the body in space and time. This ability is useful for every human being, as a pro-health, keeping everyone in a very good psychophysical condition. If we add to this elements of good nutrition, hygiene elements of life and mental training, we will achieve full harmony of the body with mind. One of the basic elements of *Tàijí* training, is work on the flexibility – stretching, so that trainees can perform motions confidently and fluently the harmonious sequences in the movement and combat forms.

Nowadays our civilization has led to neglect physical activity. *Tàijí* is watching nature, going back to nature and draws inspiration from it, to create new forms and exercise, to achieve complete harmony between man and nature. For this reason an essential and inseparable element to obtain proper performance of *Tàijí* is the practice of *Qigong* (气功(*Qìgōng* – master use of ones internal energy), consist on a combination of concentration (mastering thoughts in an advanced aspect) through the use of multiple senses while performing movement (polymodal synaesthesia spontaneous and directed). We achieve complete conscious control over every tiny motion of the body (skeletal, nervous, muscular, circulatory system, etc.) combined with correct breathing. The experience of primal body control in relation to the mind is achieved by the right order of understanding harmony lever between earth and universe, mind and body and lastly applying in in actual form of combat and healing our body.

In general, the level of knowledge about our body is very modest, and *Tàijí* is a powerful knowledge about the man. Practicing *Tàijí* affects the deepening awareness of the body and mind in carrying out various activities, even outside of training time. Besides, it teaches conscious breathing, which also is translated into the health facet. In *Tàijí* training is another aspect of health that cannot be overlooked: it is relaxation – meditation combined with breathing techniques and meditation in motion, or to relax our bodies. Adding to the self-defence training and combat elements, we increase self confidence in the action, reduce the fear of failure, and thus aggression.

Source of inspiration Program and *Tàijí* training implemented by the author are the result of decades of experience gained during stays in China, training many styles beside martial art masters like: *Kyokushin* – A. Drewniak, J. Pietras; *Aikido* – C. Tissier; *Qìgōng* & Tàijíquán yang style – Jwing-Ming Yang; *Jujitsu* in polish Jujitsu association; *Wing Chun Kuen* – William Cheung, D. Beddar, B. Corles; *Gongfu Wu Dang* – M. Plyaskin; *Tàijíquán Chen* style & *Qìgōng* – Han Kui Yuan, M. Plyaskin.

Innovation and implementation Rich experience led to the creation of authors programs: 50+ activation, martial art workshop for blind, deaf, deaf-mutes and regular training groups that proves how training can be adapted in a wide range cases of diseases or disability. Even young individuals in the age of 9-11 years already receive the possibility of multifaceted development of both body and spirit, because

of the greater plasticity of the brain. People middle-aged and older regain verve, health and stamina. But nevertheless recent research shows that the brain regenerates until death, and new connections are created through aspects of polymodal stimulus through training.

Conclusion Generally, these actions are a continuation of the path initiated by the creators and subsequent masters of *Tàijí*. Enriched with their own experiences and thoughts, the influence of Chinese culture, as well as advancing scientific knowledge in the field of biomechanics, manual therapy (techniques, stretching, mobilization of peripheral joints and spine, as well as neuromobilization), dietetics, neuropsychology, proxemics and a new field of neuroscience polymodal synaesthesia allowed to create their own author training program.

Acknowledgement To Henryk Knapik for academicals input toward creating correct patterns of training elements and improving understating scientifically aspects of body by aspects of biomechanics, physiotherapy's techniques (muscle stretching, joints mobilization, neuromobilization) and conditioning neuropsychological patterns of mental training, *Shiatsu therapy*, who also is one of the eldest student. To Szczepan Dominik Mateja who is my active student for many years not only in training, but also take part in improving understanding scientifically aspects as an scientific and Chinese culture adviser – for editing and faithful translation presented paper.

Keywords: *Qìgōng* training • self-defence • stretching techniques • traditional movements forms of *Tàijíquán Chen* Style

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1st World Congress on Health and Martial Arts in Interdisciplinary Approach, HMA 2015

Hapkido: Korean martial art

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Abstract

Background & Study Aim. *Hapkido* is Korean martial art. A conditioning and development of coordination motor abilities are valuable for citizens in the contemporary society. The aim of our short communication is related to effects of *hapkido* training on motivation and some aspects of coordination motor abilities in participants. We would like present *hapkido* as a physical activity which can be trained as an alternative syllabus in physical education at preliminary school.

Material and Methods: Some original research findings about incentives in study 1 [1] and effects of *hapkido* training on our pupils in study 2 [2] were synthesized. The syllabus of *hapkido* for students of preliminary school is shortly characterized [3].

Results: Study 1. Health in the hierarchy of incentives of persons who train hapkido [1]

The purpose of this study was to determine the motivation of persons practicing *hapkido* as well as the importance for them to maintain health and to improve their age and gender related physical fitness. The survey was conducted among 60 persons, including 21 girls and women as well as 39 boys and men. Due to a wide range variability of the subjects' ages, they were divided into three categories: the younger – to 13 years (n = 33); adolescent – between 13 -18 years (n = 17); and older one – above 18 years of age (n = 10).

The questionnaire of motivation that was used [4] consisted of 27 questions concerning nine motives, why those children, youngsters and adults engaged in physical activities. The tested normality of distribution was taken into account during the statistical study as well as the mean values and measures of variation were computed and compared for every motivational factor in those age groups. The following conclusions were drawn: 1) Attainment of fitness and good health were the strongest incentive regardless of the age and gender of the people who trained *hapkido*, 2) The gender of the persons practicing *hapkido* did not bear on the hierarchy and intensity of motives, 3) The motivation of the people who practiced *hapkido* depended essentially on age. The factors related to extrinsic success, intrinsic success and ambition for power and domination were higher in the youngest group.

Study 2. Effectiveness of exercises used during Hapkido recreational and sport camp [2]

We have assumed that the training methods applied at the two-week *hapkido* camp for boys should cause beneficial changes regarding body adaptation to effort as well as coordination and motor skills. The participants of the sports and recreation *hapkido* camp have taken part in the physical activity programme which included: hiking, general physical exercises as well as agility and acrobatic techniques, games and recreation activities both on land and water, self-defence exercises in pairs (techniques required for the yellow, green, blue and black belt according to European Hapkido Alliance), formal *hapkido* techniques performed individually and in groups.

Body height in the examined group (n = 25) was very different (ranging from 137 to 190.5cm, the average height was 160.3cm), which was connected with the boys' ages (9-16, the average age was 13). Therefore, the campers were divided into two age groups i.e. 9-12 year-olds and 13-16 year-olds (there were only two 16-year-old boys). Every day during the morning training, which lasted for about 30 min., *bong hyung* stick forms were mostly performed.

During the camp (on the second and the thirteenth day) we carried out the examination that included: measuring of body weight (electronic scale) and height (anthropometer), Ruffier-Dikson (RD) test, which involves performing 30 knee bendings in 45 s (heart rate was measured before, just after the effort and after 1 min. break (Polar, Finland) and computer tests evaluating coordination skills [5]. After the results had been standardized, the individual profiles were worked out. A t-Student test for paired variables was then applied to evaluate the statistical significance of differences ($p<0.05$) between the results of the measurements at the beginning and at the end of the camp.

The results at the beginning of the camp showed that seven students had poor physical efficiency, sixteen – average and two – good. There were no substantial statistical changes neither in the body weight nor in the RD rate of adopting to effort. In some cases, however, increase

and in some cases decrease in body weight and the above mentioned RD rate was noticed. These results are likely to be connected with the different levels of commitment to trainings at the camp. Comparison of the average results of the computer tests evaluating different aspects of coordination, which were carried out at the beginning and at the end of the camp, showed that there were significant betterment in orientation in space as well as in the ability to divide attention. The performed exercises had actually the biggest influence on the increase of the students' ability to divide attention ($t = -10.985$; $p<0.001$). However, we have not noticed any significant changes in simple reaction time, complex reaction time or sense of direction ($p<0.05$).The hypothesis about the increase of body adaptation to endurance effort has not been completely proved (because of too short time). In conclusion, what has been acknowledged is that attending a well-organized *hapkido* camp for boys in their growth period brought beneficial changes in coordination and motor skills.

Hapkido martial art as an alternative for conventional physical and health education, and sport in schools

In our country, alternative forms of physical education in schools are gaining more attention, which is proved by the author's program of physical education teaching based on hapkido martial art approved by the Ministry of Education and Sport [3]. The results of another investigation constitute additional argument for health professionals, who should be aware that there are certain alternative methods to traditional exercise which can increase physical fitness and health of the middle-aged population [6].

In the final remark we would like to state, that a construct *Hap* – coordination, *Ki* – internal energy and *Do* – moral way is a good prophylactic mean for people who present sedentary style of life. The knowledge summarized here can be useful during *Health by Martial Arts Gala Congress Gala* under the **World Congress on Health and Martial Arts in Interdisciplinary Approach** in which our Hapkido Demonstration Team gave show of their unique skills (please see Figs.1-10, Piotr Feczko with permission, and Figs. 11-13 from archives of European Hapkido Alliance).

Key words: education • health • motivation • motor abilities • self-defence

Fig.1. Family training for fun

Fig.2. Instructors in action using bamboo sword

Fig.3. Instructors using Fan as a weapon in self-defense

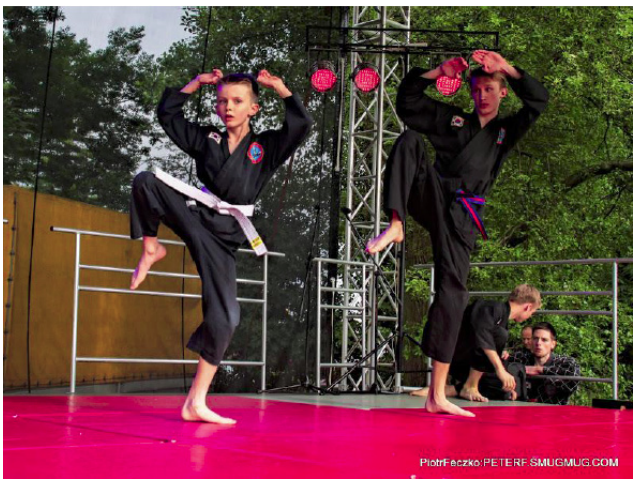

Fig.5. Fragment of formal exercise beneficial for balance mastering

Fig.6. Just before breakfall

Fig.7. Formal exercise in pair using wooden swords

Fig.8. Self-defence

Fig. 9. Soft landing after *hapkido* throw execution

Fig.10. Self defense

Fig.11. Hapkido group with flags in background

Fig. 12. Sam Plumb in action

Fig.13. Hapkido black belts / instructors during International Seminar

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Silat Olahraga: The Malay Combat Sports

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Abstract

Silat olahraga is a sport that existed in the midst of development of thousands of silat schools in the world. Olahraga means the ability for a silat exponent to perform his silat techniques in combat with striking and defensive actions such as punching, kicking, throwing, catching, parrying and blocking and any skill related to silat techniques. Thus, the purpose of the present paper is to provide the review of Silat Olahraga sports since it was introduced 30 years ago in Malaysia. There are three types of silat contests that are championship, showmanship and freestyle. The championship is a contest in which a participant aims to become a district champion, state champion, a national champion or international champion. In silat olahraga there are several types of strikes athletes can use during competition. The assessment of winning or losing is determined by the standard of attack, the defence, the falls and clinching that takes place in the competition. The fighters are judged on the prestige of their techniques and the beauty of silat that is portrayed. There are several skills that contribute to success in silat performance where every aspect of these skills will contribute to success of the fighter. However, several factors will also influence the game such as injury and error of marking. Thus, the tournament of silat olahraga is like a golden bridge which strengthens the ties among the athletes from different schools at the state, national and international levels with spirits of friendship and warriorship.

Key Words: martial arts • combat sports • regulations • arts • techniques

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Seni Silat Malaysia: The Malay Arts of Self-Defence

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Abstract

The purpose of the present paper is to provide the review of Silat curriculum based on the effective ancient roots Malay warfare. It is intended to introduce the background of Malay martial arts in the modern context and its contribution to world civilization. Silat is the type of self-defence originated from Malaysia. Silat is deeply entrenched in the traditions and culture of Malaysian civilization. The knowledge of self-defence is especially concerned with methods of defending oneself from any attacks, be they through erosion, parrying, dodging and others, which may endanger the attacker. Seni Silat (the arts of silat) not only to defend oneself from being attack but also to attack the opponent thus preventing the attacker from causing any harm. The attacks and defence must be well executed to achieve the maximum effect. Compare to other silat schools in Malaysia, Seni Gayung Fatani is the only styles to have truly originated from the Malay Peninsula. It is an original silat whose syllabus does not hold techniques taken from other martial art forms or other silat styles. The school has been acknowledged as a Malaysian heritage of martial art and its curriculum has become the basis for the Malaysian Seni Silat Curriculum (Seni Silat Malaysia). This curriculum teaches self-defence techniques, arts, combat, and also trains exponents for Silat Olahraga (silat sports). The techniques learnt here gives the student a better understanding of right techniques and their applications to real combative situations.

Key Words: Martial Arts • Gayung • Curriculum • Combat • Seni

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Material and methods should describe clearly the selection of observational or experimental subjects including controls, such as age, gender, inclusion and exclusion criteria, (the circumstances for rejection from the study should be clearly defined), randomization and masking (blinding) method. Use of subheadings is advised.

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Drayer DE, Koffler D. Factors in the emergence of infectious diseases. Emerg Infect Dis [serial online] 1995 Jan-Mar [accessed 1996 Jun 5];1(1):[24 screens]. Available from: URL:http://www.cdc.gov/ncidod/EID/eid.htm

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Identify statistical measures of variations such as standard deviation and standard error of the mean. Do not use internal horizontal and vertical rules. Be sure that each table is cited in the text.

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Figures should be drawn professionally. Photographs must be sharp and delivered in high-quality electronic format. The resolution of color images should also be at least 300 dpi. All color art should be in RGB format. Please submit files in TIFF, JPG or EPS. Only Times, Helvetica, Arial, or Symbol fonts should be used. Using other fonts may result in lost or improperly converted characters. Figures should be numbered (with Arabic numerals) consecutively according to the order in which they have been first cited in the text. Figures should contain the following information: (a) figure title; (b) all the necessary explanations of symbols and findings, written continuously; (c) statistics. Do not put the title of the figure on the figure! Several figures related to the same patient, i.e. exercise/task shown in steps, should be labeled Figure 1 A, B, C, etc. rather than Figures 1, 2, 3. Symbols should be consistent throughout a series of figures. Use simple symbols, like closed and open circles, triangles and squares. Different types of connecting lines can be used. The meanings of symbols and lines should be defined in the legend. The axes should be equal in length so as to make the diagrams square. Each axis should be labeled with a description of the variable it represents. Only the first letter of the first word should be capitalized. The labeling should be parallel with the respective axis. Axes should not extend beyond the last numeral, and should never be terminated by arrows. Choose units so that the values expressed may fall within the range between 0 and 999.

Graphs or charts must be provided as complete Excel files. Do not draw three-dimensional graphs if not absolutely necessary. Do not shade the background. Do not use grids.

Photomicrographs should have internal scale markers. Symbols, arrows, or letters used in photomicrographs should contrast with the background. If photographs of people are used, either the subjects must not be identifiable or their pictures must be accompanied by written permission to use the photograph.

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Units of Measurement. Measurements of length, height, weight, and volume should be reported in metric units (meter, kilogram, or liter) or their decimal multiples. Temperatures should be given in degrees Celsius. Blood pressures should be given in millimeters of mercury.

Abbreviations and Symbols. Use only standard abbreviations. Avoid abbreviations in the title and abstract. The full term which an abbreviation stands for should precede its first use in the text unless it is a standard unit of measurement.

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