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CONTENTS

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ORIGINAL RESEARCH PAPER

A MODEL FOR OPTIMIZING THE LEARNING OF BASIC TECHNIQUES OF FIGHT IN STANDING POSITION FOR YOUNG JUDOKAS

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Abstract

The growing popularity of judo around the world is forcing researchers and coaches to constantly look for new, effective, and scientifically based tools and methods for learning judo techniques for optimal competition performance. The opinions of judo specialists on mastering the judo technique are divided into two groups: one believes that a smaller amount of technique should be taught, and that the focus should be on mastering these techniques better, while the other believes that the basics of technical training are the acquisition of basic techniques, i.e., the acquisition of 40 techniques. Increasing the efficiency of the training process with a well-thought-out set of tools and methods is an important condition for mastering the basic techniques of fight in standing position in judo. The research aim is the approbation of the model for optimizing the learning of basic techniques of fight in standing position for young judokas. Research methods: research and analysis of literature sources, expert evaluation method, modelling, observational experiment, and mathematical statistics. The research involved judokas aged 7-12 (58 judokas) and 3 judo experts. The research results reveal that the model for optimizing the acquisition of basic techniques of fight in standing position in judo consists of identifying the learning needs of judokas; setting learning goals; setting learning tasks; choice of learning methods and tools; assessment of learning results, as well as general developmental, auxiliary exercises, and special developmental and competition exercises. The optimization of learning the basic techniques of fight in standing position in judo is initially done by using general developmental, auxiliary exercises, special

development, and competition exercises, during which the elements of the technique are mastered up to the skill level, followed by 5 student grades (kyo) with 8 techniques in each. The experience of accumulated movements is expanded, and body movements are managed in 3 planes, as well as physical properties are developed in parallel, with an emphasis on coordination skills.

Key words: *judo, judo techniques of fight in standing position, optimizing learning of the basic technique for young judoka.*

Introduction

Optimization theory reveals that from some of the available alternatives, the best choice can be determined that optimizes (maximizes or minimizes) a specific goal function (Bhatti, 2000), thus optimizing the training process while planning the learning process is possible in setting the learning-training goals and tasks; in the selection and specification of the curriculum, taking into account the goal, as well as the selection of the most appropriate forms, methods and means of learning (Bocioaca, 2014). Learning optimization is a system of measures that enables a coach to achieve the best possible results in the specific circumstances. Optimizing the learning-training process by taking into account the general learning and training goals, pedagogical regularities, learning principles, real learning opportunities for each athlete and the entire learning group, as well as the coach's own capabilities, means to define specific learning tasks for the specific learning-training session or the session cycle, to specify the learning content in accordance with them, to select appropriate forms, methods and means of learning-training. All this makes it possible to achieve the planned training results within the allocated time with the optimal effort of the students.

Movement learning theory emphasizes that movement skills are acquired by restricting excess degrees of freedom, (Bernstein, 1947), revealing that the coordination of movements is, in essence, the restriction of excess degrees of freedom as a condition for the acquisition of basic techniques of fight in standing position in judo by developing physical properties, selecting methods and means, and increasing the demands on the judoka psyche, attention, and its development. (Sielużycki et al., 2019; Koshida et al., 2017; Franchini et al., 2017; Iermakov et al., 2016; Franchini et al., 2013; Bompa & Haff, 2009). The learning process should start with mastering the elements of judo at a high level, but unfortunately the coaches do not pay much attention to it and are in a hurry to teach steep fighting techniques, as well as to complete the competition tasks. Once the elements of judo are mastered at a high level, you should continue to teach the basics

of martial arts. A long-term approach to coaching (adapted from Balyi, 2005) plays a very important role in athlete training. Coaches need to understand what tools and methods are best for each age and what to look for. This knowledge is based on sensitive periods of human development. The goals and objectives of training change at each age so that the athlete does not get tired of doing the same thing. The long-term training of judo is grouped according to the students' mastery levels (*kyo*).

The amount of technical training is the number of techniques that an athlete can perform or performs in training. This is called the total or training volume. The competition volume is the number of different techniques performed in the competition. Judo uses more than 100 different techniques, but most leading judokas use only a small portion of these techniques (often 1-2 "crown numbers"). Of course, this does not mean that they do not know how to perform other techniques. When fighting with less qualified athletes, a rich arsenal of techniques is used, but in responsible fights - only the favourite techniques (Adam, 2007; Kłys et al., 2020). The basics of fight in standing position in judo are stances (9 types), grips (6 types), movement types (3 types), turns (7 types), movement directions (9 types), falling technique (7 types) and moving the opponent to an unstable position (8 types), which are to be mastered at a high level of skill (Inogai & Habersetzer, 2002). It is also necessary to determine the technical tactical variables of the fight and their role in the competition and, consequently, in the training process (Miarka et al., 2012; Kłys, 2020).

At each stage, optimization can be performed under an important condition, i.e., a conscious practice and an individualization process (Baker & Young, 2014; Macnamara et al., 2016; Ericsson, 2020). Learning in childhood is usually uncritical and trust-dominated: the child tries to acquire as much as possible and trusts the adults as they introduce the child to what he or she needs to know. However, interest in learning has been growing since the onset of puberty. The development of young people's identity is linked to their ability to choose goals and frameworks, and therefore the formation of identity is very important in the learning process during this period (Illeris, 2007). The aim of this research is approbation of the model for optimizing the learning of basic techniques of fight in standing position for young judokas.

Material and methods

To approbate the model for optimizing the learning of basic techniques of fight in standing position for young judokas, research and analysis of literature sources was performed, as well as expert evaluation method, modelling, observational experiment, and mathematical statistics were applied. The research involved judokas aged 7 – 12 (58 judokas) and 3

judo experts. The study has been approved by the Latvian Academy of Sport Education Ethics commission.

The aim of the application of the expert evaluation method was to determine the level of acquisition of the basic techniques of fight in standing position of young judokas before and after the application of the content of the learning optimization model. Within the framework of the research, the evaluation of student throw complexes (student kata) was implemented. Three experts participated in the research. Before the evaluation, the experts got acquainted with the evaluation criteria, the aim, and tasks of the event. The technical performance was evaluated with a certain number of points:

1. grip – 1 point.
2. adaptation to the throw, unbalancing the opponent – 1 point.
3. body turn – 1 point.
4. pre-throw position (starting position) – 2 points.
5. execution of throws – 2 points.
6. fixation after the throw with securing the partner – 1 point.
7. large amplitude and throw speed – 1 point.
8. performance of the whole action without the slightest braking (the whole set of movements is smooth and beautiful) – 1 point;
9. the allowable reduction of the judge's evaluation for a small mistake – 0.5 points.

Aesthetics (0-3 points) – movement without lifting the legs, correct bow, synchronous performance and leaving correctly, and moving on the ground.

The purpose of modelling in this research work is to develop and test the model for optimizing the learning of basic techniques of fight in standing position for young judokas. The model type is structurally functional, which is based on a theoretical and conceptual model. The model is developed in several stages: *First stage.* In the first stage of the modelling, the research of scientific literature sources on the possibilities of optimizing the learning of basic techniques of fight in standing position in judo for young judokas was performed. At the beginning of the model development, a problem was defined, which is related to the diversity and possibilities of performing the diverse and complex basic techniques of fight in standing position in judo, which poses many unresolved tasks, the goal of which is to increase the efficiency of the training process. The analysis of the scientific literature provided an understanding of the research problem. *Second stage*. In the second stage of modelling, the realization of the arsenal and efficiency of the techniques of fight in standing position of the strongest judokas in the world and in Latvia was analysed and described, explaining its significance in the technical training of a judoka in the competition and

training process. *Third stage.* In the third stage of modelling, the acquisition of the basic techniques of fight in standing position for young judokas was determined before the development of the model for optimizing the learning of the basic techniques of fight in standing position for young judokas. *Fourth stage.* In the fourth stage of modelling, a model for optimizing the learning of the basic techniques of fight in standing position for young judokas was developed and approbated. *Fifth stage.* In the fifth stage of modelling, the acquisition of the basic techniques of fight in standing position for young judokas was determined after the approbation of the model for optimizing the learning of the basic techniques of fight in standing position for young judokas.

The observational experiment was carried out with the aim to determine and analyse the efficiency of the model for optimizing the learning of the basic techniques of fight in standing position for young judokas. The experiment took place in three stages. In the first stage of the research (January 2019 – March 2019), the acquisition of basic judging techniques for young judokas before the development of the optimization model was studied. In the second stage of the research (January 2019 – December 2019), the model for optimizing the learning of basic judo fighting techniques was used in practice. In the third stage of the research (December 2019), the acquisition of basic judging techniques by young judokas using the optimization model is analysed and defined. The groups of participants in the experiment consisted of 58 judokas aged 7 – 12 (the first group included 29 people, and the second group included 29 people). The model for optimizing the learning of basic techniques of fight in standing position in judo consists of identifying the learning needs of judokas; setting learning objectives; setting learning tasks; selecting learning methods and tools; assessment of learning results, as well as general developmental, auxiliary exercises, special developmental and competition exercises. The task of these exercises: extension of the accumulated movement experience, management of body movements in 3 planes, development of physical properties, with emphasis on coordination skills. The model is based on 352 exercises and the learning process is divided into three stages: the initial learning stage - creating an idea of the learner's movement; the stage of in-depth and detailed learning (skill development); the stage of strengthening and further development (skill building).

The obtained data were mathematically processed with Microsoft Office Excel and SPSS 22.0 data processing programme. Calculated descriptive statistics, Kolmogorov-Smirnov test, Spearman’s rank correlation and Mann-Whitney U test.

Results

Acquisition of judo fundamental techniques for young judokas before the development of the model for optimizing the learning of basic techniques of fight in standing position for young judokas.

The level of technical preparedness of judokas aged 7 – 12 was determined. The young judokas were divided according to age and the skill levels. Each pupil's skill level determines the number of throws from different throw classification groups, which must be performed using different types and principles.

The results of *the yellow belt (5th kyo)* are as follows:

1. *De-ashi-barai* M= 6.82 (SD=0.91) with value range from 4 to 8.
2. *Sasae-tsurikomi-ashi* M=6.07 (SD=0.97) with value range from 4 to 8.
3. *O-soto-gari* M=6.48 (SD=0.90) with value range from 4 to 8.
4. *O-goshi* M=6.15 (SD=0.86) with value range from 4 to 8.
5. *Morote-seoi-nage* M=6.19 (SD=1.03) with value range from 4 to 8.
6. In aesthetics M=1.68 (SD=0.47) with value range from 1 to 3.

The results of *the orange belt (4th kyo)* are as follows:

1. *Uki-goshi* M=7.40 (SD=0.64) with value range from 6 to 8.
2. *O-uchi-gari* M=6.57 (SD=0.87) with value range from 5 to 8.
3. *Ko-soto-gari* M=6.70 (SD=1.52) with value range from 4 to 8.
4. *Ko-uchi-gari* M=6.33 (SD=1.16) with value range from 4 to 7.5.
5. *Koshi-guruma* M=7.05 (SD=0.51) with value range from 6 to 8.
6. *Tsurikomi-goshi* M=5.33 (SD=1.79) with value range from 3 to 9.
7. *Okuri-ashi-barai* M=6.13 (SD=1.21) with value range from 4 to 8.
8. *Tai-otoshi* M=6.27 (SD=1.04) with value range from 5 to 8.
9. *Harai-goshi* M=6.20 (SD=0.96) with value range from 5 to 8.
10. In aesthetics M=2.07 (SD=0.87) with value range from 1 to 3.

The results of *the green belt (3rd kyo)* are as follows:

1. *Ko-soto-gake* M=6.50 (SD=1.08) with value range from 4 to 8.
2. *Tsuri-goshi* M=7.24 (SD=0.59) with value range from 6 to 8.
3. *Yoko-otoshi* M=7.47 (SD=0.65) with value range from 6 to 8.
4. *Ashi-guruma* M=6.78 (SD=0.98) with value range from 4 to 8.
5. *Uchi-mata* M=6.79 (SD=0.75) with value range from 5 to 8.
6. *Tomoe-nage* M=7.15 (SD=0.74) with value range from 6 to 8.
7. *Kata-guruma* M=6.74 (SD=0.66) with value range from 6 to 7.5.
8. In aesthetics M=1.53 (SD=0.35) with value range from 1 to 2.5.

The evaluation of the acquisition of basic martial arts techniques by three experts before the development and approbation of the learning optimization model shows that the level of athletes in all three levels of students' mastery (*kyo*) is almost good. The arithmetic mean is 6.57 points. The model for optimizing the learning of basic techniques of fight in

standing position for young judokas is based on the sources of scientific literature, scientific theories and on the results of previous research (Fig. 1).

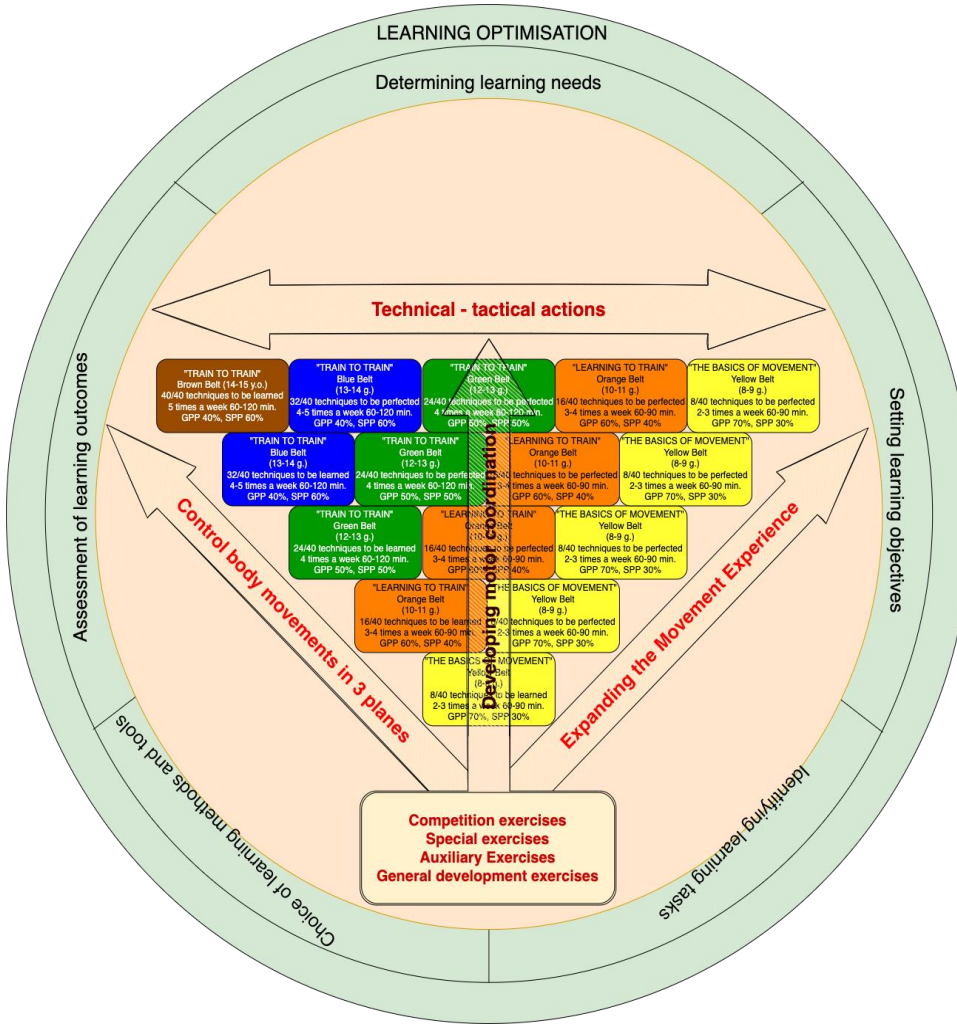

Figure 1. *The Model for Optimizing the Learning of Basic Techniques of Fight in Standing Position for Young Judokas*

The outer circle – learning optimization – includes the second circle - learning optimization stages. The stages are as follows: determining the learning needs of judokas; setting learning objectives; setting learning tasks; choice of learning methods and tools; assessment of learning outcomes, followed again by the first stage, which indicates that the variability of these stages is an ongoing process. At each stage, optimization can be performed under a conscious practice and an individualization process. This model for

optimizing the learning of basic techniques of fight in standing position for young judokas content is based on general, advanced, and competitive exercises. The most important physical trait required to master the basic techniques of judo fighting in standing position is coordination, and it must be developed all the time (see the arrow that goes through the triangle). In parallel, there is an extension of technical experience (see the right side of the triangle) and control of body movements in the horizontal, vertical, and sagittal planes (see the left side of the triangle), while the upper edge of the triangle indicates an extension of the technical tactical operation. The rectangles in the triangle represent the long-standing preparation of the judokas. The rectangles are in different colours (according to the colours of the belts) and indicate the age, the number of workouts per week, their duration, and the percentages of general physical preparation (GPP) and special physical training (SPT). The best judo specialists in different countries have identified and use a certain number of separate technical units (ATVs) from different classification groups. The world-renowned Kodokan Five-Step (*Go-kyo*) Basic Technique Kit contains 40 standing techniques. In 5 – 7 years, students learn eight to forty techniques of standing fighting. The five-step system allows you to solve several tasks. In each level of pupils' judo skills (5^{th} *kyo*-1^{st} kyo – yellow-brown belt), 8 basic combat techniques must be mastered, which contain different principles of throwing from four groups of throws (legs, hips, hands and throws while falling).

If in the first year of training the yellow belt technique of fight in standing position is mastered, then in the second school year the orange belt technique of fight in standing position must be mastered, improving the previously acquired yellow belt technique. When teaching the green belt technique, the technique of all previous belts should be improved. This principle should continue to be followed when learning other belt techniques - always improve the previous technique to reach a skill level that will help to create combinations or connections of the technique. The main task of the student is to expand the movement experience to find their best throws to compete with. A judoka with a large range of learned throws can decipher his/her opponent's intentions and successfully defend himself/herself. To master a complex movement task, the movements must be repeated many times with a partner on one place from both sides, moving straight in both directions, and in various other directions. Knowledge creates an opportunity to acquire skills and abilities to perform techniques. The acquisition of certain techniques is a means of developing the coordination of movements. This is due to two factors that contribute to the improvement of coordination:

1. inclusion of limbs and body parts in the performance of movements.
2. performance of movement tasks in different anatomical planes and around different axes of the body (vertical, horizontal, sagittal).

General preparatory exercises (routine exercises, elements of acrobatics and gymnastics), special preparatory exercises, adapted games, games and simplified forms of wrestling, as well as competition exercises (tipping, throwing), which include all technical activities used in competitions and Kata in a demonstration, are used as assets.

After applying the content of the model for optimizing the learning of basic techniques of fight in standing position for young judokas, an exam was organized to determine the level of pupils' technical readiness. The Mann-Whitney U test for the 2 independent clusters helped to determine that the increase in scores was mathematically significantly different, as almost all throws had a p-value of <0.05 or <0.01 for the reciprocal alternative, so it can be assumed with 95% or 99% probability that the average score for judo combat techniques is significantly different. Thus, in this case the increase is statistically significant. The reliability of all throw changes is shown in Table 1, 2, 3.

Table 1

Credibility of the Change in Average Technique Assessment of the Yellow Belt (5th *kyo*)

Nr.	Name of Technique	1st assessment	2nd assessment	Increase Credibility
	De-ashi-barai	M=6.82 (SD=0.91)	M=8.15 (SD=0.96)	p<0.01
	Sasae-tsurikomi-ashi	M=6.07 (SD=0.97)	M=7.95 (SD=1.03)	p<0.01
	O-soto-gari	M=6.48 (SD=0.90)	M=8.21 (SD=0.85)	p<0.01
	O-goshi	M=6.15 (SD=0.86)	M=7.86 (SD=0.76)	p<0.01
	Morote-seoi-nage	M=6.19 (SD=1.03)	M=8.02 (SD=0.81)	p<0.01
	Aesthetics	M=1.68 (SD=0.47)	M=2.33 (SD=0.49)	p<0.01

The increase of the results of the yellow belt (see Table 1) is plausible for all techniques, as p <0.01. The average increase for all techniques is 1.7 points.

An increase in the results for ***the orange belt*** (see Table 2) is plausible in 6 cases, as p <0.01 or 0.05, but unlikely in 3 cases. The average increase for all techniques is 2.16 points.

Table 2

Credibility of the Change in Average Technique Assessment of the Orange Belt (4th *kyo*)

N.	Name of Technique	1st assessment	2nd assessment	Increase Credibility
1.	*Uki-goshi*	M=7.40 (SD=0.64)	M=9.38 (SD=0.64)	p<0.01
2.	*O-uchi-gari*	M=6.57 (SD=0.87)	M=8.65 (SD=0.91)	p<0.05
3.	*Ko-soto-gari*	M=6.70 (SD=1.52)	M=8.68 (SD=1.54)	p>0.05
4.	*Ko-uchi-gari*	M=6.33 (SD=1.16)	M=8.47 (SD=1.28)	p>0.05
5.	*Koshi-guruma*	M=7.05 (SD=0.51)	M=9.08 (SD=0.54)	p<0.05
6.	*Tsurikomi-goshi*	M=5.33 (SD=1.79)	M=7.77 (SD=1.97)	p>0.05
7.	*Okuri-ashi-barai*	M=6.13 (SD=1.21)	M=8.48 (SD=1.37)	p<0.05
8.	*Tai-otoshi*	M=6.27 (SD=1.04)	M=8.55 (SD=1.20)	p<0.05
9.	*Harai-goshi*	M=6.20 (SD=0.96)	M=8.37 (SD=1.05)	p<0.05
10.	Aesthetics	M=2.07 (SD=0.87)	M=2.73 (SD=0.48)	p>0.05

An increase in the results of the ***green belt*** (see Table 3) is plausible for all techniques, as p <0.01 or 0.05. The average increase for all techniques is 1.59 points.

Table 3

Credibility of the Change in Average Technique Assessment of the Green Belt (3rd *kyo*)

N.	Name of technique	1st assessment	2nd assessment	Increase credibility
1.	*Ko-soto-gake*	M=6.50 (SD=1.08)	M=8.31 (SD=0.67)	p<0.05
2.	*Tsuri-goshi*	M=7.24 (SD=0.59)	M=8.64 (SD=0.54)	p<0.01
3.	*Yoko-otoshi*	M=7.47 (SD=0.65)	M=9.07 (SD=0.51)	p<0.01
4.	*Ashi-guruma*	M=6.78 (SD=0.98)	M=8.60 (SD=0.48)	p<0.01
5.	*Uchi-mata*	M=6.79 (SD=0.75)	M=8.36 (SD=0.75)	p<0.01
6.	*Tomoe-nage*	M=7.15 (SD=0.74)	M=8.65 (SD=0.74)	p<0.05
7.	*Kata-guruma*	M=6.74 (SD=0.66)	M=8.15 (SD=0.74)	p<0.05
8.	Aesthetics	M=1.53 (SD=0.35)	M=2.58 (SD=0.26)	p<0.05

After processing the results, it can be concluded that the use of the content of the model for optimizing the learning of basic techniques of fight in standing position for young judokas technique has improved the technical preparation results for all three grades of students (kyo – yellow, orange, green belt) by an average of 1.82 points. This is due to the fact that more attention was paid to the biomechanics of teaching of judo elements and the implementation of techniques. Thus, the basic principles of performing technical techniques were determined and appropriate means were selected for their acquisition.

Discussion

We can conclude that the optimization of the acquisition of basic

optimizing learning and improving the technical skills of athletes; improving the conditions of the training process, the level of the coach's knowledge, sparing partners in a level of equal and higher technical training, in the context of equipment and inventory (Туманян, 2006; Шулика, 2006; Ciaccioni et al., 2019, 2021).

The obtained results are of practical significance because they allow to understand the development trends of judo technical skills; to find outwhat techniques are most often used today and to recognize them automatically during the fight at the so-called level of intuition (anticipation); to apply adequate protection and to perform the necessary countermeasures; to develop a tactical technical model against a specific fighter; to make general adjustments in the curriculum and in the training of athletes. Colleagues from the University of Zagreb think similarly. They say that the results of this type of research can serve professionals in choosing more rational technical and tactical training content and in developing new, modern learning procedures and approaches in judo training (Segedi & Sertić, 2014).

The model for optimizing the learning of basic techniques of fight in standing position for young judokas consists of general developmental, complimentary exercises, special developmental and competition exercises. The task of these exercises is to expand the accumulated movement experience, to control body movements in 3 planes, to develop physical properties, with an emphasis on coordination skills. Training should begin with basic elements of judo martial arts, continuing with 40 basic judo martial arts techniques, all of which should be completed in 5 – 7 years. All the above is intended to expand technical tactics. The author of the dissertation used 352 exercises as a basis for the model and divided the learning process into three stages. The stages are as follows: the initial learning stage - creating an idea of the learner's movement; the stage of in-depth and detailed learning (skill development); the stage of strengthening and further development (skill building). 352 exercises were selected as the basis for solving the question of optimizing the learning of the basic techniques of judo's complex and varied standing fighting. These are: general developmental exercises – 30; judo special preparatory exercises – 5; physical training exercises – 29; acrobatic exercises – 16; judo standing martial arts exercises – 39; judo standing basic competition exercises – 179; fall technique learning exercises – 34; custom sports games and simplified types of fighting – 20. All these exercises are arranged in chains of training algorithms. The chain of training algorithms is the sequential use of the training parts (introductory, main, and final) with the chosen tools and methods according to the objectives of the training. Circuits of training

algorithms have been developed for each of the principles of performing the basic technique of upright fighting, which was used to prepare students for taking the set of techniques – the *kyo* exam.

The learning process should start with mastering the elements of judo at a high level, but unfortunately the trainers do not pay much attention to it and are in a hurry to teach steep fighting techniques, as well as to complete the competition tasks. Once the elements of judo are mastered at a high level, you should continue to teach the basics of martial arts. A long-term approach to coaching (adapted from Balyi, 2005) plays a very important role in athlete training. Coaches need to understand what tools and methods are best for each age and what to look for. This knowledge is based on the sensitive periods of human development. The goals and objectives of training change at each age so that the athlete does not get tired of doing the same thing. In his work, the author has grouped the long-term training of judo according to the students' mastery levels (*kyo*).

The results of the research allow to improve the efficiency of the training process and, thus, to improve the new judo learning programme in the initial stage of training. Recommendations for judo coaches to facilitate technical preparation and optimize the learning of complex and various techniques of fight in standing position for children and adolescents aged 7 – 12:

1. The acquisition of the technique must begin with the basic elements of judo standing technique, achieving them at the skill level.
2. This should be followed by 40 basic judo fighting techniques, divided into 5 students' mastery levels (*kyo*).
3. The assessment must take place under equivalent conditions according to the same criteria and parameters, using the same type of judo technique assessment protocols.
4. In order to control the rich spectrum of basic judo techniques of fight in standing position (diversity), the authors of the research recommends the use of the modified *Kodokan* standing basic techniques of fight in standing position classification according to anatomical features, and the division of the technique according to the principle of household performance (lifting-breaking, sweeping, cutting, mowing, chopping), as well as the use of short explanations of throws in the mother tongue for better technical learning.
5. Coaches must use chains of training algorithms, which in accordance with the objectives of the training exercise contain the implementation of successive parts of training (introductory preparation, main and final part), using the selected means and methods.

6. In the period from 7 to 12 years of age, the receipt of students' mastery degrees (*kyo*) is determined by the main criteria for judo training, i.e., technical fitness indicators, which are based on appropriate physical fitness, but the results of the competition – victories and prizes – are a secondary criterion.

Conclusions

At the beginning of the experiment, the level of athletes in all three skill levels (*kyo*) was almost good. The arithmetic mean was 6.57 points:

In the yellow belt (5^{th} *kyo*) the lowest rated *sasae-tsurikomi-ashi* M=6.07 (SD=0.97), with a value range from 4 to 8, but the highest in the *de-ashi-barai* M=6.82 (SD=0.91), with a value range from 4 to 8. The average score for the yellow belt is 6.34 points.

In the orange belt (4^{th} *kyo*) the lowest rated *tsurikomi-goshi* M=5.33 (SD=1.79), with a value range from 3 to 9, but the highest rated *uki-goshi* M=7.40 (SD=0.64), with a value range from 6 to 8. The average score for the orange belt is 6.44 points.

In the green belt (3rd *kyo*) the lowest rated *ko-soto-gake* M=6.50 (SD=1.08) with a value range from 4 to 8, but the highest in the *yoko-otoshi* M=7.47 (SD=0.65), with a value range from 6 to 8. The average score for the green belt is 6.95 points.

The model for optimizing the learning of basic techniques of fight in standing position for young judokas consists of identifying the learning needs of judokas; setting learning objectives; setting learning tasks; choice of learning methods and tools; assessment of learning results, as well as general developmental, auxiliary exercises, special developmental and competition exercises. The task of these exercises: to expand the accumulated experience of movements, to control body movements in 3 planes, to develop physical properties, with an emphasis on coordination skills. The model is based on 352 exercises and the learning process is divided into three stages: the initial learning stage - creating an idea of the learner's movement; the stage of in-depth and detailed learning (skill development); the stage of strengthening and further development (skill building). The content of this model was used in training sessions for a whole year, after which the result of the model implementation was determined.

The evaluation of the acquisition of the basic techniques of fight in standing position after the development and approbation of the learning optimization model shows that the level of athletes in all three levels of students' mastery (*kyo*) is very good. The arithmetic mean is 8.39 points:

In the yellow belt (5th *kyo*) the lowest rated was *sasae-tsurikomi-ashi* M=7.95 (SD=1.03), with values ranging from 6 to 10, but the highest rated was *O-soto-long* M=8.21 (SD=0.85), with values ranging from 6 to 10. The average score for the yellow belt is 8.04 points.

In the orange belt (4th *kyo*) the lowest rated was *tsurikomi-goshi* M=7.77 (SD=1.97), with values ranging from 5 to 10, but the highest was *uki-goshi* M=9.38 (SD=0.64), with values ranging from 8.5 to 10. The average score for the orange belt is 8.60 points.

In the green belt (3rd *kyo*) *kata-guru* was rated the lowest M=8.15 (SD=0.74), with values ranging from 7 to 9, but the highest was the *yoko-otoshi* M=9.07 (SD=0.51), with values ranging from 7.5 to 10. The average score of the green belt is 8.54 points.

The use of the model for optimizing the learning of basic techniques of fight in standing position for young judokas has improved the technical preparation results for all three grades of students (*kyo* - yellow, orange, green belt) by an average of 1.82 points, which is statistically significant.

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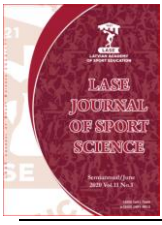

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ORIGINAL RESEARCH PAPER

ANALYSIS OF TRAINING VOLUME AND METHODOLOGY FOR HIGH-CLASS CANOE SPRINT ATHLETE – A CASE STUDY

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Abstract

Historically in canoe sprint as predominant abilities have been considered endurance and strength. As the sport develops, the often-changing competition programme in Olympic games and international championships with short and high-speed distances added, speed and power become also very important. The aim of this study is to give a detailed description about the training loads and volume and, in addition, to discuss the training methodology (strength training impact in total training amount) for high – class canoe sprint athlete (preparing and racing in the 200m distance). The research person is a medallist and participant of European and World championships. To study the research subject, the document analysis in form of training diary was used. The analysis was divided in three full training year cycles in one-year periods (macrocycles) from September to the following years September. In total 1119 workouts were analysed. In addition, the athletic and sport's specific training forms were distinguished. The athletic strength training was defined as: athletic strength ≥ 80% one repetition maximum (≥ 80% 1RM); athletic strength 60-70% 1RM; athletic strength speed oriented 60 – 70% 1RM; general physical fitness (GPF); statodynamic strength training. The specific strength was defined as: paddling with resistance; paddling with the additional weight in the boat; paddling from boat's standing position; continuous paddling in sports zone II (heart rate of 125 – 140beats/min) with certain maximum strength manifestation in strokes. The total training volume in megacycle of the high-class canoe sprint athlete was 1211h, where the largest part (815.9h) consisted of athletic strength and sport's

specific strength. Research showed a total part of 54% (which corresponded to 235.9h) of strength expression training forms from the total training volume.

Key words: *Canoe sprint, training load, strength training, specific strength training.*

Introduction

Athletic performance in any sport is affected by combinations of bio-motor abilities, where the three main bio-motor abilities are strength, speed, and endurance (Bompa & Buzzichelli, 2018; Zatsiorsky, 1995, 2006; Konrads, 2002). Many kinds of sports can be classified according to their predominant bio motor ability. Historically in canoe sprint predominant abilities have been considered endurance and strength. As the sport develops, the often-changing competition programme in Olympic games and international championships with short distances added, speed and power become very important. Modern canoe sprint is characterized by high intensity, a tight competition schedule (April to August) and specialization in a particular discipline. By specialization we mean adapting the training of athletes to a specific distance and boat class. If before the 2008 Beijing Olympic Games the athlete often competed in several disciplines and boat classes, then with the next Olympic cycle this trend has changed, and athletes specialize in a specific distance and a specific boat class. This is due to changes in the competition program, which makes it difficult to start in several disciplines. From the International Canoe Federation (ICF), this has been done with the aim of increasing rivalry – bigger the number of participants in certain disciplines and improved athletic performance. Therefore, higher, and higher demands are placed on the physical, technical, tactical, and psychological training of athletes.

Appropriate force is required to move the body and reach the required speed. When paddling at higher speeds, the boat has less water resistance due to the reduced draft of the boat or the reduced surface contact area due to the reduced draft. It is not possible to reduce the water resistance to the hull of the boat to obtain a higher speed, but the athlete's strength can be increased (Szanto, 1999). Strength plays an important role in canoe sprint without the development of strength it is not possible to achieve high results. A strong relationship between force and speed has been demonstrated in the following studies (Costill, Miller, Myers, Kehoe & Hoffman, 1968; Vandewalle, Peres, Heller, Panel & Monod, 1987; Young, Mc Lean & Ardagna, 1995; Bret, Rahmani, Dufour, Messonnier & Lacour, 2002; Cronin & Hansen, 2005; Giroux, Rabita, Chollet & Guilhem, 2016). According to Bompa and Buzzichelli, strength and the ability to perform

high power (i.e., large force development at high speed) are important determinants of performance in many sports. Research shows that strength and power are also important in endurance sports, such as long-distance running (Paavolainen, Hakkinen, Hamalainen, Nummela & Rusko, 1999; Jung, 2003) and cross-country skiing (Paavolainen, Hakkinen & Rusko, 1991; Hoff, Helgerud & Wisloeff, 1999; Hoff, Gran & Helgerud, 2002; Østerås, Helgerud & Hoff, 2002). The study by Rønnestad and Mujika (2014), which showed an improvement in the economy of running and cycling and an improvement in performance during the endurance training process, including maximum strength training. Strength and power performance also affect agility. Athletes with better strength and power scores perform better in agility tests (Peterson, Alvar & Rhea, 2006). Given that strength and power have such an impact in many sports, it is important for coaches and athletes to understand how developing these skills affects performance, and to understand the basic guidelines for strength training. According to Bompa and Buzzichelli physiological adaptation of the neuromuscular system can be achieved by a seven-phase model – anatomical adaptation, hypertrophy, maximal force, conversion, maintenance, termination, and compensation. Depending on the physiological requirements of the sport, the periodization of strength training involves at least four of these phases – anatomical adaptation, maximal force, conversion to specific force (power or strength endurance) and maintenance (Bompa & Buzzichelli, 2018).

However, most of the research does not give total amount of training load in hours, where each research has its own countifying system and one of the biggest problems is that amount that athletes have paddled has been counted in kilometres, but amount of athletic or other workouts have been expressed in hours. The information above defines the problem of our research – what is a role of strength training in canoe sprint, specializing in 200m discipline. How large is it? And how substantially is its impact on the total training volume in macrocycle (one year period) and even megacycle (three-year period)? What tools can be used to develop strength and power? There are studies in canoe sprint that reflect training load and its content (Zamotin & Sinjavin, 2018; García-Pallarés, Sánchez-Medina, Pérez, Izquierdo-Gabarren & Izquierdo, 2010; Vishnjakov, 2014; Verlin, 2015; Zhurauskij & Shantarovic, 2016a; Zhurauskij & Shantarovic, 2016b; Englert & Kiesler, 2009; Buchek & Hamar, 1998; Issurin, 2008; Li, 2015).

Material and methods

The research person was a European and World championships medallist. At the beginning of the research subject was 22 years of age, height – 191.2cm, weight – 93.1kg. With 7 years of international competition experience and 12 years of total training experience in canoe sprint. The permission of the Ethics Commission of Latvian Academy of Sport Education was received for this study.

To analyse and summarize available materials the analysis of documents was used. The method included analysis of training diaries (daily training diary and training camp diary) and digital document analysis (Garmin Connect digital diary). The information from the sports watch about each workout was synchronized with both the mobile phone application and the windows application on a computer, and the information obtained can be viewed in the Garmin Connect digital diary mentioned above. Synchronization is possible either in the presence of a wireless Internet connection (Wi-Fi) or via a Bluetooth wireless connection. The analysis of the training process was started from September 2018. In sports, the markers of the year are also planned and listed along with the main annual competitions (Issurin, 2010). In kayaking, a typical macrocycle usually lasts from August to the following years August. So, the research took 3 full training years (periods) from September till September. During research period subject participated in 10 international races and in 8 cases finished in top 8 places (A finals respectively). A total of 1119 workouts were analysed. All workouts were summarized using the Microsoft add-in Excel (Figure 1). The following information was collected for the analysis of the content of the training process (columns indicators were numbered, see number in the brackets behind indicator):

1. Numbering of training sessions (1)
2. Days of the week (2)
3. Date (3)
4. Content of the training session (as wide as possible, the mentioned exercises are listed, their duration, intensity, duration of rest breaks, number of repetitions, number of passes, number of series, aids used, etc.) (4)
5. Average heart rate (HR) during training session (5)
6. Maximum HR during exercise (6)
7. Total training time (in minutes, later transferred to hours) (7)
8. Total amount completed in the training session (in kilometres) (8)
9. Average training session speed (km/h) (9)
10. Maximum indicated speed in training session (km/h) (10)

1	2	3	4	5	6	7	8	9	10
		4.12.	Off day						
65			Paddling: 20"(p40"),20"X8sēr.; 500m pace	126	174	122:56:00	19,43	9,5	20,4
66	***Tr***	5.12.	*Paddling: 7x5' 2.zone (last min HR till 160bpm); with additional weight 10kg*	127	164	90:01:00	15,01	10	14,8
67			Athletic strength: Speed oriented 60-70% 1RM: 3 exercises, 4 sets per 15"/20" repetitions.			45:00:00			
68			**Paddling: 4x20"(p40")X8series; resistance - 2 tennis balls**	132	172	118:41:00	17,91	9,1	13,9
69	***Ce***	6.12.	Athletic strength: ≥80% one repetition maximum (1RM): Deadlift 8x130kg, incline Bench press 8x70kg, core exercises			90:00:00			
70			Paddling: 10"(p50"),10"X9; 200m pace	130	175	136:15:00	19,19	8,5	22,2
71	***Pk***	7.12.	*Paddling: 10'(p2'),8'(p2'),6'(p2'),4'(p2'),2' ; 2.zone; with additional weight 5kg*	122	137	97:36:00	15,75	9,7	13,2
		8.12.	Off day						
72			Paddling: 5x15"(p2"45")X3 sēr; P7'; Tempo: 90 s/min	121	161	104:10:00	15,8	9,1	20,1
73			*Paddling: 8X6' (on each 2'30" -->30" with Max strong stroke and pause; with additional weight 10kg*	125	151	96:52:00	15,73	9,8	13,8
74	***Sv***	S	Athletic strength: Statodynamics . 3 exercises (iccline bench press,squats, behind neck pull-down) X2series; 30"(p30"),30"(p30"),30"(p30"),30"(p30"),30";statodynamic regime; 40-60 % 1RM			80:00:00			

p – pause between repetitions; P – pause between series; HR – heart rate; 1RM – one repetition maximum

Figure 1. An example of a training process table summary created by the author. For explanation see text below.

By summarizing the training process, it was also necessary to mark free days, competition days, as well as to organize the analysis of the training process content. For example, the Figure 1 shows a holiday in light grey shade, making it easier to see smaller microcycles. In the column number one training sessions were numbered. The column number 2 marked the days of the week, in upper figure letters marked in bold, underlined and italic indicated that the subject was in a training camp. The column number 4 reflected the content of the training session, it this case different marked letters reflect different training forms, for example, session 68, marked in bold letters was sport's specific strength training form – paddling with the resistance. Sessions 66.71 and 73 are marked in italic letters, because these were sport's specific training form – paddling with additional weight in the boat. Columns number 5 and 6 reflected average and maximum HR of the training sessions. Column 7 reflected total time of training session. Column 8 reflected total distance completed in training session. Columns 9 and 10 reflected speeds in training session (average and maximum).

Overall, in our research of high-class canoe sprint athlete's training methodology and volume the training process was divided in three basic training forms:

1. Specific training load (paddling on the water).
2. Non-specific training load (other physical activities except paddling and

athletic strength).
3. Athletic Strength.

Non-specific training load included following training forms:

1. Bicycle.
2. Running.
3. Swimming.
4. Cross-country skiing.
5. Paddling on ergometer.
6. Roller-skiing.

By summarizing the training process, the methodology of strength development was divided in two forms: athletic strength and sport's specific strength, respectively. Canoe sprint due to its specifics, provides opportunities to use strength tools in sports-specific training on the water, for example, putting an additional weight in the boat, putting a rope with added tennis balls around the boat's hull (hydraulic resistance), making a sprint from boat's standing position, making a continuous paddling with certain maximum strength manifestation in strokes etc.

Athletic strength in following training forms were distinguished:

1. athletic strength ≥80% 1RM,
2. athletic strength 60 – 70% of 1RM,
3. athletic strength speed oriented 60 – 70% 1RM,
4. athletic strength - general physical fitness (GPF),
5. statodynamics (40 – 60% 1RM 3 – 5x per 20 – 40" (p20 – 40"))

By analysing the forms used in the training process in the specific sports trainings (on the water), training sessions were distinguished in which the exercises were used with the aim to develop strength and forms of its expression. According to the author's summary, the following forms were presented:

1. paddling with resistance,
2. paddling with the additional weight in the boat,
3. paddling from boat's standing position*
4. continuous paddling in sports zone II with certain maximum strength manifestation in strokes*

*The last two are marked with an asterisk because these shapes are fixed when no resistances or extra weights are used. If such forms are executed with resistance or with added weight, the executed load is counted towards the first two forms.

Other sport specific forms were:

1. paddling CDT (*continuous distance training).*
2. paddling (rest activities).

Furthermore, when the main analysis of training diaries was completed, it was divided into three parts (the macrocycles). Each macrocycle was divided into mesocycles and the total volume for sport's specific, non-specific, and athletic strength was obtained. In our research those were the basic forms for further analysis, also this classification type is like a training volume classification made by Norwegian researchers in cross-country skiing (Tonnessen et al., 2014).

To analyse and summarize the training volume and to distinguish the strength training and sport's specific strength training all three macrocycles were explored separately and mesocycle (approximately one month time) was chosen as smallest time for counting the different loads. (See table 1).

Table 1

Primary training load list table in the first mesocycle

Training forms	Minutes	Hours	Kilometres	Count
Bicycle	302:40:00	5	90.43	11
Running	52:57:00	0.88	7.66	2
Athletic Strength	295:14:00	4.9		3
Paddling	389:42:00	6.5	65.11	5
Total time (h)		17.3		

This mesocycle basically consisted of four training forms – two of the non-specific forms were cycling and running, the third was athletic strength and the fourth was paddling (specific load). To complete the aim, there was a need for much wider allocation of the training forms (see table 2). The basic training volume forms were to be divided in more detail, as seen in table 2, for example, such non-specific training forms as bicycle continuous distance training (Bicycle CDT) and running CDT were divided.

Table 2

Detailed training load list table in the first mesocycle

	Minutes	Hours	Kilometres	Count
Bicycle CDT	302:40:00	5	90.43	11
Running CDT	52:57:00	0.88	7.66	2
Athletic strength 60-70% 1RM	120:00:00	2		1
Athletic Strength GPF	175:14:00	2.9		2
Paddling CDT	389:42:00	6.5	65.11	5
Total time (h)		17.3		

CDT – continuous distance training

For each mesocycle, the total performed training volume (h) was recorded (see table 3) for basic training forms – specific work, non-specific work and athletic strength and total training volume of mesocycle was

determined. The sport's specific strength load on the water was also listed separately so that it's total share in the training volume could be estimated later.

Results

Total training volume for the first macrocycle was 419.7h. Specific training form was 251.8h (which corresponded to 60% of the total training volume), athletic strength was 83.6h (which corresponded to 20% of the total training volume) and non-specific training form was 84.3h (which corresponded also to 20% of the total training volume). Specific training form with expression of strength was 135.8h (corresponded to 32% from total training volume). Overall training volume relationship in first macrocycle showed, that trainings with strength expression dominated through whole training process (see figure 3).

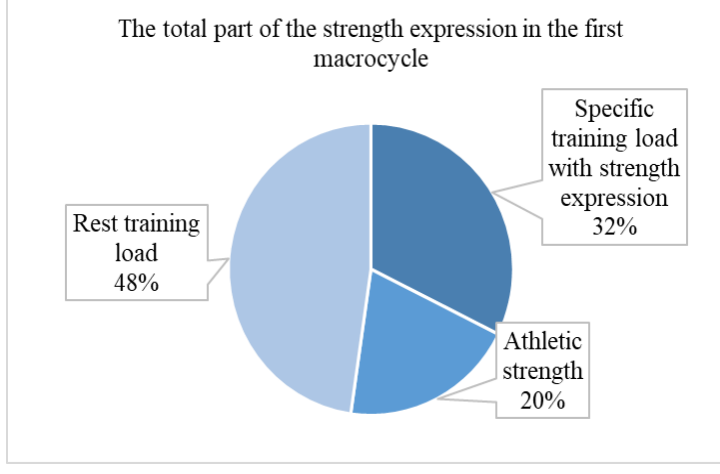

Figure 3. The total volume of training with strength expression in the 1st macrocycle of the athlete

Total training load for the second macrocycle was 461.4h. Specific training form was 296.5h (which corresponded to 64.3% of the total training volume), athletic strength was 95.2h (which corresponded to 20.6% of the total) and non-specific training form was 69.7h (which corresponded to 15.1% of the total). Specific training form with expression of strength was 161h (which corresponded to – 34.9% of the total). Overall training volume relationship in second macrocycle showed, that trainings with strength expression dominated through the whole training process (see figure 4).

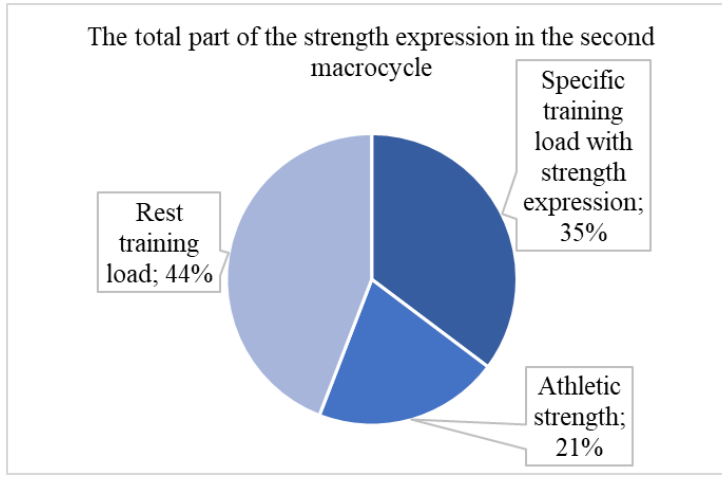

Figure 4. The total volume of training with strength expression in the 2nd macrocycle of the athlete

Total training volume for the third macrocycle was 440.9h. Specific training form was 292.1h (which corresponded to 66.3% of the total training volume), athletic strength was 68.3h (which corresponded to 15.5% of the total) and non-specific training form was 80.5h (which corresponded to 18.2% of the total). Specific training form with expression of strength was 163.6h (which corresponded to – 37.1% of the total). Overall training volume relationship in third macrocycle showed, that trainings with strength expression dominated through whole training process (see figure 5).

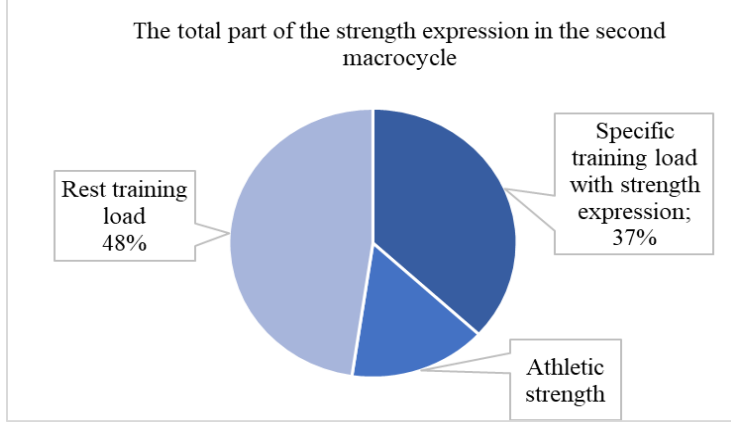

Figure 5. The total volume of training with strength expression in the 3rd macrocycle of the athlete

During three-year period the total training volume was 440.7±20.9h an average per macrocycle. From that 280.1±24.6h was dedicated for sports

specific load – paddling on the water (which corresponded to 64% average per macrocycle). For athletic strength it was 82.4±13.5h average (which corresponded to 19% average per macrocycle). For non-specific training it was 78.2±7.6h average (which corresponded to 18% average per macrocycle). However, the total training volume of sports-specific strength trainings was 153.5±15.4h average per macrocycle (which corresponded to 35% average per macrocycle). By summarizing the total amount of training volume with strength expressions – athletic strength together with specific strength, research showed a total part of 54% average per macrocycle from the total training volume.

Discussion

Research on training volume and its methodology in canoe sprint are limited (Zamotin & Sinjavin, 2018; García-Pallarés, Sánchez-Medina, Pérez, Izquierdo-Gabarren & Izquierdo, 2010; Vishnjakov, 2014; Verlin, 2015; Zhurauskij & Shantarovic, 2016a; Zhurauskij & Shantarovic, 2016b; Englert & Kiesler, 2009; Buchek & Hamar, 1998; Issurin, 2008; Li, 2015). Most of the research does not give total amount of training volume in hours – each research had its own countifying system. One of the biggest problems is that the amount that have been paddled by athletes has been counted in kilometres, but amount of the athletic strength or other workouts have been expressed in hours. Most of these research does not reflect the total training volume in hours. Moreover, completed research in eastern Europe provide a quite detailed information of training volume and its methodology, but most of the times amount of the sports-specific volume was counted in kilometres, however, for example, athletic strength was counted in hours. And to get the total training volume in hours, you must do your own mathematics, which will not be exact. In research by Zamotin and Sinjavin (2018) authors looked on the Russian national team athletes, who raced 1000m, training amount on the water was reflected. On-water trainings were divided by five intensity zones – depended on heart rate and speed at the special on-water physical tests (5km and 1250m) (Zamotin & Sinjavin, 2018). They reported a total amount of 3500km done by athletes during whole year macrocycle. Researcher Vishnjakov (2014) in his study reported amount of 4115km for national team members in 1000m. However, he also reported high amount of specific work also for youth and juniors – 4416.5km and 3856.5km accordingly. In case of our research, we can compare athletic strength, also including generally developing exercise – those are counted in hours. For men's team the total amount is 183h (Vishnjakov, 2014). In our case those are more than a half less hours – 82.4. Verlin (2015) brought forward a five-intensity zone model for planning

training load and volume for high-class canoe sprint athletes, according to speed form 200m distance test and lactate acid in the blood. However, this research also reported very high amount of specific work for 200m canoe sprint athletes. Sprinters should manage 3500 – 4000km per year. If we compare our subject, his highest number of paddled kilometres during the time (seasons) research was done was around 2600km. Zhurauskij and Shantarovic (2016a, b) reported even higher numbers of paddled kilometres, an average of 5111.16km per season. However, both research completed on Belarusian national team, in these cases there were no separation of 200m specialists or 1000m specialists. They also presented a five-zone planning model according to lactate acid in blood and sprint exercise time limitation. Interesting, that five zone planning model of Verlin (2015) differed from Zhurauskij and Shantarovic (2016a, b). However, the summarizing of non-water training load was similar in those studies. In case of our research, we compared athletic strength (also including generally developing exercise) they were counted in hours. Zhurauskij and Shantarovic (2016a, b) reported several 90.33h, compared to our research 82.4h.

According to Buchek and Hamar (1998) they reported similar total number of training load per season. 510h versus our subjects 440.7h, of whom water training took 58% (295.8h) versus our subjects 64% (280.1h), athletic strength took 28% (142.8h) versus our subjects 19% (84.2h) and other activities took 14% (71.4h) versus our subjects 18% (72.8h). The percentage of specific training load were very similar, also non-specific training load. However, athletic strength and total training load are reported higher by Buchek and Hamar (1998).

Research by Engler and Kiesler (2009) gave an insight in Germans national team training load totals from seasons of 2003–2008. The total training volume per season was reported around 800 h, from that 400–550h was specific training load. By closing to 2008 Olympics, the amount of specific training increased. But this was also research on 500m and 1000m athletes. Only from 2009, the 200m meter distance become Olympic. Also, when we look on our research – both specific training volume (similar as in research by Engler and Kiesler (2009)) and specific strength training volume part from the total training volume increased.

Very detailed information was provided in research done by García-Pallarés and colleagues (2010). They were investigating physiological effects of tapering and detraining in world-class canoe sprint athletes – 14 Spanish national team kayakers. Although this study analysed changes in neuromuscular, body composition, and endurance markers during 4 weeks of tapering and subsequent 5 week of reduced training or training cessation, it provided very detailed information about total training load and its

content. They reported total amount of 4415±374km average paddled per season. That is more than reports Zamotin and Sinjavin (2018) and Verlin (2015). But it is close to amount reported by Vishnjakov (2014). However, it was less than the amount reported by Zhurauskij & Shantarovic (2016a, b) – they reported a total paddled average amount of 5115km per season, which is by far the biggest amount reported in studies about canoe sprint in last 20 years. Historically there were also bigger amounts reported. By comparing training load amounts between our research and Spanish research they differed, but in case, that our subject specialised in 200m distance and they according to period when research was published, for 500m and 1000m distances, not so much. Average specific work 280.1h versus 312.6h; athletic strength 82.4h versus 114.6h.

Nowadays the sharing of sensitive information in sport's training volume and methodology is increasing, also one of the best canoe sprint coaches and sport science practitioner Alexander Nikonorov gave an insight in canoe sprint training process for 200m distance. We must mention that his athletes won the London 2012 and Rio 2016 Olympics in K1 200m and in K2 200m took bronze and silver. "I remember times when training volume was 1500 h; my athletes from London and Rio did around 600h." (Nikonorov, 2020a, b). According to him they tried to do as much as they could, they simply could not do more because of the intensity and of a lot of power development work.

As we see, there are a lot of differences in training volume of high-class canoe sprint athletes. However, in last two decades there is an overall tendency to decrease the total volume of training, but to increase the intensity to get athletes better in their main discipline – distance and boat class they are specializing in. The athletic strength in studies usually consisted of 20% till 30% from total training volume. In our research it was similar – an average of 19% from total volume per season. Considering that 200m demonstrate the highest power outputs, this indicator should be higher. And as said by Nikonorov (2020), one of the most important parts of the training process is the application in the boat. How to transfer the maximum strength and power you have developed through athletic strength to the paddling. For example, top class athletes can do a maximum bench pull of 160 – 180kg but in the paddling in pulling phase athletes can pull only 37kg, the rest of the force goes different ways. As reported in literature, to maintain the work athletes do in canoe sprint, a high strength endurance in combination with relative high power is needed (Szanto, 1999; Krauksts, 2003). To enhance performance in muscle endurance sports, maximal strength training should be followed by a specific combination of metabolic and special strength training to prepare the body for the needs of the sport (Платонов, 2004; Bompa & Buzzichelli, 2018). Researchers Bompa and Buzzichelli (2018) proposed a seven-phase model corresponding to the physiological adaptation of the neuromuscular system. These seven phases are anatomical adaptation, hypertrophy, maximal force, conversion, maintenance,

termination, and compensation. Depending on the physiological requirements of the sport, the periodization of force involves at least four of these phases – anatomical adaptation, maximal force, conversion to specific force (power or strength endurance) and maintenance (Bompa & Buzzichelli, 2018).

With reference to all the above, the importance of the transferring the strength and power to paddling on the water was confirmed. And as we clarified in our research in training process of our subject, a grate part of sports specific strength training was conducted, and four specific strength training forms were distinguished.

Conclusions

During three-year period the total training load was 440.7h average per macrocycle. For developing the strength two basic forms were used:

1. Athletic strength (all workouts with strength expressions on the ground).
2. Specific-strength workouts when paddling on the water.

For athletic strength it was 82.4h average (19% from total training volume). However, the total training load of sports-specific strength trainings was 153.5h average per macrocycle (35% from total training volume).

The total amount of training volume with strength expressions – Athletic strength + Specific strength, research showed a total part of 54% (which corresponds to 235.9h per macrocycle) from the total training volume.

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ORIGINAL RESEARCH PAPER

RELATIONSHIP BETWEEN RESPIRATORY SYSTEMS' PARAMETERS AND RESULT IN SWIMMING

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Abstract

The efficiency of swimming time could have a close relationship with swimming technique as well, as respiratory system parameters. This research aimed to evaluate the relationship between respiratory system parameters and result in a 100m distance in 44 competitive swimmers (males n=28, females n=16). Swimmers were divided in two groups: young swimmers (males n=14, ages 16.5±0.3 years, body mass 74.3±7.5kg, height 183.9±3.5cm; females n=11, ages 16.5±0.3 years, body mass 60.2±7.2kg, height 170.3±7.1cm) and adults athletes (males n=14, ages 21.2±3.3 years, body mass 83.2±10.0kg, height 187.8±7.2cm; females n=5, ages 21.8±4.5 years, body mass 65.7±7.5kg, height 174.20±7.29cm). Outcome measures were 100m distance time and respiratory parameters. Results. The average competition results in the men's group were 628 FINA points, in the women's group 592 FINA points, in the group of 16-17-year-old athletes men's group is 588 FINA points, in the women's group 574 FINA points. Respiratory system indicators: men`s group FVC – 6.47±0.53l., PIF – 8.55±1.34l/s, PEF – 9.95±0.40l/s, in the women's group FVC – 4.86±0.67l., PIF – 6.15±0.67 l/s, PEF 7.57±0.43 l/s. Conclusions. A strong relationship was found between 100m competitive swimming time and peak inspiratory flow in the adult male swimmer group (r=.75). As well as a relationship between the volume of fortified inhale per second and a competitive result in a group of 16-17 years old was found during the research (r= .55).

Key words: *swimming time, respiratory system characteristics, competitive swimmers.*

Introduction

Swimming, although a cyclic sport, has a unique set of characteristics that set it apart from other sports, including the horizontal position of the body, increased humidity, limited ventilation underwater, and higher external pressure. Because of the higher specific heat and conductivity of water, body heat loss is also rapid. The pressure on the diaphragm is also higher during swimming than running (Mehrotra, Varma, Tiwari & Kumar, 1998). Of course, all of these elements should be considered, while preparing the strategy for the training process and looking for the right method to develop precisely those skills and abilities, that will influence the outcome in these specific circumstances. There is an increase in the number of mitochondria in muscle fibers as a result of low-intensity, long-duration swimming training. All of these modifications result in greater endurance with less weariness (Widmaier, Raff & Strang, 2004).

Swimming performance is highly dependent on the underwater phase, which begins with the start and turn, consisting of gliding and dolphin kicking during the first 15 m of the distance. The efficiency of swimming time could have a close relationship with swimming technique as well, as with respiratory system parameters (Wells, Plyley, Goodman & Duffin, 2005). The condition of the respiratory system can affect the performance of high-level athletes, especially at a high intensity (Harms, Wetter, Croix, Pegelow & Dempsey, 2000).

The aim of this research was to evaluate the relationship between respiratory systems parameters and results in 100m distance in young and adult competitive swimmers. Respiratory system parameters and swimming time relationship determination and analysis could help identify the most important respiratory parameters that affect swimming performance and sports result. This knowledge could help to improve the training process in competitive swimming.

Respiration in the body is responsible for gas exchange within the body. Respiration can be categorized as either external respiration or internal respiration. External respiration describes the exchange of gas at the alveolar-capillary membrane and the pulmonary capillaries. Internal respiration is the exchange of gas between the pulmonary capillaries and the cells of the surrounding tissues. The respiratory system performs ventilation functions, air mass exchange to and from the body during inhalation and exhalation. The respiration process requires coordinated ventilatory muscles activity, rib cage movements, appropriate structure and function of the upper and lower respiratory tracts (Kisner & Colby, 2007).

Usually, during normal daily life activities oxygen intake by inhaling is viewed as an active process, which is provided by a diaphragm, external

intercostals, and interchondral part of internal intercostal (part which elevates ribs up) muscles. The neck, chest, and shoulder muscles such as sternocleidomastoid, scalenes group, and pectoralis major also help during deep breathing inhale. But the transfer of carbon dioxide with exhaled air during quiet breathing appears to be a passive process due to the elastic recoil of the lungs, chest, and diaphragm. It is known that the following helps while exhaling during some active work,: internal intercostals muscles part, which pulls ribs down, abdominals – pull ribs down and compress abdominal contents thus pushing diaphragm up and quadratus lumborum and also pulling ribs down. We can observe the same process in swimming. When a swimmer is underwater, the compression effect of water reduces bronchial patency, vital capacity, and maximum ventilation of the lungs, the inspiratory reserve volume increases by 6 – 8%, and the expiratory reserve volume decreases by 10 – 12%, which naturally needs to be compensated. Resistance to airflow in the pulmonary system during active swimming increases by more than 50%, which requires the increased activity of the respiratory muscles (Солопов, 1988).

However, factors such as additional work of the inspiratory muscles to overcome water resistance, active work of the expiratory muscles, periodic disturbances in the rhythm of breathing, holding the breath while inhaling and lengthening the exhalation when performing turns and sliding, unexpected breath holdings in case of accidental ingress of water into the trachea create an additional load on the swimmer's pulmonary system. In turn, the condition of the respiratory system will undoubtedly affect the result in swimming.

The following parameters have been used for the respiratory system evaluation in the study, such as:

1. Forced expiratory volume (FEV) – the amount of air a swimmer can exhale during a forced breath. The amount of air exhaled was measured 1s (FEV1) of the forced breath.
2. Forced vital capacity (FVC) – the total amount of air exhaled during a deep breath. during exhale.
3. Forced inspiratory volume during 1s (FIV1) - the amount of air that can be inhaled during the first 1s.
4. Peak expiratory flow (PEF) – a person's maximum speed of expiration.
5. Peak inspiratory flow (PIF) – a person's maximal speed of inspiration.

In the scientific literature, there are several publications about swimmers' pulmonary system condition (Солопов, 1988; Rumaka, 2008). In the Bougault et al. (2009) research, it was shown that chemicals formed from the interaction of chlorine with organic substances can irritate the respiratory tract, cause upper, and lower respiratory symptoms, and affect

respiration system parameters and swimming time, especially in children, lifeguards, and high-level swimmers. The study of about 14 years old Polish swimmers' respiratory system parameters and result in 100m distance showed the correlation analysis between the sports result and the selected breathing parameters in the study group. Significant correlation took place only in one case – between the swimming fitness test and the volume of forced exhalation in 1s (FEV1). In all other cases, no statistically significant correlation was observed (Dybinska & Kucia–Czyszczon, 2007).

It has been recognized that endurance training for respiratory muscles, in addition to regular swimming training, is more effective than just regular swimming training for 50m and 200m distance time results (Lemaitre, Coquart, Mucci & Costalat, 2013). It was shown that after 8 weeks of the training period, including respiratory muscle endurance training, swimming results improved by 3 – 4%. Similar conclusions were made in research with club-level competitive swimmers – additional respiratory muscle training had a positive effect on 100m and 200m distance swimming time (Kilding, Brown, McConnell, 2009). Endurance training of respiratory muscles for 4 weeks (30min per day, 5 days per week) significantly increased the endurance of swimmers.

However, this study shows the relationship between some respiratory systems' parameters and 100m results in young and adult competitive swimmers.

The hypothesis of the study is that the respiratory system parameters of the swimmers have a close relationship with 100m distance time in competitive young and adult swimmers. To define that, a correlation analysis of 100m distance time and individual respiratory system parameter indicators in young and adult competitive swimmers has been performed.

The identification of the relationship level between respiratory system parameters and result in swimming could help in young swimmers' selection process as well as improve the efficiency of the training process in competitive swimming.

Material and Methods

The primary technique of measurement was direct observation of the following variables:

1. A spirometry test is used to measure the level of the physical condition of different characteristics of the respiratory system.
2. The level of readiness for swimming is determined by the result at a distance of 100m.

Forty four competitive swimmers (28 males, 16 females) from Latvia, Lithuania, Estonia, and Russia participated in the study. Participants' characteristics are presented in Table 1.

Table 1.

Participant's characteristics

	Number of participants	Age (years) (mean±sd)	Height (cm) (mean±sd)	Body mass (kg)(mean±sd)	Qualification FINA points*	Age group (years)
men	14	21.23±3.32	187.84±7.17	83.17±10.01	≥ 640	18+
	14	16.5±0.33	183.85±3.46	74.26±7.53	640 - 540	16-17
women	5	21.8±4.54	174.20±7.29	65.7±7.47	≥640	18+
	11	16.5±0.33	170.27±7.08	60.24±7,17	± 540	16-17

* The qualification of swimmers represents FINA points -an objective swimming performance evaluation tool. The points are calculated using a cubic curve: with the swim time of the current athlete (T) and the base time (The base times are defined every year, based on the latest World Record that was approved by thee international swimming federation FINA. For short course (25m SCM) the base times are defined with the cut of date of August 31st. For long courses (50m LCM) the base times are defined at the end of the year (December 31st). of the distance (B) in seconds: P=1000* (B / T)*3.

Spirometer Schiller SP – 250 (Switzerland) S. Forced vital capacity (FVC) was used for swimmers respiratory system parameter evaluation, forced expiratory volume during first second (FEV1), forced inspiratory volume during first second (FIV1), peak expiratory flow (PEF) and peak inspiratory flow (PIF) were tested. Data was preceded by Shiller SDS-10 software (Switzerland) according to ATS/ERS criteria.

Testing procedure. Before performing spirometry, the equipment used must be calibrated, or at least the calibration checked at the beginning of the session. Environmental data (temperature (measured at 22 – 25 degrees Celsius), atmospheric pressure (1005hPa), and relative humidity (36 – 40%).

Prior to doing spirometry, the swimmer's identity should be verified, their height and weight measured without shoes or boots, and their age and sex documented, from which the individual norm is determined.

The observed subject was in a sitting position. The participant was requested to take a nose clip and then it was placed on the subject's nose, and he was instructed to take the deepest breath possible, followed by a maximum of rapid and deep breathing, and a maximum of rapid and deep breathing into the spirometer. Three trials were registered, with the best measurement utilized for data processing.

Data analysis. The data obtained were entered and mathematically processed with Microsoft Office Excel data processing program, proceeding with:

1. Descriptive statistics – arithmetic mean, standard errors, confidence interval (α<0,05);

2. Calculation of the Kolmogorov-Smirnov test criterion (to determine whether the data is parametric or non-parametric); in this test, the deviation of the empirical distribution from the normal distribution is considered significant if the significance is $p<0.05$;
3. The correlation between the selected parameters of the respiratory system and the result of the competition at a distance of 100m was sought using Pearson linear correlation by calculating the correlation coefficient (r) data processing is performed with the Microsoft Office Excel program. To determine the correspondence of the measurement data to the normal distribution (confidence interval $\alpha<0.05$), on the basis of which mathematical-statistical methods for further processing of data were selected.

The value α is determined on the basis of the "Scientific Convention" agreements received in the scientific community, based on practical experience in various fields of research. Such a value α is recommended for small samples.

Results

The athletes' sports results (FINA points) are listed in Table 2.

Table 2.

Average race results at Fina Points

Gender	Age	FINA points
men	16 – 17 (mean±sd)	588±59.1
	Adults (mean±sd)	674±52.6
	Average (mean±sd)	628±70.6
women	16 – 17 (mean±sd)	574±56.3
	Adults (mean±sd)	649±54.4
	Average (mean±sd)	592±61.9

The average results in the men's group is 628 FINA points, in the women's group 592 FINA points, the percentage difference is 5.73%. In the group of 16 – 17 year-old athletes, the average result in the men's group is 588 FINA points, in the women's group 574 FINA points, the percentage difference is 2.3%. In the adult men's group is 674 FINA points, women are 649 FINA points, the percentage difference is 3.7%.

The table (Tab. 3) shows the average values of the measured indicators of the respiratory system.

Table 3.

Statistical values of measured respiratory parameters

gender	age	FVC	FEV1	FIV1	PEF	PIF
men	16 – 17(mean±sd)	6.17±0.55	5.49±0.47	4.81±1.47	9.67±1.36	7.6±1.50
	18+ (mean±sd)	6.78±0.62	5.67±0.53	5.37±1.63	10.24±1.02	9.5±1.67
	Average(mean±sd)	6.47±0.53	5.58±0.12	5.09±0.39	9.95±0.40	8.55±1.34
units of measurement		l	l	l	l/s	l/s
women	16 – 17 (mean±sd)	4.38±0.63	3.91±0.57	3.08±1.03	7.26±1.26	5.64±1.53
	18+ (mean±sd)	5.34±0.89	4.67±0.55	4.55±0.94	7.88±0.55	6.59±0.73
	Average (mean±sd	4.86±0.67	4.29±0.53	3.81±1.03	7.57±0.43	6.15±0.67

(FVC - forced vital capacity, FEV1 - forced expiratory volume during first second
FIV1 - forced inspiratory volume during 1 s, PEF - peak expiratory flow
PIF - peak inspiratory flow)

In contrast to the data obtained from the scientific literature, in the surveyed objects, peak respiratory flow indicators prevail over peak inspiratory flow indicators, in all age and gender groups.

To test the promoted hypothesis, the obtained data were processed using Pearson's linear correlation by calculating the linear correlation coefficient (r).

A correlation analysis was carried out to identify the relationship between the respiratory rates of adults and young swimmers and the results of the competition (Tab. 4).

Table 4.

Correlation indicator (k) between sports results and selected parameters of the respiratory system

0.39	0.09	0.48*	0.05	0.63*	Men
0.19	0.02	0.55*	-0.25	0.22	M16-17
0.08	-0.1	0.38	0.12	0.75*	18 +
FVC	FEV1	FIV1	PEF	PIF	
0.22	0.12	0.33	-0.15	0.12	Woman
-0.28	-0.38	-0.019	-0.58*	-0.007	W16-17
0.17	0.048	0.09	0.41	-0.21	18 +
0.34	0.11	0.33	0.14	0.48	average

In the male group, the most closely matched result correlates with the closest result correlated with the peak inspiratory flow (r= .63), the fortified inhalation volume per second (r= .480), and the fortified vital capacity (r= .39). A weak correlation is determined by the volume of the forced expiratory volume during the first second (r= .09) and the peak expiratory flow (r= .05).

In the female group, statistically reliable correlation factors were obtained between the result of the race (FINA Points) and the forced

inspiratory volume per second (r = .33), the fortified vital capacity (r = .22). A weak correlation factor is detected between the result of the race and the volume of the fortified exhalation per second (r = .12) and the maximum rate of the exhalation flow, as well as the (r = -.15).

The first (Fig. 1) and second (Fig. 2) figures show a graphical representation of the highest indicators of correlation analysis.

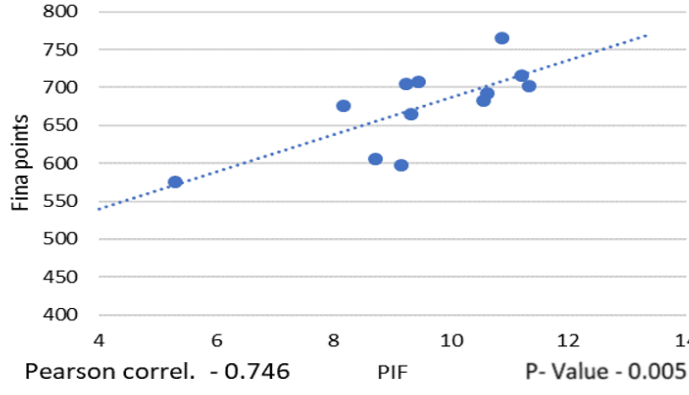

Figure 1. Dispersion chart: Fina points vs. PIF – peak inspiratory flow l/s – adult men swimmers

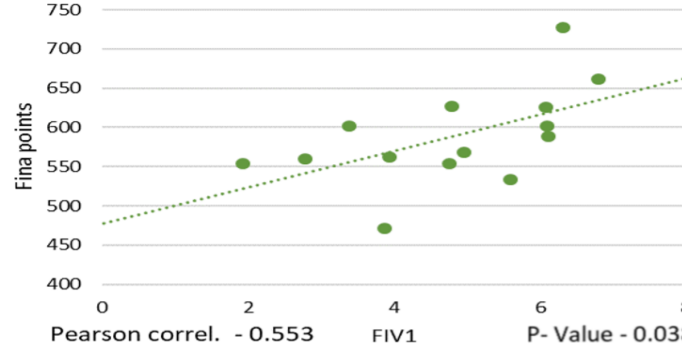

Fig. 2 Dispersion chart: Fina points vs. PIF - forced inspiratory volume during 1/s, – 16-17 men swimmers

Based on the detailed analysis of the chosen respiratory parameter levels male and female swimmers and relation to their sports result in 100m distance, the following general statements have been formulated:

Strong relationships were found between 100 m competitive swimming time and peak inspiratory flow in the adult male swimmer group (r= .75). In addition, a link was discovered between the volume of fortified inhale per second and a competitive result in a group of 16 – 17 year olds (r= .55).

Discussion

The results of studies have shown that the volume of the swimmer's breathing rate is mainly determined compared to the breathing rate volume. According to scientific literature, swimmers, due to the peculiar nature of breathing during swimming, have a pre-fertilization of the peak inspiratory flow over the peak expiratory flow (Абрамов, 1964).

The obtained data show that both the male group (PEF=9.97l/m) and the female group (PEF=7.46l/m), have a low peak inspiratory flow (male group (PIF=8.45, female group PIF=5.94/m). The provided findings contradict data from the specialized literature (Солопов, 1988), as well as the complete determination of Latvian pelting groups with effective underwater swimming.

The aquatic environment that swimming competitions take place it limits breathing freedom and alters breathing patterns. As a result, it demonstrates how important the respiratory system is in swimming.

It is worth evaluating whether or not it's possible to improve the air ventilation system, and if so, how far these improvements may be applied. In competitive swimming, a well-functioning respiratory system can be a critical aspect in deciding the final athletic result. According to scientific literature, swimmers have a pre-fertilization of the volumetric rate of exhalation due to the distinctive character of swimming breathing.

The purpose of this article was to determine whether there is a relationship between specific parameters of swimmers' breathing and the final competition results.

The hypothesized thesis has been confirmed, (as the correlations between chosen respiratory system parameters and the competitive results of the tested swimmers were statistically significant in several circumstances ($p<0.05$).

Conclusions

It seems that the results of this examination, apart from having a theoretical function, can be used in practice, as they can help coaches and instructors diagnose, forecast, analyze or plan the training process for young swimmers, especially in relation to the shaping of the functional abilities of the respiratory system.

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ORIGINAL RESEARCH PAPER

PRINCIPLE OF COMPLEMENTARITY AND DESTRUCTIVE INTERFERENCE IN THE COGNITIVE RESTRUCTURING PROCESS

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ABSTRACT

Changing the Paradigm – the Holistic Worldview

Bohr's Universal Principle of Complementarity. The scientific basis for the principle of complementarity has been formulated by the Danish atomic physicist Niels Bohr (1928). The main idea of this principle presupposes that opposites are complementary "contraria sunt complementa" (from Latin). The essence of the principle of complementarity is expressed in Bohr's definition – opposites complement each other, which does not mean a struggle between the opposites, but the complementary effect of the two opposites, because of which a new "truth" is formed. As formulated by Bohr, it is a unit of the two "Great Truths", where each party includes a part of the "Truth", but only a combination of them forms the "Profound Truth". The picture of truth is incomplete if both sides are not represented (Plotnitsky, 2012). The way a person looks, feels and what their state of health is depends directly on what information forms and maintains this matter (Tribus & McIrvine,1971). Accordingly, if we understand that information forms matter, then changes to the information field are required to change the matter. To make changes to the information field, it is necessary to collapse the space by changing the state of consciousness and the frequency of brain waves (Engström, Martensson, Avventi, Norbeck & Skare, 2015). At the quantum level, matter is a volatile phenomenon and exists only as a possibility, a probability, a variant (Ford, 2009). This is based on the discovery that by observing the elementary particles of matter, it is possible to influence them or change their

\behaviour. They appear and disappear, depending on the observer's focus on the appearance of a particular elementary particle. Only when the observer focuses on the location of a particular electron does the electron appear in that location. As the observer looks away, the elementary particle disappears again, transforming into energy (Meier, 1999). According to this phenomenal effect, physical matter cannot exist or manifest until it is observed. In quantum space, the observer influences phenomena, space, and time, as well as makes the infinite probabilities to collapse. When consciousness makes the probability wave to collapse, choosing one of the possible edges of an electron, that edge becomes reality. Probability is transformed into reality via consciousness. The wave collapse is the moment when the observer finds, sees, captures a thing. The moment when the probability is minimized and fixed at a certain point, in an event. Louis de Broglie, the developer of the wave theory, received the Nobel Prize for this discovery in 1924. According to the discoveries of quantum physicists, light constantly behaves in accordance with the expectations of the experimenters. In experiments designed to detect particles, it appears in the form of particles, while in experiments designed to detect waves, light always behaves like a wave. In both cases, the result confirms the experimenter's expectations. Lynne McTaggart points out that "living consciousness is in some ways a central factor in transforming this undeveloped quantum world into something like everyday reality. Reality is not fixed, but fluid, and hence possibly open to influence." (McTaggart, 2008). Dr.phil. Dean Radin argues that one of the most important tools for influencing matter is intention. Intention can have a measurable physical influence on matter up to the level of subatomic particles. When thinking about one or another result for more than 30 seconds a day, the cumulative results really can affect "fate" in one direction or another (Radin, 2008). This publication will look at the complementarity of a person as a physical and spiritual being, or how thoughts affect the intensity of lower back pain.

Key words: *quantum field, quantum atom structure, perceptions of epigenetics, wave collapse, cognitive restructuring, complementarity, destructive interference.*

Introduction

Within the framework of the research, the performance of a thinking task or cognitive restructuring was based on the principle of destructive interference. *The principle of complementarity states* – opposites complement each other, which does not mean a struggle between the opposites, but the complementary effect of the two opposites, because of which a new "truth" is formed (Bohr, 1928). *The principle of interference*

*presupposed mutual reinforcement of cancellation***.** By denoting any disease in the human body with a negative amplitude ("-" sign) and denoting negative thoughts with a "-" sign, it can be concluded that the disease will intensify or prolong as a result of constructive interference. In turn, in the case of destructive interference, the wave amplitudes will cancel each other out, thus creating a null platform for further thoughts, beliefs, opinions etc. They will depend on the person's choice in the future. When two waves are not synchronized – one wave goes up, the other goes down, and at the convergence point these unsynchronized waves cancel each other out. In this case, there is no energy wave at the point where the waves interfere with each other. This phenomenon of cancelling energy waves is called destructive interference (Lipton, 2016).

Research aim: To reveal the impact of thoughts on the intensity of lower back pain, using a combination of physical exercise and conscious thought changes.

Research hypothesis: Using physical exercise in combination with conscious thought changes will be more effective in reducing the intensity of lower back pain, rather than using only physical exercise for people aged 25 – 55.

The following *tasks* were set for the achievement of the research goal:

1. To determine the intensity of lower back pain in people aged 25 – 55,
2. To find out the main, dominant thoughts, the most characteristic emotions and the most common emotional states of people involved in the research,
3. To develop thinking tasks (thinking forms),
4. To determine the process of the thinking task at the Alpha brain wave frequency (7.5 – 14Hz/sec), using the electroencephalography method (EEG),
5. To compare and evaluate the changes in the research participant's dominant thoughts, emotions, and intensity of lower back pain after the experiment (conscious and controlled changes in thoughts).

Materials and methods

Used in the research:

- Numerical Rating Scale (NRS).
- Semi-structured interview.
- Pedagogical experiment.
- Electroencephalography (EEG).
- Qualitative Data Analysis.
- Mathematical – statistical methods of data processing.

Results

Men and women aged 25 – 55 with chronic lower back pain were invited to apply for the research, observing certain exclusion criteria.

The research begun with 40 participants, 30 women and 10 men aged 25 – 55. The age amplitude was determined based on the participants' physical ability to participate in the performance of exercise tasks for 8 weeks, as well as the desire to find out whether the effects of thoughts on the physical body are equally applicable to people of various ages and genders. The average age of the participants is 34. The participants were randomly divided into two groups – an experimental group and a control group. Thus, 14 women and 6 men participated in the experimental group, while 16 women and 4 men participated in the control group. During the experiment, both groups participated in the physical activity group "Healthy Back", where classes were held to reduce the intensity of lower back pain under the guidance of a certified physiotherapist. The physical activities were performed 3 times a week, 1 hour each time, online, on Zoom platform. A total of 24 physical activity classes took place. In addition to physical activities, the experimental group also performed thinking tasks (cognitive restructuring). The thinking exercises were performed 3 times a week, for 15 minutes each time. The total duration of the research was 8 weeks. The research begun on March 1, 2021 and was completed on April 26. The duration of the experiment was determined on the basis of similar research related to thinking tasks (Kim, Lee, Choi & Suh, 2009).

Determination of Pain Intensity Before the Experiment

One of the tasks of the research was to determine the intensity of lower back pain. For this purpose, the method of basic clinical examination and evaluation of pain was used – the Numerical Rating Scale. The task of the research participants was to subjectively assess their pain threshold at the beginning of the research on a scale from 0 to 10, where 0 – "no pain at all", and 10 – "the pain is maximally strong, unbearable". The intensity of bordering marks (10 and 1) was not indicated by any participant.

In the experimental group, the initial intensity for one person was 9 points, for four people – 8 points, for six people – 7 points, for three people – 6, for two people – 5 points, and for four people – 4 points according to the NRS (Fig. 1.).

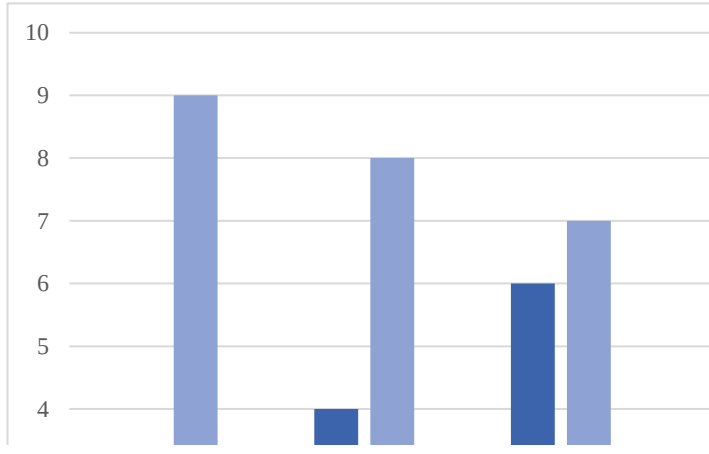

Figure 1. Number of People and Pain Intensity in the Experimental Group at the Beginning of the Research

In turn, in the control group (Fig. 2), the initial pain intensity for five people was 8 points, for eight people – 7 points, for five people – 6 points, for one person – 5 points, and for one person – 3 points according to the NRS.

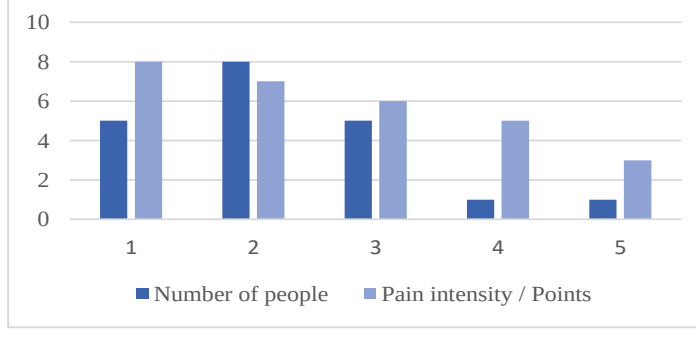

Figure 2. Number of People and Pain Intensity in the Control Group at the Beginning of the Research

Determination of the Most Common Thoughts, Emotions and Emotional States

Next, the main dominant thoughts, the most characteristic emotions and the most common emotional states of the people involved in the research were identified. In order to obtain the necessary information and data, a semi-structured interview was developed, and 20 participants of the experimental group were invited to the interview, including 14 women and 6 men. The interview consisted of 11 open-ended questions. The

participants were very cooperative, open and truthfully expressing their thoughts and feelings. The average interview time was 45 minutes.

Questions of the Semi-Structured Interview

1. How are you feeling right now?
2. What makes you feel that way? *(if the answer to Question 1 is negative; if it is positive – go to Question 3)*
3. Do you think you could feel better? Evaluating from 1 to 10, for how many points would you like to feel better? (where "1" means almost not at all, and "10" means – a lot)
4. Is there a reason or an obstacle that hinders you from feeling better?
5. What thoughts (about what) do you think most often?
6. How often? (how many times a week?)
7. How would you describe your emotions or feelings when you think these thoughts?
8. What are you worried about most often? Which area of your life worries you the most?
9. How long have you been feeling these emotions? *(from Question 8, if emotions were negative)*
10. Imagine a situation – if you currently had a unique opportunity to obtain a "magic wand" for a few seconds and you could fulfil any of your wishes in life...what would you choose to be absolutely happy right now? *(a situation, a thing, an event, a feeling...).*
11. Imagine for a moment that your wish *(Question 10)* has come true. How are you feeling right now? What emotions do you feel? Tell me about them. Thank you.

This publication will present the data obtained from Questions 5, 6, 7 and 8 of the interviews, as these results reveal the possible causes of the participants' emotions and well-being.

In the process of qualitative data processing, the answers to Questions 5, 6, 7 and 8 were coded. As a result, two types of thought codes and two types of emotion codes were obtained:

Thought code No. 1 – thoughts on financial instability and insecurity today and in the near future; work, finances, money, the feeling that you will not be able to provide for yourself and your family in the near future.

Thought code No. 2 – other thoughts.

Emotion code No. 10 – fear, insecurity, anxiety, discomfort, stress, depression.

Emotion code No. 20 – other emotions.

Furthermore, the frequency (times a week) and duration (years) of these thoughts and emotions were also studied.

The data included in Table 1 show that 16 individuals think about financial instability and insecurity today and in the near future: work, finances, money, the feeling that you will not be able to provide for yourself and your family in the near future. The above-mentioned thoughts are indicated with code “1”. Moreover, only 4 participants think other thoughts marked with code “2”.

Table 1

The Main, Dominant Thoughts, the Most Characteristic Emotions and Emotional States of Research Participants

Gender	*Thought Code*	*Emotion Code*	*Times a Week*	*Duration*
F	1	10	4	2 years
F	2	20	3	4 years
M	1	10	7	6 years
F	1	10	7	10 years
F	1	10	7	1 year
F	1	10	5	10 years
M	1	10	4	3 years
M	2	20	3	2 years
M	1	10	7	2 years
M	1	10	7	1 year
F	2	20	7	10 years
F	1	10	7	7 years
F	1	10	7	2 years
F	1	10	7	2 years
M	2	20	7	3 years
F	1	10	5	3 years
F	1	10	7	4 years
F	1	10	7	7 years
F	1	10	5	5 years
F	1	10	7	3 years

It can be concluded that 80% of the participants of the experimental group think the same thoughts. Thoughts related to job insecurity and how to retain work in the future; finances and their stability; cash flow – will I have enough money “today” to cover my basic needs; the ability to provide for oneself and one's family relatively "tomorrow". Accordingly, the emotions reported by the research participants were fear, insecurity, anxiety, discomfort, stress, depression, which were marked with the category code “10”, and other emotions marked with the code “20”. The duration of the felt emotions, measured from 1 year to 10, as shown in Table 1, allows to identify the activity of emotional states. At this stage of the research, it is

found that the negative thoughts expressed by the participants regarding the insecurity about the job and the possibilities to retain work in the future; finances and their stability; cash flow – will I have enough money "today" to cover my basic needs; the ability to provide for oneself and one's family relatively "tomorrow" in combination with appropriate emotional states can cause lower back pain.

Figure 3. *Distribution of Thought Codes "1" and "2" Between the Participants of the Experimental Group*

Development of a Thinking Task (Thinking Form)

Further work was done on the formulation of a new thinking task, or thinking form, based on the principles of complementarity and destructive interference. Work continued creating a new thinking task. According to the method of destructive interference, the existing negative thoughts were replaced by opposite, positive thoughts. For example, if a research participant worries that they may not earn enough money in the future to support their family successfully, the new thinking task was to think that the subject's financial situation is completely satisfactory and that the participant feels safe, stable, and satisfied with their life.

The participants had to think for 8 weeks, 3 times a week for 15 minutes each time, observing the emotions during the thinking. The frequency of thinking was selected according to the number of physical activities per week. Both the experimental and control groups performed specialized exercises to reduce the intensity of lower back pain 3 times a week for 1 hour each time, for a total of 8 weeks. According to the research hypothesis, physical activities in combination with conscious thinking (performing a thinking task) have a higher efficiency or pain intensity will decrease faster than performing only physical exercises.

This morning (today, tonight) I see .....smell.....taste ... (*something from it all and capture what you see, feel, hear....)*
Today I am happy about.....and I am grateful for.....
What am I feeling right now?..... *(There the task is to simply capture the feeling...not to analyse, not to evaluate)*
I HAVE!!!! the most important thing in my life and that is my value, my foundation, my stability, my present … It (*they*) is .....
I feel truly grateful and happy about it. I feel so good today!!!!
I say thank you to my past and its events, the people and situations that taught me to become exactly who I am today.....Exactly who I need to be for my loved ones.....for my.....
I like who I am today. I like.....*(makes a list of things the person likes in oneself)*
Today and every day from now on, I release the energy of cash flow and let it flow into my life from a variety of sources.... in the best way for me and my loved ones.
I am aware that everything is safe, stable and harmonious in my "today". I feel at the centre of my life and accept all areas of my life. I allow energy to flow freely around me, seeing, hearing, feeling, and enjoying my present.
Today I am happy and feeling light!
Thank you.

Figure 4. Thinking Task for a Research Participant (Developed by the Author)

Physical Exercises to Reduce the Intensity of Lower Back Pain

After participants from both groups (experimental and control) determined their initial level of lower back pain intensity, physical exercise classes were started in groups. Both groups exercised 3 times a week for 8 weeks according to the same physical exercise programme aimed at reducing the intensity of lower back pain. Exercise classes were conducted under the guidance of a certified physiotherapist.

Each class consisted of an introductory part, a main part, and a concluding part. The task of the introductory part was to warm up the body, preparing it for more intense exercises (its duration 7 – 8min). The main part was performed in a crawling position, with the forearm support, lying on the abdomen, lying on the back, on the sides, in the knee stance and ruined knee stance. Its duration was 35 – 40min.

The task of the concluding part was to loosen, stretch and relax the main muscle groups used during the class. Static and dynamic stretching exercises, relaxation positions and breathing exercises were used. In total, it took 12 – 15min. The exercises were performed while lying on the back, abdomen, and sides, crawling, in forearm support, ruined knee stance and standing. Attention was drawn to the stretching of muscles and muscle groups that affect the development of incorrect posture and lower back pain *(m.iliopsoas, m.piriformis, mm. glutei, m.biceps femoris, m.semitendinosus, m.semimenbranosus, m.quadriceps femoris, m.quadratus lumborum, mm.erector spinae (pars lumbalis, pars thoracica, pars cervicalis),*

m.trapezius, mm.rhomboidei, m.levator scapulae, m.pectoralis major et minor). Also, at the end of the class, a few minutes were devoted to questions and comments.

Determining the Course of the Thinking Task Process, EEG Method. In order to determine the course of the thinking task process at the Alpha brain wave frequency (7.5 – 14Hz/sec), in the last week of the research, three of the research participants were randomly invited to perform an electroencephalography procedure with the aim to record brain wave activity during the thinking task.

Electroencephalography (EEG) is a method of examining the brain that records the bioelectrical activity of the brain.

The task of the method was to check whether the research participants perform the thinking task. If the task is performed and the thinking process takes place, changes in Alpha wave activity are recorded in the electroencephalograph. Alpha waves have a frequency of 7.5 to 12 oscillations per second, and they are generated by the right hemisphere of the brain. The alpha frequency of the brain is very important in training and learning new information, developing imagination, as well as is related to creative issue solving, creativity and mental work. When a person's alpha rhythm is normal, the person is in a good mood and sees the world positively. Being in the alpha waves is a relaxed state of mind. In this state, the person daydreams. These waves are also responsible for dreams and fantasies. Alpha waves are involved in many types of healing practices where the visualization method is actively used.

The EEG procedure was performed at the Sport Science Research Laboratory of the Latvian Academy of Sport Education, in Riga. The EEG recording was performed using NeoRec – NVX136 equipment. The procedure lasted a total of 1 hour, Figure 4 shows the research participant No. 12.

Figure 5. EEG Procedure for Determining the Course of the Thinking Task Process

During the procedure, the participant felt comfortable and cosy, as well as did not feel any anxiety. Initially, moderate activity of all waves was recorded in the electroencephalograph, because the participant's task was to feel free for about one to two minutes, and not to think about anything. After about two minutes, the participant had to start thinking about her thinking task, which had been performed for the research so far. As the participant was in a separate room, no communication took place during the procedure. Thus, information on how well the participant was doing could only be obtained after the end of the procedure.

The EEG recording shows that at the beginning of the recording, the participant's brain wave activity is moderately active at all levels, which corresponds to the given task of thinking nothing for the first two to three minutes.

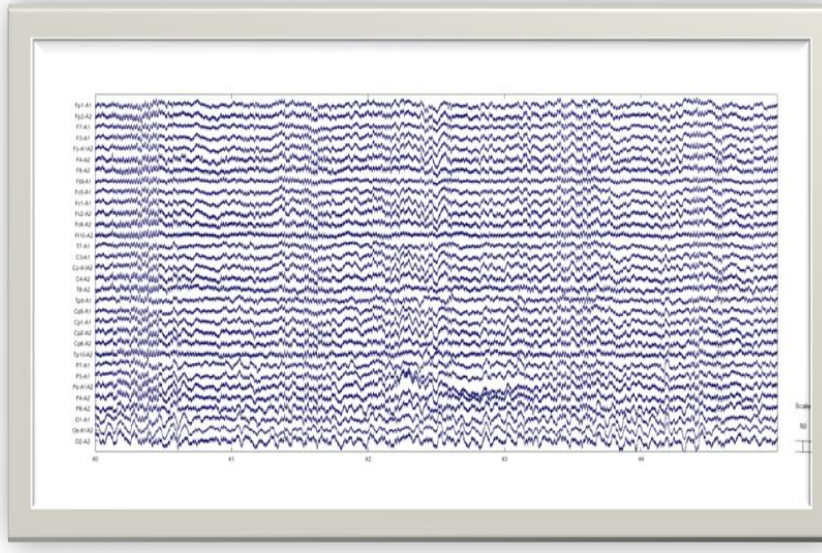

Figure 6. Moderate Brain Wave Activity in the 40th to 44th Second of the EEG Recording

According to the results of the recording, in the time from the 40th to 44th second, the participant still has moderate wave activity, which corresponds to the norm.

The EEG results show that the participant had started to perform the thinking task during the 89th second, as evidenced by the increase in Alpha wave activity.

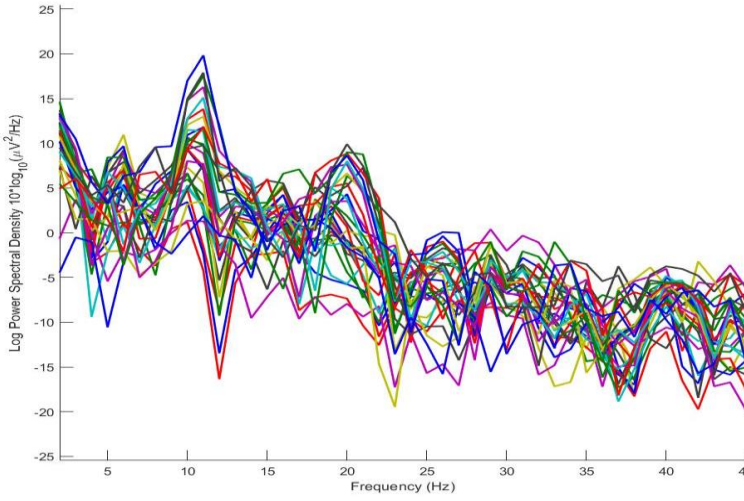

Figure 7. Spectral Representation of Brain Wave Activity at the 5 – 45Hz Frequency at the 89th Second

Changes in the Dominant Thoughts, Emotions and Intensity of Lower Back Pain After the Experiment

At the end of the research, the results were compiled for both groups. The level of lower back pain intensity after the experiment was determined from the participants of both groups. In addition, the participants of the experimental group repeated the semi-structured interview, the aim of which was to find out the participants' progress during the research regarding the regularity of thoughts, feelings during thinking and possible changes in emotions outside of performing the research tasks.

In the interview, the participants revealed that all 20 participants had similar feelings about the change in pain intensity – the pain changed in a wave-like manner. During the first week there was a significant change – the pain either disappeared completely or decreased rapidly. In the second week, the pain reappeared, but not as severely as before. Moreover, pain intensity was moderate during the second and third week and decreased steadily starting from the third or fourth week. At the end of the research, several participants had completely relieved their pain, which corresponds to the "0" mark according to the NRS.

After the research, 85% of the participants found that they felt calm during thinking; safety; relying on the flow of one's life; feeling happy; faith in one's own strength; joy, satisfaction with one's life; good, stable feeling.

In turn, 15% of participants felt positive emotions such as gratitude and love.

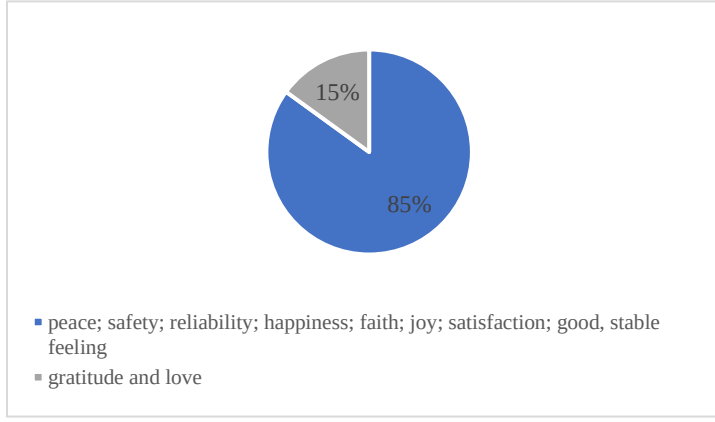

Figure 8. Emotions in the Experimental Group During the Thinking Task Performance

Changes in Pain Intensity After the Experiment

After the research, changes in pain intensity were observed in both the experimental and control group. The changes in the two groups are significantly different. The experimental group shows significant improvements in the reduction of pain intensity – four people in the experimental group have lost their pain as such, indicated answer “0” according to NRS. Six people have an intensity score of “1” and 5 people have an intensity score of “2”, which means that the pain is very small, sometimes no pain at all. For three people the lower back pain equals "4", which is medium to low pain. Finally, one person evaluated their pain after the experiment with “5”, and one person – with “6”.

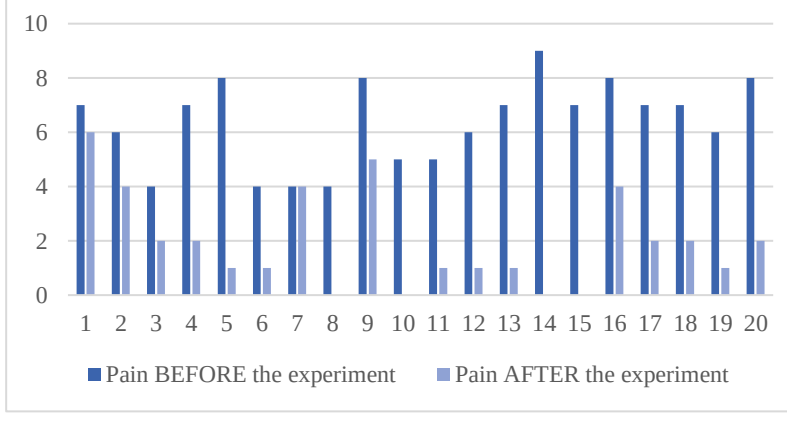

Figure 9. Pain Intensity Before and After the Experiment (Experimental Group)

In turn, the changes observed in the control group are more even, with a smaller amplitude between the pain intensity before and after the experiment.

One person indicates a pain level of "8", four feel severe pain of around "7", four people indicate that it hurts around "6", ten people have retained a pain intensity of "5", and only one person has very little pain, sometimes no pain at all corresponding to the "1" mark according to NRS.

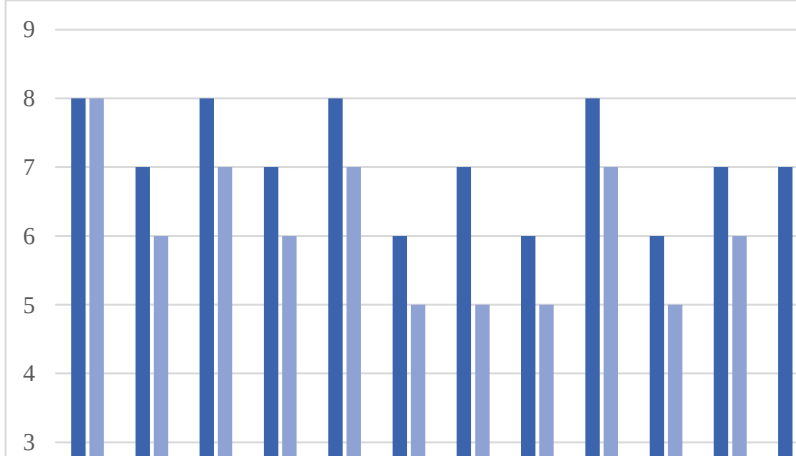

Figure 10. Pain Intensity of Control Group Participants Before and After the Experiment

Changes in Pain Intensity Before and After the Experiment for Both Groups

Spearman's correlation analysis:

No statistically significant correlation was found between the pre-research pain intensity and the post-research pain intensity in the experimental group *(Spearman's correlation analysis, rho=0.169, p=0.475)*. In contrast, a statistically significant positive nonlinear and strong correlation between pre- and post-research pain intensities was found in the control group. *(Spearman's correlation analysis, rho=0.871, p<0.001).*

Table 2

Pain Intensity Before and After the Experiment in Both Groups

	Group; median (IQR)	
	Experimental	*Control*
Pain intensity *BEFORE* the research	7.0 (5.0 – 7.5)	7.0 (6.0 – 7.5)
Pain intensity *AFTER* the research	1.5 (1.0 – 3.0)	5.0 (5.0 – 6.5)
Spearman's correlation coefficient	0.169	0.871
p value	0.475	<0.001

The above-mentioned correlation analysis data indicate that the pain intensity of the experimental group was influenced by an external factor which has not been found in the control group.

The only significant difference between the two groups was the thinking task for the experimental group, which the control group did not perform. Correlation analysis shows that the decrease in the intensity of the control group is statistically predictable, while the results of the experimental group have changed due to a different external factor.

Table 3.

Correlation Between Pain Intensity and Both Groups Before the Research

		Group, n (%)		p value
		Experimental	Control	
Pain Intensity Before the Research	0	0 (0.0)	0 (0.0)	0.299
	1	0 (0.0)	0 (0.0)	
	2	0 (0.0)	0 (0.0)	
	3	0 (0.0)	1 (5.0)	
	4	4 (20.0)	0 (0.0)	
	5	2 (10.0)	1 (5.0)	
	6	3 (15.0)	5 (25.0)	
	7	6 (30.0)	8 (40.0)	
	8	4 (20.0)	5 (25.0)	
	9	1 (5.0)	0 (0.0)	

Fisher's exact test:

Analysing the correlation between pain intensity and the two groups before the research, it can be concluded that there is no statistically significant correlation. *(Fisher's exact test, p=0.299).*

Analysing the correlation between pain intensity and the two groups after the research, a statistically significant correlation was found *(Fisher's exact test, p<0.001).*

Table 4

Correlation Between Pain Intensity and Both Groups After the Research

		Group, n (%)		p value
		Experimental	Control	
Pain Intensity After the Research	0	4 (20.0)	0 (0.0)	<0.001
	1	6 (30.0)	1 (5.0)	
	2	5 (25.0)	0 (0.0)	
	3	0 (0.0)	0 (0.0)	
	4	3 (15.0)	0 (0.0)	
	5	1 (5.0)	10 (50.0)	
	6	1 (5.0)	4 (20.0)	
	7	0 (0.0)	4 (20.0)	
	8	0 (0.0)	1 (5.+0)	

In the experimental group the most likely pain intensities were 0-2, while in the control group they were 5 and 7.

Discussion

"Having divided a bull into steaks and then cooking it, it is no longer possible to get the bull back!", says neuroscientist T. Čerņigovska. This quote vividly shows one of the current issues in modern science – the prevalence of the principle of reduction. If science continues to go *from big to small*, studying the finer and smaller components of the whole, it will undoubtedly reveal many new and interesting things, but at the same time it will lose the initial question - what does it mean for a person? Whether and how it affects a person's quality of life, including health and well-being? To assess this, feedback is needed, or the opportunity to view a person as a bioenergetic being holistically – in a united, complex manner. Understanding the cause-effect principle, according to which the human physical body also functions, it becomes possible to accurately identify and, if necessary, change the cause, rather than to fight the consequences for a long time and without success.

In order to prove the effect of thoughts on the intensity of lower back pain, a multidisciplinary, mixed-type fundamentally applied research was conducted, which covers qualitative and quantitative research methods.

The research involved 40 participants – men and women aged 25 – 55 years with chronic, non-specific lower back pain. The number of research participants was determined based on the number of people who volunteered. The existing number of research participants is not sufficient to make the obtained data representative, but the set goal of the research was achieved. The effect of thoughts on the intensity of lower back pain was revealed, using a combination of physical exercise and conscious thought changes.

The results of the research show that thoughts about insecurity in the current job and the possibilities to retain it in the future; finances and their stability; cash flow; ability to provide for oneself and one's family in the near future is the cause of chronic lower back pain. Thus, changing the cause also changed the consequences - the intensity of pain significantly decreased or even disappeared completely.

The research participants were given a sufficiently wide age range of 25 – 55 years for two important reasons:

1. chronic lower back pain is experienced by people at different ages, including young people, as evidenced by the average age of the study participants – 34;
2. in the age group 25 – 55, people are physically active and like to participate in various physical activity events. Taking into account that

all 40 research participants had to participate in regular exercise classes for a total of 8 weeks (a total of 24 classes), the relevant age criteria is important.

Novelty of the research:

1. Scientifically proven influence of thoughts on the physical body, incl. on the body's biochemical processes.
2. Two types of practical approaches to pain relief have been studied and compared, and their effectiveness has been assessed – physical effects on the body (piezoelectric approach/exercise) and energy effects (deliberate change in thoughts/thinking task).
3. The following principles of quantum energy have been used in the development of the experimental thinking task (thinking form):
   b. Wave collapse
   c. Non-local binding
   d. Destructive interference
   e. Quantum tunnelling
2. Developed 11 semi-structured interview questions as a set, the answers to which provide a general description of the respondent's well-being and precisely indicate the content, frequency and duration of the dominant thoughts and emotions. The set of questions also indicates the potential content of the corrective thinking task that the respondent reveals according to the principle of destructive interference.
3. A thinking task has been developed to reduce the intensity of lower back pain with the possibility of individual adjustment to a specific individual.

The practical significance of the paper presupposes a holistic approach to the person as a whole, emphasizing the complementarity of the human physical body and mental state. This approach makes it possible to diagnose and determine the informative causes of a person's actual well-being at the level of thoughts and, if necessary, to make changes according to the principle of destructive interference. This approach is suitable for everyone, especially athletes, for whom the daily well-being of the physical body is decisive for achieving athletic results.

Conclusions

1. Determining the intensity of lower back pain in 40 research participants aged 25 – 55 before the research begun, it can be concluded that:
   1.1. Analysing the correlation between pain intensity and the two groups before the research, it can be concluded that there is no statistically significant correlation. *(Fisher's exact test, p=0.299).*

1.2. The experimental group consisted of 20 participants, including 14 women and 6 men. The distribution of pain in the group was as follows: for one person – 9 points, for four people – 8 points, for six people – 7 points, for three people – 6 points, for two people – 5 points, and for four people – 4 points, according to the Numerical Rating Scale (NRS).

1.3. The control group consisted of 20 participants, including 16 women and 4 men. The distribution of pain in the group was as follows: for five people – 5 points, for eight people – 7 points, for five people – 6 points, for one person – 5 points, and for one person – 3 points, according to the NRS.

2. Based on the method of a semi-structured interview and summarizing the data on the main thoughts, the most characteristic emotions and the most common emotional states of the research participants in the experimental group, it can be concluded that:

2.1. 80% of respondents think most about insecurity in their current job and how to retain the job in the future; finances and their stability; cash flow; ability to provide for oneself and one's family in the near future. Dominant emotions are fear, insecurity, anxiety, discomfort, stress, depression. The duration of emotional activity is from 1 year to 10 years; activity of emotional states is detected.

2.2. 60% of respondents experience the negative emotions referred to in paragraph 2.1 on the basis of an imaginary problem situation - one that does not exist in reality but is likely to materialize in the future. Scientific literature indicates that the human brain perceives both real threats in physical reality and imaginary dangers in the future, which may not materialize at all and is only a set of the subject's inner imagination and emotional experiences. According to several authors, emotions are the chemical feedback of thoughts and will always be in a subordinate position to thoughts or, in other words, the charge of emotions and thoughts will be the same. Positive thoughts will be followed by positive emotions and vice versa. Thus, respondents who experienced a possible negative scenario only in their thoughts felt in reality as if the event had already been experienced and caused a negative emotional experience. (Lipton, 2016). It can be concluded that thoughts about a possible negative scenario in the future affect the respondents' well-being now.

2.3. Correlations between negative thoughts and corresponding emotional states regarding job insecurity and opportunities to retain it in the future; finances and their stability; cash flow; ability to provide for oneself and one's family in the near future may be the cause of lower back pain.

3. Individually developed and applied thinking tasks or thinking forms according to the principles of complementarity and destructive interference caused significant changes in the thoughts, emotions and general well-being of the participants, as well as caused changes in the intensity of lower back pain. In the experimental group, the pain level decreased significantly compared to the control group.
4. Physical exercise classes to reduce the intensity of lower back pain affected the intensity of pain in the control group. Compared to the experimental group, which also performed a thinking task, the reduction in pain intensity was small. It can be concluded that performing physical exercises in combination with thinking tasks gave better results than just performing physical exercises. In the experimental group, the most likely pain intensities were 0 – 2, while in the control group they were 5 and 7. The correlation between pain intensity and the two groups after the research is statistically significant *(Fisher's exact test, $p<0.001$)***.**
5. Implementing the task of the dissertation regarding the detection of the course of a thinking task with the EEG method, it can be concluded that the thinking task was performed successfully, which is evidenced by the increase of the amplitude of the Alpha waves starting from the 89th second in a 10 – 15Hz/sec interval.
6. After the experiment, the intensity of lower back pain has changed in both groups. The changes in the two groups are significantly different:
   6.1. In the experimental group, four people had no pain at all anymore, with a score of 0 points according to NRS. For six people the pain intensity is 1 point, and for five people – 2 points, which indicates that the pain is very small, sometimes it is not there at all. For three people, the lower back hurts up to 4 points, which is medium to low pain. One person evaluated the pain with 5 points, and one – with 6 points.
   6.2. The changes observed in the control group are more even, with a smaller amplitude between the intensity of pain before and after the experiment. One person indicates a pain level of 8 points, four feel severe pain of 7 points, four people have pain of 6 points, ten people have pain intensity of 5 points, and only one person has very little pain, sometimes it does not hurt at

all, which corresponds to 1 point according to the Numerical Rating Scale.

6.3. Comparing the two groups before and after the experiment, it can be concluded that:

6.3.1. No statistically significant correlation was found between the pre-research pain intensity and the post-research pain intensity in the experimental group *(Spearman's correlation analysis, rho=0.169, p=0.475)*. In contrast, a statistically significant positive nonlinear and strong correlation between pre- and post-research pain intensities was found in the control group. *(Spearman's correlation analysis, rho=0.871, p<0.001).*

6.3.2. The correlation between pain intensity and the two groups after the research is statistically significant *(Fisher's exact test, p<0.001).* In the experimental group the most likely pain intensities were 0 – 2, while in the control group they reached 5 and 7.

The hypothesis of the study was confirmed –

In practice, using physical exercises in combination with conscious changes in thoughts is more effective in reducing the intensity of lower back pain than using only physical exercises for people aged 25 – 55.

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ORIGINAL RESEARCH PAPER

THE RELATIONSHIP BETWEEN RECREATIONAL PHYSICAL ACTIVITY AND STATE AND TRAIT ANXIETY

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Abstract

Physical activity is associated with better mental health, but the literature does not distinguish which types of activity (e.g. recreational versus other types) are more strongly associated with better mental health. Physical activity has benefits for reducing levels of anxiety. However, factors that affect physical activity participation for individuals with anxiety disorders have not been well studied. Anxiety should be seen as a complex, heterogeneous phenomenon. Spielberger et al. have emphasized that anxiety can be conceptualized in two ways, as a stable disposition and as a transient emotional state that everyone experiences from time to time. Both trait and state anxieties have been conceptualized as unitary constructs. Here, we aimed to clarify the roles of state and trait anxiety in physical activity participation by examining relationships among four major study variables in Latvian adults. Materials and methods, Instruments. Method: 31 Latvian adults (in age 27-58) were evaluated. An exclusion criterion was practicing leisure time physical exercises. Respondents were measured 4 times within 2 years. After excluding from the sample only 17 were used to process the results. State-Trait Anxiety Inventories (STAI-S and STAI-T), (The State-Trait Anxiety Inventory (STAI-Y) (Spielberger, Gorsuch, & Lushene, 1970) and check list about recreational physical activities. Results: Changes were evaluated 4 times within 2 years The results do not show statistically significant reduction of

the level of the trait anxiety of STAI-Y ($p<.05$) related to frequency and type of recreational physical activity. Conclusions: there is significantly less research about the effects of physical activity on anxiety. As a consequence, there is not enough evidence to draw conclusive connections between exercise and anxiety is not enough evidence to draw conclusive connections between exercise and anxiety. Limitations: The use of self-rating measures which bears the risk of an under- or overestimation of symptoms.

Keywords: *recreational physical activity, emotions, state anxiety, trait anxiety.*

Introduction

Anxiety – trait anxiety. Anxiety is characterized by excessive worrying, hypervigilance (Wittchen & Hoyer, 2001), and physical symptoms originating due to heightened activation of the sympathetic nervous system (Kong et al., 2022).

Anxiety is becoming the most common mental disorder among various populations worldwide (Booth et al., 2016; Steel et al., 2014). An important conceptual development in the exploration of the phenomenon of anxiety can be attributed to the work of Spielberger (1966). Spielberger defined anxiety as a state characterized by subjective, consciously perceived feelings of tense and apprehension accompanied by arousal of the autonomic nervous system (Spielberger, 1966). Spielberger also has made a distinction between state and trait anxiety. He defined 2 forms of anxiety: state and trait anxiety.

State anxiety is the temporary dimension of anxiety that is related to stress responses, and trait anxiety is the character dimension of anxiety that is related to the long-term stability of personality (Spielberger, 1983).

Anxiety can be a personality trait which implies a predisposition to perceive a wide range of circumstances as threatening and a tendency to respond with excessive apprehension to such situations (Spielberger, 1966). Anxiety as a trait is a personal disposition that characterizes an individual's tendency to perceive situations as threatening and thus to experience anxiety in stressful situations (Gaudry et al., 1975). It is a relatively stable personality trait and a risk factor for the origins of various anxiety-related disorders, depression, and other mental disorders. High trait anxiety causes cognitive control deficit, implicit emotion regulation deficit and risks of emotional disorders (Kong et al., 2022). Besides, high trait anxiety is associated with reduced self-regulatory executive functions and implicit emotion regulation deficits, which may cause emotional and behavioural problems (Liu & Wang, 2018). It is posing a threat to the quality of life, well-being, and could even lead to suicidal tendencies (Abreu et al., 2018). It can

take over all areas of a person's life and cause them to worry about stimuli that are not actually dangerous. Individuals tend to respond with extreme anxiety in everyday situations, but in anxious situations they may experience intense anxiety accompanied by manifestations of autonomic nervous system dystonia (palpitations, dizziness, respiratory changes, gastrointestinal disturbances, fatigue, etc.) (Brants, 2019).

It is possible that an individual who has anxiety as a trait also experiences the tension caused by various frustrations more intensively, thus he is at a higher risk of depression. People with high trait anxiety fail to synchronize default mode network of the brain during resting state (Imperatori, 2019) which means that anxiety as a trait can have far-reaching consequences in a person's daily life. Since the autonomic or voluntary part of the nervous system is involved, it is important that these bodily reactions cannot be controlled by the person`s will.

Anxiety as a trait is not directly observed but is expressed as a state of anxiety when stress is experienced (Reiss, 1997).

State anxiety. State anxiety has been defined as an unpleasant emotional response while coping with threatening or dangerous situations (Spielberger, 1983), which includes cognitive appraisal of threat as a precursor for its appearance (Lazarus, 1991). Eysenck and Calvo (1992) argue that state anxiety occurs in threatening situations and is mutually influenced by trait anxiety and situational stress.

Even a low trait anxiety person will experience state anxiety providing a presence of a sufficiently threatening situation. However, trait anxiety tends to moderate the levels of state anxiety, which are provoked by certain situational demands. High trait anxiety individuals can experience more frequent and more intensive state anxiety compared to low trait anxiety individuals; however, they are not anxious all the time. On the other hand, similar short-lived states of anxiety can be found in individuals who don’t have a high tendency towards anxious responding. In such cases, experience of state anxiety can be a reaction to certain situational demands (Tovilovic et al., 2009).

The main assumption of the state-trait models is that the effects of traits on behaviour are mediated by states, i.e., that state influence more directly internal processing activities and have a more direct effect on behaviour than trait.

The relationships between anxiety and behaviour outcomes have been described in Spielberger’s Cross-Sectional Model of Anxiety. This model proposes that state anxiety causes behavioural reactions directly through defence mechanisms and adaptive processes to avoid stressful situations Spielberger, 1983; Spielberger, 1966). In addition, trait anxiety directly

influences one's cognitive appraisal, which has an impact on how an individual perceives stressful situations (Spielberger, 1966). This model led to consider that state and trait anxiety may have a profound influence on physical activity behaviour.

Studies on physical activity behavior and its association with anxiety can be highlighted research of Hainaut and Bolmont (2006). Authors of the study point out that state anxiety increases muscle tension, arousal, and thereby focus of attention, which regulates sensory processing. Robazza, Bortoli, and Nougier (1998) studied the relationship between anxiety and performance of members of the Italian national Archery team and concluded that there is a relationship between high anxiety and weak performance.

It has been pointed out (Kroenke et al., 2007) that more research is needed focusing on anxiety, it's screening, diagnosis, and treatment.

Physical recreational activity. Physical activity is a broad term relating to any skeletal bodily movement which results in energy expenditure, whereas exercise is an organized subset of physical activity for the goal of improving physical fitness (Caspersen et al., 1985). "Recreational" physical activity means organized or non-organized sport, leisure time physical activities (Zulyniak, 2020). Recreational activities are mainly performed in leisure time and covers sport and exercise activities, cultural activities, outdoor activities, social activities and similar activities with the purpose of bringing pleasure, joy, amusement and meaning to our lives (Pressman et al., 2009). Many studies have investigated terms either 'physical activity' or 'exercise'. Physical activity has been shown empirically great benefits for physical health (Ellye & Arroll, 2002) and psychological functioning (Berger & Owen, 1998; D`Alonzo et al., 2004). Large, cross-sectional analyses have determined significant associations between physical exercise and mental health outcomes.

Physical activity has been shown in a meta-analysis to help reduce levels of anxiety (Pertuzzello et al., 1991; Schuch, 2019) not only by its impact on biological systems, (Goldfarb et al., 1991; Hoffmann, 1997) but also by improving emotional status (Stutts, 2002) especially when exercise gives people relief and time away from daily worries (Breus & O'Connor, 1998).

Healthcare providers increasingly recommend regular physical activity as an appropriate treatment to improve physical and psychological health (Ma et al., 2009; Berger & Owen, 1998). Individuals with anxiety disorders have been shown to have higher levels of state and trait anxiety than the general population (McLean & Woody, 2001; Spano, 2001; Pertuzzello et al., 1991). Studies examining outcomes of recreational running assessed

psychological outcomes such as mood, well-being, affect, cognitive function, self-efficacy, vitality, flow, perceived health, and life satisfaction. Likewise, some studies reported reductions in depression, anxiety, and stress (Pereira, 2021).

Santos (2008) also found anxiety relation with physical activity levels. A group of 200 elderly subjects was divided into two groups of 100, one physically active and the other inactive. It was observed that the inactive individuals obtained higher anxiety scores than their active counterparts. Leisure activities eliminate negative feelings and thoughts and help achieve positive ones (Steptoe et al., 1989). As low force, rhythmic and long-term activities do not force the body and include no risk of turning into a competitive content, participation in sports, social and cultural activities are recommended to cope with anxiety (Bond et al., 2002; Gosselin & Taylor, 1999). Implementation of these activities in groups increases its effectiveness (Cahill & Foa, 2005).

As leisure activities are important in eliminating anxiety, especially exercising supports releasing hormones providing relaxation and so eliminates some negative feelings such as depression and anxiety. The importance of doing leisure activities is highlighted in many resources (Kalyon, 1994; Müftüoğlu, 2005). it is seen that there are studies investigating exam anxiety, state, and trait anxiety (Günay et al., 2008; Kozacıoğlu, 2012) and reporting that socio-cultural and sports activities have an effect on self-esteem and social anxiety (Steptoe et al., 1989; Togo et al., 2006).

Studies show the importance of exercises, sports, and participation in socio-cultural activities in coping with anxiety (Bond et al., 2002; Steptoe et al., 1989) as regular physical activities are supportive in the positive orientation of feelings and behaviors and reduce the level of anxiety. Regular physical activities are stated to be supportive in the positive orientation of feelings and behaviors and reduce the level of anxiety (Müftüoğlu, 2005).

In their study, Ardahan and Lapa (2011) have indicated that individuals participate in outdoor recreational activities to integrate nature, to influence their health positively, to get rid of troubles and stress, to get rid of monotony, to relax, to increase work efficiency, to be with friends, to acquire and use new skills, to get into a new circle, to get rid of loneliness, etc.

A review by Schuch et al. highlighted inconsistencies in exercise treatments (e.g., type and intensity of physical activity), that may be related to the conflicting results in this literature. With these inconsistencies, there is risk that positive aspects of the relationship between physical activity and mental health are being overlooked (Schuch et al., 2017). Looking to anxiety, there is significantly less research about the effects of physical activity on

anxiety. As a consequence, there is not enough evidence to draw conclusive connections between exercise and anxiety (Stonerock et al., 2015). Physical activity is associated with better mental health, but the literature does not distinguish which types of activity (e.g., recreational versus other types) are more strongly associated with better mental health. These findings suggest key questions about the roles of state and trait anxiety as they relate to recreational physical activity in Latvian adult population.

The objective of this study is to measure relationships of physical activity and state and trait anxiety, distinguishing between recreational forms and frequency of physical activity.

Our objective is to clarify the role of state and trait anxiety in physical activity participation of Latvian adults, by examining the relationships among four variables: state anxiety, trait anxiety, frequency of physical activity and form of recreational physical activity.

Materials and methods

This study was composed sample of 31 Latvian adults (8 men and 23 women) in age 27 – 58. An exclusion criterion was practicing leisure time physical exercises.

Respondents were measured 4 times within 2 years. Excluded from the sample were respondents who did not complete at least one assessment test, refused to participate, or did not correctly fill out the questionnaires. As a result, from sample of 31 respondents, only 17 were used to process the results.

Data Collection Procedures. Measurements were taken twice a year – in spring and autumn. All individuals received the same verbal instructions, and any doubts were clarified before the questionnaires were filled out. The instruments also contained written instructions on how to complete them.

Assessment instruments. Data for this study were collected using 3 instruments: the Demographic Inventory (DI), Physical activity checklist, the State-Trait Anxiety Inventory Form Y (STAI-Y).

DI -Demographic data on study subjects included three items: age, sex, education. *Physical activity checklist* included data about habits of physical activities –indoor or outdoor physical activity, type of Physical activity and frequency of Physical activity.

State-Trait Anxiety. – In order to operationalize distinction between state and trait anxiety, Spielberger, Gorsuch and Lushene developed the State-Trait Anxiety Inventory (STAI; 1970) (Spielberger, 1983). The Spielberger State-Trait Anxiety Inventory (STAI) has been widely used to measure the state and trait components of anxiety. The STAI-Y is a self-administered questionnaire that measures subjective feelings of state and trait

anxiety. The STAI has been shown to have excellent psychometric properties with good reliability and validity (Barnes et al., 2002). The STAI-Y includes 40 items rated on a 4-point Likert-type scale from 1 (not at all) to 4 (very much). The STAI-Y has two subscales that assess state anxiety (Y1, 20 items) and trait anxiety (Y2, 20 items). In this inventory anxiety was measured by the two self-rated STAI scales (State and Trait Anxiety Inventory). State anxiety, i.e., how one feels now; and Trait anxiety, i.e., how one generally feels. Both scales consist of 20 items. The state scale has 10 reverse-scored items, the trait scale has 7. The state scale (STAI-S) requires individuals to express how they feel "at the moment" in relation to the 20 items contained on a 4-point Likert scale (not at all – 1; somewhat – 2; moderately so – 3; very much so – 4). The trait scale (STAI-T) also has 20 items, but individuals are instructed to respond how they "generally feel" on a different 4-point Likert scale (almost never – 1; sometimes – 2; often – 3; almost always – 4). Total STAI-Y scores can range from 40 to 160, with higher scores indicating higher anxiety. The score of each scale can vary from 20 to 80 points, with scores below 30 indicating a low degree of anxiety, 31 – 49 a medium level and 50 or more a high degree.

The questionnaire can measure anxiety both in healthy and in clinical populations (Oei et al., 1990). It can be used to test anxiety in various special subgroups and several health conditions. A large body of previous evidence (Booth et al., 2016; Julian, 2011;) have shown the utility and validity of the STAI scales. It is often used in behavioural as well as physiological studies such as skin conductance (Kasos et al., 2018).

The internal validity factor (Cronbach's alpha) in the original study is 0.89 to 0.96 (Spielberger et al., 1983). English Spielberger's Anxiety Test adapted in Latvian version (Škuškovnika, 2004), obtaining the internal validity coefficient (Cronbach's alpha) 0.83 – 0.91 and the average values in subscales in different age and gender groups from 36.60±7.09 to 43.00±9.11.

Statistical Analysis. As the first step of the *item selection***,** we removed reverse-scored state (numbers 1, 2, 5, 8, 10, 11, 15, 16, 19, 20) and trait (numbers 21, 26, 27, 30, 33, 36, 39) STAI items, as the before mentioned findings pointed out the confounding nature of the reverse-scored items (Andras et al., 2020).

The data were analysed using the R Studio statistical package (R Core Team, 2013).

The sample was characterized using descriptive statistics, namely mean and dispersion (standard deviation) measures. The Shapiro-Wilk and Levene tests were used to verify sample normality and homogeneity of variances, respectively. Pearson's product-moment correlation was applied to

determine the association between PA and the parameters of anxiety state and trait. A p-value < 0.05 was considered significant.

Results

First, the relationships between STAY-1 and STAY-2 were measured each time. A total – four times. Pearson's product-moment correlation had determined the coefficient correlation and significant correlation of State and Trait among Latvian adults. There is a close correlation in all four measurements between STAI Y-1 and STAIY. In all four cases p <0.001.

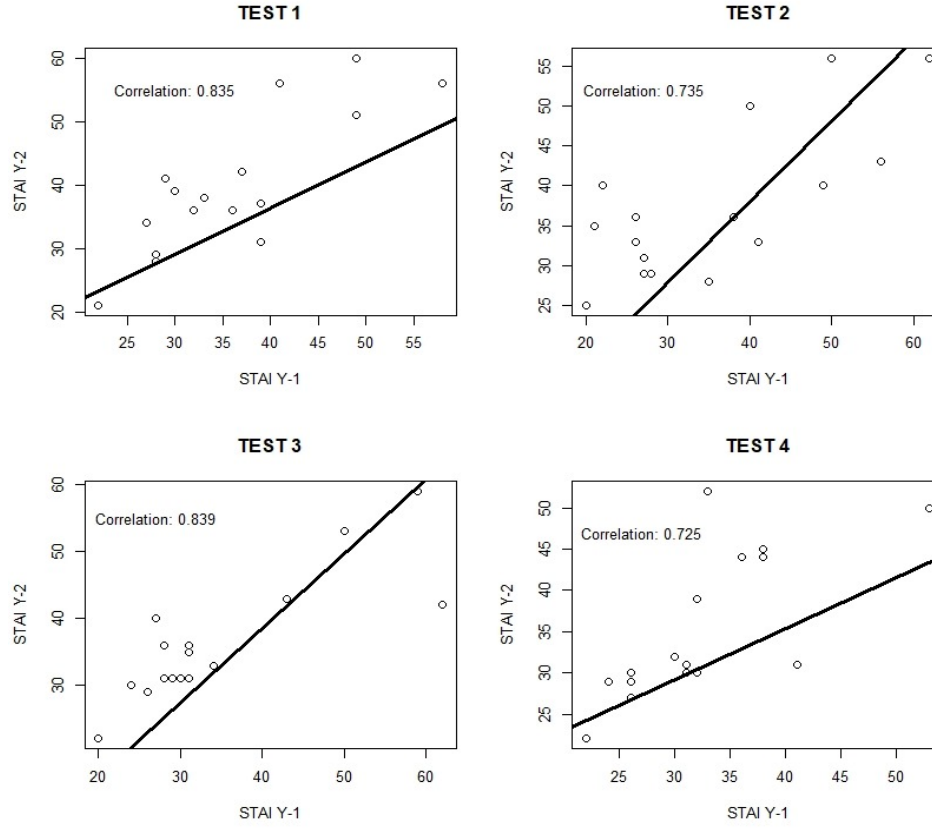

Figure 1. State Anxiety correlation with Trait Anxiety

Descriptive statistics examined the mean and standard deviation which State (M=34.83 SD=7.402) and Trait (M=37.45, SD=7.525). The scores of each scale indicating a medium level of State-Trait Anxiety (31-49).

The findings are consistent with the with theoretical support for the Spieberger`s construct of anxiety and this was demonstrated by high correlations between Anxiety-State and Anxiety-Trait scales in the subsamples (Vitasari et al., 2011; Novy et al., 1993). The data obtained in the

study do not indicate relationship between type of recreational physical activities (indoor or outdoor recreational physical activity) and frequency of physical activity ($p>0,05$).

Discussion

The Spielberger State-Trait Anxiety Inventory (STAI) is the most frequently used measure of state and trait non-disorder-specific anxiety (Spielberger, 1970; Manzoni et al., 2008). State anxiety is the temporary dimension of anxiety that is related to stress responses, and trait anxiety is the character dimension of anxiety that is related to the long-term stability of personality (Spielberger, 1989).

Pearson correlations had determined the coefficient correlation and significant correlation of State and Trait among participants. The results showed significant correlation with $p=.000$ ($p<.05$). A similar trend between anxiety as a State and as a Trait has been observed in other studies (Vitasari et al., 2011). The two subscales have been shown to have satisfactory reliability and validity (Spieberger, 1970), which is also confirmed by this study.

This study data does not support the theoretical findings that state, and trait anxiety may have a profound influence on physical activity behaviour and that the inactive individuals obtained higher anxiety scores than their active counterparts (Steptoe et al., 1989).

The data obtained rather confirm findings by Schuch et al. that highlighted inconsistencies in exercise treatments (e.g., type and intensity of physical activity), that may be related to the conflicting results in this literature. With these inconsistencies, there is risk that positive aspects of the relationship between physical activity and mental health are being overlooked (Schuch et al., 2017).

Conclusions

The result of this research supports the main assumption of the state-trait models is that the effects of traits on behaviour are mediated by states, i.e., that state influence more directly internal processing activities and have a more direct effect on behaviour than trait.

If anxiety as a personality trait implies a behavioural disposition that encourages an individual to perceive a broad, objectively safe set of objects as threatening and react more intensely than is objectively necessary (Spielberger et al., 1972), then a statistically significant decrease in anxiety will change both individual behaviours. It will be more adequate in a particular situation and the individual's emotional state.

However, research shows that not only high but also very low levels of anxiety hinder the achievement of high scores, such as in sports (Jones,

1995) or exam (Hancock, 2001). Which leads to the conclusion that an individual's reaction to an anxiety situation is individual. It is possible that anxiety affects the behaviour of everyone in different ways – one starts playing sports more, another directly – less. This study does not show an association between the variables Anxiety as a condition and feature and the type and frequency of physical activity.

Looking to anxiety, there is still significantly less research about the effects of physical activity on anxiety. Therefore, there is not enough evidence to draw conclusive connections between physical activities and anxiety.

Study limitations the generalizability of our results has some limitations. First, the data were collected from Latvian adults, aged 20 – 60 years. Thus, our results may not be applicable to people younger than 20 or older than 60 years, living in other countries with different cultures, or with other mental diseases or disorders. Second, the information was obtained from questionnaires and interviews, which may have bias related to memory capacity, personal influences or opinions, and social desirability. Third, subjects were recruited by voluntary sampling. Thus, outcomes cannot be generalized for individuals diagnosed with anxiety disorders who did not participate or who were attending other clinics. Fourth, this study is limited by using a cross-sectional design to explore relationships between State and Trait anxiety and recreational physical activity. There is still lack of autonomic nervous evidence which implies the psychophysiological response of the body of populations to stressors. Therefore, it is meaningful to design a paradigm for analysing autonomic nervous system (ANS) patterns of State and Trait anxiety by using machine learning methods.

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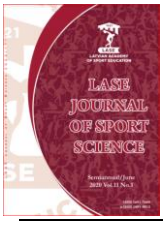

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ORIGINAL RESEARCH PAPER

THE INVESTIGATION OF MENTAL TOUGHNESS COMPONENTS OF TAEKWONDO ATHLETES OF LATVIA

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Abstract

This study was aimed to investigate mental toughness components of taekwondo athletes of Latvia. Forty taekwondo athletes (n=40, 17 – 23 years old, at least10 years in the national and international championship) were the subjects. The athletes answered the Latvian version of the Sports Mental Toughness Questionnaire (SMTQ). All computations were performed using SPSS software version 26. The comparison of the results of the research showed there was a statistically significant difference in the confidence component of mental toughness, but control and constancy didn't change. As mental toughness plays a vital role in athletes' preparation, coaches should put mental training in their plans.

Keywords: *mental toughness, confidence, constancy, control, taekwondo*

Introduction

The theory of mental toughness highlights the importance of cognitive skills. Not only does a successful athlete need to have a high standard of physical skill needed for his sport, but the ability to cope with the pressure, the opponent, or the training can have a decisive role in his sporting career and mental health.

The first idea of mental toughness was, however, not inside sports science. The first shots fired in the cognitive revolution in America were in the mid-1950s from MIT and coincided with the advent of computers. Noam Chomsky is the most notable name associated with the beginnings of cognitive sciences. The mental movement began to take hold in America in the 1960s after Miller and Bruner founded the Harvard Center for Cognitive Studies. Cognitive science became an interdisciplinary discipline (psychology, philosophy, linguistics, anthropology, neuroscience, and computer science) (Miller, 2003). Likewise, cognitive psychology began to study intelligence, language, thinking, problem-solving, memory, attention, and perception. Cognitive theory endeavored to bridge the gap between the brain and mind (Miller, 2003).

The winner's mentality is not about winning; it is about behaving and thinking like a winner. Athletes need the mindset to excel, succeed, and be the best they can be. Winners know how to concentrate and focus, overcome obstacles, not lose sight of their goals, learn from defeats, overcome discouragement and frustration, and perform maximally. Winners know how to maintain a winning attitude even in failure. This is a positive mindset. The core mental skills utilized in the winner's mentality are goal setting, visualization, feelazation (like emotive imagery), energy management, practical thinking, and mental toughness. The winner's mentality cannot be achieved without achieving mental toughness. One could say that mental toughness as a cognitive construct is synonymous with the winner's mentality. Mental toughness is a somewhat elusive concept to define, yet it is a quality that every coach desires in their athletes, covets, and sports fans everywhere admire. Mention a sports hero or legend; a common trait will be mental toughness. Mental toughness takes on special significance because it is not maintainable without its peak performance. Mental toughness benefits include increased confidence, control of individual performance, emotion management, and emotional endurance regarding long-term goal acquisition (Reese, 1998). Achieving mental toughness is the winner's mentality.

Mental toughness is possessing the persistence and resilience of a winner (Reese, 1998) and further describing this illusory construct, including the ability to re-focus and re-concentrate. In addition, mental toughness also includes accepting responsibility and accountability for actions and their results – both successes and failures. Without mental toughness, one cannot fully achieve the winner's mentality. Every study that includes the construct of mental toughness has just as many definitions. Since the pioneering work of Loehr in the mid-1980s, the term *mental*

toughness has become synonymous with sporting greatness. Following Loehr's regular interactions with elite American athletes, he identified a highly relevant construct that has become a frequently used Layman's term for individual tolerance to stress and performance maximization. While the work of Loehr was essential for bringing the time mental toughness into modern-day parlance, the work was limited in its development of the construct, and it could be argued that the anecdotally based work generally lacked the rigors of a scientific approach. Over the next 20 years, interest in mental toughness was limited to that of sporting practitioners and journalists, and the term became increasingly mentioned on television and radio broadcasts.

From an applied perspective, whether one is dealing with coaches of professional sides or an under-10 football team, the one thing that they all want is mental toughness instilled into each of their players. Unfortunately, this 'toughening up' of players usually involves employing psychological skills training, hoping to fix this problem. However, as the concept of mental toughness remains a little 'ill-defined,' it is challenging to attempt to address the lack of it. From a theoretical perspective, the conceptual development of mental toughness will benefit from considering related constructs. Existing relevant constructs include Resilience (Dyer et al., 1996), Hardiness (Kobasa, 1979), and Physiological Toughness (Dienstbier, 1989), and most of the terms have their roots firmly in health psychology. Kobasa (1979) considers that hardiness is an essential factor in the way individuals perceive situations and how they decide to undertake an appropriate set of actions. Kobasa proposed three components of Hardiness (control, challenge, and commitment). These components are briefly summarized as follows. Power is "expressed as a tendency to feel and act as if one is influential (rather than helpful) in the face of the varied contingencies of life" (Kobasa et al., 1982). The definition of mental toughness is highly narrow and, at the same time, is open to broad interpretation by the subjects. Also, there is no way to determine the tense or honesty of the reports. Clough and his team (Clough et al., 2002) took another existing model, the 3 C's model, which was initially an existential psychological theory of hardiness (Kobasa, 1979), and by adding one more component of "confidence," Clough used it in the sports field. The final 4 C's model consisted of commitment, challenge, control, and confidence.

In taekwondo, athletes try to reach the highest level of body and mind development. In taekwondo, "a person gains self-satisfaction, peace of mind, a strong body, and becomes a master of self-defense art" (Park, 2003). Taekwondo is a martial art that allows athletes to develop traits parents desire to cultivate in their children, along with a sense of well-being within

the participant (Kim, 1985). "Central to the proposed benefits of martial arts is a belief in the ability to achieve higher levels of personal well-being through dedicated training practices" (Mainland, 2010). Taekwondo does this by combining both mental and physical activities in a constructive leisure activity. Taekwondo empowers athletes to achieve specific goals by mastering certain physical and mental actions. Taekwondo is a combat sport that has evolved in scientific and technological aspects since its inclusion as an Olympic discipline, forcing countries to seek information from the different variables involved in the sport process to achieve the best international results. Present-day taekwondo adheres to a philosophy like its ancient predecessor's (Park et al., 2000), with psychological, physical, and spiritual aspects often incorporated into training (Lee, 2010). Practitioners are expected to display respect for themselves and others, humility, perseverance, self-control, and honesty to better ascribe to the guiding principles of martial art (Park et al., 2000). The research focusing on taekwondo's impact on psychological health, although limited, suggests it is associated with several positive outcomes. These include increased cognitive and affective self-regulation and prosocial behavior in children (Lakes et al., 2004) and reduced aggressive behavior in youth and undergraduate populations (Harwood et al., 2017). Studies have also demonstrated improvements in mood (Yang et al., 2018) and enhanced strategies for coping with and managing stress (Petrovic, 2017) in taekwondo athletes. However, taekwondo has not yet been comprehensively examined in psychological research.

Mental toughness may be seen even more crucial in martial arts, not only if the pressure of competitions and performance is assumed, which is alike in many other sports, but more importantly, contact fighting (or even full-contact), sometimes extended life-term learning, and negative energy control during the fight when the focus is critical may be very demanding. The aspects of full contact practice, body to body, and dealing with violence and negative energy make martial arts a fruitful area for testing mental toughness and its development, as well as exploring the application and influences of cognitive skills training. Mental toughness in martial arts is a current topic of sports research. The phenomenon of mental toughness entered the research field more than 20 years ago, but we cannot say the same thing about mental toughness in Taekwondo and martial arts. Solanki and Singh (2013) about mental toughness have tested the difference between taekwondo athletes and cricket players. As the combination may seem irrelevant, the results are surprising. In this research, cricket players scored higher in handling pressure, rebound and motivation overall mental toughness. The authors suggested it may be because of the importance of the

team in a competition, whereas taekwondo athletes face the challenges alone. The team may play a crucial role in motivation and dealing with pressure. In other research, wrestling athletes took part in research regarding mental toughness and concentration. Finally, no significant correlation was found. The author, therefore claimed mental toughness and concentration did not influence each other. However, the idea of increasing mental toughness during the career was supported. International-level athletes and, therefore more advanced ones scored higher than those on a national level (Bhardwaj et al., 2014). Singh and Solanki (2015) were interested in the differences in mental toughness between judo and taekwondo athletes. In their study, 40 athletes were randomly selected (50% male and 50% female). However, no significant correlation was found between the style and the mental toughness score. This may suggest that the style of martial arts is not so important the improvement of mental toughness; nevertheless, to achieve appropriate conditions, it is necessary to choose such which is in balance within individual's opinion. Even though the authors did not find any difference, they decided to take gender into account. That is not very common in martial arts studies. On the one hand, it could provide important data and lead to future fields. But also, the area of martial arts maintains a more masculine community. Therefore, it is difficult, and in some styles/disciplines, almost impossible to reach equal representation of the genders in the research. In the research mentioned before, Bhardwaj, Singh, and Rathee (2014) studied the mental toughness of wrestlers. They found that females a had higher score in the Mental Toughness scale than males. An opposite result has been found by Azaiez et al. (2013). In the study, 12 mental skills were t in both male and female judo, box, wrestling and karate athletes. No significant difference was found in the results of Ottawthe a Mental Skills Assessment Tool between the genders during both competition and training. However, this study reveals that there is a lack of management skills for fears, emotions, and stress. Applying the measurement of mental toughness on judo (Japanese martial arts,) Heiny (2012) discovered that mental toughness and self-esteem could be protective factors for aggression. A negative correlation between self-esteem and mental toughness on one side and aggression and hostility on the other side was described. In this research, males (94) and females (46) participated. The author has noticed the growing study of mental toughness and decided to apply it the martial arts, which was the main goal. The context of martial arts mental toughness is “unique”, according to Heiny. This discipline requires certain body contact and is realized in an octagon (“cage”). Because of high emotional and stressful demands the authors therefore asked if there is any correlation between the mental toughness and a level of performance.

Dividing the athletes into three groups (professional, semiprofessional, and amateur) a significant difference was found between them. As expected, professionals scored higher than semi-professionals and those scored higher than amateurs. These findings suggested the athlete must develop specific mental skills during the career and must score high on them to succeed and increase the level of the competition's difficulty. The authors accordingly appeal for further research dealing with mental toughness in martial arts and inclusion mental toughness training into the workouts. This opinion is also shared by Mînjină (2014). only 5 – 10% of athletes their training time is spent developing essential psychological skills such as mental toughness (Truelove, 2014). In the Latvian sports environment, it is often observed that in case of an unsuccessful performance, athletes, and their coaches plan to adjust their physical or technical fitness routine, perceiving the psychological aspect as less important (Astafičevs et al., 2020), also to the knowle of researchers, there wasn't any research regarding mental toughness component in Latvian taekwondo athletes, and understanding the components of mental toughness will help coaches to use mental skill training and improve their athletes mental toughness so this research planned. The aim of the research was an investigation of mental toughness component of top taekwondo athletes from Latvia and to answer this question that how mental toughness in taekwondo athletes is. Based on the above, the topic of the research "an investigation of mental toughness component of top taekwondo athletes from Latvia" was determined.

Material and methods

Participants: The study participants were 40 taekwondo athletes from 6 taekwondo clubs (female n=22, male n=18). The criteria for athletes were aged 17 to 23 years old, athletes have at least 10 years of experience in their sport, are active athletes, have succeeded in their sport and has experience in Latvian and international competitions.

Methods: The Latvian version of the Sports Mental Toughness Questionnaire (SMTQ) (Astafičevs et al., 2020) was identified and analyzed for the implementation of the task. Three parameters are analyzed through the SMTQ. First is confidence, which is characterized as a positive interpretation of threats and stress by the athlete. Second is constancy, which is an insight into how strong an athlete's commitment is to complete the set and planned tasks to the end. Third is control which shows how well or poorly an athlete can control oneself in situations where he/she begins to worry about poor performance. The answer options are ranked on a Likert scale from A to D, where A stands for „Very true" and D stands for „Not at

all." Items 1 – 6 measure Confidence; 7 – 10 measure Constancy; 11 – 14 measure Control. Confidence scores range from 6 – 24; Constancy and Control scores range from 4 – 16; Composite scores range from 14 – 56. Items 1 – 8 are positively scored (i.e., A=4, B=3, C=2, D=1). Items 9 – 14 are negatively scored (i.e., A=1, B=2, C=3, D=4), (Sheard et al., 2009).

Procedure: The participants of the study were addressed and asked to agree to complete the sports mental toughness questionnaire survey as part of the study. After obtaining the consent of the participants, indicating that their answers are confidential and will be used only for the purpose of the study, as well as after explaining the study methodology, athletes were given a questionnaire to complete each survey statement, as well as their personal information – age, level of sport, sporting experience and achievements. In the end, the data were collected and analyzed using data analyses.

Statistical Analysis: The descriptive statistics (mean and standard deviation) and an analysis of variance (ANOVA), Pearson corelation were conducted to determine whether there were significant differences and relationship in the components of the mental toughness of Latvian taekwondo athletes.

Results

The gender information is shown in figure 1. The range of values for each variable is shown in figure 2. The boxplot shows that for confidence, most values are between 12 and 22. For Constancy, the range of values is between 7.5 and around 16. Lastly, for Control, the range of values is between 7.5 and about 14.

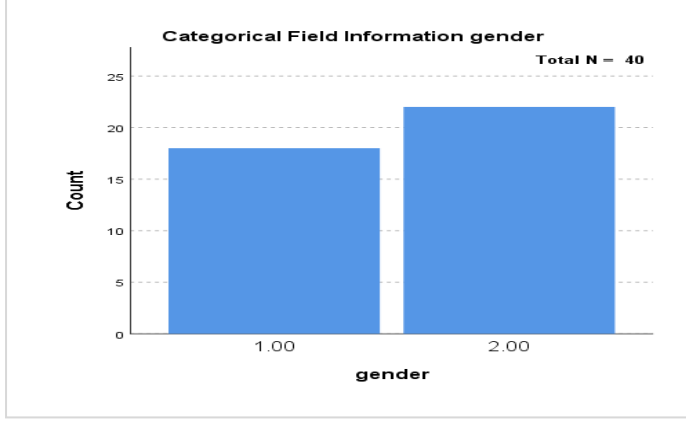

Figure 1. Gender information

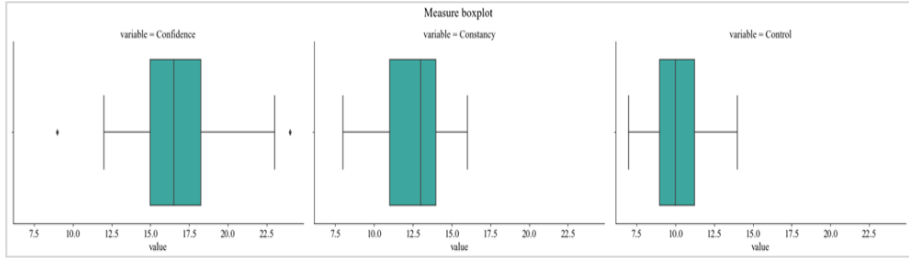

Figure 2. Boxplot of each SMTQ measure

The following part of the analysis is to see if there is a statistically significant difference between males and females as well as characterize each gender by its most dominant characteristic (confidence, constancy, or control).

-The hypothesis for the study is that taekwondo athletes have significant and mental solid toughness components (confidence, control, constancy). To test for significance between the groups (gender: male, female), the mean, standard deviation (Tables 1 – 3) and an analysis of variance (ANOVA) (Table 2), and Pearson correlation were conducted to determine whether there were significant differences in components of mental toughness (confidence, constancy, and control) according to sports mental toughness questionnaire by gender.

Table 1

Mean comparison of mental toughness component in gender

confidence	Male	18	15.7222	2.05242	.48376
	Female	22	17.8182	3.86235	.82346

Results show for confidence; the p-value is lower than 5%, p-value of 0.045<0.05 at a 5% level of significance, which means that there is a statistically significant difference between males and females in terms of confidence. However, for constancy and control, the p-value is significantly higher than 5%, which means no difference between males and females.

Table 2

ANOVA for athletes' comparison

		Sum of Squares	df	Mean Square	F	Sig.
confidence	Between Groups	43.491	1	43.491	4.294	**.045***
	Within Groups	384.884	38	10.129		
	Total	428.375	39			
constancy	Between Groups	.036	1	.036	.010	.922
	Within Groups	142.364	38	3.746		
	Total	142.400	39			
control	Between Groups	2.627	1	2.627	.761	.389
	Within Groups	131.273	38	3.455		
	Total	133.900	39			

(Significant*)

Also, in Table 1 and 2, confidence shows the most difference between males and females on average and the females are more confident than males.

Table 3

Overall comparison of components across gender

gender		conf	constant	ctrl
Male	Mean	15.7222	12.6667	10.1667
	N	18	18	18
	Std. Deviation	2.05242	1.97037	1.29479
Female	Mean	17.8182	12.7273	10.6818
	N	22	22	22
	Std. Deviation	3.86235	1.90693	2.21222
Total	Mean	16.8750	12.7000	10.4500
	N	40	40	40
	Std. Deviation	3.31421	1.91083	1.85293

The overall composition of components across the gender is in Table 3; The comprehensive report shows that confidence is more robust in females. The rest of the components are approximately the same in males and females; the control tool part was in the lower level.

Based on the results of toughness range, as seen in figure 3, most of the Latvian taekwondo athletes had moderate mental toughness.

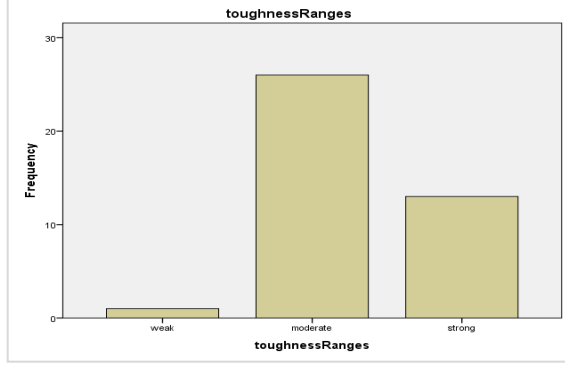

Figure 3. Mental toughness range in taekwondo athletes

Lastly the relationship between the components is explored using Pearson correlation. The results are summarized in Figure 4.

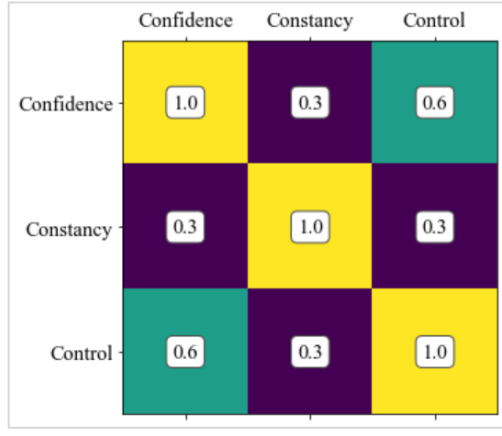

Figure 4. Correlation plot

Control and Confidence show the highest correlation of around 0.6. However, Constancy has 0.3 correlation with both Confidence and Control, which is not very significant.

Discussion

The purpose of this study was to investigate and analyze the components of the mental toughness of Latvian taekwondo athletes. The Latvian version of SMTQ (Astafičevs et al., 2020) was identified and analyzed for the implementation of the task. The descriptive statistics (mean and standard deviation) and an analysis of variance (ANOVA), based on the results of the study, as the only component of mental toughness that is significant, is confidence and just in female taekwondo athletes. Other components (control and constancy) were not substantial, and the mental toughness range in Latvian taekwondo athletes was moderate.

Mental toughness, in scientific literature, is described as one of the most widely used but least understood terms in sports psychology. “Congenital or established psychological dominance over one’s opponent, which helps to maintain perseverance, self-confidence and act effectively in high-stress situations during the most responsible moments of competitions” (Jones et al., 2002). Taekwondo is a combat sport that has evolved in scientific and technological aspects since its inclusion as an Olympic discipline, forcing countries to seek information from the different variables involved in the sport process to achieve the best international results. The most significant performance gains come from prescribing an optimal amount of physical training with appropriate psychological skills to allow for the best adaptation before competition. Mental toughness and its components are important in martial arts and, taekwondo, Gucciardi (2011) stated there is a positive relation between time (years of training, hours of

exercise per week) to the desire to achieve, attentional control and global mental toughness attribute, the idea of increasing mental toughness during the career was supported. International-level athletes and, therefore more advanced ones scored higher than those on a national level (Bhardwaj et al., 2014).

Conclusion

The obtained data from the research concluded that based on the results of the study as the only component of mental toughness that is significant is confidence, and just in female taekwondo athlete. The components of control and constancy were not important. Other researchers should try to find out ways to increase the mental toughness of taekwondo athletes and other sports. The SMTQ is a useful tool for testing mental toughness, emphasizing that participants come from an extensive variety of sports and compete on different levels, from regional to international.

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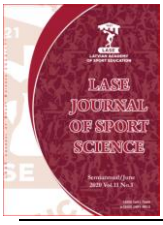

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REVIEW PAPER

EFFECTS OF MEDITATION ON BIOCHEMICAL MARKERS IN HEALTHY PEOPLE: A SYSTEMATIC REVIEW OF THE LAST 5 YEARS

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Abstract

Meditation, through its different practices such as yoga, mindfulness and transcendental meditation, can have beneficial effects on health, not only on a psychological level by reducing levels of stress and anxiety, but also physically by reducing blood pressure and heart rate. The objective of this systematic review is to know what are the effects of the different meditation practices on some biochemical markers such as cortisol, serotonin, dopamine, oxytocin and endorphins, which are associated with depression, anxiety, stress and happiness. The literature review was done according to the PRISMA methodology. The Science Direct, PubMed, Scopus and Web of Science databases were reviewed, narrowing the search between the years 2016 – 2020. After applying the inclusion/exclusion criteria, twenty-one articles were analyzed in depth. The different meditation practices have a positive effect by increasing the levels of oxytocin and endorphins, modulating the behavior of dopamine and serotonin in the central nervous system, and reducing the production of cortisol. These changes in the biologically active concentrations of these

chemical markers are associated with improvements in the indicators of stress, anxiety and depression, and of the well-being perceived by the participants of the studies. The regular practice of the different forms of meditation improves the general well-being, having a positive effect on the indicators of happiness of the people. The systematization of the theoretical body of meditation, the development of standardized protocols and working with more people with active control groups, could improve the conclusions drawn from the research.

Key Words: *neurotransmitters, hormones, stress, happiness, mood*

Introduction

Various studies based on qualitative and quantitative approaches have established that different meditation techniques, such as mindfulness and yoga, have beneficial therapeutic effects for the treatment of stress, anxiety, control of emotions, and improvement of people's health status, both physically and mentally (Keng et al., 2011; Kiran net al., 2014; Shonin et al., 2014). In the review of quantitative studies, Keng et al. (2011) found an increase in subjective well-being, a decrease in emotional reactivity indices, and improvements in behavior regulation, attributable to the meditation techniques used. On the other hand, in the review by Shonin et al. (2014), participants in various studies who had stress problems and low mood, experienced improvements in psychological well-being attributed to the meditation technique performed.

The stress reduction based on mindfulness (MBSR) is a consolidated therapy for the control of stress and anxiety in healthy people (Chiesa & Serretti, 2009) and in people who have any ailment that compromises their health, such as cancer, diabetes mellitus, HIV and other chronic diseases (Niazi & Niazi, 2011). From this it follows that the changes reported by people at a psychological level could have an impact at a physiological level, as concluded in numerous investigations on the subject (Kirk & Axelsen, 2020; May et al., 2016; Miodrag et al., 2013; Tang et al., 2015; Voss et al., 2020; Younge et al., 2015)

In that sense, Singleton et al. (2014) found changes at the brain level after an eight-week intervention with mindfulness, detecting a significant increase in gray matter in some regions of the brain, which was positively correlated with the increase in the psychological well-being of the participants. In the review and meta-analysis carried out by Fox et al. (2014) it is concluded that there are eight areas of the brain that are affected in people who meditate, among them, those that are related to the consolidation of memory (hippocampus) and the regulation of emotions (anterior and middle cingulate; orbital cortex frontal). A study by Taylor et

al. (2011), where magnetic resonance imaging (MRI) images of the brain were obtained while they were emotionally stimulated by images, found that meditation produces an attenuation in the response to visual emotional stimuli, and in those people who have been meditating for a longer time it occurs, a reduction in prefrontal-cingulate activity. Also, through the use of images by MRI, Hernández, Barros-Loscertales, Xiao, González-Mora, and Rubia (2017) found that meditation affects areas of the brain that process attention and emotional control.

Based on these studies, it can be established that just as stressful environments and circumstances can negatively affect people's health, the repeated practice of different forms of meditation can have a positive effect, since these beneficial effects depend on physiological and biochemical processes, whose molecular and epigenetic mechanisms are beginning to be understood (Venditti et al., 2020).

Meditation, through all its forms, can significantly affect certain biochemical markers such as cortisol (associated with stress) (Lee et al., 2015) and oxytocin, dopamine, serotonin and endorphins (associated with sensation and perception of pleasure) (Dfarhud et al., 2014; Mitchell & Phillips, 2007). Cortisol is the main glucocorticoid produced in the adrenal cortex whose concentration in the blood increases upon awakening and in stressful situations, so its determination in intervention studies to treat chronic stress disorders and their effects on health is very common (Lee et al. 2015). On the other hand, molecules of happiness or pleasant sensations are associated with all pleasant physiological and emotional processes, negative emotions, those that promote interpersonal relationships and mediate events of stress and body pain (Dfarhud et al., 2014; Mitchell & Phillips, 2007; Pilozzi et al., 2021). In this sense, the purpose of this systematic review is to establish how the different meditation techniques affect the levels of cortisol, oxytocin, dopamine, serotonin and endorphins, as well as how these markers correlate with the well-being perceived by the participants.

Materials and Methods

A systematic review of the literature was carried out in relation to the effect of the different meditation techniques on the levels of cortisol, oxytocin, dopamine, serotonin and endorphins and their relationship with the emotional state in people without any chronic pathology, following the procedures suggested by Moher et al. (2009). To provide the fullest possible understanding of the topic addressed in this systematic review, we chose to include quantitative studies with different statistical approaches, such as crossover designs, completely randomized and post-test studies.

Search strategy. Science Direct, Scopus, PubMed and Web of Science were used as search engines for electronic sources, with the keywords "meditation, relaxation, mindfulness, cortisol, health, endorphins, serotonin, dopamine, oxytocin", limiting the review between 2016 to the 2020. The review was completed in October 2020.

The searches were carried out in the search field type "Title, abstract and keywords" or equivalent (for example, "Title" for the Web of Science database). Published scientific articles were examined, excluding gray literature (ie, master's/doctoral dissertations and conference proceedings).

Finally, the terms are combined with the Boolean operator "OR" (Cooper et al., 2009). Based on the results of the Boolean-based search, other search modes were carried out. The reference lists of all studies were hand searched. In addition, reference citations (in the Web of Science and Scopus databases) and the first authors 'investigators' publications (in the Web of Science and Scopus databases) were also examined.

Inclusion and exclusion criteri. The criteria used for the selection of the articles were: a) articles within the range of years considered, b) that includes the determination or activity of some of the previously mentioned chemical compounds, c) that the method used to quantify the concentration or activity of the chemical compounds mentioned, d) that the participants do not have a chronic disease, e) original research papers and with a precise description of the statistical approach used, and f) articles written in English. Studies were excluded if a) contained insufficient data for analysis, b) study participants had a chronic medical condition such as diabetes, cancer, etc., c) did not clearly indicate the meditation technique considered in the study, and d) articles written in a language other than English.

To structure the analysis of the articles, the procedure followed by Bores-García, Hortigüela-Alcalá, Fernandez-Rio, González-Calvo, and Barba-Martín (2020) that takes into account if the article belongs to an indexed journal, that the description of the methodology is clear, that it indicates the number of participants in the study and the duration and statistical approach used. For the analysis of the articles, a table was constructed containing: study, number of participants, subjects, average age, chemical marker, meditation technique, duration, design, and relevant results.

Results

Figure 1 shows the scheme of the selection process used to obtain the articles in this systematic review and the number of articles consulted. After applying the exclusion/selection criteria, from the initial number of articles that was 1020, the list was reduced to only 21 articles, which are shown in summary form in Table 1.

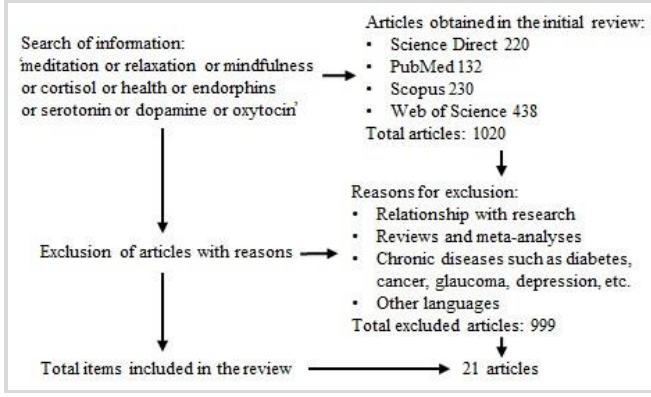

Figure 1. Process followed for the systematic review.

For the analysis of the articles, they were classified according to the biochemical marker considered (oxytocin, serotonin, dopamine, cortisol and endorphins) and the type of biological sample where the determination was made (saliva, hair and blood).

Table 1.

Summary of the studies included in the systematic review

Study	*N*	*Subjects*	*Age*	*Technique*	*Duration*	*Design*	*Results*
Oxytocin in saliva							
Bellosta-Batalla et al.(2020a)	68	Students	24	Mindfulness – Meditation	1.5h – 30min	CG (active)	IG Post>Pre; CG (active) Pre=Post; Post IG>CG
Bellosta-Batalla et al.(2020b)	90	Students	24	MCBI	2 months– 2h/week	CG(active) CG (inactive)	IG Post>Pre CG (active-inactive) Pre=Post.
Serotonin and Dopamine							
Newberg et al. (2017)	14	Community members	54	REI	1 week	Pre	DAT – SAT Post<Pre
Cortisol in saliva							
Bottaccioli et al. (2020)	40	Students	25	PNEIMED	4 days – 30h	Control (lessons)	Basal IG<CG IG Pre>Post CG Pre=Post
Cahn et al. 2017	38	Retirement attendees	35	Yoga – Meditation (retirement)	3 months	Pre	30min Post>Pre BDNF Post>Pre
Christopher et al. (2018)	61	Police officers	[~44]	MBRT	8 sessions week – 2h/session	Inactive control	IG < CG
Furtado et al. (2016)	35	Women	84	Chair yoga	14 weeks, 2sessions/week	CG (inactive)	Not changes

Table 1. continuation

Study	*N*	*Subjects*	*Age*	*Technique*	*Duration*	*Design*	*Results*
Ho et al. (2020)	51	Families	NI	FBMI	Parents: 6sessions/1.5h Children 8 sessions/1h Parents-sons 2sessions/ 30min	Control (waiting list)	Parents Night IG < CG Children Tomorrow and pending; IG<CG
Klimes-Dougan et al. (2020)	29	Students	20	Transcen-dental meditation.	2 months 2 sessions day15 – 20min	Control (waiting list)	IG <CG (4th week) TSST CG=IG
Lindsay et al. (2018)	153	Healthy adults	32	Mindfulness with smartphone	2 weeks – 20min/day	Monitor, Control	AUCI IG<CG, M. SST IG<C=M Systolic pressure IG<C, M
Manigault et al. (2019)	86	Adults with moderate stress	24	MBSR, CBT	6 weeks 45 – 50min/day	Control (waiting list)	There are no effects on cortisol
Marshall et al. (2020)	13	Active women	[20, 8]	Yoga (Hatha, Vinyasa)	2 sessions 30min	Pre-Test	Hatha Post<Pre
Roberts et al. (2020)	47	Parents of children with disabilities	79	MBSR	8 sessions week – 2h/session	Pre	Post < Pre (CAR)
Rosenkranz et al. (2016)	68	Meditators	49	Mindfulness	-	CG (Inactive)	LTM<CG Inflammatory responsivity, TSST LTM<CG
Unger et al. (2017)	111	Students	[21]	Visualization relaxation	1 session – 35min	Control active (reading)	CG = IG
Wagner et al. (2019)	83	Meditators	58	MBSR	Does not apply	Meditatio n time	AUCG meditators (> 26 years) > meditators (≤ 10 years)
Yoo et al. (2016)	42	School children	10	MSM	2 months 4 sessions week 30min	CG (readings)	IG <CG
Cortisol in blood							
Bansal et al. (2016)	16	Healthy adults	20-50	Meditation Osho	21 days – 1 h/day	Pre	Post<Pre
Magan & Yadav (2020)	97	Healthy adults	38	Meditation	2 weeks	Inactive control	LTM<STM, CG
Cortisol in hair							
Lamothe et al. (2020)	25	Doctors	48	MBSR	8 sessions week/2h/sessio	Pre-test	Pre=Post
Schultchen et al. (2019)	47	Students	22	BSM	2 months – 6 sessions week	Control (audio book)	Relation Cortisol /DHEA IG Pre<Post IG<CG

Table 1. continuation

Study	*N*	*Subjects*	*Age*	*Technique*	*Duration*	*Design*	*Results*
Endorphins in blood							
Magan & Yadav (2020)	97	Healthy adults	38	Meditation	2 weeks	Inactive control	LTM>STM>CG

Note. MCBI, mindfulness compassion based intervention; CG, Control Group; IG, intervention group; Post, measurements made after the intervention; Pre, measurements made before the intervention; DAT, dopamine transporter binding; SAT, serotonin transporter binding; LTM, long term meditators; NM, new meditators;MSM, mind subtraction meditation; BDNF, brain-derived neurotrophic factor; MBSR, mindfulness based stress reduction; AUC_G, area under the curve with respect to ground; TSST, trier social stress test; FBMI, family-based mindfulness intervention; PNEIMED, psychoneuroendocrinoimmunology based meditation; M, monitor; AUC_I, area under the curve with respect to increase; SST, social stress test; CBT, cognitive behavioral therapy; CAR, cortisol awakening response; MBRT, mindfulness-based resilience training; STM, short term meditators; BSM, body scan meditation; DHEA, dehydroepiandrosterone

In these works, the determination of cortisol in saliva predominates, as a biochemical marker of stress levels and its possible variation due to interventions using different meditation techniques such as mindfulness and yoga. The preference of saliva, over other biological samples, may be due to the relative simplicity with which the sample can be taken and without generating stress on the person (Vining & McCinley, 1986), even with simple instructions for collection and storage, that can be carried out by the study participant himself at home during his daily activities, avoiding the stress that is generated when visiting a health center and that can introduce a source of variability in the study (Titman et al., 2020). Additionally, saliva is a sample of less complexity than urine or blood, easy to obtain and contains the biologically active form of cortisol (Törnhage, 2002). The use of hair as a sample for the determination of cortisol, allows to see the secretions prior to this glucocorticoid more than at the time of taking the sample (Lamothe et al., 2020; Schultchen et al., 2019), therefore, it is expected that it will be useful in studies with a relatively long intervention time. For the quantification of cortisol in saliva, blood and hair samples, immunoassay methods were used, together with luminescent detection techniques, which, despite being very sensitive, do not provide adequate specificity and can introduce errors in the determination (Perogamvros et al., 2009; Turpeinen & Hämäläinen, 2013).

On the other hand, studying the activity of the dopamine and serotonergic centers in the brain due to meditation activities is a novel approach, not only because meditation can reduce stress, but also because it can contribute to the good mood of the people and the biochemical markers associated with these states (Kjaer et al., 2002; Newberg et al., 2017). A study was located where the content of β-endorphin and other chemical markers related to the inflammatory response in blood was quantified and two studies where oxytocin levels in saliva were determined.

When the statistical approach of the studies is reviewed, post-test type comparisons are used, completely randomized designs with active and

inactive control groups and crossover designs, and in general, in addition to the measurements of biochemical markers, different tests are applied to to know the psychological state of the participants, psychological stress tests and in some cases of physical inflammatory response are applied, to verify the additional benefits of therapies based on meditation to treat stress, anxiety and the management of emotions of the participants. According to the review carried out and in accordance with that indicated by Sharma (2006), the research works in this area follow two general patterns. On the one hand, participants who have no experience or very little experience in any meditation practice are selected, on which the intervention is carried out for some time, generally under the guidance of a person experienced in meditation practices and then they are made the respective observations in the variables of interest. In the other approach, participants who have experience in certain meditation practices are selected and compared well with other less experienced participants or stress response tests are applied to observe their behavior in relation to the variables of interest.

Discussion

According to Kumar Nehra, Sharma, Kumar, and Nehra (2013), the term mindfulness "is an English translation of Vipassana, which is a combination of two words *Vi* (in a special way) and *Passanna* (to see, to observe) which implies observing in a special way" (p. 200). This process of analyzing emotions, without judgment, but rather recognition, can allow emotions to be better managed, which in turn can be reflected in the variation of biochemical markers such as oxytocin, which is strongly related to the well-being of the patient. practicing. Well-being in human beings is conditioned by many variables, but there is no doubt that some of them are trust, positive emotions and the possibility of establishing meaningful relationships with other people (Ishak et al., 2010).

From a biochemical point of view, the hormone that is associated with these human qualities is oxytocin (Ishak et al., 2010). From a chemical point of view, oxytocin is a neuropeptide secreted by the hypophysis, and transported and stored in the neurohypophysis, from which it is released into the circulatory system, exerting effects on the body and some specific effects on the brain (Ishak et al., 2010). Oxytocin can act to counteract the effects of stress and anxiety, and in bonding that people establish on a personal and sexual level. There is no doubt that oxytocin plays an important role in feeling good, and failures in this neuropeptide can generate problems such as schizophrenia and some social phobias (Ebert & Brüne, 2018; Ishak et al., 2010; Patin et al., 2018). The regular practice of mindfulness can have a beneficial effect by increasing oxytocin levels, as shown in the works of Bellosta-Batalla et al., (2020a, b) (see Table 1

where, in general, in interventions to groups of students with mindfulness, they found a significant increase in oxytocin levels [from ~ 150ρg mL^{-1} to ~ 225ρg mL^{-1} in Bellosta-Batalla, et al. (2020a); from ~ 130ρg mL^{-1} to ~ 180ρg mL^{-1} in Bellosta-Batalla, et al. (2020b)], increased levels of empathy, decreased anxiety and negative emotions. These studies show that mindfulness not only reduces stress by attenuating the effect of stressors, but also activates the body's natural systems that increase human well-being (Sharma, 2006).

Serotonin and dopamine are neurotransmitters that are related to adaptive behavior, including decision-making and reinforcement of learning (Bäckman et al., 2006; Cools et al., 2011). Serotonin and dopamine are believed to interact in complex ways with cortisol, although serotonin is said to increase dopamine production and decrease cortisol production (Field et al., 2005). Additionally, dopamine and serotonin have an effect on reducing both depression and stress effects (Field et al., 2005). However, understanding the dynamics of these two neurotransmitters and the neural circuits in which they participate is by far a difficult task. For example, for the treatment of depression, the use of drugs that selectively inhibit serotonin reuptake has been suggested (Loonen & Ivanova, 2016). On the other hand, it is found that while dopamine and norepinephrine increase sexual desire, serotonin has the opposite effect (Stahl, 2015). Taking this in context, Newberg et al., (2017) evaluated the effect of an Ignatian spiritual retreat on serotonin (SERT) and dopamine (DAT) transporters and on the perception of health and well-being. In this study they found changes in the dopaminergic and serotonergic systems, as well as an increase in the perception of health and well-being; however, they do not give a clear explanation of how these changes correlate with people's perceived well-being. In an Ignatian spiritual retreat, activities of meditation, breathing, and examination of consciousness are carried out, similar to what is done during an Ignatian retreat. relaxation, meditation and mindfulness therapy, and although it is not possible to indicate that they are equivalent, in the end they pursue the same objectives. Previous studies had already found that meditation produces an increase in dopamine levels (Kjaer et al., 2002) and that massage therapies, while increasing dopamine and serotonin levels, decrease cortisol levels (Field et al., 2005). There are also studies that suggest that mindfulness significantly improves the symptoms of depression (Hofmann & Gómez, 2017) and the enjoyment of sexual activity (Pepping et al., 2018). In these studies, the common focus is the improvement in the management of emotions and stressful situations, which in turn modulates the biochemical response of the neurochemical systems involved.

In response to stressful situations, two neuroendrocrine systems are activated in mammals: the sympathetic nervous system (SNS) and the hypophysis-pituitary-adrenal (HPA) axis (Sheridan et al., 1994). In the case of the HPA axis, the secretion of adrenocorticotropic hormone (ACTH) by the pituitary stimulates the adrenal glands to release glucocorticoids, whose function in mediating metabolic and cardiovascular adaptation to stress (Sheridan et al., 1994). Chronic stress situations (due to labor demand, traffic, economic problems, etc.) can make the HPA system work for a long time, generating health problems such as hypertension, coronary heart disease, diabetes, among others, so it is done It is desirable to monitor the functioning of this allostatic system (McEwen, 1998; Salleh, 2008). The main glucocorticoid associated with the level of stress to which the individual is exposed is cortisol, and as shown in Table 1, it is one of the main indicators used to verify the physiological effects of meditation practices on stress and anxiety. In 12 of the 18 studies indicated in Table 1, a significant decrease in cortisol levels is reported as a consequence of meditation practice; in three of the studies there are no significant changes and in three studies there is an increase in cortisol levels. Marshall, McClanahan, Warren, Rogers, and Ballmann (2020) compared the effect of two types of yoga exercises, one of a meditative nature (Hatha) and the other of a more active nature (Vinyasa, which involves exercises of the major muscles and abdominal work) on cortisol levels, and found that Meditative yoga style decreases cortisol levels (pre=2.6ηg mL^{-1}, post=1.4ηg mL^{-1}) and anxiety levels, attributing this finding to the controlled breathing style that is carried out during the Hatha yoga session. For long-time meditators, Rosenkranz et al. (2016) conclude that they present a lower level of perceived stress, lower basal cortisol levels in response to the social stress task (SST, tests that simulate stressful situations in people, such as a job interview, linguistic and mathematical problems, among others), and lower inflammatory response, when compared to a control group of people who do not meditate. Canh, Goodman, Peterson, Maturi, and Millset (2017) found an increase in cortisol levels 30min after awakening (pre ~ 12.5ηmol L^{-1}; post ~ 16ηmol L^{-1}) and an increase in brain-derived neurotrophic factor (BDNF, pre 2.5ηg mL^{-1}; post 7.0ηg mL^{-1}). These results, in relation to the variation of cortisol levels, are heterogeneous, so they suggest that further research should be done on meditation therapies and their effects on stress and their biochemical responses. The increase in BDNF levels due to meditation activities is incorporated into what is already known about this protein molecule and its effect on learning and memory, whose blood levels are also increased by regular physical activity (Miranda et al., 2019).

As previously indicated, the quantification of cortisol is generally carried out using immunoassay methods, which are susceptible to interferences derived from the treatment of the sample and to the presence of cortisone, a metabolite from cortisol which is metabolically converted in the salivary glands by the enzyme 11β-hydroxysteroid dehydrogenase type 2 (11β-HSD2) (Perogamvros et al., 2009). Therefore, the use of quantification methods that guarantee the accuracy of the results, could help to better understand the panorama of the effect of the different meditation practices on cortisol levels, in particular those methods that combine gas chromatography or liquid chromatography. with detection by mass spectrometry (Vieira et al., 2014; Perogamvros et al., 2009). When the results obtained for the cortisol levels obtained by immunoassay are reviewed, from the works shown in Table 1: Furtado et al., (2016) 570-650ηg mL^{-1}; Cahn, Goodman, Peterson, Maturi, and Millset, (2017) 4.3-5.3ηg mL^{-1}; Unger, Busse, and Yim (2017) 14-9ηg mL^{-1}; Manigault et al., (2019) 1.6-2.4ηg mL^{-1} and Bottaccioli et al., (2020) 3.4ηg mL^{-1} and they are compared with those obtained using liquid chromatography and mass spectrometry: Vieira, Nakamura and Carvalho, (2014) 0.5 (0.24-3.7)ηg mL^{-1} and Perogamvros et al., (2009) 3.0 (1.2-5.4)ηg mL^{-1}, it is observed that the values obtained by immunoassay are significantly higher. The importance of using reliable analytical methodologies could reduce the errors made in the final hypothesis tests.

Like oxytocin, serotonin, and dopamine, endorphins are associated with happiness (Dfarhud et al., 2014). Endorphins are neurotransmitters of an opioid nature that are released during pleasant activities such as sex, exercises, meditation, chocolate intake, among others, and it has been suggested that they can act as a mediator in pain sensations (Dfarhud et al., 2014; Suri et al., 2017). **β**-endorphin has a superior analgesic effect than morphine and is also part of the HPA system that is responsible for responding to stressful situations that can cause pain (Pilozzi et al., 2021). Magan & Yadav (2020) found that the group of people who practice meditation regularly (>5 years, at least 5 days a week, preksha meditation) had higher levels of β-endorphins in plasma (4.38ρg mL^{-1}), when compared to a group that only performed two weeks of meditation (2.71 ρg mL^{-1}) or an inactive control group (2.09ρg mL^{-1}). Additionally, the group with the longest meditation time had lower plasma cortisol levels (112.6ρg mL^{-1} versus 192.03ρg mL^{-1}). Although it is not a definitive conclusion, an increase in endorphin levels and a decrease in cortisol levels is associated with a greater sense of well-being (Dfarhud et al., 2014).

Conclusions

According to the systematic review of the literature carried out, it can be concluded that the practice of the different meditation techniques has an important effect on the biochemical markers of stress (cortisol) and those that are associated with the emotional, physical and mental well-being of people (oxytocin, dopamine, serotonin and endorphins). However, further research should be done to establish clear intervention protocols that allow us to discern how meditation produces these biochemical changes, establishing procedures and levels of practice to achieve the desired results. In the reviewed works, the incorporation of active groups in the experimental design, as well as the pre-test and post-test approaches allow us to find trends that are useful and that could be generalized.

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REVIEW PAPER

THE IMPORTANCE OF HUMAN RESOURCES IN HEALTH AND FITNESS SECTOR

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Abstract

Rapid development and growth of health and fitness industry is a necessity for all involved to ensure enough skilled employees for the future. Exercise professionals are the main source to convey exercise-related information for the public. Unfortunately, there is a lack of review studies on the analysis of trainers' education and professional competencies, little is known about personal training, customer service and work peculiarities. Until now, the professional title of 'personal trainer' is not ''protected'' in most countries, so everyone can call himself personal trainer. The standards are an important step but implementing them into the fitness sector and communicating it to a broader public is a long-term process which just has started. The collaboration between healthcare systems and the H&F sector is very important, yet the interaction between both also in Europe is not always sufficient. The aim of this study was to reveal the situation of human capital in health and fitness sector and to overview future opportunities and challenges of integration to European sport and health policy. In this review we presented the picture of fitness industry, European regulations for qualifications and recognition of exercise specialists, current picture of personal training in Europe and the situation with Lithuanian human capital. We hope that this study will initiate a broader discussion on the topic in other European countries and assist national sport educators and politicians in further developments to align with the European Qualification Framework (EQF) and sport sectors' qualifications.

Keywords: *human capital, health and fitness industry, trainers, education.*

Introduction

The European health and fitness (H&F) sector is rapidly developing. Societies in the developed countries have ever-decreasing demand for organized and competitive sports services, and the demand for individual H&F services is increasing (Paoli and Bianco, 2015). *The European Health & Fitness Market Report 2018* maintains information that currently this market serves over 60 million consumers, generates 26.6 billion Euro in revenues, employs 650.000 people, and consists of 59.000 facilities (Deloitte and EuropeActive, 2018). With a total market volume Europe continues to be the largest fitness market in the world. At constant currency exchange rates, the year-on-year growth rate amounts to 3.8%. Market growth is primarily driven by a 3.2% increase in the number of clubs across all countries, supported by an increase in the average membership per club (+0.7%), leading to a total increase in members of 4.0% to 60.0 million (Deloitte and EuropeActive, 2018).

At present, the Lithuanian H&F sector covers about 200 clubs of various sizes, which could be attributed to the H&F sector. This sector is represented by Lithuanian Health and Fitness Clubs Association. A large part of H&F clubs is united by the Lithuanian Federation of Fitness and Bodybuilding. Interestingly, most clubs in the Lithuanian H&F sector are private. In other European countries, H&F sector is not only private but also public, i.e., H&F centers are maintained or at least partially supported by municipalities. They do not offer such a variety of services, but they help to ensure equal opportunities for communities to exercise because they price much lower than in the private sector.

Rapid development and growth of the sector is a necessity for all involved in the sector to ensure enough skilled employees for the future. An important cornerstone is employer skills surveys, which have been conducted, and the latest findings from the new "European Personal Trainer Research" (Gronau and Titze, 2018) provide us with better understanding of what we need to do to make sure we have skilled workers and entrepreneurs to sustain continuous growth of the sector (Deloitte and EuropeActive, 2018). Condition for successful business is the right and intelligent AGENT - TRAINER. This was illustrated in the new EuropeActive publication "Human Capital in the Fitness and Active Leisure Sector" (Middelkamp and Rutgers, 2018). Therefore, to attract customers and provide quality service, it is necessary to discuss human resources issues.

The job market for fitness trainers currently shows excellent opportunities because obese and ailing populations now understand the need of fitness, nutrition, and an active lifestyle. Although this segment is growing rapidly, little is known about personal training. What is the situation with the

recognition of fitness professionals in the world? What should a consumer expect of a personal trainer (PT)? And when is a person qualified to use the label of PT? The answer to questions like these is important for accurately matching demand with supply. This process is still in its infancy in Europe and in other continents, which is partly due to the broad interpretation given to the profession of personal training.

The Special Eurobarometer (2018) reported that fitness is the largest "participation sport" in Europe, showing an increase in the number of people partaking in fitness activities. It also revealed that nearly half of Europeans never exercise or play sport, and the proportion has increased gradually in recent years. Respondents in Sweden (44%) are, by far, the most likely to engage in sport or physical activity in a health or fitness centre, followed by respondents in Denmark (24%) and the Netherlands (22%). The lowest proportions are found in Lithuania (2%), Latvia and Estonia (both 4%) (Special Eurobarometer, 2018).

Policy makers, such as governments and health insurers at both the EU and national levels, recognise the importance of people becoming more active, and the fitness sector can play an important role in achieving this (Deloitte and EuropeActive, 2018). The current H&F industry includes healthy lifestyle, exercise and conditioning, health-related physical fitness, and the pursuit of the fullness of life. Usually, adults and older people exercise in this sector, but it can also provide some rehabilitation services (through physiotherapy), children and adolescents supervised by adults, disabled persons, pregnant women, and professional athletes can exercise there as well. This sector also serves places of employment (e.g., H&F clubs are visited by people who have been granted membership by their employers), and they can also provide their services to educational institutions. Thus, the sector's goals are very extensive – from promoting healthy lifestyles and preventing diseases to rehabilitation.

To maintain the momentum, the Professional Standards Committee of EuropeActive has turned its attention to reviewing the qualification structure of fitness professionals, and most notably for the PTs and those with more specialised skills (Deloitte and EuropeActive, 2018). For the first time, there is a European qualification for PTs, which was presented at the highest levels in the Commission, the Parliament, and the Council. The recommendations proposed by EuropeActive on how to "harmonise" qualifications could well be the model for many other sectors.

Exercise professionals are the main source to convey exercise-related information for the public. They provide information and implement exercise counselling, exercise prescription, client's fitness assessment and guidance. Unfortunately, there is a lack of review studies on the analysis of their

education and professional competencies (Stacey et al., 2010), it is unclear how they obtain evidence–based information and other issues associated with their education and lifelong learning (Stacey et al., 2010; Waryasz et al., 2016).

The aim of this study was to reveal the situation of human capital in H&F sector and to overview future opportunities and challenges of integration to European sport policy. It is necessary to discuss the competencies, professional qualification and recognition for fitness and exercise professionals not only in Lithuania and across the EU countries.

The fitness industry employs around 650.000 people, in different roles, age categories and contract types. Therefore, this article attempts to answer the questions most relevant to trainers: Why did they join the fitness industry, and what keeps them motivated? What is the type of recruitment of PTs? What service is usually provided by PTs? What is the education and the most important professional skills of PTs? What is the average salary of PTs? What threats or opportunities are most visible? Are the Lithuanian and European health and fitness sectors prepared to collaborate with the national healthcare sectors? Do fitness specialists demonstrate solid competencies? Do these competencies align with the requirements of the European (EuropeActive) standards? In Europe, personal training is still a relatively new phenomenon for the fitness sector in general and towards consumers. On personal training, there are plenty opinions, personal (mostly social media) publications, etc. It is like football; the whole nation is an expert. But what is known about this profession from independent (scientific) research and which lessons can be learned from studies on personal training around the globe? In many countries, regular quantitative and qualitative research of the fitness sector is still missing, therefore, this study will review the situation of overall human resources in the European H&F sector.

Material and methods

The analysis of scientific literature, official documents, industry voice, books and presentations from global H&F events was applied to disclose theoretical ground of the work. Relevant policy documents and industry reports were sought by tracking the websites of the leading organizations in the fitness industry (e.g., EuropeActive, International Health, Racquet & Sportsclub Association, the European Register of Exercise Professionals, UKActive, etc.). Specialist texts, such as professional textbooks and handbooks and professional publications were analysed to identify latest developments in the (fitness) field. The retrieved literature was analysed thematically in order to assess the evidence on fitness professionals as an occupational group; their role in physical activity for health agendas;

and the nature of the professional education and training that is available to support them. It is discussed, how is evolving H&F industry and what the current picture of human capital and especially personal training has been formed and transmitted publicly, as it defines the mission, vision, and goals, together with different trainers' occupational descriptions, competencies and service they provide.

The rationale for this approach was that thematic analysis has been considered to be a flexible tool which can potentially provide a rich and detailed understanding of eclectic data. For the purposes of this article, and following our extensive analysis of the available literature, findings were organized into four key topics: (1) Policy and challenges for health and fitness sector; (2) Human capital in the fitness and active leisure sector; (3) European standards and recognition; and (4) Personal training in Europe. While each of these issues are presented and discussed separately in this article, we believe that they are interconnected.

This overview of documents and research results should give probable more clear understanding for society, educational organizations, policy makers, sports, medicine, and health care sectors about the key professions in Sport and Active Leisure sector that seeks our trust and recognition.

Results

1. Policy and challenges for health and fitness sector

Physical activity is one of the basic human functions. It is an important foundation of health throughout life. Despite the known benefits of physical activity, there is a worldwide trend towards less total daily physical activity. Globally, one third of adults do not achieve the recommended levels of physical activity. In Europe, estimates indicate that more than one third of adults are insufficiently active (Hallal et al., 2012; Special Eurobarometer, 2018). Physical inactivity has been identified as contributing to the energy imbalance that leads to weight gain. There is significant evidence to show that physical inactivity and over-nutrition are associated with a substantial economic burden in industrialized countries. Collectively, physical inactivity not only has substantial consequences for direct health - care costs but also causes high indirect costs due to increased periods of sick leave, work disabilities and premature deaths. For a population of 10 million people, where half the population is insufficiently active, the overall cost was estimated to be €910 million per year (WHO, 2007). From the evidences published at Lancet Series on Physical Activity (2012, 2016), there is a clear message that physical activity and exercise can play a major role at the Public Health agenda, and significant funding and resources are being allocated to identify cost-effective active living models of implementation and delivery.

Changing community health-related lifestyles requires cooperation between the health sector and the H&F sectors. Even in 2013, the International Olympic Committee initiated a wide-ranging discussion inviting doctors, physiotherapists, public health professionals, H&F trainers, IT specialists, business representatives, and scientists. This discussion was completed with the statement that in order to change public health behaviours, and most importantly, in order to develop the necessary skills, not only complex public health promotion programs are needed, but also individualized support and care, which have to last long enough.

Sport and active leisure sector are a part of a broader sector which includes cultural arts and entertainment in the new ESCO (European Skills/Competences, Qualifications and Occupations) classification. EuropeActive (www.europeactive.eu), a non-profit organization representing the whole of the European H&F sector in Brussels, uniting a large number of European non-governmental and private organizations which are active in health sector, has developed an organogram that reveals key professions in sport and active leisure sector through the European Skills Competencies Qualifications and Occupations (ESCO) project. *Active leisure* is a combination of fitness and outdoor-based activities that are generally unstructured and non-competitive. They promote active, healthy lifestyles through activities, events, and exercise. They are commonly provided under the direction of qualified animators or instructors so that the activities are tailored to match the abilities of the participants and meet their needs in an enjoyable and safe way (https://www.ehfa-standards.eu/es-referencing-policies).

The leadership for promoting health-enhancing physical activity is set out for the national ministries of health with a formal encouragement to establish coordination mechanisms between the areas of health, sports, education, transport, urban planning, environment, and social affairs sectors. The collaboration between healthcare systems and the H&F sector is very important, yet the interaction between both also in Europe is not always sufficient (Muth et al., 2015; Sagner et al., 2014). And what we consider are the reasons for this?

- *Firstly*, exercise professionals have not historically been considered as an extension of the health care team (Muth et al., 2015). Unfortunately, representatives of healthcare systems tend to view the H&F sector to be founded on principles that differ from the medical system and lacking the "credibility" and "authenticity" to partner on NCDs prevention (Matheson et al., 2013). The main problem is that the H&F sector in some cases is seen as a private multibillion industry, feeding modern consumerism, and making business by manipulating clients' concerns similarly as hamburger restaurant

chains (Andreasson and Johansson, 2014). However, it should be emphasized that the H&F sector worldwide covers not only the private sector, but also the public and the community sector, and such opinion should change.

- *Secondly*, the healthcare system is not prepared to apply exercise prescription as a first-line therapy because of the lack of the specific health-enhancing physical activity (HEPA) related education in the training of general practitioners (Joy et al., 2013).
- *Thirdly*, the source of distrust that is being encountered is the competences of H&F trainers. The H&F sector is relatively young, so the education requirements for instructors and trainers working in this field are quite different. EU countries have huge differences in the education, competencies, and employment of fitness professionals. Education is offered through many institutions and their requirements range from brief online courses to university degrees (Stacey et al., 2010). However, it is revealed that exercise professionals with higher level of education (e.g., graduate degrees) are more likely to use scholarly sources of evidence compared to those with lower levels of education who are more likely to rely on mass media, including the internet (Hare et al., 2000; Forsyth et al., 2005).

Getting and staying fit is the result of the integration of both physical activity and exercise in the lifestyle, and the application of solid evidence-based interventions will guarantee effective positive results achieved safely and progressively. Science and applied research are progressing faster than ever, and exercise professionals, should be able to build the bridge between theory and practice. Exercise professionals should be upskilled based on the current evidence allowing the public to achieve their exercise goals easier, faster and safer.

High-quality research and robust evidence are the cornerstones of effective policy, and while is known that physical activity is one of the most powerful medicines available to society and have proven that adding just small amounts of activity improves the health and wellbeing of almost everyone – all the resources and time spent investigating activity amounts to very little unless we know how to support more people to be more active more often.

Due to the aforementioned challenges in public health, the healthcare and the H&F sector should review and reformulate their current strategies. This will be critically important in the light of the implementation of the EU-WHO Physical Activity Strategy for the European Region 2016-2025. Moreover, it will be relevant for the recognition of the value of the H&F sector as an effective partner on the public health agenda worldwide (Jimenez and Pajaujiene, 2017).

2. Human capital in the fitness and active leisure sector

Health and fitness specialist is a qualified sports instructor and/or trainer who develops and conducts exercise programs that help people of all ages and opportunities to improve their health-related physical fitness and achieve their fullness of life (www.europeactive.eu). This definition definitely proves that the role of a sports and fitness trainer has long outgrown a narrow body design culture. In terms of the role itself, it has been suggested that a PT must be a teacher, trainer, counsellor, coach, supervisor, supporter, nutritionist, bodybuilding evaluator and consultant, life management advisor, weight controller, personal life consultant, and a physical fitness advocate (Chiu, Lee, & Lin, 2010). He/she must also be able to effectively communicate and apply science-based principles of personal counselling, be able to communicate professionally with other specialists, and be empathetic.

Whether you own one fitness club, 100 clubs, or any business in the fitness and active leisure sector, the key to success is people. Human capital is defined in multiple ways. The new findings and valuable insights were presented in a book "Human Capital in the Fitness and Active Leisure Sector" (Middelkamp and Rutgers, 2018), in which the prominence of the professionalization of human capital and high-level professionals for a fast-growing sector is detailed. There, managers and employers from different companies, leading health networks and businesses as well as scientists share their insights. Human capital is a measure of the economic value of an employee‘s skill set. Human capital is a collection of traits, all the knowledge, talents, skills, abilities, experience, intelligence, training, judgment, and wisdom possessed individually and collectively by individuals in a population (Middelkamp and Rutgers, 2018). With new health challenges and rapidly spreading digitalisation and robotization, there is also an increasing demand for competent professionals who are able to learn and adapt quickly. Therefore, the most important future work is to discover new talents, lovers of the profession, develop leaders and create competitive companies, organizations, and services for the whole health sector.

Educated, qualified and certified exercise specialists are the well-known global trend. American College of Sports Medicine (ACSM) annually announces global trends in H&F sector. These predictions are made by interviewing thousands of trainers, managers, owners of H&F clubs in the H&F sector, and other professionals in this cluster. Usually, anonymous surveys try to find out what the respondent thinks are the basic things that are most important for the sector (Thompson, 2018, 2020). Interestingly, these surveys, conducted since 2007, always point out that the professionalism of H&F trainers is paramount, emphasizing their education, experience and competencies. It should be noted that in 2008-2013, this category ranked first

and thus contributed to the development of new training programs, their accreditation and quality assurance.

There are just a few studies available that investigate which skill-set fitness professionals require to support the needs of their customers and match certain industry quality criteria (Baart de la Faille, Middelkamp, & Steenberger, 2012). Standards focus mainly on topics like physiology, anatomy, injury prevention, energy systems, and different kind of training. Less focus is placed on motivation and the promotion of behaviour change. In German study on PTs (Horn, 2011), a set of success factors for trainers was summarised by the trainers themselves. There are social competences, sympathetic looks, capability, communicative skills, appearance and being a role model. US – based study summarised similar success factors, including motivational skills, individuality (the ability of the trainer to give the customer a special feeling), emphatic ability and social skills (Melton et al., 2010). The focus on this kind of these so called "soft – skills" is becoming more apparent within fitness professionals and training providers. Skills to motivate and support clients on behaviour change have a double impact. *First,* it helps the clients to adapt and maintain health – related behaviours, which results in a higher level of health and fitness. *Second,* in supporting clients on motivation and behaviour change, PTs can improve the levels of client (member) retention, which affects their business as a professional (Middelkamp and Steenberger, 2012).

In the study of Melton et al. (2010), the participants agreed that the appearance of one's physique was a critical consideration for clients hiring a PT. Other factors like gender or race and niche (being a specialist) are also mentioned as important. To achieve client loyalty, four factors are considered including motivational and social skills (Fig. 1).

More employers than ever took part in the 2018 skills survey organised by EuropeActive, which helped to provide the evidence and direction for future qualification and skills development of fitness professionals. The survey included a notable increase in the number of larger clubs and chains that took part. Employers have high expectations that when they are recruiting, they need trainers who are willing to learn, and who are well-presented. Some of the main findings include:

1. Only 16% of employers find it easy or very easy to recruit the trainers they want to work in their clubs.
2. The top three main missing skills in new recruits are in customer service (51%), personal and communication skills (44%) and specific technical skills to be a PT (40%).

3. 90% of employers said that they think PTs should have additional education/training to work with special populations including children, older adults, in pre- and post-natal, and with diabetics and over-weight clients.
4. 79% of employers think that it would help if there was an agreed European standard for certifying PTs and group fitness trainers.
5. Recognition the European Register of Exercise Professionals (EREPS) remains quite high with 53% reporting that they are aware of the EREPS (2018 Employer Skills Survey Results, EuropeActive, 2018).

As identified in previous years, the main skills gap for fitness trainers remains in the areas of inter-personal skills and in the ability to work with a more diverse customer base whilst technical skills training seems to be generally satisfactory. The continued high level of expectation for harmonisation of qualifications (certification) of fitness trainers at a European level supports the work that EuropeActive has initiated through EU funded project activities to create a sector qualification framework and with the implementation of EREPS.

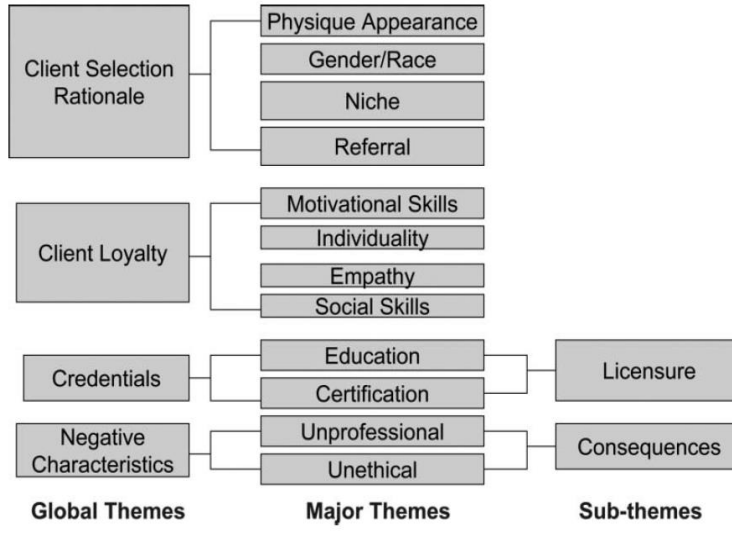

Figure 1. Hierarchy of themes for success in personal training (Prepared by the author based on Melton et al., 2010).

Consequently, it is important to establish, publicise and maintain standards of ethical behaviour in all EU countries fitness instructing practice, and to inform and protect members of the public and customers using the services of exercise professionals. EREPS Code of Ethical Practice defines what is best in good practice for professionals in the fitness sector by reflecting on the core values of rights, relationships, responsibilities and standards (Rocha, Rieger, & Jimenez, 2015).

3. European standards and recognition

Despite the lack of scientific efforts, the need to structure the qualifications of the European H&F sector has emerged in the last decade. The European H&F industry qualifications are regulated by *EuropeActive* (www.europeactive.eu). The Professional Standards Committee (PSC) of EuropeActive is responsible for the developing of regulatory framework, which underpins public confidence in the work and development of the European H&F sector. Furthermore, the PSC has developed the Sectoral Qualifications Framework (SQF) and set the educational standards for the H&F sector. Its activities are based on the European Qualifications Framework (EQF), thus strictly implementing guidelines set by the European Commission. The standards have been developed through extensive consultation and define the knowledge, skills and competencies that exercise professionals need to achieve registration of European Register of Exercise Professionals (EREPS). EREPS promotes mobility of employment within Europe and beyond by co-operating with other registers who use similar standards and systems of quality assurance in recognising exercise professionals. EREPS has members working in 32 different European countries and 10% of its members change their country of work each year.

Educational standards for all vocational levels and for the first academic level have been developed.

Table 1.

The European Fitness Sector Qualification Framework
(Prepared by the author based on www.europeactive.eu)

EQF/SQF (Bologna process)	*General Population*	*Special Population*
7 and 8	x	x
6	x	Advanced Health and Exercise Specialist
5 (Short cycle)	x	Exercise for Health Specialist Pre-diabetes Exercise Specialist Weight Management Exercise Specialist Pregnancy and Postnatal Exercise Specialist
4	Personal Trainer Pilates Trainer	Youth Fitness Trainer (12 – 17 years) Children's Fitness Trainer (6 – 11 years) Active Aging Trainer
3	Fitness Instructor Group Fitness Instructor Group Exercise to Music Instructor Aqua Fitness Instructor	x
2	Fitness Assistant	x

It should be noted that levels 2 – 5 in this qualification framework are attributed to vocational training and levels 6 – 8 correspond to academic education (6 – undergraduate (bachelor), 7 – master, 8 – doctoral degree) (Tab. 1).

Not only in Lithuania, but also in Europe, the problem is that trainers solve health problems, "cure" diseases, write diet plans for what they have neither competences nor rights. According to the job description, the trainer or instructor can work only with healthy clients! If there are illnesses or special health conditions, exercise for health specialist - trainer will never work alone.

For example, in case of obesity a trainer with EQF – level 5 should work with other health care professionals as a unified team including a physician (general practitioner, endocrinologist, cardiologist), dietician, physiotherapist, psychologist, and not solve the problem working alone. Pregnancy, postnatal period, elderly, and children also require additional competencies to conduct workouts successfully and safely or provide exercise programs. That should be done, but unfortunately reality is different.

What is the situation with the recognition of fitness professionals in the world? There is no clear answer, every country has its own laws, however to our knowledge, in many EU countries, USA, Canada, UAE, Australia, H&F sector employers control the qualifications of their instructors through the *European Register of Exercise Professionals* (EREPS, www.ereps.eu.com) certification. This certification is provided by EuropeActive accredited training providers. Unfortunately, the qualifications accepted by the European employers (EREPS certification) have not fully been recognized by the Eastern European authorities. There is no officially recognized national register for fitness specialists in the Eastern European countries. To date March 2021, there have been nearly 10.000 officially registered fitness professionals in EREPS, among them – 289 from Lithuania, and most of them are graduates of the private Lithuanian fitness school ActiveTraining (www.activetraining.eu). EREPS registration is sometimes called a 'license to practice' and is clearly understood by H&F operators and consumers. EREPS is also recognised by the EU Commission as a good example for a sector developed "professional card", a concept being further developed under Directive 2013/55EC. Interestingly, the H&F sector itself seeks to recognize the qualifications of fitness professionals, so registers in some of the major countries have signed co-operation agreements. For example, International Confederation of Registers for Exercise Professionals (ICREPS) and the European Register of Exercise Professionals (EREPs) both provide relationships between fitness associations in different countries across the world. This relationship allows international portability enabling

fitness professionals to transfer their fitness qualifications within each member country of ICREPs and EREPs. Besides enabling fitness professionals to work within different countries, the purpose of these international registers is to ensure that fitness standards are maintained and are consistent between the countries.

The suggestion for every EU country is to have a national register for the health and fitness professionals. The certification of fitness qualification from American Council on Exercise (ACE), National Strength and Conditioning Association (NSCA), American College of Sports Medicine (ACSM), National Academy of Sports Medicine (NASM), International Sports Sciences Association (ISSA) is also credible and recognised globally.

Do fitness professionals demonstrate solid competencies, which are important or even mandatory for collaborating with the healthcare and other sectors? Do these competencies align with the requirements of the European standards? The only data about the competencies of Lithuanian fitness trainers was recently published by Jankauskiene and Pajaujiene (2018), and results are not comforting. Their study aimed to test the competencies of fitness trainers in reference to the European requirements for EQF – level 3 standards. The study was conducted in fitness clubs throughout Lithuania and included 202 fitness trainers. According to the European Standards (EQF – level 3 for Fitness Instructors and Group Fitness Instructors), Core Knowledge (CK) is compulsory for all instructors, yet Specific Knowledge (SK) is associated with the specific professional field. Only three individuals in the sample, namely female group fitness instructors, successfully passed the exam for the EQF level – 3 standards and might be registered onto EREPS. Only a minority (7.1%) of fitness trainers met the requirements (≥70% of correct answers) for the CK. However, this sample demonstrated relatively high practical instruction skills (Tab. 2).

Table 2.

The number of fitness instructors who successfully passed core knowledge, specific knowledge, and practical skills testing **(**Jankauskiene and Pajaujiene, 2018).

Took and passed the tests and final exam according to EREPS requirements	*Fitness Instructor*	*Group Fitness Instructor*
Took core knowledge test	59	64
Passed core knowledge test	2	6
Took specific knowledge test	54	34
Passed specific knowledge test	0	7
Took practical instruction test	43	34
Passed practical instruction test	29	31
Took EREPS full exam	43	34
Passed EREPS exam	**0**	**3**

Interestingly, there were no differences in the exam test results between the age, gender, work experience and education groups.

All these fitness trainers were not on the EREPS during research, but they had a university degree or National licence / permission to train people! This study revealed that universities and vocational education schools should develop or update the core knowledge of fitness professionals, especially in the area of lifestyle management, as behavioural changes are the main task in enhancing physical activity and the healthy lifestyle promotion (Biddle et al., 2012; Matheson et al., 2013; Sagner et al., 2014; Jankauskiene & Pajaujiene, 2018).

These findings are very disappointing regarding the challenges for the professionalization of the H&F sector (Pettitt, 2013; Muth et al., 2015; Shephard, 2015). Lithuanian H&F sector remains mainly private, and education of fitness professionals is implemented through formal and informal education. Following the Bologna process, institutions of higher education offer bachelor and master's programmes in sport (EQF levels 6 and 7) and there is a possibility to receive vocational training for EQF level 3. Unfortunately, there is no alignment of the sport and H&F sector with the EQF for EQF levels 1, 2, 4 and 5. Moreover, there are no officially accepted professional standards, no qualification descriptions of the fitness trainer's competency in Lithuania. Thus, anyone holding a sport-related university degree, having vocational training or a four-year-duration licence for sports-related work might officially be employed as a fitness instructor or personal trainer (Jankauskiene and Pajaujiene, 2018). Moreover, gaining education at EQF – level 6 does not mean that a person has already achieved a good EQF – level 3 as the EQF describes qualification levels but not the progression stages (Lester, 2015).

The results of Jankauskiene and Pajaujiene (2018) study highlighted the importance of testing the competencies of exercise professionals in other European countries and strengthening the necessity of lifelong learning. The competencies of fitness trainers are an important source of trust for the healthcare providers and other sector stakeholders implementing the strategy for the prevention of non-communicable diseases.

4. Personal training in Europe

In Europe, as in the rest of the world, *Personal Training* is on the move and developing rapidly. In general, the United States of America are perceived as a fundamental market for personal training. Around 261.100 fitness professionals were counted in 2008; approximately 149.000 were PTs (US Bureau of Labor Statistics, 2010). In Europe, the most developed PTs market appears to be the United Kingdom (IBISWorld, 2020).

Personal training is undoubtedly one of the most important occupations in the European fitness industry. There is a little knowledge with regard to the basic question of how many PTs there are currently offering their services. A major reason is that neither the term "Personal Trainer" is strictly defined nor "Personal Trainer" is a protected title. Hence, anyone offering any kind of one–to-one training could call himself a PT in many countries. The prognostic calculations of researchers suggest that the total number of PTs in Europe would sum – up to 70.700 (Gronau and Titze, 2018).

A personal trainer's role includes designing, implementing, and evaluating exercise/physical activity programmes for individual clients by collecting and analysing client information to ensure the effectiveness of personal exercise programmes. A PT should also actively encourage potential clients/members to participate in and adhere to regular exercise/physical activity programmes, employing appropriate motivational strategies to achieve this. EuropeActive on 2011 took important steps with the development of standards to define this profession more explicitly (at level 4 within the European Qualification Framework; EQF). These standards were updated in 2018, and the job was done by global Technical Experts Group and active external evaluation from a variety of specialists in worldwide fitness and health sectors (EuropeActive, 2018).

A PT should convey a large number of characteristics so that the clients continued to attend personal training sessions for a longer period of time. The following list provides a short overview:

1. *Professionalism*. Fitness instructor is professional. However, more is demanded of a PT in the area of professional attitude, communication, motivation and follow-up with clients. PTs must adopt a more proactive attitude. They must take the lead in coaching clients in every detail of the exercise programme.
2. *Knowledge and experience*. PTs increase their knowledge in different ways: by attending training and courses, using systems and reading books and journals. PTs apply information they get immediately.
3. *Marketing, promotion and sales*. Successful PTs are empathic. They behave tactically and dress professionally. PTs use instruments as personal training promo-boards, business cards and referral cards that look great and a website with testimonials, a strategy where entrepreneurs let someone else talk about their success. PTs also master sales techniques and regularly review these processes in order to improve.
4. *Integrity and behavioural code*. PTs strictly keep to certain behavioural codes and maintain their integrity. This means that they handle information

from and about clients carefully and confidentially, and practise ethics in matters such as sexuality and etiquette (Rieger, Jones, Jimenez, 2016).

The 2018 European Survey of Personal Trainers (Gronau and Titze, 2018), initiated and supported by EuropeActive, revealed numerous statistics that helped to create a clearer image of the European personal trainer. A total of 4370 fitness professionals from 15 European countries participated in the survey that has been online from June to September 2017 (Gronau and Titze, 2018). On average, 63.8% of participants were male and 36.1% female. PTs are rather young group of professionals. Average age of PT is 34 years. The majority of PTs (36.8%) are in the range between 31 to 40 years and only 7.7% in the 51 to 60 cluster. Similar data came from Horn's (2011) study, where PTs had an average age of 36 years, with a variation of 22 to 59 years. The majority of PTs in Germany were men (60 %) and they were highly educated. A recently conducted survey study with a response of 207 personal trainers in the Netherlands (Middelkamp, Wolfhagen and Wouters, 2017) demonstrated that most trainers are ''young in their profession'' and are active for less than three years. Two major factors might influence this age distribution. On the one hand, personal training itself is a rather "young" offering that is still developing and, therefore, not so many "older" people are engaged in this profession. On the other hand, personal training is mostly related to doing sports and being active within the role of a trainer. Therefore, it tends to be practiced rather by younger professionals than in other jobs. However, considering older client groups and understanding the PT role more as a life coach than fitness instructor, personal training could develop more into a profession that is also attractive for older age groups in future years.

An important aspect in the fitness industry is to understand why someone has chosen to work as a PT. A wide range of motivation from extrinsic factors like earning money to intrinsic parameters such as helping people or turn hobby into career provides potential reasons to start this specific profession. Insights in what motivates the employees are critical (Middelkamp and Rutgers, 2018). The most important motivation is the general interest in sports and fitness (76.3%), followed by helping people (61.9%), and turning hobby into career (61.1%). Only one quarter of the participants mentioned making money as their key motivation (Gronau and Titze, 2018). This leads to the overall observation that people in the fitness and active leisure sector are intrinsically motivated, focused on helping their clients, and aim to learn and development themselves.

It is important to understand that PTs in Europe are employed by different types of contracts. Both a fitness club and a PT should think about how they would like to offer personal training. This choice is largely

determined by a commercial perspective, but personal or organisational elements also play a role. Roughly three business models exist, and a few sub-forms can be distinguished (Tab. 3). Each model has its own characteristics (Middelkamp and Willemsen, 2010).

Table 3.

Overview of Personal Training Business Models (Middelkamp & Willemsen,2010)

Model	**Characteristics**
Employee	Personal Trainer on club's payroll Turnover goes to club Personal trainer often receives a commission per session
Licence	Personal trainer is an independent entrepreneur Turnover goes to personal trainer Club supports personal trainer with a multitude of facilities Club receives licence fee (part rent and part payment for licence facilities)
Rent	Personal trainer is independent Turnover goes to personal trainer Personal trainers pay rent and define their own way of working Personal trainers take care of everything themselves (including their own personal training materials)

Almost three-quarters of the PTs (73.1%) are self – employed and the difference between women and men is not as significant; 7% indicate working in both categories. The employment status differs strongly between the individual countries. More than 92.5% of the trainers in Belgium are working as self-employed, comparing with 36.9% in Norway. In the three Scandinavian countries the portion of self-employed PTs is higher than in other countries.

The PTs from Horn (2011) study showed that 55% of trainers worked full-time and only 34% part-time. It is interesting to note that work engagement differs significantly on a national level. While in the UK almost 60% of PTs work fulltime, the portion is only 27.6% in Sweden. On average, PTs have a maximum availability of 21.4h for personal training session per week (Gronau and Titze, 2018).

Based on the market situations, obviously different levels of revenue are realized by PTs in the individual countries. The by far highest net revenues are realized in Switzerland with 3866 EUR per month, followed by Germany and Norway with 2698 EUR per month. The lowest average revenue is achieved in Portugal, Austria, and Finland. In all countries, the average income of men was higher than that of women. While male PTs achieve an average of 2.152EUR per month in Europe, the average of female PTs is only 1.371EUR or 781 less. Revenue size was associated with working experience: the income of more experienced personal trainers was higher. Age up to 30 years was also significantly related to lower income (Gronau

and Titze, 2018). Based on this research, the average price for a 1-on-1 session is 53EUR. Interestingly, although the monthly income of female PTs is lower, women charge a higher average price than men for their personal training, respectively 60EUR and 50EUR. It is known that training rates differ significantly between countries. The lowest average price (35EUR) is seen in the three South - European countries (Italy, Spain, and Portugal) together with Ireland. Higher rates are supported by the Scandinavian group (69 – 77EUR). By far the highest average price for 1-on-1 session is realised in Switzerland with 119EUR. Also, the experience as well as the size of the city a PT is working in has an impact on the price of personal training session (Gronau and Titze, 2018).

Beyond the description of the actual prices of personal training, the relation of the prices to specific parameters is worth examining. A very important and potential influencing factor might be the individual highest level of education achieved by a trainer. PTs with a basic fitness – related vocational qualification achieves an average of 1130EUR per month. In comparison, PTs with a fitness – related bachelor's or even master's degree earn an average of 2069 EUR and 2100EUR respectively. PTs with a fitness – related doctorate programme achieves even higher income (2923EUR per month), however, the number of such trainers even at the European level is very small (Gronau and Titze, 2018).

It is generally accepted that good education is an essential prerequisite for a successful PT. Although the official educational requirements differ strongly from country to country, it becomes evident that comprehensive fitness-related vocational programmes are the most commonly provided educational level in most of the countries. Their share ranges from 26.2% in Norway to 54.1% in Ireland; only in Portugal the proportion is significantly lower, with 13.6%. In Portugal, the highest share of PTs (48.4%) has fitness-related graduate programmes with master's degree, however, this is probably due to the national regulations under which only the bachelor's degree holder may work as a personal trainer.

Given the importance of qualification, it is interesting how much time and money PTs actually invest in their profession. More than half of the participating PTs state to invest between 26 and 100 hours per year into on-going education. With respect to the money invested in education the amounts vary significantly between the individual countries. While PTs in Norway and Switzerland spend an average 2400EUR per year, those in Spain, Portugal, Finland only invest about 1200EUR (Gronau and Titze, 2018).

Among the most important skills for PTs, there are personality skills, communication (85.7%) followed by willingness to learn (79.5%), and

customer service skills (72.6%). Specific skills (most of which seem to be the most important) are ranked only sixth. Information technology (IT) or digital skills are rated the least important. That is an interesting outcome because the majority of PTs and employers see that the increasing use and importance of technology in the field of fitness as well as wearable technology are on top in "Worldwide Survey of Fitness Trends for 2019" published by American College of Sports Medicine (Thompson, 2018). The development and growing importance of technology is a key driver in many industries. With respect to the measurement and tracking of their clients' development, most PTs take digital notes (59.3%); also, digital notes are often used to provide training plans to their clients (64.1%). Wearables are used only by 16.2% of the participating trainers in their personal training work, but with regard to their expectations for the future importance of technology in their field, the vast majority of PTs see the necessity to use it (Gronau and Titze, 2018).

One of the obviously most interesting aspects in the field of personal training is the clients, but little is known from research about clients or potential clients of PTs. Kronsteiner (2010) conducted a study that provides some information. The average age of the client sample is 43 years old, 51% have a university education, compared to 43% of the non-personal training clients in the same club; 42% of the clientele are self-employed, many are managers. A striking third group are pensioners (11%). The average consumer may struggle to understand what personal training is.

Based on Gronau and Titze (2018) study, the majority of clients (64.7%) are women, and more than half (55.4%) of the clients are in the group of the 30- to 49-year-olds. By far the most important goal in personal training is weight loss. Two-thirds (67.2%) of the trainers see losing weight as the most important aim of their clients. It is followed by get fit (46.4%), get toned / build muscle (41.7%) and be healthy (40%). Thereby, the most frequent reason to choose a PT is a lack of knowledge about correct exercising (63.1%). The inability to commit to a plan or missing self – discipline (both very important for motivation) also s clients to PTs.

Another area of interest is the actual offering of PTs. European survey on fitness professionals' study, conducted by Middelkamp, Wolfhagen and Steenbergen (2015) was found that PTs sometimes obtain multiple categories: 45% had qualification as group fitness instructors (EQF – level 3), 12% as exercise for health specialists (EQF – level 5). The largest group of PTs (75 %) charge money for 1-on-1 session of 60 minutes, followed by small group training (41.7%) and group fitness classes (38.3%). The most popular services are muscle development training (89.1%), functional training (84%) and cardio training (78.7%), which obviously are the core services of a PT. A second group of services offered by two-thirds to half of

the PTs are training plan development (65.9%), nutrition advisory (64.6%) as well as lifestyle or mental coaching (50.3%). Services like wellness treatments, yoga or Pilates, circle concepts and electro stimulation training play a rather subordinate role in the offering of PTs (Gronau & Titze, 2018). However, fitness professionals now find themselves working with clients with a wide variety of problems, including irregular heart rhythms and medications, diabetes, Parkinson's disease, degenerative nerve conditions, pregnancy, injury, and other health-related issues (Hutson, 2013; Lloyd, & Payne, 2013). With respect to health-behaviours (including physical activity, exercise, healthy eating, relaxation, limited sitting, non-smoking, sleeping) Middelkamp et al. (2015) in their study revealed that majority of fitness professionals address different health behaviour determinants in their programmes. The most frequently used decisional balance strategy to increase behavioural change of potential clients (clients in the pre-contemplation, contemplation, or preparation stage) focussed on the ''useful benefits for the client'', with 91.7% of the fitness professionals using this strategy.

Based on the survey, three different types of locations where the trainer offers his/her services are obviously the most commonly used. For the employed trainers, the employers' fitness club is the location used the most, while 52.6% of self-employed trainers use the club infrastructure as well. Own facilities are used by 49% of the PTs. Almost a quarter (24.3%) of the personal training sessions are realised outdoors, 22.1% of the sessions take place at the client's home (Gronau & Titze, 2018).

Although the European H&F market is growing, it is understandable that the competitiveness of services also increases. The more competitive the market, the more important the marketing activities are. In all 15 countries, at least 71% of trainers expect an increase in competition. Second and third rank changes in taxation and online fitness offering. Boutique clubs as well as physiotherapists are seen as the weakest threats in comparison to others. At the same time, PTs rate the relevance of various opportunities significantly higher: elder people, lifestyle programs, and preventative healthcare are seen as the top opportunities for the personal training market in future. It is a pity that the Baltic States and other countries of the former Soviet bloc did not participate in this study, and lag slightly behind in ensuring the comprehensive and necessary competences of fitness professionals and the recognition of European standards. This study only provides an initial idea of the market for fitness professionals in different countries. In the future, consistent and reliable research is needed in each country, assessing the specific conditions for working as a fitness instructor, personal trainer, or exercise for health specialist.

Discussion

As the H&F sector expands very fast, exercise professionals should play a proactive role model for thousands of clients. The education and professional development of exercise professionals miss solid training in basic research and evaluation skills (from critical analysis to data collection, pre- and post- intervention assessments, data analysis and reporting) (Jimenez & Pajaujiene, 2017). Personal training is undoubtedly one of the most important occupations in the European fitness industry. The highest fitness – related qualifications achieved by a PT have a positive impact on the price to be charged by PTs. These new skills integrated in the formal training and practice of exercise professionals will allow the whole physical activity sector, and especially the H&F industry, to develop new knowledge, transform current professional practice, inform public policy, and expand the innovation capacity of our field.

Unfortunately, there are no European standards applied in the fitness sector in Lithuania (and other Baltic countries), only a small number of trainers are in the EREPS register, and there are also a number of "illegal" trainers who do not have any formal qualifications but work successfully. This requires clarity, formal recognition, and a register to make it easier for clients to recognize real professionals. Since the beginning of independence, people with a higher education in sport and graduates of non-formal adequate education received in higher education institutions or other schools have been able to work in the H&F field. The biggest evil is that there is still no control over the quality of teaching in different schools. At the same time, it should be acknowledged that the formal education lacks the development of skills at the professional level, which is possible through the development of a system of cooperation between universities, accredited schools, and wellness clubs.

It is important for all exercise professionals to understand their professional qualifications and boundaries, and to always refer to clients who require services outside their scope of practice to the appropriate qualified healthcare professionals. Doing so ensures that clients are provided with appropriate care from qualified providers and prevents healthcare professionals from offering services that they do not have the education, training, credentials, and/or legal right to offer (Bryant, Merrill, & Green, 2014). Therefore, given exercise professional's role in advising the general public, their accessibility, and the emerging evidence-based guidelines on the best practices related to the use of exercise and nutrition interventions, further research is needed to ensure that exercise professionals, working with the public, integrate new research knowledge into their fitness assessment and exercise guidance (Stacey et al., 2010).

It is our firm belief that 'fitness professionals' have the potential to play a key role in improving the lives of those millions of people who engage with their services. For this potential to be realised, however, changes across the sector are required. Issues to be addressed include: participant dropout and poor membership retention (Middelkamp & Steenbergen, 2012), a lack of 'effectiveness' for interventions targeting specific population groups (Pavey et al., 2011), a paucity of research grounded in the everyday contexts/situations that fitness professionals encounter and, more generally, persistent gaps between the higher education and fitness sectors (Anderson, 2012), minimal training and education for fitness practitioners (Lloyd & Payne, 2013), and the perpetual sense of dissatisfaction for many gym users (Frew & McGillivray, 2005).

Public health commissioners should not only pursue the evidence-based practice, but also insist that ongoing data capture is a feature of all commissioned interventions. Accordingly, fitness "players" (practitioners, operators and training providers) must become adept at embedding data capture and analysis into all relevant activity. Representative bodies must lobby government, health agencies and research councils to provide greater funding for effectiveness research (Beedie et al., 2016).

The value of research and evaluation for the H&F industry will be immense in delivering solutions and innovative ways of tackling inactivity at the population level, and its broad implementation will become a long-lasting legacy for a different, positive and more active future. One critical element in this regard is the fact that the H&F industry is not investing resources to provide solid evidence supporting its capacity to deliver meaningful and sustainable public health outcomes (Jimenez & Pajaujiene, 2017).

Conclusions

Educated, certified and experienced health and fitness trainers are a strongly established global trend largely influencing the future of sports and active leisure sector. However, it is a fairly young profession, more often represented by private business, and it still lacks uniform job standards and proper attitudes of the state and the public. There is no doubt that the role of the modern fitness professional and the expectations from this role are continually redefined.

It is obvious that the recognition of H&F sector activities requires a systematic, multi-level and intersectoral approach that promotes personal and organizational behavioural changes, develops a new perception of what it means to be "fit" and what to expect from the trainers and other professionals working in the sector, and encourages political, social and environmental changes.

This paper supports the growing realisation that it is necessary to have a better understanding of the burgeoning 'fitness industry', its workforce and the health-related expectations placed upon it. We hope that this study will initiate a broader discussion on the topic in other European countries and will assist national sport educators and politicians in further developments to align with the EQF and sport sectors' qualifications.

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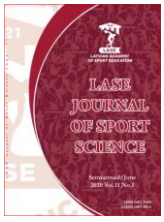

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SCHORT COMMUNICATION

NEW TRENDS IN THE SELECTION OF LITERATURE SOURCES FOR BACHELOR AND MASTER PAPERS IN SPORT SCIENCE (2006-2020)

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Abstract

In producing bachelor and master theses, sport science students can use various information sources: books, sport periodicals, online materials, archival documents, videos, interviews, etc. The research reveals what kind of literature sources – printed or electronic material – the sport science students of the Latvian Academy of Sport Education (LASE) have chosen when writing their Bachelor and Master theses during the last fourteen years. Using 80 randomly selected bachelor theses and 64 randomly selected master theses, this study determined the proportion of electronic sources in bachelor and master theses in sport science and the proportional representation of different languages (Latvian, English, Russian and German) in the lists of literature sources in the period from 2006 to 2020. It was found that the use of electronic sources has increased significantly over the recent years in both bachelor and master theses in sport science, as did the preference for sources in English, possibly because sources in English are widely available in virtual format, and also because the sport science students' reading competence in English has improved.

Keywords: *literature sources in sport science, printed sources, electronic sources, contemporary sort students, reading competence, foreign languages sources; Bachelor thesis in sport science, Master thesis in sport science*

Introduction

As modern communication technologies continuously develop, so does the process of reading. We spend increasingly less time reading books

and more times reading texts from computer. However, the greatest changes took place recently, since 2020, with the beginning of Covid-19 pandemic, when the study process in sport science – just as in other disciplines – was transferred to the virtual environment and libraries were no longer available for attendance. In writing reports, term papers, bachelor and master theses as well as other works in sport science, sport science students have been actively using the Internet which enabled them to find new information sources, which was not possible a decade or two ago, including sport science databases, journals in sport science, the materials of sport science conferences and even YouTube videos relevant to their chosen areas in sport, as well as minutes of sport contests, regulations, calendars, homepages of various sport organisations, etc., from their computer. This enabled all educators and scholars working in sport science to continue their work in education and research, and helped sport students produce bachelor and master theses of good quality.

When we started our study of literature sources used by sport science students in writing bachelor and master theses in sport science fifteen years ago, we wanted to emphasize the fact that authors must know how to work correctly with hypertexts. Today's students have learned to use electronic sources comparatively well, as these are part of our daily life, especially for younger students, aged under 26, who are described as Generation Z or "digital natives" and are reputed to have a high level of competence in using digital sources of information for their studies (Kravalis et al., 2021). They no longer face difficulty in choosing the right reading strategy: to read an entire text, to go to a different link, to exercise critical thinking in using information they read, all of which are indicators of reading competence as defined by Baumert and Geske (Baumert et al., 2001; Geske et al., 2015). Therefore it was interesting to trace the development of the selection of literature sources by students in writing bachelor and master theses in sport science, especially over the last few years, because these research works present the results of the entire process of studies and best reflect the priorities and options available to sport science students in choosing their sources.

Materials and Methods

The basis of the research is formed of studying and analysing the lists of literature used in bachelor and master theses in sport science. We have randomly selected 80 bachelor and 64 master theses presented at the Latvian Academy of Sport Education in 2006, 2010, 2016 and 2020 in sport science. For every year, 20 bachelor and 16 master theses were studied. In producing bachelor and master theses, sport science students can use various

information sources: books, sport periodicals, online materials, archival documents, videos, interviews, etc. Thus, after analysing each list of literature, we determine which sources were published in hard copy and which were available in electronic format and calculated their percentual ratio. The collected data were processed using Excel 2010 software.

Results

As we can see on Fig. 1, the situation with bachelor theses in sport science is as follows: the number of electronic sources is growing with every year, and, if only 6% of sources were electronic in 2006, there were 25% in 2010, 39% in 2016, and 53% in 2020, when the number of electronic sources exceeded the number of printed sources (47%) for the first time. This growth in the number of electronic sources used in writing bachelor theses in sport science can be explained both by rapid development in electronic communication strategies and by the fact that sport science students graduating in 2020 no longer had physical access to libraries since March 2020. In writing bachelor theses in sport science, students mostly used books over the previous fourteen years, but already in 2020 two bachelor theses had nearly 80% of electronic sources in their lists of literature. Still, other works had only 3-5 Internet sources. Thus, electronic sources were included in all lists of literature in theses in sport science written over the last years.

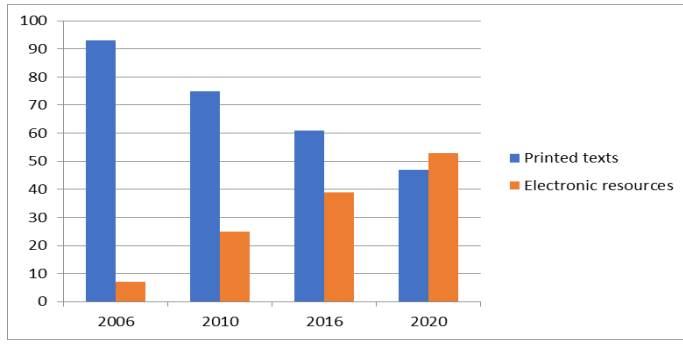

Figure. 1. The use of printed and electronic literature sources in bachelor theses in sport science (2006-2020)

Remarkably, the situation is different with master theses (see Fig. 2). It is noteworthy that, over fourteen years, the use of electronic sources increased from 4% in 2006 to 48% in 2020. Also the analysis of master theses in sport science produced in 2016 and 2020 shows that there was not a single list of literature that would not include at least some electronic sources, and certain works in sport science have 70 – 90% of electronic sources in the lists of literature. We can conclude from the above that sport

science students use an increasing number of electronic sources in developing master theses, a tendency which, compared to 2006 and 2020, increases. We expect that the overall use of electronic sources will augment, even though master students in sport science prioritize printed literature sources. As of now, we have not found a single master thesis in sport science presented at the Latvian Academy of Sport Education that would use only electronic sources.

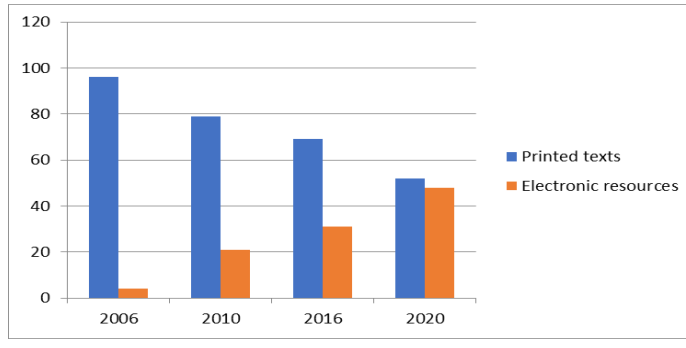

Figure. 2. The use of printed and electronic literature sources in master theses in sport science (2006-2020)

In comparing the above charts (Figs. 1 and 2), we conclude that in the last few years (2016 and 2020) electronic sources make up approximately 30% – 52% of all used literature sources in both bachelor and master theses in sport science. In bachelor theses in sport science, the number of electronic sources grows every year, and in 2020 it exceeded the number of printed sources, whereas the number of printed sources in sport science grows gradually, and almost equalled the number of printed sources in 2020. This new tendency to use an increasing number of electronic sources intensifies in both cases, which is only logical, because a growing number of sources in sport science is available in electronic format (for instance, contest minutes, regulations, homepages of sport organizations, etc.). Given the fact that over the last years there were periods when, due to Covid-19 pandemic, libraries were closed and not physically accessible, this tendency has intensified.

One of the aims of foreign language study courses provided by the Latvia Academy of Sport Education was to teach sport science students to work with special and scientific literature in a foreign language, in analysing the types of sources used in developing bachelor and master theses, we paid attention to the language of sources. The students' choice would indicate, among other things, how well they have mastered foreign languages. Previous studies indicate that, albeit sport science students have

characteristic mistakes in all the foreign languages they study at the Latvian Academy of Sport Education, that is, English, German and Russian (Malahova and Ropa, 2021), but this need not necessarily have an adverse effect on their reading competence in a foreign language.

The study shows that, in developing bachelor theses, sport science students in 2006-2010 mostly used sources in Latvian (58% – 60%), Russian (20% – 25%) and English (10% – 15%), and, lastly, in German (5% – 6%). Over the last years, the situation changed drastically: English took the second place (33% – 37%), which can be partially explained by the grown number of electronic sources, with scientific databases and e-books about sport being largely available in English only, but also by improved level of English competence. Sources in Russian are used with decreasing frequency (10% – 12%), and sources in German rarer still. In 2020, only 2 sources in German were used, which can be explained by the insignificant number of students in sport science who have learned German. The above demonstrates that, as we can see on Fig. 3, bachelor students in sport science mostly use literature sources in Latvian, literature in Russian is being used increasingly less, albeit certain theses use a considerable number of sources in Russian, which may be partially explained by the fact that this is the native language of some of the students, and partially by the specificity of their research theme. The ratio of sources in English is growing rapidly, which, we believe, is related to the fact that English is studied as the first foreign language at school and most students in sport science choose English during their undergraduate studies. The use of literature sources in German is relatively low, which can be explained by the insignificant number of students in sport science who have studied German.

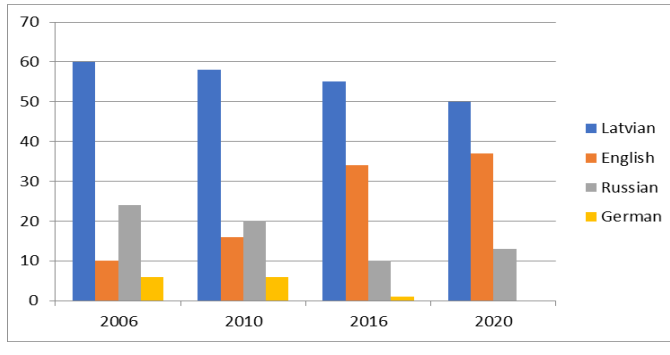

Figure. 3. The use of sources by language in writing bachelor theses in sport science (2006-2020)

An interesting comparison can be made with the use of sources in master theses in sport science (see Fig. 4). The situation is comparable to

that with bachelor theses in sport science: in the earlier years (2006 and 2010) the majority of sources was in Latvian (58% – 65%), and the second language in popularity was Russian (15% – 28%) followed by English (10% – 15%) and German (3% – 5%). In 2010, the number of sources in English already exceeded the number of sources in Russian, and in 2016 the number of English sources it significantly exceeds the number of sources in Latvian.

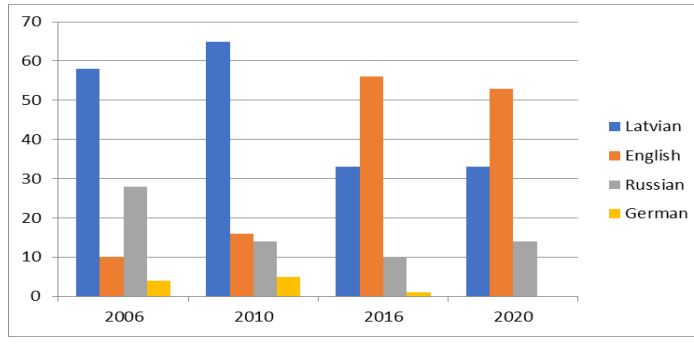

Figure 4. The use of sources by language in writing master theses in sport science (2006-2020)

As we see on the charts for 2016 and 2020, over 50% of all the sources used are in English, which can be explained also by the fact that sport students writing master theses in sport science use scientific databases and other literature in sport science in English. Also the scientific journal of the Latvian Academy of Sport Education the *LASE Journal of Sport Science* is published in English only. The use of sources in German makes up only 1% in 2016, and only three German sources were used in 2020; this number is no longer reflected in percentage and coincides with the number of students who know German. Apart from the above mentioned languages, master students in sport science also used literature in other languages. The study shows that, over 14 years, students included in their lists of used literature 3 sources in Swedish, 2 in Norwegian, and 1 source each in Lithuanian, Slovak, Danish, Polish, Ukrainian and Estonian languages. We think that these languages were learned at the secondary school or were the students' native languages, as is likely to be the case with the Lithuanian, Estonian and Ukrainian languages. Meanwhile, the use of other foreign languages stopped in the recent years, and in 2020 only sources in English, Latvian, Russian and German were included in the list of used literature.

Discussion

There are considerable differences between printed texts and electronic unreviewed sources from the web. As a result, students should have appropriate competences in order to work with digital sources and

electronic texts, which are not only growing in popularity but are often the only available sources. In working with electronic texts or hypertexts, the relations between the reader and the author change. The reader can become a co-author (Runkehl et al., 1998). In a hard copy, the text is printed: it is freely available, defined, constant and linear, but an electronic text, which A. Storrer terms "hypertext" is accessible only on the computer or another gadget, often includes multimedia elements and mostly is non-linear. This means that individual parts of a text have a high level of independence (such a hypertext offers various alternatives, and the reader can choose the most appropriate one for him/herself). Texts from the Internet can be blocked; alternatively, they can be linked to other texts all over the world – in different ways than that which intertextuality in printed texts implies, where reference is made to another printed text or cultural entity and can be spotted by a reader who shares the same cultural capital with the author (see the example in Ropa A. 2021). In this way, hypertexts are "more than just texts". Hypertexts can be edited at any moment with very limited technical means; they can be updated and changed, which is the reason why Storrer describes them as "not yet texts" or "texts in the making", which can offer both advantages and disadvantages (Storrer, 2000). In reading these hypertexts, the reader should decide on one of the two strategies, the first being the so-called "ignorant reading" *(ignorierende Lektüre* in German), when the reader reads the entire texts before deciding to which link to proceed to achieve the reading aim, and the second being when the reader does not read the entire text, but the reader jumps from one link to the other and has to decide instantly whether to continue reading the text or go to a different one (*zerfasernde Lektüre* in German) changing the goal of reading entirely (Steinig & Huneke, 2007).

Another problem is quality control. If a text is published in a book, i.e., it is published by a printer or a publishing house, it means that it is normally (though not always any longer) copy-edited and/or peer-reviewed. The same may be true of electronic sources, such as scientific databases and journals, where all texts are peer-reviewed, but students must be very careful with unreviewed texts published on the web (for instance, social media, personal websites). This means that requirements towards the text user change, and readers must exercise extra caution in working with such texts.

Critical attitude towards a text that is being read is only possible if the reader has developed reading competence; this means the reader should know how to see information in a text, how to interpret it, think it over and assess (Baumert et al., 2001). Baumert notes that reading competence is the ability to understand and use the written text to reach one's aims, further

developing one's knowledge and potential in order to participate in social life. Reading competence does not mean only understanding the superficial meaning of the text, but also the author's communicative aim and the author's ability to achieve it, as well as knowing how to argue one's opinion about the text. A reader should be able to not only determine the genre of the text, but also to single out its structure and be able to:

- to follow the author's argument,
- to compare and contrast information included in a text,
- to make one's own conclusions,
- to analyse the arguments used in a text and to compare them with one's own opinion,
- to pinpoint and understand metaphors, humour and irony,
- to recognise nuances in the use of language,
- to recognise structural units in a text and the tools used by the authors,
- to relate what they have read with their experience and knowledge (Geske et al., 2013).

Reading competence involves the reading of various texts and documents. In graduating from school, a pupil, in order to achieve the highest sixth level of reading competence must be able to make multiple comparisons, contrasts and conclusions, which are at once detailed and specific. A pupil must also demonstrate complete and detailed understanding of one or multiple texts, which may include integrated information from multiple texts. Further, a pupil should be able to operate with unfamiliar concepts in the presence of important competing information and to make general conclusions for interpretations. In performing tasks that require reflection and assessment, a pupil should be able to critically evaluate a text or make suppositions on a complicated and unfamiliar text using various criteria, employing one's own experience, conducting precise analysis and paying attention to inconspicuous details in the text (Geske et al., 2015). Having analysed the use of sources by the students of the Latvian Academy of Sport Education in writing bachelor and master theses in sport science, it can be concluded that most of them have well-developed reading competence.

The language in which a text is written also has an influence on the reading competence. A reader may have good competence in his/her native language, and a lower competence in a different language. The choice of language for literature sources may be pragmatic, reflecting the availability of sources (including electronic sources), but it can also reflect reading competences and cultural values, especially in choosing texts in languages other than English. While English is the most common and powerful

language in the global world, other national languages can be chosen as sources because of their cultural value (Druviete, 2021). The choice of sport science students today to use sources in Latvian, Russian or German may reflect both their reading competence and their cultural choice.

Conclusions

In writing bachelor and master theses in sport science in the period between 2006 and 2020, sport science students are using an increasing number of electronic sources, with the use of digitally available sources exceeding the number of printed sources in bachelor theses in 2020.

There is approximately the same percentage of printed and electronic sources used in 2020 in bachelor and master theses, which can possibly be explained by the fact that libraries were not accessible in person starting from March 2020.

Electronic sources require special competences to work with correctly, because, unlike printed texts, electronic texts are not always edited and peer reviewed, which is why students should have well developed reading competence to enable them to process electronic sources correctly.

In writing bachelor and master theses, students previously preferred literature sources in Latvian, Russian, English and German. However, in the recent years, the number of sources in English has grown rapidly, and the use of sources in Russian and German has decreased.

The growth in the number of English sources can be explained by the accessibility of scientific databases and other electronic sources in sport science, improvement in the level of English competence, the latter being necessary in order to use English sources in writing bachelor and master theses.

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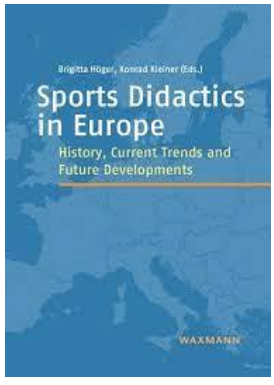
SCHORT COMMUNICATION

SPORTS DIDACTICS IN EUROPE

HISTORY, Current Trends and future Devepopments

(eds. Waxmann Verlag GmbH, June 2022)



During the past decades, the scientific discipline of Sports Didactics has developed in a heterogenous manner across national borders and individual university locations in Europe. Its position and situatedness has been characterised by its relation to and differentiation from Sports Pedagogy and other sub-disciplines within sports and educational sciences. The significance of Sports Didactics remains closely connected to the role of the school Subject Physical Education as well as Physical Education Teacher Education at universities and colleges. This collected volume provides an overview of the Subject understandings, theory landscapes, research contexts and practice models across 24 European countries along five lines of investigation: national historical developments of Sports Didactics, main trends and tendencies of theoretical differentiation, application fields of research and theory formation, recent research perspectives and possible future developments.

Sports Didactics in Latvia

Juris Grants, Inta Bula-Biteniece, Ieva Rudzinska
Latvian Academy of Sport Education

The teacher's work in the 21st century does not mean knowing everything and delivering this knowledge to students. We must move from knowledge delivering to the mode in which students develop the skills with which they are able to analyse a large amount of information and personalize education. We need a teacher who is able to change continuously. Every citizen of every state has the right to a quality education. Providing quality education that caters to students' aptitudes and needs will be a primary challenge for lifelong learning, from early childhood education through to further and higher education. Quality is neither one-dimensional nor straightforward. Quality education is defined by its inputs (including students' background, teachers' qualifications, working conditions, class-size and investment in education), by the education process and by projected outcomes. A contextual approach to quality is never deterministic, as it depends on creativity and constant development. Quality education must be underpinned by credible educational research. The findings of such research should inform the theories and practice of teaching. Research should also draw on the actual professional experience of teachers. This should culminate in an inseparable link between education and research which would help to generate new understandings and knowledge and improve pedagogical skills.

SCHORT COMMUNICATION

REGARDING THE METHODOLOGICAL MATERIAL METHODOLOGICAL RECOMMENDATION FOR THE WORK OF A SPORT PSYCHOLOGIST

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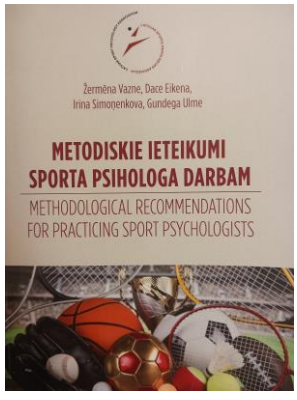

Latvia is a land of sport, the representatives of this country not only successfully take part in prestigious competitions and championships, but also a great part of our society is involved in sport actìvÌties every day. This means that professional athletes and coaches, as well as other people involved in sports, as well as anyone who is involved in recreational sport, can benefit from the professional support of a psychologist.

As it is known, sport can be lìnked with the work of several areas of a psychologist's professional activity – educational and school psychologists, counseling psychologists, workplace and organizational psychologists. That is the reason why the developed methodological material should be supported, it gives a good insight into the content and organization of the work of a sport psychologist, emphasizing legal and ethical aspects, analyzing specific examples of practice, pointing out the specifics of a psychologist's professional cooperation with athletes, teams and other sport-related professìonals. It is also useful for parents of athletes. Also, these recommendations allow the athletes themselves, sport managers, and other professionals who work with athletes to understand the limits of the professional activity of a sport psychologist. The material also can be used in the educational process of psychologists and other sport professionals, sport teachers, as well as in the process of psychological training for coaches. It is safe to assume that these recommendations are about to play an important role not only in improving the understanding of psychologists`work in the professional environment regarding the professional activities of psychologists in the field of sport, but also in developing best professional pactices in this field.

Dr.iur., Mg.art., Ivans Jānis Mihailovs
Vice-chair of the Psychology Certification Commission
Deputy director of State Education Quality Service Licensing and Register Department

CONGRATULATION

We congratulate Katrīna Volgemute, PhD student at the Latvian Academy of Sport Education, who has defended his thesis "IMAGERY ABILITY AND PHYSICAL SELF-EFFICIENCY IMPROVEMENT OF ALPINE SKIERS" for obtaining the Doctoral (Ph.D.) Degree in the field of Health and Sports Science in the Sub-branch of Sport pedagogy at the Latvian Academy of Sport Education on 14th of April, 2022.

Scientific Novelty of the Research: adapted internationally widely used imagery ability questionnaire – "Sport Imagery Ability Questionnaire" in Latvian, which can be used in Latvia in further research. The adapted Latvian version of the Sport Imagery Ability Questionnaire allows this questionnaire to be used as a measurement tool in intercultural research, where the data obtained can be objectively compared with data obtained in other countries. The Improvement of Athletes' Imagery Ability and Physical Self-Efficacy for the Growth of Athletic Achievements in Sport Model and its content for the promotion of athletic success has been developed and tested. The application of the content of the Improvement of Athletes' Imagery Ability and Physical SelfEfficacy for the Growth of Athletic Achievements in Sport Model in alpine skiing, which ensures the increase in the growth of achievements, has been evaluated. The application of the content of the developed model increases the growth of the athletic achievements of alpine skiers.

Practical Relevance of the Research: the adapted Sport Imagery Ability Questionnaire has practical application for coaches in work with athletes and it can be used by sports scientists in intercultural research in sports science. The developed and scientifically argued the Improvement of Athletes' Imagery Ability and Physical Self-Efficacy for the Growth of Athletic Achievements in Sport Model has been practically approbated. The content of the developed model can be used by coaches in work with athletes to promote athletes' imagery ability, physical self-efficacy, as well as athletic achievement. The content of the Improvement of Athletes' Imagery Ability and Physical Self-Efficacy for the Growth of Athletic Achievements in Sport Model has been developed: "Imagery for Maximum Performance" is a factor that promotes the imagery ability of athletes, which are closely linked to the performance of the competition and helps to prepare and adapt to the competition as optimally as possible. "Imagery for the Optimization of Skills and Abilities" is a factor that promotes the

imagery ability of athletes, which are closely related to the activities of training and helps to adjust to the activities to be performed in the training process. “Physical Self-Efficacy” is a factor that promotes the physical self-efficacy of athletes. Recommendations for coaches to promote athletes’ imagery ability and physical self-efficacy in sports have been developed.

Supervisors: Prof. Dr.paed. Daina KRAUKSTA (LASE)
Prof. Dr.paed. Žermēna VAZNE (LASE)

has been developed by ESF support withim the project “Strengthening of the Academic Staff of the Latvian Academy of Sport Education in the Field of “Health Care”

LSPA LATVIJAS SPORTA PEDAGOĢIJAS AKADĒMIJA
NACIONĀLAIS ATTĪSTĪBAS PLĀNS 2020
EIROPAS SAVIENĪBA Eiropas Sociālais fonds
IEGULDĪJUMS TAVĀ NĀKOTNĒ

CONGRATULATION

We congratulate Agris Liepa, PhD student at the Latvian Academy of Sport Education, who has defended his thesis "THE IMPACT OF THE USE OF VIRTUAL REALITY (WITH 3D HEADSET) GAME CONTENT ON THE DEVELOPMENT OF SENIOR COGNITIVE AND SENSORIMOTOR SYSTEM FUNCTIONS" for obtaining the Doctoral Degree (Ph.D.) in the field of Health and Sports science in the Sub-branch of Sport pedagogy at the Latvian Academy of Sport Education on 21st of April, 2022.

Scientific novelty of the research: the dissertation expands the understanding of the concept of virtual reality in 3D environment in sports science. The content of the virtual reality (with 3D headset) game has been developed, which is based on task-oriented and motor control theory, as well as ecological theory and philosophical understanding of the holographic universe as the unity of mind and body. By activating the level of the cognitive and sensorimotor system, based on task-oriented and motor control theory, as well as the theory of ecology, the influence of virtual reality (with 3D headset) game content on seniors is scientifically established, and it improves their cognitive and sensorimotor functions. 40 The results of the study reveal new knowledge about the interrelationships of cognitive and sensorimotor system functions in seniors in sports science, using immersive virtual reality (with 3D headset) technologies.

Practical significance of the research – The content of the virtual reality game (with 3D headset) under the guidance of a physiotherapist is usable and can be used in practical sessions with seniors, for whom the sum of the results of functional performance tests battery is ≥ 6. – The use of virtual reality (with 3D headset) game content improves the cognitive function, core muscles of the trunk and functional performance of seniors associated with the risk of falling. – The use of virtual reality (with 3D headset) game content can be more effective in improving the cognitive function in seniors than other activities that promote physical and cognitive activity.

Supervisor: Prof. Dr.med. Viesturs LĀRIŅŠ (LASE)

CONGRATULATION

We congratulate Normunds Vārpa, PhD student at the Latvian Academy of Sport Education, who has defended his thesis "CHANGES IN MUSCULOSKELETAL FUNCTION ON LOWER LIMB BY ALTERED CENTRAL NEURAL REGULATION" for obtaining a Doctoral degree (PhD) in Health and Sport Science, sub-field of Sports Theory and History at the Latvian Academy of Sport Education on 19th of May, 2022.

Scientific novelty of the research: The analysis is conducted on how qualitative functional disorders of central neural regulation affect the quantitative parameters of local blood flow in the lower leg flexor muscles. It is studied how the qualitative functional disorders of central neural regulation affect the electrical activity of the lower limb flexors and quantitative indicators of H-reflex. It is determined how the qualitative functional disorders of central neural regulation affect the changes in muscle tone of knee flexors. It is assessed how the qualitative functional disorders of central neural regulation affect the isometric endurance of the lower limb muscles.

Practical application of the research: Verification of the qualitative results obtained by applied kinesiology diagnostic method with quantifiable values. A theoretical explanation is provided on the effects of central neural regulation functional disorders on the changes of quantitative results of lower limb local blood flow, electrical activity, H-reflex, muscle tone and endurance of the lower leg flexor 51 muscles, which should be included in the content of specialized study courses for sports coaches, sports doctors, and physiotherapists. The evidence is provided for coaches and other sports professionals, proving that the altered movement stereotype can affect muscles endurance; and it is recommended to pay deeper attention to a muscle with neural regulation functional disorders and to use the AK testing method for efficient identification of them.

Supervisors: Dr. biol., prof. Alvis PAEGLĪTIS (LASE) Dr. paed., prof. Mati PÄÄSUKE (Tartu University).

CURRENT NEWS

Latvian Academy of Sport Education

European Researchers' Night 2022 Sport Science
Latvian Academy of Sport Education, Brivibas gatve 333

September 30, 2022, Riga, Latvia

OSRESS

Outdoor Sports and Recreation Education Summer School 2022

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Department of Neuroscience, Biomedicine and Movement
University of Verona, Italy

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http://osress.weebly.com/

GUIDELINES FOR CONTRIBUTORS

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- ✓ *short communications* (maximum 3 standard pages of typescript plus two table or figure and up to 5 references),
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Papers must be accompanied by the following submission letter (form available at journal's website), signed by all Authors: "The undersigned Authors transfer the ownership of copyright to the **LASE Journal of Sport Science** should their work be published in this journal. Authors state that the article is original, has not been submitted for publication in other journals and has not already been published except in abstract form, preliminary report or thesis. Authors state that they are responsible for the research that they have carried out and designed; that they have participated in drafting and revising the manuscript submitted, which they approve in its contents. Authors also state that the reported article (if it involves human experiments) has been approved by the appropriate ethical committee and undertaken in compliance with The Helsinki Declaration."

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Format

Document format – Microsoft Word 97-2003 or 2007.

Page format – 334x237mm (book fold). Text – single column (font Times New Roman, letter size 12 pt), line spacing – Single, paragraph alignment – Justified, Inside margine – 220mm, Qutside margin 150mm, bottom margin – 190mm, top margin – 144mm.

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Papers must be written in a clear, concise style appropriate to an international readership. Familiar technical terms may be used without explanation. Acronyms and abbreviations are likely to need full presentation at least once.

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Research or project reports, case studies of practice, action research reports, and reports on teaching practice or techniques will be accepted.

Research reports should include a description of the practical application(s) of the ideas tested, while reports of teaching practice or techniques should contain an explanation of the theoretical foundation underlying the practice or technique in question.

Material in the form of illustrations or photos is welcomed. This material should be accompanied by text clearly setting out its philosophical or practical origins or implications. All material should be clearly referenced to its sources.

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The manuscripts should be arranged as follows: title page, abstract and body text.

Title page should contain title of the paper, first and last names of authors with affiliation, first and last name of corresponding authors with postal address, telephone, fax and e-mail.

Abstract (up to 250 words) consisting of the following sections: justification and aim of the study, material and methods, results, conclusions, as well as 3 – 6 key words, should be provided before the body text.

Body text should be sectioned into: Introduction, Material and Methods, Results, Discussion, Conclusions, Acknowledgements (if necessary) and References. In articles of other types, the text should follow in a logical sequence and headings of its sections should reflect issues discussed therein.

Introduction – should be short and concise; it should introduce readers into research problems addressed in the study as well justify undertaking the research and specify its aim.

Material and methods – should describe the subject of the study (in the case of human subjects' data should include their number, age, sex and any other typical characteristics) and methods applied in a sufficiently exhaustive way to enable readers to repeat the experiments or observations. For generally known methods only references should be given, whereas detailed descriptions are to be provided for new or substantially modified methods.

Results – should be presented in a logical sequence in the text, tables, and figures. Data collated in table and figures should not be repeated in the text which should summarize the most important observations.

Discussion – should emphasize new or important aspects of experimental results and discuss their implications. Results of own studies are to be compared with findings described in the respective domestic and international references used by the Authors.

Conclusions – should be started in points or descriptively and should be logically connected with objectives stated in the *Introduction*. Statements and conclusions not derived from own observations should be avoided.

Author's declaration on the sources of funding of research presented in the scientific article or of the preparation of the scientific article.

References

References should follow the instructions for Authors on References (APA style).

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Claessens (2010) found 6 evidence that attention will be given to multi-compartment models, such as the 3-water, 3-mineral and 4-compartment models, to assess percentage of body fat.

However, Raslanas, Petkus and Griškonis (2010) noted that Aerobic physical load of low intensity got 35.1% of total trainings time. Research on physical loading also focused on identifying the basis of much years' research of physical activity (Bytniewski et al., 2010). According to Ezerskis (2010), "… heavy physical loads had the undulating character depending on the dynamics of workloads…" (p. 71) yet girls are more ascertained that the Track & Field training helps to develop courage.

Instructions for Authors on References (APA style)

Please provide all the required elements in the references to your paper. Please pay particular attention to spelling, capitalization, and punctuation. Accuracy and completeness of references are the responsibilities of the author. Before submitting your article, please ensure you have checked your paper for any relevant references you may have missed.

A complete reference should give the reader enough information to find the relevant article. If the article/book has DOI number, the author should include it in the references. And most importantly, complete, and correct references may allow automatic creation of active links by the MetaPress technology that we use for making the electronic version of our journal. Active reference linking is regarded as the greatest benefit of electronic publishing, and it adds a lot of value to your publication.

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Tables – should be prepared on separate pages (saved in separate files) and numbered using subsequent Arabic letters. They should be provided with titles (above). Every column in a table should have a brief heading and more extensive explanation should be given under the table, e.g., statistical measures of variability.

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