ISSN 2664-9837

PEDAGOGY of Physical Culture and Sports

№03/2020

2664983720201 03

Pedagogy of physical culture and sports
(Pedagogics, psychology, medical-biological problems of physical training and sports)

2020
03

Key title: Pedagogy of Physical Culture and Sports (Abbreviated key-title: Pedagogy phys. cult. sports; ISSN 2664-9837).
Previous title «Pedagogics, psychology, medical-biological problems of physical training and sports» (e-ISSN 2308-7269; p-ISSN 1818-9172; ISSN-L 2308-7269).

Founders: Iermakov Sergii Sidorovich (Ukraine); (doctor of pedagogical sciences, professor, Department of Physical Education, Kharkov National Pedagogical University).

Certificate to registration: KB 22063-11963P 16.05.2016.

Frequency – 6 numbers in a year.

Journal is ratified Ministry of Education and Science of Ukraine:
physical education and sport: (11.07.2019, № 975, "A" - 24.00.01, 24.00.02, 24.00.03; 017); (13.03.2017, № 374).
pedagogical sciences: (07.05.2019, № 612, "A" - 13.00.02; 011, 014); (07.10.2016 №1222).

Address of editorial office:
Box 11135, Kharkov-68, 61068, Ukraine,
Tel. 38 099 430 69 22
e-mail: sportart@gmail.com
https://www.sportpedagogy.org.ua

Journal is reflected in databases:

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[Emerging Sources Citation Index (ESCI)]
http://ip-science.thomsonreuters.com/mjl

DOAJ (Directory of Open Access Journals)
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PEDAGOGY of Physical Culture and Sports (Pedagogics, psychology, medical-biological problems of physical training and sports)

Investigating the effects of wrestling gear in flatfoot deformity of wrestlers

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Authors' contributions: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection.

Abstract

Purpose: In this study, our aim was to determine the effects of wrestling shoes, wrestling mats and wrestling styles on postural deformation of the foot and to elaborate its possible causes.

Material: Study group comprised of 158 athletes (109 males, 59 females) from 26 different countries who participated in the 12th World University Wrestling Championship. Of the athletes, 102 (59 females, 43 males) performed in freestyle and 56 performed in Greco-Roman style. The age range of the athletes was 19 to 31 years and they have done wrestling for 3 to 18 years. Were evaluated to determine the relationship between flatfoot deformity and gender, age, wrestling style and years in the sport. Footprint parameters were used to determine and evaluate the overall structure of the foot. The Staheli and the Chippaux-Smirak indexes were used in the study. Statistical analyses were performed using the SPSS v.21.0 software, with the significance level set at α=0.05.

Results: No significant relationship was found either between the gender of the wrestlers or their age and their pes planus state. A significant relationship was detected between the wrestling style performed and the wrestlers' pes planus state, and between the years in the sport and their pes planus state.

Conclusions: The fact that wrestlers wear the wrestling shoes for a long time can be a cause of pes planus. The center of mass of freestyle wrestlers shifts during continuous feet movement, and the surface of their soles extends the contact surface on the mat to maintain balance. This situation can also lead to a higher prevalence of pes planus in wrestlers. In addition, the wrestling shoes wrap around the Achilles tendon and thus the stretching of this tendon is restricted. Such restriction strengthens the opinion that freestyle wrestlers experience pes planus more.

Keywords: flatfoot; pes planus; postural distortion; wrestling.

Introduction

Physical structures formed due to the movements in different sport subdivisions differ from each other in terms of both posture features and anthropometric features [1]. Studies report that sport subdivisions demonstrate differences in postural forms [2]. Wrestling is a performance sport and it requires one to be physically healthy and balanced in addition to features such as physiological, psychological, technical, tactical, strength, and agility. Among these features, balance has a different aspect in wrestling. Foot posture plays an important role in maintaining balance. Pes planus, which distorts foot posture, is a foot deformation that is characterized by the inner longitudinal arch's disappearance and the heel's outer movement. Medically, pes planus, expressed as flat feet, is the flattening or disappearance of one of the longitudinal or transverse arches. This condition rules out the springiness of the foot and obstructs normal movements during walking or running. In another expression, pes planus is defined as when the "foot's medial longitudinal arch's heights decrease or the deformation caused by its total collapse" [3]. Pes planus disorder is characterized by the foot arch's flatness in the medial part and the contact of the whole foot with the ground. The reason for this disease, which usually does not cause pain, may be the nonformation of foot arches in childhood. The rate of pes planus in 3-year-old children is 44%, whereas it decreases to 24% in 6-year-old children [4]. Daneshmandi, Rahnema, and Mehdizadeh reported a meaningful relationship between obesity and pes planus [5].

In recent years, heavy training techniques have been employed by athletes at an early age. Such training practices may bring about significant changes in the body as the musculoskeletal system is not mature enough [6]. Hawkins et al. reported that when an athlete, a tennis player for example, is exposed to a unilateral overload, he may display an apparent inconsistency, such as increased external rotation and decreased internal rotation of one foot compared to the other [7]. It is known that sport-specific training and repeated practices may have an effect on the arch index of the sole of the athletes [6]. Gymnasts who begin training at early ages, weightlifters who lift enormous weights during training periods and wrestlers who require complex and heavy training sessions are included in this category. The arch of the foot develops and strengthens in early childhood as a part of normal growth of bones, ligaments, muscles and tendons. When misalignment or deformation of the bones, or weakening of the tendon or ligament occur, a postural defect of the foot, such as pes planus, can pose serious problems [8].

Pes planus has two clinical forms; flexible and rigid. Using insoles is a basic application suggested for

doi:10.15561/26649837.2020.0301

individuals with pes planus. Depending on the severity and the type of the deformity; whether pediatric or adult, congenital or acquired or flexible or rigid, several types of orthoses may be used in the treatment of pes planus [9, 10]. It is important to determine the factors involved in forming and maintaining the arches of the foot, and to evaluate the foot posture correctly in order to identify flatfoot deformity and differentiate cases that need treatment from those that need only reassurance [8]. Doctors often suggest using insoles made of steel arches and leather surfaces with shock-absorbing material, such as silicon or semi-rubber [11]. Açak [12] and Yurt [13] reported that the use of insoles in pes planus reduced the pain and the subjects got tired later than usual. Nevertheless, it should be noted that these insoles do not provide the original setting for a standard arch's height, but are rather used only for pain-relief purposes.

Wrestling was first performed barefoot on a dirt surface in the 1st Modern Olympics in Athens in 1896, whereas it was practiced on thick and soft mats and with leather shoes, which covered ankles tightly, in London in 1908 [12]. These high neck wrestling shoes used in the London Olympics made it to our day with almost the same features. The shoes do not have any elevation in the heel or any orthopedic insole. It is still debatable whether the foot arch morphology or the use of flat shoes causes pes planus in athletes. The literature holds no study on postural distortion of the foot in wrestlers. The lack of elevation in the heel or an orthopedic support causes postural distortions on the soles of wrestlers, which constitutes the topic of our study. Thus, the aim of this study was to determine the effects of wrestling shoes, wrestling mats and wrestling styles on postural deformation of the foot and to elaborate possible causes. We hypothesized that the foot structure would be affected by wearing the wrong wrestling shoes, thus showing an increased eversion at the mid-stance phase.

Material and Methods

Participants: The study was designed based on the quantitative screening model to evaluate the flatfoot deformity of wrestlers. Our study group comprised of 158 athletes (109 males, 59 females) from 26 different countries who participated in the 12th World University Wrestling Championship. Of the athletes, 102 (59 females, 43 males) performed in freestyle and 56 performed in Greco-Roman style. The age range of the athletes was 19 to 31 years and they have done wrestling for 3 to 18 years. The participants were categorized under four different age groups: those 19 years old and under, 20 to 23 years old, 24 to 27 years old and 28 years old and above. The athletes were also categorized according to the time they performed the sport: 5 years or less, 6 to 10 years and 11 years or more.

Procedure: Footprint parameters were used to determine and evaluate the overall structure of the foot. An evaluation form was created after receiving the approval of the officials of the championship, and measurements were made based on this form. The Staheli and the Chippaux-Smirak indexes were used in the study [14].

Statistical analysis: Statistical analyses of the data were performed using the SPSS v.21.0 software. The significance level in comparisons was set at α=0.05. The chi-square test was used in the evaluation of the qualitative data and the significance of the difference between the observed and expected frequencies.

Results

The prevalence of flatfoot was 18.4% in female wrestlers and 19.3% in males. The chi-square test revealed no significant relationship between the gender of the wrestlers and their pes planus state (n=158; X^2=0.018, df=1, p>0.05) (Table 1).

The prevalence of flatfoot was 10.5% in the wrestlers that are 19 years old or younger, 15.7% in those who are 20 to 23 years old, 26.2% in the 24 to 27 years old wrestlers and 28.6% in the 28 years old and above. The chi-square test revealed no significant relationship between the age of the wrestlers and their pes planus state (n=158; X^2=3.733, df=3, p>0.05) (Table 2).

The prevalence of flatfoot was 22.5% in the freestyle wrestlers and 12.5% in the Greco-Roman style wrestlers. The chi-square test revealed a significant relationship between the style performed and the wrestlers' pes planus state (n=158; X^2=18.234, df=1, p<0.05) (Table 3).

Regardless of the gender and style of the sport performed, the prevalence of flatfoot was 9.1% in wrestlers who wrestled for 5 years or less, 13.6% in wrestlers who wrestled for 6 to 10 years and 28.8% in wrestlers who wrestled for 11 years or more. The chi-square test revealed a significant relationship between the years in the sport and the wrestlers' pes planus state (n=158; X^2=6.042, df=2, p<0.05) (Table 4).

Table 1. Prevalence of flatfoot based on gender

Participants	Pes planus state			
	Not present		Present	
	n	%	n	%
Woman	40	81.6	9	18.4
Male	88	80.7	21	19.3
Total	128	81.0	30	19.0

X^2=0.018, df=1, p=0.894

Table 2. Prevalence of flatfoot based on age groups

Age group	Pes planus state			
	Not present		Present	
	n	%	n	%
19 years old and under	17	89.5	2	10.5
20 to 23 years old	70	84.3	13	15.7
24 to 27 years old	31	73.8	11	26.2
28 years old and above	10	71.4	4	28.6
Total	128	81.0	30	19.0

X^2=3.733, df=3, p=0.064

Table 3. Prevalence of flatfoot based on style

Style	Pes planus state			
	Not present		Present	
	n	%	n	%
Freestyle	79	77.5	23	22.5
Greco-Roman style	49	87.5	7	12.5
Total	128	81.0	30	19.0

X^2=18.234, df=1, p=0.44

Table 4. Prevalence of flatfoot based on years in the sport

Years in the sport	Pes planus state			
	Not present		Present	
	n	%	n	%
5 years or less	10	90.9	1	9.1
6 to 10 years	76	86.4	12	13.6
11 years or more	42	71.2	17	28.8
Total	128	81.0	30	19.0

X^2=6.042, df=2, p=0.049

Discussion

The results of our study, which exhibit a significant relationship between the wrestling style and pes planus state of freestyle and Greco-Roman wrestlers (Table 3), are in concordance with those of Taşkıran et al. [15] Their leaning forward further, standing on their feet spread sideways for balance and pulling and pushing the opponent forward, backward, and sideways may be an important factor of higher prevalence of flatfoot deformity in freestyle wrestlers in comparison to the Greco-Roman style performers. The surface of the sole extends the contact surface with the mat, or the contact surface may be wider than desired due to the shock-absorbency characteristics of the foam core. This might lead us to think that such incident may be a predisposing factor for higher incidence of flatfoot deformity among freestyle wrestlers. Moreover, by wrapping around it, the wrestling shoes avoid the movement of the Achilles tendon. The failure of the Achilles tendon to stretch supports the opinion of its predisposing effect in the higher incidence of flatfoot deformity among freestyle wrestlers.

Based on the age variable of the participants in our study, the prevalence of flatfoot was 10.5% in the 19 years old and younger wrestlers, 15.7% in the 20 to 23 years old wrestlers, 26.2% in the 24 to 27 years old wrestlers and 28.6% in the 28 years old and older wrestlers; showing a steady increase in the prevalence as the age went up (Table 2). However, no significant relationship was detected between the age of the wrestlers and their pes planus state. The prevalence of the deformity was higher in the male athletes, yet, the difference with their female counterparts was statistically insignificant (Table 1).

A significant relationship was detected between the years in the sport and the wrestlers' pes planus state (Table 4). The athletes were more prone to having flatfoot deformity as their years in the sport increased. Our results were accordant with the results from the study of Taşkıran et al.,[15] in which postural deformities of the feet were examined. In another supporting study, Wojtys et al. suggested that frequent training sessions in early ages have an impact on the posture [16]. In their study on the height of the arch of athletes playing different sports, Aydog et al. observed that the prevalence of flatfoot among

gymnasts was significantly lower than that of wrestlers [6]. Considering that the gymnasts from Aydog et al.'s study had started sports four years before the participating wrestlers, our results exhibiting the relationship with the time spent in the sport and flatfoot deformity support the view that suggests that the prevalence of the deformity in wrestlers is higher.

As flatfoot patients lack a normal arch, the impact on the sole is dispersed without absorption. Forces exerted on the soles and upper parts of the body will cause a chain reaction in especially in the spine and lumbar spine [17]. Flatfoot deformity has been shown to cause pain while standing [18], walking and running [10]. The deformity has also shown a positive correlation with waist pain in the studies of Violante et al. [19] and Oskay et al.[20]. Kaufman et al. [21] showed that flatfoot triggered feeling of pain and stiffness in the foot, imbalance in foot muscles and tension in ligaments, fatigue when walking and most importantly the stress fractures. Taking such complications into account, it is not hard to predict that wrestlers are prone to facing serious problems.

The increase in the time spent in the sport in turn means more training and matches, and thus, wearing the wrestling shoes more. This might suggest that the wrestling shoes lead to unfavorable results in the long term. The characteristics of the sole of the wrestling shoes depict similarity to those of the boots worn in the folk dance, *horon*. In their study, Aydos et al. [22] revealed that significant deviations occur in the soles of *horon* dancers, due to the characteristic figures of the dances performed over a long period of time and the incapability of the shoes in supporting and protecting the feet. It is natural to expect that similar characteristics will lead to similar results.

Continuous and balanced feet movements are necessary to perform the practiced figures, to disrupt the opponent's balance and to intimidate him. While disrupting the opponent's balance, a wrestler will have a significant advantage in technical performance and preserving energy as long as he maintains his balance. In addition, an accessory navicular in flatfoot individuals will stretch the posterior tibial tendon and impair its elasticity to a great extent. This in turn will significantly restrict the performance of moves like salto, arm throw and takedown, where rising on tiptoes, springing and throwing the opponent over your own body are performed.

Under the light of the outcomes of our study, we can recommend the following; the need for redesigning the wrestling shoes, raising the heels of the wrestling shoes like those in sneakers and daily shoes, placing orthopedic insoles in the wrestling shoes, and that the wrestlers wear normal sneakers when performing exercises other than wrestling, such as warm up runs and moves, and educational and sportive activities.

Conclusion

The pes planus seen in wrestlers was found to be in direct proportion to the style, wrestling year and age of the wrestlers. It was noted that the factors such as; freestyle wrestlers tying their shoes very tightly, transferring their center of gravity to the front, the wrestling shoes not supporting the foot arch area, the wrestling cushion being soft and athletes running whilst the wrestling shoes on might have contributed to pes planus. It was concluded that wrestling shoes, which were produced more than 100 years ago and have not changed much, should be produced or researched in accordance with the health of athletes.

Conflict of Interests

The authors declare that they have no conflict of interests.

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Cite this article as:
Acak M, Korkmaz MF, Taskiran C, Demirkan E. Investigating the effects of wrestling gear in flatfoot deformity of wrestlers. *Pedagogy of physical culture and sports* (*Pedagogics, psychology, medical-biological problems of physical training and sports)*, 2020;24(3):106-110.
https://doi.org/10.15561/26649837.2020.0301

Received: 19.11.2019
Accepted: 09.12.2019; Published: 05.01.2020

Effects of neuro-linguistic programming course on job stress, positive organizational behavior and job motivation in physical education teachers

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Authors' contributions: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection.

Abstract

Purpose: The purpose of this study was to investigate the effects of a neuro-linguistic programming course on job stress, positive organizational behavior and job motivation among physical education teachers of Khorasan Razavi province of Iran.

Material: The statistical population of the study consisted 150 physical education teachers of Khorasan Razavi province. 40 physical education teachers were selected as statistical sample. At first, the questionnaires of job stress of Steinmetz (2002), Luthans Psychological Capital questionnaire (2007) and Hackman job motivation questionnaire (1976) were administered to the subjects and then the subjects received the presented protocol. At the end of the course questionnaires were re-presented. Data were analyzed using repeated measures ANOVA and Bonferroni post hoc test at 5% error level.

Results: The results showed that neuro-linguistic programming had a significant increase in job motivation and positive organizational behavior and a significant decrease in teachers' job stress ($P<0.001$). There was no significant change in job motivation, positive organizational behavior and job stress in the control group ($P<0.05$).

Conclusions: According to the findings, it can be concluded that to increase the job motivation, these course can be used and affect the motivation and job stress of the employees.

Keywords: neuro-linguistic programming, job stress, positive organizational behavior, job motivation.

Introduction

The most important part of organizations is their human resources. First of all, human resources should be examined and their motivations and potentials should be recognized and a reasonable degree of their satisfaction or success should be provided, because without understanding the motivations and desires of the human resources, they cannot be forced to serve and work beneficially. Regarding the necessity of understanding the motivations of human resources, it is also important that almost all human beings spend most of their lives in organizational environments, and work is an experience that most of the people gain, since our society is strongly dependent on the effective and efficient performance of its organizations. It is, therefore, necessary to have an evoked force. Today, the importance of motivation in performance is obvious and widely known, and it is an issue of concern in human resource management [1-3]. Therefore, any effort for better managing human beings requires discovering basic needs, understanding the behavioral motivations of individuals, and reactions of different group works. Therefore, identifying one in an organization and understanding the basics of his/her behavior, and consequently, motivating him/her is in fact one of the most vital and most difficult tasks of managers [2]. If we want people to do their jobs willingly and eagerly in the workplace, we need to be aware of these needs and desires, and create an environment in which these requests and desires are fulfilled, and the motivations are satisfied. In such an environment that the emotional, psychological and social needs of employees are taken into enough consideration, it is expected that individuals will feel involved and attached to their work environment, their interest and motivation for working will be increased, and thus, they will work with more morale and satisfaction [4, 5].

Job stress is one of the factors that is a problem for many organizations and their employees. Not so long ago, nervousness was considered to be a human disease, whereas today, behavioral science experts believe that nervousness is not a disease, but an inevitable fact that a degree of which is useful for pursuing organizational goals and also personal and group objectives and people's efforts should be directed at controlling, directing, and properly using such pressures, not at resisting them [4, 6]. Experts define job stress and factors causing job stress differently. Lutanz has considered stress as a response a person gives as a psychological or physical behavior in order to adapt to an external situation different from the normal one. In this definition, stress is the reaction of an individual to the threatening situations in the environment. Hans defines stress as a reaction to external unfavorable or unexpected factors, or simply, to the disturbance in the human body's adaptation system to the external environment. From his point of view, whenever the balance and adaptation of the organism are eliminated due to disruptive factors, the

doi:10.15561/26649837.2020.0302

individual becomes stressed out [7].

On the other hand, there is a fundamental change in the attitude of some psychologists. The new focus and direction of this attitude is called perfectionism or health psychology, which deals with the healthy aspect of human nature, not the unhealthy aspect of it. This new approach, also called positive psychology, has recently attracted the attention of many researchers in the field of organization and management, thus creating a new movement called Positive Organizational Behavior. Like Positive Psychology, Positive Organizational Behavior does not claim to have achieved a new breakthrough in Positive Behavior, but rather points to the need to more focus on theorizing, researching, and effectively applying employees' positive states, traits, and behaviors [8]. After physical capital, human resources consisting of the knowledge, skills, and experiences of employees, and ultimately social capital, was raised as a set of networks of individual relationships with others [8].

Considering these, research needs to be done to enhance positive organizational motivation and reduce management job stress in organizations. Therefore, it is necessary to use appropriate methods for this issue. In this regard, verbal neural planning has been the subject of a lot of research studies in the past few decades. The impact of this concept on communication skills and job skills has been frequently investigated by researchers and its role in managing and improving communication has been questioned by many researchers. Neuro-linguistic programming (NLP) is a revolutionary approach to the development of human and individual communication. Some call it the science and art of individual success or mental experiences. This approach offers the highest level of skills in communicating between individuals and practical ways to transform thinking and behavior [8, 9]. Through NLP, individual and organizational goals can be achieved faster and more effectively than ever before. Using NLP techniques, mental resources will be employed, and the use of the word element will facilitate the achievement of goals, and mental status will be achieved and beliefs and values will be aligned to achieve the desired results. Neuro-linguistic programming is the study of the structure of mental and logical experience [10, 11]. Neuro-linguistic programming raises self-awareness and provides new insights into the relationship between body and mind. In this regard, the awareness of the system of representations, goals, beliefs, and values of the individual has been developed and leads to the awareness of others, and based on these levels of awareness, the individual's communicative action becomes more effective and the individual support and communication networks are developed, and beliefs of self-efficacy and self-esteem are changed [12].

In this regard, Troesch and Bauer [6] believe that self-efficacy has a greater impact on job stress, and Howard [8] associates positive self-assessment with positive psychological capital. Also, Jancenelle et al. [13] believe that in the economic environment, psychological capital and market approach have a major impact on the economic conditions and performance of lending companies and the behavior of borrowers. Ray et al. [14] correlated job stress and quality of work life, and Wu and Park [15] has found a significant impact of the satisfaction with expertise of nursing students on psychological capital and professional values, and Pan et al. [8] has found the impact of psychological capital and positive organizational behavior on job attachment and interest in the workplace meaningful. Younesian [16] found that college students' psychological capital is related with learning empowerment and interaction. Ahmadi et al. [7] emphasized on the effect of neuro-verbal programming training on depression, and Kajbaf et al. [17] confirmed the effect of this training on marital adaptability, and Mikaili and colleagues [18] verified its effect on mental health of nurses. Ashok & Santakumar [19] found verbal neural planning to improve learning effective, and Thompson et al. [20] found it effective in improving individual and organizational performance, and Grosu et al. [21] found it effective in decision. Lashkarian and Sayyadian [22] also found the effect of verbal neural planning to increase motivation and Florina et al. [23] found it effective in reducing anxiety. Yemm [24] believes that NLP can help in the business world. However, there are ways that NLP can easily harm companies.

Job motivation in physical education teachers as a key stimulator of teachers' performance is the missing link in developing physical education in schools. Physical education teachers deal with a variety of problems inside and outside the organization that increase job stress and decrease job motivation in teachers. Therefore, in addition to trying to solve the livelihoods and organizational problems of physical education teachers, appropriate measures should be taken to improve their job motivation to perform better. Therefore, it seems necessary to examine strategies for promoting motivation and positive organizational behaviors and reduce job stress in teachers. Background research shows that so far research has been done on verbal neural planning and organizational behavior and job motivation variables, and the positive effects of these variables have been reported. Also, developing verbal neural planning and managing emotions in controlling individuals' internal emotions can improve their feelings about themselves and the organization and create a positive sense of belonging that enhances employees' job satisfaction and motivation, which is the missing link of the organization. The performance of physical education teachers in training education plays an important role in the development of sports in the country and can provide the basis for further development of sports in the country. Sport science is directly linked to the development of students' physical and mental health and the training of healthy lifestyles. Assessing primary physical health and improving students' health indicators and, to a higher level, improving their motor and athletic skills are among the duties of a physical education teacher. Meanwhile, a knowledgeable physical education teacher plays an important role in identifying the country's future champions, with his or her strategies of recognizing

talented students. However, in order to develop the job motivation of the teachers, appropriate measures must be taken inside and outside the organization. Therefore, it is necessary to study the factors affecting their job motivation and conduct research in this area. Thus, the purpose of this study was to determine if verbal neuroscience training is effective on positive organizational behavior and job stress and how does this effect on job motivation?

Material and methods

Participants

The statistical population of the study consisted 150 physical education teachers of Khorasan Razavi province. 40 physical education teachers with the highest scores in job stress were selected as statistical sample.

Research Design

The present study is a quasi-experimental research with pre-test and post-test in control and experimental groups. In terms of purpose, this research is a kind of applied research**.**

Statistical sample (40 teachers) randomly divided in two control and experimental groups. Then experimental group received neuro-linguistic programming based on the research goals for ten sessions. The teachers in the control group did not receive any intervention. The training protocol is as follows (tabl. 1).

At the end of the course, job stress questionnaires of Steinmetz [25], and psychological capital questionnaire of Luthans [26] and job motivation questionnaire of Hackman [27] were re-presented to the subjects, and their indices were assessed.

The validity of the research questionnaires has been evaluated in various research studies and they were found to be standard tools having validity. The Job Stress Questionnaire of Steinmetz [25], consisted of 36 questions and was designed on a Likert scale. A score of 150 to 180 indicates a high level of job stress, a score of 110 to 149 indicates a moderate level of job stress, a score of 80 to 109 indicates a low level of job stress, and a score below 79 indicates a very low level of job stress. The validity of the questionnaire was confirmed in several researches and its reliability was calculated as 0.89 by Cronbach's alpha test. The Luthans [26], psychological capital questionnaire was designed on a Likert scale and consisted of 20 questions. A score of 80-100 indicates a high level, 60-79 indicates a good level, 40-59 indicates a moderate level, and a score below 39 indicates a low level of psychological capital (positive organizational behavior). This tool is standard and its validity has been confirmed by various studies and its reliability was calculated by Cronbach's alpha of 0.91. Hackman [27], Job Motivation Questionnaire contains 25 questions on the Likert scale, with a score of 100 to 125 indicating a very good level of job motivation, a score of 75 to 99 indicating a good level of job motivation, a score of 55 to 74 indicating a low level of job motivation, and a score of less than 54 indicating a very low level of job motivation. The validity of this questionnaire has been confirmed by various research studies, and it is a standard tool and its reliability was calculated and confirmed by Cronbach's alpha of 0.90.

Statistical Analysis

The analysis was performed at both descriptive and inferential levels. In descriptive level, mean and standard deviation indices, and in the inferential level, variance with repeated measures of (2×2) were used for analysis. Tests were performed at 5% error level using SPSS software version 25. The assumptions of variance analysis model were examined with repeated measures such as the normality of error distribution by Shapiro-Wilk Test, the homogeneity of variance error by Levin test, and the homogeneity of covariance by Box test on the data of the present study.

Results

The normality of the error distribution was evaluated by Shapiro-Wilk Test, and based on the results of this test, the variable of job stress was ($p = 0.794$) in pre-test, and it was ($p = 0.554$) in post-test, the variable of job motivation was ($P = 0.485$) and it was ($p = 0.696$) in post-test, and the variable of positive organizational behavior was ($p = 0.134$) in pre-test, and ($p = 0.893$) in post-test, and no evidence was found to reject the assumption of normality. The homogeneity of variance error between groups was also evaluated by Levin test. Based on the results of this test, the assumption of homogeneity of variance between groups for the variable of job stress was ($p = 0.065$) in pre-test, and ($p = 0.05$) in post-test, for the variable of job motivation, it was (p-0.416) in pre-test, and ($p = 0.416$) in post-test, and for

Table 1. Training Protocol

Sessions	Learning content
First and Second Sessions	Introductions and Introductory Concepts of Neuro-linguistic programming
Third Session	Teaching how to set and reach goals
Fourth Session	Teaching to create a sense of self-esteem and self-love
Fifth Session	Concepts of control and flexibility in problems and mind control to solve crises
Sixth Session	Concepts of closed mindedness and readiness to accept new beliefs
Seventh Session	Giving yourself motivation and hope and optimism
Eighth Session	Concepts of self-efficacy and utilization of your inner abilities
Ninth Session	Teaching strategies to improve self-confidence
Tenth Session	Getting familiar with how to make effective relationship and the ways of reaching it

Table 2. The mean and standard deviation of the scores of job stress, job motivation and positive organizational behavior in two groups in pre-test and post-test and repeated measures of ANOVA test results.

Variable	Group	Pre-test		Post-test		P Value		
		Mean	SD deviation	Mean	SD deviation	Group	track	Interaction Effect
Job Tension	Experimental	147.75	8.97	74.60	6.68	<0.001	<0.001	<0.001
	Control	145.80	5.72	146.45	5.40	(0.926)	(0.943)	(0.944)
Job Motivation	Experimental	48.60	4.42	101.30	8.04	<0.001	<0.001	<0.001
	Control	52.95	5.61	52.75	9.07	(0.801)	(0.912)	(0.913)
Positive Organizational Behavior	Experimental	37.95	4.94	85.05	5.24	<0.001	<0.001	<0.001
	Control	39.60	3.66	38.50	3.47	(0.906)	(0.950)	(0.954)

the variable of positive organizational behavior, it was (p = 0.169) in pre-test, and it was (p = 0.07) in post-test, therefore the assumption of homogeneity of variance was not rejected. The assumption of homogeneity of variance covariance matrix was also confirmed by Box test in all three variables of job stress (p = 0.137), job motivation (p = 0.748) and positive organizational behavior (p = 0.223).

Based on the results of analysis of variance with repeated measures, the assumption of the equality of mean scores in two stages of pre-test and post-test in the variables of job stress (F(1, 38) -623.97, p<0.2η, 001-0.943); job motivation (F(1,38)-391.78, p<0.2η, 001-0.912); and positive organizational behavior (F(1,38)-717.32, p<0.2η,001-0.950) was rejected. The effect of experimental group on error level of 5% for the variables of job stress (F(1,38)-475.062,p<0.2η, 001-0.926); job motivation (F(1,38)-153.20, p<0.2η, 001-0.801); and positive organizational behavior (F(1,38)-366.193,p<0.2η,001-0.906) was significant. Also, the interaction effect between the experimental group and the measurement time on variables of job stress (F (1, 38) -646.54, p<0.2η, 001-0.944); job motivation (F (1, 38) -623.97, p<0.2η, 001-0.943); and positive organizational behavior (F (1, 38) -623.97, p<0.2η, 001-0.943) at error level of 5% was meaningful.

The result of Bonferroni post hoc test on the interaction effect on job stress showed no significant difference in the control group in the two stages of pre-test and post-test (p = 0.753) but in the training group, teachers' job stress had a significant decrease in post-test compared to pre-test (p <0.001). In addition, in inter-group comparison, it was found that in pre-test, there was no significant difference in teachers' job stress between the experimental and control groups (p = 0.418), but after the intervention, the level of job stress was significantly lower in the experimental group, the job stress was significantly lower than the control group (p <0.001).

Considering the variable of job motivation, in the control group the mean scores of job motivation in two stages of pre-test and post-test were not significantly different (p = 0.916), but in the training group, the teachers' job motivation in post-test was significantly increased compared to pre-test (p <0.001). In addition, it was found that in pre-test, the job motivation of the teachers in the experimental group was significantly lower than the control group (p = 0.010), but after the intervention, the job motivation in the teachers of the experimental group was significantly higher than the control group (p <0.001).

Regarding the variable of positive organizational behavior it was shown that in the control group, the mean score of organizational behavior in the two stages of pre-test and post-test was not significantly different (p- 0. 350), but in the training group of teachers, the positive organizational behavior in post- test was significantly increased compared to the pre-test (p <0.001). Additionally, in inter-group comparison, it was found that in the pre-test phase, considering the organizational behavior, there was no significant difference between the control group and the experimental group (p - 0.223), but after the intervention, the organizational behavior in the experimental group was significantly higher than the control group.

Discussion

The findings of the study showed that Neuro-linguistic programming has a significant effect on the improvement of positive organizational behavior, reduction of job stress and extension of job motivation. It is very important that how employees interpret and analyze the intra-organizational events and the incidents in their own lives. There may be many positive and negative events in the lives of all individuals and all employees in the organization, but our perceptions of these events are more important. Neuro-linguistic programming helps employees to interpret daily events and events in a way that minimizes stress and tension and provides a better and positive view of life. This will improve their behaviors and make them show more positive and effective behavior in the organization, which is confirmed by the findings of the study.

In other words, after learning the components of Neuro-linguistic programming, they learn how to better communicate with others, control their own inputs, and evaluate events in a positive way so they can have a higher level of motivation and a lower level of stress and tension in the organization, in other words school. In other words, people trained in Neuro-linguistic programming in this study learned how to better communicate with others and

with the environment and to have a better understanding of colleagues, individuals and students, and even events, and this helps the physical education teachers who are actively in contact with students in the realm of sport to have more control over their own minds and others' perceptions while teaching, and be able to manage their thoughts in a positive way, and not to allow stress and tensions and negative atmosphere to increase in the mind.

Job stress and Neuro-linguistic programming were correlated based on the findings of the study and after the end of the course of Neuro-linguistic programming, the level of job stress in teachers was significantly reduced. Job stress can greatly affect the performance of physical education teachers and create other psychological problems at home and outside the workplace, which is a good solution to manage this stress was Neuro-linguistic programming. In the presented course, the concepts of self-worth and self-love were presented to the teachers, which makes the teachers of physical education consider their job worthy despite all the problems and value their job and their social status as teachers, and manage their stress better in this way. Mental toughness and internal control can be largely effective in controlling the difficulties and the problems that are induced by one's psyche, and physical education teachers feel less stressed by the lessons presented. Job stress is a component whose control and amount depends on the spiritual and mental management in individuals, and Neuro-linguistic programming can help teachers to experience a lower level of job stress. In other words, physical education teachers whose inclusion criterion was being exposed to high levels of job stress had experienced less stress after the end of the course and experienced less stress indicating that they had been able to control the stress by using the training provided.

Positive organizational behavior was another variable examined in this study. The components of positive organizational behavior consisted of optimism, hope, resilience, and self-efficacy consistent with the headlines of the training course, and we observed an increase in this variable among the participants of the study. Self-motivation and positive thinking and the concepts presented in the relevant sessions are highly consistent with the optimistic and hopeful statements in positive organizational behavior that result in a significant increase in this variable in the post-test period. Setting goal and increasing self-confidence, and effective relationship were the indicators emphasized in the course of the training, and self-efficacy and its elements are in line with these components. In other words, it can be said that Neuro-linguistic programming has a positive effect on creating positive organizational behaviors in physical education teachers and in this regard, physical education teachers can optimally and hopefully cope with internal and external problems in the workplace and enhance their effectiveness in the organization and non-work environments, and Neuro-linguistic programming is an effective factor in this regard.

Job motivation is also a factor which has been discussed and examined in the teachers, and many studies have highlighted the lack of motivation of teachers in various societies and majors. In this study, pre-test showed a low level of job motivation in teachers of physical education and on the other hand, it was found that job motivation had a positive and significant increase under the influence of Neuro-linguistic programming. Job motivation as the main driving force in the job of physical education teachers determines their performance and shows to what extent they perform their job with interest and motivation. The topics taught in Neuro-linguistic programming, including self-esteem, emphasized on the importance of the job of physical education teachers and emphasized on their motivation and interest in their work and taught them to value themselves and their jobs. Self-motivation and hope, positive thinking, self-efficacy, and utilizing the intrinsic abilities were the concepts presented during this period, increasing the motivation of physical education teachers in their jobs was emphasized, and it was tried to train physical education teachers to be positive about themselves and their job and have more hope and motivation in their jobs and lives.

Based on the findings of Ray et al. [14] job stresses decreases the life quality, and tools like Neuro-linguistic programming are needed to manage these stresses properly in individuals in order not to cause mental and personality crises. In their research, Ahmadi et al. [7] and Kajbaf et al. [17] and Mikaili et al. [18] also found Neuro-linguistic programming effective in reducing tension, stress and anxiety and mental disorders and improvement of adaptation of individuals which is in line with the findings of this research. In other words, people who can control their mental inputs and effectively adapt to other people and organizations, and this concept is in line with the concept of positive organizational behavior and, on the other hand, the effect of Neuro-linguistic programming on improving mental tranquility and reducing stress which can be considered to be associated with a decrease in job stress that results in increased job motivation in physical education teachers. Ashok & Santakumar [19], Thompson et al. [20] and Grosu et al. [21] also emphasize on the importance of Neuro-linguistic programming and its effective role in improving learning, performance development, and enhancing the decision making skills in individuals which is consistent with the findings of this study. Lashkarian and Sayyadian [22] also believe that for better communicating with students, a teacher can improve university students' effectiveness, motivation, and skill through Neuro-linguistic programming, enhancing learning environments, and a positive interaction, and the present study also emphasizes on the importance of Neuro-linguistic programming in the process of education for teachers, students and university students. Florina et al. [23] also found that Neuro-linguistic programming is effective in reducing anxiety and improving information inputs, which is in line with the findings of this study. Yemm [24] believes that Neuro-linguistic programming can be effective for businesses and can be damaging when damaging cases are related to employees quitting the job

due to their increased ability and feeling superior to the organization level which is inconsistent with findings of this study. But in physical education teachers, Neuro-linguistic programming can be considered as an effective factor, as the educational area differs from the business environment especially in European countries, and physical education teachers through reducing tension and anxiety and job stress and developing self-efficacy and control skills, and consequently positive organizational behavior can develop skills related to Neuro-linguistic programming and experience higher job motivation, and their performance can be effectively increased. Teaching Neuro-linguistic programming along with emphasizing on skills like effective communication and improving self-confidence can increase the interest of physical education teachers in their jobs and even their personal lives, and make them internally plan for reducing the focus on problems and mental reconstruction. Based on the topics presented in this course, physical education teachers have learned to set a different goal for their job and be able to cope with toughness and mental problems, and provide positive motivation to themselves, and these solutions improved their mental state and psychological readiness, and based on the findings of this research, it leads to the improvement of their motivation and relieve from job stress, and considering the training of communication skills and effectively understanding others, teachers' behavior with others, including students, colleagues and individuals outside the organization is promoted, and the development of positive behavior in teachers is enhanced.

Conclusion

Based on the findings of the study, it is suggested that although organizational and life problems and personal problems of teachers require macro planning and national support and determination, education managers can improve organizational behaviors by conducting useful Neuro-linguistic programming courses and reduce the stress of job stress in physical education teachers. In other words, it is recommended that NLP courses be held during the academic year for in-service physical education teachers and by setting a rating for these courses, so that teachers can benefit from these trainings and develop positive organizational behaviors. These courses are also effective in reducing job and psychological stress and relieving the mind of the teachers. It is recommended that courses be held for teachers. Based on the research findings, in this section, organization-supervised courses as well as courses outside the organization framework sponsored by the organization are recommended for physical education teachers. These courses, with the topics presented in this study, can increase the focus of physical education teachers on internal management and control of problems, and it is recommended that courses with these topics are held for the teachers throughout the year.

Conflict of interest

The authors declare that there is no conflict of interest.

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Cite this article as:
Anjomshoa MR, Fahim Devin Y, Esmailzadeh MR, Keshtidar M. Effects of neuro-linguistic programming course on job stress, positive organizational behavior and job motivation in physical education teachers. *Pedagogy of physical culture and sports (Pedagogics, psychology, medical-biological problems of physical training and sports)*, 2020;24(3):111-117. https://doi.org/10.15561/26649837.2020.0302

Received: 20.11.2019
Accepted: 26.12.2019; Published: 05.01.2020

PEDAGOGY of Physical Culture and Sports (Pedagogics, psychology, medical-biological problems of physical training and sports)

The effect of Zumba exercises on body composition, dynamic balance and functional fitness parameters in 15-17 years old women with high body mass index

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Abstract

Purpose: The aim of this study was to investigate the changes in body composition-dynamic balance and functional movement capacity of 60 female high school students with body mass index (BMI) over 24.9 before and after the eight-week zumba exercise program.

Material: The study included 60 volunteer healthy young women whose body mass index was higher than 24.9 (mean age: 16.75 ± 0.43 years, mean weight: 75.99±10.91 kg, mean body fat: 36.83 ± 6.1%, BMI: 29.56 ± 4.12). The portable stadiometer Seca-213 was used to determine the lengths of the study group. TANITA-Bc 545 N Innerscan Segmental Body Composition Analyzer, "Y-Balance Test was implemented to determine the dynamic balance values for the lower and upper extremities, Functional Movement Screen (FMS) test, was used to determine functional movement capacity. To determine the number of heart beats during zumba exercises, Polar M430 Heart Rate Monitor was used and a total of 24 zumba exercise sessions were conducted from three days a week for eight weeks.

Results: According to the findings of the study, during the 8-week zumba training program, it is seen that it provided statistically significant improvement in total body weight loss (p=.000), BMI parameter (p=.000), body fat % (p=.002), FMS values (p=.000) and lower an upper extremity dynamic balance parameters (p=.000).

Conclusions: It was found that the eight-week zumba training program had positive effects body composition values, functional mobility assessment results and dynamic balance parameters of high school students with a high body mass index of 15-17 years of age.

Keywords: zumba, dynamic balance, FMS, body fat, high BMI.

Introduction

In recent years, overweight and obesity in childhood and adolescence have become an important health problem all over the world, especially in developed countires due to the decrease in physical activity [1]. The World Health Organization (WHO) stated that approximately 40% of individuals over the age of 18 were overweight [2], and studies have shown that the rate of overweight and obesity is more common in women than in men [3]. In Turkey, as in similar studies carried out worldwide prevalence, rate of overweight and obesity was higher in women compared to men [4]. Concerns about the appearance of women's bodies are effective not only during adolescence but at every stage of their lives [5]. Therefore, positive changes in physical perception affect daily life positively. In order to achieve this effect, it is very important that regular physical activity takes place in daily life. Studies have shown that sedentary lifestyle is one of the leading factors that increase overweight and obesity [6, 7]. Many countires around the world are looking for ways to struggle against overweight, obesity and lack of physical activity. Regular physical activities such as walking, plates, zumba appear to be one of the most effective and popular methods for preventing obesity, weight loss and body tightening among women with nutrition [5, 8]. Long-term monotonous training contents of exercise programs are one of the reasons why phsyical activities cannot be sustained regularly [9]. Although they exercise with music and movements, they do not feel like working out while performing zumba exercises. Therefore these are effective ways to prevent sedentary lifestyle. It also provides a disguised fitness activity atmosphere with its pleasant way of exercising to prevent overweight and obesity. Zumba exercises that can be practiced easily by all individuals starting from the age of 4 with competent trainers, which attracted 14 million participants in 150 countries, and are among the top 10 sports trends: it is a very popular Latin-dance sports program [10, 11]. One of the reasons for its popularity today is that there is no right or wrong method in zumba exercise practices. Zumba activities, whose motto is "put aside the training and join the party" causes individuals to engage in physical activity by making them want to repeat the exercises with fun content [9]. Zumba exercises; improves strength, balance, coordination and fitness as well as improving the rate of fat reduction in women is a dynamic study to change the body composition in a positive way [12-14].

The concept of balance, which is capable of keeping the center of gravity within acceptable limits of the support surface in daily physical activities [15], is learned and developable skill and has an important role in performing functional movements in daily life [16]. Studies have shown that adipose tissue deposition and low

doi:10.15561/26649837.2020.0303

physical activity levels decrease body balance and create a positive correlation between high BMI and postural instability. In this case, it is observed that the individual will need more effort to maintain the postural balance [17]. Weak balance is known to be a risk factor for the occurrence of injuries during daily physical activity and athletic performance, especially in women [18]. Therefore, the balance-enhancing effect of regular zumba exercises appears to be an effective method in reducing these factors [13]. Functional movement is the ability to produce and maintain basic movements for activities that provide a balance between mobility and stability along the kinetic chain [19]. Many people do not have sufficient knowledge of how to do basic physical activities in their daily lives and this may cause problems in achieving the intended physical fitness criteria in the long term [20]. Functional Movement Screen (FMS) testing, which aims to simulate the needs and constraints of physical activity in daily life, as a screening tool to assess functional mobility and postural stability [21], should be considered for proper physical activity applications. It is a practical and important measurement method, and it is guiding in the estimation of dynamic balance scores in women and men [22, 23].

In spite of its popularity, there have been no studies dealing with all body composition parameters, functional movement capacity scores and dynamic balance values of lower and upper extremities of young zumba participants. In this respect, the general purpose of the study was to determine the changes in Body Composition-Dynamic Balance and Functional Movement Capacity of female high school students with body mass index (BMI) over 24.9 before and after the eight-week zumba exercise program.

Hypothesis.

Regular participation in 8-week zumba exercise can improve the body composition (body weight, body fat percentage, BMI parameters) of young female high school students with high BMI values.

8-week zumba exercise applications can improve the dynamic balance control of the lower and upper extremities of the working group with functional movement capacity values, which are important parameters for disability prevention and healthy living.

Purpose. The aim of this study was to investigate the changes in Body Composition-Dynamic Balance and Functional Movement Capacity of 60 female high school students with body mass index (BMI) over 24.9 before and after the eight-week zumba exercise program within one group pre test-post test experimental design**.**

Materials and Methods

Participants. For the purpose of the study; 60 female (Xage;16,75 ± 0,43) students participated in the study, who have higher than 24.9 BMI values (BMI; 29.56±4.12; body fat %; 36.83 ± 6.1) and no physical and neurological diseases, no serious limb discomfort and no sports activity.

Tests and protocols

Data Collection Tools

The portable stadiometer Seca-213 was used to determine the lengths of the study group. TANITA-Bc 545 N Innerscan Segmental Body Composition Analyzer, "Y-Balance Test was implemented to determine the dynamic balance values for the lower and upper extremities, Functional Movement Screen (FMS) test, one of the determinants of functional mobility capacity, was performed to determine the values of physical fitness and injury risk. To determine the number of heart beats during zumba exercises, Polar M430 Heart Rate Monitor was used.

Data Collection

Body Composition Measurements

In order to determine body composition parameters of the study group, TANITA-Bc 545 N device was used in sports clothes and bare feet.

Dynamic Balance Measurements

Dynamic balance measurements were evaluated with the Y-Balance Test, a functional test that required strength, flexibility, neuromuscular control, stability, range of motion, balance and proprioception, taking into account corrected arm and leg length [24]. The test was applied in two parts in order to determine the dynamic balance values of the lower and upper extremities. In the first section, the lower extremity mesaurements were performed in the anterior/posterio-lateral and posterio-medial plane, and in the second section the upper extremity measurements were performed in the superior/inferior and medial plane. Lower limb lengths of the study group were performed before the test, from the lower edge of the anterior superior iliac spine of the right leg to the distal edge of the medial malleolus while the subject was in a supine position on a table; the length of the upper limb, C7 vertebral spine after defining the spine from the tip of the right middle finger to the end point measured in centimeters with a tape measure [25]. Sufficient warm-up time was given to all participants before the test, and after 5 minutes of rest, trial measurements were made. Pariticipants were asked to perform and complete the test by stretching the foot in the air as far as possible in the planes indicated on one leg without hands and waist in sports clothes. The highest value was recorded after three replicates [23, 25]. It was defined "combined balance test score":

Relative (normalized) reach distance (%) = maximum reach distance/limb length * 100.

Data were calculated separately for both arms and legs. Upper extremity applications were determined by the formula [26]:

Relative (normalized) reach (%) = maximum reach distance/limb length * 100

After body composition measurements and dynamic balance tests, FMS measurements were performed, scored and the results were analyzed.

Functional Movement Screen (FMS) Test

The FMS test protocol developed by Cook was used

to evaluate functional movement [27]. A test consisting of 7 subtest (deep squat, hurdle step, in-line lunge, shoulder mobility, active straight leg raise, trunk stability push-up, and rotary stability) was shown to the research group to explain and demonstrate FMS movements to ensure consistency before testing. After two trials, the study group was tested and then 3 trial rights, approximately 5 seconds between each trial and 1 minute rest between each test. The results were evaluated according to Cook's instructions in the range of 0 to 3 points, depending on the quality of body movements and how it was performed.

Zumba Fitness Program

A total of 24 zumba exercise sessions were conducted from three days a week for eight weeks, and the studies were conducted by a certified zumba instructor as a 60-minute session between 16.00-17.00 hrs. Zumba choreographies were generated from movements with less strain on the skeletal muscle system, avoiding high-intensity jumping movements suitable for the overweight study group. The warm-up part of zumba program is 8-10 minutes and consists of basic dance steps without jumping and bouncing movements accompanied by gradually accelerating music tempo (tempo 120-140 bpm) and aims to increase body temperature, muscle blood flow, joint mobilization and psychological preparation. The mean phase of the zumba exercise, where the intensity was determined by changing music tempo in the study sections, was performed with approximately 10 zumba songs in the tempo range of 140-160bpm and a resting time of 20-30 seconds was given between the songs [9]. During the study, Polar M430 Heart Rate Monitor was implanted to the person with the highest BMI value considering the possible risks in practice and the maximal heart rate was tracked according to the formula (208-(0.7xAge)). In the last stage of the exercise, the cooling phase, the music gradually slowed down and the exercise was completed with a 120 bpm paced song.

Statistical Analysis

It was used SPSS 22 software. Body Weight, BMI, Body Fat%, FMS (functional mobility capacity), Lower Extremity Y-Balance Test values show normal distribution. Pre-test and post-test analyzes are not suitable for normal distribution. The significance level was determined as 0.05. The body weight, BMI, Fat%, dynamic balance, and functional mobility capacity of the study group which were changed during zumba exercises were calculated by the following formula:

$$\%\Delta=(\text{post-test-pre-test})/\text{pre-test} * 100$$

Results

According to the purpose of the research, the findings were as follows: the results of the body composition of the study group, the functional movement capacity (FMS) measurement results and results of the lower and upper extremity dynamic balance measurements are given in Table 2 and Table 3.

Table 1. The training program for the study group

Workout Plan	Content	Duration
Starting-Warm-up Part (8-10 minutes)	Zumba dance movements consisting of basic dance steps without jumping and bouncing movements at 120-140 bpm music pace, which lasts approximately 8-10 minutes, gradually accelerating/resting time between songs 20-30 seconds	Eight weeks (24 sessions of zumba sessions each of which consists of 60 minutes)
	minutes *Average Song time 4.30 min	
Mean Phase (40-45 minutes)	Zumba dance moves with 10 zumba songs in the tempo range of 140-160 bpm lasting approximately 40-45 minutes *Average Song time 4.30 min/ Rest time between songs 20-30 seconds	
	Approximate	
Cooldown (approximately 5 minutes)	Cooling and stretching movements at 120 bpm tempo, which lasts approximately 5 minutes and gradually slows down	

Table 2. Study Group mean (±SD) weight, BMI, body fat percentage, FMS

Indicators	Test	Mean	Development %	Sig. (2-tailed)
Weight (kg)	Test	75.99±10.91	-4.16	0.000*
	Re-test	72.83±10.63		
BMI	Test	29.56±4.12	-4.22	0.000*
	Re-test	28.319±3.98		
Body Fat %	Test	36.83±6.1	-3.75	0.002*
	Re-test	35.44±5.78		
FMS (score)	Test	13.7±2.53	15.45	0.000*
	Re-test	15.82±1.98		

*p<0.005

Table 3. Study Group Upper and Lower Extremity Y Balance mean (±SD) Test-retest

Balance	Indicators	Test	Left / Right	X± S	Development %	Sig. (2-tailed)
LOWER EXTREMITY Y BALANCE	ANTERIOR (A)	Test	Left	65.27±7.24	5.22	0.000*
		Re-test		68.68±7.54		
		Test	Right	66.52±6.92	7.54	0.000*
		Re-test		71.54±7.08		
	POSTERO MEDIAL (PM)	Test	Left	94.19±11.00	2.01	0.002*
		Re-test		96.08±12.27		
		Test	Right	95.88±11.76	3.41	0.000*
		Re-test		99.15±11.93		
	POSTERO LATERAL (PL)	Test	Left	95.13±10.46	4.08	0.000*
		Re-test		98.99±11.13		
		Test	Right	95.88±11.07	4.41	0.000*
		Re-test		100.11±11.15		
	COMPOSITE reach distance (%)	Test	Left	84.87±8.28	3.6	0.000*
		Re-test		87.92±8.59		
		Test	Right	86.10±8.74	4.85	0.000*
		Re-test		90.27±8.83		
UPPER EXTREMITY Y BALANCE	MEDIAL	Test	Left	67.75±20.47	5.4	0.000*
		Re-test		71.41±18.46		
		Test	Right	65.45±20.50	6.37	0.000*
		Re-test		69.62±18.16		
	SUPERIOR	Test	Left	50.12±15.09	5.78	0.000*
		Re-test		53.02±14.85		
		Test	Right	49.97±17.61	7.58	0.000*
		Re-test		53.76±16.32		
	INFERIOR	Test	Left	62.23±18.02	3.67	0.000*
		Re-test		64.52±18.49		
		Test	Right	62.63±20.39	5.37	0.000*
		Re-test		65.99±19.36		
	COMPOSITE reach distance (%)	Test	Left	60.04±16.29	4.91	0.000*
		Re-test		62.98±15.55		
		Test	Right	59.35±17.80	6.36	0.000*
		Re-test		63.12±16.28		

*p<0.005

There was a statistically significant improvement in pre-test, post-test weight, BMI, body fat % and FMS values obtained from the study group ($p<0.05$). When the percentages of development were examined, it was observed that all the parameters related to body composition of the study group were changed in the expected way.

According to the pre-test and post-test lower extremity dynamic balance measurement results Anterior (A), Postero Medial (Pm), Postero Lateral (PL) and Composite values were found to be statistically significant ($p<0.05$). When the development percentages are examined, there is a positive change in all parameters. In the pre-test and post-test upper extremity dynamic balance measurement results; Balance scores of Medial (M), Superior (S), Inferior (I) and Composite values were found to be statistically significant ($p<0.05$). When the percentages of development were examined, Medial (M), Superior (S), Inferior (I) and there is a positive change in the composite values.

Discussion

This study aims to analyze the effects of eight week zumba exercise program on body composition, dynamic balance and functional movement capacity values of 15-17 year old female high school students with high body mass index (BMI>24.9) without sports background. The research supports "*the hypothesis that regular participation in 8-week zumba exercise practices can improve body composition (body weight, body fat*

percentage, BMI parameters) parameters, functional movement capacity values and dynamic balance control of upper and lower extremities of young female high school students with high BMI values".

According to the findings of the study, during the 8-week zumba training program, it is seen that it provided statistically significant improvement in total body weight loss (p=.000), BMI parameter (p=.000), body fat % (p=.002), FMS values (p=.000) and lower an upper extremity dynamic balance parameters (p=.000) (Tables 2-3). At this point, it is possible to talk about the positive effect of the zumba exercise program. In parallel with the study, Nedkova and Nikolova [7], in a series of studies covering university student, showed that zumba exercises with different methodologies increased the willingness of students to participate in these studies within the scope of physical education course. Ljubojević et al. [9] also stated that universal music rhythms also motivate participants to participate in regular physical activity through the desire to return to the zumba program over and over again. Group fitness exercises such as zumba are a sport that helps lose weight, positively affects BMI values and provides positive effects on body composition [6], as well as positive changes in women's body composition, it shows positive effects on motoric and functional abilities [9].

Studies based on overweight women show that the condition gained as a result of zumba exercises positively affects health and can be recommended as an effective method for weight control for overweight women [28-30]. Baştuğ et al. [31]: reported that they observed positive effects on body composition and BMI values with 12-week zumba exercises applied to intervention group and these results show that the study is supported by the literature.

The realization of most of the daily activites depends on the provision of proper posture and balance in this position. It is known that balance is a risk factor especially for the occurrence of injuries in women [18] and studies have shown that there is a positive correlation between high BMI and postural instability, and this requires greater effort to maintain postural balance in the individual [17]. As a result of the study, it was observed that 8-week zumba exercise program made a significant difference in the improvement of post-exercise balance performance in dynamic balance tests similar to the literature, however, zumba studies also improved posture control. Many studies have reported that participation in regular zumba exercises creates significant positive changes in static and dynamic balance parameters [13, 32] and that zumba dance activities create significant improvements in static and dynamic balance values even in patients with Parkinson's disease [33]. In 2018, Baştuğ examined the effects of dance exercises on body composition, flexibility, balance and concentration, including zumba, and recommended regular dance exercises for the development of all these features [34].

Functional Movement Screen (FMS) test is used as a screening tool to evaluate functional mobility and postural stability [21]. FMS test aims to simulate the needs and constraints of physical activities in daily life. In order to perform physical activity applications correctly. FMS test should be considered as a guide in estimating dynamic balance scores in women and men [22, 23]. Determination of functional mobility capacity through FMS is an application method that tries to increase the educational activites of physical activities in daily life, including sports activities, to identify and simulate situational needs and constraints. Assuming that endurance, motion, flexibility and stability are a prerequisite for optimal athletic performace, FMS can be considered a safe screening tool to assess functional mobility and postural stability [21]. According to the results of the study, significant improvements were observed in FMS scores, which are the determinants of functional fitness, consisting of seven subtests, which measure functional fitness, and the results were statistically significant (Table 1). When health benefits are taken into consideration, it can be said that controlled zumba exercise studies will have a positive effect on FMS scores as a result of functional movement development.

Conclusion

The results of the study clearly show that the eight-week zumba training program (3 days-60 minutes per week) has produced significant positive improvements in body composition values, functional mobility assessment results and dynamic balance parameters of high school students with a high body mass index of 15-17 years of age. In line with this, zumba exercises can be suggested as an effective group exercise for this age group. Considering the benefits of regular physical activity, the importance of participation in fitness activites such as zumba in terms of health must be emphasized. And it is thought that such multi-repetitive training programs will provide benefits for individuals as increasing functional movement capacity values and dynamic balance parameters as well as improvement of BMI. In addition, zumba exercises can be suggested as an effective exercises for encouraging individuals with sedentary lifestyle to physical activity in long term weight control and body composition development.

Conflict of interests

The authors declare that there is no conflict of interests.

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Cite this article as:
Eroğlu Kolayiş I, Arol P. The effect of Zumba exercises on body composition, , dynamic balance and functional fitness parameters in 15-17 years old women with high body mass index. *Pedagogy of physical culture and sports* (*Pedagogics, psychology, medical-biological problems of physical training and sports)*, 2020;24(3):118-124. https://doi.org/10.15561/26649837.2020.0303

Received: 12.11.2019
Accepted: 16.12.2019; Published: 05.01.2020

Anthropometric evaluation of ratio between extremity length and body length in basketball player adolescents

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Abstract

Purpose: To determine whether the limb length-to-body ratio in young basketball players (15-18 years) is different in comparison to those who do not play basketball, and to contribute to the hypothesis that those with which body type can be more successful in basketball.

Material: The measurements were performed on 42 individuals (29 boys, 13 girls) who have played basketball for at least three years and 41 individuals (31 boys, 10 girls) who did not play basketball. A standard form was prepared for these measurements and the measurements were made according to this form. The data were summarized using mean and standard deviation values, and their accordance with normal distribution was evaluated with the Shapiro-Wilk test. The t-test was used for evaluating the independent samples. Values of $p<0.05$ were considered significant. The measurements were performed using a tape measure.

Results: As a result of the measurements, the height/fa (forearm) ratio was 7.09 in non-basketball players and 6.71 in basketball players. The height/hl (hand length) ratio was 10.0 in non-basketball players and 9.06 in basketball players. The height /lll (lower limb length) ratio was 1.86 in non-basketball players and 1.73 in basketball players. The height /tl (thigh length) ratio was 3.28 in non-basketball players and 3.41 in basketball players. According to our findings, the ratio of forearm, hand, thigh and leg to body were increased in basketball players. There was no significant difference in terms of gender.

Conclusions: Athletes possess anthropological and physiological characteristics specific to the sport in which they participate. In terms of limb length, there was an anthropometric difference between the young population who played basketball and the normal population.

Keywords: basketball, morphometry, anthropometric, limb.

Introduction

Humans have various body types from an anthropological perspective. These types are defined in anthropological terms such as endomorph, mesomorph and ectomorph. In general, people choose or are directed to sports that are suitable for their body type. This increases the success of people in the related sport. Often, there are anthropological and physiological differences between individuals who participate in sports and those from the normal population [1-3].

There are many articles on basketball players. However, we failed to come across any anthropometric study in the literature similar to ours. The most similar study was performed in 1991 by a researcher named Bale [4]. This researcher grouped the basketball players according to their positions on the field and reported that the midfield players had longer limbs than the defenders.

The comparison of the anthropometric measurements of athletes is of great importance in modern sports and is still being studied by this sport science [5].

The literature holds this type of studies in various sports branches. Sedeaud et al. reported about the physical differences between the normal population and individuals that played baseball, football, ice hockey and basketball. In the same study, the authors reported that the top scorers in the NBA were over 2 meters [6, 7].

Gabbett et al. performed anthropometric measurements on young volleyball players from the first-tier, second-tier and amateur leagues. The authors showed that the physical and anthropometric features (such as height, skinfold thickness, lower body muscle strength and agility) of the players increased according to the level of the league [8].

Anthropometric studies comparing different sports branches can also be found in the literature. Bayios et al. took the anthropometric measurements of 518 players from the Greek women's first basketball, volleyball and handball leagues. The authors concluded that volleyball players comprised the tallest of the three groups and that basketball players were taller and leaner than the handball players [9].

Studies on extremity profiles have shed light on the literature [9-11].

In a study on body profiles of professional soccer players, Snow et al. reported different extremity profiles for those who played soccer in comparison to the individuals from the normal population [12].

Pelin et al. compared the athletes who played American football, basketball, volleyball and soccer among themselves and with non-player individuals in terms of anthropometric features. The authors observed longer lower limbs in volleyball and basketball players, an increased biiliac width in American football players,

doi:10.15561/26649837.2020.0304

and a smaller structure in soccer players [5].

In our study, we tried to present the anthropometric differences in terms of limb length between the young population who played basketball and the normal population.

Materials and Methods

Participants.

Attention was paid to the include subjects who have played basketball for at least three years. The measurements were performed on 42 individuals (29 boys, 13 girls) who played basketball and 41 individuals (31 boys, 10 girls) who did not play basketball.

Research Design.

A standard form was prepared for these measurements and the measurements were made according to this form.

The following parameters were used during the measurements:

- Upper limb length (ULL): The distance between the tips of the shoulder and the middle finger (cm);
- Arm length (AL): The distance between the shoulder tip and the midline of the elbow joint (cm);
- Forearm length (FAL): The distance between the midline of the elbow joint and the wrist (cm);
- Hand length (HL): The distance between the wrist midline and the middle fingertip (cm);
- Lower limb length (LLL): The distance between the anterior superior iliac spine and the ground (cm);
- Thigh length (TL): The distance between the anterior superior iliac spine and the mid-knee joint (cm);
- Leg length (BU): The distance between the mid-knee joint and the ground (cm);

Statistical Analysis.

The data were summarized using mean and standard deviation values, and their accordance with normal distribution was evaluated with the Shapiro-Wilk test. The t-test was used for evaluating the independent samples. Values of $p<0.05$ were considered significant. The measurements were performed using a tape measure.

Results

In order to standardize the measurements, the ratios to the subject's height were considered in the assessments. All ratios and their statistical evaluations are presented in Table 1.

While the height/ULL ratio was 2.28 in non-basketball players, it was found 2.26 in basketball players. ULL was greater in basketball players (p=0.140). However, no significant difference was observed regarding the upper limb length.

While the height/AL ratio was 5.75 in non-basketball players, it was found 5.57 in basketball players. Basketball players had a greater AL (p=0.082). However, no significant difference was observed regarding the arm length.

The height /FAL ratio was 7.09 in non-basketball players and 6.71 in basketball players. Forearm length was higher in basketball players and the difference was found to be significant (p=0.001).

The length/HL (hand length) ratio was 10.0 in non-basketball players and 9.06 in basketball players. Hand length was also found to have increased significantly in basketball players (p=0.001).

The height/LLL (lower limb length) ratio was 1.86 in basketball players and 1.73 in basketball players. Lower extremity length was also found to have increased significantly in basketball players (p=0.004).

The height/TL (thigh length) ratio was 3.28 in non-basketball players and 3.41 in basketball players. Thigh length was also found to have increased significantly in basketball players (p=0.002).

The height/LL (leg length) ratio was 3.86 in non-basketball players and 3.51 in basketball players. Leg length was also found to have increased significantly in basketball players (p=0.0001).

Table 1. The height-to-limb length ratios in basketball and non-basketball players.

Group	n	Mean	St deviation	P value
Height/ULL Non-basketball player	41	2.28	0.06	0.140
Basketball player	42	2.26	0.06	
Height/AL Non-basketball player	41	5.75	0.42	0.082
Basketball player	42	5.57	0.50	
Height/FAL Non-basketball player	41	7.09	0.48	0.001
Basketball player	42	6.71	0.53	
Height/HL Non-basketball player	41	10.00	1.53	0.001
Basketball player	42	9.06	0.72	
Height/LLL Non-basketball player	41	1.86	0.25	0.004
Basketball player	42	1.73	0.11	
Height/TL Non-basketball player	41	3.41	0.21	0.002
Basketball player	42	3.28	0.16	
Height/LL Non-basketball player	41	3.86	0.23	0.0001
Basketball player	42	3.51	0.27	

Discussion

Several comparative anthropological and physiological studies on various sports exist in the literature [1-3]. Needless to say, these studies help us to learn the anthropological and physiological characteristics of the individuals who are active in any sport and help those who want to participate in sports to make their choices. Sanchez-Munoz et al. compared the anthropometric characteristics of male and female tennis players who played in the premier and amateur leagues. There was no significant difference in terms of height and weight between the male players in the premier and amateur leagues, however, a difference was detected in female players [13].

Some studies in the literature have compared the athletes in terms of anthropometric and physiological aspects according to gender, age and the zones they played. For example, Gabbett reported about the anthropometric and physiological characteristics of the rugby league players (Youth League and Young Women's League) in two studies. There was no significant different in terms of anthropometric and physiological differences between the selected and unselected players in the Young Women's premier rugby league, whereas a significant difference was found between the offensive and defensive players in terms of body mass, skinfold thickness and acceleration [14, 15]. In another study, Bale grouped the young female basketball players who played in the first league according to their positions on the field, performed anthropometric measurements, and found that midfield players had longer limbs, wider hips, and more muscles [4]. Ostojic et al. compared the physical and physiological measurements of the basketball players who played in the first league. The researchers found that the defenders were older and experienced, the midfielders were taller and heavier, and the offensive players were taller and heavier than the defenders [16].

A study comparing various anthropometric measurements in terms of age in the same sport was conducted by Karalejic et al. The authors performed and compared anthropometric measurements of basketball players aged 12 to 14 years, and noted that all measurements other than the sitting height-to-standing height ratio and body mass index were different [17].

As in our study, athletes have been compared with the normal population in several studies [18-20]. In our study, basketball players and non-basketball players were compared in terms of some anthropometric values. In our study where we compared the individuals who were 15 to 18 years of age and played basketball with those who did not play basketball, the hand, forearm, lower limb, thigh and leg lengths were found significantly increased in basketball players.

Conclusion

Athletes possess anthropological and physiological characteristics specific to the sport in which they participate. There was an anthropometric difference between the limb lengths of the young population that played basketball and those of the normal population. If this study is to be performed with the participation of more subjects and the inclusion of other parameters, we believe that it will provide more detailed information to those who are interested in basketball.

Source of Funding

No financial or material support was received in conducting this research or in preparing this manuscript.

Conflicts of interest

The authors declare no conflict of interest.

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Cite this article as:
Korkmaz MF, Cetin A, Bozduman O. Anthropometric evaluation of ratio between extremity length and body length in basketball player adolescents.. *Pedagogy of physical culture and sports* (*Pedagogics, psychology, medical-biological problems of physical training and sports)*, 2020;24(3):125-128.
https://doi.org/10.15561/26649837.2020.0304

Received: 17.11.2019
Accepted: 16.12.2019; Published: 05.01.2020

Needful-motivational tasks as an effective condition for the technical training of schoolchildren aged 11-12 during the training of the volleyball section

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Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection

Abstract

Purpose: To develop a module of need-motivational training tasks of the section "Volleyball for students aged 11-12"..

Material: The experiment involved the schoolchildren aged 11-12 (n=43). The schoolchildren had no contraindication to the physical education. Classes according to the author's module of need-motivational teaching tasks were conducted with the secondary school students of the fifth form "A" (n=22, experimental class). Pupils of the fifth form "B" (n=21) took a traditional training program during the physical education lesson of the "Volleyball" section. The study was conducted for two months (October-December 2018). Each pupil used a fitness bracelet during the class monitoring the heart rate at a physical education lesson. Special testing was used in three blocks. The first block is the calculation of the number of correctly performed technical actions with the ball without a partner. The second block is the calculation of the technical actions in pairs through the net. The third block is an educational game. Statistical analysis of the data was performed using t-student test..

Results: A significant ($p<0.01$ and $p<0.05$) advantage of the secondary school students of the experimental class was revealed in comparison with another approach to teaching the technical elements of volleyball. A higher mastery level of the basic elements in volleyball was obtained according to the special set of tasks: receiving and passing the ball with two hands from above; receiving and passing the ball with two hands from below (in place, with various types of movements, with lightened and complicated conditions).

Conclusions: It is proved that an increase of the theoretical needful-motivational teaching tasks during the physical education classes has a positive effect on the activation of motor activity of the schoolchildren. The synergetic relationship between theoretical and practical training allows to achieve personal, regulatory, communicative, cognitive and objective results.

Keywords: motivation, need for activity, training, volleyball, physical education, schoolchildren, technical training.

Introduction

The main role of the activity approach in the formation of the younger generation is justified in the field of psychology of physical culture and sports by the experts [1, 2]. Recently, attention has been focused on the study of the motivational aspects in physical education in various organizations of the middle and higher levels [3, 4]. Active motivation in the activities of the schoolchildren influences and transforms the surrounding world [5]. Such motivation serves as a means of satisfying a variety of fitness and fitness needs [5]. The motivation is simultaneously a factor in the physical, mental and spiritual formation of a socially useful person [6, 7]. The structure of training activity includes: need, motive, goal, conditions for its achievement [8, 9]. It represents the unity of two parties - internal (goal, analysis of conditions, action scheme, choice of means) and external (physical activity of the subject, interaction of means with the object or subject of activity, objective processes, result) [10, 11]. Any systematic educational activity is necessarily correlated with the concept of need and motive [12, 13]. It is one of the leading components of the educational process. Such a formation of need and motive is important for the harmonious upbringing of a young person and the processes of formation of his physical culture-oriented consciousness [14, 15].

Moreover, the emphasis shifts to the functional chain: "goal-means-result" in a real system of physical education [16]. At the same time, due attention is not paid to the

doi:10.15561/26649837.2020.0305

need-motivating component [17]. This is most clearly manifested in sports and fitness activities [18, 19]. In this case, the teacher focuses students on the operating side. The teacher determines what and how to do [18, 19]. In the implementation of this process, cause-effect relationships are ignored: why it is necessary to do just that [19, 20]. Motivational-semantic guidelines remain without any attention. They are aimed at achieving certain values in the implementation of the technical training [21, 22]. With this approach, the secondary school student masters the system of motor actions at the level of operations [23]. In this case, the goal and means are a set and subsequent reflection does not occur [23]. Ultimately, this does not contribute to the effectiveness of the processes of training and education [24, 25]. In many respects, efficiency is determined by the principle of meaningfulness of the technical actions [24, 25]. Therefore, it is important disclosing the internal relationships of the needful-motivational link to the schoolchildren: the study and improvement of the new technical actions during the lesson of physical education [12].

The needful-motivational component is reduced to the following sequence of links: need, motive, interest, value orientations, etc. [17, 26]. They are the main initial mechanism of educational activity, its motivating and organizing beginning [6]. This approach determines the nature of the chosen goals and the means achieving them. It is accompanied by the student's mental activity [16]. Here his worldview, conviction and conscious attitude to the development of the values of physical culture and sports are formed [27]. In this case, the particular relevance to the formation of the need for motor activity among the schoolchildren is the conscious motivation for the learning process. However, an insufficiently studied issue is the implementation of these processes in the practice of studying the new technical actions during the physical education classes.

Hypothesis of the research. The use of the needful-motivational training tasks during the lesson of the volleyball section will let to achieve a higher effectiveness level of technical training among the schoolchildren aged 11-12.

The purpose of the research: to develop a module of the need-motivational training tasks of the "Volleyball" section and proving the effectiveness of its implementation of the technical training of the schoolchildren aged 11-12 during the physical education classes.

Material and methods

Participants: The schoolchildren aged 11-12 years took part in the experiment (n=43, fifth form of the secondary school). The schoolchildren had no contraindication to physical education. Classes according to the author's module of need-motivational teaching tasks were conducted with the fifth form "A" schoolchildren (n = 22, experimental group — EG). The pupils from the fifth form "B" (n = 21, control group – CG) took a traditional training program of a physical education lesson of the "Volleyball" section. The parents gave informed consent for their children to participate in the study. For the research, classes were selected in which the volleyball section was not previously studied during the physical education lesson. In the previous academic year, these schoolchildren studied outdoor games with the volleyball elements.

Organization of the research: The study was conducted for two months (October-December 2018). Each pupil used a fitness bracelet monitoring the heart rate during a physical education lesson [28]. At the end of each physical education lesson, the teacher collected data of the average heart rate of each pupil of four parts of the lesson: preparatory part (10-15 minutes), training in the first half of the main part (12-14 minutes), improvement in the second half of the main part (10-12 minutes) and the final part (5-7 minutes). At the end of the research (December 2018), control tests of the schoolchildren were conducted testing the technical readiness of the volleyball section. Within two days, the secondary school students passed a set of tests (n=7). The first testing unit included counting the number of correctly performed technical actions with the ball without a partner: receiving the ball with two hands from above (juggling), receiving the ball with two hands from below (juggling), receiving and passing the ball with two hands from above the wall, receiving and passing the ball with two hands below the wall. The second block of diagnostics was based on the implementation of the technical actions in pairs through the net: receiving and passing the ball with two hands from above through the net, receiving and passing the ball with two hands from below through the net. The third block included a training modified game of volleyball. The difference between this mobile game and the official volleyball game was as follows: the transfer could be carried out an unlimited number of times on its field (but not less than three times); the opponent received the ball by catching the ball with his hands and only then the previously studied technical actions (receiving and passing the ball with two hands from above or below) were implemented.

Currently, the pupils mastering the motor technical actions and pedagogical process of modeling a motor task are considered in three main forms [23]:

- cognitive (reflection of the action as it is);
- prognostic (reflection of the action in terms of its improvement);
- value-orientation which includes value awareness of the need (what needs to be done in a given situation), value-setting (for what), value-semantic decision (understanding the meaning and significance of the chosen means) (Fig. 1):

During the experiment, the physical education lessons (n=24) were implemented weekly three times a week. The exception is vacation for one week. The part of the lessons of physical education (n=16) was devoted to the study of technical actions: receiving and passing the ball with two hands from above; receiving and passing the ball with two hands from below in place, with various types of movements, with lightened and complicated conditions. The part of the lessons of physical education (n=8) was

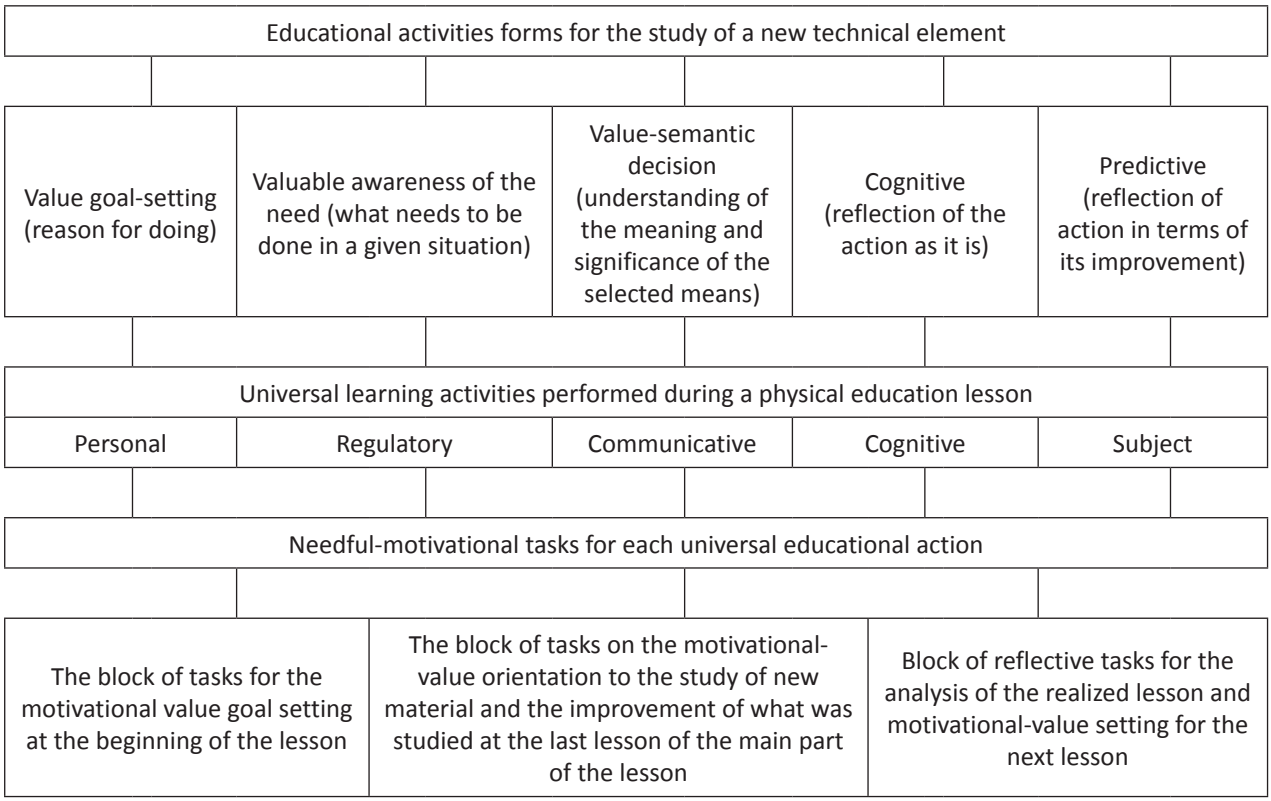

Fig. 1. The author's module of needful-motivational teaching tasks during the physical education classes

devoted to: studying the rules of the game of "Volleyball"; the implementation of general and special physical fitness; the various types of outdoor games, including elements of the Volleyball game. In the experimental and control class, technical training was carried out according to the program for 5–9 forms [29].

An example of the introduction of the author's module during one of the physical education lessons of the section "Volleyball" is presented in table 1.

Statistical analysis: SPSS20 program was used to evaluate the results of studies. The level of reliability of the obtained data was determined using Student's T-test at $p<0.05$ and $p<0.01$.

Results

In the fifth forms two physical education lessons from three per week (n=16) were accompanied by the author's module of needful-motivational training tasks of the volleyball section during the entire experimental work. After each lesson indicated above, the teacher collected data of the heart rate (pulse) of each pupil. In Fig. 2-3 average data are presented for each focus group of heart rate in each of the four analyzed parts of the lesson:

Based on the obtained data of average indicators of heart rate of each student, an unreliable difference ($p>0.05$) between the EG and the CG was revealed. It can be reliably stated that the introduction of the need-motivational training tasks at a physical education lesson did not affect the decrease or increase in the average motor load during the volleyball classes. The significance of differences ($p<0.01$) between the pulse of the schoolchildren from the EG and the CG was revealed in the main part of the lesson. In this part of the lesson, the maximum pulse increase was recorded in the EG compared with the CG. The significance of differences ($p<0.05$) between the pulse of the schoolchildren from the EG and the CG of the preparatory and final parts of the lesson was also revealed. In these parts of the physical education lesson, an increase of heart rate was recorded in the CG compared to the EG. A comparative analysis of the heart rate did not reveal significant differences between the EG and the CG at a level $p> 0.05$ in the main part of the lesson.

After the end of the research (December 2018), control tests of the schoolchildren were conducted to test the technical preparedness to the volleyball section in three test blocks. Table 2 presents the average indicators for each of the focus groups for the first and second block. The third block presents the results of 10 games (up to 10 points).

Based on the analysis of the obtained comparative data between the EG and the CG, the significance of the difference was revealed. The exception is the not reliability of the difference ($p>0.05$) for only one test, "Taking the ball with two hands from the bottom without a partner (juggling)". According to the test "Receiving and passing the ball with two hands from below through the net", the most significant difference ($p<0.01$) was revealed between the CG and the EG. The analysis of the effectiveness of the number of won games (n=9) of the third block of diagnostics clearly demonstrates the technical superiority of EG schoolchildren.

Table 1. The content of the needful-motivational training tasks at a physical education lesson with the topic "Receiving and passing the ball from above with two hands after moving forward"

The need-motivational tasks for universal educational actions of the "Volleyball" section at a physical education lesson with the topic: "Receiving and passing the ball from above with two hands after moving forward"				
Personal	**Regulatory**	**Communicative**	**Cognitive**	**Subject**
At the beginning of the lesson				
The volleyball player's gaze fasten eyes on the ball, which is either closer or further. This strengthens the eye muscles, develops the eye, and it makes the organs of vision work at full "power". And what do you think: how does volleyball influence the healing of the body?	In order for us to succeed a success during the lesson, we must achieve new results today: learn a new technical action; repeat the material of the last lesson. At the previous lesson, we evaluated ourselves on a scale of «Step forward!». How do we evaluate our skills today?	Volleyball teaches to communication and effective communication. And nowadays - the more friends, the more opportunities! At the game, team members understand each other perfectly. Players on the volleyball site will soon turn into the friends, assistants, business partners and advisers outside of training. And how do volleyball lessons help you in communicating or interacting with classmates?	At the last lesson, we studied the new technical action, "Receiving and passing the ball from above with two hands". Today we will improve it and study a new topic. And what do you think: to master this technical action, what should be done today? And what do you think: what game action is most often used in a game and is very important for victory in volleyball?	What unites the words: Victory, Russia, Team, Net, Ball. We recall the knowledge gained at the last lesson: in which year and where did volleyball originate? "Volleyball was born in 1895 in the USA in college of Association of Young Christians. Physical education teacher William Morgan invited students to throw the ball through the tennis net.
During the main part of the lesson				
Individualization of teaching the technique of new elements in volleyball: by gender; anthropometric data; by the students themselves to choose attacking or defensive technique.	Students' independent choice of tasks proposed by the teacher. Dosages for improving technical actions. Forms of self-monitoring and control during training activities.	Practical activities to improve the technique of admission in an interactive form (teacher and student): using comparisons and mini-experiments; when using information technology.	Organization of viewing video or visual demonstration material: studying new material that was prepared by the pupils as their homework.	Theoretical explanation of technical elements in an interactive form (teacher and student) by creating problem situations.
After the final part of the lesson (on the example of the scale "Step forward!" in one line)				
If you think that the studied topic today and in general volleyball lessons will be useful to you in your life as a health or personal development - take 2 steps forward.	Take as many steps forward as you set a mark to yourself for the correct execution of a new technical action (which we have studied today). If you were able to make self-esteem in the lesson and determine the conclusions for further self-improvement, then take 2 more steps forward.	If you today: could interact when working in pairs and in a team; You understood today teachers and students (who showed technical actions) - again take 2 steps forward.	If you have studied or learned new things during the sports game "Volleyball" today and you were interested - take 2 steps forward.	Who has showed their homework today (general developmental exercises) or prepared presentation material to study the new topic of the lesson - take two steps forward.

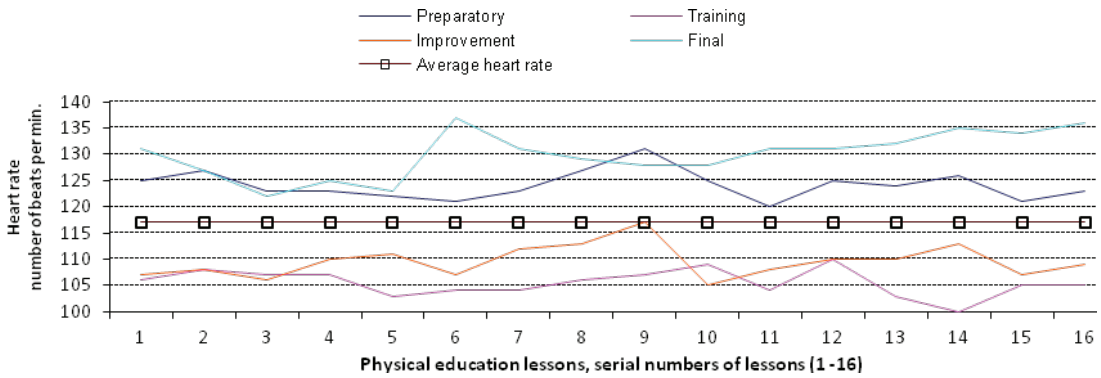

Fig. 2. The results of the pulse of each part of the lesson in the control class

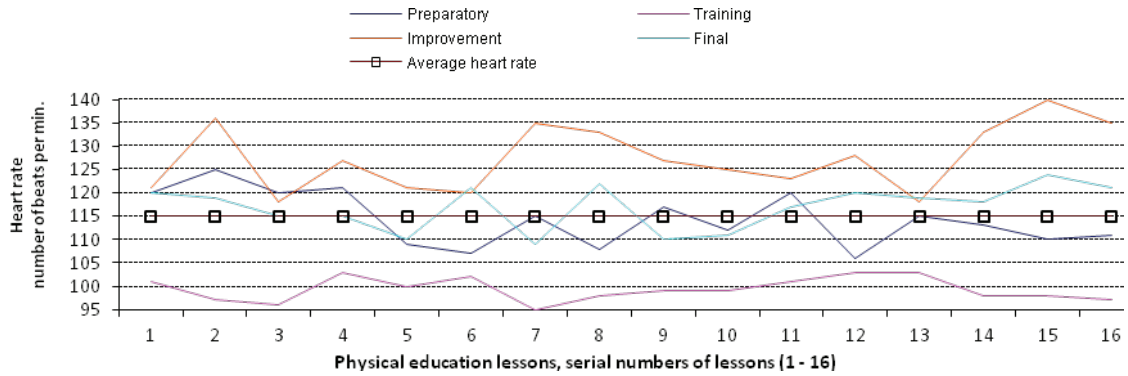

Fig. 3. The results of the pulse of each part of the lesson in the experimental class

Table 2. The results of the research of three test blocks

Test	Reception of the ball (juggling)		Reception and transfer of the ball from the wall		Receiving and passing the ball through the net		Educational games (n = 10)
	Above	Below	Above	Below	Above	Below	
EG	15.3	14.8	12.8	1.2	9.1	8.1	9
CG	13.6	9.5	9.2	8.4	6.6	3.3	1
P	>0.05	<0.05	<0.05	<0.05	<0.05	<0.01	

* During the test after the warm-up, only one attempt was counted before losing the ball

Discussion

In the implementation of active learning activities, it is recommended that the schoolchildren choose their goals and means of achieving them [25]. The authors prove the priority of independence in the process of learning the schoolchildren a new motor action in the process of physical education and sports [14]. The scientists especially note that it is before the start of the technical action that the formation and implementation of the individuality of the subjects of the training process takes place: the students and teachers [6], athletes and trainer [30]. The process of the joint needful-motivational activity is aimed at mastering a new technical action through an interactive exchange of meanings and values during the volleyball classes. At the same time, cognitive, acmeological, reflective and correctional processes are activated [15, 31]. As the results of this study show, only the systemic formation of all universal educational actions (personal, regulatory, communicative, cognitive and substantive) allows us to achieve reliable ($p<0.01$ and $p<0.05$) positive results. In this case, the time for practical actions is reduced in favor of the implementation of needful-motivational training tasks and reliable technical result is achieved. The experimentally obtained data are confirmed by individual and paired technical readiness. It is confirmed by the pupil's performance of the EG during the implementation of competitive activities.

It is necessary to place special emphasis on the fact that when implementing the educational activities at a physical education lesson, it is necessary using the practical and theoretical training [16, 18]. This statement is extremely important for understanding the essence of physical education as a sociocultural phenomenon [3, 10]. Particularly relevant for understanding the implementation of the technical training process for various types and sections of the subject "Physical Culture" is the creation of a theory system of physical culture and sports in a motivational aspect [10, 27]. A special priority of interpersonal communication during the lesson in the joint physical education activities of the schoolchildren

is assigned to their inclusion in cultural values, including physical [7, 24]. In this direction, the spiritual world of the schoolchildren is reflected in motor actions. The pupil receives satisfaction from the final result and from the performance of the technical actions [13, 19]. At the same time, a number of signs of active experiences of a teenager are highlighted. They are associated with the feeling of "fusion of processes of action and consciousness, theory and practice", the state of inspiration from "muscle joy" [11, 21]. In such cases, the motivational-demanding sphere of thinking dominates. The student enjoys the process of theoretical and practical activity [18, 26]. The results of our experiment prove the synergistic relationship of theoretical and practical training at a physical education lesson. They supplement the studies of other authors [11, 21, 18, 26]. The practical implementation of the module of the needful-motivational training tasks of the volleyball section significantly reduced the motor activity in certain parts of the lesson. The significance of the changes ($p<0.05$) was recorded during the preparatory and final parts of the lesson, in which the theoretical preparation was used to a greater extent. However, it did not have a significant effect on the average level of heart rate during the lesson ($p>0.05$). This can be explained by the fact that it was the generated motivation for the result that activated the practical activities of the schoolchildren at the stage of improving the technical actions in the main part of the lesson [28]. As the study shows, in this short period, a significant rise ($p<0.01$) was recorded in the heart rate increase of the schoolchildren of the experimental class during the lesson compared with the participants of the CG.

Conclusions

The study proved that the introduction of the module of the needful-motivational training tasks of the volleyball section is effective in the process of training and improving the technical training of the schoolchildren aged 11-12. With the help of regular classes in a special author's set of theoretical and practical tasks, a higher level of mastery of the basic elements was reliably obtained in volleyball: receiving and passing the ball with two hands from above; receiving and passing the ball with two hands from below in place, with various types of movements, with lightened and complicated conditions. The study proved that an increase in theoretical needs-motivational teaching tasks at the beginning and at the end of physical education lesson has a positive effect on the activation of motor activity of the schoolchildren in the main part of the physical education lessons. The synergetic relationship between theoretical and practical training contributes to the formation of personal, regulatory, communicative, cognitive and objective results.

The results of the experiment will be of interest to a wide range of the students and specialists in the field of physical education and sports as well as volleyball players. The author's recommendations on the implementation of diagnostic procedures for monitoring technical preparedness in volleyball will increase the motivation of the pupils setting their individual goals for improving the sports results. Further research will be aimed at studying the influence of the author's module of the need-motivational teaching tasks of different age and qualification categories of the population. An experimental study will cover a larger sample of the subjects with different individual capabilities and needs for the implementation of motor activity.

Conflict of Interest.

The authors declare that there are no conflicts of interest.

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Cite this article as:
Nagovitsyn RS, Kudryavtsev MD, Osipov AYu, Altuvaini AH, Markov KK, Doroshenko SA, Kuzmin VA, Savchuk AN, Kamosa TL, Plotnikova II. Needful-motivational tasks as an effective condition for the technical training of schoolchildren aged 11-12 during the training of the volleyball section. *Pedagogy of physical culture and sports* (*Pedagogics, psychology, medical-biological problems of physical training and sports)*, 2020;24(3):129-136.
https://doi.org/10.15561/26649837.2020.0305

Received: 20.11.2019
Accepted: 24.12.2019; Published: 05.01.2020

Changes in heart rate and blood lactate concentration during karate kata competition

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Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection

Abstract

Purpose: Karate is going to take part in the Olympic games, for the first time in Tokyo 2020. The aim of this study was to analyse the changes in heart rate (HR) and blood lactate concentration of karate practitioners performing different katas in competitive conditions.

Material: This study consisted of five elite male athletes (26.80±5.97 years), members of the Bulgarian national team in Shotokan karate, competing in the kata discipline. The study was conducted in competitive conditions during national competitions, in which three katas were performed by each of the competitors. Capillary blood lactate concentration (La) was determined at rest and after each kata. Heart rate (HR) was registered and physical activity was monitored by using three-dimensional accelerometers.

Results: The mean La increased progressively after each following kata: 1.4±0.32 mmol/L at rest, 4.7±1.91 mmol/L after the first, 6.8±2.59 mmol/L after the second, and 7.1±2.35 mmol/L after the third kata. This increase was significant after the second ($p<0.05$) and third ($p<0.01$) kata, in comparison with the registered La at rest. The mean HR values reached 179±11.55 bpm during the first, 180±11.63 bpm during the second, and 181.5±15.44 bpm during the third kata. Notwithstanding the differences in the physiological and biochemical parameters of participants No1 and No2, the mean physical activity units (FAU) were similar: 120 165 FAU after the first kata, and 111 805 FAU after the second vs 126 618 FAU after the first, and 89 544 FAU after the second kata, respectively. The explanation of these different observations is probably due to the style of the competitors. For instance, according to his coaches, participant No2 is performing kata with a higher level of tension in those muscle groups which are not necessarily involved in maintaining the posture and executing the moves. In contrast, the lower La values observed in participant No1, in comparison with the other competitors, were probably due to a more relaxed performance with smaller amplitude of the moves. Participants No4 and No5 from our study showed moderate La values after each of the three katas. According to their coaches, those competitors perform kata with optimal speed and amplitude, without too high a level of tension in the muscle groups which are not involved in the moves.

Conclusions: The La appeared to be a more informative parameter than heart rate, and the moderate increase of the La values (4-6 mmol/L) indicated optimal muscle tension and amplitude of moves when performing katas in competitive conditions. Further research is needed to determine the optimal La levels for the performance of different katas.

Keywords: accelerometer, competitors, elite, karateka, Shotokan.

Glossary

Kumite – karate competitive discipline in which two athletes perform various kicking, punching and blocking techniques towards each other with maximum control in order to score points and win the fight. The fights are ritualistic and non-contact [1].

Kata – karate competitive discipline in which each athlete performs various katas (prescribed sequences of karate techniques) [2].

Performance – (noun) the level at which an athlete is carrying out their activity, either in relation to others or in relation to personal goals and standards [2].

Technique – (noun) a way of performing an action [2].

Introduction

Karate is a martial art, which was developed in Japan, and has two competitive disciplines: kumite and kata [3]. Kata is comprised of a predetermined sequence of techniques, which represent actual fights against imaginary opponents, and the practitioners in this discipline are judged on the execution of their technique, rhythm, power and expressiveness of movements [4]. The performance in kata incorporates different types of kata techniques. During competitions, the karate practitioners perform fixed kata styles (katas) that have a different duration for every kata performed [3].

There are twenty-six fixed katas in Shotokan karate: Heinan Shodan, Heian Nidan, Heian Sandan, Heian Yondan, Heian Godan, Tekki Shodan, Bassai Dai, Kanku Dai, Enpi, Jion, Hangetsu, Kanku Sho, Tekki Nidan, Bassai Sho, Nijushiho, Jitte, Tekki Sandan, Unsu, Sochin, Gankaku, Meikyo, Wankan, Chinte, Jiin, Gojushiho Sho, Gojushiho Dai. The first five kata styles (Heian) are more

doi:10.15561/26649837.2020.0306

basic, and, therefore, they are the first learnt by karate practitioners. Each kata can be used in competitions in accordance with the athlete's ability and the rank of the competition [5].

It is recommended that karate practitioners should perform more specific training, plyometric exercises, and interval training in order to increase the ability to buffer acid muscle and blood concentrations [6]. The training and testing processes have to be very similar to competitive conditions for achieving high performance results in karate. Different specific karate tests, such as the Karate Specific Aerobic Test [7, 8], which has been reported to be valid and reliable field test for assessing karateka's aerobic fitness [9, 10], and programmed karate models [11, 12] have been developed. However, those studies are mostly concerned with karate competitors in the kumite discipline. The articles which analysed the physiological and biochemical changes in karate practitioners during karate kata competitions in the scientific literature are scarce, and the fact that this sport is going to be part of the Olympic games in Tokyo 2020 [13, 14], is increasing the interest in new studies in this area. Some authors reported heart rate responses [15, 16] or heart rate and oxygen uptake responses [17] of karate practitioners performing kata. The energy supply in karate kata comes from both anaerobic alactic and aerobic systems [18]. However, it is very difficult to determine visually the muscle efforts, as well as the energy expenditure of karate practitioners, while they perform one or another kata. Therefore, the assessment of physiological and biochemical changes in the body while performing kata can provide information on the functional status of the athlete, and help determine work capacity and level of training.

The aim of this study was to analyse the changes in heart rate and blood lactate concentration of karate practitioners performing different katas in competitive conditions, and compare the physiological and biochemical changes in the parameters of individual competitors in different katas.

Material and methods

Participants

This study consisted of five male competitors in karate kata from the Bulgarian national team. All participants possess black belts, and had a mean age of 26.80 ± 5.97 years, with an average sports experience in karate of 16.60 ± 7.27 years. Body weight and height were measured, and body mass index (BMI) was calculated as body weight [kg] divided by body height [m] squared.

The participants in this study were informed about its purpose, and signed informed consents were obtained, in accordance with the requirements of the Declaration of Helsinki for Human Research [19].

Procedure

Three of the participants were tested during the 2018 National Karate Championships, and the other two at the 2018 Bulgarian National Cup. All of them qualified for the finals and won medals. The participants performed three katas at the competitions, and the average time between the end of the first kata and the beginning of the second was around 25 minutes, and the time between the second and the third was around 20 min.

Heart rate (HR) and Physical activity

Heart rate (HR) was registered with the Sigma heart rate monitor, and recorded with the 'beat by beat' telemetric system, called TEMEO, produced by the Security Solutions Institute, Bulgaria [20]. The telemetric system also recorded the average accelerations in three orthogonal axes (X, Y and Z) using a built-in three-dimensional accelerometer. In order to assess the physical activity during the kata performance, the total average acceleration vector (AccV) from the three axes was taken in periods of 100 milliseconds, and this data was summed during the time of performance of each kata in order to be obtained as physical activity units (FAU).

Lactate concentration (La)

Capillary blood was taken from the pendant of the athlete's ear before the first kata, and 5 min after the end of each kata, and the lactate concentration was determined using LactatePro 2 LT-1730, produced by the Japanese company, Arkray Global Business Inc [21].

Statistical analysis

The statistical analyses were conducted with Excel 2010 spreadsheets and GraphPad Prism 7.04 Software. Statistically significant differences between the average values were evaluated at $p < 0.05$, by using the non-parametric Friedman test with Dunn's multiple comparisons *post hoc* test. The data in the text and the tables are presented as mean ± standard deviation (SD), and in the figures are presented as mean ± SE.

Results

The anthropometric parameters, each athlete's sport experience in karate, as well as the best sports achievements from national and international competitions of all participants in this study, are presented in Table 1.

The names of the katas which were performed by each athlete at the competitions, and their duration, are presented in Table 2. The average time of the kata performances after the first stage of the competitions was 1:08 ± 0:02 min. The shortest performance was 1:05 min, and the longest was 1:13 min.

The individual values of the blood lactate concentration (La) after warm-up, first, second and third kata, in addition to their individual mean values from the three katas, are presented in Table 3. The mean La after the warm-up was 1.4 ± 0.32 mmol/L, and progressively increased after each following kata: 4.7 ± 1.91 mmol/L after the first, 6.8 ± 2.59 mmol/L after the second, and 7.1 ± 2.35 mmol/L after the third kata.

A statistically significant increase in the blood lactate concentration was found after the second ($p < 0.05$) and third ($p < 0.01$) kata, in comparison with the registered La at rest (after the warm-up). However, the increase in lactate concentration after the third kata vs the second one is not significant.

Heart rate and physical activity were monitored throughout the performance of each kata, and the individual heart rate before the first kata varied from

Table 1. Anthropometric parameters, sports experience and main achievements of the karate practitioners.

No	Age [years]	Experience [years]	Dan	Competition, place/frequency	Height [cm]	Weight [kg]	BMI [kg.m^{-2}]
1	20	6	1	IST, 3/1	183.0	80.0	23.9
2	23	18	2	WC3/1; EC3/1; NC1/1	165.0	73.0	26.8
3	25	13	1	NC 1/3	175.0	64.0	20.9
4	32	22	2	WC3/1; EC3/1; NC2/4	171.5	64.2	21.8
5	34	24	3	WC 3/1; NC 1/5	170.0	74.0	25.6
Average	26.80	16.60			172.90	71.04	23.81
SD	5.97	7.27			6.69	6.88	2.48

WC - World SKDUN Championships; EC - European SKDUN Championships; NC – National SKDUN Championships; IST – International Shotokan Tournaments

Table 2. Name and duration of each kata performed by the participants

No	Time 1st	mm:ss	Time 2nd	mm:ss	Time 3th	mm:ss
1	Jion	01:05	Enpi	01:02	Gojushiho-sho	01:47
2	Jion	01:08	Enpi	00:52	Kanku-dai	01:33
3	Jion	01:08	Enpi	01:01	Gojushiho-sho	01:22
4	Bassai-dai	01:13	Jion	01:19	Sochin	00:56
5	Kanku-dai	01:09	Enpi	01:21	Sochin	00:59

Table 3. Individual and mean values of the lactate concentration (La) after the warm-up (Rest), first, second and third katas during the competitions (n = 5).

No	Rest	La After 1st	La After 2nd	La After 3th	Average La after 1st,2nd and 3rd
	mmol/L	mmol/L	mmol/L	mmol/L	mmol/L
1	1.2	3.0	3.0	4.3	3.4 ± 0.75
2	1.3	7.8	9.8	8.1	8.6 ± 1.08#
3	1.1	4.5	6.6	10.5	7.2 ± 3.04
4	1.9	3.3	6.1	6.7	5.4 ± 1.81
5	1.5	5.0	8.5	5.9	6.5 ± 1.82
Average	**1.4**	**4.7**	**6.8***	**7.1****	
SD	**0.32**	**1.91**	**2.59**	**2.35**	
SE	0.14	0.85	1.16	1.05	

* - p< 0. 05 vs La at Rest; ** - p< 0. 01 vs La at Rest; # - p< 0. 05 vs the mean La of the three katas performed by participant No1.

84 bpm (participant No2) to 108 (participant No4). The heart rate increased in all competitors at the end of the performance of each kata, and the highest registered values were 189 bpm (participant No1 after the first kata) and 194 bpm (participant No3 after the second kata). During the rest periods between the performances, heart rate decreased and varied between 84 and 116 bpm. The heart rate and physical activity from two of the tested karate practitioners (No1 and No2) are presented in Figure 1.

The mean HR values of the karate practitioners showed a big increase while performing katas, reaching 179 ± 11.55 bpm during the first, 180 ± 11.63 bpm during the second, and 181.5 ± 15.44 bpm during the third kata (Figure 2). Heart rate decreased during the breaks between each kata (102.3 ± 13.02 bpm after the first, 105 ± 10.80 bpm after the second, and 105.5 ± 5.92 bpm after the third kata) and was close to the initial 96.3 ± 10.01 bpm.

Discussion

Elite senior male competitors in karate kata (n=12) from Serbia were reported to have a mean height of 174.3 ± 5.5 cm, weight 70.5 ± 5.0 kg, and BMI 23.2 ± 1.8 kg.m^{-2} [22]. These anthropometric results are very close to the

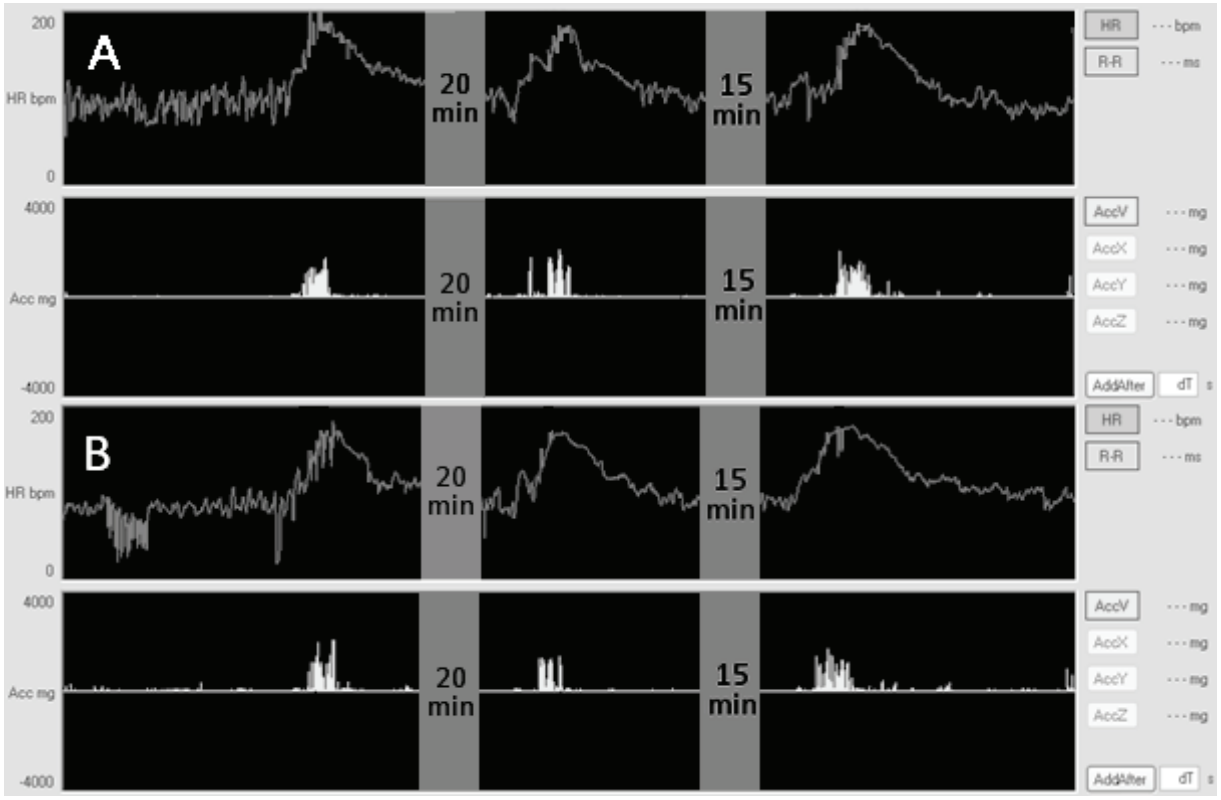

Figure 1. The heart rate (HR) and physical activity data presented as total average acceleration from the three-dimensional accelerometer (AccV) of karate practitioners No1 (A) and No2 (B) during the performance of 3 katas.

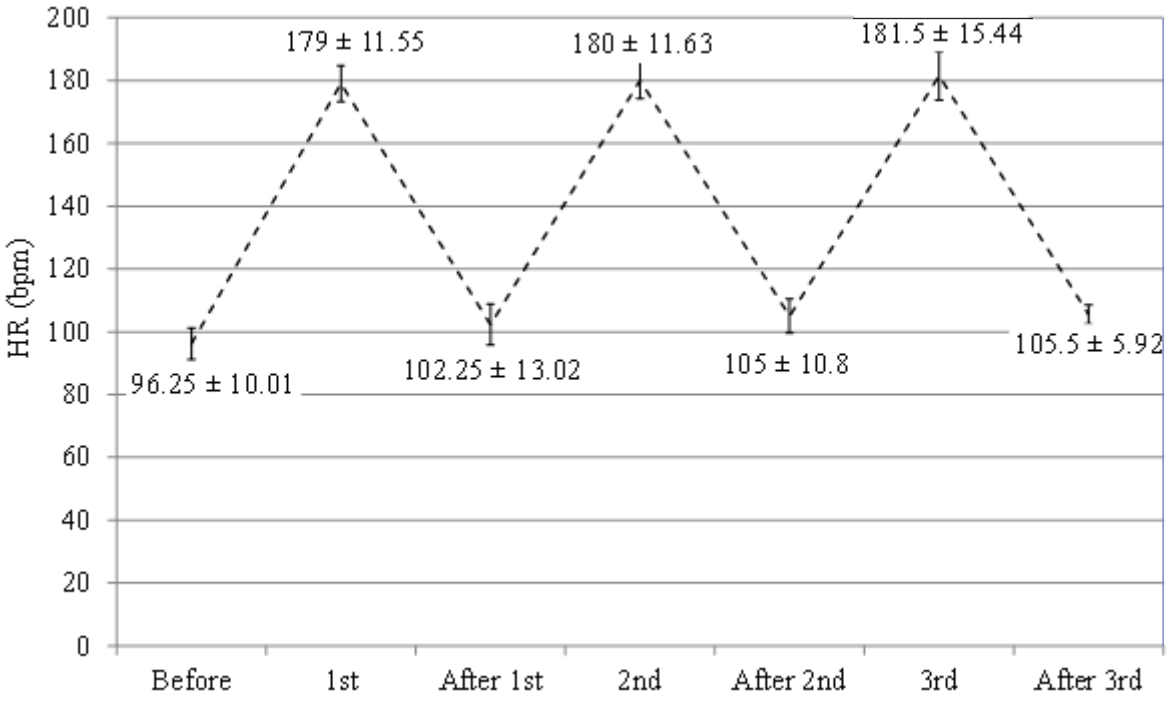

Figure 2. Mean heart rate (HR) values of the karate practitioners before and after the performance of each kata.

findings from our study: 172.9 ± 6.7 cm, 71.0 ± 6.9 kg, 23.8 ± 2.5 kg.m^{-2}, respectively.

In a study of three world champions in karate kata from Italy, the mean blood lactate concentration (La) was 4.8 mmol/L after performing Gankaku kata in training conditions [4]. Those values are very close to the ones in our study after performing the first kata (4.7 mmol/L). However, the individual La values of participant No2 in our study were considerably higher after the performance of each of the three katas (7.8 mmol/L, 9.8 mmol/L, and 8.1 mmol/L) in comparison with the other competitors. Similar values were registered only at the end of the third kata (Kanku-dai) in participant No 3 (10.5 mmol/L), but the duration of Kanku-day kata from participant No3 was 1.5 times longer than the other katas. Although participant No2 had the highest La values, his heart rate was lower than the other athletes, both during the kata performance (170 bmp) and during the recovery periods (around 90 bmp). Notwithstanding the differences in the physiological and biochemical parameters of participants No1 and No2, the mean physical activity units (FAU) were similar: 120 165 FAU after the first kata, and 111 805 FAU after the second vs 126 618 FAU after the first, and 89 544 FAU after the second kata, respectively. The explanation of these different observations is probably due to the style of the competitors. For instance, according to his coaches, participant No2 is performing kata with a higher level of tension in those muscle groups which are not necessarily involved in maintaining the posture and executing the moves. In contrast, the lower La values observed in participant No1, in comparison with the other competitors, were probably due to a more relaxed performance with smaller amplitude of the moves. According to Bussweiler and Hartmann, the style variations and the type of kata in karate lead to different levels of tension in muscle mass, especially in the lower body, due to the variety of stances [18]. Participants No4 and No5 from our study showed moderate La values after each of the three katas. According to their coaches, those competitors perform kata with optimal speed and amplitude, without too high a level of tension in the muscle groups which are not involved in the moves.

The mean heart rate value in the three world champions in karate kata, from the study already mentioned, was reported to be 150 bpm [4], which is lower than the one registered in our study for all participants and in all katas. The performance of Gankaku kata by the Italian elite competitors was defined to be of high technical difficulty, and was executed with a lower heart rate than that in our study, but with a similar blood lactate concentration values, which is probably because the Italian athletes performed this kata in training conditions.

In another study, which was also conducted on karate kata practitioners at international level (n=3), the authors reported an average increase of La by 6.5 ± 1.3 mmol/L above resting level after performing Unsu kata during a simulated competition [3]. The mean HRmax during this simulated kata competition was 176 ± 12.0. These findings are similar to the ones from our study.

Conclusions

The blood lactate concentration (La) provided valuable information about the assessment of the performance in karate kata, and it was also shown to be a more informative parameter than heart rate. In our study, the moderate increase of the La values (4-6 mmol/L) indicated optimal muscle tension and amplitude of moves when performing kata in competitive conditions. Further research is needed to determine the optimal La levels for the performance of different katas, both in training and in competitive conditions.

Conflict of interests

The authors declare that there is no conflict of interests.

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Cite this article as:
Penov R, Petrov L, Kolimechkov S. Changes in heart rate and blood lactate concentration during karate kata competition. *Pedagogy of physical culture and sports* (*Pedagogics, psychology, medical-biological problems of physical training and sports)*, 2020;24(3):137-142.
https://doi.org/10.15561/26649837.2020.0306

Received: 02.12.2019
Accepted: 30.12.2019; Published: 05.01.2020

Professional education of teachers in physical training and health: the experience of Denmark

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Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection.

Abstract

Purpose: Today physical training becomes an integral part of the European education system as it brings knowledge and insight centered on principles and concepts of the 21st-century learning skills. The article offers an analysis of the structural model, content and goals of the basic physical education projects in the professional teacher training system of Denmark. As this country has gained a positive experience in creating its own strategies for reforming of all the important teacher education components, based on the widespread use of modern motion-focused technologies in the learning process.

Material: Data for this study were collected from multiple sources of Ukrainian, European and Danish educational environments at various time points from 1990 to 2019. Three cultural generations of 50 scientific articles that researched the topics of physical training teachers' education have been chosen.

Results: Our research reveals that the Danish strategy of "healthy nation" with the "sports-for-all" approach calls for the new generation teachers, pedagogically competent in their physical training subjects and able to promote healthy life thinking.

Conclusions: Three major projects: "Learning in motion", "Put the school into motion", "Learning and Talent in Sport" brought considerable impact into physical training teacher education in the Danish environment, implementing innovative ideas of the close connection between learning abilities and physical activities. The research findings may be used in reforming physical training teacher education in Ukraine, especially its transformation from traditional to innovative type by means of the overall implementation of the modern strategies, assimilating movement and physical exercises into the teaching process.

Keywords: physical training, sports, teacher education, Danish dimension, healthy life thinking.

Introduction

At the present stage of social development, the majority of countries in the world pay great attention to the health conditions of their nations, and physical culture and sport are regarded as vehicles for health promotion [1]. Physical education provides an excellent opportunity for all to learn and practice sport skills that will enhance lifelong fitness and good health. Moreover, mastery of the basic sport skills will help young people to perform and understand the value of physical activities better in their future life, at work or during leisure time [2]. However, in European dimension, physical education is not limited to training in sport skills and has more than just an entertaining aspect [3]. Involvement in physical activities brings knowledge and insight centered on principles and concepts of the 21st-century learning skills. They may be regarded as: social inclusion (awareness linked to personal interaction and teamwork), competitiveness (rules of the game and fair play), continuous personal development and tactics of individual growth [4].

With the increase of the physical and mental health problems caused by sedentary lifestyles and obesity, all European countries recognize the importance of physical education at all levels [5]. A significant role in this process is given to teachers of physical training. They are considered to be carriers of the health values of a developed society and without their active participation, progressive changes are impossible. Teachers play a key role in transmitting the policy aims of physical and sports education into effective practice at school [6]. Educators themselves, embodying the concept of a "healthy nation", are able to target their students to mastering basic sport skills (including healthy lifestyle) [7]. These skills will help young citizens to be prepared better for employment difficulties in the international labor market adapting to work and live in an epoch of fast change, physical and psychological pressure [8].

The social and educational functions of sport are recognized by the 2009 Lisbon Treaty. Article 165 is regarded by the European Union as a legal basis for a new competence on physical training and sport. It calls pedagogic communities for action to develop the European dimension in sports education [9]. So teachers should be prepared for the intensive increase in promoting the development of physical education and sport activity in the school learning process. Thus, physical training, sport and healthy lifestyle must become an integral part of the professional education of a modern teacher.

However, it should be emphasized that from the point of view of physical training teachers professional education in Ukraine there are quite serious contradictions. On the one hand, on a country-wide basis, there is a clear tendency to reform the entire system of teacher education. On the other hand, limited access to information sources, lack of coordination, internal resistance to innovations at local levels prevent educational institutions from meeting their strategic goals to train high-quality specialists with the 21st-century skills and competencies. Therefore

doi:10.15561/26649837.2020.0307

Ukrainian specialists find it difficult to compete in the international labor market [10]. In order to overcome such contradictions, it is necessary to make a substantial upgrade of the entire education system in the country including the professional education of physical training teachers. We consider that a comparative study will contribute to a better understanding of educational situation with the professional teacher training system in advanced European countries and will help to justify new approaches to training of future PT teachers in Ukraine.

The subject matter of our study is the professional teacher training system structure in Denmark. We consider this focus to be essential since Denmark has gained positive experience in creating its own strategic plans for reforming all the teacher education structural components. Moreover these transformations were based on the widespread political will to develop and encourage sports activities as a determinant of social well-being and health [11].

In the context of our research, comparative analysis of teacher education systems around the world is valuable. The general trends in the development of humanistic pedagogic education in democratic states were highlighted by Ukrainian comparativists: Mukan [12], Lytovchenko and Ogiienko [13]. The principles of the organization of teacher training in higher education institutions of European countries were revealed by Tezikova and Pukhovska [14], Leshchenko et al. [15]. The analysis of scientific sources made it possible to state that different aspects of physical training in the system of Ukrainian education are investigated in the works of such scholars as Ivashchenko and Moskalenko [16]. Different physical education practices in Ukraine during its transition into European environment were substantiated by Krasilshchikov et al. [10].

Our comparative study of modern European environment demonstrated that the number of studies on the subject of physical training and health education has increased significantly. The results show that the subject matter of pedagogical practices with training of students to some sports techniques and development of sport biology in context of the population health and physical activity are investigated by American and European scholars. Thus Warner (USA) [17], Łubkowska et al. (Poland) [18] research the issues relating to the theory and practice of physical activity, sports and health. The role of sport in the context of education and as a means of healthy lifestyles in European dimension were discussed in the works of Naul (Germany) [19, 20], Matthiessen et al. [9].

Although comparative research in physical training and sport is growing, investigation into the subject of PT teachers training in European countries are still, with a few exceptions, rare [21]. Nevertheless the content analysis of the received data from pedagogical literature and dissertations has demonstrated that the problem of professional education of a physical training teacher in Danish environment, was not the issue of a systematic study. So that is why, we think it requires the special inquiry.

More specifically the following goals will be considered:

1) to examine the structure of physical training teacher professional education in Denmark;

2) to define and characterize the basic physical education projects through their influence on the PT teachers programs content, and;

3) to identify the area of PT teacher professional competence in Danish educational dimension.

Materials and methods.

Data sources.

Data for this study were collected using the systematic, synergetic, culturological, axiological approaches to the comparative analysis of pedagogical phenomena. Basic information was gathered from multiple sources of Ukrainian, European and Danish educational environments at various time points from 1990 till 2019. We choose more than three social and cultural generations of 50 scientific articles that researched the topic of physical education. The following sources were analyzed: Eurydice reports and monitoring on physical education and sport in Europe; documents of European Physical Education Association (EUPEA); Denmark physical activity factsheets; Bachelors and Masters programs of Danish-style physical education and sport in VIA University College, Gerlev Physical Education and Sports Academy, University of Southern Denmark; B.Ed. programs for primary and lower secondary school teachers approved by Danish Ministry of Education and Science; European pedagogical periodicals, in particular: European Journal of Education, European Educational Research Journal, Scandinavian Journal of Educational Research, Pædagogik, DPU Quarterly: Teacher Education, Årbog for Dansk Skolehistorie; materials and theses of scientific conferences conducted by national and international scientific organizations on problems of teachers professional training.

Research Design

The systematic search of the European documents was conducted in three stages.

The first stage was “material collection”. This stage included compellation of existing research data (in the Internet base) according to the object of the conducted study. The second stage was “selection and inclusion”. The information was selected for its inclusion into the current study within the publication context, dates limits, publication languages – English and Danish. The third stage “synthesis completion” was conducted through both writing up and live-discussions of the research results and critical feedback from Nordic and Ukrainian scholars.

Qualitative analysis

The data collection took place via Internet resources, in a short-term research project within the funds of the Royal Library of Denmark in Copenhagen and during the author’s personal participation in European ECER Conferences, arranged in Denmark and Nordic countries.

A case study has been used to formulate structural characteristics of PT teacher training in its functional

connectivity with the Danish educational system [22]. Using a case study approach that includes qualitative methods and is based on analytical induction and generalization, a "contextualized comparison" has been carried out to identify characteristic features of teacher education in institutions of higher learning of Denmark and to explore the process in chronological order [23].

Results

Features of PT teacher education in Denmark

For a detailed study of the physical training and health teachers professional education model in Denmark, let us dwell on the general characteristics of this country's initiatives in this sphere. Our research reveals that in the European educational setting, Denmark is considered to be the country that takes constant care of different aspects of the population's health-related behaviors, focusing on developing a sports culture in schools and different educational institutions [24]. The new Political Agreement on Sports (Politisk stemmeaftale om idræt), adopted in May 2014, launched the Danish strategy of "healthy nation" using a so-called "sports-for-all" approach [25]. In the result two main action plans have been started in Denmark to further enhance physical activity: 1) the updated Folkeskole Act of 2014, focusing on improving physical activity in schools [26] and 2) the campaign "Learning in motion" (Læring i bevægelse) [27]. The latter aimed at encouraging future teachers to choose physical training and health as their core subject and to expand the incorporation of PT technologies into all levels of overall Danish education system.

This means that Denmark calls for new generation teachers, pedagogically competent in their PT subjects. Danish teachers should be able to organize and practice in sports and physical activities, to promote a healthy way of life, to increase the motivation of young people for physical exercise, involving them in various sports that develop healthy life thinking [27]. To do this, future PT teachers should receive appropriate initial education and continuous professional development [28].

Analysis of the curriculum documents and results of surveys show that Denmark goes its own way and has its own strategy in the direction of physical training and health teachers professional education [29].

We distinguish two peculiar features in Danish teacher education: 1) Denmark is the only Nordic country that has a dual system of teacher education; 2) the Bachelor degree in education qualifies to be a teacher in two or three subjects (not in one as in Ukraine and the majority of European countries).

So, we continue our analysis, taking into account these above-mentioned characteristics. It is necessary here to clarify exactly what is meant by "duality" in Danish dimension. In this paper, duality is defined as "the dual perspective" for future teachers to receive tertiary education both in the professional sector, represented by university colleges and academic sector, represented by universities [30, 31]. Teachers are needed in Danish schools of two levels [32]: 1) Folkeskoles (public secondary schools) and 2) Hφjskoles (public and private upper secondary schools). So appropriately there are two basic types of teacher education programs: medium-term and long-term programs [29].

Universities and colleges in the structure of Danish physical training and health teacher education

Our research has tended to focus on the fact that approximately two-thirds of qualified physical training and health teachers work in Danish primary and lower secondary schools [31]. They have to complete a medium-term (mellemfristet videregående uddannelse - MVU) Bachelor of Education program. From the first of January 2008, the medium-term training programs (MVU) for Danish PT teachers of secondary schools are equivalent to 240 European Credit Transfer System (ECTS) [31]. Four years of specialized pedagogical training are implemented in 8 university colleges, which are unique Danish non-profit institutions under public administration. VIA University College, University College of South Denmark, UCC University College, Gerlev Physical Education and Sports Academy are famous for their special, unique educational programs for physical training and health teachers.

It is important to note that the final third of physical training and health teachers in Denmark are mainly involved in teaching for upper secondary schools (both public and private), vocational colleges, adult education, and social institutions [31]. Moreover, there are famous all over the world "Athletic", "Gymnastics and Sports" folk high schools, founded by gymnast and educator Niels Ebbesen Mortensen Bukh [33]. These schools have special focus on physical education, where about half of the course is dedicated to sports, while the other half is of more general education [19]. Teachers in such institutions must accomplish research-based long-term Master of Education programs (langsigtet videregående uddannelse - LVU) in universities [20].

The flexibility of Danish pedagogical education is easy to demonstrate by the fact that any student, having completed a medium-term program, can become a student of a long-term one through the system of credit units enrollment. After the first three years of professional education at the university, a Bachelor's degree is awarded. Bachelor's degree in a PT teacher training program may be both the final point or the starting part in the educational trajectory change. Pedagogic education may continue to the Master's degree, as well as the Doctor of Philosophy (Filosofisk doktor - PhD) or the Doctor of Pedagogical Sciences (læge i pædagogiske Videnskaber) [34].

In the result of the postmodern reforms, the Danish government reduces the number of universities from 12 to 8, five of which combine several pedagogic faculties, including physical training, sports, and health. Universities in Denmark have a high degree of autonomy and self-governance [35]. The first place in the structure of PT education belongs to the University of Copenhagen (Københavns Universitet), the oldest university in the country with almost twenty-six thousand students. Aarhus

University (Aarhus Universitet), established in 1928 as a private institution, after the recent transformation, is operating under the control of the Danish Ministry of Education; and is almost twice as small as the University of Copenhagen. The youngest university in which PT teachers are trained is located in Odense (Odense Universitet/SDU). It trains 5,500 students, one-third of whom studies sport culture and humanities [36].

From 2011 the University of Southern Denmark takes an active part in the research-based projects "The Child Database" (Børnedatabasen) [37]. It has become compulsory for Danish schools to report on school-children progress in physical activity, making it possible to evaluate the effect of increased schools PT on pupils' body composition. These data are collected and assessed by the researchers of the University of Southern Denmark. Thus the implementation and the effects of a nationwide school-based health initiative on PE and PA are objectively measured. These results influence both teacher education content and research. Our analysis demonstrates that this practice is unique for the Danish environment – corresponding national routine surveillance of PA does not exist in any European country [38].

A major reform of teacher education in Denmark has as its guiding principles: deregulation, internationalization and a strong connection between teacher training and the needs of the Danish public school system [37]. In recent years Denmark suffers from an insufficient number of teaching staff for secondary schools. Thus in 2015, the number of admissions to Danish pedagogical higher education institutions was 2,943 students, compared with 3,710 applicants in 2011 [31]. So the Danish Ministry of Education submitted for consideration a special credit transfer program for mobile training of teachers for schools at all levels. In the result, an alternative pathway to obtaining teacher qualification in physical training is the merit-teacher program, which addresses students with prior vocational work experience or a higher education degree. This allows students to transfer credits from relevant (vocational) experience to the teacher education. Consequently, the program is comparatively short and lasts only for two and a half years, comprising 150 ECTS. Therefore more teachers in a shorter period of time may join pedagogic teams satisfying labor market needs as well as the interests of every particular Danish school [36]. In such a way, in the result of current transformations, short-term (kortvarig videregående uddannelse - KVU) programs recently became available in Danish PT teacher education [35].

The current study found that the characteristic feature of physical education in Denmark schools is that it is sport and health-focused (the Folkeskole subject is called "Physical Training and Health") [39]. Danish professional PT teachers hold the general view that schools, Folkeskoles, first and foremost are much more than just a place of a child education. They have a much wider social function, which is to prepare future members of a democratic society for adulthood and to make young people aware of responsibility for their own lives, showing them how to be socially involved in a local community [40]. So the traditional task of a physical training teacher, consisting in the formation of sports skills and physical abilities of students, has gone away into the past [41]. Danish PT teachers today see their mission in the development of personal and social 21st-century skills such as active citizenship and personal independence, self-esteem, self-efficacy, leadership, ability to work in a team, self-confidence, collaboration, competition, healthy way of life including mental well-being, etc [42].

Discussion

In this section of our analysis we want to discuss the influence of the basic Danish physical training and sport focused projects on PT teachers education content.

Our research demonstrates that the situation with physical education in Denmark was not always as positive as it is at present moment. Danish schools experienced gradual reduction from seven to four lessons a week in 1937, from four to three in 1960, from three to two in 1980 [21]. Only over last ten years, when this country chooses sports-for-all model, the situation has changed [43].

Denmark becomes a pioneer in the development of the global initiative "Learning in motion". We must stress that Danish physical education is characterized by sports-oriented secondary schools, offering sports as either a specific program or as an available option with extra physical education lessons [43]. As we have already mentioned, in the Danish democratic environment, physical education and health instructors are also teachers of two other subjects. So very often they aim for flexibility concerning physical activities, general motoric development, and different learning approaches to support education in a broader holistic sense [42]. Background for this position lies in the ideas of the research program LET'S (Learning and Talent in Sport), belonging to Physical education and innovative teaching, founded by the University of Southern Denmark (SDU), Department of Sports science and Clinical Biomechanics. LET'S scholars investigate practical experiences by implementing innovative ideas and strategies in physical education and sport, making action transformation in sports practice and learning [39]. From the point of view of Danish LET'S program researchers, there is a close connection between learning abilities and physical movement or sports activities. The Danish Evaluation institute together with LET'S has conducted an assessment, showing that physical activity has a positive impact on pupils' learning environment. In particular, the findings show a positive influence on the students' motivation to learn, as well as on their communicational skills and their social environment [44].

Taking into account these conclusions, the project "Put the school into motion" (Sæt skolen i bevægelse) initiated the new integrated cross-subject educational curriculum for future PT teachers in colleges and universities [43]. This curriculum constructed around modules that will help future Danish teachers of primary and lower-

secondary schools to assimilate movement and physical exercises into their teaching, in order to strengthen the pupils' learning, health, resilience, and well-being [45].

These three modules are the following:

1) the first module, "integration", a course, in which the students teachers are educated in the various ways of integrating movement into their teaching of core subjects (very often the supported subjects could be Mathematics, Physics, English or Social Science);

2) the second module, "study in motion", gives a wide variety of exercises, methods, tools and strategies which the future teachers can incorporate into their teaching in order to encourage movement and creativity;

3) the third module, "practical physical training", these are classes of competitions, games, outdoor activities and ideas of healthy way of life [39, 46].

As PT teachers educational curriculum in Danish colleges and universities consists of four main blocks: 1) educational subjects in the form of general educational theory, psychology, and educational science; 2) citizenship/ livsoplysning; 3) two or three core subjects (physical training among them); 4) teaching practice. Consequently the abovementioned modules are incorporated into almost all the subject blocks of the curriculum [36].

The purpose of these interdisciplinary modules is, on one hand, to support future teachers to combine theoretical knowledge, practical ideas, and skills with the latest research on the connection between learning abilities and physical movement or activities [47]. Our study has demonstrated that Danish scholars in pedagogy and psychology press the point that pupil's learning abilities are contingent upon both concentrations, psychological, physiological, social and cognitive aspects [30]. Such a learning approach aims at making the teaching situation more benign for learning abilities to thrive by stimulating some of these aspects through movement and physical exercises [48]. On the other hand, the modules (especially the third one) provide particular ideas on how to make physical training lessons more efficient, applying different new movement activities such as motoric fundamentals, traditional games, brain-break exercises, body-balance control or minor aerobic challenges [49].

Another important aspect that we want to discuss in this study is what competences a teacher of physical training and health should have to be efficient in Danish classroom environment. In European pedagogical research the term "competence" is an evaluative [50]. It denotes the ability of a teacher to use knowledge and skills in practical professional activities [51]. In total such education program content encourages five levels of PT teacher competence development:

- first - knowledge about how to implement and combine learning abilities with physical activity; • second - ability to design teaching in various subjects where physical activities and movement are included and support the learning objectives;
- third - knowledge about using physical activities within the subjects, as in-between 'brain breaks' or co-curricular subject-connections;
- fourth - ideas for physical activities and motoric fundamentals;
- fifth - ability to initiate innovation processes and develop activities according to the student's age, level, and learning content [46, 52].

This competence area represents the strategic goal for future sport-focused teacher education in Denmark. The suggested competence levels may be regarded as that way in which all the transformations in the education of physical training and health teachers for Danish schools should be directed [42]. Our analysis of the advanced features of the sport-related pedagogic education system in Denmark makes it possible to formulate our own effective strategy bringing transformational changes into physical training as an important component of Ukrainian teacher education.

Conclusions

Thus, the conducted study allows us to make the following conclusions:

- the peculiar feature of physical training teacher professional education model in Denmark is its duality or the twofold perspective for the future PT teachers to receive tertiary education both in the professional sector, represented by university colleges and also academic sector, represented by universities;
- three major projects: "Learning in motion", "Put the school into motion", and research program LET'S (Learning and Talent in Sport) brought considerable impact into PT teacher education in the Danish environment, implementing innovative ideas of the close connection between learning abilities and physical movement or sports activities;
- five main professional competency levels may be regarded as a strategic goal for future sport-focused PT teacher education in Denmark.

The analysis of Danish experience may be used in reforming physical training and sports education in Ukraine, especially its transformation from traditional to innovative type by means of the overall implementation of the modern strategies, assimilating movement and physical exercises into the teaching process.

Suggestions for further research

We assume that the results drawn from this particular study may provide a clearer picture of general prospects for the use of Danish experience in the Ukrainian educational environment. They may comprise the following:

- transformations in teacher education structure - duality in structure and flexibility of Danish PT teacher education programs should be good practice for Ukraine. These include the variety for student choice of subjects and elements within the program, not least the limitations on the preference of key school subjects. It also implies the possibilities for credit transfer from different types of higher education including university study program for example in special semiautonomous professional institutions, so-called Centers for Higher Education (university colleges, CVUs) to the teacher education

program, and vice versa;

- co-existence of long-term (broad) programs; medium-term and short-term (narrow) programs in PT teachers professional training. "Broad educational programs will generally appeal to students whose motives for education are part of their desire to develop themselves as persons. They can start a study program with the aim of finding out in the process who they are and want to be, and then later adopt a more specific plan for education and career. Narrow educational programs, on the other hand, will appeal to students who take a stronger interest in professional skills and work in personal development [34, p.11]";

- Danish training concept of a school teacher not of one, but of two or even three core subjects (at the request of a student-teacher) can become a perspective one on the basic level of Ukrainian lifelong pedagogic education system. At the same time, Danish experience shows that the main subjects of specialization should not be related (since such experience in training of teachers of Ukrainian and foreign languages or mathematics and physics already exists in Ukraine). Wider specialization profile of future teachers will give an opportunity to the Ukrainian higher pedagogical educational institutions to be more flexible to respond to the needs of the regions and the country as a whole.

This research is not exhaustive. The importance of the discussed problems determines the necessity of their continuous study. We see the prospects for further comparative investigation in the design of the content and methods for the formation of professional competencies for the PT teachers of various educational programs both in Nordic and Ukrainian dimensions.

Conflict of interests

The author states that there is no conflict of interests.

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Cite this article as:
Roliak AO. Professional education of teachers in physical training and health: the experience of Denmark. *Pedagogy of physical culture and sports* (*Pedagogics, psychology, medical-biological problems of physical training and sports)*, 2020;24(3):143-150.
https://doi.org/10.15561/26649837.2020.0307

Received: 02.10.2019
Accepted: 10.11.2019; Published: 05.01.2020

Aspects of psychomotor development of primary school children with hearing loss from the standpoint of Bernstein's theory of movement construction

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Abstract

Purpose: As the latest research shows, psychomotor development and motor learning of deaf children is garnering a great deal of attention from scientists. Effectively correcting the psychomotor development of hearing-impaired kids requires a deep understanding of the disorders, structures, depth, and the children's potential motor learning capabilities. We believe this understanding can be reached with the Bernstein approach. However, we were able to find only a handful of studies on psychomotor development of hearing-impaired children from the point of view of the theory of how motor skills are formed. Based on this theory, the purpose of this study was to create a diagnostic program that can evaluate and analyze psychomotor disorders and uncover their mechanism in hearing impaired kids compared to their peers with normal hearing.

Material: The study included 54 children from primary schools in Lviv with normal hearing and 94 primary school children with hearing loss from the Lviv Specialized Boarding School named after Maria Pokrova №101 and the Zhovkiv Training and Rehabilitation Center "Zlagoda" (51 children with hearing loss and 43 deaf children). The research sample we chose was random and the children ranged in age from 7-8 years old. To study a single motor skill based on the involvement of multiple levels of central nervous system control, the jump model was chosen. The study consisted of 10 tests, each of which was rated on a 5point scale. Gathered and analysed data were used for the quantitative method.

Results: It was established that children with hearing loss had psychomotor retardation on all motor skill levels compared to their peers with normal hearing. Hearing impaired children had a low level of static and dynamic coordination, speed of movement, and motor memory. The lowest level of development was purposeful movement.

Conclusions: We identified specific psychomotor disorders in primary school children with hearing loss compared to their peers with normal hearing on all levels of motor skill formation, and found correlations between the overall assessment of hearing impaired children and the studied components by level of movement construction: for any motor activity, there is a primary level, which forms the foundation of the movement and all other levels that are activated when performing the movement. The aspects of sensory-motor functions in primary school children with hearing loss depend on the level of hearing loss and consist of an absence of coordination on multiple levels of movement construction.

Keywords: children, hearing loss, psychomotor, Level-Based Approach, psychomotor deficits.

Introduction

According to the World Health Organization, over 5 % of the world's population, or 466 million people, has hearing loss (432 million adults and 34 million children). It is estimated that by 2050, over 900 million people, or 1 in 10 people, will have hearing loss [1]. These figures show that the number of children born with hearing loss is steadily increasing. The problems associated with hearing loss should be addressed early in child development, especially in the early years of life and school years to ensure the child develops properly.

Currently, the process of integrating children with hearing loss is improving due to early diagnostics [2, 3], cochlear implants [4, 5], as well as early corrective [6, 7], and compensatory work [8]. Comprehensive and complete development for hearing impaired children is impossible without physical education, which not only provides the required level of physical development [9, 10], but also corrects deviations in children with auditory deprivation [11, 12].

Studies by a number of authors show that children with hearing loss differ in the following aspects of psychomotor development:

- low level of motor skills [13];
- difficulties maintaining static and dynamic equilibrium [14, 15];
- relatively low level of spatial orientation development [16];
- slow speed of performance of particular phases and tempos of movements [17];
- deviations in motor skills, which as a whole, characterize a low level of coordinative abilities [18];
- relatively low level of figurative thinking development due to a lack of internal speech and verbal support [19, 20].

Effectively correcting the psychomotor development

doi:10.15561/26649837.2020.0308

of young, school-age children with hearing loss requires a deep understanding of the nature of the disorders, their structure, depth, and potential motor development. Such an understanding can only be achieved by studying psychomotor development in the process of applying adequate research techniques.

Motor disorders and pathologies in children have been identified using methods described by Ozeretsky [21], modified by researchers such as: Göllnitz [22] in Germany, Lincoln and Henderson [23] in the USA, and others. Ozeretsky's method is a set of motor skill tests used to study individual components of motion: static coordination, dynamic coordination, speed of movement, rhythm, voluntary muscle movement causing simultaneous involuntary muscle contractions (synkinesis), and simultaneous movements and their forces. It should be noted that there is no generally accepted methodology for studying psychomotor learning. However, in the specialized literature, there are numerous tests with various levels of complexity for studying motor skills in normal-hearing and disabled children: strength, speed, endurance, agility, and flexibility. For children with hearing loss, various holistic techniques and individual quantitative tests are used [24]. However, the quantitative assessment of motor test results does not reveal all the aspects of the motor capabilities of the deaf. A visual description cannot serve as a qualitative analysis, because it does not answer the question: why are children with hearing loss, for example, not able to jump as far as normal-hearing children? Could it be due to muscle weakness in the legs, a low level of neuromuscular coordination, poor motivation, willpower, or other reasons? Using Ozeretsky's method, Weizman [25] noted that some children perform tests intended to evaluate motor skills in older children but fail to perform tests intended for younger children. In other cases, even though subjects were able to perform more complex movements (for example, bouncing a ball on the floor), they had trouble performing what would be considered simple actions, such as throwing a ball forward from their chest.

It is impossible to explain these facts without using Bernstein's Level-Based Approach [26], which can identify the level of the disorder, retardation, and nervous system pathologies, to analyze motor actions and how motor skills tests are structured. All of this prompted us to investigate the motor skills in kids with hearing loss in the context of the level-based theory of movement construction. Based on this theory, this paper attempts to analyze the psychomotor disorders of hearing impaired children and reveal their mechanism – everything from simple movements and actions to complex, deliberate motor skills, to find out the level of motor learning compared to normal-hearing children.

Material and Methods

Subjects:

The study included normal-hearing children from primary schools in Lviv (54 subjects) and 94 children with hearing impairments - from Lviv Specialized Boarding School named after Maria Pokrova №101 and Zhovkiv Educational and Rehabilitation Center "Zlagoda" (51 subjects with hearing loss and 43 deaf subjects). The research sample we chose was random and the children ranged in ages from 7-8 years old.

Procedure:

The psychological-pedagogical approach to studying psychomotor skills of young, school-age children with hearing impairment includes the use of basic and supplementary methods for a more comprehensive assessment of the development of motor functions. Namely, 1. *observational methods*: observation of posture, gait, coordination, and facial expressions; 2. *studying medical history*: with emphasis on the aspects of psychomotor development of children with hearing loss; 3. the *metric approach*: taking into account Bernstein's theory of movement construction for studying psychomotor development, a method of examining children with hearing loss was developed, consisting of 10 tests. Each test was evaluated using a 5-point scale; 4. *methods of mathematical statistics*.

For an in-depth study of one motor skill, which is constructed on different levels of central nervous system activity, a *jump model* was used.

Static motor coordination test:

1. Standing on tiptoes with eyes open and closed before vestibular loading (spinning in place) and after vestibular loading.

The test reveals the predominant activity of the lower level of movement construction (*Level A*). Stepping out of place or losing balance is considered a mistake.

Dynamic motor coordination tests:

2. Jump in place, back and forth, right and left, on both feet, and on one foot (test for accuracy and simultaneity of movements and absence of synkinesia).

3. Jump 180 ° with hands on waist.

4. Jump and clapping three times in front of the chest while in mid-air.

Tests 2-4 reveal the predominant involvement in the motor skill of the *synergy level B* and the *lower sublevel of the C1 spatial field*. They ensure the internal coordination of complex components of one large movement and its correlation with spatial environment.

Tests 2 and 4 are considered incomplete if the subject cannot simultaneously jump with both feet, lands on heels instead of tiptoes, jumps less than 7-8 times within 5 seconds or if the subject makes unnecessary and uncoordinated movements.

Speed of performance tests

5. Jump 180° while catching a ball upon landing.

6. Jump in an outlined circle. Any deviations from the circle are recorded.

Tests 5-6 reveal the involvement of the *upper sublevel of the C2 spatial field*, which determines the maximum accuracy in the final stage of movement. Test 5 is considered incomplete if the subject catches the ball less than three time out of five attempts.

Motor memory and coordination of movement tests:

7. Jump with various elements of hand coordination (arms up, legs apart and vice versa). Accuracy is recorded.

8. Jump to the rhythm of a light signal. The number of deviations from the rhythm is recorded.

Tests 7-8 reveal the involvement of *level D* in the hierarchy of movement construction.

Purposefulness of movement tests:

9. The subject must learn to jump half the maximum height they're capable of jumping. After each of the 10 attempts they're given, they are informed of the actual jump height. The test is considered complete if the subject becomes accustomed to jumping half of their maximum height through muscular conditioning.

10. Think of an animal and imitate its movements.

Tests 9-10 reflect a high level of movement construction (*level E*), which is associated with memorizing the task and conscious self-regulation and improvisation of movements.

If unsuccessful or incomplete, all of the tests can be repeated but no more than three times.

These tests were used to assess the components and levels movement construction for hearing-impaired children. The research methods revealed qualitative disorders of psychomotor skills of children with hearing loss. These tests were not used to identify motor skill development based on the age of the subjects.

Statistical Analyses:

The collected data were analyzed through arithmetic mean, standard deviation, Analysis of Variance (ANOVA), and the measured statistical significance was 0.01-0.05.

Results

As a result of this psychological-pedagogical study, it was established that compared to their normal-hearing peers, the psychomotor skills of deaf and hard of hearing children are characterized by a lack of development in all of the associated components (Table 1).

Experimentally, it was determined that children with hearing impairment had a lack of static coordination development compared to normal-hearing children (the average score for normal-hearing children was – 4.0; hearing-impaired children –3.0; deaf children – 2.2).

Normal-hearing children had average coordinative motor skills (average score –3.9), while hard of hearing and deaf children had a low level of dynamic coordinative motor skills (hard of hearing – 3.2; deaf – 3.0). Compared to their normal-hearing peers, children with hearing impairment had a low level of speed of performance in motor skills (average score for normal hearing – 3.8; hard of hearing – 2.6; deaf – 2.2). Motor memory was also found to be on a lower level of development for hearing-impaired and deaf children compared to children with normal hearing (average score for normal hearing – 3.6; hard of hearing – 2.4; deaf – 2.0).

The lowest indicators in the study were found to be associated with purposefulness of moment and its meaning on the highest level of movement construction, *level E*, which manifests as memorizing the task at hand, conscious self-regulation, and improvised movements (average score for kids without hearing loss – 3.4; hard of hearing – 2.2; deaf – 1.6). The difference in overall scores for subjects with hearing impairment and deafness compared to peers was 1.3 and 1.9, respectively.

The results of the study were subjected to mathematical analysis for multiple correlations, which revealed a relationship between the overall assessment of motor development of children with hearing impairment and the studied components by levels of movement construction, characterizing static and dynamic coordination, speed of performance, motor memory and coordination of movement, purposefulness of the movement and its meaning (r = 0.9593).

Table 1. Results of the study on psychomotor development in primary school children with deafness, hard of hearing, and normal hearing (in score, mean, standard deviation, and statistical significance)

Parameters for assessment and levels of movement construction	Normal hearing	Hard of hearing	Deaf
Static coordination (Level A)	4.0	3.0*	2.2**
Accuracy and simultaneity of movements (Level B)	3.7	2.9**	1.8**
Dynamic coordination (Level C1)	3.9	3.2**	3.0**
Speed of performance (Level C2)	3.8	2.6**	2.2**
Motor memory and coordination of movements (Level D)	3.6	2.4**	2.0 **
Purposefulness of movement (Level E)	3.4	2.2**	1.6**
Average score for all levels	3.7±0.6	2.7±0.3	2.1±0.2

NOTE: Statistical significance: * – $p < 0.05$; ** – $p < 0.01$.

Discussion

Static ataxia observed in children with auditory deprivation is characterized by the difficulty of maintaining balance and the appearance of tremors in the extremities while maintaining a static pose, especially with eyes closed. Deaf children had more difficulty with static coordination than hard of hearing children, who have better vestibular control. According to the data by Melo [15] qualitative characteristics of erect body positioning among deaf children are directly dependent on preservation of vestibular apparatus. Problems with static poses can be explained by a lack of development in regulating movement on *level A*, which provides subconscious, involuntary muscular regulation and arbitrary motor skills, connected with taking a pose and retaining it. Hartman and Vitkovic in their researches [6, 14] have identified that deaf children, students of preliminary schools, have difficulties with spatial awareness.

In the course of performing tests on dynamic coordination movements (absence of synkinesia), most subjects with auditory deprivation (deaf children) had uncoordinated movements of the hands and feet. The 180° jump proved to be the most difficult test for those subjects. In physical education class, the same subjects were observed to have uncoordinated movements while walking and running. Movement features such as shuffling gait, wide foot placement, lateral swing, forward leaning, walking and running on heels and bent legs, and non-linear movements were observed. Melo [27] found the same pathological movement features in his study of deaf children. Increased stiffness and a lack of consistency in movements when performing tests studying the dynamic construction of movement allows us to confirm the presence of synkinesia in children with hearing impairments, which points to a lack of development in *level B* movement construction – autonomous motor control. We also established a low level of development in the spatial field of *sublevel C1*, which evaluates the purposefulness of motion. Researches by Engel-Yeger, [13] have shown that hearing and vestibular analyzers dysfunctions are leading towards lowering the level of spatial awareness. This manifests in walking, running, orientation in the body scheme, exercises with objects. This is why the test which required jumping and clapping three times proved rather difficult for the subjects. Fellinger [2] has determined that loss of hearing is also accompanied by delay in motor development.

The majority of subjects showed unnecessary or, conversely, lacked certain movement elements when performing tests on *level D* of movement construction. Successful completion of the tests were recorded in isolated cases. Therefore, we can state that there is a lack of development in hearing-impaired children on *level D* – coordinated movement. This is explained by impaired auditory perception, which is caused by specific changes in the decrease of motor memory. This feature was also pointed at by Lévesque [2].

The biggest difference in the compared groups was in the purposefulness of movement (*level E*). The explanation for this lies in the hearing-impaired children's comprehension of their own voice and other people's voices and their capacity for imaginative thinking. A significant and qualitative difference in the actions of these children is based on the fact that internal speech and language are not activated in the process of solving motor tasks and the ability to plan movements is absent. Additionally, hearing is closely related to movement – hearing loss, language development and motor skills are fundamentally interdependent. The absence of internal speech and verbal support causes a delay in motor skill development, what is also shown in researches by Peñeñory [18].

The results reported in this study are in agreement with what has been found in previous studies examining psychomotor skills in the deaf [28, 29].

The analysis of the obtained results allows us to assert that primary school children with hearing loss have delayed development compared to their normal-hearing peers on all levels of movement construction according to Bernstein's theory. This study shows that deafness can lead to problems that may reflect in delayed motor learning and development.

Conclusion

Bernstein's theory made it possible to isolate the areas of psychomotor impairment in primary school children with auditory deprivation on all levels of movement construction compared to their peers with normal hearing:

- In the hierarchy of the interaction of levels of the central nervous system, which provide levels of movement construction, the principle of dynamic subordination applies. This means that the psychomotor development of kids with hearing loss should be studied from a comprehensive perspective on all levels of movement construction.

- Correlations were established between the general assessment of psychomotor development of primary school children with hearing loss and the studied components by the levels of movement construction, which characterize static and dynamic coordination, speed of performance, motor memory and coordination of movements, and purposefulness of movement. The obtained correlational ties indicate that there are several levels involved in the construction of a particular motor activity: a primary level, which forms the foundation of the movement and all other levels that are activated when performing the movement. The aspects of sensory-motor functions in primary school children with hearing loss depend on the level of hearing loss consist of an absence of coordination on multiple levels of movement construction.

- The analysis of the motor development disorders of primary school children with auditory system pathologies from the standpoint of the level-based theory of movement construction provides an opportunity to study, understand, and choose more appropriate methods of adapted physical education to correct psychomotor retardation. This

corrective work should be done on an individual basis, taking into account the children's level of psychomotor impairment.

Conflict of interests

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Cite this article as:
Stepanchenko N.I., Hrybovska I.B., Danylevych M.V., Hryboskyy R.V., Aspects of psychomotor development of primary school children with hearing loss from the standpoint of Bernstein's theory of movement construction. *Pedagogy of physical culture and sports* (*Pedagogics, psychology, medical-biological problems of physical training and sports)*, 2020;24(3):151-156. https://doi.org/10.15561/26649837.2020.0308

Received: 05.11.2019
Accepted: 10.12.2019; Published: 05.01.2020

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SCIENTIFIC EDITION (journal)
Pedagogy of physical culture and sports (Pedagogics, psychology, medical-biological problems of physical training and sports), 2020;24(3)
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designer: Iermakov S.S.
editing: Yermakova T.
designer cover: Bogoslavets A.
administrator of sites: Iermakov S.S.
_____
passed for printing 01.05.2020
Format A4.
Red Banner str., 8, Kharkov, 61002, Ukraine.
PRINTHOUSE (B02 № 248 750, 13.09.2007).
61002, Kharkov, Girshman, 16a.