

ISSN 1993-7989 (print)
ISSN 1993-7997 (online)



ТЕОРІЯ ТА МЕТОДИКА ФІЗИЧНОГО ВИХОВАННЯ

НАУКОВО-МЕТОДИЧНИЙ ЖУРНАЛ



№ 2 · Том 21 · червень 2021

Адреса журналу в Інтернет:

<https://tmfv.com.ua>

<https://doi.org/10.17309/tmfv.2021.2>



/ ОВС ТОВ
Харків
Україна



Теорія та методика фізичного виховання
Teoriâ ta Metodika Fizičnogo Vihovannâ
Theory and Methods of the Physical Education
Abbreviated key-title: Teor. metod. fiz. vihov.

Науково-методичний журнал
Scientific-methodological journal

Чотири випуски на рік. Заснований у 2000 році
Four issues per year. Established in 2000

<https://www.tmfv.com.ua>. E-mail: tmfv@tmfv.com.ua

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Теорія та методика фізичного виховання

Науково-методичний журнал

Червень 2021. Том 21, № 2

<https://doi.org/10.17309/tmfv.2021.2>

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Teoriâ ta Metodika Fizičnogo Vihovannâ

Scientific-methodological journal

June 2021. Vol. 21, Num. 2

<https://doi.org/10.17309/tmfv.2021.2>

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ORIGINAL SCIENTIFIC ARTICLE

THE CONFIGURATION OF EDUCATIONAL FACTORS IN THE FAMILY IN TERMS OF THEIR IMPACT ON THE FORMATION OF INTEREST IN SPORTS IN MIDDLE SCHOOL CHILDREN

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Accepted for Publication: April 14, 2021

Published: June 25, 2021

DOI: 10.17309/tmfv.2021.2.01

Abstract

Research purpose: The aim of the study was to examine the features of the educational concept of the family in mutual understanding with middle school children with different levels of physical activity.

Material and Methods. 212 students aged 11-12 years, including 104 students (48 girls and 56 boys) who are not involved in sports and 108 students who go in for sports (36 girls and 72 boys). The following research methods were used to solve the problems set in the work: analysis and generalization of scientific and methodological literature data; content analysis; method of comparison; sociological methods of research (questionnaire "My family"); methods of mathematical statistics.

Results. The results of the testing of boys and girls revealed the following 8 factors of upbringing in the family: severity; fostering independence; mother or father domination; attitude to school and teachers; cruelty; relationships in the family; mutual assistance; community of interests. The rating of the factors of upbringing that affect the level of understanding in the family of girls aged 11-12 years, determines that in those who do not go in for sports "rigor and demanding attitude in upbringing" is in the first place, and in the second – "common interests", while for girls who go in for sports "mutual assistance in the family" is in the first place and in the second "rigor and demanding attitude in upbringing". The results of the definition of mutual understanding in the family show that the "successful" level was mostly determined by 57.14% of boys aged 11-12 who go in for sports, and the lowest percentage is noted for boys aged 11-12 years old who do not go in for sports (22.22%). Boys and girls who do not play sports are characterized by a "less prosperous" level of mutual understanding in the family (61.11 and 66.67%, respectively).

Conclusions. The socialization of students in the micro and macro environment through the formation of values in the field of physical culture and sports is ensured by the following factors: rigor, fostering initiative, attitude towards school, rigidity in upbringing, family relationships, mutual assistance in the interests of the community.

Keywords: sports, students of secondary school age, social concept.

Introduction

In today's context, the role of physical culture as an integral part of the general culture of society is increasing and its social functions are becoming increasingly important (Bezverkhnia, 2004; Moyseyuk, 2007; Mamayeva & Mamayev, 2010). Physical culture functionally adapts to the heterogeneous differentiated needs of society, to its evolving and

changing structure. The unity of functional, value and activity that make up the content of physical culture, deepens the understanding of its integrative, human-forming, spiritual and physical essence (Udalova, Kokurina, & Likhomanov, 2017; Serhiienko, 2018; Andrieieva et al., 2019).

The analysis of researches of many authors allows to define the basic trajectories of socialization of the person by means of physical culture and sports, for their construction and realization, namely: formation of value attitude to physical culture and sports, motivation of employment to them

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(Karpushin, 2013; Udalova, Kokurina, & Lihomanov, 2017); using the potential of the family, social environment in the socialization of the individual (Levchenko, 2006; Bagnatova, 2011a); adaptation of students to the values of physical culture and sports (Bezpalco, 2009; Liasota, 2012; Bahach, 2015); ensuring identification at the level of values and ideals (Gogunov, 2004; Bagnetova, 2011; Boiko, 2013; Krutsevich & Marchenko, 2017).

Carried out by Osadchaia and Maksymenko (2008), Turchik (2017), an analysis of studies on the impact of parents on children's sports in the United States shows that parents often consider children's participation in sports a vital part of their socialization process, providing material and financial support to meet the needs of children in the classroom (Collins, Micheli, Yard, & Comstock, 2008).

A review of literature indicates that in the United States, family is determined to be a dominant influence on youth throughout their socialization process (Dorsch, Smith, & McDonough, 2009), and parent involvement in sports is a key factor in youth involvement (Barnett, 2008). By encouraging children to engage in sports and enabling them to engage in sports systematically, creating the conditions for the formation of values and norms that children learn in the exercise, parents influence their children and promote their socialization (Danish, Forneris, Hodge, & Heke, 2004).

The aim of the research was to study the features of the social concept of the family in mutual understanding with middle school children with different levels of physical activity.

Materials and methods

Study participants

The study was conducted on the basis of secondary schools № 87, № 94 in Kyiv, Ukraine. In the research participated 212 students 11-12 years, including 104 students (48 girls and 56 boys) who are not involved in sports and 108 students who go in for sports (36 girls and 72 boys).

Study organization

To solve this goal, the following research methods were used: analysis and synthesis of scientific and methodological literature; content analysis; method of comparison; sociological methods of research (questionnaire "My family"), methods of mathematical statistics.

The "My Family" Student Socialization Questionnaire is designed to identify certain factors of upbringing in the family.

Statistical analysis

Statistical analysis was performed using the IBM SPSS Statistics 20 statistical software package. The following parameters were calculated: arithmetic mean, standard deviation.

Results

To find out the degree of external and internal influences on the formation of motivation for self-improvement in the process of physical education of students and their formation as individuals, the following questions were analyzed:

teacher's advice, parents' tips, tips of friends, TV programs, knowledge about the benefits of classes, attending, sports competitions, etc. In the first place, the impact of family education was determined by 54.7% of boys and 58.3% of girls. Family traditions are passed down from generation to generation. It is proved that children involved in physical culture and sports are less prone to such bad habits as alcoholism, smoking, drug addiction, substance abuse, etc.

The percentage of schoolchildren (27.3% and 33.3% of girls among boys), who believe that physical education and sports interest is influenced by physical education and sports,

Table 1. Ranking factors of education that affect the level of understanding in the family of boys 11-12 years

Factors of education	Boys who aren't go in for sports (n = 56)			Boys who are go in for sports (n = 72)		
	X	SD	Rating	X	SD	Rating
Education Initiative	9.19	2.86	6	12.32	2.43	1
Attitude to school	10.45	3.01	3	10.89	2.61	6
Rigor and demanding education	11.91	2.42	1	10.70	2.88	2
Relationships in the family	9.87	1.97	5	9.77	2.97	4
Mutual family assistance	10.38	2.85	4	10.37	2.07	5
Common interests	11.45	3.42	2	11.04	3.24	3

attracts attention. This is due to the teacher's authority in the relationship with the students and their relation to the subject.

An analysis of the factors of education that affect the level of understanding in the family, boys 11-12 years, who are not go in for sports and exercise are presented in Table 1.

Boys who are not go in for sports put the factor "rigor and demanding in education" in the first place, the second factor is "common interests".

Boys who go in for sports place "education of initiative" in the first place, "rigor and demanding in education" in the second place, usually common interests in the family promote understanding and this factor in them in the third place.

Boys who go in for sports are different from peers who are not go in for sports, the reality of self-esteem, less fear of failures, lower anxiety. A similar feature of teenagers who do and do not exercise is the high level of harassment (Meyerson, 1988; Vulkanova, 2005).

The test results of girls (who are not involved in sports and those engaged) revealed the following six factors of family education: education initiatives; attitude to school and teachers; rigor and demanding in education; relationships in the family; mutual assistance; community of interests (Table. 2).

The rating of the factors of education that affect the level of understanding in the family of girls 11-12 years, determines that in those who are not go in for sports in the first place "rigor and demanding in education", and in the second – "common interests", in while for girls who go in for sports in the first place "mutual assistance in the family" and in the second "rigor and demanding in education".

These results indicate that not all parents understood the problems of education, they can not always find an individual

Table 2. Rating of factors of education that affect the level of understanding in the family of girls 11-12 years

Factors of education	Girls who aren't go in for sports (n = 48)			Girls who are go in for sports (n = 36)		
	X	SD	Rating	X	SD	Rating
Education Initiative	10.30	3.07	5	10.24	2.61	5
Attitude to school	11.42	2.67	3	10.29	2.66	4
Rigor and demanding education	12.68	3.07	1	11.00	3.62	2
Relationships in the family	10.07	2.47	6	9.59	2.35	6
Mutual family assistance	11.02	2.39	4	11.35	2.57	1
Common interests	12.18	2.82	2	10.53	3.18	3

approach to every conflict that may arise in the relationship between parents and children. According to scientists, such relationships lead to the formation of adolescents feelings of self-doubt, moral responsibility for their actions. Usually, such relationships continue in later life (Danish et al., 2004; Udalova et al., 2017).

Comparing the results of testing boys and girls who go in for sports, we can conclude that the majority of athletes (both boys and girls) note a more prosperous and less prosperous relationship in their families (Table. 3).

Table 3. Level of understanding in the family of middle school children who go and don't go in for sports, %

Age, years	School children	Sex	Trouble-free, %	Less trouble-free, %	Satisfactory, %
11-12	Don't go in for sport	b.	22.22	61.11	16.67
		g.	33.33	66.67	.00
11-12	Go in for sport	b.	57.14	21.43	21.43
		g.	25	33.33	41.67

Test results show that the highest level of "trouble-free" in the majority was determined by boys who go in for sports, 57.14%, and the lowest percentage is observed in boys 11-12 years who do not go in for sports (22.22 %).

Therefore, athletes are more independent and purposeful than peers who do not go in for sports. In this regard, there may be a conflict situation with parents who are not yet aware or do not wish to be aware of the adulthood and independence of their own children. And their authoritarian style of family relationships causes alienation of children and misunderstandings in the family (Gogunov, 2004; Olkhova-Marchuk, 2009).

The percentage of students who identified the next rated level of family understanding – "less trouble-free" are boys and girls who are not go in for sports (respectively 61.11 and 66.67 %).

The level of relationship in the family is "satisfactory", that is, average, noted by girls who go in for sports. This can be explained by the fact that their parents do not approve of sports, their children/girls, especially as it is power, high-speed types such as boxing, karate, etc.

Discussion

According to the results of research allowed to determine the following factors of family upbringing: education initiative; attitudes towards school and teachers; rigor and exactingness in upbringing; family relationships; mutual assistance; common interests. We have identified a certain hierarchy of factors of family upbringing in boys and girls who do not play sports and those who do), which will determine the individual approach to the formation of the child's personality. The results provide an opportunity to make informed decisions in matters of education, mutual understanding, comprehensive support for children who play sports and those who do not, but have other interests.

Describing the style of interpersonal relationships in the family, respondents indicated that one parent's authoritarian style was dominant. Most often, it is the mother's authoritarianism. We can assume that in these families much attention is paid to physical activity and sports, which serves as a personal example and an additional incentive for sports activities for middle school students.

Our research shows that if parents play sports themselves, the family cultivates sports and physical activity, in which children are involved from an early age. This confirms the fact established by scientists that one of the significant external factors influencing the motivation of students to play sports is the example of parents (Bezverkhnia, 2004)

Comparing the results of testing boys and girls who play sports, we can conclude that most athletes (both boys and girls) have a successful and satisfactory level of relationships in their families. We can assume that in these families much attention is paid to physical activity and sports, which serves as a personal example and an additional incentive for school sports, which confirms the study Olkhova-Marchuk (2009).

The researcher studied the main forms of educational work with parents on the formation of a culture of interpersonal relationships of primary school children through physical education. The researcher claims that in involving parents in the formation of a culture of interpersonal relationships of students through physical culture, parent conferences aimed at showing practical examples of physical education in specific families and open physical education lessons were important, where parents had the opportunity to observe their children directly during physical and game activities (Olkhova-Marchuk, 2009).

In own research, Bezverkhnia (2004) also identifies family education as a fundamental factor in the formation of physical and sports interests of students, and the formation of personality, but in the age section notes a gradual decline in this indicator. This is mostly due to the age-old pattern associated with the mental development of adolescents and their desire for independent decision-making, as opposed to parental advice. Although this issue requires additional research, taking into account the timeline and trends in the modern dimension.

There is an opinion in the literature (Levchenko, 2006; Sergienko, 2018), that one of the important needs of transitional age is the need for parents, teachers, and seniors to be exempt from control and custody, and the rules and procedures established by them.

Trussell (2009) in own research states that in a situation where a child in the family is treated as a future sports star,

the relationship between his siblings can become strained. Camiré et al. (2011) note that relationships in families where the younger siblings have been more successful are particularly difficult. By the way, children often dropped out of sports to compare their results with a more successful sibling.

Vulkanova (2005), which dealt with the impact of sports on the development of personal prerequisites for resistance to stress in adolescence, states that the adolescents of both sexes and non-sports, exhibit both typical and atypical correlation relationships of self-esteem, achievement motivation and anxiety.

The first are the negative correlation relationships of indicators of self-esteem and anxiety, the positive correlation relationships of indicators of divergence of levels of harassment and self-esteem with indicators of anxiety, fear of failure and anxiety. The second is the negative correlation of indicators of fear of failure and anxiety, which can be regarded as a sign of a tendency to refuse to achieve the goal at high risk, which leads to a decrease in anxiety.

The analysis of the studied sources on the problems of family upbringing gives us grounds to conclude that the regulation of such a situation depends to a greater extent on the parents. After all, family upbringing is an interaction of parents with children, which is based on family emotional closeness, family harmony, love, care, respect and protection of the child and helps to create favorable conditions to meet the needs of full development and self-development of the child (Konoshenko, 2013). In our opinion, the example of brothers and sisters can be a strong motivating external factor for self-improvement and sports activities.

Scholars argue that the family is especially important in shaping the value system through which a child enters the system of social ties (Turishcheva, 2007).

Turishcheva (2007) with the help of the questionnaire "My family" determined the degree of manifestation in family upbringing of the following parameters: rigor-flexibility of educational attitudes; education of independence, initiative; mother or father dominance; attitude to school and teachers; rigidity-flexibility of methods of education; family relationships; mutual assistance in the family, the presence or absence of family affairs; common interests; the level of well-being in family relationships. This questionnaire allowed to identify one of the parents, whose educational influence is dominant. It was found that in most families the role of educator belongs to the mother (80.6%); families in which the leading role in upbringing belongs to the father, make up 9.7%; both parents – 9.7%. The results of this study coincide with the results of our research: respondents said that the authoritarianism of the mother is dominant (78%). We believe that this leads to a lack of parental care and control in the process of growth and development of children.

A study conducted by Feodorova (2014) found that adolescents-athletes of both sexes positively perceive parents who are interested in their lives, support their independence, and show emotional warmth. It was found that adolescents' motivation for various activities is related to their parents' perceptions. The positive attitude of parents is more related to the formation of motivation to study and friendships in the family than to the promotion of motivation for sports.

Conclusions

The socialization of students both in the micro and macro environment through the formation of values in the field

of physical culture and sports is ensured by the following factors: rigor, upbringing of initiative, attitude to school, rigidity in upbringing, relationships in the family, mutual assistance in the family, common interests. Comparing the results of testing boys and girls who go in for sports, we can conclude that most athletes (both boys and girls) have a positive and satisfactory level of relationships in their families. We can assume that in these families much attention is paid to physical activity and sports, which serves as a personal example and an additional incentive for sports.

Conflict of Interest

Authors declare no conflict of interest.

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КОНФІГУРАЦІЯ ВИХОВНИХ ФАКТОРІВ У СІМ'Ї З ТОЧКИ ЗОРУ ЇХ ВПЛИВУ НА ФОРМУВАННЯ ІНТЕРЕСУ ДО СПОРТУ У ДІТЕЙ СЕРЕДНЬОГО ШКІЛЬНОГО ВІКУ

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Авторський вклад: А – дизайн дослідження; В – збір даних; С – статаналіз; D – підготовка рукопису; Е – збір коштів

Реферат. Стаття: 8 с., 3 таб., 29 джерел.

Метою дослідження було вивчення особливостей освітньої концепції сім'ї у взаєморозумінні з дітьми середнього шкільного віку з різним рівнем фізичної активності.

Матеріал та методи. У дослідженні приймали участь 212 школярів 11-12 років, у тому числі 104 учні (48 дівчат та 56 хлопчиків), які не займаються спортом, і 108 учнів, які займаються спортом (36 дівчат та 72 хлопчика). Для вирішення поставлених в роботі завдань використовували наступні методи дослідження: аналіз та узагальнення даних науково-методичної літератури; контент-аналіз; ме-

тод порівняння та зіставлення; соціологічні методи дослідження (опитувальник «Моя сім'я»), методи математичної статистики.

Результати. Результати тестування хлопчиків і дівчаток виявили наступні 8 факторів виховання в сім'ї: строгість; виховання самостійності; домінування матері чи батька; ставлення до школи та вчителів; жорсткість; стосунки в сім'ї; взаємодопомога; спільність інтересів. Рейтинг факторів виховання, що впливають на рівень розуміння в сім'ї дівчаток 11-12 років, визначає, що у тих, хто не займається

спортом, у першу чергу «строгість і вимогливість в освіті», а по-друге – «спільні інтереси», у той час як для дівчат, які займаються спортом, насамперед «взаємодопомога в сім'ї», а на другому – «суворість та вимогливість до освіти». Результати визначення взаєморозуміння в сім'ї показують, що «успішний» рівень в основному визначали 57,14% хлопчиків віком 11-12 років, які займаються спортом, а найнижчий відсоток відзначається у хлопчиків 11-12 років, які не займаються спортом (22,22%). Юнаки та дівчата, які не займаються спортом, характеризуються «менш благо-

получним» рівнем взаєморозуміння в сім'ї (61,11 та 66,67% відповідно).

Висновки. Соціалізація учнів у мікро- та макросередовищі через формування цінностей у галузі фізичної культури та спорту забезпечується такими чинниками: строгість, виховання ініціативи, відношення до школи, жорсткість у вихованні, взаємовідносини у сім'ї, взаємодопомога у сім'ї, спільність інтересів.

Ключові слова: спорт, учні середнього шкільного віку, соціальний концепт.

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Cite this article as: Krutsevich, T., Marchenko, O., Trachuk, S., Panhelova, N., Napadij, A., & Dovgal, V. (2021). The Configuration of Educational Factors in the Family in Terms of their Impact on the Formation of Interest in Sports in Middle School Children. *Teoriâ ta Metodika Fizičnogo Vihovannâ*, 21(2), 101-106. <https://doi.org/10.17309/tmfv.2021.2.01>

Received: 12.03.2021. Accepted: 14.04.2021. Published: 25.06.2021

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ORIGINAL SCIENTIFIC ARTICLE

RESEARCH OF TRAINING LOADS OF BASKETBALL PLAYERS

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Accepted for Publication: May 12, 2021

Published: June 25, 2021

DOI: 10.17309/tmfv.2021.2.02

Abstract

The study objective is to identify physiological indicators for the systematization of basketball players' special exercises and limit values of physiological indicators with sufficient "distinctive power" in each of the allocated training load ranges.

Materials and methods. The study used empirical methods of measuring heart rate during competitions, pulmonary ventilation values, O₂ consumption during physical work, O₂-debt, "excess" CO₂ emissions and individual pulse rates, methods of mathematical statistics.

Results. Relationships between the level of physical activity and physiological shifts in the body of basketball players have been established. It is revealed that indicators of pulmonary ventilation can be used to control the training effect of aerobic exercise. Exercises of anaerobic glycolytic orientation have been shown to have the most pronounced effect on the body of basketball players. There are certain mean and limit values for different physiological parameters, characteristic of different ranges of training loads.

Conclusions. It is established that in assessing the urgent training effect of special exercises of basketball players, different physiological indicators have different "distinguishing power". Based on the results of the study, it is proposed to systematize the special exercises of basketball players according to the ranges of training loads by the nature of their training effect.

Keywords: basketball, special exercises, evaluation, load, training effect, power difference.

Introduction

Problem statement. The progress of the sport of excellence is related to the justification of the elements of the system of athletes and its orientation to the sports result (Nelsen, 2015). The training of high-end basketball players is a complex, dynamic pedagogical process based on a deep understanding of the causes of the factors that determine its effectiveness under the direct influence of changes occurring in basketball (Raiola, Altavilla, Tafuri, & Lipoma, 2016; Doroshenko, Su-shko, Koryahin, Pityn, Tklich, & Blavt, 2019). This requires mastery of a complex of knowledge of the latest scientific achievements in the training of high-skilled athletes (Backman, Danielson, 2011; Hoare, 2000).

One of the most important prerequisites for effective management of the training process is the creation of a unified system of accounting training loads. Such accounting can be implemented by systematizing physical exercises used

as training aids, on the basis of any particular attribute (Gonzalo-Skok, Tous-Fajardo, Valero-Campo, Berzosa, Bataller, Arjol-Serrano, & Mendez-Villanueva, 2017; Karpowicz & Karpowicz, 2013). So far, the question of the applicability of systematisation to the special means used in the preparation of basketball players remains relevant.

Analysis of recent research and publications. To date, the developed systematization of special exercises in basketball was in most cases based on assessments of the nature of the technical and tactical tasks and their degree of compliance with the specifics of basketball players' game activity (Asadi, Saez de Villarreal, & Arazi, 2015; Ben Abdelkrim, Castagna, El Faza, & El Ati, 2010). Another approach and systematization of special exercises of basketball players is based on the account of the physiological impact of loads on the body of athletes (Beaver, Wasserman, & Whipp, 1986; Ciuti, Marc-cello, Macis, Onnis, Solinas, & Lai, 2009).

The effectiveness of the system of long-term training of basketball players is constantly in the center of attention of

specialists (Aiken, Fairbrother, & Post, 2012; Montgomery, Pyne, & Minahan, 2010). Achieving the ultimate goals – the preparation of a highly qualified reserve depends crucially on the special training tools used in the preparation of the basketball players (Backman & Danielson, 2011; Tyshchenko, Hnatchuk, Pasichnyk, Bubela, & Semeryak, 2018).

Based on the literature, two fundamental approaches can be used to establish the training load gradations in basketball:

- systematization of exercises taking into account the characteristics of physical activity (Gonzalo-Skok, Sánchez-Sabaté, Izquierdo-Lupón, & Sáez de Villarreal, 2019; Erčulj, Blas, & Bračič, 2010; Karpowicz & Karpowicz, 2013);
- gradation of loads on the basis of taking into account the physiological changes that occur in the body under the influence of physical activity (Ben Abdelkrim, El Fazaa, & El Ati, 2007; Conlee, McGown, Fisher, Dalsky, & Robinson, 2017).

It has been proven that in basketball, it is not always possible to accurately determine exercise parameters (Anastasiadis, 2006). There is an opinion that in the systematization and normalization of training loads, the account of the response of the physiological reactions of the body is considered more appropriate (Sallet, Perrier, Ferret, Vitelli, & Baverel, 2005; Tomlin & Wenger, 2002).

However, the question of the applicability of physiological criteria-based systematization to the special means used in the preparation of basketball players is still unresolved.

Purpose of the research is to identify physiological indicators for the systematization of basketball players' special exercises and limit values of physiological indicators with sufficient "distinctive power" in each of the allocated training load ranges.

Materials and methods

Study Participants

The study involved 18 professional basketball players who took part in the championship of Ukraine.

Study organization

The study of the heart rate during competitions was conducted by means of the method of continuous automatic registration using the multichannel system (Koryagin & Blavt, 2019). This allowed determine the maximum mean pulse rate during the game, as well as the maximum pulse rate total during the game and during the recovery.

The level of pulmonary ventilation was determined by way of collecting expired air into Douglas bags with the subsequent measurement of the volume of the air contained in the bag using a laboratory gas meter (Beaver, Wasserman, & Whipp, 1986). The accuracy of the gas meter readings was checked by passing a precisely measured volume of air through it. When passing 100 litres of control volume of air, the deviation in the gas meter readings in 35 measurements amounted to an average of 0.84 ± 0.13 (MacDougall, Wenger, & Green, 2017).

The air collection was carried out using a breathing mask and a low-resistance valve (6 mm Hg) at the air flow velocity of 300 l/min. The diameter of the air-conducting paths was 4.5 cm.

All parameters of ventilation of lungs were brought to the conditions of the body temperature, atmospheric pressure and saturation with water vapour.

The percent composition was determined by way of analyzing the samples using the gas analyzers Spirolit and ME-TAMAX that are capable of recording the concentration of O₂ and CO₂ in expired air.

The accuracy of the performed analyzes was controlled using duplicate determinations of the gas composition of the same sample. The total error in the measurements of O₂ consumption and CO₂ release during competitive activity made up 0.9%.

In the recovery period, air samples were taken for 32 minutes. At the same time, the sportsmen's heart rate was also recorded during the recovery period.

All the indicators of the heart rate, as well as the level of O₂ consumption, total O₂, the level of CO₂ release and oxygen pulse rate were calculated according to the method described in the works (Volkov, 1986; Zankovets, 2016).

Statistical Analysis

Mathematical methods (Vincent, 2005) of information delivery for statistical analysis of experimental data were applied in two stages. The first stage is the stage of aggregation and grouping of the received statistical material. At this stage, they have summarized and systematized the empirical data of the experimental study, moving from their qualitative characteristics to quantitative expression. This was implemented by descriptive statistics methods and represented using graphical methods. The second stage is the stage of responding to the task of the research objective by evaluating the final results. For this purpose, a regression analysis of the search for models of the relationship between two quantities, expressed in the regression function, was applied. Analytical statistics methods have been used to process statistics and formulate conclusions.

Results

First of all, it should be noted that according to empirical data, physiological indicators by which it is possible to evaluate the urgent training effect of special exercises of basketball players, have different "distinctive power" (Anastasiadis, 2006; Beaver, Wasserman, & Whipp, 1986). With the change of physical activity parameters, each indicator changes specifically until it reaches the limit values. Above these values, physiological indicators become insensitive to the increasing impact of physical activity (Conlee, McGown, Fisher, Dalsky, & Robinson, 2017; Yeager & Karsten, 2016).

The simplest way to establish the "distinctive power" of individual physiological indicators is to analyze the regression dependencies that relate these parameters to the parameters of the leading physiological functions (Doroshenko, Sushko, Koryahin, Pityn, Tklich, & Blavt, 2019). Examples of such dependencies are shown graphically (Fig. 1-3).

In Fig. 1 presents the dependence of the two most important indicators of aerobic and anaerobic metabolism – the level of O₂ consumption and the rate of release of "excess" CO₂. The regression of these indices can be approximated by an exponential dependence. Only when performing moderate exercises, the energy request of which does not exceed the

level of O_2 consumption of 2.3 l/min, is there a linear proportion between aerobic metabolism and excess CO_2 evolution in anaerobic lactic acid production.

With increasing exercise power, the level of anaerobic metabolism, estimated by the rate of release of “excess” CO_2 , increases much faster than the intensity of aerobic processes increases. The sections of the graph, indicated by different hatching, correspond to the values of the measured indicators relating to the ranges of training loads of different orientation. Based on the established relationships between the indicators of physical activity and physiological shifts in the body, we attributed all the studied exercises to 4 ranges of training loads:

- loads of mainly aerobic orientation;
- loads of mixed aerobic-anaerobic effects;
- loads of anaerobic glycolytic orientation;
- loads of anaerobic alactate action (Anastasiadis, 2006; Ingebrigtsen, Jeffreys, Rodahl, 2013; Volkov, 1986).

As can be seen in the regression graph (Fig. 1), the values of the O_2 -consumption and Ex- CO_2 indicators related to the different exercises are clearly grouped on the selected sections of the regression field. Based on this grouping of indicators characterizing the urgent training effect of exercises of different orientation, it is possible to determine the boundary values of physiological indicators inherent in the distant ranges of training loads.

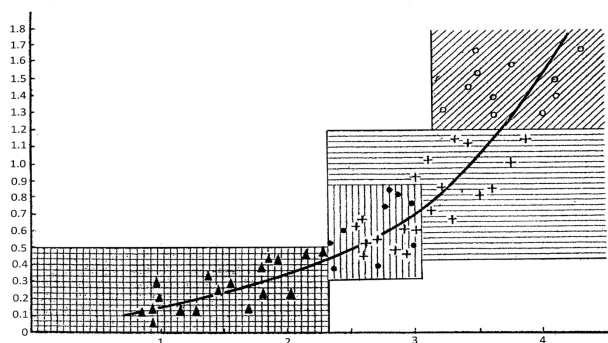


Fig. 1. Regression between indicators of “non-metabolic excess” of CO_2 and O_2 -consumption at performance of special exercises of basketball players. In the ordinate – the level of release of “excess” CO_2 , l/min. Symbols: 1 – exercises of aerobic orientation, 2 – aerobic-anaerobic; 3 – anaerobic alactate; 4 – anaerobic glycolytic orientation

Setting these values in the future can be used to control the training process. For example, from the analysis of the given regression dependence it follows that when performing exercises mainly aerobic orientation values of the rate of excess CO_2 emission should not exceed 0.5 l/min, and the level of O_2 consumption should not be higher than 2.3 l/min. When performing aerobic-anaerobic exercise, the change in the rate of CO_2 evolution is limited by the range of values from 0.5 to 1.2 l/min, and the measurement of the level of O_2 consumption – from 2.3 l/min to the maximum values of O_2 . Exercise of alactate anaerobic orientation is characterized by the following limits of variation for the rate of excess CO_2 evolution – from 0.35 to 0.8 l/min, for the level of O_2 consumption – from 2.3 to 3.1 l/min. Exercise of anaerobic glycolytic orientation exercises is accompanied by the release of excess CO_2 in sizes from 1.2 l/min to maximum values, and

the level of O_2 consumption – in the range from 3.2 l/min to values of maximum O_2 .

In Figure 2 presents regression graphs of the O_2 -consumption level indicator and the indicators evaluating the intensity of anaerobic tissue changes. At the top of the change in the level of O_2 consumption are compared with the increase in the rate of release of “excess” CO_2 , characterizing the relative power of the glycolytic process. It can be clearly seen here that changes in the O_2 consumption are observed only in the range of glycolysis rate values, which do not exceed 50-70% of the maximum capacity of this anaerobic process. At higher values of the rate of anaerobic transformations in the body, the values of O_2 consumption do not change. This suggests that for high-intensity exercise, where anaerobic processes are the main focus of exercise energy, the level of O_2 consumption no longer has sufficient “distinctive power” and cannot be used in the exercise gradation.

This is confirmed by the data of the analysis of the dependence of the level of O_2 consumption on the rate of formation of alactate O_2 debt (Fig. 2.B). Here, the points related to exercise of alactate anaerobic orientation, strongly fall out of the total dependence established on the results of measurements of these indicators in other ranges of training loads. Changes in pulmonary ventilation indices, which estimate the size of O_2 flow through the lungs, depending on the detected shifts of the basic parameters of aerobic and anaerobic metabolism, are presented in Fig. 3.

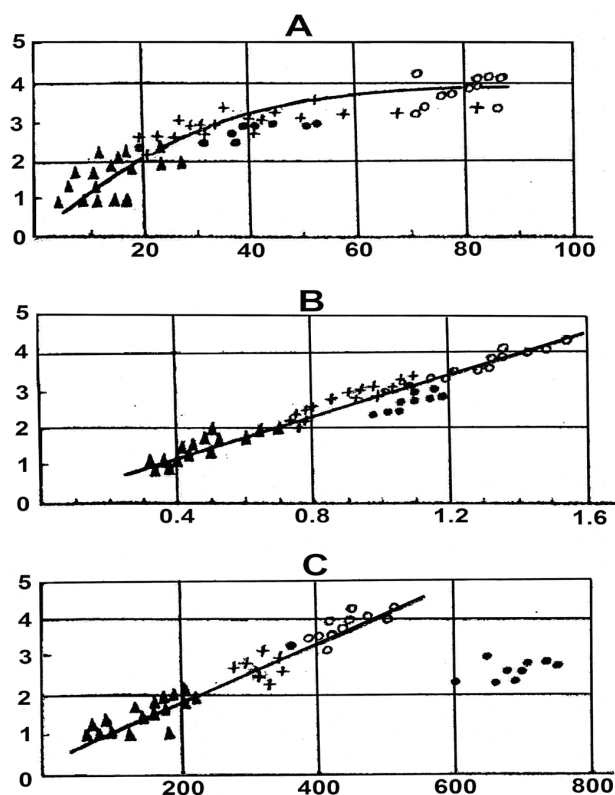


Fig. 2. Change of the O_2 consumption indicator depending on the intensity of metabolic processes in the performance of special exercises of basketball players. A – Regressions of O_2 consumption figures by level of anaerobic metabolism (Ex CO_2 , % max); B – the rate of use of macroergies ($\sim P/t$, M/min); C – the rate of formation of alactate O_2 -debt (Alact. O_2 -debt/t ml/min). At the ordinate, O_2 -consumption, l/min.

It can be seen that there is a linear relationship between pulmonary ventilation rate and aerobic process speed that covers all ranges of training loads. This suggests that the effects on systems responsible for oxygen transport are progressively increased by the stimulation of aerobic processes in tissues. Consequently, pulmonary ventilation indicators may well be used to control the training effects of aerobic exercise.

Based on the analysis of the relationship between the indicators of pulmonary ventilation and the rate of "excess" CO_2 evolution, it is established that an increase in the rate of O_2 intake through the lungs is detected only until the value of "excess" CO_2 emission reaches 50 % of the maximum. Changes in pulmonary ventilation depending on the rate of splitting of macroergs show a tendency to increase exponentially at high exercise powers. This can be regarded as an indication that the degree of metabolic activity of working muscles is the main factor in the regulation of external respiration during intense muscular work.

Discussion

Studying the different characteristics of physiological indicators to systematize the specific exercises of basketball players remains an important element in obtaining informa-

tion about the current status and capabilities of each athlete in the team (Montgomery, Pyne, & Minahan, 2010; Sallet, Perrier, Ferret, Vitelli, & Baverel, 2005).

Interpretation of the received data about the changes in the players' physiological functions in the process of training and competition makes it possible to better understand them (Ben Abdelkrim, El Fazaa, & El Ati, 2007). Some data on such characteristics have been obtained previously (Ciuti, Marcello, Macis, Onnis, Solinas, & Lai, 2009; Kozina, Iermakov, Cretu, Kadutskaya, & Sobyannin, 2017). Considering the above will to some extent help to resolve the question of the possibility of applying the systematization of the physiological criteria of special training means of training basketball players, which was confirmed by other data of our study (Gonzalo-Skok, Tous-Fajardo, Valero-Campo, Berzosa, Bataller, Arjol-Serrano, & Mendez-Villanueva, 2017; Ramos, Rubio, Martínez, Esteban, & Jiménez, 2010).

Contributes to the solution of the question of selection of special training aids for the preparation of basketball players for the first time the data obtained on the results of the study of the "distinctive power" of individual physiological indicators. To some extent, these findings confirm the results of the study (Anastasiadis, 2006; Koryagin, Blavt, & Grebinca, 2016).

According to the results of the analysis of empirical data of the study, the limits of physiological indicators of the distant ranges of training loads of basketball players were established. Identifying such values can be used to control the training process, which is consistent with the ideas outlined in the literature (Crisafulli, Melis, & Tocco, 2005; Zankovets, 2016).

The result obtained during the control of the physiological features of basketball players was consistent with the information (Thoden, Wilson, & MacDougall, 1991; Tomlin & Wenger, 2002) which the consumption of O_2 cannot be used when graduation exercises.

The result obtained during the pedagogical control of the physiological features of basketball players, corresponded to information (Kozina, Iermakov, Cretu, Kadutskaya, & Sobyannin, 2017; Narazaki, Berg, Stergiou, & Chen, 2009; Sallet, P., Perrier, D., Ferret, J.M., Vitelli, V., & Baverel, 2005), regarding changes in the parameters of the physiological functions of basketball players during the game.

The results of the study supplement the information on the physiological control of competitive and training activities of basketball players regulating the expediency of training influences to ensure the efficiency of the basketball players' actions (Ciuti, Marcello, Macis, Onnis, Solinas, & Lai, 2009; Scanlan, Fox, Borges, Tucker, & Dalbo, 2018; Scanlan, Fox, Borges, Tucker, & Dalbo, 2018).

Conclusions

1. In assessing the urgent training effect of special exercises of basketball players, different physiological indicators have different information capacity. Indicators of the rate of cleavage of macroergs in working muscles, the rate of formation of alacticity of O_2 debt and the "excess" of CO_2 are the most "sensitive" to change of load. Indicators that estimate the intensity of aerobic metabolism (O_2 consumption level) have more limited "differential power".

2. On the basis of the study of the means and methods of training of basketball players, it is proposed to systematize special exercises by the nature of their training effect: exercise

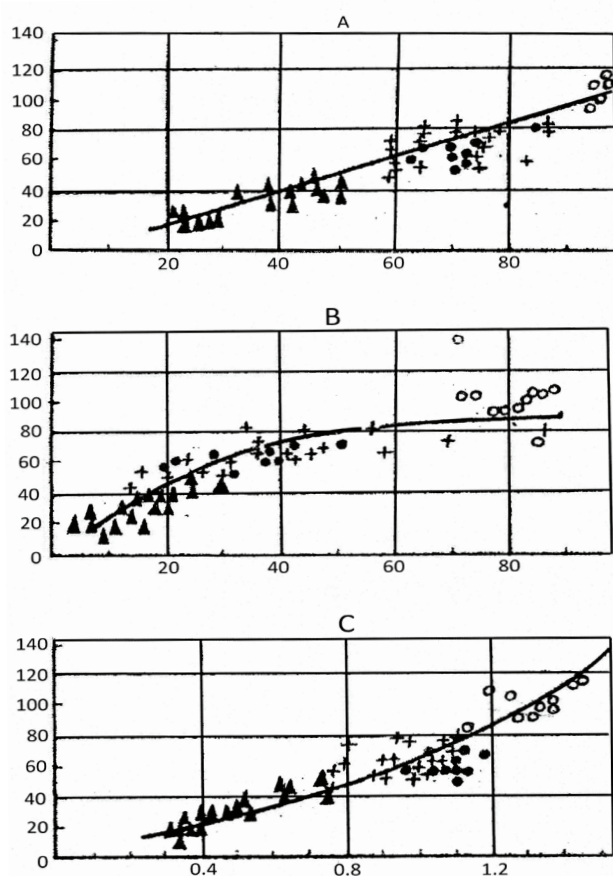


Fig. 3. Changing the indicator of pulmonary ventilation depending on the intensity of metabolic processes during the performance of special exercises of basketball players. Regressions of pulmonary ventilation are presented: A – by the level of aerobic metabolism (VO_2 , % max); B – level of anaerobic metabolism (Ex CO_2 , % max); C – speed of use of macroergs ($\sim P/t$, M/min). At the ordinate – the level of pulmonary ventilation, l/min.

of predominantly aerobic effects; exercises of mixed aerobic-anaerobic orientation; exercise anaerobic lactate exposure; exercise anaerobic glycolytic orientation.

Conflict of interest

The authors state no conflict of interest.

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ВИЗНАЧЕННЯ ТРЕНУВАЛЬНОГО ЕФЕКТУ СПЕЦІАЛЬНИХ ВПРАВ БАСКЕТБОЛІСТІВ

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Авторський вклад: А – дизайн дослідження; В – збір даних; С – статаналіз; D – підготовка рукопису; Е – збір коштів

Реферат. Стаття: 8 с., 3 рис., 33 джерела.

Мета дослідження – виявлення фізіологічних показників для систематизації спеціальних вправ баскетболістів і граничні значення фізіологічних показників з достатньою «розрізняльною потужністю», в кожному з виділених діапазонів тренувальних навантажень.

Матеріали та методи. У дослідженні було використано емпіричні методи вимірювання частоти серцевих скорочень під час змагань, величини легеневої вентиляції, O₂-споживання під час фізичної роботи, O₂-боргу, «надлишку» виділення CO₂ і окремих пульсових показників, методи математичної статистики.

Результати. Встановлені співвідношення між рівнем фізичного навантаження і фізіологічними зрушеннями в організмі баскетболістів. Виявлено, що показники легеневої вентиляції можуть бути використані для конт-

ролю тренувального впливу вправ аеробного характеру. Показано, що найбільш виражений вплив на організм баскетболістів мають вправи анаеробної гліколітичної спрямованості. Певні середні і граничні значення для різних фізіологічних показників, характерних для різних діапазонів тренувальних навантажень.

Висновки. Встановлено, що при оцінці термінового тренувального ефекту спеціальних вправ баскетболістів різні фізіологічні показники володіють різною «розрізняльною потужністю». На основі результатів дослідження, запропонована систематизація спеціальних вправ баскетболістів згідно діапазонів тренувальних навантажень за характером викликаного ними тренувального ефекту.

Ключові слова: спеціальні вправи, баскетболіст, оцінка, тренувальний ефект, розрізняльна потужність.

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Cite this article as: Koryahin, V., Blavt, O., Prystynskyi, V., & Stadnyk, V. (2021). Research of Training Loads of Basketball Players. *Teoriâ ta Metodika Fizičnogo Vihovannâ*, 21(2), 107-112. <https://doi.org/10.17309/tmfv.2021.2.02>

Received: 11.01.2021. Accepted: 12.05.2021. Published: 25.06.2021

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ORIGINAL SCIENTIFIC ARTICLE

GENDER DIFFERENCES IN ABSOLUTE AND RELATIVE VALUES OF HAND DYNAMOMETER TEST WITH 9 AND 10-YEAR OLD CHILDREN FROM THE SKOPJE REGION IN R.N. MACEDONIA

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

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Accepted for Publication: May 12, 2021

Published: June 25, 2021

DOI: 10.17309/tmfv.2021.2.03

Abstract

Background. Handgrip strength test is applied both to adults and children to indicate muscular fitness as well as the nutritional and health status. It differs in adults and adolescents depending on the gender. However, it is not clear whether a difference exists also in children at 9 to 10 years of age, and what are the factors that influence it. The goal of the research was to determine the absolute and relative values of the hand dynamometer test with healthy Macedonian boys and girls aged 9 and 10 from the Skopje region as well as to determine the factors that affect the handgrip strength at that age.

Materials and methods. The research was conducted on a sample of 775 children (boys n = 386; girls n = 389), whereby the following characteristics were measured: handgrip strength, weight, height, body fat percentage, muscle mass percentage and the body mass index (BMI) was calculated. The maximum handgrip strength was measured with a digital Takei TKK 5101 dynamometer.

Results. The research found that there are statistically significant differences in the absolute values obtained in the hand dynamometer test between healthy boys and girls in Macedonia at 9 and 10 years of age. On the basis of the results obtained from the research, one can conclude that the results of the hand dynamometer test are affected by age, gender and body composition.

Conclusion. Based on the increasing predominance of children's obesity, the present study can provide clinicians and researchers with an insight how body composition influences muscular fitness, and can serve policy-makers to develop gender-specific strategies about body-weight management and promotion of muscular performance among children and adolescents.

Keywords: handgrip strength, dynamometer, nutrition, children, early phase of puberty.

Introduction

Physical fitness is used as a means to predict an individual health condition throughout a lifetime (Ortega et al., 2008; Artero et al., 2011; Cooper et al., 2011; Ortega et al., 2012). There is evidence that muscle fitness is associated with insulin sensitivity in children and adolescents (Benson, Torode & Singh, 2006) which is associated with a risk of type 2 diabetes mellitus (T2DM) later on in life (Sabin et al., 2015). The effect of muscle fitness is also well known in preventing some chronic diseases (Wolfe, 2006). In this regard, the handgrip strength (HGS), which is an indicator of muscle fitness, is

used in both adults and children, and also as an indicator of the nutritional status (Schlüssel, Anjos, & Kac, 2008). In fact, an association between some micronutrient deficiencies, which occurs in some situations in European young people (Valtueña et al., 2013), and HGS has been found (Bohannon, 2001). In addition, this parameter is also correlated with several diseases and clinical complications (Bohannon, 2001; Snow-Harter et al., 1990; Lamprinouidi et al., 2014; Webb et al., 1989) and can predict mortality in both adults and children (Sasaki et al., 2007; Ortega et al., 2012; Leong et al., 2015).

Currently, there are various studies proposing reference values for the hand dynamometer test, and some of them refer exclusively to young people in Europe. Unfortunately, there is not enough data about Macedonian students from

9 to 10 years of age (Gontarev et al., 2018). In the IDEFICS study, which was conducted on European children, the hand dynamometer test was used only for 9-year-old girls and boys (De Miguel-Etayo et al., 2014).

The HELENA study with the hand dynamometer test examined a large group of young people from several European countries, however they were older than 12 years (Ortega et al., 2011). Other researches provide values for the hand dynamometer test only for Spanish (Gulías-González et al., 2014) or Estonian (Semproul et al., 2007) children from 9 to 10 years of age. The reference values are necessary to identify children with malnutrition or at risk for other clinical complications, as well as to plan an appropriate treatment approach.

Furthermore, it is assumed that some anthropometric variables and indices could have an impact on the results, but currently their relationship is not clear enough. Some authors point out the effect of body height on the hand dynamometer test, in the early stage of puberty, especially in boys. A parallel increase of HGS has also been demonstrated with age (De Miguel-Etayo et al., 2014; Ortega et al., 2011; Gulías-González et al., 2014), that seems largely dependent on the increase in body mass index (BMI) and, particularly, muscle mass (Sartorio et al., 2002). However, this could simply reflect the sexual dimorphism (Loomba-Albrecht et al., 2009), due to the action of sex steroid hormones.

The goal of the research was to determine the absolute and relative values of the hand dynamometer test with healthy boys and girls at the age of 9 and 10 years from Skopje region, in R.N. Macedonia. Furthermore, in this study we wanted to determine how anthropometric measures, body composition assessment measures, age and gender affect the results of the hand dynamometer test at this age.

Materials and methods

Study Participants

The sample included 775 children from the Skopje region in North Macedonia, at 9 and 10 years of age. The sample was divided into two subsamples according to gender, with 386 male and 389 female respondents. Each of the subsamples is divided according to the chronological age into 2 age groups within a calendar year, 179 male respondents at 9 years of age and 207 male respondents at 10 years of age, 216 female respondents at 10 years of age and 173 female respondents at 9 years of age.

The study included all students whose parents agreed to participate in the study, who were psychophysically healthy and who regularly attended Physical and Health Education classes. The respondents were treated in accordance with the Helsinki Declaration (revision of Edinburgh 2013). The protocols were approved by the Ethics Committee at the Ss. Cyril and Methodius University of Skopje.

The measurements were realized in March, April and May 2019, in standard school conditions at the regular classes in Physical and Health Education.

Anthropometric measures and body composition

The anthropometric measurements were taken according to the standard methodology of the International Biological Program (IBP) and according to the recommendations of

the World Health Organization (WHO) and Weiner & Lurie (1981). Weight was measured in underwear and without shoes with a medical decimal weight scales, to the nearest 0.1 kg, and height was measured barefoot in the Frankfurt horizontal plane with a telescopic height measuring instrument (Martin's anthropometry) to the nearest 0.1 cm. Body mass index (BMI kg/m²) was calculated as weight in kilograms divided by the square of height in meters.

Components of the body composition have been determined by the method of bioelectrical impedance (measuring of the electric conductivity – Bioelectrical Impedance Analysis - BIA). The measuring was realized by a Body Composition Monitor, model "OMRON – BF511", by means of which we have measured the weight (kg), body fat percentage (BFP %) and muscular mass percent (MM %). Prior to commencing the measurement we had entered the parameters of gender, years and height of the respondent in the Body Composition Monitor. In order to provide better precision of the results obtained from the estimation of the body composition, prior to each measurement, we ensured that the preconditions recommended by ACSM (2005) and Heyward (2006) had been fulfilled.

HGS measurement

With the use of a digital Takei TTK 5101 dynamometer (range, 1-100 kg), the maximum grip strength was measured for both hands. The subject holds the dynamometer in the hand to be tested, with the arm at right angles and the elbow by the side of the body. The handle of the dynamometer is adjusted if required – the base should rest on the first metacarpal (heel of palm), while the handle should rest on middle of the four fingers. The children were instructed to squeeze the dynamometer three consecutive times with each hand as tight as possible, and the highest value (maximal value in kilograms) was used for the analyses (Haidar et al., 2004). By dividing maximal handgrip strength by BMI, the grip-to-BMI ratio was calculated.

Statistical Analysis

Data are reported as mean $\pm$ (SD). A t-test was performed to compare the means between the genders. The Pearson correlation was used to identify the variables correlated to the HGS and grip-to-BMI ratio given that the continuous variables were normally distributed according to the Kolmogorov-Smirnov test (age, weight, height, BMI, body fat percentage and muscle mass percentage). The Multivariate hierarchical linear regression analysis was used to determine the independent contributions of age, weight, height, BMI, body fat percentage percent and muscular mass percent on predicting the HGS and grip-to-BMI ratio. Significant differences were assumed to be present at $p < 0.05$ (two-tailed). All comparisons were performed using SPSS 22.0 for Windows (IBM Corporation, New York, NY, United States).

Results

Table 1 shows the significance of the differences (t-test) of the arithmetic means of the anthropometric measures, the body composition assessment measures, and the absolute and relative value obtained from the hand dynamometer fit-

Table 1. Differences in anthropometric measures. body composition assessment measures and hand dynamometer test between boys and girls at 9 years of age

Indicator	Boys (n = 179)		Girls (n = 173)		t	df	P-values	C' d
	Mean	Std.Dev.	Mean	Std.Dev.				
Age	9.42	0.29	9.46	0.30	-1.38	393.00	0.17	-0.1
Height (cm)	138.07	7.01	137.67	6.93	0.57	393.00	0.57	0.1
Weight (kg)	38.39	9.63	35.74	8.80	2.86	393.00	0.01	0.3
BMI (kg/m ²)	19.98	3.80	18.69	3.46	3.52	391.00	0.00	0.4
BFP (%)	25.62	7.86	23.09	8.62	3.02	391.00	0.00	0.3
MM (%)	31.44	2.41	30.95	2.04	2.21	391.00	0.03	0.2
Handgrip (kg)	15.08	2.90	13.84	2.59	4.50	393.00	0.00	0.5
Grip-to-BMI (kg/kg/m ²)	0.77	0.17	0.75	0.15	1.09	391.00	0.28	0.1

Table 2. Differences in anthropometric measures. body composition assessment measures and hand dynamometer test between 10-years-old boys and girls

Indicator	Boys (n = 207)		Girls (n = 216)		t	df	P-values	C' d
	Mean	Std.Dev.	Mean	Std.Dev.				
Age	10.48	0.28	10.46	0.29	0.44	378.00	0.66	0.0
Height (cm)	143.89	6.49	144.04	7.32	-0.20	378.00	0.84	0.0
Weight (kg)	42.67	11.39	40.79	10.07	1.69	378.00	0.09	0.2
BMI (kg/m ²)	20.39	4.32	19.47	3.71	2.18	376.00	0.03	0.2
BFP (%)	24.93	8.62	24.03	8.77	0.99	376.00	0.32	0.1
MM (%)	32.68	2.26	31.95	2.28	3.13	376.00	0.00	0.3
Handgrip (kg)	16.94	3.25	16.16	3.13	2.39	378.00	0.02	0.2
Grip-to-BMI (kg/kg/m ²)	0.85	0.19	0.85	0.17	0.34	376.00	0.73	0.0

ness test in boys and girls at 9 years of age. From the review of Table 1, it can be seen that there are statistically significant differences between boys and girls at 9 years of age in 5 out of 8 variables. Intergroup differences were found in the following variables: weight ($t = 2.86$; $p = .01$), body mass index ($t = 3.52$; $p = .000$), body fat percentage ($t = 3.02$; $p = .000$), muscle mass percentage ($t = 2.21$; $p = .030$) and the absolute values obtained in the hand dynamometer test ($t = 4.50$; $p = .000$). The partial effect of the determinants C' d is ranked between 0.2 and 0.5 and shows a small to medium effect. The greatest effect in determining the differences is shown by the variables of the absolute values obtained in the hand dynamometer test (C' d = 0.5).

Table 2 shows the significance of the differences (t-test) of the arithmetic means of the anthropometric measures, the body composition assessment measures, and the absolute and relative value obtained from the hand dynamometer fitness test in boys and girls at 10 years of age. The overview of Table 2 shows that there are statistically significant differences between boys and girls at 10 years of age in 3 out of 8 variables. Intergroup differences were found in the variables: body mass index ($t = 2.18$; $p = .030$), muscle mass percentage ($t = 3.13$; $p = .000$) and the absolute values obtained in the hand dynamometer test ($t = 2.39$; $p = .020$). The partial effect of the C'd determinants is ranked between 0.2 and 0.3 and shows little effect.

Table 3 shows the correlation coefficients between the absolute and the relative value obtained from the hand dynamometer fitness test and the anthropometric measures, the body composition assessment measures, age and gender.

From the overview of Table 3 it is observable that a moderately positive statistically significant correlation was found (within the range of .34 to .57) between the absolute value

obtained from the hand dynamometer fitness test and age, height, weight, body mass index, the body fat percentage and the muscle mass percentage. A statistically significant negative low correlation was established between the absolute value obtained from the hand dynamometer fitness test and gender (-.19). Moderately negative statistically significant correlation (within the range from -.29 to .38) was found between the relative value obtained from the hand dynamometer test and weight, the body mass index and the body fat percentage. Low positive statistically significant correlation (within the range from .19 to .29) was found between the relative value obtained from the hand dynamometer test and height and age. Moderately positive statistically significant correlation (.66) was found between the relative value obtained from the hand dynamometer fitness test and the muscle mass percentage. A statistically significant correlation

Table 3. Correlation between the absolute and the relative value obtained from the hand dynamometer test and the anthropometric measures, the body composition measurement measures, age and gender

Indicator	Handgrip (kg)		Grip-to-BMI (kg/kg/m ²)	
Gender	-0.19	$p=.000$	-0.06	$p=.109$
Age	0.39	$p=0.00$	0.29	$p=.000$
Height (cm)	0.57	$p=0.00$	0.20	$p=.000$
Weight (kg)	0.53	$p=0.00$	-0.28	$p=.000$
BMI (kg/m ²)	0.39	$p=0.00$	-0.48	$p=0.00$
BFP (%)	0.23	$p=.000$	-0.58	$p=0.00$
MM (%)	0.34	$p=0.00$	0.66	$p=0.00$

Table 4. Hierarchical regression analysis of the hand dynamometer test expressed in absolute values and the anthropometric measures. the body composition assessment measures. age and gender

Indicator	β	Sig	Partial r	β_1	Sig ₁
R = 0.540 R ² = 0.292***					
Age	.347	.000	.379	.169	.000
Body mass index	.343	.000	.373	.536	.001
Gender	-.116	.000	-.134	-.031	.274
R = 0.635 R ² = 0.403***					
Age	.178	.000	.200	.169	.000
Body mass index	-.007	.964	-.002	.536	.001
Gender	-.130	.000	-.163	-.031	.274
Height (cm)	.293	.000	.128	.007	.934
Weight (kg)	.272	.154	.052	.214	.000
R = 0.699 R ² = 0.488***					
Age	.169	.000	.204	.169	.000
Body mass index	.536	.001	.115	.536	.001
Gender	-.031	.274	-.040	-.031	.274
Height (cm)	.007	.934	.003	.007	.934
Weight (kg)	.214	.233	.043	.214	.233
Body fat percentage	-.220	.007	-.097	-.220	.007
Muscle mass percentage	.406	.000	.301	.406	.000

Note. Partial r – partial correlation coefficient; β – standardized partial regression coefficient; β_1 – value of β – coefficient in the last equation analysis; R – Multiple correlation coefficient; R² – change the coefficient of determination; Significance. * P < 0.05. ** P < 0.01. *** P < 0.001.

Table 5. Hierarchical regression analysis of the hand dynamometer test expressed in relative values and the anthropometric measures. the body composition assessment measures. age and gender

Indicator	β	Sig	Partial r	β_1	Sig ₁
R = 0.289 R ² = 0.083***					
Age	.284	.000	.283	.163	.000
Gender	-.038	.271	-.040	-.031	.240
R = 0.651 R ² = 0.424***					
Age	.191	.000	.219	.163	.000
Gender	-.119	.000	-.153	-.031	.240
Height (cm)	.674	.000	.506	.078	.172
Weight (kg)	-.817	.000	-.606	-.021	.792
R = 0.733 R ² = 0.538***					
Age	.163	.000	.208	.163	.000
Gender	-.031	.240	-.043	-.031	.240
Height (cm)	.078	.172	.049	.078	.172
Weight (kg)	-.021	.792	-.010	-.021	.792
Body fat percentage	-.399	.000	-.215	-.399	.000
Muscle mass percentage	.357	.000	.282	.357	.000

Note. Partial r – partial correlation coefficient; β – standardized partial regression coefficient; β_1 – value of β – coefficient in the last equation analysis; R – Multiple correlation coefficient; R² – change the coefficient of determination; Significance. * P < 0.05. ** P < 0.01. *** P < 0.001.

has not been found between the relative value obtained from the hand dynamometer fitness test and gender.

In order to determine the multivariate effects of the anthropometric measures, the body composition assessment measures, age and gender on the absolute value obtained from the hand dynamometer fitness test, a hierarchical regression analysis has been applied. The results of the regression analysis are presented in Table 4.

The first regression equation explains 29.2% (p < 0.001) of the total variability of the criterion variable, with statistically significant influence on the predictive variables years, body mass index and gender. By including both anthropometric

variables (height and weight) in the second step, the amount of the explained variance increases to 40.3% (P < 0.001), and the coefficients of the linear correlation in the equation for this system of 5 predictors with the absolute value obtained from the hand dynamometer fitness test is R = 0.635 (F = 103.11, p < 0.001). Age (β = 0.178, p < 0.001), gender (β = -0.130, p < 0.001) and height (β = 0.293, p < 0.001) are important determinants that have a significant statistical effect on the criterion variable. By including the third block of variables, the amount of the explained variance increases to 48.8% (p < 0.001). The variables age (β = 0.169, p < 0.001), body mass index (β = 0.536, p < 0.01), body fat percentage

($\beta = -0.220$, $p < 0.01$) and muscle mass percentage ($\beta = 0.406$, $p < 0.001$) have statistically significant influence on the overall predictive system. After including the third block of variables for body composition assessment, it can be seen that the variables gender, height and weight in the final regression equation become statistically insignificant.

In order to determine the multivariate effect of the anthropometric measures, the body composition assessment measures, age and gender of the relative value obtained from the hand dynamometer fitness test, a hierarchical regression analysis was applied. The results of the regression analysis are shown in Table 5. The first regression equation explains 8.3% ($p < 0.001$) of the total variability of the criterion variance, with a statistically significant effect on the predictive variable age. By including both anthropometric variables (height and weight) in the second step, the amount of the explained variance increases to 42.4% ($p < 0.001$), and the coefficients of the linear correlation in the equation for this system of 4 predictors with the relative value obtained from the hand dynamometer fitness test are $R = 0.651$, ($F = 140.90$, $p < 0.001$). Age ($\beta = 0.191$, $p < 0.001$), gender ($\beta = -0.119$, $p < 0.001$), height ($\beta = 0.674$, $p < 0.001$) and weight ($\beta = -0.817$, $p < 0.001$) are significant determinants that statistically significantly affect the criterion variable. By including the third block of variables, the amount of the explained variance increases to 53.8% ($p < 0.001$). The variables age ($\beta = 0.163$, $p < 0.001$), body fat percentage ($\beta = -0.399$, $p < 0.001$) and muscle mass percentage ($\beta = 0.357$, $p < 0.001$) have a statistically significant influence on the overall predictive system. After including the third block of variables for body composition assessment, it can be seen that the variables gender, height, and weight in the final regression equation become statistically insignificant.

Discussion

Recent scientific research suggests that physical fitness is a powerful indicator of the health status in childhood and adolescence, as well as in adulthood (Ortega et al., 2008; Cooper et al., 2011; Ortega et al., 2012). Even in children and adolescents, physical fitness is negatively correlated with cardiorespiratory diseases, high blood pressure, abdominal adiposity, total obesity, impaired skeletal health, hyperinsulinemia, insulin resistance, impaired lipid profile and metabolic risk factors (Ortega, et. al. 2008).

In this research, we give the maximum and relative HGS value of apparently healthy Macedonia school girls and boys aged from 9 to 10, from Skopje region. Furthermore, as expected, we demonstrated a significant difference in HGS performance between the genders. We also found a relation between maximum and relative HGS with the age, gender, weight, height, BMI, body fat percentage and muscle mass percentage.

The research results are significant with regard to more than one aspect. The hand dynamometer test is used as an index of physical fitness related to children's health. (Ortega et al., 2008; Vicente-Rodriguez et al., 2008; Artero et al. 2011; Ortega et al., 2012). Physical activity plays a key role in normal growth during the first phase of life and it also affects the psychosocial maturation of young people. The hand dynamometer test is also an index of the nutritional status (Schlüssel et al., 2008; Valtueña et al., 2013; Flood et al., 2014; White et al., 2012) and it is useful for examining patients with neuromuscular diseases (Wiles et al., 1990). In addition, the

test is an indicator of mortality in young people (Ortega et al., 2012). Therefore, the availability of normative data about the test may help identify children who need special dietary or pharmacological treatments or children at high risk for clinical complications (Bohannon, 2001; Snow-Harter et al., 1990; Lamprinouidi et al., 2014; Webb et al., 1989).

In a certain number of studies, such as EUROFIT and CHMS, the test result that is taken into consideration is the best result obtained from the left and the right hand, while in the studies IDEFICS and HELENA, the authors used as a test result the average value obtained from the better result of both trials with the right and the left hand. However, both methods have been shown to be very consistent, without a statistically significant difference. In this research, the methodology used in the IDEFICS and HELENA studies was applied. As it was expected, our results are very different from the results obtained in the CHMS study, conducted on Canadian children in which the hand dynamometer test was applied and where the test results were obtained between 24 and 27 kg in boys and between 21 and 24 kg in girls from 8 to 10 years of age (Tremblay et al., 2010). This data emphasizes the importance of having a reference value for different populations, which have different lifestyles, eating habits, opportunities to engage in different physical activities, as well as differences in education and training systems.

The results of our research showed that boys at 9 and 10 years of age achieve better results in absolute values obtained in the hand dynamometer test compared to girls, however when the test result is divided by the body mass index, there are no statistically significant differences between boys and girls at 9 and 10 years of age. In this regard, we found that at 9 years of age, the absolute values obtained in the hand dynamometer test were 13.8 ± 2.6 in girls and 15.1 ± 3.0 kg in boys. At 10 years of age, the absolute values obtained in the hand dynamometer test were 16.2 ± 3.1 in girls and 17.0 ± 3.2 kg in boys. At the age of 9, the relative values obtained in the hand dynamometer test were 0.75 ± 0.1 in girls and 0.77 ± 0.2 kg/kg/m² in boys. At the age of 10, the relative values obtained in the hand dynamometer test were 0.85 ± 0.2 in girls and 0.85 ± 0.2 kg/kg/m² in boys. Our results were similar to those obtained in the EUROFIT study, in which the maximum handgrip strength was 14.1 ± 2 in girls and 15.7 ± 3 kg in boys at 9 years of age and 17.1 ± 3 in boys and 16 ± 3 kg in girls at 10 years of age (Gulías-González et al., 2014). Gender differences were also identified in the in CHMS, HELENA and IDEFICS studies (Tremblay et al., 2010; Ortega et al., 2011; De Miguel-Etayo et al., 2014). The results of the research showed that the differences in the test in terms of gender disappear when the test result is expressed in relative values (the absolute result of the test divided by the body mass index - BMI), and the biggest factor that affects the differences in terms of gender are sex hormones. In fact, muscle mass is related to sex hormones and is more common in boys than in girls. In this regard, it is well known that sexual dimorphism in the body is largely due to the action of sex steroid hormones. Recent research has shown that sexual differences in body composition are manifested ever since fetal life, and the differences in estrogen and testosterone are evident before external signs of puberty appear, leading to differences in the absolute values obtained in the hand dynamometer test. However, if we look at the results, it is observable that the muscle mass percentage is the main determinant that leads to differences between boys and girls. Interestingly, at 9 years of age, boys have a higher per-

centage of adipose component than girls, and at the age of 10, differences have not been found in the percentage of adipose component between boys and girls. This suggests that in addition to sex hormones, diet and physical activity also affect body composition (Sartorio et al., 2002).

The past research has shown that the hand dynamometer test is positively related to weight, height, and body surface and that in the early stages of puberty, height may be a key factor that affects the handgrip strength (Chatterjee & Chowdhuri, 1991; Jürimäe et al., 2009; Montalcini et al., 2016). Our results are consistent with this research. However, when the multivariate hierarchical regression analysis included the body fat percentage and the muscle mass percentage as independent variables, the influence of the gender factor, height and weight disappeared. Similar results were obtained when the relative value of the hand dynamometer test (ratio of the test result and the body mass index – BMI) was used as a criterion. The result of the test is mostly determined by the variables for body composition assessment (body fat percentage and muscle mass percentage) and age.

In addition, the improvement of the result in the hand dynamometer test by increasing age can be attributed to hormonal changes over time. However, in boys, the growth hormone and testosterone have greater effects on test scores than in girls (Neu et al., 2002).

This research confirmed the need of the hand dynamometer test that will help in planning interventions aimed at improving muscle fitness, especially in children who have achieved low results in this regard. The components of prenatal, prepubertal, and pubertal growth have long-term consequences for the values in the hand dynamometer test in the middle years of life. Early interventions may help build muscle mass, which will prevent morbidity and mortality later on in life (Rudolph et al., 2013; Kulkarni et al., 2014; Battjes-Fries et al., 2015).

Unfortunately, the hand dynamometer test is not practiced in the pediatric population despite the low cost and portability of the device, hence our research suggests that in the future the hand dynamometer test will be used more often in experimental, epidemiological studies and in schools as one of the tests for assessing physical fitness related to health.

Conclusions

According to the finding in the research, there are significant differences in the absolute values obtained in the hand dynamometer test between healthy boys and girls in Macedonia at 9 and 10 years of age, from the Skopje region. Based on the results of the research, it can be concluded that the results of the hand dynamometer test are influenced by age, gender and body composition. Based on the increasing predominance of children's obesity, the present study can provide for clinicians and researcher an insight how body composition influences muscular fitness, and can also serve for police-makers to develop gender-specific strategies about body-weight management and promotion of muscular performance among children and adolescents.

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article

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ГЕНДЕРНІ ВІДМІННОСТІ В АБСОЛЮТНИХ ТА ВІДНОСНИХ ЗНАЧЕННЯХ ТЕСТУ КИСТЬОВОЇ ДИНАМОМЕТРІЇ У ДІТЕЙ 9 ТА 10 РОКІВ ІЗ РЕГІОНУ СКОП'Є РЕСПУБЛІКИ ПІВНІЧНА МАКЕДОНІЯ

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Реферат. Стаття: 8 с., 5 табл., 38 джерел.

Метою дослідження було визначити абсолютні та відносні значення тесту кистьової динамометрії у здорових македонських хлопчиків та дівчаток 9 та 10 років із регіону Скоп'є, а також визначити фактори, що впливають на силу кисті у цьому віці.

Матеріали і методи. Дослідження було проведено на вибірці з 775 дітей (хлопчиків n = 386; дівчаток n = 389), у результаті чого були виміряні такі характеристики: сила кисті, маса тіла, зріст, відсоток жиру в організмі, відсоток м'язової маси та індекс маси тіла (ІМТ). Максимальну силу кисті вимірювали цифровим динамометром Takei TKK 5101.

Результати. Дослідження показало, що існують статистично значущі відмінності в абсолютних значеннях,

отриманих під час тесту на кистьовому динамометрі, між здоровими хлопцями та дівчатами в Македонії у віці 9 та 10 років. На підставі отриманих результатів дослідження можна зробити висновок, що на результати тесту кистьової динамометрії впливають вік, стать та склад тіла.

Висновки. Дослідження може надати клініцистам та дослідникам уявлення про те, як склад тіла впливає на м'язову систему, а також може допомогти розробити гендерні стратегії щодо управління масою тіла та обсягом м'язової діяльності дітей та підлітків.

Ключові слова: сила кисті, динамометр, харчування, діти, рання фаза статевого дозрівання.

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Cite this article as: Elezi, A., Elezi, G., Gontarev, S., & Georgiev, G. (2021). Gender Differences in Absolute and Relative Values of Hand Dynamometer Test with 9 And 10-Year Old Children From the Skopje Region in R.N. Macedonia. *Teorià ta Metodika Fizičnogo Vihovannà*, 21(2), 113-120. <https://doi.org/10.17309/tmfv.2021.2.03>

Received: 03.10.2020. Accepted: 12.05.2021. Published: 25.06.2021

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ОРИГІНАЛЬНА НАУКОВА СТАТТЯ

МЕТОДОЛОГІЧНЕ ТА МЕТОДИЧНЕ ЗАБЕЗПЕЧЕННЯ ОРГАНІЗАЦІЇ ІНКЛЮЗИВНОГО НАВЧАЛЬНО-ТРЕНУВАЛЬНОГО ПРОЦЕСУ СПОРТСМЕНІВ З ІНВАЛІДНІСТЮ В КАРАТЕ

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Прийнято до публікації: 14.05.2021

Опубліковано: 25.06.2021

DOI: 10.17309/tmfv.2021.2.04

Анотація

Мета дослідження: визначення ключових засад методологічного та методичного забезпечення організації інклюзивного навчально-тренувального процесу спортсменів з інвалідністю в карате.

Матеріали і методи. Учасниками дослідження були експерти у сфері фізичного культури і спорту, а саме: заслужений тренер України, заслужений працівник сфери фізичної культури і спорту України, голова Комітету спорту інвалідів Української федерації карате, спортсмени з інвалідністю, що мають статус чемпіонів Світу та чемпіонів Дефлімпійських ігор та ін. Усі експерти є досвідченими, та мають спортивний (професійний) стаж від 5 до 20 років. Для досягнення поставленої мети дослідження були використані наступні методи: аналіз та узагальнення науково-методичної літератури, метод експертної оцінки, анкетування. Статистичний аналіз проводився за допомогою методів математичної статистики. Експертна оцінка проводилась методом ранжування. Ступінь узгодженості експертів визначався за допомогою коефіцієнта конкордації Кенделла.

Результати. В ході дослідження було визначено методологічні та методичні аспекти організації інклюзивного навчально-тренувального процесу спортсменів з інвалідністю в карате. Однією з головних особливостей в організації тренувальних занять в карате серед осіб з інвалідністю є їх нозологічна група. Саме від нозологічної групи залежить подальший підбір засобів та методів навчально-тренувальної роботи. Під час інклюзивних тренувальних занять найбільшу увагу приділяють корекційно-компенсаторній (14,6 %), рекреативно-оздоровчій (13,6 %) та профілактичній (13,4 %) роботі. Разом з цим, не менш важливу роль відіграє вирішення такого завдання, як соціалізація осіб з інвалідністю через спорт, як систему взаємовідносин у суспільстві.

Висновки. На підвищення ефективності організації інклюзивного навчально-тренувального процесу впливає правильно підібране методологічне та методичне забезпечення, яке має свої особливості, що, по-перше, залежать від нозологічної групи, по-друге, характеризуються правильним вибором засобів, методів, принципів та функцій, що реалізуються під час занять, по-третє, направлені на соціалізацію осіб з інвалідністю.

Ключові слова: інклюзивний підхід, спортсмен з інвалідністю, нозологічна група, навчально-тренувальний процес, методологічне та методичне забезпечення, адаптивна фізична культура, спорт, карате.

Вступ

Постановка проблеми. Організація навчально-тренувального процесу регламентується чинними нормативно-правовими документами України. Зміст спортивно-виховної роботи відображається у навчальних планах, програмах, підручниках, посібниках, інших

дидактичних матеріалах, тобто в структурі методологічного та методичного забезпечення навчально-тренувального процесу спортсменів (Палатний, 2017; Когут, Маринич, & Чебанова, 2017).

В Україні з 2012 р. розпочалося активне залучення осіб з інвалідністю до занять карате, завданням якого є фізичний розвиток, психологічна підтримка та соціальна адаптація каратистів. У період з 2012 р. до теперішнього часу розвиток карате для осіб з інвалідністю

відбувається, насамперед, через створення комерційних інклюзивних спортивних клубів. Тренувальний процес для осіб з інвалідністю в таких клубах здійснюється за зразком тренувального процесу для здорових спортсменів. Карате для осіб з інвалідністю, це вид спорту, що не представлений у програмі Паралімпійських ігор, крім цього, він не є видом спорту, який розвивається у закладах позашкільної освіти спортивного профілю (дитячо-юнацькі спортивні школи для осіб з інвалідністю, спеціалізовані дитячо-юнацькі спортивні школи для осіб з інвалідністю паралімпійського та дефлімпійського резерву). Ось чому, сьогодні в нашій державі не існує навчально-тренувальної програми з даного виду спорту або будь-яких інших дидактичних матеріалів, які дали б змогу зробити навчально-тренувальний процес в карате для осіб з інвалідністю більш ефективним. Тому виникає нагальна потреба розробки необхідного програмно-методичного забезпечення, що надасть змогу якнайкраще реалізовувати поставлені завдання.

З метою забезпечення ефективності навчально-тренувального процесу спортсменів з інвалідністю, які тренуються в умовах інклюзивного середовища, необхідним є розроблення методичних рекомендацій, посібників щодо психолого-педагогічних особливостей в організації навчально-тренувального процесу, комплексної реабілітації та створення передумов для соціалізації осіб з інвалідністю в умовах інклюзивного підходу (Хіменес & Задорожна, 2018). Інклюзивне освітнє середовище – сукупність умов, способів і засобів їх реалізації для спільного навчання, виховання та розвитку здобувачів освіти з урахуванням їхніх потреб та можливостей. Інклюзивний підхід у спорті – це сукупність єдиносформованих за змістом принципів і методів організації навчально-тренувального процесу, що дозволяє забезпечити ефективне залучення та включення до занять всіх його учасників. Інклюзивний навчально-тренувальний процес – це сукупність послідовних дій, засобів, спрямованих на підвищення рівня фізичного розвитку та фізичної підготовленості всіх його учасників, в тому числі осіб з інвалідністю, якщо не має медичних протипоказань.

Аналіз останніх досліджень і публікацій. Для успішної організації навчально-тренувального процесу спортсменів з інвалідністю необхідним є його методологічне та методичне забезпечення (Евсеев, Шелков, Чурганов, & Гаврилова, 2014; Kiurppis, 2018; Sparkes & Smith, 2012). У наукових дослідженнях вітчизняних та зарубіжних фахівців сфери адаптивної фізичної культури і спорту розкрито окремі аспекти систематизації наукових знань щодо підготовки спортсменів в адаптивному спорті (Розторгуй, 2017; Wilhelmsen & Sorensen, 2017; Bastos, Corredeira, & Fonseca, 2019), обґрунтовано сучасні методичні підходи до вирішення науково-практичних завдань тренувального процесу спортсменів з відхиленням розумового розвитку за програмами Спеціальних Олімпіад (Бріскін, Передерій, & Пітин, 2017; Helmer, Panetta, Pimentel, Renker, & Sawanec, 2017). Деякі дослідження присвячені питанням розвитку програмно-методичного забезпечення діяльності ДЮСШ (Дідух & Когут, 2017; Шандригось, Первачук, Яременко, & Латишев, 2017), нормативно-правовому забезпеченню розвитку неолімпійського спорту (Титаренко & Кропивницька, 2019), організаційному забезпеченню фізкультурно-оздоровчої

роботи з молоддю в позашкільних навчальних закладах та на заняттях з позашкільної освіти (Kogut & Marynych, 2016; Sekhri, 2019), підготовкою тренерів та вчителів для роботи з особами з інвалідністю (Braga, Taliaferro, & Blaggrave, 2018; Richards, & Wilson, 2020). Окремі дослідження розкривають питання соціалізації через спорт (Cazee, 2020; Justice, Logan, Lin, & Kaderavek, 2014; Todor & Turcu, 2018; Foster, Fitzgerald, & Stride, 2018), зокрема через єдиноборства (Kasum, Gligorov, & Nastasić-Stošković, 2011; Oblak, Karpljuk, Vodičar, & Šimenko, 2020) та карате (Yip, 2019; Greco, Cataldi, & Fischetti, 2019; Ben Messaud, 2016). Разом з тим, залишається недостатньо вивченим питання, що присвячене методологічному та методичному забезпеченню організації саме інклюзивного навчально-тренувального процесу спортсменів з інвалідністю в карате.

Гіпотеза дослідження. Навчально-тренувальний процес спортсменів з інвалідністю в карате буде більш ефективним, якщо визначити та реалізувати специфічні характеристики методологічного та методичного забезпечення, пов'язаних з інклюзивним підходом.

Мета дослідження. Визначення ключових засад методологічного та методичного забезпечення організації інклюзивного навчально-тренувального процесу спортсменів з інвалідністю в карате.

Матеріали і методи

Учасники дослідження

У дослідженні взяли участь 10 експертів у сфері фізичної культури і спорту віком від 25 до 60 років. Серед них: заслужений тренер України (версія JKS), заслужений працівник сфери фізичної культури і спорту України (версія WKF), голова Комітету спорту інвалідів Української федерації карате (версія WKF), чемпіонка Світу з пара-карате 2016 року (версія WKF), трикратна чемпіонка Дефлімпійських Ігор 2017 року (версія WKF) та ін. Всі експерти мають досвід роботи тренером зі спортсменами з інвалідністю (порушення слуху та опорно-рухового апарату) за версіями WKF та JKS. Стаж професійної (спортивної) діяльності експертів – від 5 до 20 років.

Організація дослідження

Для вирішення поставлених завдань були використані такі методи дослідження: аналіз та узагальнення науково-методичної літератури, метод експертної оцінки, анкетування.

Для визначення специфіки інклюзивного підходу до побудови навчально-тренувального процесу в карате та його методологічного та методичного забезпечення проведено анкетування та експертне оцінювання. Експерти були залучені для визначення критеріїв, які лягли в основу формування навчально-тренувального процесу спортсменів з інвалідністю. Їм було запропоновано визначити методологічні та методичні аспекти організації інклюзивного навчально-тренувального процесу а саме: особливості тренування спортсменів, які мають вади у розвитку; основні функції, що реалізуються під час занять в інклюзивному карате, а також принципи культурного і духовного розвитку людини та суспіль-

ства, включаючи осіб з інвалідністю. Для проведення анкетування було розроблено анкету, яка включала 13 запитань. У вступній частині анкети розміщено обґрунтування проблематики та мету дослідження. Перша частина анкети передбачала фіксацію відомостей про стаж та професійну кваліфікацію респондентів. Основна частина анкети включала запитання щодо досліджуваної проблематики, а саме: факторів, функцій та принципів, які впливають на організацію навчально-тренувального процесу осіб з інвалідністю в карате. Анкетування проводилось у відкритій формі.

Статистичний аналіз

Методи математичної статистики (середнє значення (X), середнє квадратичне відхилення (SD), коефіцієнт конкордації за методом Кендалла (W) використано з метою аналізу та статистичної обробки отриманих результатів дослідження. Статистична обробка матеріалів проводилась за допомогою програмного пакету Microsoft Excel 2016.

Метод експертної оцінки дозволив отримати необхідні кількісні результати за суб'єктивними оцінками експертів. Експертиза проводилась за допомогою методу ранжування, у якості оцінки була обрана порядкова шкала, за якою експерти оцінювали твердження по рангах від 1 до 10. Таким чином, найменший ранг, що дорівнює 1, відповідав найменш значущому твердженню експертизи, а найвищий ранг – 10 найбільш значущому.

Ступінь узгодженості відповідей експертів визначалась за допомогою коефіцієнта конкордації Кендалла (W). Для оцінки значущості коефіцієнта конкордації було використано критерій узгодженості Пірсона. При визначенні узгодженості думок експертів приймався рівень надійності $P = 99\%$ (ймовірність помилки 1 %, тобто рівень значущості $p = 0,01$ або $p = 0,001$).

Результати

Визначено, що особливості тренувального процесу спортсменів з інвалідністю в карате обумовлені декількома факторами, такими як: вид захворювання дитини, рівень інтелектуального розвитку, рівень соціалізації та фізичний і психологічний стан (рис. 1).

Результати експертної оцінки свідчать про те, що в роботі зі спортсменами з інвалідністю найбільш впливовим фактором, який обумовлює специфіку побудови тренувального процесу в карате, є їх приналежність до конкретної нозологічної групи. Це пояснюється тим, що для кожної нозологічної групи підбираються комплекси спеціальних фізичних вправ та рухливі ігри, які сприяють покращенню стану здоров'я та підвищенню рівня фізичного розвитку.

Побудова навчально-тренувальних занять осіб з інвалідністю в карате має різну структуру в залежності від їх захворювання. Наприклад, при дитячому церебральному паралічі (ДЦП) важливими є вправи на гнучкість та координацію, при затримці фізичного розвитку (ЗФР) – вправи на силу та швидкість. Розвиток витривалості є в рівній мірі корисним для всіх представлених нозологій. Також варто зауважити, що при складанні планів занять в карате так само важливо враховувати й інші представ-

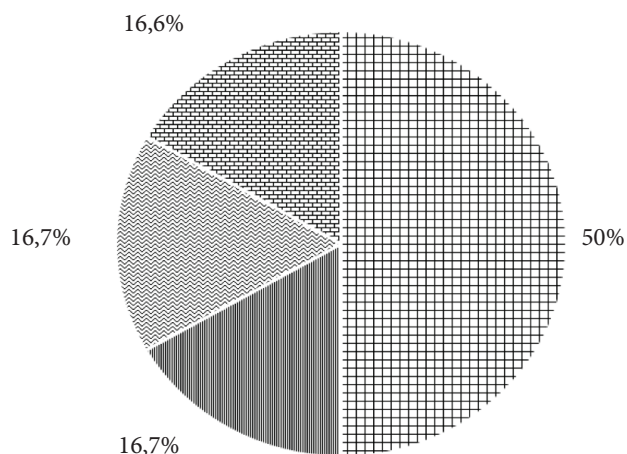


Рис. 1. Фактори, що обумовлюють специфіку тренувального процесу спортсменів з інвалідністю в карате (за результатами експертного оцінювання, $n=10$), %: – нозологічна група; – рівень соціалізації; – можливість сприйняття інформації; – рівень фізичного розвитку

лені фактори. Від рівня соціалізації залежить ефективність роботи в парах на занятті, від рівня інтелектуального розвитку – складність навчального матеріалу, від рівня фізичного розвитку – величина навантаження.

Базуючись на власному досвіді професійної діяльності (тренерська діяльність у спортивних клубах, спортивних секціях, викладацька діяльність тощо), експертами були визначені основні функції, що реалізуються під час тренувальних занять в пара-карате.

Експертам було запропоновано проранжувати функції виховання, які необхідно реалізовувати на навчально-тренувальних заняттях (табл. 1). Саме ці функції представляють собою основну мету роботи тренера з особами з інвалідністю.

Визначено ступінь узгодженості думок експертів за коефіцієнтом конкордації $W=0,932$ та χ^2 критерію = 102,51 (при $p < 0,01$), що свідчить про високий ступінь узгодженості експертів.

Таким чином, можна вважати, що думки експертів щодо функцій, що реалізуються під час тренувальних занять в пара-карате цілком узгоджені.

За даними експертів (рис. 2), під час тренувальних занять зі спортсменами з інвалідністю найбільш важливими є такі функції: корекційно-компенсаторна (14,6 %), рекреативно-оздоровча (13,6 %) та профілактична (13,4 %). Майже не реалізуються: видовищна та естетична (1,9 %), гуманістична (2,2 %).

Для визначення головних принципів культурного та духовного розвитку для осіб з інвалідністю, експертам було запропоновано проранжувати принципи, що реалізуються під час тренувальних занять та змагань в карате (табл. 2).

Визначено ступінь узгодженості думок експертів за коефіцієнтом конкордації $W=0,806$ та χ^2 критерію = 32, (при $p < 0,01$), що свідчить про високий ступінь узгодженості експертів.

Таким чином можна вважати, що думки експертів щодо принципів культурного та духовного розвитку осіб з інвалідністю цілком узгоджені.

Таблиця 1. Функції, що реалізуються під час тренувальних занять в пара-карате (за результатами експертного оцінювання, n = 10)

Номер експерта	Номер твердження											
	1	2	3	4	5	6	7	8	9	10	11	12
1	12	11	6	5	3	4	9	10	2	7	8	1
2	12	10	7	4	3	5	11	9	2	6	8	1
3	11	12	6	3	4	5	10	9	1	7	8	2
4	10	12	5	3	6	4	11	8	1	9	7	2
5	12	9	5	3	4	6	10	11	1	7	8	2
6	12	10	6	4	3	5	11	9	2	8	7	1
7	10	8	5	4	3	7	12	11	2	6	9	1
8	12	11	6	2	4	5	10	8	3	7	9	1
9	11	10	4	2	6	5	12	9	1	7	8	3
10	12	11	4	3	5	6	10	9	2	8	7	1
Сума рангів	114	104	54	33	41	52	106	93	17	72	79	15
Відхилення від середньої суми рангів	49	39	-11	-32	-24	-13	41	28	-48	7	14	-50
Квадрат відхилення	2401	1521	121	1024	576	169	1681	784	2304	49	196	2500

Примітки. * 1 – корекційно-компенсаторна; 2 – профілактична; 3 – освітня; 4 – розвиваюча; 5 – виховна; 6 – ціннісно-орієнтаційна; 7 – рекреативно-оздоровча; 8 – спортивна і змагальна; 9 – гуманістична; 10 – інтегративна; 11 – комунікативна; 12 – видовищна та естетична.

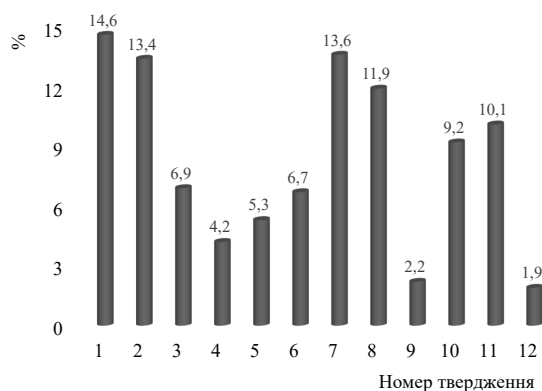


Рис. 2. Виховні функції, що реалізуються тренерами на навчально-тренувальних заняттях з карате: 1 – корекційно-компенсаторна; 2 – профілактична; 3 – освітня; 4 – розвиваюча; 5 – виховна; 6 – ціннісно-орієнтаційна; 7 – рекреативно-оздоровча; 8 – спортивна і змагальна; 9 – гуманістична; 10 – інтегративна; 11 – комунікативна; 12 – видовищна та естетична

Дискусія

У дослідженні припускалось, що методологічне та методичне забезпечення має безпосередній вплив на ефективність організації інклюзивного навчально-тренувального процесу спортсменів з інвалідністю в карате. Результати експертної оцінки показали, що в карате формування плану навчально-тренувального процесу в більшості залежить від принципів, методів та засобів тренування, а в організації інклюзивного підходу не менш важливими є функції, які реалізуються під час занять. Аналіз результатів досліджень фахівців сфери адаптивної фізичної культури і спорту показав, що переважна більшість робіт направлена на систематизацію наукових знань щодо навчання та підготовки спортсменів

Таблиця 2. Принципи культурного та духовного розвитку осіб з інвалідністю (за результатами експертного оцінювання, n = 10)

Номер експерта	Номер твердження				
	1	2	3	4	5
1	1	3	4	2	5
2	1	2	5	3	4
3	2	1	4	3	5
4	3	1	4	2	5
5	1	2	5	3	4
6	1	3	4	2	5
7	2	1	5	3	4
8	1	2	4	3	5
9	2	1	3	4	5
10	1	2	4	3	5
Сума рангів	15	18	42	28	47
Відхилення від середньої суми рангів	-15	-12	12	-2	17
Квадрат відхилення	225	144	144	4	289

Примітки. * 1 – гуманістичного спрямування; 2 – безперервності фізкультурної освіти; 3 – соціалізації; 4 – інтеграції; 5 – пріоритетної ролі соціуму.

в адаптивному спорті (Бріскін та ін., 2017; Евсеев та ін., 2014; Bastos, Correideira, & Fonseca, 2019). В даних дослідженнях адаптивний спорт розглядається саме як спорт вищих досягнень, а отже і має подібне методологічне та методичне забезпечення. Крім того, вивчаються різні аспекти підготовки спортсменів більшості нозологічних груп: з вадами зору, слуху, порушеннями опорно-рухового апарату та ін (Бріскін та ін., 2017; Розторгуй, 2017). Наявні дослідження фахівців сфери фізичної культури і спорту направлені на вивчення питань програмно-методичного та нормативно-правового забезпечення організації навчально-тренувального процесу в олімпійських

(Дідух & Когут, 2017; Палатний, 2017; Шандригось та ін., 2017) та неолімпійських (Титаренко, Кропивницька, 2019) видах спорту. Наші дослідження, в першу чергу, доводять важливість методологічного та методичного забезпечення в організації навчально-тренувального процесу не тільки в спорті вищих досягнень (олімпійському, неолімпійському), а й в адаптивних видах спорту (зокрема, пара-карате) та в спортивно-масовій роботі з особами з інвалідністю. Нами описані методологічні та методичні аспекти організації інклюзивного навчально-тренувального процесу в карате. Ми визначили, що формування навчальних планів в більшості залежить від принципів, методів та засобів тренування, а в організації інклюзивного навчально-тренувального процесу не менш важливими є функції, які реалізуються під час занять. В карате для осіб з інвалідністю одним з головних завдань є підвищення рівня фізичного розвитку та покращення рівня здоров'я (реалізація корекційно-компенсаторної функції). Заняття карате для осіб з інвалідністю дає можливість корегувати та розвивати сенсорні функції: вестибулярну, зорову, слухову, тактильну, кінестетичну; соматичні функції, такі як постава, дихальна та серцево-судинна системи; моторні функції: відхилення у розвитку фізичних якостей, координації рухів; психічні функції (увагу, мову, поведінку, пам'ять та ін.). Основними завданнями рекреаційно-оздоровчої функції є задоволення потреб осіб з інвалідністю у активних формах відпочинку та відновленні фізичного та психологічного станів організму. Різноманітні форми фізичної активності, що адаптуються згідно нозологічних груп, дають можливість реалізувати вищезгадані потреби, а спортивні заходи, такі як змагання в пара-карате є засобами соціалізації осіб з інвалідністю. Крім корекційно-компенсаторної, рекреаційно-оздоровчої та профілактичної функцій в адаптивному спорті виділяють і інші, які, на жаль, в карате не реалізуються.

Важливо відмітити і вплив нозологічної групи на специфіку організації навчально-тренувального процесу в карате та на його подальшу ефективність. Саме від нозологічної групи залежить подальший підбір методів і засобів, що будуть використовуватися, та принципів і функцій, що будуть реалізовані у навчально-тренувальному процесі. Згідно з думкою експертів, найбільш важливими принципами розвитку осіб з інвалідністю, які реалізуються в спорті, є пріоритетна роль соціуму та соціалізація. Це можна пояснити тим, що заняття карате в інклюзивній групі особам з інвалідністю дають можливість мати відповідний статус, бути залученими до соціальної системи, яка в свою чергу, справляє на них системоформуючий вплив (формуючи відповідне мікросередовище). При взаємодії з суспільством (мікросередовищем) особи з інвалідністю мають змогу визначити характерні для себе риси, наприклад, такі як самосвідомість, цінність орієнтації, автономність, а також соціальні відносини. Про соціальні відносини (соціалізацію) осіб з інвалідністю можна сказати, що це становлення не

загальних соціальних якостей, а виникнення конкретного соціального досвіду, який зумовлений мікросоціумом, в якому вони перебувають. Тому, варто зазначити, що заняття в інклюзивній групі дають можливість соціалізуватися всім учасникам навчально-тренувального процесу не залежно від стану здоров'я. Отже, змагання, що інтегровані в систему загального календарного плану – це чинники, що формулюють основу психологічних зв'язків всіх учасників та глядачів змагань. Тому варто зазначити, що спорт, це не лише система фізичних вправ, але і система відносин у суспільстві, які мають свою важливу соціальну роль та визначають свою інтегративну функцію, як складову процесу соціалізації осіб з інвалідністю. Проте, основним завданням інклюзивного навчально-тренувального процесу в карате залишається саме соціалізація осіб з інвалідністю. Саме через спільні заняття спортом, в даному випадку карате, особи з інвалідністю зможуть підвищити свої адаптивні можливості соціалізації через отримання нових знань, формування нових умінь і навичок. Водночас соціум навчиться сприймати інвалідність як суспільне явище, а осіб з інвалідністю як партнерів у взаємодії.

Висновки

На підвищення ефективності організації інклюзивного навчально-тренувального процесу впливає правильно підібране методологічне та методичне забезпечення, яке має свої особливості, які, по-перше, залежать від нозологічної групи, по-друге, характеризуються правильним вибором засобів, методів, принципів та функцій, що реалізуються під час занять, по-третє, направлені на соціалізацію осіб з інвалідністю.

За результатами експертного оцінювання спеціалістів сфери фізичної культури і спорту виявлено основні функції виховання, що реалізуються на заняттях з інклюзивного карате: корекційно-компенсаторна (14,6%), рекреаційно-оздоровча (13,6%), профілактична (13,4%); встановлені основні принципи розвитку осіб з інвалідністю, що реалізуються під час занять: пріоритетна роль соціуму (31,33%) та соціалізація (28%).

Вдячності

Роботу виконано в рамках теми 1.7. «Організаційно-методичні основи розвитку адаптивного спорту» Тематичного плану науково-дослідної роботи в сфері фізичної культури і спорту на 2016–2020 рр. Міністерства освіти і науки України (номер державної реєстрації 0116U001613).

Конфлікт інтересів

Автори заявляють про відсутність конфлікту інтересів.

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METHODOLOGICAL AND METHODICAL SUPPORT FOR THE ORGANIZATION OF AN INCLUSIVE EDUCATIONAL AND TRAINING PROCESS FOR ATHLETES WITH DISABILITIES IN KARATE

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Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection
Report. Article: 8 p., 2 fig., 2 tabl., 27 sources.

The purpose of the study: to determine the key principles of methodological and systematic support for the organization of an inclusive educational and training process for athletes with disabilities in karate.

Materials and methods. The experts in the field of physical culture and sports participated in the study, namely: honored coach of Ukraine, honored worker of physical culture and sports of Ukraine, chairman of the Sports Committee for People with Disabilities of the Ukrainian Karate Federation, athletes with disabilities who have the status of world champions and Deaflympics champions, etc. All experts had sports (professional) experience from 5 to 20 years. To achieve the purpose of the study, the following methods were used: analysis and generalization of scientific and methodological literature, the method of expert evaluation, questionnaire surveys. Statistical analysis was performed using the methods of mathematical statistics. Expert evaluation was performed by the ranking method. The degree of agreement of the experts was determined using the Kendall's coefficient of concordance.

Results. In the course of the study, the methodological and systematic aspects of the organization of the inclusive educational and training process for athletes with disabilities in karate were

determined. One of the main features in the organization of karate training sessions among people with disabilities is their nosological group. The further selection of means and methods of educational and training work depends on the nosological group. During inclusive training sessions, the greatest attention is paid to correctional and compensatory (14.6%), recreational and health (13.6%), and preventive (13.4%) work. At the same time, no less important is the solution of such a problem as the socialization of people with disabilities through sports, as a system of relationships in society.

Conclusions. Properly selected methodological and systematic support affects the effectiveness of the organization of the inclusive educational and training process. This support has its own characteristics, which, firstly, depend on the nosological group, secondly, are characterized by the correct choice of means, methods, principles and functions implemented during classes, and thirdly, are aimed at the socialization of people with disabilities.

Keywords: inclusive approach, athletes with disabilities, nosological group, educational and training process, methodological and systematic support, adaptive physical culture, sports, karate.

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Cite this article as:

Kohut, I., Marynych, V., & Chebanova, K. (2021). Methodological and Methodical Support for the Organization of an Inclusive Educational and Training Process for Athletes with Disabilities in Karate. *Teoriâ ta Metodika Fizičnogo Vihovannâ*, 21(2), 121-128. <https://doi.org/10.17309/tmfv.2021.2.04>

Received: 24.02.2021. Accepted: 14.05.2021. Published: 25.06.2021

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ORIGINAL SCIENTIFIC ARTICLE

DYNAMICS OF BODY TYPE INDICATORS OF ADULT WOMEN UNDER THE INFLUENCE OF AQUA FITNESS

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Accepted for Publication: May 18, 2021

Published: June 25, 2021

DOI: 10.17309/tmfv.2021.2.05

Abstract

The study purpose was to determine the effectiveness of a differentiated approach to aqua fitness classes with women of the first period of adulthood.

Materials and methods. 30 adult women, whose average age was 30.57 years, took part in the study. The study was conducted during 2019-2020. Anthropometric measurements included body length, body weight, chest, shoulder, calf, thigh, waist, buttocks and wrist circumferences. To determine the overweight we calculated the body mass index. Measurements were taken at the end of each mesocycle of wellness training. Statistical analysis covered determination of mean, standard deviation, reliability of the differences (Wilcoxon signed-rank test).

Results. The effectiveness of a differentiated approach to aqua fitness classes was proven by improvement of women's body type. By the end of the study, there were no women with obesity class II and underweight. The number of women with obesity class I decreased by 3.33%. The number of women with normal body weight increased by 13.37%.

Conclusions. The implementation of a differentiated approach to aqua fitness classes with adult women has significantly corrected their body proportions. This allows recommending a differentiated approach according to a body type to implement into aqua fitness classes.

Keywords: aqua fitness, body type, differentiated approach, correction of body proportions, wellness classes.

Introduction

The current rate of society development leads to a deterioration of the population health. In adulthood, involutionary processes begin to appear in systems, organs and tissues (Leiros-Rodriguez, Romo-Perez, Perez-Ribao, & Garcia-Soidan, 2019). This reduces motor activity and affects the physique (Dorofeeva, Yarimbash, & Zavatska, 2018; Prylutska et al., 2019). Deviation of body components from optimal values negatively affects the physical and emotional state (Tomilina, 2016), and overweight exacerbates comorbidities (Anders, Bedorta, & Brennan, 1992; Goncharova et al., 2020).

The most popular type of wellness classes that allows women to improve their body type is aqua fitness (Rýžková, Labudov, Grznár, & Šmída, 2018). Aqua fitness affect the functional state of the body, the level of psycho-emotional state. They are a major factor in slowing down the aging process, maintaining good health and increasing physical

activity (Shalaeva, Sazonova, & Krokhina, 2018; Andrieieva et al., 2019; Goncharova et al., 2020; Vysotskaya, Shutova, & Golubnichy, 2020).

Scientists have been actively researching the problems of health-improving physical education with adults. The analysis and systematization of modern fitness programs on health physical culture with women of mature age were carried out in the studies of Martyniuk (2016), Tkachuk, Soverda, Stepaniuk, and Kozibroda (2019), Belyak, Hrybovska, Muzyka, Ivanochko, and Chekhovska (2018).

There are number of scientific studies that substantiate the criteria for differentiation in physical education process with different group of people. Among the criteria for differentiation, experts note the following: low adaptive capacity of the organism (Kanishcheva, 2011), genetic factors (Dargatz & Röwekam, 2017; Krutsevich & Marchenko, 2020), hereditary factors (Borovik, 2013), the rate of biological development (Sitovsky, 2008) and physique (Ryabchenko, 2011; Trotsenko & Pivovarov, 2018).

Scientists from different countries (Leiros-Rodriguez et al., 2019; Andrieieva et al., 2019; Goncharova et al., 2020; Vy-

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sotskaya et al., 2020; Foulis et al., 2021) confirmed data about the expediency of using body type indicators as a criterion for the differentiation in the process of physical education. However, these works do not reveal the features of differentiated approaches to aqua fitness classes with women of the first period of adulthood with different body types.

The study purpose was to determine the dynamics of adult women's physique under the influence of aqua fitness classes using a differentiated approach to training depending on their body type.

Materials and methods

Study participants

The study involved 30 women of the first period of adulthood. Women were divided by body type into 3 subgroups of 10 people each. The first subgroup included 10 women of normosthenic body type with normal body weight. The second subgroup involved 3 women of asthenic body type (1 woman with dystrophy of II degree and 2 ones – with dystrophy of I degree) and 7 women of normosthenic type with body weight at the lower limit of normal. The third subgroup comprised 10 women of hypersthenic body type (7 women with obesity class I and 3 ones – with obesity class II). The average age of women was 30.57 ± 3.63 years. All study participants gave written consent to participate in the study.

Study organization

The study was conducted during 2019-2020 years in fitness-club Sport Life in Dnipropetrovsk region (Ukraine). A differentiated approach was introduced in aqua fitness classes with women of mature age. The aim is to increase the level of physical state due to a marked improvement of women's morphological parameters according to a body type and improvement of the functional capabilities, the development of physical qualities. For women of asthenic type we proposed to tone muscle tissue and increase body size, for women of normosthenic type – to maintain the current level of body size, for women of hypertensive type – reduction of the comprehensive body size).

The whole health and training process was divided into three stages – preparatory, basic and supporting. The main stage was divided into mesocycles. Mesocycles contained loading and recovery microcycles. During the loading microcycles, the volume, intensity, nature of motor activity, starting positions and equipment were gradually varied, increased and became more complicated.

Wellness classes were conducted three times per week for 45 minutes. Classes were designed according to the complex type of lesson.

The duration of the preparatory part of class was 10 minutes. Heart rate ranged from 100 to 120 beats per minute. The main task is to prepare the body, muscles and joints to perform the main load.

The content of the main part was aimed at correcting morphological parameters according to the body type of women. Duration – 25 minutes.

Classes for women of asthenic type were aimed at toning muscle tissue and increasing the overall size of the body, improving the functional capabilities and development of physical qualities. Cyclic, acyclic, strength and complex coordination exercises were used.

The exercises were aimed at the simultaneous work of large muscle groups of the legs, torso and arms. During the first two months of training (the stage of achieving the physical shape), women performed exercises without equipment at an average and above the average pace. Rest pauses between series of exercises lasted 15 seconds. From the third month (the stage of maintaining the physical shape), women performed 70-80% of exercises with equipment (Noodles, Aqua-jogger, Aqua-dumbbell). Intensity of loads was average and above the average. Rest pauses between series of exercises lasted 10-15 seconds. Heart rate ranged from 120 to 130 beats per minute. The amplitude of performance varied from above to maximum and vice versa.

Women of normosthenic type were offered strength endurance, cyclic, acyclic and high-intensity coordination exercises. It was taken into account that women of this type of physique need to maintain the existing level of body size, functional state of the cardiovascular and respiratory systems. During the stage of achieving the physical shape, women performed exercises without equipment at above the average (heart rate was 120-130 beats per minute) and high pace (heart rate was 130-160 beats per minute). At the stage of maintaining the physical shape, 50% of exercises were performed with equipment with a high pace. Depending on the type of exercise, the rest between series was 5-10 seconds, the amplitude of performance varied from minimum to average, from average to maximum, from maximum to minimum.

Hypertensive type of women required weight loss and size parameters. They used cyclic aerobic exercises of strength endurance focus, acyclic exercises and exercises of complex-coordination focus with high and average intensity. During the stage of achieving the physical shape, women performed exercises without equipment with average pace (heart rate was 90-120 beats per minute). Rest between series was 15-20 seconds depending on the type of exercise. At the stage of maintaining the physical shape, exercises were performed at a higher than the average (heart rate was 120-130 beats per minute) and high (heart rate was 130-160 beats per minute) rates. Aqua fitness exercises were varied: 30% – with equipment and 70% – without equipment. Depending on the type of exercise, the rest between series was 10-15 seconds, the amplitude varied from minimum to average, from average to maximum, from maximum to minimum.

The final part of the class lasted 10 minutes. The main task was to return to the initial state of pulse and respiration, to relieve muscle tension.

The current control was performed three times during the study – at the end of each mesocycle (on November, on December, on February). The dynamics of physique indicators of adult women under the influence of a differentiated approach was studied. The program of aqua fitness classes was corrected according to the results of current control.

Anthropometric examination was performed by standard devices according to the known unified method: chest (cm), shoulder (cm), calf (cm), thigh (cm), waist (cm), buttocks (cm) and wrist (cm) circumferences with measuring tape; body weight (kg) was determined with medical scales. To determine the overweight the body mass index was calculated (Krutsevich, Vorobjov & Bezverhnyia, 2011).

Assessment of body shape harmony was performed by calculating the index of proportionality of circumferential sizes by dividing the value of body length (cm) to the circumferential sizes of different body parts (cm) and comparing actual and normative values (Krutsevich, Vorobjov, & Bezverhnyia, 2011).

Table 1. Dynamics of body composition of women from the first subgroup (n = 10)

Indicators	Initial data (September 2019)	Current control No. 1 (November 2019)	Current control No. 2 (December 2019)	Current control No. 3 (February 2020)	Final data (March 2020)
			X ± s		
Body weight, kg	62.75 ± 5.45	62.40 ± 5.30	61.71 ± 5.08	60.80 ± 4.71	60.10 ± 4.98*
			p < 0.01		p < 0.05
			p < 0.05		
Body mass index, kg / m ²	22.75 ± 2.39	22.62 ± 2.36	22.37 ± 2.30	22.04 ± 2.17	21.79 ± 2.20*
			p < 0.01		p < 0.05
			p < 0.05		
Chest circumference, cm	88.60 ± 4.65	88.50 ± 4.50	88.40 ± 4.14	88.30 ± 4.19	88.20 ± 4.08
Shoulder circumference, cm	28.50 ± 3.37	28.40 ± 3.20	27.80 ± 2.90	26.80 ± 2.90	26.40 ± 3.06*
			p < 0.05		p < 0.05
			p < 0.01		
Waist circumference, cm	68.80 ± 6.27	67.80 ± 6.11	66.60 ± 5.74	65.40 ± 5.34	64.60 ± 5.32*
			p < 0.05		p < 0.01
			p < 0.01		
Thigh circumference, cm	55.80 ± 6.91	55.20 ± 6.73	54.40 ± 6.54	53.70 ± 6.30	53.40 ± 6.24*
			p < 0.05		p < 0.01
Buttocks circumference, cm	89.20 ± 17.18	88.60 ± 17.12	88.10 ± 17.28	87.20 ± 16.88	86.10 ± 16.54
Calf circumference, cm	33.50 ± 4.14	33.40 ± 4.27	33.30 ± 4.16	32.80 ± 4.29	32.50 ± 4.35
Wrist circumference, cm	16.00 ± 0.82	16.10 ± 0.74	16.20 ± 0.79	16.30 ± 0.67	16.40 ± 0.70*
			p < 0.05		p < 0.01

* – statistically significant difference between the initial and final indicators.

Table 2. Dynamics of body composition of women from the second subgroup (n = 10)

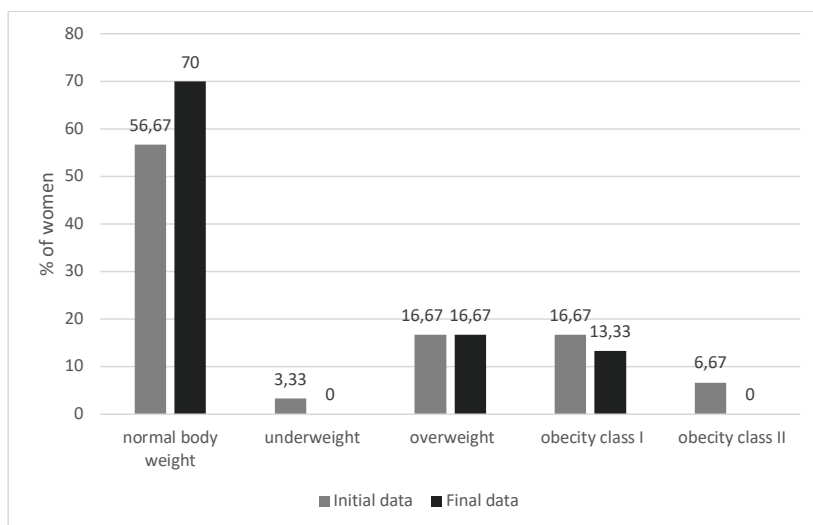
Indicators	Initial data (September 2019)	Current control No. 1 (November 2019)	Current control No. 2 (December 2019)	Current control No. 3 (February 2020)	Final data (March 2020)
			X ± s		
Body weight, kg	63.50 ± 7.56	63.20 ± 7.04	62.80 ± 7.37	62.10 ± 7.12	61.60 ± 7.34
Body mass index, kg / m ²	25.38 ± 1.52	21.95 ± 1.39	21.81 ± 1.30	21.57 ± 1.19	21.38 ± 1.00*
			p < 0.05		p < 0.01
Chest circumference, cm	86.30 ± 6.43	86.20 ± 6.36	86.00 ± 5.71	85.90 ± 5.62	85.80 ± 5.38
Shoulder circumference, cm	29.80 ± 2.85	29.20 ± 3.27	28.20 ± 2.94	27.50 ± 2.99	26.80 ± 2.50*
			p < 0.05		p < 0.01
			p < 0.01		
Waist circumference, cm	71.00 ± 10.11	70.10 ± 9.67	69.10 ± 9.48	68.20 ± 8.16	66.90 ± 8.22*
			p < 0.05		p < 0.05
Thigh circumference, cm	61.00 ± 9.41	59.90 ± 8.98	59.10 ± 8.46	57.90 ± 8.19	56.90 ± 7.45*
			p < 0.05		p < 0.05
Buttocks circumference, cm	94.40 ± 4.27	93.60 ± 4.07	92.50 ± 4.20	90.60 ± 3.64	90.80 ± 3.68*
			p < 0.05		p < 0.01
			p < 0.01		
Calf circumference, cm	34.50 ± 8.47	33.90 ± 8.20	33.80 ± 7.76	33.20 ± 7.57	33.00 ± 7.44*
			p < 0.05		p < 0.05
Wrist circumference, cm	15.20 ± 1.89	15.30 ± 1.89	15.40 ± 1.90	15.50 ± 1.38	15.86 ± 1.07*
			p < 0.05		p < 0.05

* – statistically significant difference between the initial and final indicators.

Table 3. Dynamics of body composition of women from the third subgroup (n = 10)

Indicators	Initial data (September 2019)	Current control No. 1 (November 2019)	Current control No. 2 (December 2019)	Current control No. 3 (February 2020)	Final data (March 2020)
	$\bar{X} \pm s$				
Body weight, kg	93.50 $\pm$ 14.39	92.40 $\pm$ 14.18	90.40 $\pm$ 13.95	88.50 $\pm$ 14.25	87.30 $\pm$ 13.82*
	$p < 0.05$				$p < 0.01$
Body mass index, kg / m ²	31.45 $\pm$ 3.36	31.08 $\pm$ 3.29	30.40 $\pm$ 3.21	29.74 $\pm$ 3.29	29.34 $\pm$ 3.14*
	$p < 0.05$				$p < 0.01$
Chest circumference, cm	106.50 $\pm$ 13.50	150.10 $\pm$ 12.78	130.50 $\pm$ 12.38	102.30 $\pm$ 11.91	101.10 $\pm$ 11.06*
	$p < 0.05$				$p < 0.01$
Shoulder circumference, cm	36.40 $\pm$ 5.25	35.60 $\pm$ 4.97	34.60 $\pm$ 4.33	33.40 $\pm$ 3.53	32.50 $\pm$ 3.17*
	$p < 0.05$				$p < 0.01$
Waist circumference, cm	91.50 $\pm$ 11.76	90.50 $\pm$ 11.54	88.70 $\pm$ 10.94	87.80 $\pm$ 10.28	86.70 $\pm$ 10.07*
	$p < 0.05$				$p < 0.01$
Thigh circumference, cm	68.40 $\pm$ 9.32	68.00 $\pm$ 9.01	66.50 $\pm$ 8.67	65.20 $\pm$ 8.92	63.60 $\pm$ 8.35*
	$p < 0.05$				$p < 0.01$
Buttocks circumference, cm	113.70 $\pm$ 14.35	112.60 $\pm$ 14.09	111.00 $\pm$ 13.70	109.50 $\pm$ 13.26	107.40 $\pm$ 13.01*
	$p < 0.05$				$p < 0.01$
Calf circumference, cm	41.90 $\pm$ 8.02	41.80 $\pm$ 7.80	41.30 $\pm$ 7.24	40.90 $\pm$ 7.16	40.20 $\pm$ 7.24
Wrist circumference, cm	19.80 $\pm$ 1.69	19.60 $\pm$ 1.84	19.50 $\pm$ 1.72	19.10 $\pm$ 1.37	18.90 $\pm$ 1.45*
	$p < 0.05$				$p < 0.01$

* – statistically significant difference between the initial and final indicators.

**Fig. 1.** Dynamics of changes in body mass index of adult women, %

Statistical analysis

Study results were processed using the “Data Analysis” package of Microsoft Excel spreadsheets. Descriptive statistics (mean and standard deviation) were determined. The reliability of the differences was estimated by the Wilcoxon signed-rank test; the withdrawal was considered to be reliable at $p < 0.05-0.01$ (Byshevets et al., 2019).

Results

In order to determine the effectiveness of a differentiated approach in aqua fitness classes with women of mature age, we studied the dynamics of their body type indicators.

Analysis of the dynamics of body composition of women from the first subgroup of normosthenic type (Table 1) during the current control no 2 showed a statistically significant decrease in shoulder circumference and waist ($p < 0.05$). Current control no 3 recorded a statistically significant improvement in body weight, body mass index ($p < 0.01$), shoulder circumference, waist, thigh and wrist ($p < 0.05$). At the end of the study, statistically significant improvement ($p < 0.05-0.01$) was determined in body mass index, shoulder, thigh, waist and wrist circumferences within the age norm.

Women from the second subgroup (Table 2) mostly needed to tone their muscle tissue. Statistically significant changes in the circumferential parameters of the shoulder

($p < 0.05$) and buttocks ($p < 0.4$) were recorded at the stage of the second current control. Current control no 3 determined an increase in muscle tone of shoulder ($p < 0.01$), thigh ($p < 0.05$), buttocks ($p < 0.01$) circumferences. At the end of the study we recorded a statistically significant improvement in body mass index ($p < 0.01$), shoulder ($p < 0.01$), waist ($p < 0.05$), thigh ($p < 0.05$), buttocks ($p < 0.01$), calf ($p < 0.05$) and wrist ($p < 0.05$) circumferences in women of this subgroup.

Women of the third subgroup required weight loss and circumference parameters (Table 3). Current control no 1 and 2 recorded statistically insignificant changes in women's circumference parameters. Current control no 3 revealed a statistically significant decrease in body weight ($p < 0.05$), body mass index, shoulder, waist, thigh, wrist ($p < 0.05$) circumferences. At the end of the study, all body parameters of women (except for curl circumference) had a statistically significant improvement ($p < 0.01$).

In order to assess the effectiveness of the implemented differentiated approach in aqua fitness with women of the first period of adulthood, the dynamics of changes in their body mass index was estimated. At the end of the study, there were no women with obesity class II and underweight. The number of women with obesity class I decreased by 3.33%. The number of women with normal body weight increased by 13.37%.

Discussion

Researchers have shown that most women of the first period of adulthood choose aqua fitness to increase their level of motor activity and improve body composition (Rýžková et al., 2018; Shalaeva et al., 2018; Vysotskaya et al., 2020). This causes a necessity of the development of new modern programs of wellness classes for women, taking into account the indicators of their physique (Dorofeeva et al., 2018; Byshevets et al., 2019; Leiros-Rodriguez et al., 2019; Andrieieva et al., 2019; Goncharova et al., 2020).

We have developed and implemented a differentiated approach to aqua fitness classes with women of the first mature age, depending on their body type. This approach also took into account the compositional constitution of the body. The intensity of the load, the pace and time of exercise and combination performance, the number of repetitions, the alternation of working positions and rest intervals depended on the body type of women.

The results of the study show that at the end of the study, the majority of women had a normal body weight. Body mass index in 100% of women of the first and second subgroups was within normal limits. In the third subgroup, 10% of women had this indicator within normal limits, 50% had overweight, and 40% had obesity class I.

We have confirmed scientists' data (Shalaeva et al., 2018; Andrieieva et al., 2019; Vysotskaya et al., 2020) that aqua fitness has a positive effect on women's physique.

Knowledge about the impact of fitness on the correction of physical condition of overweight women (Borovik, 2013; Andrieieva et al., 2019; Goncharova et al., 2020) were further developed. Information about methods of physical training with use physical activity of various types based on body composition (Shutova & Vysotskaya, 2019), some issues of complex aqua fitness classes to improve women's physical

fitness (Shalaeva, et al., 2018; Podrihalo et al., 2020) were continued.

Scientific data (Hakman, Duditskaya, Slobozhaninov & Kovtun, 2020; Kostrzewa-Nowak, Nowakowska, Zwierko, Rybak, & Nowak, 2020) have confirmed that aqua fitness classes are the most effective for improving the physical state of adult women.

Information about the features of building a comprehensive program of wellness training for adult women (Artemyeva, Latvinska & Moshenska, 2020; Prylutska et al., 2019), the positive impact of aqua fitness on adult women's body (Kashuba et al., 2019; Sarah, Derek & Katie, 2019; Williams, Barreria & Tseh, 2020) was extended and supplemented.

Conclusions

The implementation of a differentiated approach to aqua fitness with women of the first period of adulthood has significantly adjusted their body proportions. To the end of the study, there were no women with obesity class II and underweight. The number of women with obesity class I decreased by 3.33%. The number of women with normal body weight increased by 13.37%.

According to women's body type we determined statistically significant improvements of their anthropometric parameters. Women with normosthenic body type had statistically significant improvement in body mass index, shoulder, thigh, waist and wrist circumferences within the age norm. A statistically significant improvement in body mass index, shoulder, waist, thigh, buttocks, calf and wrist circumferences was recorded in women of asthenic body type. Women with hypersthenic body type had statistically significant improvement of all body parameters except for curl circumference.

This indicates the effectiveness of the implemented differentiated approach in aqua fitness with women of these subgroups and allows recommending it for further implementation.

Conflict of interest

The authors declare that there are no conflicts of interest.

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ДИНАМІКА ПОКАЗНИКІВ ТІЛОБУДОВИ ЖІНОК ПЕРШОГО ПЕРІОДУ ЗРІЛОГО ВІКУ ПІД ВПЛИВОМ ЗАНЯТЬ АКВАФІТНЕСОМ

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Реферат. Стаття: 7 с., 3 табл., 1 рис., 31 джерело.

У статті представлені зміни показників тілобудови жінок першого періоду зрілого віку під впливом занять аквафітнесом.

Мета дослідження – визначити ефективність диференційованого підходу до занять аквафітнесом з жінками першого періоду зрілого віку.

Матеріал і методи. У дослідженні взяли участь 30 жінок першого періоду зрілого віку, середній вік яких склав $30,57 \pm 3,63$ років. Дослідження проводилось протягом 2019-2020 років. Антропометричні вимірювання визначали довжину тіла, масу тіла, окружність грудної клітки, обхват плеча, гомілки, стегна, талії, сідниць та зап'ястку. Для визначення наявності надлишкової ваги розраховувалися індекс маси тіла. Вимірювання проводилися наприкінці кожного мезоциклу оздоровчого тренування. Статистичний аналіз охоплював визначення середнього, середньоквадратичного відхилення, достовірності відмінностей (t-критерій Вілкоксона).

Результати. Ефективність диференційованого підходу до занять аквафітнесом доведена покращенням показників тілобудови жінок. Наприкінці дослідження серед загальної кількості обстежених жінок не було виявлено жінок з ожирінням II ступеня та з дефіцитом маси тіла. На 3,33% зменшилася кількість жінок з ожирінням I ступеня. На 13,37% зросла кількість жінок з нормальною масою тіла. Також визначено статистично значуще поліпшення антропометричних параметрів жінок з різними типами тілобудови.

Висновки. Впровадження диференційованого підходу до занять аквафітнесом з жінками першого періоду зрілого віку дозволило значно скорегувати їх пропорції тіла. Це дозволяє рекомендувати використання диференційованого підходу залежно від типу тілобудови у оздоровчих заняттях аквафітнесом.

Ключові слова: аквафітнес, тілобудова, диференційований підхід, корекція пропорцій тіла, оздоровчі заняття.

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Cite this article as: Pirohova, K., Mykytchuk, O., Afanasiev, S., Omelchenko, O., Sydoruk, T., Stepanova, I., & Kosheleva, O. (2021). Dynamics of Body Type Indicators of Adult Women Under the Influence of Aqua Fitness. *Teoriâ ta Metodika Fizičnogo Vihovannâ*, 21(2), 129-135. <https://doi.org/10.17309/tmfv.2021.2.05>

Received: 24.02.2021. Accepted: 18.05.2021. Published: 25.06.2021

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ORIGINAL SCIENTIFIC ARTICLE

IMPLEMENTATION OF THE OSTRC HANDBALL INJURY PREVENTION EXERCISES IN PROFESSIONAL HANDBALL

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Accepted for Publication: May 18, 2021

Published: June 25, 2021

DOI: 10.17309/tmfv.2021.2.06

Abstract

Purpose. The Oslo Sports Trauma Research Center (OSTRC) handball injury prevention exercise is an evidence-based injury prevention exercise designed to prevent handball injury. This study aimed to assess the implementation of the OSTRC handball injury prevention exercises among professional handball players in the Gulf Cooperation Council (GCC) countries.

Materials and methods. A web-based survey to acquire information regarding the implementation of OSTRC handball injury prevention exercises was distributed to 267 professional handball players in six GCC countries.

Results. A total of 250 handball players from the GCC countries responded to the survey (response rate 93.6%). The mean ($\pm$ SD (Standard Deviation)) of the total implementation score was 13 ($\pm$ 2.558), with no statistically significant difference between the GCC countries, with a P-value of 0.123. The highest mean score was shown from Bahrain at 13.60 ($\pm$ 2.614), while the lowest was from Qatar at 12.10 ($\pm$ 2.427).

Conclusions. A low implementation level of the OSTRC handball prevention exercises among the handball players in the GCC countries was reported in the current study.

Keywords: athletic injuries, surveys and questionnaires, exercises, sports.

Introduction

Handball is a sports game founded in 1946 and for the first time in the Olympic games in 1972 (Luig et al., 2018). The fame of this sport game has increased in recent years, and currently, worldwide there are 25 million players (Moller, Attermann, Myklebust, & Wedderkopp, 2012), including male, female, senior, and youth players (Alesi et al., 2019). There are multiple beneficial effects derived from handball practice, such as improvements in cardiovascular, metabolic, muscular, and psychosocial health (Engebretsen et al., 2013; Hornstrup et al., 2019; Póvoas et al., 2012), this sport game presents a high injury risk (Kniubaite, Skarbalius, Clemente, & Conte, 2019). Mainly because of high-intensity specific demands, like change in direction, jumps with abrupt landings and repetitive throws, frequent physical contact with other players (Fredriksen, Cools, Bahr, & Myklebust, 2020; Tsigilis & Hatzimanouil, 2005). Low physical fitness, wrong technique, lack of flexibility, and inadequate rehabilitation

treatment of injuries have been reported as risk factors related to the occurrence of injuries (Ekstrand, 2013; Häggglund et al., 2013). Also, the high intensities and training volumes increase the injury incidence (Häggglund et al., 2013). In this regard, injuries are associated with negative results like team success reduction (Bahr & Holme, 2003), costs increased related to treatments (Øiestad, Holm, & Risberg, 2018), and the risk of suffering from new injuries (O'Brien, Finch, Pruna, & McCall, 2019). Besides, injuries have long-term health consequences influencing the quality of life and career (Van Mechelen, Hlobil, & Kemper, 1992). Therefore, a key positive impact for both players' and teams' performance in reducing the injury incidence. To comprehensively address this issue, important to apply injury prevention approach (Roald Bahr, Clarsen, & Ekstrand, 2018). Van Mechelen et al. (Van Mechelen et al., 1992) confirmed that developing effective injury prevention strategies analysis as the first step, analysis several studies of handball players' injury profile, showing the incidence of 4.1 to 12.4 injuries per 1000 hours overall exposure (Giroto, Hespanhol Junior, Gomes, & Lopes, 2017; Olsen, Myklebust, Engebretsen, & Bahr, 2006; Rafnsson,

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Valdimarsson, Sveinsson, & Árnason, 2019) confirming that match injury incidence is significantly higher than training injury incidence. Additionally, the lower extremities injuries more than upper extremities injuries, affecting the ankle, knee, and head, with ligament sprains and muscle strains being the most type of injuries (Giroto et al., 2017; Hopkins, Marshall, Quarrie, & Hume, 2007; Olsen et al., 2006). Despite the good number of epidemiological studies focused on handball players, there is a discrepancy of definitions addressing injuries and data collection procedures, which suggests a requirement to perform a more detailed study of the injury profile in handball to expand and clarify the present knowledge regarding handball injuries.

Injuries are considered a complex (Mayer, Rühlemann, & Jäger, 2019) produced by the interaction of multiple risk factors (O'Brien et al., 2019), where players' characteristics (e.g., gender or age) are the foremost influential ones (Nielsen & Yde, 1988), can be explained by different game behaviours and physical contact among players (Rafnsson et al., 2019). Additionally, training load performed by the players during matches and training sessions should be taken into consideration when injury risk factors are analysed (O'Brien et al., 2019) surveyed to analyse the implementation of evidence-based injury prevention exercises to commonest injuries among soccer coaches and players. A significant amount of research was conducted to better understand sports specific injuries, body parts most at risk, how these injuries occur, what causes them and how to prevent them. Therefore, this paper aims to assess the implementation of Oslo Sports Trauma Research Center (OSTRC) handball injury prevention exercises among in professional handball players in the Gulf Cooperation Council (GCC) countries.

Materials and methods

Survey Development

To the authors' knowledge, no validated surveys are addressing the implementation of injury prevention exercise among worldwide handball players. Therefore, a survey was developed specifically for the current study. Respondents were prompted to answer every question provided in the survey before the next set of questions was presented. A respondent should answer a maximum of 33 questions categorized into three sections: (1) the study invitation and participation agreement, (2) socio-demographics questions, and (3) the implementation of OSTRC handball injury prevention exercises.

Items were in the form of multiple-choice questions and scoring of each item was dichotomous (correct answer = 1; incorrect answer = 0). The maximum score of the survey is the sum of all items (a score of 27) and transformed into a percentage score for ease of data analysis and data reporting. When questions are answered correctly, higher scores reflect more implementation and knowledge (possible range of correct answers 0–27). The respondents were able to see the total score, correct answers, and the questions they missed immediately after submission. The survey was available in English and Arabic language supported by videos demonstrating each exercise. This project was reviewed and ethically approved by the Biomedical Ethics Committee at Umm Al Qura University. Approval Number. HAP002K012202010465. A consent was obtained from each participant included in the study

before data collection begins. After obtaining permission from each participant and assuring their confidentiality, the participants were then asked to fill out the questionnaire. All participants were informed that their participation was entirely voluntary and confidential.

Survey Dissemination

A survey invitation was distributed through the Saudi Arabia, UAE, Kuwait, Bahrain, Oman, and Qatar Handball Federation. The invitation provided a brief background about the survey and encouraged to participate. Once the participants read the scope and aim of the survey, they were asked to provide informed consent and access the survey. The survey was filled anonymously and electronically via a web-based form. Responses were collected from June to October 2020.

Sample Size and Statistical analysis

Considering a 6% margin of error at a 95% confidence level, 267 professional handball players in six GCC countries were invited to participate.

Responses were organized in Microsoft Excel 2010 (Microsoft Corporation, Redmond, Washington, USA) and analysed using Statistical Package for the Social Sciences (SPSS) version 24.0 (IBM Corp., Armonk, New York, USA). Descriptive statistics were computed to describe the sample characteristics and survey data. One-way Welch ANOVA was used to determine differences in the overall survey score.

Results

A total of 250 handball players from the GCC countries responded to the survey (response rate 93.6%). The highest percentage of the participants (20.4%) was from Saudi Arabia, while participation from the remaining GCC countries was almost similar (around 16% from each), as shown in table (1).

The rate of implementation of each of the OSTRC injury prevention exercises is shown in table (2). Overall, the implementation rate ranged from 44.8% for the Y fall exercise to 55.6% for the jump and push, and shoulder rotation exercises at 55.6% for each, as shown in table (2).

The comparison among the GCC countries with respect to the mean of the total implementation score is shown in table (3). The mean ($\pm$ SD) of the total implementation score was 13 ($\pm$ 2.558). Generally, there was no statistically significant difference between the GCC countries in the mean of the total implementation score, with a P-value of 0.123. The highest mean score was shown from Bahrain at 13.60 ($\pm$ 2.614) followed by the United Arab Emirates (UAE) at 13.34 ($\pm$ 2.640).

Table 1. Frequencies and percentages of all participant from different countries of the Gulf Cooperation Council

Indicators	Frequency	Percent
Saudi Arabia	51	20.4 %
Bahrain	42	16.8 %
Kuwait	42	16.8 %
Oman	34	13.6 %
Qatar	41	16.4 %
United Arab Emirates	40	16.0 %
Total	250	100.0 %

Table 2. Percentages and frequencies for different points

Exercises	Frequency (%)
Triangle run	129 (51.6 %)
Run with backwards throws	122 (48.8 %)
Run with foot plant	119 (47.6 %)
Jump & push	139 (55.6 %)
Side lying rotation	114 (45.6 %)
Bow and arrow	134 (53.6 %)
Shoulder external rotation	139 (55.6 %)
Push up passes	119 (47.6 %)
Single-leg deadlift with partner	138 (55.2 %)
Backwards throws	128 (51.2 %)
Forwards speed-skating jumps	131 (52.4 %)
Run and jump: Double-leg landing	133 (53.2 %)
Rotating jump with push: Double-leg landing	124 (49.6 %)
Hip flexors stretch +	116 (46.4 %)
Shoulder press	126 (50.4 %)
Shoulder external rotation+	115 (46.0 %)
Push up passes+	116 (46.4 %)
Drop & catch	121 (48.4 %)
Bounding	119 (47.6 %)
Run and jump: Single-leg landing	132 (52.8 %)
Rotating jump with push: Single-leg landing	114 (45.6 %)
Kneeling lunge with rotation	138 (55.2 %)
Y fall	112 (44.8 %)
Overhead shoulder strength	130 (52.0 %)
Push up + backwards toe walk	126 (50.4 %)
Backwards throwing +	117 (46.8 %)

Table 3. Comparison among the Countries of the Gulf Cooperation Council with respect to total score.

Indicators	N	Mean	SD	Median	Min	Max	*P-value
Saudi Arabia	51	12.86	2.615	13	8	20	0.123
Bahrain	42	13.60	2.614	14	7	18	
Kuwait	42	13.02	2.523	13	8	19	
Oman	34	13.06	2.348	14	8	18	
Qatar	41	12.10	2.427	12	7	17	
United Arab Emirates	40	13.43	2.640	13	8	18	
Total	250	13.00	2.558	13	7	20	

Table note: * One-way analysis of variance (ANOVA).

On the other hand, the lowest implementation rate was found in Qatar at 12.10 (± 2.427).

The comparison between the GCCs by the implementation of each exercise is shown in table (4). Overall, there were no significant differences between the GCCs in the implementation rates of all the addressed exercises since all P values were >0.05 . A borderline significant difference (0.056) was shown with the run and jump: single-leg landing exercise, being highly implemented in Saudi Arabia at 60.8%, and the lowest in UAE at 37.5%.

Discussion

This study aimed to assess the level of implementation of the OSTRC handball injury prevention exercises among handball players in the GCCs, and to the best of our knowledge, this is the first study to address this topic. The results revealed low implementation rates of the assessed exercises that ranged from 44.8% to 55.6%.

The scarcity of similar data in the literature makes comparing the current study findings difficult. However, in line with the current study findings of low implementation rates

of handball injury prevention exercises, previous randomized controlled trials (RCTs) showed that despite the high effectiveness of the evidence-based injury prevention training in reducing musculoskeletal injuries by approximately 40%, such training has limited public health impact (Emery, Roy, Whittaker, Nettel-Aguirre, & Van Mechelen, 2015; Rössler et al., 2014; Soomro et al., 2016). This is mainly because the training is not widely or properly implemented or sustained (Donaldson & Finch, 2013; Finch & Donaldson, 2010).

Unfortunately, the reasons for non-implementation in the current study were not addressed. A recently published study by Ageberg E et al. (Ageberg et al., 2019), suggested that activities to facilitate the implementation of an injury prevention intervention for team handball players should focus on ensuring that both the players and coaches know and understand the principles, importance, and benefits of such training. In addition, Joy EA et al. (Joy et al., 2013) reported that inadequate implementation knowledge is one of the major obstacles for adopting a prevention program for anterior cruciate ligament injury. Therefore, based on the current study results it is highly recommended that the OSTRC handball injury prevention program should reach and involve all stakeholders, including players, coaches, and clubs and governing bodies. Moreover, for promoting the implementation, it is essential to assure understanding of the relevant benefits of the injury prevention exercise program for all stakeholders, enhancing program fidelity, and encouraging maintenance by establishing policies and procedures at the team, club, and governing body levels.

As with any study, the current study has its limitations. Besides handball players, who were invited to participate in this study, coaches and physical therapists are other relevant participants potentially affecting the success of the implementation, however, they were not included in the current study. In addition, implementation of a prevention program is a complex process and the word 'implement,' which was assessed in the current study, is only facet. Therefore, future research should aim to more precisely define and allocate the varied factors contributing to concepts such as program usage, feasibility, or suitability. Despite these limitations, this is the first study in this area, and data was collected from handball players from the whole GCCs, therefore, the result could be generalized to the region.

Conclusions

Overall, the implementation levels of the OSTRC handball prevention exercises among the handball players in the GCC countries is considered low. Future studies addressing the barriers for non-implementation and how to overcome them are needed.

Acknowledgement

The author(s) would like to thank all GCC Handball Federations for distributing the survey and all players who participated in this project.

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Table 4. Comparison among the Countries of the Gulf Cooperation Council with respect to different points.

Indicators	Countries						P-value
	Saudi Arabia	Bahrain	Kuwait	Oman	Qatar	U.A. E	
	(n = 51)	(n = 42)	(n = 42)	(n = 34)	(n = 41)	(n = 40)	
Triangle run	25 49.0%	24 57.1%	25 59.5%	14 41.2%	21 51.2%	20 50.0%	0.664
Run with backwards throws	25 49.0%	19 45.2%	19 45.2%	16 47.1%	23 56.1%	20 50.0%	0.928
Run with foot plant	25 49.0%	26 61.9%	22 52.4%	13 38.2%	13 31.7%	20 50.0%	0.097
Jump & push	29 56.9%	23 54.8%	20 47.6%	22 64.7%	17 41.5%	28 70.0%	0.111
Side lying rotation	26 51.0%	20 47.6%	15 35.7%	14 41.2%	17 41.5%	22 55.0%	0.508
Bow and arrow	26 51.0%	21 50.0%	20 47.6%	22 64.7%	24 58.5%	21 52.5%	0.689
Shoulder external rotation	26 51.0%	24 57.1%	27 64.3%	15 44.1%	23 56.1%	24 60.0%	0.564
Push up passes	28 54.9%	20 47.6%	18 42.9%	18 52.9%	18 43.9%	17 42.5%	0.777
Single-leg deadlift with partner	26 51.0%	25 59.5%	26 61.9%	18 52.9%	19 46.3%	24 60.0%	0.670
Backwards throws	31 60.8%	28 66.7%	20 47.6%	15 44.1%	17 41.5%	17 42.5%	0.089
Forwards speed-skating jumps	25 49.0%	19 45.2%	24 57.1%	17 50.0%	22 53.7%	24 60.0%	0.775
Run and jump: Double-leg landing	23 45.1%	29 69.0%	17 40.5%	20 58.8%	20 48.8%	24 60.0%	0.081
Rotating jump with push: Double-leg landing	24 47.1%	22 52.4%	17 40.5%	21 61.8%	22 53.7%	18 45.0%	0.510
Hip flexors stretch +	23 45.1%	23 54.8%	20 47.6%	11 32.4%	18 43.9%	21 52.5%	0.461
Shoulder press	25 49.0%	22 52.4%	24 57.1%	13 38.2%	20 48.8%	22 55.0%	0.660
Shoulder external rotation+	25 49.0%	22 52.4%	17 40.5%	19 55.9%	16 39.0%	16 40.0%	0.534
Push up passes+	18 35.3%	19 45.2%	20 47.6%	19 55.9%	19 46.3%	21 52.5%	0.493
Drop & catch	22 43.1%	16 38.1%	22 52.4%	20 58.8%	17 41.5%	24 60.0%	0.218
Bounding	27 52.9%	18 42.9%	21 50.0%	17 50.0%	15 36.6%	21 52.5%	0.621
Run and jump: Single-leg landing	31 60.8%	24 57.1%	24 57.1%	22 64.7%	16 39.0%	15 37.5%	0.056
Rotating jump with push: Single-leg landing	26 51.0%	20 47.6%	22 52.4%	12 35.3%	15 36.6%	19 47.5%	0.507
Kneeling lunge with rotation	27 52.9%	23 54.8%	18 42.9%	23 67.6%	23 56.1%	24 60.0%	0.391
Y fall	21 41.2%	13 31.0%	26 61.9%	17 50.0%	15 36.6%	20 50.0%	0.064
Overhead shoulder strength	25 49.0%	25 59.5%	23 54.8%	16 47.1%	22 53.7%	19 47.5%	0.854
Push up + backwards toe walk	22 43.1%	23 54.8%	22 52.4%	18 52.9%	21 51.2%	20 50.0%	0.906
Backwards throwing +	25 49.0%	23 54.8%	18 42.9%	12 35.3%	23 56.1%	16 40.0%	0.368

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ВПРОВАДЖЕННЯ ВПРАВ OSTRC З ПОПЕРЕДЖЕННЯ ТРАВМ У ПРОФЕСІЙНОМУ ГАНДБОЛІ

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Авторський вклад: А – дизайн дослідження; В – збір даних; С – статаналіз; D – підготовка рукопису; Е – збір коштів

Реферат. Стаття: 6 с., 4 табл., 29 джерел.

Мета дослідження. Вправи по запобіганню гандбольних травм – це науково обґрунтовані вправи, запропоновані Центром досліджень спортивного травматизму в Осло (OSTRC). Це дослідження мало на меті оцінити реалізацію вправ OSTRC щодо запобігання травматизму серед професійних гандболістів у країнах Ради співпраці країн Перської затоки (GCC).

Матеріали і методи. Інтернет-опитування з метою отримання інформації щодо виконання вправ OSTRC із запобігання травматизму в гандболі було розповсюджено серед 267 професійних гандболістів у шести країнах GCC.

Результати. Загалом в опитуванні взяли участь 250 гандболістів із країн GCC (рівень відповіді 93,6%). Середнє значення ($\pm$ SD (стандартне відхилення)) загальної оцінки впровадження становило 13 ($\pm$ 2,558), без статистично значущої різниці між країнами GCC, значення Р становило 0,123. Найвищий середній бал був показаний в Бахреїну в 13,60 ($\pm$ 2,614), тоді як найнижчий був у Катару в 12,10 ($\pm$ 2,427).

Висновки. У поточному дослідженні повідомлялося про низький рівень виконання вправ OSTRC з гандболу серед гандболістів у країнах GCC.

Ключові слова: атлетичні травми, опитування та анкетування, вправи, спорт.

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Cite this article as: Wesam Saleh A. Al Attar, Nawaf Al Masoudi, Ali AL Zubeadi, & Ahmed Qasem, (2021). Implementation of the OSTRC Handball Injury Prevention Exercises in Professional Handball. *Teoriâ ta Metodika Fizičnogo Vihovannâ*, 21(2), 136-141.
<https://doi.org/10.17309/tmfv.2021.2.06>

Received: 12.03.2021. Accepted: 18.05.2021. Published: 25.06.2021

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ORIGINAL SCIENTIFIC ARTICLE

MANAGEMENT OF TRAINING PROCESS OF TEAM SPORTS ATHLETES DURING THE COMPETITION PERIOD ON THE BASIS OF PROGRAMMING (FOOTBALL-BASED)

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Accepted for Publication: May 18, 2021

Published: June 25, 2021

DOI: 10.17309/tmfv.2021.2.07

Abstract

The purpose of the study was to experimentally substantiate the effectiveness of organization of structural arrangements of the training process in skilled football players within the limits of the competition period on the basis of programming.

Material and methodology. 18 skilled football players of “Burevisnyk” student team took part in the research. The average age of participants was 19.8 ± 5.8 years and the qualification was category 1. The programme of the competition period of the skilled football players consisted of four blocks: the first one included the types and ratios of the training work, the second one included quantitative indexes of training sessions (non-specific, specific, comprehensive) and games (educational, control, official), and the third one included the ratio of means (general preparatory exercises, special preparatory exercises, developing exercises, competitive exercises) and training loads (aerobic, mixed aerobic and anaerobic, anaerobic alactic, anaerobic glycolytic loads), and the fourth one included preparedness criteria.

Results. We have redistributed training loads of various orientation by taking into account the specifics of competitive loads in skilled football players. Thus, shares of loads of the aerobic and anaerobic glycolytic orientation at the formative stage of the experiment were increased by 53.6 and 3.0 %, respectively, and the loads of the mixed and anaerobic alactic orientation were decreased by 40.0 and 3.4 %, respectively. Positive dynamics of indexes of physical (1.2-2.2 %) and functional (5.4-6.7 %) preparedness and competitive activity (3.6-23.8 %) of skilled football players at the formative phase of the experiment in comparison to the ascertaining phase was evident.

Conclusions. Theoretical and methodical aspects of programming of the training process may be conditioned upon the hierarchical structure, in which smaller programmatic structural arrangements are subordinate to the larger ones; the objectives with respect to the training programmes at every phase of the training macrocycle; general and special principles of athlete training; algorithmicity, i.e. step-by-step planning and correction of managerial influences; proper selection of training means and use of training loads with different focuses in the process of training cycles; use of informational criteria for control at every phase of the training process.

Keywords: football players, competitive period, program, managerial influences, microcycles, load orientation, load volume, physical preparedness, functional preparedness, competitive activity.

Introduction

Preparatory, competitive and transitional periods of the macrocycle are successive stages of the process of managing the development of sports form. Maintaining sports form in players during the long-lasting competition period for team sports is one of the central problems in the system of athlete

training (Kostiukevych, Lazarenko, Shchepotina, Kulchytska et al., 2019). Objective regularities of organism development do not allow for an increase in the training load. Due to this fact, experts continue to hold discussions on the optimum parameters of physical loads in athletes during the competition period. And specifically, works by Andrade et al. (2018) and Duarte et al. (2019) studied the peculiarities of training loads and recovery in volleyball players during the competition period. Assessment of external and internal side of the

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training load in elite football players during the competitive period was presented in the studies by Oliveira et al. (2019). The purpose of studies by Manzi et al. (2010) was to determine main parameters of physical loads in elite basketball players during various regimens of weekly microcycles, depending on the calendar of competitions.

Thus, taking into account modern tendencies of the development of team sports, among which the expansion of competition calendar and the increase in the competition practice should be given first priority, while the need for optimization of the training process in players during the competition period becomes evident (Andrade et al., 2018; Kostiukevych, Lazarenko, Shchepotina, Poseletska et al., 2019). It becomes possible due to rational planning of stimulation and recovery phases, i.e. regimens of load and rest for the purpose of forming urgent, delayed and cumulative training effects (Bompa & Haff, 2009; Platonov, 2013; Koryahin, Blavt, Doroshenko et al., 2020). However, on the basis of traditional planning which determines only the distribution of quantitative parameters of training work in structural arrangements of a macrocycle it is difficult to consider the training process of athletes in dynamics in conjunction with different sides of training (Kostiukevich, Stasiuk, Shchepotina et al., 2017). And most importantly, planning does not allow to determine direct impact on the formation of training effects. For this purpose, programming of training process may be used in the structure of managerial influences (Gerhard, 2009; Khudolii, 2019; Adamchuk, 2020).

Theoretical and methodical foundations of programming in the system of training in team sports athletes were substantiated by a wide circle of specialists, however, primarily with respect to separate components of training. And specifically, multidirectional programmes of physical training in female volleyball players were presented in the works by Malikova et al. (2018) and Veličković et al. (2018). As for football players' training, Karsten et al. (2016) proposed to use programming method in the process of strength-focused training of players. Comprehensive programme for the development of physical qualities in football players was presented in the study by Chtara et al. (2017). A more substantive approach was proposed by Shamardin (2013): the author developed two variants of training of a football team which takes part only in the championship of Ukraine and of a team which takes part in the Eurocup.

Presented analysis of literary sources allows to claim that the problem of programming of training process in athletes is relevant and promising. At the same time, the accumulated data related to the peculiarities of programming of athlete training in the team sports requires further study and clarification. Therefore, substantiation of scientific and methodical approach to the development of programmes of structural arrangements of the training process in athletes of team sports within the limits of an annual macrocycle and the ways of its practical fulfilment remains opportune which encouraged our study.

Study hypothesis: it is foreseen that the programming of structural arrangements of the training process in skilled football players within the limits of the competition period allows to optimize training loads by way of targeted managerial influences.

The purpose of study was to experimentally substantiate the effectiveness of organization of structural arrangements

of the training process in skilled football players within the limits of the competition period on the basis of programming.

Material and methodology

Study participants

18 skilled football players of "Burevisnyk" student team took part in the research. The average age of participants was 19.8 ± 5.8 years and the qualification was category 1. The criteria for inclusion of football players into the sample was their game status: a starter player or an active backup player. The study was approved by the ethics committee of Vinnytsia Mykhailo Kotsiubynskyi State Pedagogical University and all the procedures were in accordance with the Helsinki Declaration. The participants gave an informed consent for participation in the experiment.

Study organization

The study was conducted over the period of two years. The ascertaining phase of the experiment was conducted over the first year and the formation phase was conducted over the second year. Pedagogical supervision of the training process of the studied football team was conducted during the ascertaining experiment. Real time monitoring of the training work which foresaw recording of the nature and duration of exercises and heart rate of players on special forms during the performance of exercises using heart rate monitor Polar RS800CX allowed to determine:

- 1) general volume of motor activities in athletes (minutes, hours);

- 2) load value coefficient (LVC) using the method of V.A. Sorvanov (Godik, 2006). LVC was calculated as a result of multiplication of the duration of the exercise by its intensity in points depending on the heart rate (Kostiukevich, Stasiuk, Shchepotina et al., 2017): intensity of exercise with the heart rate 114 bpm was evaluated in 1 point; 120 bpm – 2 points; 126 bpm – 3 points; 132 bpm – 4 points; 138 bpm – 5 points; 144 bpm – 6 points; 150 bpm – 7 points; 156 bpm – 8 points; 162 bpm – 10 points; 168 bpm – 12 points; 174 bpm – 14 points; 180 bpm – 17 points; 186 bpm – 21 points; 192 bpm – 25 points; 198 bpm – 33 points;

- 3) load intensity using the coefficient of the training load intensity (CItI) was determined as a ratio of the LVC to the duration of the training session in minutes (CItI, point·min⁻¹);

- 4) ratio of multidirectional means while taking into account the specifics of the team sports: general preparedness exercises, special preparedness exercises, developing and competitive exercises (Platonov, 2013; Kostiukevich, 2016);

- 5) ratio of physical loads with various physiological orientation: loads of aerobic, mixed aerobic-anaerobic, anaerobic lactate or anaerobic glycolytic orientation (Johnson, Haskvitz, & Brehn, 2009; Wilmore, Costill, & Kenney, 2012; Platonov, 2013).

Pedagogical testing allowed to determine the indexes of physical preparedness in players and foresaw the use of tests: 30 m run from high start (the best result out of two attempts was taken into account, with a rest interval of 3-5 minutes), 7×50 m shuttle run (running seven fifty meter stretches with a mandatory condition that the support leg is put over the start and finish line), long jump from the spot (three attempts

were made and the best result among them was recorded), Cooper test (continuous run during 12 minutes with determination of the distance which the player overcame; the test was preceded by 5 minute rest after warm-up). All the tests were conducted according to the generally accepted method after an obligatory warm-up, they correspond to the requirements of reliability and informativeness and are standard for assessment of physical preparedness in football players (Godik, 2006; Kostiukevich, Stasiuk, Shchepotina et al., 2017). Athletes were first given instructions on the correctness of the performance of test exercises. Pedagogical testing was organized over the period of two days: 30 m run and 7×50 m shuttle run on the first day, long jump from the stop and Cooper test on the second day.

Maximum oxygen consumption (VO_{2max}) was determined by indirect method and was based on the high correlation between physical preparedness and aerobic productivity of an organism (Karpman, Belotserkovskiy, & Gudkov, 1988). According to the method for conducting a run-based variant of the test $PWC_{170(V)}$ (Kostiukevich, 2016) the players performed two 5-minute run loads by overcoming the distances of 700-900 and 1100-1300 m accordingly, with their heart rate being recorded at the end of the first and second load (the period of rest between run loads made 5 minutes). $PWC_{170(V)}$ was determined using the formula:

$$PWC_{170(V)} = V_1 + (V_2 - V_1) \frac{170 - f_1}{f_2 - f_1} \quad (1)$$

whereas: V_1 and V_2 represent run speed during the first and second run loads (determined as a ratio between the distance length and the time for overcoming the distance), $m \cdot s^{-1}$; f_1 and f_2 represent heart rate immediately after the first and second run load, bpm.

The following formula (Karpman, Belotserkovskiy, & Gudkov, 1988) was used to convert $PWC_{170(V)}$ in $m \cdot s^{-1}$ into PWC_{170} in $kgm \cdot min^{-1}$

$$PWC_{170} = 417 \cdot PWC_{170(V)} - 83, \quad (2)$$

Absolute index of maximum oxygen consumption (VO_{2max} , $ml \cdot min^{-1}$) was determined using the formula:

$$VO_{2max} = 1,7 \cdot PWC_{170} + 1240, \quad (3)$$

Relative index of maximum oxygen consumption ($VO_{2max(rel)}$, $ml \cdot min^{-1} \cdot kg^{-1}$) was determined as a ratio of an absolute index to the body mass of the studied football player.

The results of completion of the 7×50 m shuttle run by football players allowed to determine the overall index of adaptation by Nevmanov which characterized the level of adaptation of the player's organism to loads of anaerobic glycolytic orientation (Kostiukevich, 2016):

$$OIA = t(f_1 + f_2 + f_3), \quad (4)$$

whereas: t is the time of performance of 7×50 m shuttle run test; f_1, f_2, f_3 is heart rate over 10 seconds at the end of the first, second and third minute of recovery.

The assessment of the competitive activity of football players was performed on the basis of 6 developed specific indexes (coefficients of intensity, mobility, aggressiveness, efficiency, single combat efficiency, creativity) as well as overall assessment, the method of determination of which is described in detail in our previous studies (Kostiukevich, Imas, Borysova et al., 2018; Kostiukevich, Shchepotina, & Vozniuk, 2020).

1. The intensity coefficient (IC) determined the overall activity of the player in the game:

$$IC = \frac{\sum_{i=1}^n TTA}{t} \quad (5)$$

where: $\sum_{i=1}^n TTA$ – total amount of technical and tactical actions;

t – time played by a player in a match.

2. The mobility coefficient (MC) characterized the general mobility of the player during the match, his desire to perform technical and tactical actions in motion in different parts of the field:

$$MC = \frac{\sum_{i=1}^n TTA(2nd MCC + 3rd MCC)}{t} \times 2 \quad (6)$$

where: $\sum_{i=1}^n TTA(2nd MCC + 3rd MCC)$ – total amount of technical and tactical actions performed by the player in the second and third modes of coordination complexity;

2 – indicator of coordination complexity.

3. The aggressiveness coefficient (AC) characterized the player's activity in single combats, in conditions of active intervention by the opponent:

$$AC = \frac{\sum_{i=1}^n TTA(3rd MCC)}{t} \times 3 \quad (7)$$

where: $\sum_{i=1}^n TTA(3rd MCC)$ – total amount of technical and tactical actions performed by the player in the third mode of coordination complexity;

3 – indicator of coordination complexity.

4. The efficiency coefficient (EC) reflected the value of the player for the team, the quality of performed by him technical and tactical actions:

$$EC = \frac{\sum_{i=1}^n preciseTTA}{\sum_{i=1}^n allTTA} \quad (8)$$

where: $\sum_{i=1}^n preciseTTA$ – total amount of precise technical and tactical actions performed by the player;

$\sum_{i=1}^n allTTA$ – total amount of all technical and tactical actions performed by the player in a match.

5. The single combat efficiency coefficient (SCEC) characterized the quality of technical and tactical actions performed by the player in conditions of active intervention by the opponent:

$$SCEC = \frac{\sum_{i=1}^n preciseTTA(stops, holds, tacklings, dummies, performed in 3rd MCC)}{\sum_{i=1}^n allTTA(stops, holds, tacklings, dummies, performed in 3rd MCC)} \quad (9)$$

where:

$\sum_{i=1}^n preciseTTA(stops, holds, tacklings, dummies, performed in 3rd MCC)$ – total amount of precise technical and tactical actions performed by the player in the third mode of coordination complexity;

$\sum_{i=1}^n allTTA(stops, holds, tacklings, dummies, performed in 3rd MCC)$ – total amount of all technical and tactical actions performed by the player in the third mode of coordination complexity during the match.

6. The creativity coefficient (CC) allowed us to integrally evaluate the player's game creativity in the confrontation

with the opponent. Usually a player with a high creativity coefficient must be confident in his actions, have a wide arsenal of technical and tactical actions and be able to apply them in accordance with the situation:

$$CC = \frac{\sum_{i=1}^n \text{preciseTTA}(DP \times 1 + SP \times 2 + GP \times 5 + GK \times 5 + G \times 10)}{t} \quad (10)$$

where: *DP* – developing passes; *SP* – sharpening passes; *GP* – goal passes; *GK* – goal kicks; *G* – goals.

7. The integral assessment (IA) of player was determined by the sum of six specific indicators and was one of the criteria for creating an athlete rating :

$$IA = IC + MC + AC + EC + SCEC + CC \quad (11).$$

Results of the ascertaining experiment provided scientific and methodical basis for programming the training process in football players during the competition period. Programming of structural arrangements of the training process consisted in the progressive development of the interconnected programmes of periods, microcycles, training sessions and their parts (training tasks) which definitely included load components for targeted formation of urgent, delayed and cumulative training effects. Programmes of structural arrangements of the training process in football players were based on the regularities of the development of adaptation processes, general principles of athlete training, peculiarities of athlete training in team sports etc. (Matveev, 2010; Wilmore, Costill, & Kenney, 2012; Platonov, 2013).

Programme of the competition period of the skilled football players consisted of four blocks (fig. 1): the first one included the types and ratios of the training work, the second one included quantitative indexes of training sessions (non-specific, specific, comprehensive) and games (educational, control, official) and the third one included the ratio of means

(general preparatory exercises, special preparatory exercises, developing exercises, competitive exercises) and training loads (aerobic, mixed aerobic and anaerobic, anaerobic alactate, anaerobic glycolytic loads) and the fourth one included preparedness criteria.

The fulfilment of the proposed programme of competitive period was carried out through the logical flowchart of the microcycles programme (fig. 2). Main target tasks for each microcycle were: formation of training effects, adaptation of players to training and competitive loads, improvement of technical and tactical skills.

Programmes for microcycles of various types, i.e. competitive, intergame, recovery microcycles, were developed for the competitive period. The structure of the microcycle proposed by Kostiukevich (2016) was taken as a basis. Load components were clearly regulated in each microcycle: volume, load value and intensity, training means etc.

The development of programmes of training sessions which solved the tasks of adaptation of football players to loads took into account such regularities and principles of formation of training effects as superloads and stress syndrome, dose/effect dependence, specificity, reversibility of the action, positive interaction, adaptation coherence (Bompa & Haff, 2009; Matveev, 2010; Platonov, 2013). Taking these regularities into account, fig. 3 shows the dynamics of load, intensity and orientation of 6-day competitive microcycle of preparedness of the skilled football players.

Statistical analysis

Descriptive statistics was used during mathematical processing of study outcomes. The mean (M) and standard deviation (SD) were determined. In order to determine statistical reliability in the difference of indexes of preparedness

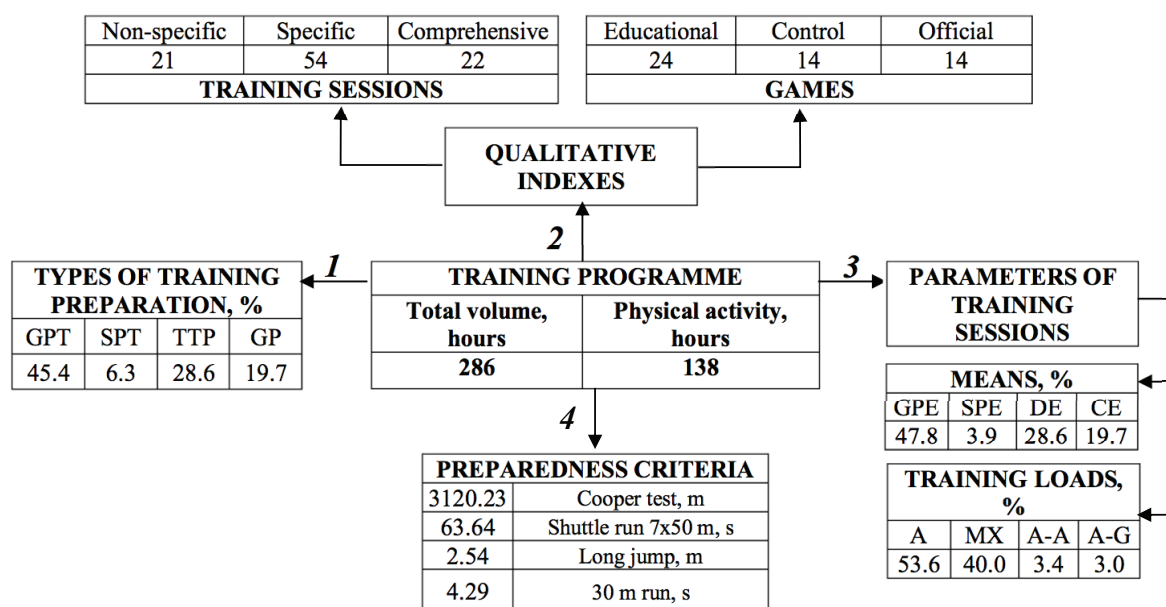


Fig. 1 The programme of preparedness of skilled football players during the competition period of the second cycle of annual preparation at the phase of the formation experiment: GPT – general physical training; SPT – special physical training, TTP – technical and tactical preparation, GP – game preparation; means: GPE – general preparatory exercises, SPE – special preparatory exercises, DE – developing exercises, CE – competitive exercises; training loads: A – aerobic, MX – mixed aerobic anaerobic, A-A – aerobic alactate, A-G – aerobic glycolytic

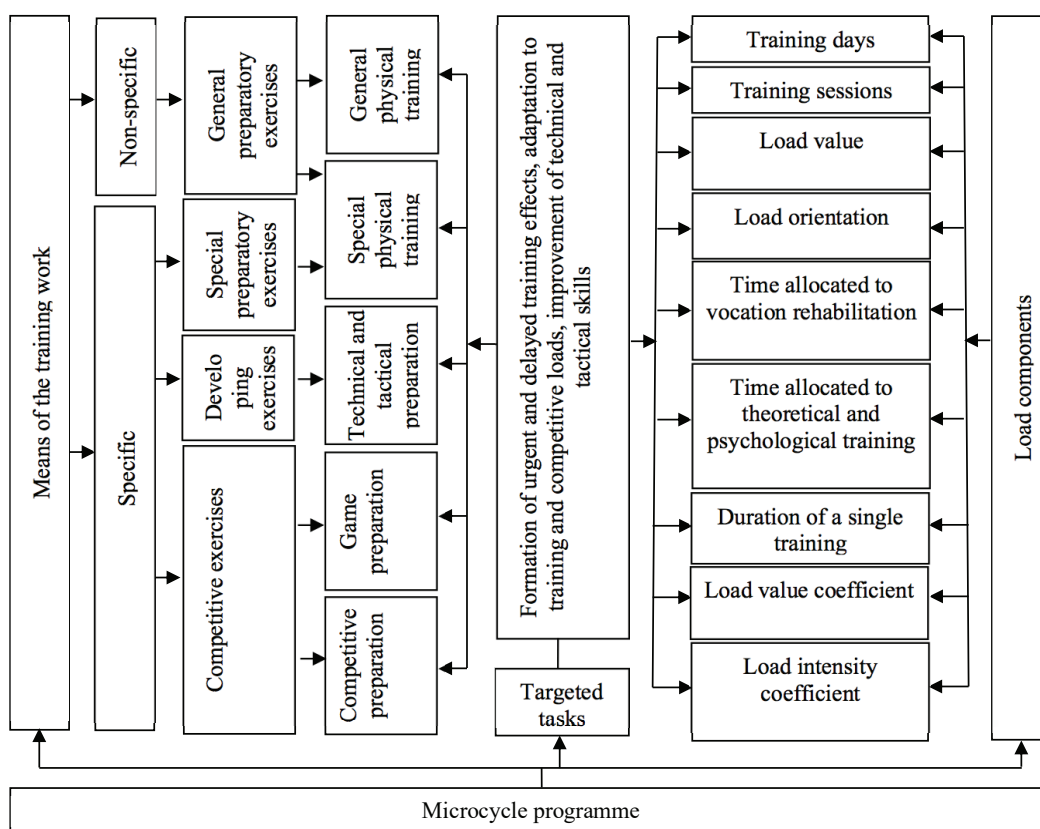


Fig. 2. Logical flowchart of microcycles in the training process of the skilled football players

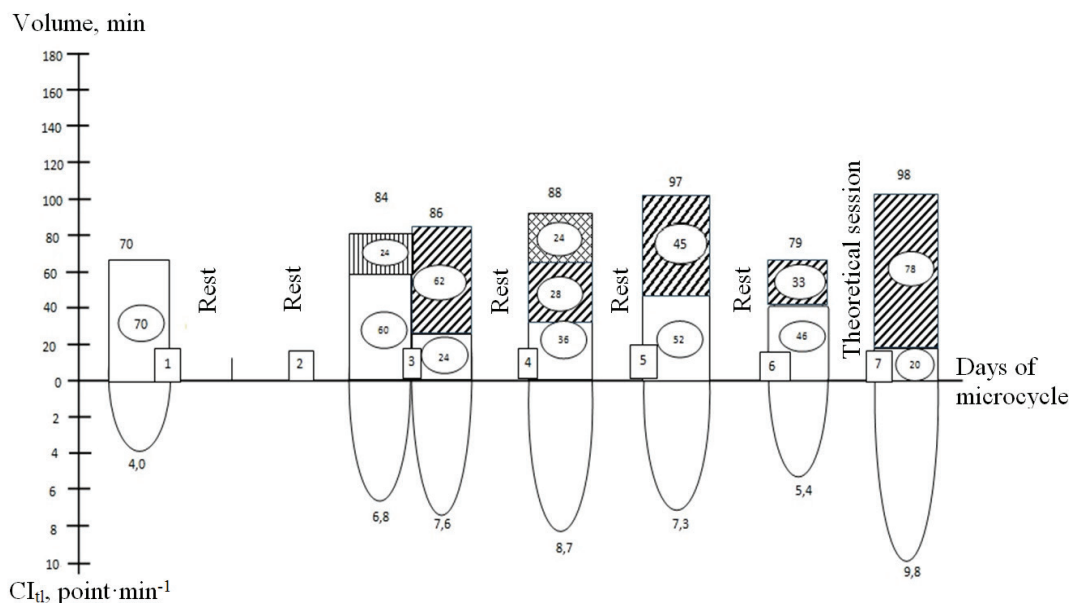


Fig. 3. Volume, intensity (CI_{tl}) and orientation of sessions of 7-day competitive (recovery and developing) microcycle of the competitive period of the second cycle of annual training of the skilled football players at the phase of the formation experiment: – loads of aerobic orientation; – loads of mixed orientation; – loads of anaerobic alactate orientation; – loads of anaerobic glycolytic orientation

and competitive activity of football players at the ascertaining and formulation phases of the experiment, Student's t-criterion was used for dependent samples. The difference between indexes was considered reliable at the levels of significance

$p < 0.05$ and $p < 0.01$. Mathematical processing of the results was conducted using the package "Data analysis" of MS Office Excel software (Byshevets, Shynkaruk, Stepanenko et al, 2019).

Results

The content of the training process of the studied football team at the formation phase of the experiment was significantly changed. Besides, the volume of training loads was reduced from 9022 min (150,4 hours) at the ascertaining phase up to 8250 min (137,5 hours) at the formation phase. The structure of the competitive period included eight 7-day competitive (recovery and developing), two 6-day competitive (recovery and developing), one 5-day competitive (developing), three 4-day competitive (developing) and four 3-day recovery microcycles (table 1).

Besides, in comparison with the ascertaining phase of experiment we have redistributed training loads of various orientation by taking into account the specifics of competitive loads in skilled football players (fig. 4). Thus, shares of loads of aerobic and anaerobic glycolytic orientation at the formation stage of the experiment were increased by 53.6 and 3.0% accordingly and the loads of the mixed and anaerobic alactate orientation were decreased by 40.0 i 3.4% accordingly.

Positive dynamics of indexes of physical and functional preparedness and competitive activity of skilled football players at the phase of the formation experiment in comparison to the ascertaining phase (table 2) was evident. Besides, the level of demonstration of speed endurance in football players reliably improved ($p = 0.05$) by 2.2% based on the index of 7×50 m shuttle run which significantly contributed to the increase in the share of loads of anaerobic glycolytic orientation. The rest of indexes of physical preparedness in players showed positive dynamics within the limits of 1.2-1.4 % ($p > 0.05$).

An increase in the share of loads of aerobic orientation showed itself in a statistically reliable improvement of functional indexes in football players which characterized the level of physical ability to work using the indexes $PWC_{170(V)}$ and PWC_{170} multiplied by 6.7% ($p = 0.00$) and 6.9% ($p = 0.05$) accordingly and aerobic productivity using the relative index of $VO_{2max(rel)}$ multiplied by 5.8% ($p = 0.04$).

Regulation of load components, quantitative indexes of training sessions and games, ratio of means for training football players which became possible due to the use of programming allowed to perform targeted managerial influences, to optimise the training process and contributed to the reliable improvement of majority of specific indexes and overall assessment of competitive activity in football players. Thus, the intensity coefficient at the phase of the formation experi-

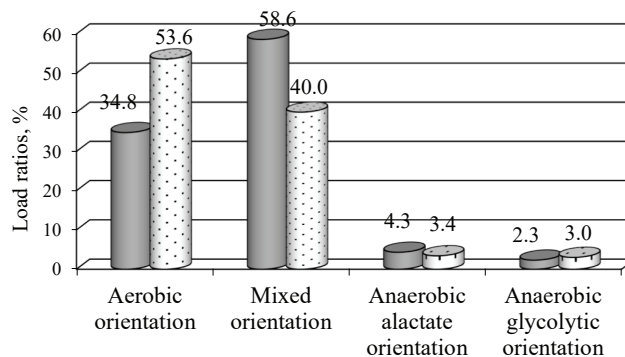


Fig. 4 The ratio of training loads of various orientation during the competition period in skilled football players at the ascertaining and formation phases of the pedagogical experiment is the following: ■ – ascertaining phase; ▨ – formation phase

ment, in comparison with the ascertaining phase, increased by 14.1% ($p = 0.01$), the mobility coefficient increased by 14.4% ($p = 0.00$), the efficiency coefficient increased by 11.6% ($p = 0.00$) and the creativity coefficient increased by 23.8% ($p = 0.01$). An increase in the specific indexes of competitive activity resulted in a statistically reliable increase of the integral assessment by 11.1% ($p = 0.01$). It is worth noting that we regarded the overall assessment as the most important index of competitive activity in football players.

Discussion

Based on the generalization of outcomes of previous studies (Gerhard, 2009; Chtara et al., 2017; Kostiukevych, Lazarenko, Shchepotina, Poseletska et al., 2019), it should be noted that modern tendencies of the development of team sports allow for the viability and efficiency of use of programming for the purpose of optimization of athletes' training. In contrast to the traditional planning, targeted fulfilment of managerial influences is carried out by way of creation of targeted programmes of structural arrangements of the training process in football players. And, above all, regulation of load components is exceptionally important for the formation of training effects (Platonov, 2013; Kostiukevych, Lazarenko, Shchepotina, Kulchytska et al., 2019). Our study substantiates theoretical and methodical foundation for pro-

Table 1. Volume and ratios of training loads in microcycles of the competition period of the second cycle of annual training in skilled football players at the phase of the formation experiment

Microcycles	Load volume, min					LVC, points / CI_{II} , points·min ⁻¹
	Aerobic	Mixed	Anaerobic alactate	Anaerobic glycolytic	Total	
7-Day competitive (Recovery and developing)	308	246	24	24	602	4296 / 7.1
6-Day competitive (Recovery and developing)	310	244	32	16	602	4695 / 7.8
5-Day competitive (developing)	232	216	28	12	488	3562 / 7.3
4-Day competitive (developing)	168	210	–	–	378	2722 / 7.2
3-Day competitive and recovery	152	–	–	–	–	668 / 4.4

Notes: LVC is a load value coefficient; CI_{II} is a coefficient of training load intensity

Table 2. Comparison of indexes of physical and functional preparedness and competitive activity in skilled football players (n = 18) during the competition period of the second cycle of annual training at the phase of the ascertaining and formation experiments

Name of the test	Statistic indices				ΔM (%)	t	p
	Ascertaining phase		Formation phase				
	M	SD	M	SD			
Physical preparedness							
30 m run from high start, s	4.35	0.26	4.29	0.23	-0.06 (-1.4)	0.78	0.45
Long jump from the spot, m	2.51	0.22	2.54	0.19	0.03 (1.2)	0.50	0.62
7×50 m shuttle run, s	65.05	1.90	63.64	1.49	-1.41 (-2.2)	2.09*	0.05
Cooper test, m	3082.01	176.31	3120.23	171.14	38.22 (1.2)	0.73	0.48
Functional preparedness							
PWC _{170(V)} , m·s ⁻¹	3.89	0.22	4.15	0.19	0.26 (6.7)	3.70**	0.00
PWC ₁₇₀ , kgm·min ⁻¹ ·kg ⁻¹	21.60	2.79	23.10	2.18	1.60 (6.9)	2.13*	0.05
VO _{2max(rel)} , ml·min ⁻¹ ·kg ⁻¹	53.71	3.62	56.81	3.26	3.10 (5.8)	2.24*	0.04
Overall adaptation index, relative units	4351.14	768.50	4114.23	713.52	-236.91 (-5.4)	1.50	0.15
Competitive activity							
Intensity coefficient, relative units	0.78	0.11	0.89	0.11	0.11 (14.1)	2.75**	0.01
Mobility coefficient, relative units	1.39	0.17	1.59	0.16	0.20 (14.4)	4.44**	0.00
Aggressiveness coefficient, relative units	0.80	0.10	0.85	0.12	0.05 (6.3)	1.25	0.23
Efficiency coefficient, relative units	0.69	0.04	0.77	0.04	0.08 (11.6)	5.71**	0.00
Single combat efficiency coefficient, relative units	0.56	0.04	0.58	0.04	0.02 (3.6)	1.42	0.17
Creativity coefficient, relative units	0.21	0.05	0.26	0.05	0.05 (23.8)	2.77**	0.01
Integral assessment, relative units	4.43	0.46	4.92	0.46	0.49 (11.1)	3.06**	0.01

Notes: * – the difference in the results is statistically reliable at the level of $p < 0.05$; ** – the difference in the results is statistically reliable at the level of $p < 0.01$; M – mean; SD – standard deviation

gramming structural arrangements of the training process in skilled football players during the competition period. Practical fulfilment of the proposed approach as well as its experimentally substantiated efficiency are reflected in the process of preparation of the studied football team “Burevisnyk”.

During the period of stabilization of the sports form the outcomes are increased, however within the limits of capabilities allowed for by the regularities of maintenance of the current sports form (Matveev, 2010; Platonov, 2013; Kostiukevych, Lazarenko, Shchepotina, Kulchytska et al., 2019). During the competition period a positive tendency of indexes of physical and functional preparedness in football players was evident. It contributed to a more efficient participation of football players in the competitive activity as specific peculiarities of the football game allow for a high level of demonstration of specifically speed qualities, speed and strength qualities and, first of all, speed endurance which corresponds to the player's movement during a match which resembles the shuttle run.

Reliability of use of integral assessment as an objective and informative criterion of effectiveness of competitive activity in skilled football players has been confirmed. Analysis of technical and tactical activity of players based only on quantitative and qualitative indexes is not always objective and sufficiently efficient for managerial influences (Solovey, Mitova, Solovey et al., 2020; Kostiukevych, Shchepotina, & Vozniuk, 2020). Integral assessment is based on comprehensive

accounting of technical and tactical activity of football players as it takes into account the coordination complexity of the fulfilment of technical and tactical actions, their tactical meaning, roles of players etc. (Kostiukevych, Imas, Borysova et al., 2018). The improvement of specific indexes of integral assessment of competitive activity of the studied football team clearly shows, on the one side, an increase in the technical and tactical skills of players and, on the other hand, a change in the tactics of the game of the team with an orientation toward a more aggressive tactical model of the game.

We have supplemented the results of the study by Oliveira, Brito, Martins et al (2019) with respect to such parameters of the training process in football players during the competition period as load volume and directly run work with the data on the volume and ratio of means and types of preparation, quantitative indexes of training sessions of different pedagogical orientation. The data on the control of indexes of physical (Godik, 2006; Karsten, Larumbe-Zabala, Kandemir et al., 2016) and functional preparedness (Shamardin, 2013; Slimani, Znazen, Miarka et al., 2019) and competitive activity (Kostiukevych, Imas, Borysova et al., 2018; Kostiukevych, Shchepotina, & Vozniuk, 2020) in skilled football players were further developed. Besides, the obtained data on the volume and ratio of training loads of various orientation in skilled football players of the student team supplement and expand the outcomes of the study by Shamardin (2013) on elite football players.

Analysis of the obtained results confirms the reliability of the use of the represented programme of the competition period in the practice of preparation of student teams as well as skilled football players. Besides, the described scientific and methodical method was approved in the process of organizing the training process of the skilled female volleyball players during the preparatory period (Kostiukevych, Shchepotina, Shynkaruk et al., 2019). It confirms the feasibility of use of the programming method for practical preparation of team sports athletes in the annual macrocycle. Among the promising directions we see the study of the problem of programming of the training process of athletes at the phases of long-term improvement which is substantiated by the need to create long-term programmes for preparation of the skilled sports reserve.

Conclusions

1. Programming is a new, more progressive form of planning of the training process which allows more reliably to accomplish the targeted outcome depending on the comprehensive influence of various factors. Theoretical and methodical aspects of programming of the training process may be conditioned upon the hierarchical structure, in which smaller programmatic structural arrangements are subordinate to the larger ones; the objectives with respect to the training programmes at every phase of the training macrocycle; general and special principles of athlete training; algorithmicity, i.e. step-by-step planning and correction of managerial influences; proper selection of training means and use of training loads with different focuses in the process of training cycles; use of informational criteria for control at every phase of the training process.

2. The developed programme of the competition period in skilled football players consisted of four blocks which determined the types and ratios of training work, quantitative indexes of training sessions and games, ratios of means and training loads as well as preparedness criteria. The proposed programme of the competition period was fulfilled through the programmes of macrocycles in which load components were clearly regulated for the purpose of forming training effects.

3. The effectiveness of organization of structural arrangements of the training process of skilled football players over the competition period on the basis of programming is confirmed by a statistically reliable improvement of indexes of physical and functional preparedness and competitive activity in players in the range from 2.2 to 23.8%.

Acknowledgements

The research was carried out within the framework of the plan of the research work of the Department of Theory and Methodology of Sports of Vinnytsia Mykhailo Kotsiubynskyi State Pedagogical University for 2016-2020 «Theoretical and Methodological Foundations of Programming and Modeling of the Training Process of Sportsmen of Different Qualifications» (state registration number 0116U005299) and for 2021-2025 «Organizational and methodological principles of programming the training process of gratified and highly gratified athletes» (state registration number 0121U109550).

Conflict of interests

The authors state that there is no conflict of interests.

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УПРАВЛІННЯ ТРЕНУВАЛЬНИМ ПРОЦЕСОМ СПОРТСМЕНІВ КОМАНДНИХ ІГРОВИХ ВИДІВ СПОРТУ В ЗМАГАЛЬНОМУ ПЕРІОДІ НА ОСНОВІ ПРОГРАМУВАННЯ (НА МАТЕРІАЛІ ФУТБОЛУ)

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Авторський вклад: А – дизайн дослідження; В – збір даних; С – статаналіз; D – підготовка рукопису; Е – збір коштів

Реферат. Стаття: 6 с., 2 табл., 4 рис., 31 джерело.

Мета дослідження – експериментально обґрунтувати ефективність побудови структурних утворень тренувального процесу кваліфікованих футболістів у межах змагального періоду на основі програмування.

Матеріал і методи. У дослідженні взяли участь 18 кваліфікованих футболістів студентської команди «Буревісник». Середній вік досліджуваних становив $19,8 \pm 5,8$ років, кваліфікація – I розряд. Програма змагального пе-

ріоду кваліфікованих футболістів складалася з чотирьох блоків: у першому з них представлені види та співвідношення тренувальної роботи, в другому – кількісні показники тренувальних занять (неспецифічних, специфічних, комплексних) та ігор (навчальних, контрольних, офіційних), у третьому – співвідношення засобів (загальнопідготовчих, спеціально-підготовчих, підвідних, змагальних) і тренувальних навантажень (аеробних, змішаних аеробно-анаеробних, анаеробних алактатних, анаеробних гліколітичних), у четвертому – критерії підготовленості.

Результати. Було здійснено перерозподіл тренувальних навантажень різної спрямованості з урахуванням специфіки змагальних навантажень кваліфікованих футболістів. Так, частки навантажень аеробної й анаеробної гліколітичної спрямованості на формувальному етапі експерименту були збільшені до 53,6 і 3,0% відповідно, а навантажень змішаної й анаеробної алактатної спрямованості – зменшені до 40,0 і 3,4% відповідно. Спостерігалася позитивна динаміка показників фізичної (1,2-2,2%) і функціональної

(5,4-6,7%) підготовленості та змагальної діяльності (3,6-23,8%) кваліфікованих футболістів на етапі формувального експерименту, в порівнянні з констатувальним.

Висновки. Теоретико-методичні аспекти програмування тренувального процесу мають бути обумовлені: ієрархічною структурою, в якій менші програмні структурні утворення підпорядковані більшим; цільовими установками щодо програм підготовки на кожному з етапів тренувального макроциклу; загальними та спеціальними принципами підготовки спортсменів; алгоритмічністю – покроковим плануванням і корекцією управлінських впливів; адекватним підбором тренувальних засобів і використанням тренувальних навантажень різної спрямованості в процесі тренувальних циклів; використанням інформативних критеріїв контролю на кожному з етапів тренувального процесу.

Ключові слова: футболісти, змагальний період, програма, управлінські впливи, мікроцикли, спрямованість навантаження, величина навантаження, фізична підготовленість, функціональна підготовленість, змагальна діяльність.

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Cite this article as: Shchepotina, N., Kostiukevych, V., Asauliuk, I., Stasiuk, V., Vozniuk, T., Dmytrenko, S., & Adamchuk, V. (2021). Management of Training Process of Team Sports Athletes During the Competition Period on the Basis of Programming (Football-Based). *Teoriâ ta Metodika Fizičnogo Vihovannâ*, 21(2), 142-151. <https://doi.org/10.17309/tmfv.2021.2.07>

Received: 13.04.2021. Accepted: 18.05.2021. Published: 25.06.2021

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ORIGINAL SCIENTIFIC ARTICLE

IMPACT OF AQUAFITNESS TRAINING ON PHYSICAL CONDITION OF EARLY ADULTHOOD WOMEN

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Accepted for Publication: May 18, 2021

Published: June 25, 2021

DOI: 10.17309/tmfv.2021.2.08

Abstract

Background. The physical benefits of fitness for middle-aged women are well-known. Unlike the usual training sessions, aquafitness occupies a special place among the types of health-related exercise training. Its health-enhancing effect results from the activation of the body's functional systems, the gravitational unloading of the musculoskeletal system, high energy expenditures, and overall body hardening effect.

The objective of this study was to evaluate the health-enhancing effects of an aquafitness program on the functional indicators and physical fitness of early adulthood women.

Materials and methods. Theoretical analysis and generalization of scientific and methodological literature, anthropometric techniques, pedagogical methods, and methods of mathematical statistics were used. The functional status of the body was assessed with the indices characterizing the function of the cardiorespiratory system, which are commonly used. The study was conducted at the Sport Life fitness club, Chernivtsi. The study involved 48 women aged 21-31 with an average age of 26.3 years. The subjects took part in a six-month aquafitness program consisting of 60-min sessions, three times a week. The program was developed by the authors and included aquatic stretching, body shaping and bodybuilding exercise, aquadance, aquatic gymnastics, and aqua tae-bo.

Results. After participation in the exercise program: vital capacity increased from 45.96 ± 4.69 to 48.88 ± 0.68 ; strength index increased from 35.80 ± 1.07 to 43.26 ± 0.71 ; Robinson's index increased from 85.72 ± 12.34 to 89.63 ± 10.11 ; Shtange test increased from 30.28 ± 10.32 to 37.78 ± 12.34 ; Hench test changed from 16.48 ± 4.24 to 25.19 ± 4.58 ; Kerdo index decreased from 5.23 ± 0.74 to 0.88 ± 0.38 ; and Rufier's test decreased from 12.21 ± 4.26 to 8.03 ± 2.14 . The assessment of somatic health of the women showed a significant improvement ($p < 0.05$). Positive changes in the autonomic system were detected.

Conclusion. The developed aquafitness program can be an effective tool for health improvement and body weight management in early adulthood women.

Keywords: women, early adulthood, physical condition, aquafitness.

Introduction

In today's environment, interest in fitness training is constantly growing (Bocalini et al., 2008; Kenny et al., 2011; Persaki et al., 2016). Physical activity allows you to stay

in good shape, to strengthen and maintain health, and to be confident, and thus to lead a full life, to be in harmony with yourself and the world around you. In this situation, the range of means of health-enhancing physical activities are being expanded and new fitness programs and technologies are being developed (AEA, 2010; Andrieieva et al., 2019; Saavedra et al., 2007; Yelizarova et al., 2020).

© Kashuba, V., Andrieieva, O., Hakman, A., Grygus, I., Smoleńska, O., Ostrowska, M., Napierała, M., Hagner-Derengowska, M., Muszkieta, R., Zukow, W., 2021.

Currently, assessment of the level of physical condition (LPC) in early adulthood women and ways to improve it are the subject of numerous studies (AEA, 2010; Andrieieva et al., 2020; Avelar et al., 2010; Bocalini et al., 2010; Broman et al., 2006). An analysis of recent publications about the impact of fitness training on a woman's body showed that the development of the field of recreation and health-enhancing physical activities now cannot do without a scientifically sound implementation of modern innovative technologies in the fitness industry (Colado et al., 2009; Kashuba, Andrieieva, 2006; Salnykova et al., 2017; Yarmak et al., 2017; Gozhenko et al., 2018a; Gozhenko et al., 2018b).

Researchers on physical education believe that the amount of physical activity (PA) per week should be 6-10 hours for people over 25 years, 10-14 hours for people aged 18-25, 14-21 hours for schoolchildren, and 21-28 hours for preschoolers (Garber et al., 2011; Schuch, et al., 2014). The WHO data demonstrated that adults aged 18-64 years should do at least 150-300 minutes of moderate-intensity aerobic physical activity; or at least 75-150 minutes of vigorous-intensity aerobic physical activity; or an equivalent combination of moderate- and vigorous-intensity activity throughout the week (WHO, 2020).

As noted by many experts in the field (Drozdovska et al., 2020; Rýžková et al., 2018; Goncharova et al., 2020; Khimenes et al., 2016, Petrenko, et al., 2016), it is crucial to consider such factors as professional activity and health status when designing health-enhancing exercise routines for early adulthood women. Furthermore, the methods of exercise prescription for women should be based on the principle of biological rationale that determined by the characteristics of a woman's body. Health-enhancing programs for women differ not only in the parameters of physical exercise, but also in the objectives and effectiveness. The studies of the impact of various exercise programs are relevant and the least developed to date (Cadore et al., 2011; Hakman et al., 2019; Balatska et al., 2020).

Health-enhancing aquafitness programs are the most popular among women. It has been reported (Urbanová et al., 2010; Kashuba et al., 2020, Yarmak et al., 2018) that water exercise can positively affect the functional state of the musculoskeletal system, development of the respiratory system, and psycho-emotional state. Furthermore, recently there has been observed a growing interest of women interest in aquafitness as a means to recover strength, maintain good athletic performance, and health.

Nevertheless, despite the significant amount of data on the effectiveness of aquatic exercise training using recreational swimming, there are virtually no studies for assessing the impact of training programs involving the use of innovative aquafitness exercise for women 21-35 years with average physical condition.

The objective of this study was to evaluate the health-enhancing effects of an aquafitness program on the functional indicators and physical fitness of early adulthood women.

Materials and methods

Study participants

The study involved 48 women aged 21-31 with an average age of 26.3 years, who had different exercise experience. Before the study, none of the subjects were engaged in aquafitness training. All the women were healthy. During the

study, the subjects were engaged only in aquafitness training and did not perform any other physical activity. Prior the beginning of the study, participants completed a questionnaire for health history and physical activity, and signed informed consent forms.

Study organization

Vital capacity of the lungs was measured with a dry spirometer according to the commonly used procedures. Hand muscle strength was assessed by the measurement of grip strength with a hand dynamometer. In addition, depending on the objectives, common indicators of the morpho-functional status of the body were used such as Kerdo index, Shtange test, Ruffier test, Hench test, strength index, vital capacity (mL/kg), index of functional changes (by R. Bayevsky), and Quetelet index.

Index of functional changes by R. Bayevsky were calculated using the following equation:

$$IFC \text{ (arb. un.)} = 0.011 \times HR + 0.014 \times BPSy + 0.008 \times BPdi + 0.014 \times A + 0.009 \times BW - 0.009 \times H - 0.27,$$

where HR is heart rate in bpm, BPSy is systolic and BPdi is diastolic blood pressure in mmHg, A is age in years, BW is body weight in kg, and H is height in cm. The functional adaptation of the cardiovascular system in adult persons is then classified as follows: satisfactory adaptation < 2.59, tension of adaptation mechanisms – 2.60-3.09, unsatisfactory adaptation – 3.10-3.49, and failure of adaptation – 3.50.

To indirectly assess body fat, the Quetelet index calculated as a ratio between body weight (in g) and height (in cm) was used.

The study was conducted at the Sport Life fitness club, Chernivtsi. The subjects took part in a six-month aquafitness program consisting of 60-minute sessions, three times a week. The program was developed by the authors and included aquatic stretching, body shaping and bodybuilding exercise, aquadance, aquatic gymnastics, and aqua tae-bo. The training program included aerobic, strength, and mixed type exercises, which have diverse effects on the body systems of the subjects. The water temperature was kept at 28 °C. When designing the program routine, we followed the recommendations of the authors of previous studies (Bocalini et al., 2010; Khimenes et al., 2016; Yarmak et al., 2017). The training session had the traditional structure and consisted of warm-up, main part, and cool-down. The warm-up part included basic movements and combinations for warming up, pre-workout stretching and cardiorespiratory warm-up (e.g., running, punches, kicks, and jumps in various directions and planes). The main part consisted of strength endurance exercises for major muscle groups (exercises of aqua aquatic stretching, body shaping and bodybuilding exercise, aquadance, aquatic gymnastics, and aqua tae-bo) performed at moderate intensity in the aerobic training zone. The intensity of exercise was corresponding to the target heart rate zone for health-enhancing training for this gender and age group. The cool-down phase consisted of exercises to restore breathing and relaxation.

Statistical analysis

The results of the study were subjected to statistical data analysis using conventional tools of Statistica 10.0 statistical software (StatSoft, Inc., USA). With an average sample size

($30 \leq n \leq 100$), the normality of the distribution was tested by several methods including the Shapiro-Wilk test as well as asymmetry and excess kurtosis. One-dimensional statistical analysis, which involved calculating the arithmetic mean (M) and standard error (SE), was applied in the research. The significance of the difference (p) according to Student's t-test (t) was used to assess the effects of exercise program on the physical condition of participants. The significance for all statistical tests was set at $p \leq 0.05$.

Results

To study the health-enhancing effects of aquafitness on the body of early adulthood women, we used the criteria of effectiveness of health-enhancing physical exercise including such important ones as an increase in the functional reserves of the body. Thus, after the implementation of the developed health-enhancing program of aquafitness classes for early adulthood women, its effectiveness was evaluated by the comparative assessment of the functional status of participants at the beginning and at the end of the study.

Assessment of the women showed that they had an average or below average level of most indicators of morpho-functional status and physical condition at the beginning of the study (Table 1). Therefore, all subjects were allowed to participate in the exercise program without significant restrictions.

The data presented in the Table 1 demonstrated a positive effect of participation in the exercise program on the pa-

Table 1. Changes in somatic health of early adulthood women participated in the aquafitness program ($n = 48$)

Parameter	Statistics			
	at the beginning		at the end	
	M	SE	M	SE
Vital capacity, mL·kg ⁻¹	45.96	4.69	48.88	0.68*
Strength index, %	35.80	1.07	43.26	0.71*
Robinson index, arb. units	85.72	12.34	89.63	10.11
Shtange test, s	30.28	10.32	37.78	12.34
Hench test, s	16.48	4.24	25.19	4.58*
Kerdo index, arb. un.	5.23	0.74	0.88	0.38*
Ruffier test, arb. un.	12.21	1.26	8.03	2.14*

Note: * – $p < 0.05$

rameters of somatic health of early adulthood women. These findings indicate the need of early adulthood women for the training of the respiratory system, which can be achieved by including special exercises in aquafitness training. Results of the Shtange and Hench tests also confirmed improved function of the respiratory system after the end of the program.

The strength index was increased from $35.80 \pm 1.07\%$ to $43.26 \pm 0.71\%$ at the end of the study.

It is known that prescribing the appropriate volume of exercise should be based on the data of the functional assessment of the cardiovascular system. For this purpose, the Robinson index was used. This index amounted to 85.72 ± 12.34 arb. un. at the beginning of the study. This corresponds to an average level and confirms the fact that there were no contraindications related to health status for participation in the health-enhancing exercise program. After the aquafitness

training, the Robinson index was found to improve to 89.63 ± 10.11 arb. un. that corresponds to a high level of function of cardiovascular system.

It is known that the ratio of heart rate to blood pressure remains constant in the normal conditions. Based on this pattern, the Kerdo index was proposed for assessing the state of the autonomic nervous system. The values of this index greater than zero indicate the sympathetic predominance in the cardiovascular regulation, the values less than zero indicate the parasympathetic predominance, and the value that is equal to zero indicates functional equilibrium. The average value of the Kerdo index was 5.23 ± 0.74 at the beginning and changed to 0.88 ± 0.38 after participation in the exercise program.

Another measure used to evaluate the effectiveness of our program was the Ruffier index. An average value of the Ruffier index (12.21 ± 1.26 arb. un.) at the beginning of the study indicates a low adaptation of the cardiovascular system to the exercise in the absence of pathology. This may be explained by hypodynamia and a sedentary lifestyle. After participation in the program, the Ruffier index improved by 4.18 arb. un.

The normal range of the index is 325–365 g/cm for women of this age group. According to the Quetelet index, 70.8% of subjects had a normal body weight, 20.8% were overweight, and 8.3% were obese at the beginning of the study. The values of the Quetelet index improved after exercise training: 79.2% of women had a normal body weight and only 20.8% (5 subjects) were overweight.

The functional assessment of the cardiovascular system was conducted using the following parameters: heart rate at relative rest, blood pressure, and adaptive capacity (AC) of the circulatory system according to R. Bayevsky (Table 2). Heart rate and blood pressure values of all the subjects were in the normal range for this age group. At the end of the study, the group average value of the IFC was changed from 2.72 ± 1.01 to 2.55 ± 0.92 . The changes in the distribution of early adulthood women by the index of functional changes is shown in Table 2.

The positive changes in the physical condition of early adulthood women (Table 3) confirm the effectiveness of the training program.

Table 2. Distribution of early adulthood women by the index of functional changes (by R. Bayevsky), % ($n = 48$)

Group	Level of adaptation	at the beginning	at the end
I	Satisfactory adaptation	8.33	62.50
II	Tension of adaptation mechanisms	75.00	33.33
III	Unsatisfactory adaptation	12.50	4.17
IV	Failure of adaptation	4.17	0.0

Table 3. Distribution of early adulthood women by the level of physical condition by O. Pirogova, % ($n = 48$)

Level of physical condition	at the beginning	at the end
Low	4.17	0.0
Lower than average	25.00	4.17
Average	29.17	12.50
Higher than average	25.00	50.00
High	16.67	33.33

Table 4. Changes in physical fitness of early adulthood women participated in the aquafitness program (n = 48)

Test	Statistics			
	at the beginning		at the end	
	M	SE	M	SE
Standing long jump, cm	148.7	5.6	158.4	6.1*
Sit-up test for 30 s, number of reps	25.7	2.1	42.3	4.6*
Sit and reach flexibility test, cm	5.08	1.2	16.4	1.4*
Push-up test, number of push-ups performed during 30 s	11.5	2.1	15.9	4.2*

Note: * – p < 0.05

The comparative assessment of physical fitness and physical condition of the subjects demonstrated a significant increase in the parameters of physical fitness in the studied sample of women compared to the beginning of the aquafitness program (Table 4). For example, the average result of the women in the standing long jump test that measures explosive force production of the thigh muscles was 148.7 ± 5.6 cm at the beginning of the study. After participation in the aquafitness training, the indicator of explosive power improved by 9.7 cm.

The strength endurance of the abdominal muscles significantly improved after participation in the aquafitness program compared to the beginning of the study. Furthermore, their flexibility was significantly improved. Similar changes were observed in the number of push-ups performed during 30 s (push-up test).

Taken together, these results indicate that the aquafitness program had a positive effect on the physical fitness of all the women, thus demonstrating the effectiveness of the developed program of water exercise.

Discussion

The analysis of special literature showed that exercise in the aquatic environment such as aquafitness and its varieties (aquatic stretching, body shaping and bodybuilding exercise, aquadance, aquatic gymnastics, and aqua tae-bo) are among the most popular types of fitness training because of their availability, emotionality, and effectiveness. However, when analyzing available literature there are few data on health-enhancing effects of aqua fitness in early adulthood women.

The data of this study on the positive effects of aquafitness training on a woman's body are in agreement with previous findings (Bocalini et al., 2010; Goncharova et al., 2020). Assessment of parameters of somatic health of women aged 21-31 years showed a significant improvement (p < 0.05) in functional status of the cardiorespiratory system and autonomic nervous system, anthropometry measurements, working capacity and physical condition.

The beneficial effects of aquatic exercise training on the functional state of the cardiovascular system of women was further confirmed, including the economization of the functions and increase in the level of functional fitness of the cardiovascular system. The knowledge on the health-improving potential of innovative aquafitness exercise was further advanced.

The results of breath holding tests demonstrated an improvement in the function of the respiratory system of early

adulthood women at the end of the program that resulted from the increased body's ability to utilize oxygen.

Conclusion

Our data extend and supplement the knowledge on the positive effects of aquafitness on the body of early adulthood women manifested as significantly improved adaptation mechanisms and physical condition.

Positive changes in body weight of the women also observed that is the main reason for choosing aquafitness training as a recreational and health-enhancing type of physical activity. The aquafitness training also stabilized the values of functional indicators of the cardiovascular system of early adulthood women. The developed program may contribute to health improvement and body weight management of early adulthood women.

Further research should focus on the development of science-based physical exercise training programs for women who want to improve their physical condition through the use of novel training equipment.

Conflict of interest

The authors declare that there is no conflict of interest that could be perceived as interfering with publication of the article.

Funding sources

This study has not received any financial support from any government, community or commercial organization.

Ethical Approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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ВПЛИВ ТРЕНУВАНЬ З АКВАФІТНЕСУ НА ФІЗИЧНИЙ СТАН ЖІНОК РАНЬОГО ЗРІЛОГО ВІКУ

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Авторський вклад: А – дизайн дослідження; В – збір даних; С – статаналіз; D – підготовка рукопису; Е – збір коштів
Реферат. Стаття: 6 с., 4 табл., 30 джерел.

Метою цього дослідження було оцінити оздоровчий вплив програми аквафітнесу на функціональні показники та фізичну підготовленість жінок раннього зрілого віку.

Матеріали і методи. Використовувалися теоретичний аналіз та узагальнення науково-методичної літератури, антропометричні прийоми, педагогічні методи та методи математичної статистики. Функціональний стан організму оцінювали за загальнозовживаними показниками, що характеризують функцію кардіореспіраторної системи. Дослідження проводилось у фітнес-клубі Sport Life, м. Чернівці. У дослідженні взяли участь 48 жінок у віці 21-31 років із середнім віком 26,3 року. Випробовувані брали участь у шестимісячній програмі аквафітнесу, яка складалася із 60-хвилинних занять тричі на тиждень. Програма була розроблена авторами і включала водне розтягування, формування тіла та вправи для бодібілдингу, акваданс, водну гімнастику та аква-тае-бо.

Результати. Після участі у програмі вправ: життєва ємність зросла з $45,96 \pm 4,69$ до $48,88 \pm 0,68$; показник міцності збільшився з $35,80 \pm 1,07$ до $43,26 \pm 0,71$; Індекс Робінсона зріс з $85,72 \pm 12,34$ до $89,63 \pm 10,11$; Тест Штанге збільшився з $30,28 \pm 10,32$ до $37,78 \pm 12,34$; Тест Генча змінено з $16,48 \pm 4,24$ на $25,19 \pm 4,58$; Індекс Кердо зменшився з $5,23 \pm 0,74$ до $0,88 \pm 0,38$; а тест Руф'єра зменшився з $12,21 \pm 4,26$ до $8,03 \pm 2,14$. Оцінка соматичного здоров'я жінок показала значне поліпшення ($p < 0,05$). Виявлено позитивні зміни у вегетативній системі.

Висновок. Розроблена програма аквафітнесу може бути ефективним інструментом для поліпшення здоров'я та управління масою тіла у жінок раннього зрілого віку.

Ключові слова: жінки, ранній зрілий вік, фізичний стан, аквафітнес.

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Cite this article as: Kashuba, V., Andrieieva, O., Hakman, A., Grygus, I., Smoleńska, O., Ostrowska, M., Napierała, M., Hagner-Derengowska, M., Muszkieta, R., & Zukow, W. (2021). Impact of Aquafitness Training on Physical Condition of Early Adulthood Women. *Teoriâ ta Metodika Fizičnogo Vihovannâ*, 21(2), 152-157. <https://doi.org/10.17309/tmfv.2021.2.08>

Received: 13.04.2021. Accepted: 18.05.2021. Published: 25.06.2021

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ORIGINAL SCIENTIFIC ARTICLE

DIFFERENTIATION OF PHYSICAL LOADS IN FEMALE STUDENTS OF DIFFERENT MOTOR AGES

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Accepted for Publication: May 25, 2021

Published: June 25, 2021

DOI: 10.17309/tmfv.2021.2.09

Abstract

Purpose: To develop and evaluate the impact of a program of sectional recreational aerobics classes, taking into account the differentiation of physical loads in female students of different motor ages.

Materials and Methods. Participants: In the ascertaining experiment, 145 second-year female students were examined, in the formative experiment – 42 female students.

The following indicators were measured: biological age (years) using V. P. Voitenko's method (1991), motor age (years) and the general level of physical conditions (points), heart rate (bpm), heart rate recovery time after 20 squats in 30 s (min, s), the level of physical health (points), physical activity index (c. u.), the level of general physical working capacity (PWC_{170} , $\text{kgm} \cdot \text{min}^{-1}$); $\text{VO}_2 \text{ max}$ ($\text{ml} \cdot \text{kg} \cdot \text{min}^{-1}$) – maximal oxygen consumption. The level of motor qualities development: 2,000 m run (min, s), 4×9 m shuttle run (s), standing long jump (cm), sit-ups in 1 min (times), push-ups (times), seated forward bend (cm).

Results. The study developed and tested an experimental program of recreational aerobics classes, taking into account a differentiated approach to dosing physical loads in female students of different motor ages. Data factorization revealed a rational combination of means for developing motor qualities: strength endurance – 15.88%, dynamic strength – 12.86%, speed and strength endurance – 8.72%, static endurance – 17.87%, flexibility – 12.69%, speed abilities – 14.66%, and coordination abilities – 17.32%. The study found a moderate negative correlation between motor age and the level of physical health ($r = -0.68$ at $p < 0.01$). Three levels of motor age with respect to the levels of physical health were identified.

Conclusions. Taking into account female students' motor age during recreational aerobics classes ensures optimal motor activity and increases the level of physical fitness.

Keywords: motor age, differentiated approach, recreational aerobics, motor qualities, dosage.

Introduction

More and more studies are focusing on scientific substantiation of forms, methods and content of physical education in higher educational institutions. The key goals here are to increase its efficiency (Kondakov et al., 2018) and the level of physical condition (Thorburn et al., 2019; Solohubova et al., 2020; Chernenko et al., 2020), to maintain students'

health (Wrench, 2019). Examination of the level of students' physical condition while studying at higher educational institutions shows a steady tendency towards its deterioration. (Krutsevykh & Bezverkhnia, 2010).

Our scientific inquiry was based on studies which prove that female students' biological age (Markina, 2001) and motor age (Borodulina, 2014; Vavilova et al., 2008) are almost twice their passport one.

The reasons given for this are:

- insufficient physical activity of students while studying at higher educational institutions (Vavilova et al., 2008; Gillis et al., 2013);

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- reduced number of hours of physical education (Burner et al., 2019);
- lifestyle (Tambalis et al., 2019);
- insufficient effectiveness of the existing system of physical education (Malinauskas et al., 2018).

Researchers studied the criteria of differentiation in physical education of students in various aspects, namely:

- combination of recreational training means in accordance with the level of morphofunctional state (Averyanova et al., 2018);
- dosage of physical loads according to the body functional and physical capabilities (Chacon-Cuberos et al., 2018);
- taking into account physical condition, rates of biological development (Bondarchuk, 2012);
- taking into account students' psychophysical state (Il'nytska et al., 2016);
- taking into account the female body biological features (Bogdanovskaya et al., 2014).

The study of physical education curricula of higher educational institutions and analysis of literature which describes the degree of impact of physical education classes on the development and improvement of students' physical qualities revealed contradictions. Some researchers observed a positive effect of classes on students' physical fitness, and some studies point out insufficient effectiveness of the existing program (Sobyanin et al., 2016).

Kondakov et al. (2018), Gonzalez-Valero et al. (2019) note that today's organization of physical education is not effective enough to increase the level of physical fitness, health, motivation, to develop professionally important psychophysical qualities and interest of a large number of students in physical exercises and sports.

However, a lot of studies on optimization of students' physical education do not describe all possible ways to improve it (Bondarchuk, 2012; Sazanova et al., 2017). We have not found any studies investigating a differentiated approach to dosing physical loads in physical education of female students of different motor ages.

In our opinion, the distribution of students in physical education classes by their level of motor age is the most accessible method that does not require special equipment. This method makes it possible to optimize the assessment of the level of physical condition and to effectively dose physical load in female students with different physical fitness.

The analysis of studies shows that there are a great number of opinions on solving the problem of deterioration of students' physical health (Borodulina, 2014; Averyanova et al., 2018). Therefore, our study aimed to solve the problem of successful physical development of female students with the use of sectional recreational aerobics classes, taking into account a differentiated approach to dosing physical loads.

Hypothesis. The study assumed that the introduction of a differentiated approach to dosing physical loads for female students of different motor ages would lead to positive dynamics and optimization of their physical condition.

Purpose. To develop and evaluate the impact of a program of sectional recreational aerobics classes, taking into account the differentiation of physical loads in female students of different motor ages.

Material and Methods

Study participants

In the ascertaining experiment, 145 second-year female students were examined. For health reasons, they were included in a basic and a preparatory medical groups.

In the formative experiment, 42 participants were selected. They were divided into two groups – a control group (CG) (20 girls) and an experimental group (EG) (22 girls).

Study organization

The female students' physical development was assessed by the following indicators: biological age (years) using Voitenko's method (1991), motor age (years) and the general level of physical conditions (points) (Vavilova et al., 2008), heart rate (determined by palpation, bpm), heart rate recovery time after 20 squats in 30 s (min, s), the level of physical health (points) (Belous et al., 2005; Krutsevych et al., 2011), physical activity index (c. u.) (Sazanova et al., 2017). The study also measured: the level of general physical working capacity (PWC_{170} , kgm min^{-1}) – an integral indicator of the body physical condition; $\text{VO}_2 \text{ max}$ ($\text{ml} \cdot \text{kg} \cdot \text{min}^{-1}$) – maximal oxygen consumption – an indicator of the body aerobic endurance (Malikov et al., 2006).

Tests for assessing the development of motor qualities were selected taking into account the physical education program for students of higher educational institutions (Kurochenko, 2004). The study recorded the results of all the participants in the following tests: 2,000 m run (min, s), 4×9 m shuttle run (s), standing long jump (cm), sit-ups in 1 min (times), push-ups (times), seated forward bend (cm).

At the first stage, the ascertaining experiment was conducted to determine the impact of physical education classes on the parameters under study. Also, factor analysis was performed to find a rational combination of physical education means for developing motor qualities in female students.

The formative experiment used the annual educational cycle (macrocycle), which is divided into 2 periods corresponding to I – fall-winter and II – winter-spring semesters. Each macrocycle, in its turn, consists of 2 mesocycles (modules) lasting 8 weeks. The mesocycles were based on 4-week microcycles.

During extracurricular sectional classes (twice a week), all the female students were engaged in recreational aerobics. During classes, the CG participants' motor age was not taken into account. Physical load was the same for all the students. For the EG participants, a differentiated approach was used; load was dosed taking into account their motor age.

Motor age was calculated using Vavilov's method (1997) "Test Yourself": in Table 1 of age assessment standards, we find the age corresponding to your result in each test, sum up all the found values of ages and divide by the number of tests. The resulting number is your motor age.

Table of age assessment standards (Table 1), where: P – push-ups, times; J – standing long jump, cm; S – sit-ups, times; H – bar hang, s; B – seated forward bend, cm.

The first period of the macrocycle (fall-winter semester) began in September, lasted 17 weeks and consisted of 2 mesocycles (modules): preparatory (4 weeks) and main (basic) (13 weeks). The second period (winter-spring semester) lasting

Table 1. Table of age assessment standards for women (Vavilov, 1997)

Age	Results of tests				
	P	J	S	H	B
7	8	104	12	6	6
8	9	120	13	9	7
9	10	132	14	12	8
10	11	142	15	15	9
11	12	152	16	19	10
12	13	160	17	23	11
13	14	167	18	27	12
14	14	173	19	31	12
15	15	177	20	35	13
16	16	180	21	39	13
17	16	180	21	41	13
18	16	178	21	42	13
19	16	176	20	41	13
20	15	172	19	39	12
21	15	167	18	35	12
22	15	161	17	30	11
23	14	155	16	25	10
24	14	149	14	22	9
25	13	143	12	19	8
26-29	11	137	10	16	7
30-34	9	131	8	13	6
35-39	7	125	6	11	5
40-44	5	120	5	9	4
45-49	3	115	4	8	3
50-54	2	110	3	7	2
55-59	1	105	2	6	1
60-64	1	100	2	5	1
>65	1	95	2	4	1

16 weeks began in February and consisted of mesocycles: preparatory (4 weeks) and main (basic) (12 weeks).

Pedagogical control of the level of physical condition, motor age, and physical fitness of the female students was carried out at the beginning and end of the academic year. To control the correction of the training program, the indicators of motor age, physical health, and physical fitness were measured at the end of each module (mesocycle).

Statistical Analysis

The study materials were processed by the statistical analysis software - IBM SPSS 20. The study used the analysis of variance techniques with the calculation of the arithmetic mean ($\bar{X}$); standard deviation (s); non-sampling error (standard error) (S); Student's t -test; Pearson's goodness-of-fit test (χ^2) (Chi-square) – a statistical test used to verify the hypothesis that the observed random variable obeys a certain theoretical distribution law; Spearman's rank correlation coefficient (r). In testing the validity of $p = 0.95$, significance levels of < 0.05 ; < 0.01 ; < 0.001 were taken as a basis.

To determine the structure of the female students' physical condition, factor analysis was conducted. The factor analysis used a principal component analysis model with the rotation method: Varimax with Kaiser normalization.

Results

Data factorization of the ascertaining experiment using the Varimax method of orthogonal rotation of the primary matrix with Kaiser normalization identified 9 factors that describe the structure of the female students' physical condition (Table 2).

The most significant factor is the one described by a group of variables which characterize the degree of development of basic motor qualities (motor age, shoulder muscle static endurance, shoulder muscle strength endurance, dynamic strength – 13.62% of data variance). The second factor (8.99%) describes the frequency of diseases and self-assessment of health (according to V. P. Voitenko). The third factor (10.41%) describes anthropometric indicators. The fourth factor (6.67%) describes the indicators of systolic and diastolic blood pressure, which directly affect the presence or absence of arterial hypertension or hypotension, respectively. The fifth factor (5.57%) determines the indicators of heart rate at rest and after exercise (recovery time). The sixth factor (9.84%) describes the characteristics of training experience, assessment of attitude towards a healthy lifestyle, and flexibility. The seventh factor (5.19%) characterizes reaction time and physical activity index. The eighth factor (5.56%) describes the indicators of age and static balance. The ninth factor (3.2%) is theoretical knowledge.

Based on factor analysis, a rational combination of means for developing motor qualities in female students was determined (Fig. 1).

The results of statistical analysis using the non-parametric test Spearman's rank correlation coefficient showed a moderate negative correlation between the level of physical health and motor age $r = -0.68$ at $p < 0.01$.

The results of correlation analysis suggest that a decrease in motor age indicators will help increase the level of physical health.

The current realities of physical education in higher educational institutions make it impossible to allocate time during PE classes for assessing the level of students' physical condition. This is due to collecting and analyzing a fairly large number of indicators, even with the use of rapid methods and the availability of additional equipment (height meter, medical scales, spirometer, blood pressure meter, etc.).

We proposed a differentiated dosage of physical loads according to motor age on the basis of the discovered statistically significant relationship between motor age and the level of physical health.

As a result of experimental data ranking, we identified three levels of motor age with respect to the level of physical health.

Motor age deviations from calendar age from 0 and less to 11 years are characteristic of a "safe" level of motor age, which includes female students with a very high and high level of physical health.

Female students whose motor age is 12 years ± 1 year older than their calendar one are in a "borderline" zone and have an average level of physical health.

If motor age exceeds calendar age by 13 years, it can be concluded that the body is in a "dangerous" zone.

The ascertaining experiment showed that in the EG, 50% ($n = 11$) of the female students have the dangerous level of motor age, 18.2% ($n = 4$) – the borderline level, and 31.8% ($n = 7$) – the safe level of motor age.

Table 2. Factor structure of the female students' physical condition. Principal component analysis with Varimax rotation and Kaiser normalization (n = 145) [$r > 0.3$]

Variables	Component								
	1	2	3	4	5	6	7	8	9
Age	0.150	0.101	0.058	0.235	0.037	0.096	-0.210	0.610	0.220
Body mass	-0.435	0.109	0.568	0.375	-0.034	0.170	-0.231	0.084	-0.055
Body height	-0.226	0.014	0.662	-0.022	0.024	-0.011	0.287	-0.020	0.116
Heart rate	-0.028	-0.060	-0.088	0.000	0.801	-0.125	0.047	0.130	-0.040
Systolic blood pressure	-0.096	0.043	0.134	0.851	0.135	0.086	0.010	-0.021	-0.053
Diastolic blood pressure	-0.068	0.156	0.085	0.823	0.038	-0.179	0.035	0.085	-0.039
Lung capacity	-0.017	-0.038	0.794	0.017	-0.026	-0.050	-0.086	0.043	-0.099
Training experience	-0.025	-0.128	0.035	-0.043	0.035	0.762	-0.008	0.067	-0.039
Cold-related illnesses per year	-0.124	0.700	0.039	-0.005	0.188	-0.183	0.155	0.225	0.031
Chronic conditions	-0.065	0.793	-0.020	0.069	0.045	0.101	-0.034	-0.134	0.139
Dynamometry	0.214	0.051	0.584	0.303	0.023	0.100	0.052	0.082	0.104
Heart rate recovery time after 20 squats	-0.004	0.305	-0.002	0.137	0.657	0.197	0.035	-0.225	0.119
Static balance	0.155	0.033	-0.064	.079	0.026	0.025	-0.187	-0.781	0.131
Reaction time	0.049	0.001	-0.071	-0.122	-0.088	0.024	-0.661	-0.013	-0.052
Assessment of attitude towards a healthy lifestyle	-0.167	-0.185	-0.248	-0.016	-0.092	0.469	0.118	-0.230	0.416
Self-assessment of health	-0.047	0.756	0.022	0.135	0.020	-0.074	0.030	0.010	-0.094
Theoretical knowledge	0.127	0.114	0.077	-0.093	-0.014	-0.126	-0.081	0.024	0.801
Physical activity index	0.062	0.102	-0.019	-0.085	-0.139	0.029	0.637	0.024	-0.102
Strength endurance	0.716	-0.082	-0.076	0.107	-0.084	-0.051	-0.265	-0.065	0.108
Dynamic strength	0.580	-0.240	0.211	-0.178	0.021	0.057	0.251	0.122	0.197
Speed and strength endurance	0.393	-0.220	-0.017	0.093	-0.127	0.349	0.108	0.327	0.391
Static endurance	0.806	0.004	-0.091	-0.172	0.066	-0.128	0.045	-0.071	-0.099
Flexibility	0.215	0.333	0.154	-0.022	-0.277	0.572	-0.046	0.014	-0.200
Motor age	-0.910	0.009	0.065	0.022	0.137	-0.210	-0.024	-0.033	-0.054
VO2 max	0.120	-0.183	-0.202	-0.155	-0.593	0.179	0.298	0.013	0.190
total variance	3.41	2.45	2.61	1.67	1.39	2.46	1.30	1.39	0.80
variance, %	13.62	8.99	10.41	6.67	5.57	9.84	5.19	5.56	3.20

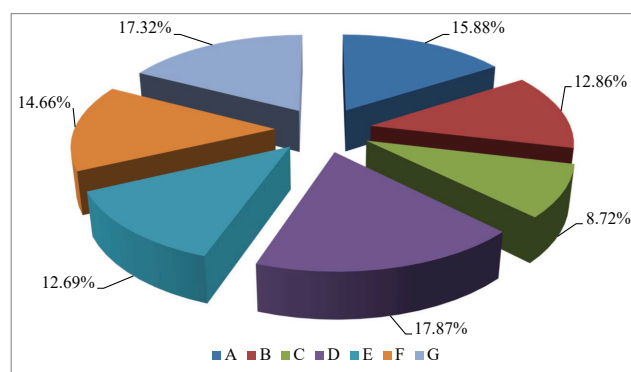


Fig. 1. Rational combination of physical education means for developing motor qualities in female students: A – strength endurance; B – dynamic strength; C – speed and strength endurance; D – static endurance; E – flexibility; F – speed abilities (reaction time); G – coordination abilities (static balance)

The obtained data confirmed the need to correct the female students' physical condition. The results served as the basis for developing a program of sectional recreational aerobics classes, taking into account a differentiated approach to dosing physical loads for female students of different motor ages.

The intensity of classes was regulated taking into account the level of motor age. The dosage of the amount and intensity of physical exercises was achieved by a certain number of repetitions, the pace of performance, changes in stance width, the use of long and short levers, changes in starting positions, and the way of performing exercises, a rational alternation of the time of load and rest, the use of various objects and apparatuses, music, words, means of visual impact on the female students' bodies.

Taking into account the individual level of motor age, the students were lined up in two ranks during the class, so that the instructor could differentiate physical load:

- first rank – students with the “dangerous” level of motor age;
- second rank – students with the “borderline” and “safe” level of motor age.

The trainees' activities were organized frontally (everyone performs exercises at the same time) and individually (independent performance of the task under the instructor's guidance).

The program of sectional recreational aerobics classes, taking into account a differentiated approach to dosing physical loads in female students with different levels of motor age has the following peculiarities:

- for students with the “dangerous” level of motor age – the intensity is 30-35% of maximal oxygen consumption, the step platform height is 15 cm without the inclusion of arm movements and the use of swing movements, the number of repetitions of strength exercises is 25-30% of the maximum, the dumbbell weight is 0.5-1 kg;
- for students with the “borderline” level of motor age – the intensity is 35-40% of maximal oxygen consumption, the step platform height is 15 cm with the inclusion of simple movements of arms, without raising them above shoulder level and using swing movements, the number of repetitions of strength exercises is 35-40% of the maximum, the dumbbell weight is 1-1.5 kg;
- for students with the “safe” level of motor age – the intensity is 45-50% of maximal oxygen consumption, the step platform height is 15 cm with the inclusion of simple arm movements and the use of swing movements, the number of repetitions of strength exercises is 40-45% of the maximum, the dumbbell weight is 1.5 kg.

The duration of classes was 80 minutes. The tempo of music was 118-122 beats per minute. The training zone of heart rate with the “dangerous” level of motor age was 100-115 bpm⁻¹, with the “borderline” level – 110-125 bpm⁻¹, and with the “safe” one – 120-140 bpm⁻¹.

The initial comparative analysis of indicators proved a relative homogeneity of the control group and the experi-

mental group. This became the basis for an objective assessment of the program we developed.

The repeated determination of indicators revealed the following. By the end of the formative experiment, the EG students had significantly higher ($p < 0.05$; $p < 0.01$ and $p < 0.001$) values of practically all parameters of the level of physical condition, motor age, physical fitness than the CG students (Table 3).

So, the indicators of heart rate decreased by 6.77% ($p < 0.01$), heart rate recovery time after 20 squats in 30 s by 19.81% ($p < 0.05$), biological age by 11.21 %, and motor age by 28.72% ($p < 0.001$), PWC₁₇₀ by 7.3% ($p < 0.05$); physical activity index increased by 8.06% ($p < 0.05$), maximal oxygen consumption by 2.17%.

The general level of physical conditions changed from satisfactory to good ($p < 0.001$) (Table 4).

There was a significant increase in the level of dynamic strength ($p < 0.01$), speed and strength endurance of the abdominal muscles ($p < 0.001$), flexibility ($p < 0.05$), strength endurance ($p < 0.01$), static endurance ($p < 0.01$). The time of overcoming the 2,000 m distance decreased by 3.15%, and dexterity by 2.54%.

The average score of the level of physical health changed ($p < 0.001$) from an average (3.33 ± 0.12) to a high (4.15 ± 0.11) level with a relative increase in the result by 19.76%.

At the beginning of the formative experiment, 50% ($n = 11$) of the female students had the “dangerous” level of motor age, 18.2% ($n = 4$) had the “borderline” level, and

Table 3. Comparative assessment of the studied indicators in the experimental group (EG $n = 22$) and the control group (CG $n = 20$) female students

Indicators		Beginning of academic year	End of academic year	t	p
		$\bar{x} \pm S$	$\bar{x} \pm S$		
Age, years	EG	18.04 ± 0.14	18.44 ± 0.10	2.32	<0.05
	CG	18.00 ± 0.19	18.39 ± 0.12	1.74	>0.05
Biological age, years	EG	34.92 ± 1.79	31.40 ± 1.09	1.68	>0.05
	CG	32.46 ± 1.61	30.50 ± 1.30	0.95	>0.05
Motor age, years	EG	30.16 ± 1.16	23.43 ± 0.57	5.21	<0.001
	CG	29.39 ± 1.02	27.26 ± 1.07	1.44	>0.05
Heart rate, bpm ⁻¹	EG	75.68 ± 1.20	70.88 ± 0.99	3.09	<0.01
	CG	76.11 ± 1.80	70.00 ± 1.70	2.47	<0.05
Heart rate (recovery time), min	EG	2.54 ± 0.14	2.12 ± 0.12	2.28	<0.05
	CG	2.42 ± 0.22	2.32 ± 0.18	0.35	>0.05
Physical health, points	EG	3.33 ± 0.12	4.15 ± 0.11	5.04	<0.001
	CG	3.24 ± 0.09	3.76 ± 0.11	3.66	<0.001
PWC ₁₇₀ , kg•m ⁻¹ •min ⁻¹	EG	604.14 ± 13.41	651.74 ± 19.73	2.01	<0.05
	CG	637.92 ± 20.39	683.95 ± 16.81	1.74	>0.05
Maximal oxygen consumption, ml•kg ⁻¹ •min ⁻¹	EG	42.45 ± 0.40	43.39 ± 0.54	1.40	>0.05
	CG	43.66 ± 0.65	44.28 ± 0.50	0.76	>0.05
Physical activity index, points	EG	31.58 ± 0.44	34.14 ± 0.95	2.45	<0.05
	CG	32.80 ± 0.95	34.84 ± 1.25	1.30	>0.05
General level of physical conditions, points	EG	-0.31 ± 0.03	-0.12 ± 0.03	4.48	<0.001
	CG	-0.26 ± 0.02	-0.20 ± 0.03	1.66	>0.05

Note: EG – experimental group, CG – control group.

Table 4. Comparative assessment of motor qualities development according to state tests in the experimental group (EG n = 22) and the control group (CG n = 20) female students

Group	before experiment $\bar{x} \pm S$	assessment	after experiment $\bar{x} \pm S$	assessment	t	p
2,000 m run (min, s)						
EG	11.47 $\pm$ 0.2	2	11.12 $\pm$ 0.22	3	1.18	>0.05
CG	11.36 $\pm$ 0.2	2	11.13 $\pm$ 0.18	3	0.85	>0.05
4x9 m shuttle run (s)						
EG	10.88 $\pm$ 0.13	3	10.61 $\pm$ 0.09	3	1.71	>0.05
CG	10.86 $\pm$ 0.12	3	10.62 $\pm$ 0.09	3	1.60	>0.05
Standing long jump (cm)						
EG	163.52 $\pm$ 2.97	1	177.08 $\pm$ 3.35	2	3.03	<0.01
CG	156.61 $\pm$ 3.44	0	164.94 $\pm$ 3.12	1	1.79	>0.05
Sit-ups in 1 min (times)						
EG	36.72 $\pm$ 0.89	2	43.6 $\pm$ 0.74	4	5.94	<0.001
CG	37.22 $\pm$ 1.65	3	42.11 $\pm$ 1.34	4	2.30	<0.05
Push-ups (times)						
EG	5.00 $\pm$ 0.61	0	9.04 $\pm$ 1.09	1	3.63	<0.01
CG	3.94 $\pm$ 0.37	0	5.44 $\pm$ 0.44	0	2.61	<0.05
Seated forward bend (cm)						
EG	13.16 $\pm$ 1.34	2	16.72 $\pm$ 1.12	3	2.04	<0.05
CG	15.22 $\pm$ 0.89	3	15.44 $\pm$ 1.36	3	0.14	>0.05

Note: EG – experimental group, CG – control group.

31.8% (n = 7) – the “safe” level of motor age. Upon completion of the experiment, all the students with the “dangerous” level of motor age moved to higher levels, so only 4.5% (n = 1) have the “borderline” level, and the level of motor age of 95.5% of the students (n = 21) is assessed as “safe”.

Discussion

At the beginning of our study, we assumed that the introduction of a differentiated approach to dosing physical loads for female students of different motor ages would lead to positive dynamics and optimization of their physical condition.

Examination of the level of students' physical condition while studying at higher educational institutions often shows a steady tendency towards its deterioration. This is due to insufficient effectiveness of the traditional training program, which is confirmed by our data and other authors' findings (Kondakov et al., 2018).

The studies of the authors (Tambalis et al., 2019; Wang et al., 2019; Kozina et al., 2019) argue that the use of aerobics means helps optimize certain components of physical condition. Our study has broadened the understanding of the impact of recreational aerobics on girls' bodies. The effectiveness of the program that we developed was assessed through a holistic and integrated monitoring of indicators of biological and motor age, the level of physical health, and assessment of motor qualities development. This created the basis for scientific substantiation of taking into account motor age when determining physical load for female students. On the basis of correlation analysis, we found a relationship between female students' motor age and level of physical health. This made it possible to find the most accessible way to differentiate physical loads for female students according to different motor ages.

Drawing on the results of our own research and the studies by the authors Chernenko and Kokarev (2017), Kibalnyk and Tomenko (2010), we developed a program of sectional recreational aerobics classes. In contrast to the existing programs, the specially developed program envisaged: an organizational structure of recreational classes; factor analysis of the ascertaining experiment results; differentiation by the levels of motor age, taking into account the dynamic management of correction of the level of physical health; load intensity; pulse mode; a rational combination of means for developing motor qualities. In addition, to optimize classes, the study used: various types of aerobics (basic aerobics, step aerobics, power aerobics, and aerobics with objects); interval or repeated ways of exercise repetition; differentiated and person-centered approaches to working with female students; medical and pedagogical control (at the end of each module).

The introduction of the program helped to increase the level of physical activity and improve the physical condition of the study participants. It is important to note that the results obtained during the formative experiment confirm the findings of a number of authors about a positive effect of recreational aerobics means on female students' physical condition (Wang et al., 2019; Niu et al., 2018). The relationship that we discovered between female students' motor age and level of physical health made it possible to find the most accessible way to differentiate physical loads for female students according to different motor ages. This principle was implemented taking into account load power, intensity, a rational combination of means for developing motor qualities (strength endurance, dynamic strength, speed and strength endurance, static endurance, and flexibility).

Thus, the findings of the study made it possible to broaden the knowledge of effective ways to optimize the motor activity and correct the physical condition of female students

of higher educational institutions. We confirmed the information on the need to improve the basic physical education program in higher educational institutions (Kondakov, Voloshina, et al., 2018; Sobyenin et al., 2016).

The obtained results confirm and supplement the studies on the indicators of physical development and morphofunctional features of students (Borodulina, 2014; Kuzmin et al., 2016). In addition, we confirmed the data of Kondakov et al. (2018), Krutsevykh et al. (2010) on the unsatisfactory state of students' physical health and physical fitness; the tendency for deterioration of these indicators while studying at higher educational institutions; the significant excess of biological age (Markina, 2001) and motor age (Borodulina, 2014; Vavilova et al., 2008) over calendar one.

We supplemented the findings of Niu et al. (2018), Kuna et al. (2018) about the optimization of physical education of students of higher educational institutions by using the most popular and accessible types of physical exercises; the data of Kondakov et al. (2018) on insufficient physical activity of young people; the data of Yarmak et al. (2018) on the factor structure of physical condition of female students of higher educational institutions; the information of Ilnytska et al. (2016), Borrás et al. (2017), Wang et al. (2019), Kuna et al. (2018) on the effectiveness of using recreational aerobics means to improve the level of students' physical condition.

Research in this area will make it possible to ensure optimal physical activity of students; increase the level of physical fitness and health; develop professionally important psychophysical qualities and interest in regular exercise and sports.

Conclusions

The results of the experiment confirmed that the process of teaching students using the basic physical education program for higher educational institutions needs to be supplemented and improved.

As a result of factor analysis, a rational combination of means for developing motor qualities was determined. The study found a correlation between motor age and the level of physical health, ranked these indicators and identified three levels of motor age with respect to the levels of physical health.

It was found that the experimental program significantly improved the indicators of physical fitness, physical health, and motor age.

This study does not cover all the tasks of the selected problem. We see the prospect of further research in studying the application of the differentiated approach to dosing physical loads for students of different motor ages using other means of physical education.

Conflict of Interest

The authors declare no conflict of interest.

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ДИФЕРЕНЦІАЦІЯ ФІЗИЧНИХ НАВАНТАЖЕНЬ У СТУДЕНТОК З РІЗНИМ РУХОВИМ ВІКОМ

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Авторський вклад: А – дизайн дослідження; В – збір даних; С – статаналіз; D – підготовка рукопису; Е – збір коштів

Реферат. Стаття: 9 с., 4 табл., 1 рис., 37 джерел.

Мета – розробити і оцінити вплив програми секційних занять оздоровчою аеробікою з урахуванням диференціації фізичних навантажень у студенток з різним руховим віком.

Матеріали та методи. Контингент – в рамках констатувального експерименту обстежено 145 студенток 2 курсу, в формуючому експерименті – 42 студентки. Визначалися такі показники: біологічний вік (років) за методикою Войтенко В.П. (1991), руховий вік (років) і загальний рівень фізичних кондицій (бали), частота серцевих скорочень (уд/хв), час відновлення частоти серцевих скорочень після 20 присідань за 30 с (хв, с), рівень фізичного здоров'я (бали), індекс рухової активності (у.о.), рівень загальної фізичної працездатності (PWC_{170} , $кгм \cdot хв^{-1}$); МПК ($мл \cdot кг \cdot хв^{-1}$) – максимальне споживання кисню. Рівень розвитку рухових якостей: біг 2000 м (хв, с), човниковий біг 4×9 м (с), стрибок в довжину з місця (см), піднімання тулуба в сід за 1 хв (раз), згинання та розгинання рук в упорі лежачи (раз), нахил з положення сидячи (см).

Результати. Розроблено та апробовано експериментальну програму проведення занять з оздоровчої аеробіки

з урахуванням диференційованого підходу в дозуванні фізичних навантажень у студенток з різним руховим віком. Факторний аналіз дозволив виявити раціональне співвідношення засобів для розвитку рухових якостей: силова витривалість – 15,88%, динамічна сила – 12,86%, швидкісно-силова витривалість – 8,72%, статична витривалість – 17,87%, гнучкість – 12,69%, швидкісні здібності – 14,66% і координаційні здібності – 17,32%. Встановлено помірний негативний взаємозв'язок рухового віку з рівнем фізичного здоров'я ($r = -0,68$ при $p < 0,01$). Визначено три рівні рухового віку щодо рівнів фізичного здоров'я.

Висновки. Облік рухового віку студенток при проведенні занять оздоровчою аеробікою дозволяє забезпечити оптимальну рухову активність, підвищити рівень фізичної підготовленості.

Ключові слова: руховий вік, диференційований підхід, оздоровча аеробіка, рухові якості, дозування.

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Cite this article as: Doroshenko, E., Hurieieva, A., Symonik, A., Chernenko, O., Chernenko, A., Serdyuk, D., Svatyev, A., & Tsarenko, K. (2021). Differentiation of Physical Loads in Female Students of Different Motor Ages. *Teoriâ ta Metodika Fizičnogo Vihovannâ*, 21(2), 158-166. <https://doi.org/10.17309/tmfv.2021.2.09>

Received: 11.02.2021. Accepted: 25.05.2021. Published: 25.06.2021

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ORIGINAL SCIENTIFIC ARTICLE

PHYSICAL EDUCATION AND LEISURE TIME ACTIVITIES AMONG PUPILS WITH AND WITHOUT HEARING LOSS

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Accepted for Publication: June 2, 2021

Published: June 25, 2021

DOI: 10.17309/tmfv.2021.2.10

Abstract

The objective of this study was to analyse differences among Czech pupils' with/without hearing loss related to feelings and opinions on physical education classes; sport preferences in physical education classes; and leisure time activities at the lower secondary schools for the deaf.

Materials and methods. Participants were 83 pupils with hearing loss ($n = 41$; 49.4%) and pupils without hearing loss ($n = 42$; 50.6%); an average age of them was 14.3 ± 1.3 years. The non-parametric Mann-Whitney U-test, Fisher exact test, Chi-square test were used for statistical analyses. For calculation of effect size coefficient $abs(r)$ was used. All tests were performed at a level of 0.05.

Results. Pupils without hearing loss are more likely to express disappointment due to cancellation of a physical education class than pupils without hearing loss ($Z = -2.168$; $p = 0.029$). A statistically significant difference was found in preference for the various physical education activities and in leisure activities, where pupils without hearing loss prefer dancing ($\chi^2 = 8.622$; $p = 0.003$), whereas pupils with hearing loss prefer volleyball ($\chi^2 = 14.833$; $p = 0.00001$). In terms of leisure time activities, pupils with hearing loss spent their leisure time watching television significantly more often ($\chi^2 = 5.198$; $p = 0.023$).

Conclusion. Both groups do not differ in feelings and opinions on physical education in terms of popularity, difficulty, importance, effort during physical education. On the contrary, differences in feelings associated with the cancellation of physical education or preference of activities in physical activities in physical education and leisure time appeared.

Key words: lower secondary school, special education, opinion, feelings, leisure time, sport.

Introduction

Individual development in various domains – depending on the aetiology – can be affected by hearing loss. Important factors are the age of the person, severity and type of impairment, quality of care, the time when the rehabilitation started, the suitability of rehabilitation methods, cognitive abilities, psychomotor skills or social and environmental factors (Coskun et al., 2019; Ochoa-Martínez et al., 2019; Van der Straaten et al., 2020). Due to physical and psychosocial limitations – difficulties in communication with peers, lower health and physical literacy, children with hearing loss may experience reduced physical activity and fitness (Ellis et al., 2014; Hartman et al., 2011). Therefore, schools for the deaf tend to encourage more physical activity through physical education classes and structured sports programs in the pupils' leisure time (Kurková, 2015).

Physical education is a priority field in the development of children health promotion, including those who are deaf or

hard of hearing. Benefits of physical education and physical activity in leisure time can improve the bio-psycho-social and spiritual domains (Marmeleira et al., 2019). Moreover, it is also fundamental to active living from early childhood to adulthood (Cheung, 2019). Generally, school-based physical education is an effective means of influencing the body and mind and develop the range of motor and cognitive competencies, impaired due to the hearing loss. Thus, physical education is essential for pupils with hearing loss. Additionally, physical education may be the best setting for individuals with hearing loss to learn about physical activity (Kurková et al., 2010; Li et al., 2019).

Research focusing on the physical education experience of pupils with hearing loss has shown that those pupils tend to find many barriers in physical education classes. In the study, Kurková et al. (2010) found some challenges for physical education classes in the ratio of students-teachers and the potential risks involved in several activities during the classes. Another research by Kurková (2015) described the worries felt by pupils with hearing loss regarding misunderstandings in com-

munication, delayed reactions when beginning a new activity, and the worries of destroying their hearing aids when participating in contact sports during physical education classes.

According to the Czech Statistical Office (2018), Czech schoolchildren consider physical education and computers to be a popular school subject. This finding confirmed a study by Kurková and Nemček (2018), where teenagers who are deaf/hard of hearing do sport significantly more often in their leisure time in comparison with teenagers with visual impairment. Engel-Yeger and Hamed-Daher (2013) compared the involvement in leisure time activities between children with hearing loss, with visual impairment and typical peers. They found out for both groups – children who are deaf/hard of hearing and with visual impairment – it was more challenging to participate in leisure activities, and it is necessary to provide support and facilitate their involvement through intervention and community programmes.

Due to the previous research, the study aimed to analyse differences among pupils' with and without hearing loss related to (a) feelings and opinions on physical education classes; (b) sport preferences in physical education classes and leisure time activity at the second grade of schools for the deaf.

Materials and Methods

Study sample

The research sample comprised eighty-three Czech pupils – with hearing loss ($n = 41$; 49.4%) and without hearing loss ($n = 42$; 50.6%) from the two lower secondary schools (European Commission, 2018) – boys, $n = 49$; 59.0%; girls, $n = 30$; 31.6%; and 4 pupils (4.9%) did not state their sex. The mean age with a standard deviation of the age was 14.3 ± 1.3 years, the age range was 11 to 17 years, and the median age was 14 years. The exclusion criterion for all participants was additional combined disabilities (e.g. cognitive, physical or visual impairment). In the Czech Republic, in all lower secondary schools for the deaf is possible to extend school attendance to ten years, upon approval from the ministry. In such a case, the first grade comprises years 1 to 6, and the second grade comprises years 7 to 10 (Act No. 561/2004 Coll., on preschool, primary, secondary, higher, and other education [Zákon č. 561/2004 Sb.]).

Within the sample, the most pupils with hearing loss have been deaf or hard of hearing from birth ($n = 33$; 80.5%). With respect to the severity of hearing impairment (hearing loss expressed in decibels), moderate to severe hearing loss

(40–80 dB) ($n = 13$; 31.7%; $n = 11$; 26.8%) is represented among the pupils. A compensation aid is used by most pupils ($n = 27$; 65.9%), in most cases a hearing aid ($n = 23$; 85.2%), fewer pupils have a cochlear implant ($n = 4$; 14.8%). In relation to participation in sport, both samples do not differ much – sport on a competitive level ($n = 18$; 43.9%; $n = 19$; 45.2%), recreational sports ($n = 19$; 46.3%; $n = 19$; 45.2%), no sports at all ($n = 4$; 9.8%; $n = 4$; 9.5%).

Data collection

The data collection were carried out in April and May 2017 at the second grade (years 7–10) of the Czech lower secondary schools for the deaf. To access the research for our group with and without hearing loss, a structured questionnaire in modified form – adapted text version and video format in the Czech sign language – was used. The pupils completed the questionnaire in the presence of the class tutor and the researcher. If necessary, a teacher, an interpreter from/to sign language was available to pupils with hearing loss to avoid any misunderstanding of the questions. The research had relevant approval from the Ethics Committee. All subjects signed an informed consent form before enrolment. In this study, we compare seven questions concerning the differences among pupils with and without hearing loss in physical education classes. The questions were related to their opinions and feelings about physical education classes and assessed: a) the popularity of physical education; b) the importance of physical education; c) the difficulty of physical education; d) effort in physical education classes; e) emotionality in physical education classes; f) emotional response if a physical education class is cancelled; g) reason for the lack of interest in physical education classes – If you do not enjoy physical education classes, what is usually the most common reason for that? Furthermore, we compared the pupil's preferences in a physical education class and their leisure time activities. Participants were asked, "What activity do you most often do in your leisure time?"; and "Which of the following physical activities would you like to do in physical education classes?" (Kurková & Langová, 2021). Another information about research participants included demographic facts.

Statistical Analysis

The data were described using absolute and relative frequencies, including the mean, standard deviation and median. For statistical analyses, we used the non-parametric

Table 1. Intergroup comparison of mean values in pupils' feelings and opinions on physical education classes

Variable	Pupils with hearing loss ($n = 41$)	Pupils without hearing loss ($n = 42$)	Total ($N = 83$)	Z	p	abs(r)
	M $\pm$ SD	M $\pm$ SD	M $\pm$ SD			
Popularity	2.17 $\pm$ 0.83	1.95 $\pm$ 0.98	2.06 $\pm$ 0.92	1.230	0.193	0.134†
Importance	1.88 $\pm$ 0.90	2.05 $\pm$ 0.91	1.96 $\pm$ 0.90	-0.861	0.365	0.094
Difficulty	3.24 $\pm$ 0.97	3.55 $\pm$ 0.86	3.40 $\pm$ 0.92	-1.266	0.171	0.138†
Effort	1.95 $\pm$ 0.83	1.91 $\pm$ 0.69	1.93 $\pm$ 0.76	0.118	0.903	0.013
Emotionality 1	2.15 $\pm$ 0.79	2.00 $\pm$ 0.94	2.08 $\pm$ 0.87	1.043	0.271	0.114†
Emotionality 2	3.10 $\pm$ 0.89	3.41 $\pm$ 0.99	3.25 $\pm$ 0.95	-2.168	0.029*	0.231†

Note. SD – standard deviation; Z – Mann-Whitney U-test statistics; abs(r) – absolute value of Cohen's r; †small effect size; p – statistical significance (*p-values < 0.05).

Mann-Whitney U-test, Chi-square test, and, for low frequencies, the Fisher's exact test. Furthermore, the effect size coefficient was used. The Z value can be used to calculate an effect size, such as the r proposed by Cohen (1988) where values $r = 0.50, 0.30$, and 0.10 may be interpreted as large, medium and small effects. All tests were performed at a level of 0.05, and we used the software R for statistical processing.

Results

Table 1 and Table 2 present the intergroup comparison of pupils with and without hearing loss in physical education

classes. Using the Mann-Whitney's U-test, it was proven in the Emotionality 2 indicator – when cancelling a physical education class – pupils without hearing loss are more likely to express disappointment due to cancellation of a physical education class ($Z = -2.168$; $p = 0.029$). The statistical significance in this indicator was also confirmed by the small effect size coefficient ($\text{abs}(r) = 0.231$) – Table 1.

Related to other analysed indicators – Popularity ($\text{abs}(r) = 0.134$), Difficulty ($\text{abs}(r) = 0.138$), and Emotionality 1 ($\text{abs}(r) = 0.114$) – a small effect size coefficient was found; however statistical significance was not proven (Table 1).

Table 2. Pupils' preferences in physical education classes and their leisure time activity

Variable	Pupils with hearing loss (n = 41)		Pupils without hearing loss (n = 42)		χ^2	p
	n	%	n	%		
Preferences in physical education classes						
Athletics	9	22.0	7	16.7	0.372	0.542
Aerobics	1	2.4	1	2.4		1.000 ^a
Badminton	4	9.8	2	4.8		0.433 ^a
Swimming	11	26.8	9	21.4	0.331	0.565
Gymnastics	1	2.4	2	4.8		1.000 ^a
Tennis	3	7.3	4	9.5		1.000 ^a
Frisbee	3	7.3	3	7.1		1.000 ^a
Combat sports	3	7.3	5	11.9		0.713 ^a
Floorball	19	46.3	14	33.3	1.466	0.226
Handball	4	9.8	5	11.9		1.000 ^a
Dancing	3	7.3	14	9.5	8.622	0.003*
Football	15	36.6	12	28.6	0.607	0.436
Volleyball	18	19.5	3	7.1	14.833	0.0001*
Basketball	7	17.1	7	16.7	0.002	0.961
Dodgeball	13	31.7	20	47.6	2.193	0.139
Zumba	1	2.4	1	2.4		1.000 ^a
Health exercises	7	17.1	7	16.7	0.002	0.961
Reasons for the lack of interest in physical education						
Unattractive content	6	14.6	3	7.1		0.313 ^a
Teacher's approach	5	12.2	2	4.8		0.265 ^a
I don't feel like exercising	3	7.3	3	7.1		1.000 ^a
Poor conditions in the gym	6	14.6	1	2.4		0.057 ^a
I focus on the subsequent classes	6	14.6	5	11.9	0.134	0.714
Leisure activity						
Television	12	29.3	4	9.5	5.198	0.023*
Listening to music	11	26.8	18	42.9	2.345	0.126
Listening to the radio	1	2.4	3	7.1		0.616 ^a
Doing sport	23	56.1	19	45.2	0.979	0.322
Visiting sport matches	10	24.4	5	11.9	2.184	0.139
Theatre, cinema, concert	3	7.3	1	2.4		0.360 ^a
Reading	3	7.3	8	19.0	2.483	0.115
Art	8	19.5	7	16.7	0.113	0.736
Friends	13	31.7	17	40.5	0.691	0.406
Computer, mobile phone	14	34.1	11	26.2	0.624	0.430
Homework, gardening	10	24.4	8	19.0	0.349	0.555
Self-education	3	7.3	3	7.1		1.000 ^a
Idleness	1	2.4	2	4.8		1.000 ^a

Note. χ^2 – the value of the test statistic for the chi-squared test; ^aFisher's exact test; p – statistical significance (*p-values < 0.05).

Looking at the sports preferences in physical education classes, using the Chi-square test, it was a statistical proof that pupils without hearing loss prefer dancing ($\chi^2 = 8.622$; $p = 0.003$), whereas pupils with hearing loss prefer volleyball ($\chi^2 = 14.833$; $p = 0.00001$). There were no other statistical differences found, pupils with hearing loss and without hearing loss prefer mostly floorball (46.3% versus 33.3%), dodgeball (31.7% versus 47.6%), football (36.6% versus 28.6%), and swimming (26.8% versus 21.4%) – Table 2.

In the question relating to the reasons for the lack of interest in physical education classes, pupils with and without hearing loss indicated unattractive content (14.6% versus 7.1%) and focusing on the subsequent class (14.6% versus 11.9%) as the most frequent reasons. In the variable concerning poor conditions in the gym, the differences approached the level of statistical significance ($p = 0.057$). Pupils with hearing loss indicated this reason more often than pupils without hearing loss (14.6% versus 2.4%).

In terms of leisure time activities, using the Chi-square test, it was statistically proven that pupils with hearing loss spent their leisure time watching television significantly more often ($\chi^2 = 5.198$; $p = 0.023$). Generally, pupils with hearing loss and without hearing loss mostly prefer doing sport (56.1% versus 45.2%), going out with friends (31.7% versus 40.5%), listening to music (26.8% versus 42.9%), and computers/ mobile phones (34.1% versus 26.2%) – Table 2.

Discussion

In the present study, we have compared the differences among Czech pupils with and without hearing loss in the various variables for physical education classes and leisure time activities. By comparing the average values of the answers of our pupils from schools for the deaf with Slovak pupils with sensory disabilities in special education (Kurková et al., 2015), pupils with sensory disabilities considered physical education to be more popular than pupils in our work. In the research of Hrabal and Pavelková (2010), the average value in the given indicator was lower, and Czech pupils from regular schools perceived physical education as more popular than our pupils. Similar results to our research are also the findings of a survey by the Czech Statistical Office, where Czech schoolchildren consider computers and physical education to be very popular school subjects (Czech Statistical Office, 2018).

By comparing the average values of the answers of our pupils from schools for the deaf with the results of the Slovak study of ordinary pupils (Antala et al., 2012) and Czech pupils from mainstream schools (Hrabal & Pavelková, 2010) in the indicator Importance, our pupils from pupils for the deaf lower average values, which means that our students rate physical education as more important. Minimal differences also appeared in the comparison of our study with Slovak pupils with sensory disabilities (Kurková et al., 2015). We can state that pupils from schools for the deaf evaluate physical education as more important in comparison with pupils from ordinary schools both in the Czech Republic and in Slovakia.

Both pupils with hearing loss and pupils without hearing loss consider physical education to be an undemanding subject. As part of our comparison of the average values of the total sample in the Difficulty indicator, pupils in our study considered physical education to be more demanding than pupils from Czech and Slovak mainstream schools (Antala et al., 2012;

Hrabal & Pavelková, 2010) and pupils from Slovak schools for the hearing and visually impaired (Kurková et al., 2015).

In the indicator Effort, in the comparison of the general population of Czech primary school pupils (Hrabal & Pavelková, 2010), the average values of our group do not differ. Compared to Slovak pupils from schools for the sensory impaired, our pupils achieve lower average values. Differences in showing effort during physical education classes may be influenced by the current activity, climatic conditions, fear of injury; current health condition and the preferred communication system can have some influence on the active participation in physical education classes of pupils from schools for the deaf, too. (Ellis et al., 2014; Jaarsma et al., 2014; Kurková, 2015).

Comparing the overall set of our study with the Slovak study of pupils with sensory disabilities (Kurková et al., 2015) in the indicator Emotionality 1 – feelings in physical education – our pupils achieved higher average values. This result means that they feel good in physical education classes, while the students of the Slovak study always feel good. Our results are also affirmed by the study of Cypriot students, where these students perceived physical education as beneficial and fun (Constantinides & Silverman, 2018). In the indicator Emotionality 2 – emotions of pupils in the case of dropping out of a physical education class – statistically significant differences in average values were found between pupils with hearing loss and pupils without hearing loss. Pupils without hearing loss are more likely to express disappointment at the dropout of a physical education class. However, when comparing the results of our pupils in the overall sample with the Slovak study of pupils with sensory disabilities (Kurková et al., 2015), our pupils show a higher degree of disappointment from dropping out of physical education class than pupils with sensory disabilities from Slovakia.

In the question concerning the causes of lack of interest in physical education classes, pupils with hearing loss most often state concentration for other class, boredom, or were not satisfied with the gym. Similar results appeared in the study by Kurková and Nemček (2016), where pupils with hearing loss most often stated unsatisfactory conditions or that they were lazy as the cause of lack of interest in physical education classes. Slovak visually impaired pupils in the same study claimed that they were lazy or the reason for their lack of interest was concentrating on the following class. The results we found also confirm the results of the study by Antala et al. (2012), where the most common causes of lack of interest in physical education classes for Slovak pupils in regular primary schools were comfort, unattractive content and concentration on the following class.

When comparing leisure activities, there is a statistical significance that pupils with hearing loss are more likely to spend their free time watching television. These pupils also play sports more often and spend time on a computer. Similar preferences verify the study of Kurková and Sigmund (2010), where pupils with hearing loss preferred sports activities and spending time on computer in their free time. The exact opposite results showed the study of Stough et al. (2016). He found that schoolchildren with hearing loss spent less time watching television due to limited sound perception and difficulty reading subtitles. However, these authors found that students with less severe hearing loss listened to music significantly more often. Pupils without hearing loss play sports more often, listen to music, spend time with friends and on the computer. Nemček (2014) also found out that pupils with physical disabilities in

their free time engaged exclusively in sedentary activities, such as listening to music, playing on a computer and watching television. There were no other differences between pupils with hearing loss and without hearing loss in leisure preferences demonstrated.

In the comparison of activities which are preferred during physical education classes by pupils from schools for the deaf, there was a statistically significant difference in dance preference, where pupils without hearing loss prefer dance significantly more often compared to pupils with hearing loss. Pupils from schools for the deaf prefer floorball, volleyball and football in physical education classes. Our findings are consistent with the results of an earlier study of Czech and Slovak pupils with sensory disabilities (Kurková & Nemček, 2018; Kurková et al., 2015).

Conclusion

In physical education classes, there were statistically significant differences in the Emotionality 2 indicator – when cancelling a physical education class – pupils without hearing loss are more likely to express disappointment due to cancellation of a physical education classes than pupils without hearing loss. The statistical significance in this indicator confirmed the small effect size coefficient. Related to other analysed indicators – Popularity, Difficulty, and Emotionality 1 – a small effect size coefficient appeared. However, statistical significance was not proven. A statistically significant difference was found in preference for the various physical education activities and in leisure activities, where pupils without hearing loss prefer dancing, whereas pupils with hearing loss prefer volleyball. In terms of leisure time activities, there was a statistical proof that pupils with hearing loss spent their leisure time watching television significantly more often than pupils without hearing loss. Furthermore, differences in feelings associated with the cancellation of physical education in physical education appeared. The results cannot be generalized – they only attest to the schools within the given region. The low number of participating schools and the number of pupils with and without hearing loss limited the study. Another limit was the lack of knowledge of the level of current fitness and overall health condition of the participated pupils.

Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

Conflicting Interests

The authors declared no potential conflicts of interest.

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ФІЗИЧНЕ ВИХОВАННЯ ТА ДОЗВІЛЛЯ СЕРЕД УЧНІВ ІЗ ВТРАТОЮ СЛУХУ ТА БЕЗ НЕЇ

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Авторський вклад: А – дизайн дослідження; В – збір даних; С – статаналіз; D – підготовка рукопису; Е – збір коштів

Реферат. Стаття: 6 с., 2 табл., 26 джерел.

Метою цього дослідження було проаналізувати відмінності серед чеських учнів із / без втрати слуху, пов'язані з почуттями та думками щодо занять фізичною культурою; спортивні уподобання на уроках фізичної культури; та дозвілля у початкових загальноосвітніх школах для глухих.

Матеріали і методи. Учасниками стали 83 учні із втратою слуху (n = 41; 49,4%) та учні без втрати слуху (n = 42; 50,6%); середній вік їх становив 14,3 ± 1,3 року. Для статистичного аналізу використовували непараметричний U-критерій Манна-Уїтні, точний критерій Фішера, критерій хі-квадрат. Для розрахунку величини ефекту використовували коефіцієнт $abs(r)$. Всі тести проводились на рівні 0,05.

Результати. Учні без втрати слуху частіше виявляють розчарування через скасування уроку фізкультури, ніж учні без втрати слуху (Z = -2,168; p = 0,029). Статистично значуща різниця була виявлена в перевазі до різноманіт-

них занять фізичною культурою та дозвіллевих заняттях, де учні без втрати слуху віддають перевагу танцям ($\chi^2 = 8,622$; p = 0,003), тоді як учні з втратою слуху надають перевагу волейболу ($\chi^2 = 14,833$; p = 0,00001). Що стосується дозвіллевих занять, учні із вадами слуху проводили своє дозвілля значно частіше за телевизором ($\chi^2 = 5,198$; p = 0,023).

Висновки. Обидві групи не відрізняються між собою почуттями та думками щодо фізичного виховання з точки зору популярності, складності, важливості, зусиль під час фізичного виховання. Навпаки, з'явилися розбіжності у почуттях, пов'язаних із скасуванням фізичного виховання чи перевагою занять фізичними вправами під час фізичного виховання та дозвілля.

Ключові слова: неповна загальноосвітня школа, спеціальна освіта, думка, почуття, дозвілля, спорт.

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Cite this article as: Zmélíková, A., & Kurková, P. (2021). Physical Education and Leisure Time Activities among Pupils with and without Hearing Loss. *Teoriâ ta Metodika Fizičného Vihovannâ*, 21(2), 167-172. <https://doi.org/10.17309/tmfv.2021.2.10>

Received: 17.05.2021. Accepted: 02.06.2021. Published: 25.06.2021

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ORIGINAL SCIENTIFIC ARTICLE

EFFECT OF 10 WEEKS GAME EXPERIENCE LEARNING (GEL) BASED TRAINING ON TEAMWORK, RESPECT ATTITUDE, SKILL AND PHYSICAL ABILITY IN YOUNG FOOTBALL PLAYERS

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Accepted for Publication: June 14, 2021

Published: June 25, 2021

DOI: 10.17309/tmfv.2021.2.11

Abstract

This study aims to examine the effectiveness of the games experience learning-based training against teamwork, respect attitude, skills, and physical ability of young footballers.

Materials and methods. Participants consisted of young male football players who had participated in matches at the district, provincial and national levels. The number of participants involved amounted to 46 divided into control and intervention groups of 23 parties each. Footballers aged 10-12 years old have a height of 140.98 ± 7.23 cm, an average body weight of 34.33 ± 8.64 kg. Instruments in this study consist of instruments to measure teamwork and respect attitude in the form of expert validated observation rubrics, passing, and dribbling skill tests, 30-meter sprints, vertical jumps, and multistage fitness tests to measure physical ability of speed, leg power, and aerobic endurance.

Results. Descriptive data showed mean values and standard deviations of control and intervention groups there were differences, the intervention group had a mean value and better deviation standards, while the hypothesis test using the Mann-Whitney test obtained a teamwork attitude score of $0.039 < 0.05$; respect attitude of $0.009 < 0.05$; passing skills of $0.039 < 0.05$; dribbling skills of $0.000 < 0.05$; speed ability of $0.004 < 0.05$; leg power of $0.002 < 0.05$; Endurance of $0.020 < 0.05$. That from the significance value of the control and intervention group ($p < 0.05$) it can be concluded that the variables of teamwork, respect attitude, passing, dribbling, speed, power, and endurance on the posttest value are not the same and the average value of all variables descriptively the intervention group has a higher average value.

Conclusions. There is a significant influence statistical analysis on teamwork, respect attitude, skill techniques, and physical ability for young football players thus training with the game experience learning model can be one solution to improve the performance of youth football.

Keywords: training, games experience learning, youth football player.

Introduction

Training aims to improve skills and competence (Schroepf & Lames, 2017; Balyi & Way, 2014; Khudolii et al., 2019). Besides, it enhance personal development and a high degree of health (Kavussanu & Spray, 2006; Harwood, 2008; Gilbert et al., 2001; Henry, 2013). Training is not only meant to improve physical aspects but also has specific objectives which include, providing positive personal development, character, and social life interactions skills for young athlete.

Moreover, in football, young athletes are technically trained with regards to the feeling and level of individual intelligence (Hyballa & te Poel, 2015).

The pattern of movement in football is carried out with low, moderate, and maximal intensity. Professional footballers can run 9-13 kilometers during a game, but the frequent mileage is with low intensity and most importantly a period of running with maximal intensity (Bangsbo, 2014). Motion analysis with modern technology has shown that professional footballers run at 28% more high intensity (2.43 vs 1.90 kilometers) and 58% more sprints with distances (650 vs 410 meters) than amateur footballers (Bangsbo, 2014; Mohr et al., 2003).

This ability is a determining factor for maximum achievement. Furthermore, it was also stated that the ball receiving ability is at a running scores of 64% (Rampinini et al., 2007), hence, ball possession training during high-intensity sessions have a positive impact on footballers performance. Also, technical training using low to high-intensity sessions have a positive impact on players' selfconfidence. The training intensity is modified based on the size of the field, numbers of player, motivation from the coach, and special rules (Bangsbo, 2008). Furthermore, modern football needs to be designed with specific training methods which suits players' needs including technical, tactical, and physical aspects. For example, center-backs cover less total distance and run with moderate intensity compared to other positions. Conversely, midfielders are expected to demonstrate high-intensity performance and short recovery (Mohr et al., 2003; Bradley et al., 2009). Therefore, variations in frequency and training intensity are important in maximizing athlete performances. In this sport, the aspects studied are very complex and not only improves individual quality but also enhance teamwork.

Sports activities are regarded as positive activities because it involves participation, competition, communication, it is also believed to develop an attitude of respect and cooperation (Goncalves et al., 2010; Khudolii et al., 2020). Teamwork is an absolute requirement to win matches because football is a sport of collectivity. A team consists of two or many individuals that contributes to one another to achieve a common goal, which is to win a match (Malone & Lorimer, 2020). Furthermore, teamwork refers to an interactive and interdependent behavior among a team (McEwan et al., 2017). For example, a midfielder passes the ball to a teammate with more developed football strategy hence, there is tendency of scoring goals against the opponents (McEwan et al., 2017). The effectiveness of teamwork is believed to be a factor in the realization of a goal (Feigean et al., 2018). It is also reported that footballers need to work together, innovative and develop scientifically to be more advanced and to compete with other teams (Wang, 2020). One of the most important points in football is the technical aspect (Wang, 2020).

Performance sports, especially football, is inseparable from good technique. This is an important requirement to win the ball, strategize in outwitting opponents, receiving and passing the ball as well as scoring goals (Rello & Widianto, 2019). Therefore, basic techniques needs to be studied and mastered perfectly as this determines whether a team wins or loses (Doewes et al., 2020). Furthermore, dribbling and passing are important basic components because when a player arranges an attack, the defender is expected to pass the ball according to the goal, hence, the attacker needs to pass the opponent with perfect dribbling (Doewes et al., 2020). A side good basic techniques, the physical features also plays an important role in winning.

Football is about scoring in the opponent's goal in order to win matches (Romeas et al., 2016). In the attack and defense line, the physical aspect is very much required, without it, football players fail to display maximum performance. Moreover, physicality is one of the most important aspects of performance sports hence, when an athlete has a good physique, such individual automatically becomes more effective and efficient in both defensive and attacking duties (Dewangga, 2020). Meanwhile, Wang (2020) stated that football as a collective sport often involves confrontation which leads to physical

contact hence, when physical aspects are not programmed from an early age as a foundation, young players often experience injuries. This is line with McKinney's et al. (2019) which stated that an athlete is an individual, with excellent physical condition to win in certain sports. Physical aspects are properly programmed when peak performance is achieved. The integral components in football include speed, endurance, and power. These three aspects greatly influence the success of an individual and a team physically. However, to develop these aspects, especially in soccer, it is necessary to carry out special trainings capable of improving athletes' development.

The major problem for adolescent, especially in football is performance development. Previous studies have applied special training methods to improve physical and tactical aspects. As with the small-sided game method, this technique is popular among footballers from amateurs to professionals. Besides, this method is considered suitable because it improves physical abilities, technical skills, and tactics (Fradua et al., 2013; Hill-Haas et al., 2011; Reilly, 2005). However, based on observations, the small-sided game method lacks focus in the aspect of skills, for example, young players without basic techniques knowledge, have difficulties with passing and dribbling, hence, its application is more suitable for athletes with good technique. Furthermore, Ben Khalifa et al. (2021) in a study titled effects of verbal interactions on skills among students, examined the effectiveness of students' verbal interaction on skill, performance, and game development in football learning. However, the study focused more on physical education and rather than cognitive development. In addition, most previous studies only examined two dependent variables, which are technique and physical ability, only few studies applied three or more dependent variables. Therefore, to deal with the gaps and lack of research, this study applies a game experience learning-based training method developed by the author and aimed at improving teamwork, respect attitude, skills, and physical abilities in young soccer players.

Materials and methods

Study participants

This study was conducted using an experimental method with two groups, namely control and intervention. The participants were 46 male football players aged 10-12 years with an average height and body weight of 140.98 ± 7.23 cm and 34.33 ± 8.64 kg respectively. In addition, participants were given a preliminary test before treatment. Afterwards, the pretest results were ranked from the highest to the lowest order. The players were divided into two groups using match subject ordinal pairing pattern, therefore, both groups were balanced in various aspects. Moreover, group A, regarded as control used the conventional training model while group B applied the games experience training method.

This training model resulted from a developmental study, validated by experts using the Aiken technique with a score of 4.46 (very good). Participants were trained by two head coaches and two assistants with 23 young football athletes in each group. The respondents received treatment in form of training with a frequency of 3 times per week for 10 weeks and were selected to participate in district, provincial, and national football competitions. The training was carried out for 90 minutes for each session.

Table 1. Games experience learning-based training procedure

Training Stages		Training Material	Strategy
Warming up		Warm-up activity	Guided activity
Core Training 1	Games to develop character values (compiled by the author)	Experience-based learning activities (playing, reflecting, discovering, and implementing)	
Core Training 2	Games to develop specific technical skills (analyzed, selected, and designed by the author)	Experiential learning activities (playing, reflecting on, discovering, and applying)	
Core Training 3	7 on 7 football matches based on the federation rules of play	Play is guided by at least one transfer of game rules	
Cooling Down	Cooling Down activity	Guided activity	

Study organization

The participants reported for treatments 3 times per week while the minimum player attendance was 80% in 10 weeks. Teamwork and respect attitude were measured using expert validated rubric observational, meanwhile, special instruments were used for passing and dribbling tests, and the 30-meter sprint, vertical jump, and multistage fitness tests were used to measure the physical ability including speed, power, and endurance. The procedure for the game experience learning-based training is presented table 1.

The experimental group was given 10 weeks a training intervention with the content of the exercise consisting of games for the development of respect and teamwork behavior in the 1st core exercise, games for the development of technical skills in the 2nd core exercise, and the 3rd core exercise as a time to apply the results of the reflection phase by doing 7vs7 football activities with standard rules of play. The games used to treat the experimental groups can be read in table 2, while the control groups are given the treatment of conventional exercise models.

Table 2. Games based on experience learning for the 1st and 2nd core exercises

No	Game for 1st core training	Game for 2nd core training
1	Fishing Ball	3 vs 1
2	Passing Down Through the Fortress	4 vs 2
3	Together we can	3 vs 2, and Finishing
4	Time Bomb	3 Vs 3 + 2 Neutral Player
5	Pair Two Two	4 vs 4 + 4 Neutral Player
6	Team Frog Jump	4 vs 2 Becomes 6 vs 4
7	Goal, Goal, Goal	3 vs 3 + 4 Neutral Player
8	Red Card	4 vs 2 + 1 Player
9	Horse Soccer	3 vs 3, (Goa Break)
10	Precious Feet	Passing Obstacles or 3 vs 1 (+2)
11	Fair Play Games	Ball Control Create Shooting Space
12	Shooting Prisoner	Placing Bombs in Villains' Nests (1 vs 1)
13	Happy and Sad	Break through the Opponent's Defense Area
14	Go Back So Door Dribble Ball	Splitting the Opponent's Fortress (5 vs 5)
15	Holding 1 on 1	Dribbling 3 vs 2
16	Chain Ball	Create Space for Shooting
17	Police Vs Prisoner	4 vs 4 In Restricted Area
18	Treasure Guard	3vs3, in the box, 3vs 3 out of the box

Statistical analysis

Data processing was conducted using SPSS 25. The first step involve comparing descriptive data with the size of the entire population and the distribution of variables thereafter, the mean and standard deviation (SD) were determined. Furthermore, the Mann Whitney analysis was applied to determine the effect of 10 weeks GEL training on teamwork, respect attitude, skill, and physical ability in the experimental group. The basis of decision-making referenced in the Mann-Whitney test: 1) if the value of significance or asymp. sig (2-tailed) < 0.05 then hypotheses are accepted; 2) if the value of significance or asymp.sig (2-tailed) > 0.05 then the hypothesis is rejected. The following is the descriptive result covering several aspects of teamwork, respect attitude, skill, and physical ability.

Results

The mean difference in the post-test result between the control and experimental group was based on the significance of the SPSS output($p < 0.05$). Based on the output in the Mann-Whitney test it is known that the value of team work is $0.039 < 0.05$; respect attitude of $0.009 < 0.05$; passing of $0.039 < 0.05$; dribbling of $0.000 < 0.05$; speed of $0.004 < 0.05$; power of $0.002 < 0.05$; endurance of $0.020 < 0.05$. Therefore, as the basis of the decision-making of the Mann-Whitney test can be concluded that the hypothesis is accepted. So it can be said

Table 3. Descriptive Result of Pre and Post Test on Attitude, Skill, and Physical Ability

Group	Attitude, Skill, and Physical Ability	Pre-Test		Post-Test	
		Mean	SD	Mean	SD
Control	Teamwork	29.57	1.50	31.17	1.74
	Respect Attitude	31.43	2.01	32.74	2.09
	Passing	6.13	1.09	7.43	0.84
	Dribbling	26.54	2.28	25.25	1.76
	Speed	5.86	0.38	5.47	0.33
	Power	29.7	4.46	32.17	4.31
	Endurance	30.05	5.48	33.03	6.10
Experiments	Teamwork	29.87	1.42	32.35	0.99
	Respect Attitude	32.96	1.10	34.30	1.06
	Passing	6.43	1.16	8.21	0.73
	Dribbling	25.18	2.02	22.80	1.15
	Speed	5.49	0.36	5.06	0.45
	Power	33.30	4.45	37.17	4.67
	Endurance	33.33	4.35	37.45	3.97

Table 4. Post-test control and experiment results using Man Whitney test

Group	Attitude, Skill, and Physical Ability	Mean	Significance
Control	Team Work	31.17	0.039
Experiments		32.35	
Control	Respect Attitude	32.74	0.009
Experiments		34.30	
Control	Passing	07.43	0.039
Experiments		08.21	
Control	Dribbling	25.25	0.000
Experiments		22.80	
Control	Speed	05.47	0.004
Experiments		05.06	
Control	Power	32.17	0.002
Experiments		37.17	
Control	Endurance	33.03	0.020
Experiments		37.45	

that there are significant differences in the value of control groups and experiments. Because there is a significant difference, the formulation of research problems is answered, namely the influence of 10-week Game Experience Learning (GEL) based training on teamwork, respect attitude, skill, and physical ability in young football players (table 3, 4).

Discussion

The theory of experiential learning was initiated by Kolb (Lehane, 2020). The experiential learning model is a learning model that emphasizes students' actions to improve knowledge, skills, effectiveness, and creative thinking through hands-on experience (Wilson & Beard, 2013; Reynolds & Vince, 2007; Arsoy & Ozad, 2005). This model was used in the learning of students in the classroom, then the author adopted the theory and developed it into a games experience learning (GEL) applied to young football school students.

Games experience learning (GEL) is a learning and training model that applies the theory of experiential learning, namely learning contains four stages, namely experience in the form of games, reflection, understanding concepts, and implementation. In the games experience learning (GEL) method developed there are two core exercises, both core exercises have the same goal. Phase (1) games, is a tangible form of training media based on Games experience learning (GEL). Games are part of the experience that should be done on every young footballer. Through games, the coach must be precise in deciding the time to do reflection. Phase (2) reflection conveys the moral knowing and moral feeling of a football player. Reflections are done with the direction of the coach, and athletes are given questions by the coach through casual discussions such as questioning «attitudes, what behaviors support success. Why can a player succeed in doing so?». The reflection is very important to develop young footballers during training. (3) the player can find, understand and deduce the concept that the coach expects. The concept of moral behavior of a positive character is expected to be practiced in phase (4) which is the implementation phase.

This study was aimed at investigating the effect of game experience learning (GEL) on teamwork, respect attitude, skill, and physical ability. The findings show that GEL has a significant effect on teamwork and respect attitude. Meanwhile, this technique is a major breakthrough in dealing with the gaps in performance sports development, especially adolescent football players. This is because, studies that examined the physical aspects of the technique were conducted on one specific variable.

The simultaneous combination of several variables is seemingly the right procedure to increase team complexity in football athletes (Eugster, 2012; Liu et al., 2015). This study was in line with previous studies which stated that teamwork is reciprocally working with two or more team members to achieve a goal (Collins & Durand-Bush, 2019; Gaffney, 2015). Therefore, football provides players, the tendency to change individual play into teamwork. Furthermore, game experience learning is a method that empirically adds to the learning experience hence, improving the characters of players on a team. The results provide a good picture of GEL on teamwork as a means to always work together in achieving desired goals. This was in line with Meiners and Wisdom (2020) which stated that experience-based learning, usually encourage professional skills such as collaboration between one individual and another. However teamwork is not enough to create a good game in football, players are expected to also show respect in the game.

Respectful Attitude is required from every adolescent because it determines how individual respect one another (Utari et al., 2019). Also, it provides an overview for learning through playing experience, where every experience affects the individual's behavior. Therefore, one thing that shapes respectful attitude is the experiential learning process in a social environment when interacting with one another (Akbar & Hastjarjo, 2019). Meanwhile, participating in football activities helps young players (12 years) improve communication skills, teamwork, respect for each other, and socialize (Yavuz, 2019). In addition, sports activities not only improve individual physical and mental state but also promote mutual respect (Goksel et al., 2017).

Furthermore, mutual respect in football is an important factor in the development of young players characters (Haugen et al., 2013). In line with this concept, GEL is an important method for developing player characters. Moreover, teamwork and respect is a psychological attribute that must be fostered in improving soccer for young athletes, however, these aspects are not sufficient when the technical and physical abilities are inadequate.

Games experience learning (GEL) based exercises developed by the author is capable of improving skills and physical abilities to achieve peak performance. Besides, skills such as dribbling and passing are fundamental technical components, compulsorily learned from a young age (Doewes et al., 2020). A football player with good dribbling skills is capable of controlling the ball's pace and maneuver through an opponent without losing ball control (Vaidya, 2020). Furthermore, good passing needs to be also considered in football. When players fail to have good passing and dribbling techniques, achieving the desired goals becomes impossible (Vaidya, 2020). The football game also requires good physical abilities. This is one of the most important attribute in achieving maximum performance. An athlete is required to have a qualified physical condition in order to perfectly achieve desired goals (Van Kooten, 2016; McKinney et al., 2019; Dewangga, 2020).

Football is a sports activity in which athletes perform high and low intensity movements (Lilić et al., 2020). Based

on the observations, coaching young athletes to develop physical aspects especially speed, power, and endurance requires a structured and programmed approach. It also needs to be in line with the long term athlete development theory which state that the main physical aspects that are developed for athletes aged between 12 to 13 years include strength, speed, agility, endurance, power, and special skills in the sports being pursued (Lloyd & Oliver, 2012). Therefore, experience-based learning contributes greatly to football coaching, especially in the achievements of complex aspects.

The descriptive results for the control group, pre and post test data, using conventional methods were as follows: teamwork with pre-test mean (29.57), standard deviation (1.50) meanwhile, post-test mean was (31.17), and standard deviation (1.74). For respect attitude, the pretest mean was (31.43), standard deviation (2.01), post-test mean (32.74), and standard deviation (2.09). Furthermore, the pre-test results for passing indicated a mean of (6.13), standard deviation (1.09), post-test mean (7.43), and standard deviation (0.84). Dribbling showed a pre-test mean of (26.54), standard deviation (2.28), post-test (25.25), and standard deviation (1.76). Regarding physical abilities, the pre-test mean for speed was (5.86), standard deviation (0.38), post-test (5.47), standard deviation (0.33). Also, power indicated a pre-test mean of (29.7), standard deviation (4.46), post-test mean (32.17) and standard deviation (4.31). Endurance showed a pre-test mean of (30.05), standard deviation (5.48), post-test mean (33.03) and standard deviation (6.10).

The descriptive results for the pre and post test data of the intervention group using the game experience learning (GEL) based training method were as follows: teamwork with a pre-test mean of (29.87), standard deviation (1.42), post-test (32.35), and standard deviation (0.99). Respect attitude indicated a pre-test of (32.96), standard deviation (1.10), post-test (34.30), and standard deviation (1.06). In addition, passing showed a pre-test mean of (6.43), standard deviation (1.16), post-test mean (8.21), with standard deviation (0.73), while dribbling indicated a pre-test mean of (25.18), standard deviation (2.02), post-test mean (22.80), and standard deviation (1.15). Regarding physical abilities, speed showed a pre-test mean of (5.49), standard deviation (0.36), post-test mean (5.06), standard deviation (0.45) while power indicated a pre-test mean of (33.30), standard deviation (4.45), post-test mean (37.17), and standard deviation (4.67). Moreover, for endurance, the pre-test mean was (33.33), standard deviation (4.35), post-test mean (37.45), and standard deviation (3.97). Therefore, based on these results, the intervention group with GEL based treatment training obtained a better average score compared to the control group.

The Mann-Whitney data analysis was conducted to test whether the post-test control and intervention group have a difference in the mean. Based on the SPSS output, there was a significant difference between the two groups in terms of teamwork (0.039), respect attitude (0.009), passing (0.039), dribbling (0.000), speed (0.004), power (0.002), and endurance (0.020). The significance level between both groups were <0.05. Therefore, the measured post-test variables for both control and experimental group were not the same. Also, the difference in the mean value for all variables showed that the intervention group has a higher mean value. Thus the effects of 10 weeks of games experience learning (GEL) based exercises for the intervention group had a better improvement compared to the control group.

Conclusion

Based on the results, the intervention group with games experience learning (GEL) based treatment on teamwork, respect attitude, skill and physical ability have significant differences and show better improvement compared to the control. Therefore, this study provides scientific contribution and reference for further studies.

Conflicting Interests

The authors declared no potential conflicts of interest.

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ВПЛИВ 10-ТИЖНЕВОГО НАВЧАННЯ ІГРОВОГО ДОСВІДУ НА КОМАНДНУ РОБОТУ, ШАНОБЛИВЕ СТАВЛЕННЯ, НАВИЧКИ ТА ФІЗИЧНІ ЗДІБНОСТІ У ЮНИХ ФУТБОЛІСТІВ

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Авторський вклад: А – дизайн дослідження; В – збір даних; С – статаналіз; D – підготовка рукопису; E – збір коштів

Реферат. Стаття: 6 с., 4 табл., 46 джерел.

Мета дослідження вивчити ефективність впливу ігрового досвіду, що базується на навчанні, на командну роботу, поважне ставлення, навички та фізичні здібності молодих футболістів.

Матеріали і методи. Учасники склалися з молодих футболістів чоловічої статі, які брали участь у матчах на районному, провінційному та національному рівнях. Кількість залучених учасників склала 46, розділених на групи контролю та втручання по 23 учасники кожна. Футболісти віком 10-12 років мають зріст $140,98 \pm 7,23$ см, середню масу тіла $34,33 \pm 8,64$ кг. У дослідженні використані: перевірені експертом рубрики спостереження для вимірювання колективної роботи та поваги, тести навичок проходження та дриблінгу, спринту на 30 метрів, стрибків у вертикальному положенні та багатоступеневих тестів для вимірювання фізичних здібностей, швидкості та сили ніг, аеробної витривалості.

Результати. Описові дані показали що середні значення та стандартні відхилення контрольної та втручальної груп, мали відмінності, група втручання мала середні значення та кращі стандартні відхилення, тоді як тест гіпотези з використанням тесту Манна-Уїтні отримав оцінку відношення до командної роботи $0,039 < 0,05$; ставлення до поваги $0,009 < 0,05$; прохідні навички $0,039 < 0,05$; навички дриблінгу $0,000 < 0,05$; швидкісні здібності $0,004 < 0,05$; сила ніг $0,002 < 0,05$; витривалість $0,020 < 0,05$. На основі аналізу даних можна зробити висновок, про достовірну динаміку змінних командної роботи, поважного ставлення, проходження, дриблінгу, швидкості, потужності та витривалості ($p < 0,05$). Група втручання має більш високі середні значення всіх змінних.

Висновки. Статистичний аналіз виявив суттєвий вплив на командну роботу, поважне ставлення, формування навичок та фізичні здібності молодих футболістів, тому тренування за моделлю навчання ігрового досвіду може бути одним із рішень для покращення результатів юнацького футболу.

Ключові слова: тренування, навчання ігровому досвіду, юний футболіст.

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Cite this article as: Sulistiyono, Akhiruyanto, A., Primasoni, N., Arjuna, F., Santoso, N., & Yudhistira, D. (2021). Effect of 10 Weeks Game Experience Learning (Gel) Based Training on Teamwork, Respect Attitude, Skill and Physical Ability in Young Football Players. *Teorià ta Metodika Fizičnogo Vihovannà*, 21(2), 173-179. <https://doi.org/10.17309/tmfv.2021.2.11>

Received: 16.04.2021. Accepted: 14.06.2021. Published: 25.06.2021

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Теорія та методика фізичного виховання

Науково-методичний журнал

Червень 2021. Том 21, № 2

<https://doi.org/10.17309/tmfv.2021.2>

Відповідальний за випуск	О. М. Худолій
Комп'ютерна верстка	М. О. Худолій
Коректор	Є. Б. Бланк

Свідоцтво про державну реєстрацію серія КВ № 6255 від 21.06.2002 р. Засновник і видавець – ТОВ «ОВС».
Передплатний індекс **74667**. Адреса редакції: <https://www.tmfv.com.ua>. Тел.: (067) 578-40-08. E-mail: tmfv@tmfv.com.ua

Наказом МОН України від 26.11.2020 № 1471 журнал включено в категорію «А» фахових видань України.

Науки: фізичне виховання і спорт. Спеціальність: 017 – Фізична культура і спорт (26.11.2020).

Науки: педагогічні (26.11.2020). Спеціальності: 011 – Освітні, педагогічні науки (26.11.2020);

014 – Середня освіта (за предметними спеціальностями) (26.11.2020).

Підписано до друку 25.06.2021. Формат 60×84 1/8. Папір офсетний. Гарнітура Таймс. Друк офсетний.

Ум. друк. арк. 11,85. Обл.-вид. арк. 12. Вид. № 02-2021. Зам. № 56. Тираж 300 прим. Ціна договірна.

ТОВ «ОВС» Україна, 61003 Харків, пл. Конституції, 18, к. 11.

Свідоцтво Держкомінформу України Серія ДК № 331 від 08.02.2001 р.

Друкарня ТзОВ «Цифра прінт». 61166, м. Харків, вул. Культури, 20-В