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[Teorià ta Metodika Fìzičnogo Vihovannâ]



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ORIGINAL SCIENTIFIC ARTICLE

A DISCRIMINANT MODEL FOR SKILL ORIENTED PREDICTION OF FEMALE CRICKETERS DEPENDING UPON SELECTED PERFORMANCE PARAMETERS

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Abstract

Research Purpose. The study aimed to develop a discriminant model for cricketers on the basis of physiological & anthropometric variables.

Materials and Methods. The study included sixty female seniors BCCI board players representing five different states with mean age 23.4 ± 2.03 , mean height 152.1 ± 3.44 , and mean weight 52.4 ± 4.21 . A multivariate technique was used to predict the cricket performance by classifying the players into batsmen and pace bowlers on the basis of selected physiological & anthropometrical variables.

Results. All the assumptions were positively full-filled (Shapiro-Wilk test $p > 0.05$ and $F = 8.121$, $p = 0.264$ for Box's M test) for applying discriminant analysis to develop the model. A total of eleven performance variables were initially selected for the study and after applying the stepwise statistical technique of discriminant analysis, the model selected certain variables namely Muscle Mass (1.311), Fat (-0.182) & Shoulder Diameter (0.292) and showed its effectiveness as the Eigenvalue for the fit model was 0.848.

Conclusion. A discriminant function $F1 = -29.531 + (1.311 \times \text{Muscle Mass}) + (-0.182 \times \text{Fat}) + (0.292 \times \text{Shoulder Diameter})$ was developed. The percentage of total variation explained by the model was 71.9%. A total of 93.2% of the observations were correctly classified using the proposed discriminant model.

Keywords: discriminant model, Wilks' lambda, eigenvalue, classification matrix.

Introduction

Cricket is one of the most widely played sports in the world, every day there are 55000 cricket matches played in India alone (Ahmad et al., 2016). Since India is such a highly populated country, it is difficult to identified talent at an early stage due to a shortage of trained coaches. The word "talent" refers to a person's natural endowment of a superior quality that can be improved (Peltola, 1992; Williams & Reilly, 2000; Mallillin et al., 2007). In today's India, most of the child wants to play cricket, and their first choice is to be a batsman rather than a bowler. However, this may not be possible because the child may have more ability to be a bowler rather than a batsman.

Different researchers identified the most important characteristics of individuals' physical, cognitive, physiological, and anthropometric abilities to identify cricketing talent (Ahmad et al., 2016). Noakes and Durandt (2000) and Hoque (2019) reported that the cricket requires physical

potential along with the mental strength to concentrate intensely for the longer duration continuously. Whereas, Johnstone et al. (2014) reported height as a key anthropometric characteristics for bowling like bounce, length in cricket. Pyne et al. (2006) also positively correlated various anthropometric characteristics with the fast bowling performance in cricket as he reported that body shape specially arm length was dominating characteristics of fast bowling in terms of Vpeak. Christie (2012) also concluded the significant role of physical and physiological demands in cricket performance but in contrasts, Rudkin and O'Donoghue (2008) and Gore et al. (1993) concluded undemanding physical and physiological competencies for cricket performance in their study. More attention has been paid in recent years to recognizing the various anthropometric, physical and physiological variables that can differentiate an athlete's position/role in different sports (Leone et al., 2002; Koley, 2006; Landers et al., 2000). A research by Nazeer et al. (2018) also admitted the strong positive significance of anthropometric and physical fitness characteristics for optimal performance in sports competition.

In every game and sports different factors responsible for good performance. Since the essence of the game is so peculiar, it's difficult to reliably evaluate a player. As a result, there are few scientific training programs available for cricketers (Bartlett, 2003). Cricketers' training plans were never as rigorous as the training programs for other team sports in the past (Woolmer, 2008). However, the situation has changed now that cricket has undergone significant changes with the advent of new formats such as T-20.

In most team sports, not only fitness but also physique and physiological parameters of a player are equally important, and the role or position of the players is often decided accordingly. Like in cricket pace bowlers are taller than batsmen with good shoulder width as well (Stretch, 1987). Batsmen and pace bowlers each have a distinct role to play in cricket. A batsman must possess certain characteristics that distinguish him from pace bowlers, and a pace bowler must possess certain characteristics that distinguish him from batsmen. Thus, in order to identify cricketers according to their specialties, researcher used a multivariate technique called Discriminant Function Analysis to build a model for cricketers using anthropometrical and physiological attributes as an outcome of present study. This multivariate technique combines with multiple regression and simple ANOVA which is used for classifying the set of observations into predefined groups on the basis of their predicting characteristics of which the groups can be determined (Thomas et al., 2011; Verma, 2013). Number the studied have been done using discriminant analysis for classifying the groups on the basis of playing position in football like defender and attacker (Tew & Wood, 1980), on the basis of area of mastery like in cricket Bowler and batsmen (Bagchi & Raizada, 2020; Pollock et al., 2013) even classifying groups on the basis of different sports like tennis, volleyball, skating, swimming (Leone et al., 2002; Pion et al., 2014).

Aim of the Study. The aim of the present study was to classify female cricketers using a variety of physiological and anthropometric variables, as well as to define the most predictive variables for both the groups.

Hypothesis. It was hypothesized that there would be the significant discriminant model developed for classifying cricketers into Batsmen and pace-bowler on the basis of some fixed predictor variables.

Materials and Methods

Selection of Subjects

For this study a total 60 senior's women board players were included with 30 batsmen and 30 bowlers with (mean age 23.4 ± 2.03 , mean height 152.1 ± 3.44 and mean weight 52.4 ± 4.21). The subjects had a minimum three years or more of playing experience in the board trophy. Subjects with any kind of recent injury related to body parts (Lower and upper limb) were excluded for the study. After the explanation of the procedure a written consent form was signed by the subjects. The study was approved by the institutes Departmental Research Committee.

Physiological Testing Protocols

Proper instructions and demonstration was given to the subjects regarding the use of different physiological instru-

ments. For the measurement of vital capacity portable dry spirometer was used. The subject was asked to take a deep inhalation for long as possible at least for the 6 seconds followed by a forcefully exhalation to record the vital capacity in liters. Detached mouthpieces were attached separately to the spirometer for each subject taking instrument into mouth. Two trails were given and second trail was recorded. VO_{2max} was measured using Queen's College Phase Test. Subjects were asked to perform four-step cadence (up-up-down-down) on 16 inches heighted wide box for 3 minutes continuously at the rate of 22 steps per minute. The heart beat was recorded just after 5 seconds of recovery immediately after completion of test up to 15 seconds from carotid artery and then the calculated reading of 15 seconds heart beat was multiplied by four to get the total heart beat per minute which was further used in formula [Women VO_{2max} (ml/kg/min) = $65.81 - (0.1847 \times \text{heart rate (bpm)})$] to estimate the value women's VO_{2max} . (McArdle et al., 1972). In addition, the researcher used Bioelectrical impedance Analyzer (BIA) also called Bio Scan to measure two body compositional (Morphologic) variables i.e. fat mass and muscles mass under correct administrative protocol. Resting heart rate was taken in the morning by radial artery using two fingers up to 10 seconds and the multiplied by 6 to get total beats per minute.



Fig. 1. Administrative Testing Protocol Illustrations

Anthropometrical Testing Protocols

Anthropometric rod was used for taking measurement of leg length, foot length, total arm length and palm length whereas; sliding caliper was used for measuring hip and shoulder diameter. The reference point for measuring hip diameter (level of greater trochanter of the two sides of hip) shoulder diameter (Distance between the most lateral points of acromial processes on either side) total arm length (distance between acromion point and dactylion point) palm length (shortest distance between Midstylian line and Dactylion) leg length (distance between the anterior superior iliac spine and the standing surface) foot length (distance between the tip of the most tarsal phalange and the most posterior part of the calcaneus) was used and data was recorded in centimeters.

Statistical analysis

The data was analyzed using IBM SPSS (version 20.0.0) software. The Shapiro-Wilk test was used to ensure that the data was normal. First, the Box M test assumption for discriminant analysis (DA) was met. The value of Wilk's lambda and the score of Eigen value were also used in the study. The model established a discriminant function with the aid of

the most dominant factors contributed for classification purpose, which were used in the study, and the model also analyzed expected group membership (Classification Matrix).

Results

All of the assumptions were tested in order to develop the discriminant model and meet the objectives, and none of them were violated. The outcome of Shaprio-Wilk test (Table 1) was used to check the normality of the data.

Table 1. Shaprio-Wilk Test for Normality of Batsmen & Pacers

Variables	Batsmen (Sig.)	Pacers (Sig.)
Vital Capacity	0.296	0.657
VO ₂ max	0.368	0.115
Muscle Mass	0.138	0.158
Fat	0.714	0.222
Resting Heart Rate	0.593	0.936
Total Arm Length	0.543	0.299
Palm Length	0.556	0.312
Foot Length	0.799	0.824
Leg Length	0.694	0.575
Shoulder Diameter	0.310	0.692
Hip Diameter	0.809	0.733

Table 2. Box's M Test For Testing Equal Population Covariance Matrices (DA)

Box's M	8.121
F	Approx
	df1
	df.
	Sig.
	1.276
	6
	2346.493
	0.264

Table 2 indicated the result of Box M test that has reported insignificant as the p value (F = 8.121, p = 0.264) for Box M test was more than 0.05 level of significance which showed no violation in the assumption of homogeneity of variances/covariance.

Table 3. Eigen Value for Developing Discriminant Model (Canonical Correlation)

Function	Eigen value	% of Variance	Cumulative %	Canonical Correlation
1	2.556	100.0	100.0	0.848

The above table 3 indicates the values of canonical discriminant function (Eigen value) for group discriminant analysis. Here the value of canonical correlation is 0.848. Since the total % of variation explained by the model is expressed as the square of the Canonical correlation. Hence 71.9% (0.848²) of the independent variables in the developed model can explain variation in the two groups of cricketers.

Table 4 indicates that the value of Wilk's Lambda is significant as the p — value is less than .05. The value of Wilk's Lambda also indicates that 28.1 % of variability is not explained by the model.

Table 4. Outcomes of Calculated Wilks' Lambda of Discriminant Function

Test of functions	Wilks' Lambda	Chi-square	df	Sig.
1	0.281	70.413	3	0.000*

*significant at 0.05 level of significance

Table 5 indicates the estimation of unstandardized discriminant coefficients which are utilized in developing function of discriminant. In this investigation, the stepwise technique was applied, and only three parameters were included

Table 5. Unstandardized Canonical Discriminant Function Coefficient (DA)

Variables	Function 1
Muscle Mass	1.311
Fat	-0.182
Shoulder Diameter	0.292
(Constant)	-29.531

in the model because of its critical segregating power. Different factors because of inadequate segregating power were not getting chosen in the model. Accordingly, the values of constants and unstandardized discriminant coefficients were taken to develop the discriminant function F1 & these three selected factors as demonstrated.

EQUATION:

$$F1 = -29.531 + (1.311 \times \text{Muscle mass}) + (-0.182 \times \text{Fat}) + (0.292 \times \text{Shoulder Diameter})$$

The above table indicates the means for the transformed group centroids. One of the basic goals of discriminant analysis is to construct a model. a decision matrix for assigning a subject into either of two groups. As a result, Group 1 (Bats-

Table 6. Functions at Group Centroids

	Function 1
Batsmen	1.545
Pacers	-1.545

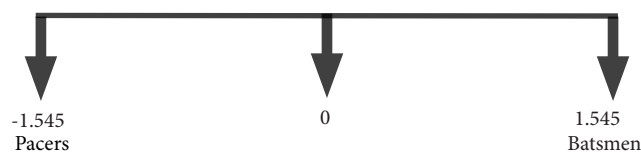


Fig. 2. Group Centroids of Discriminant Model

men) has a corrected mean of 1.545, while group 2 has a revised mean of -1.545 (Pacers). This indicates that the midway between these two is 0. By placing the midpoint of these two groups' means on a straight line, as illustrated in figure 2, these two groups' means can be plotted on a straight line.

The decision rule for assigning a new subject into either of two groups is depicted in the diagram above. If any new subject's discriminant score falls to the right of the midpoint (F1 > 0), then the subject will be classified into batsmen group, and if it falls to the left of the mid-point (F1 < 0), the subject will be classified into pacers group.

Table 7 shows the classification matrix, which is a description of correct and incorrect subject classification cases in to one of the two groups on the basis of selected parameters

Table 7. Classification Results (DA)

Observations results	Variant	Classification Results		
		Batsmen	Pacers	Total
Count	Batsmen	28	2	30
	Pacers	2	28	30
%	Batsmen	93.3	6.7	100.0
	Pacers	6.7	93.3	100.0

*93.3% of correctly classified original group cases

through which discriminant model has been developed. The above table shows that out of 30 players (batsmen) 28 (93.3%) players were correctly classified by the discriminant model but other 2 (6.7) players were wrongly classified in another group (pacers). On other hand in case of (pacers) out of 30 players 28 (93.3%) players were correctly classified by the model whereas 2 (6.7%) players were classified wrongly in other group i.e. batsmen. Thus, the model accurately categorized 55 (93.3%) of the 60 observations, which is a high in percentage, and the model can be regarded accurate & effective.

Discussion

The main objective of the study was to develop the model to categorize female cricketers on the basis of physiological and anthropometric parameters for the talent identification purpose. The concept of the present study was to find out the most prominent factors (physiological & anthropometric) responsible for the classification of cricketers into one of the area of specialty i.e. batsmen, & pacers as well as the contribution of each variables selected by the model for the discrimination purpose and the study supported by Stretch (1987), Bagchi and Raizada (2020) also concluded that difference exist between batsmen and bowlers in physical, anthropometric and morphological characteristics. However, the another study by Stretch & Buys (1991) reported contradictory findings in his study with no significant differences in the height, girth, diameters, and skin fold measurement among batsmen, bowlers and all-rounder.

After applying discriminant analysis, the first two predicting variables identified by discriminating model among all the selected variables by the model were Muscle Mass and fat mass. There is no doubt that the excellent performance in any games and sports is highly influenced by body composition (Brechue et al., 2010; Gacesa et al., 2011; Prado et al., 2006). The body composition consists of fat mass and lean body mass (muscle mass and bone density and fluids). When it comes to fat mass, fat is not a contractile tissue and it also represents extra weight that the athlete must bear when performing a movement, so it appears that in activities that require a body to be pushed through space, calculated body fat percentage has been thought to negatively affect performance. The findings supported by Potteiger et al. (2010) in which he strongly mentioned that the excessive body fat reduced the skating speed of the ice hockey players would lead to minimize the force production. In a cricket match, a cricket players require fastest running between the wicket in a shortest time duration as a batsman, a cricket players require great linear momentum of the body to transfer his or her generated body momentum to the ball in the line of

the wicket to get the wicket as well as to secure more run as a pacer also as a fielder they have to chase the ball quickly and react accordingly and to do these task efficiently every cricket players either batsmen, pacer or spinners must keep his or her body fat very low or can say in a optimum require level. On the other hand an increased muscle mass has been confirmed to improve overall performance in all games and sports. There is a positive relation of muscles and the forces generated by these muscles (Högström et al., 2012; Carbuhn et al., 2010). So further to this it may assume that the body with increased muscles mass has capability to generate more force and power, resulting the batsmen may hit the bigger shots (Boundaries) to score more runs, pacers may give the more speed to the ball to get the more wicket as well all the batsmen or bowler as a fielder may give the long and accurate throw from the boundary line to save the score for their teams. So, the ideal muscles mass can be convinced easily to all of us as the best predictor of enhancing performance not only in cricket but also in all games and sports.

The other predicted variable that was identified by the discriminant model was Shoulder Diameter. There is no denying that a broad shoulder implies a high degree of strength of the arm. Regarding shoulder strength, to score the most runs, a batsman needs good shoulder strength to hit the ball out of the boundary. So, as much as the strength in the shoulder with a great timing as a batsman, bat speed increases lead the ball covers the maximum horizontal distance resulting sixes and fours. In case of bowlers, for the faster and good length delivery of the ball they need to hold a good strength in the shoulder. Because pace bowlers have broad shoulders, they are typically fielded on the boundary line in many matches and can quickly pass the ball to the wicketkeeper's gloves. The finding supported by sketch reported broad shoulders of bowler compared to batsman as anthropometric characteristic and the study supports in discriminating pace bowlers and batsmen on the basis of shoulder diameter. Many other researchers also argued in their findings as a support that in the modern cricket format like T-20 as well as the IPL where the cricket match becomes so fast and skillful aimed scoring maximum scores in the given balls. So, to survive in this fast format of modern cricket the more focus of the batsmen on power hitting shots to score more through boundaries rather a defensive stroke because the boundaries give player's an opportunity to score more runs in a single ball (Spaniol et al., 2006; Basile et al., 2007; Bonnet et al., 2008).

On the other hand as considering the playing position, Stretch & Buys (1991) reported contradictory findings in his study with no significant differences in the height, girth, diameters, and skinfold measurement among batsmen, bowlers and all-rounder.

Conclusion

The researcher's discriminant model (Batsmen and Pace – Bowler) meets all of the relevant assumptions. The discriminant model explained 71.9 percent of the variation. The discriminant model reveals that the subjects were successfully classified into groups with high accuracy. Overall, 93.2 percent of the cricketers were correctly identified, according to the classification matrices, along with developed discriminant function $F1 = -29.531 + (1.311 \times \text{Muscle mass}) + (-0.182 \times \text{Fat}) + (0.292 \times \text{Shoulder Diameter})$. As a result, the model is quite good at classifying subjects into one of two groups. Three predictor variables which are selected by the model were muscle mass, fat, and shoulder diameter.

Conflict of Interest

Authors declare no conflict of interest.

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ДИСКРИМІНАНТНА МОДЕЛЬ ДЛЯ ОРІЄНТОВАНОГО НА НАВИЧКИ ПРОГНОЗУВАННЯ У ЖІНОК-ГРАВЦІВ У КРИКЕТ НА ОСНОВІ ВИБРАНИХ ПАРАМЕТРІВ РЕЗУЛЬТАТИВНОСТІ

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

Реферат. Стаття: 7 с., 7 табл., 2 рис., 35 джерел.

Мета дослідження – розробити дискримінантну модель для гравців у крикет на основі фізіологічних та антропометричних змінних.

Матеріали та методи. У дослідженні взяли участь шістдесят жінок-гравців старшого віку Управління з контролю за крикетом в Індії, представниць п'яти різних штатів, середній вік яких становив $23,4 \pm 2,03$, середній зріст $152,1 \pm 3,44$ та середня вага $52,4 \pm 4,21$. Для прогнозування результативності у крикеті використовувався багатовимірний метод з класифікацією гравців на бетсменів і пейс-боулерів на основі вибраних фізіологічних та антропометричних змінних.

Результати. Усі припущення були повністю виконані (тест Шапіро-Уїлка $p > 0,05$ та $F = 8,121$, $p = 0,264$ за М-тестом Бокса) для застосування дискримінантного

аналізу та розробки моделі. Спочатку для дослідження було відібрано одинадцять змінних результативності, а після застосування поетапного статистичного методу дискримінантного аналізу модель вибрала певні змінні, а саме: м'язова маса (1,311), жир (-0,182) та діаметр плеча (0,292), модель показала свою ефективність, оскільки власне значення відповідної моделі становило 0,848.

Висновок. Розроблено дискримінантну функцію $F1 = -29,531 + (1,311 \times \text{м'язова маса}) + (-0,182 \times \text{жир}) + (0,292 \times \text{діаметр плеча})$. Відсоток загальної варіації, що пояснюється моделлю, становив 71,9%. Загалом 93,2% спостережень було правильно класифіковано за допомогою запропонованої дискримінантної моделі.

Ключові слова: дискримінантна модель, лямбда Уїлка, власне значення, класифікаційна матриця.

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ORIGINAL SCIENTIFIC ARTICLE

THE EFFECT OF VIRTUAL MEDIA-BASED OBSTACLE RUN TRAINING ON WOMAN FUTSAL PLAYER'S DRIBBLING ABILITY DURING COVID-19 PANDEMIC

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Abstract

The study purpose. This study aimed to observe the effect of virtual media-based obstacle run training on dribbling ability of women futsal players in the Women's Futsal Student Activity Unit (UKM) during the Covid-19 pandemic by examining the effect of the treatment.

Materials and methods. The research used a pre-experiment method using a quantitative descriptive approach with One Group Pretest-Posttest Design. A total of 30 students who participated in the Women's Futsal UKM at the University of Suryakancana became the research population. These female futsal athletes are campus team amateur athletes below the professional level of the Indonesian Futsal League.

Results. Based on research data, the average value before the obstacle run training treatment was 10.840 seconds and after the treatment was 9.600 seconds, which means that there was time reduction, or in other words, the woman futsal player's dribbling ability increased. The result of the test showed that the value of the interval training results before and after being given was 0.859.

Conclusions. It is suggested that further research explore the use of different kinds of media in improving the dribbling skills of futsal athletes during the Covid-19 pandemic.

Keywords: futsal, dribbling, Covid-19, virtual zoom.

Introduction

Ranging from children to adults in the world, considering that the game is easy to learn and not difficult to play (Nogueira et al., 2018) In the Futsal game, there are several basic techniques that must be mastered by a Futsal player. Futsal is a variant of association football that is played on a smaller pitch and mainly played indoors (Varkiani et al., 2013). The basic techniques include passing, holding the ball (control), chipping, dribbling, shooting, and heading (Pelana et al., 2020). A Futsal player must have good individual techniques and excellent physical condition to build cooperation between teammates and produce victory (Barcelos et al., 2017). Therefore, the ability of dribbling is important to be mastered by current futsal players in order to pursue

maximum achievements because Futsal players with good dribbling skills are able to create effective games that can produce victories. Each player certainly has different kick performance abilities, this can be seen from several factors from the physical component and the quality of training (Matzenbacher et al., 2014).

Futsal competitions between universities in Indonesia are rapidly growing and being held more and more every year, especially in the West Java region. Not only for men, but also for women, where Suryakancana University was once the Runner Up at Futsal Pakuan Women's Cup 2019. This achievement is a matter of pride for the Futsal Student Activity Unit (UKM) of Suryakancana University and becomes a benchmark for achieving better achievements. But at the end of 2019 and early 2020, there were obstacles and a global epidemic that befell people around the world, which of course includes Indonesia. The outbreak, called

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the Covid-19 epidemic, initially appeared in Wuhan, China, which caused problems and obstacles for the community in carrying out physical activities and sports. In sports competitions, athletes usually break previous records and set new ones (Rezaimanesh et al., 2011).

Regarding the outbreak and the emergence of the Covid-19 epidemic, the process of regaining achievements, such as the runner up at Pakuan Women's Cup 2019, and carrying out the planned training schedule has been disrupted so that athletes find it difficult to do activities and trainings, especially the training programs that has been planned by coach. Training is a process that must be done by every athlete if he wants to increase his abilities (T. Bompá & Carrera, 2015), so the process of improvement requires what is called training, because an athlete who is diligent in implementing the right training program will get the best results in his performance (T. O. Bompá & Buzzichelli, 2019). Training is a necessity for every athlete, thus, in training, it needs to be supported by a good training program (Pate et al., 2016) It is explained that mental formation training is specifically aimed at forming sportsmen who not only have physical, technical, and tactical abilities, but also have the maturity and high mental qualities to win the matches (Kirkham-King et al., 2017) The opinions of several experts above show the importance of training to increase achievement, but in this pandemic it is very difficult to carry out the training so that a form of training that can be used in this pandemic is needed. One form of training that can be used is training with virtual media. By using the online room, the exercise can be carried out via a video call or a zoom room application. In this method, the learning / training media that generally can be used are VCD (video compact disk) or DVD (video disk drive) (Osgerby, 2013) Exercise is usually defined as a systematic process that is carried out in the long term, repetitive, progressive, and has the aim of improving physical appearance (van der Graaf et al., 2020). Many factors affect the performance of students or athletes, these factors are physical, technical, tactical or strategic, and mental abilities (Bramantoro et al., 2020) From some of the opinions above, it can be concluded that obstacle run training for a Futsal athlete using virtual media is needed to improve the players' movement ability in order to master the dribbling technique.

The observations on dribbling skills of female students who take part in the Futsal UKM, Suryakancana University, were the background of the author's interest in conducting this research. During the observation, the writer saw that there were still many students who made basic mistakes

when doing dribbling. They still often did long dribbling to easily take the ball by the opponent (González-Ródenas et al., 2019). To improve dribbling skills, programmed and appropriate training is needed to achieve the expected results. Obstacle Run was used in this study to improve dribbling skills of female students involved in Futsal UKM, Suryakancana University. Obstacle Run training is a form of training that supports improving dribbling skills with virtual media use due to constraints of Covid-19.

Materials and Methods

Study participants

A total of 30 students who participated in the Women's Futsal UKM at University of Suryakancana became the research population. These female futsal athletes are campus team amateur athletes below the professional level of the Indonesian Futsal League. The sampling technique was Random Sample Test. The research was conducted from April to May 2020 at University of Suryakancana sports field.

Study organization

This research conducted a pre-experiment using a quantitative descriptive approach with the One Group Pretest-Posttest research design. Presenting the facts of the problematic symptoms systematically will make the analysis easier to understand and conclude (Tangkudung, 2018). The researcher first conducted a pretest on the group receiving treatment. Then, researchers did the treatment. When the treatment was finished, the researcher conducted a post-test. The magnitude of the effect of treatment can be known accurately by comparing the results of the pre-test and post-test.

The study was conducted for 16 meetings with training frequency 3 times a week.

In this study, a pre-experiment was conducted using a quantitative descriptive approach with the One Groups Pretest-Posttest research design, including (pre-test): conducting an initial test of dribbling before the sample received the treatment, X: implementing the treatment which was the obstacle run training using virtual zoom media, (post-test): performing the final test to see whether there was an improvement after the sample received the obstacle run training through virtual media or not. The instrument test used in this study was dribbling test instrument which specifically aimed to determine the Futsal player dribbling ability (Figure 1). This

Table 1. Training Procedure, 16 Zoom App Meetings

Warm Up	Obstacle Run Coaching Points:	Training Targets for Each Meeting For 16 Meetings
1. Preliminary	1. Dribbling ability	1. First step: run and then jump and bounce the ball
2. Introduction	2. Dribbling touch quality	2. Second step: run past the Hurdle jump and do a stap run
3. lined up pray	3. Concentration – Movement Adaptation	3. Third Step: Players carry out Hurdle jumps and stap
4. Explanation		4. Fourth Step: run with the ball over the hurdle
5. Material		5. All Exercises Are Virtually Performed With ZOOM App
6. Warm Up		



Fig. 1. Pratical 16 Meetings With 3 Times A Week Training Frequency

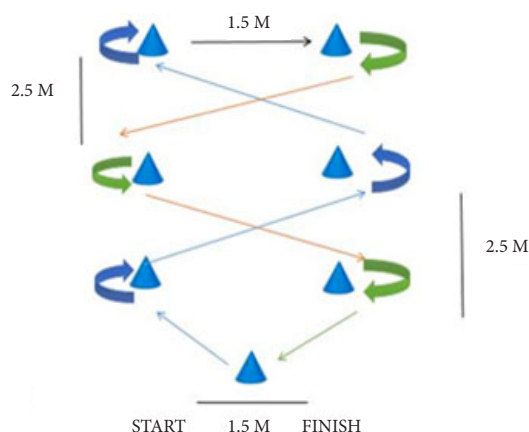


Fig. 2. Futsal Dribbling Test Instrument

Futsal dribbling test instrument, with a validity of 0.89 along with a reliability of 0.71, can be stated feasible to be used to measure dribbling abilities.

Statistical analysis

Statistical processing of the data was carried out on a computer using the standard SPSS 25 programs.

Result

The female students' dribbling skill of Futsal UKM, University of Suryakancana, was improved after receiving treatment. The mean value results of students' dribbling test decreased after receiving treatment. This can be seen in Table 2: Mean value results of dribbling paired samples statistic.

Table 2 shows that the average dribbling ability score of students who participated in the Suryakancana University women Futsal UKM before receiving the training was 10.8400 seconds and after receiving treatment with the Virtual Media-Based Obstacle Run Training was 9,600 seconds. This means

Table 2. Mean value results of dribbling paired samples statistic

		N	Mean	Std.deviation	Std.Error Mean
Pair 1	Pre-Test	30	10.84	1.475	0.208
	Post Test	30	9.46	1.064	0.150

that there was a decrease in time, which indicates that there was an improvement on students' Futsal dribbling skills after carrying out the Virtual Media-Based Obstacle Run Training.

The result of the test, with the value of the interval training before and after receiving treatment, was significantly improved. The results of dribbling correlation coefficient can be seen in Table 3: Results of the dribbling correlation coefficient paired samples correlations.

Based on the results of the output in Table 3, the effect coefficient of virtual media-based Obstacle Run Training on Dribbling Ability of women Futsal UKM, University of Suryakancana, before and after receiving treatment is 0.859 with a p-value of 0.00 <0.05, which concludes that there was a significant effect.

Table 3. Results of the dribbling correlation coefficient paired samples correlations

	N	Correlation	Sig.
Pair 1 Pre_Test & Post_Test	30	0.859	0.000

Discussions

The main factor in dribbling ability in order to beat opponents lies in the speed of the dribbling in the match. This is reinforced by the statement of (Beltrão de Matos, 2008) that said Futsal athletes have good dribbling skills if their time records are shorter when passing through obstacles. In this discussion, it can be said that the Obstacle Run practice through virtual media in the form of zoom meetings and google meetings has a significant effect. Therefore, it can be concluded that training is a support in maximizing achievements. In the covid-19 pandemic situation, trainers have to be more innovative and initiative, one of which is by carrying out training through virtual media. Currently, virtual classes have begun to be used as an alternative for learning (Riemann et al., 2020). This is because learning is no longer bound by time and space. So, practices can be carried out virtually and obstacle run training through virtual media can be carried out well so that it can increase dribbling skills, because virtual training can be done anywhere according to situations that make it impossible to carry out regular training in the Covid-19 epidemic. Virtual Classroom uses a combination of several tools to recreate a structure and learning experience from a physical classroom (Hassenfeldt et al., 2020) Virtual Classroom is a special application of social learning (O'Connor et al., 2020). Virtual reality is an innovative technology that enables students to practice sport. This study shows specific results, an increase in dribbling ability. Increased dribbling skills can help improve performance. In obstacle training, which is carried out through virtual media, it can be done in various places. It is called a virtual class because this exercise can help the process and progress of the training during Covid-19. Sports activities involve components of physical fitness, because physical components are the basis of human movement or physical activity, in addition to exercises that can strengthen ligaments, tendons, and bones (Pérez-Turpin et al., 2019). Exercise is a process that is done repeatedly to improve the physical quality and functional ability of the body's equipment to achieve planned goals. Exercises must be planned systematically and programmed so that the goals are planned. Therefore, planning is important for trainers in their efforts to direct a well-organized training program [5]. Based

on the opinion above, it can be seen that almost all virtual media can be used and utilized to support the process of conveying messages or materials. Virtual media can be helpful as a coach supporter element or as the main training element.

A relevant research states that there is an effect of obstacle run and down the line drill on the agility of the extracurricular football participants of Buah Batu 1 junior high school in 2015 (Suwariana et al., 2015). The most utilized rotation and translation movement while in the ball-possession among futsal players (Ismail et al., 2016). The effect of squat thrust and obstacle run exercises on increasing agility of badminton players and the effect of fartlek and obstacle run training on cardiorespiratory resistance. It can be concluded that obstacle training carried out through virtual media impacts the dribbling ability of the University of Suryakencana Women Futsal UKM. Prior to the training of obstacle run based on virtual media, the dribbling ability was 10,8400 seconds. Meanwhile, after receiving virtual training, it was 9.600 seconds. This means that there was a decrease in time, so that women Futsal dribbling skills were said to have increased. The test results with an interval value of $0.00 < 0.05$ showed a significant effect. It shows that there is a significant effect on the ability of female students' futsal dribbling skill after receiving obstacle run training through virtual media. The most important thing about this exercise is that it can be done anywhere, especially in a pandemic situation that limits activities in public sports facilities, which cannot be done in practical trainings in general.

Conclusion

Any comments and suggestions are welcomed so that we can constantly improve this template to satisfy all authors' research needs. From the data analysis results and discussion that have been stated, it can be concluded that the virtual media-based obstacle runs training has a significant effect on increasing the dribbling ability of the women futsal UKM, University of Suryakencana.

Suggestions and recommendations for further research are to use other training models based on virtual media that can be developed and to create several options where athletes can choose the training menu independently based on their needs.

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We want to express our gratitude to all authors and university institutions who have always supported all of these research activities. We want to thank the Chancellor and Dean of the FKIP University of Suryakencana and the students that supported the implementation of this research. We also would like to express our gratitude to the University of Suryakencana futsal coach and all parties that we cannot mention in this research. I hope this research can continue to analyse hitting skills from other parameters.

Conflict of interest

The authors state no conflict of interest.

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ВПЛИВ ТРЕНУВАННЯ З БІГУ З ПЕРЕШКОДАМИ ЗА ДОПОМОГОЮ ВІРТУАЛЬНИХ МЕДІА НА ВМІННЯ ДРИБЛІНГУ У ФУТЗАЛІСТОК ПІД ЧАС ПАНДЕМІЇ COVID-19

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

Реферат. Стаття: 5 с., 3 табл., 2 рис., 35 джерел.

Мета дослідження – дослідити вплив тренування з бігу з перешкодами за допомогою віртуальних медіа на здатність дриблінгу у футзалісток секції жіночого футболу відділу студентської діяльності (UKM) під час пандемії Covid-19.

Матеріали та методи. У дослідженні використовувався передекспериментальний метод з кількісним описовим підходом за планом попереднього та підсумкового тестування однієї групи. Учасниками дослідження стали 30 студенток, які займаються у секції жіночого футболу відділу студентської діяльності (UKM) Університету Сур'яканчана. Ці футзалістки є спортсменами-аматорами університетської команди з підготовкою нижче професійного рівня Індонезійської футзальної ліги.

Результати. За даними дослідження, середнє значення до тренування з бігу з перешкодами становило 10,840 секунд, а після – 9,600 секунд, тобто відбулося зменшення часу, або, іншими словами, вміння дриблінгу у футзалісток підвищилось. Результат тесту показав, що значення результатів інтервального тренування до і після проведення становило 0,859.

Висновки. Пропонується подальше дослідження використання різних видів медіа для покращення навичок дриблінгу у футзалісток під час пандемії Covid-19.

Ключові слова: футбол, дриблінг, Covid-19, віртуальний Zoom.

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ORIGINAL SCIENTIFIC ARTICLE

RELATIONSHIP OF SELECTED ANTHROPOMETRIC AND LINEAR KINEMATICAL VARIABLES WITH THE PERFORMANCE OF TOE-TOUCH SKILL IN KABADDI

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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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Abstract

The purpose of this study was to find out the relationship of selected anthropometric and linear kinematical variables with the performance of toe-touch skill among male kabaddi players (raiders).

Materials and Methods. One hundred male raiders were selected for this study. The age of the subjects ranged between 18 to 25 years. Selected anthropometric variables: foot length, upper leg length, lower leg length, thigh girth and calf girth were measured by standardized equipment. Selected linear kinematical variables were measured by digital software "Kinovea version-0.9.3". The toe-touch skill performed by raiders was assessed by three experts rating. The inter-rater reliability of the scores awarded by the experts to the subjects was tested by Cohen's Kappa test and Kappa coefficient was found significant.

Results. Spearman's rank correlation revealed that there was significant correlation in case of thigh girth ($r_s = 0.230$, $p = 0.022$), distance ($r_s = 0.245$, $p = 0.014$) and center of gravity ($r_s = -0.270$, $p = 0.007$) variables, and there was not significant correlation in case of upper leg length ($r_s = 0.048$, $p = 0.634$), lower leg length ($r_s = -0.90$, $p = 0.373$), calf girth ($r_s = 0.093$, $p = 0.355$), foot length ($r_s = -0.17$, $p = 0.863$) and time ($r_s = -0.006$, $p = 0.952$) variables with the performance of toe-touch skill in kabaddi.

Conclusion. The study concludes that thigh girth and distance positively and center of gravity negatively contributes to the performance of toe-touch skill in male kabaddi players.

Keywords: kabaddi, raider, skill, anthropometrical variables, linear kinematics.

Introduction

Kabaddi is combative team game, which is played all over India. In terms of success, this game is also getting a good status in Asian sports (Jadhav, 2012). It is also known as the "game of the masses," since spectators totally involve themselves and give a great deal of encouragement to the players (Dey, Khanna & Batra, 1993; Arshaq & Martin, 2018). This sport requires a high amount of physical fitness in the players to execute offensive push, falls, turns, sudden change of direction holding, bending, jumping, leg and hand touch, and maintaining holding and respiration. An athlete of this sport should have physical stamina, agility, individual proficiency, neuromuscular coordination, mental toughness with the presence of mind on both attackers and defenders (Nataraj & Chandrakumar, 2008). There are many offensive and defensive skills in kabaddi which are used by defenders and raiders.

Kabaddi is perhaps the only combative sport in which attack is an individual attempt while defense is a group effort (Patel, Pandey, Saxena, & Kalyanpur, 2011). Toe-touch is an offensive skill which is used by the raider to touch the opponent during raid. While performing this skill, the raider requires to extend his leg suddenly towards the anti. He extends all the joints (knee and ankle) in order to cover more distance and touch with the inner portion of the toe (Ittoo & Jain, 2020).

Sports performance is based on a complex and intricate diversity of numerous factors such as physical, physiological and anthropometric, variety mixture of all inborn qualities, represent most important and fundamental criteria of athletes' performance, which play vital role in success in a specific sport and reach to high level of performance (Bosco, Komi, Tihanyi, Fekete & Apor, 1983; Campo, Vaeyens, Philippaerts, Redondo, De-Benito & Cuadrado, 2009; Gaurav, Singh & Singh, 2011). Talent identification and its improvement have emerged as an important region of studies in sports. In prediction consequences are anticipated be-

forehand. Usually, the expected effects aren't risk of guesses, however are based upon some known statistics of courting or cautiously conceived beliefs (Clarke, Harrison & Clarke-David, 1972).

Kinanthropometry is the measurement of body size and proportions. The measurements encompass frame weight, height, circumferences, skin fold thickness, bony widths and lengths. At present, sportsman for superior performance in any sports activities is chosen on the basis of bodily shape and frame length (Heyward, 2006). Anthropometric dimensions and morphological characteristics of athletes play a vital role to decide the achievement, especially in sports activities. In diverse ways, information of anthropometric traits is important to establish their importance for the fulfilment in competitive sport (Keogh, 1999; Viswanathan & Chandrasekaran, 2011; Wilmore & Costill, 2005).

According to Hatze, "Biomechanics is the science which studies structure and function of Biological systems using the knowledge and methods of mechanics". Biomechanics can be stated that the cumulative function of skeletal, Muscular, and Joints to execute any task. Proper understanding of biomechanics has the greatest application in injury prevention, rehabilitation along with the mastery over the technique (Hatze, 1981).

It is very essential to understand about the application of physics to games and sports, Exercises Such as Speed, distance, displacement, resistance, Acceleration, forces, resistance, momentum and friction which play vital role in sports. The general role of biomechanics is to understand the cause effect relationship of biomechanical variables and performance. Video has much application in the field of sports and science. Athlete and coaches use medium more and more to measure the correct technique. Video analysis software has many applications in biomechanical research (Bartlett, 2007).

Various studies have been conducted by the researchers to find out the relationship of anthropometric variables with the playing ability of kabaddi players (Devaraju & Needhiraja, 2012; Johnson, 2016; Pandey & Sardar, 2016). But there is not a single study available in a literature which describes the relationship of anthropometric variables with a particular skill performance on kabaddi. There is a very smaller number of biomechanical studies in kabaddi (Ram, 2019ab). Hence, the purpose of this study was to find out the relationship of selected anthropometric and linear kinematical variables with the toe-touch skill performance (TTSP).

Table 1. List of variables

S.N.	Variables	Explanation
1.	Foot length	A measure of the distance from the heel to the longest toe of the left foot
2.	Upper leg length	The distance from the trochanterion to the tibiale laterale
3.	Lower leg length	The distance from the tibiale laterale to the sphyrion tibiale
4.	Thigh girth	Measurement taken perpendicular to the long axis of the thigh at the level midway between the trochanterion and tibiale laterale sites
5.	Calf girth	The calf girth measurement is a measure of the circumference of the lower leg
6.	Time	Time taken to execute toe-touch skill
7.	Distance	Distance between both feet during an execution phase of toe-touch skill
8.	Center of gravity	Location of the concentrated weight of a raider during an execution phase of toe-touch skill

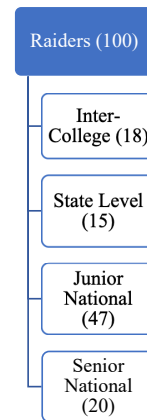


Fig. 1. Description of sampling plan

Materials and Methods

Study participants

One hundred male raiders were selected for this study by purposive sampling technique who at least participated in inter-college level competition. The age of the subjects was ranged between 18-25 years. All the subjects had knowledge and training experience in kabaddi.

The subjects were selected from various kabaddi academies of four states: Punjab, Himachal Pradesh, Haryana and Uttarakhand, and one union territory: Chandigarh. A prior permission was taken from coaches of kabaddi academies before data collection.

Total 8 variables (5 anthropometrical + 3 linear kinematical variables) were selected in this study (Table 1). This study was the part of PhD topic which was approved by DRC (Departmental Research Committee).

Procedure

All the participants were informed in details about research protocol and the basic characteristics of the study. No special motivation technique was used to motivate the players before data collection. All the participants executed the same protocol under the same circumstances and were guided by researcher. The measurements of foot length (cm), upper leg length (cm) and lower leg length (cm) were taken with a standardized equipment Lafayette Bone Caliper (Model 01293). The measurements of thigh girth (cm) and calf girth (cm) were taken with a standardized equipment Gulick Anthropometric tape (Table 1) (Norton & Olds, 2006).

To measure the performance of the toe-touch skill of raiders, instructions were given to raiders that they have to raid in opponents side and perform a toe-touch skill. Appropriate time was given to raiders and defenders for general and specific warm-up. Match situation was created and raiders were asked to raid. Three raids were given to every raider and best one was considered. Performance of every

Table 2. Description of selected tools and their measuring units

S.N.	Variable	Tool	Measuring Unit
1.	Foot Length	Lafayette Bone Caliper (Model 01293)	Centimeter
2.	Upper Leg Length	Lafayette Bone Caliper (Model 01293)	Centimeter
3.	Lower Leg Length	Lafayette Bone Caliper (Model 01293)	Centimeter
4.	Thigh Girth	Gulick Anthropometric tape	Centimeter
5.	Calf Girth	Gulick Anthropometric tape	Centimeter
6.	Time Taken for execution of the skill	Kinovea Software	Second
7.	Distance between both feet during the execution phase of skill	Kinovea Software	Centimeter
8.	Center of Gravity during the execution phase of skill	Kinovea Software	Centimeter
9.	Toe-Touch Skill Performance	Rating Scale	Points

**Fig. 2.** Subject performing Toe-Touch skill

raid was recorded by Y1-Action Camera with a speed of 240fps (Figure 2).

For the measurement of selected linear kinematical variables, recorded videos of skill performance were analyzed by digital software 'Kinovea version-0.9.3' speed (seconds), distance (cm) and center of gravity (cm) variables were calculated (Gogoi & Rajpoot, 2019).

After the completion of data collection process, researchers contacted with kabaddi experts and explained them about the purpose of this study and also about their role to give rating to the subjects according to their performance. Rating scale was given to each expert before starting the evaluation process (Table 2). The recorded videos of subjects' performances were shown to three experts for rating purpose. All experts were having diploma of coaching in kabaddi and also having participation in national level competitions. The inter-rater reliability of experts was tested by using Cohen's Kappa inter-rater reliability test and Kappa's coefficient was found significant (Kvålseth, 1989). The average of the total scores given by the subjects was taken as final performance score of the subjects.

Statistical Technique

Descriptive statistics i.e., median, inter-quartile range was calculated. According to the nature of data non-parametric test 'Spearman Rank Correlation' was employed to find out the relationship between TTSP and anthropometric variables with the help of SPSS-software version 23. Level of significance was set at 0.05 (Zar, 2005).

Table 3. Explanation of Rating Scale

S.N.	Comment	Score
1.	Very Good	5
2.	Good	4
3.	Average	3
4.	Satisfactory	2
5.	Poor	1

Results

Table 4 shows the median and inter quartile range values of skill performance scores and selected anthropometric variables. Median and inter quartile range values of performance scores, foot length, upper leg length, lower leg length, thigh girth and calf girth variables are 3(1), 25(1.88), 41.50(4.50), 37.50(2.88), 54(6) and 36(2.50) respectively. It also shows that there is an insignificant relationship of foot length ($r_s = -0.17$, $p = 0.863$), upper leg length ($r_s = 0.048$, $p = 0.634$), lower leg length ($r_s = -0.90$, $p = 0.373$) and calf girth ($r_s = 0.093$, $p = 0.355$) with toe-touch skill performance and significant relationship of thigh girth ($r_s = 0.230$, $p = 0.022$) with toe-touch skill performance.

Table 5 shows the median and inter quartile range values of skill performance scores and selected linear kinematical variables. Median and inter quartile range values of performance scores, time, distance and enter of gravity variables are 3(1), 0.433(0.19), 86.25(24.78) and 44.12(14.76) respectively. It also shows that there is an insignificant relationship of time variable ($r_s = -0.006$, $p = 0.952$) with toe touch skill performance and significant relationship of distance variable ($r_s = 0.245$, $p = 0.014$) with toe-touch skill performance at 0.05 level of significance and center of gravity variable ($r_s = -0.270$, $p = 0.007$) with toe-touch skill performance at 0.01 level of significance.

Discussion

There is evidence that anthropometric variables contribute significantly in the playing ability of male kabaddi players (Devaraju & Needhiraja, 2012). The purpose of this study was to find out the relationship of selected anthropometric and linear kinematical variables with the performance of

Table 4. The Relationship of selected anthropometric variables with the performance of toe-touch skill

S.N.	Variable	Median	IQR	'r' value	p-value (sig.)
1	Performance Scores	3	1	-	-
2	Foot Length	25	1.88	-0.017	0.863
3	Upper Leg Length	41.50	4.50	0.048	0.634
4	Lower Leg Length	37.50	2.88	-0.090	0.373
5	Thigh Girth	54	6	0.230	0.022*
6	Calf Girth	36	2.50	0.093	0.355

Note: IQR = Inter Quartile Range; *Denotes significant relationship at 0.05 level of significance

Table 5. The Relationship of selected linear kinematical variables with the performance of toe-touch skill

S.N.	Variable	Median	IQR	'r' value	p-value (sig.)
1	Performance Scores	3	1	-	-
2	Time	0.433	0.19	-0.006	0.952
3	Distance	86.25	24.78	0.245	0.014*
4	Center of Gravity	44.12	14.76	-0.270	0.007**

Note: IQR = Inter Quartile Rang. *Denotes significant relationship at 0.05 level of significance. **Denotes significant relationship at 0.01 level of significance

toe-touch skill among male kabaddi players (raiders). Five anthropometric variables: foot length, upper leg length, lower leg length, calf girth and three linear kinematical variables: speed, distance and center of gravity were taken in this study.

The result showed that there was an insignificant relationship ($rs = -0.17$, $p = 0.863$) between foot length variable and TTSP. The result of this finding is supported by the study conducted by Pandey and Reddy (2019) where they found that anthropometric variable foot length has no significant correlation with the performance of Forehand Overhead stroke i.e., clear, smash and drop in a Badminton (Pandey & Reddy, 2019).

The results showed that there was an insignificant relationship ($rs = 0.048$, $p = 0.634$) between upper leg length variable and TTSP. The results also showed that there was an insignificant relationship ($rs = -0.90$, $p = 0.373$) between lower leg length variable and TTSP. The results of these findings are supported by the study conducted by Yallappa (2020) and Sharma (2019) where they found that there was no significant relationship of no relationship of leg length with the kabaddi playing ability among university male kabaddi players and no significant relationship of shot-put performance with upper leg length and lower leg length (Yallappa, 2020; Sharma, 2019).

The result showed that there was an insignificant relationship ($rs = 0.093$, $p = 0.355$) between calf girth variable and TTSP. The result of this finding is supported by the study conducted by Arshaq & Martin (2018) where they found that there was an insignificant correlation between calf girth and performance of kho-kho game (Arshaq & Martin, 2018).

The result showed that there was a significant relationship ($rs = 0.230$, $p = 0.022$) between thigh girth variable and TTSP. The result of this finding is supported by the study conducted by Johnson (2016) and Madegowda & Venkatesh (2016) where they found significant relationship between thigh girth and playing ability among kabaddi players (Johnson, 2016, Madegowda & Venkatesh, 2016).

The result showed that there was an insignificant relationship ($rs = -0.006$, $p = 0.952$) between time variable and TTSP. The result of this finding is partially supported by the study conducted by Hart et al. (2016) who found that there was an in significant relationship of foot velocity with the kicking accuracy in football (Hart, Nimphius, Spiteri, Cochrane & Newton, 2016).

The result showed that there was a significant relationship ($rs = 0.245$, $p = 0.014$) between distance variable and TTSP. The result of this finding is supported by the study conducted by Landers et al. (2011) where they found that there was significant relationship of stride length with running and triathlon performance (Landers, Blanksby & Rackland, 2011).

The result showed that there was a significant relationship ($rs = -0.270$, $p = 0.007$) between center of gravity variable and TTSP. The result of this finding is supported by the study conducted by Bal et al. (2009) who found that there was a significant relationship of center of gravity at the releasing moment of lay-up shot in basketball (Bal, Deol & Kaur, 2009).

In case of anthropometrical variables, the results of this study are contradictory as compared to previous studies. Previous studies conducted in kabaddi shows relationship between anthropometric variables and playing ability of kabaddi players (Devaraju K., Needhiraja, 2012; Johnson, 2016, Madegowda & Venkatesh, 2016). The reason behind these differences can be that in previous studies overall performance of players was measured. Players were allowed to perform any skill and there was not any specificity regarding the skill. But this study was focused only on performance of a single raiding skill: toe-touch.

In case of linear kinematical variables, there are not previous studies available in the literature in kabaddi. But, on the basis of experience of the researcher being a kabaddi player, it can be said that by increasing in distance between both feet during the execution phase of toe-touch skill can

increase the chances to touch an opponent by foot for which this skill is performed during the raid. Lowered center of gravity provides better stability to perform movement smoothly. In case of toe-touch skill performance, if raider lowers down his center of gravity during the raid while performing toe-touch skill, then he can get more stability to perform skill smoothly.

Conclusion

The study concludes that increase in the size of thigh girth and distance positively contributes in toe-touch skill performance in kabaddi. Center of gravity negatively contributes in toe-touch skill performance in kabaddi. It can help coaches while make training plan for raiders to enhance their raiding performance.

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ЗВ'ЯЗОК МІЖ ВИБРАНИМИ АНТРОПОМЕТРИЧНИМИ Й ЛІНІЙНИМИ КІНЕМАТИЧНИМИ ЗМІННИМИ ТА ВИКОНАННЯМ ДОТИКУ ПАЛЬЦЕМ НОГИ В КАБАДДІ

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

Реферат. Стаття: 6 с., 5 табл., 2 рис., 33 джерела.

Мета дослідження – виявити зв'язок між вибраними антропометричними й лінійними кінематичними змінними та виконанням дотику пальцем ноги у чоловіків-гравців кабадді (рейдерів).

Матеріали і методи. Для дослідження було відібрано сто чоловіків-рейдерів. Вік випробовуваних коливався від 18 до 25 років. Вибрані антропометричні показники: довжина стопи, довжина стегна, довжина гомілки, обхват стегна та обхват ікри були виміряні за допомогою стандартного обладнання. Вибрані лінійні кінематичні змінні вимірювалися з використанням цифрового програмного забезпечення “Kinovea version-0.9.3”. Виконання дотику пальцем ноги рейдерами оцінювалося трьома експертами. Надійність рейтингових оцінок, нарахованих експертами випробовуваним, було перевірено за допомогою тесту Каппа Коена, коефіцієнт Каппа визнано достовірним.

Результати. Рангова кореляція Спірмена показала, що існує значна кореляція змінних обхвату стегна ($r_s = 0,230$, $p = 0,022$), відстані ($r_s = 0,245$, $p = 0,014$) та центру ваги ($r_s = -0,270$, $p = 0,007$), і не має значної кореляції змінних довжини стегна ($r_s = 0,048$, $p = 0,634$), довжини гомілки ($r_s = -0,90$, $p = 0,373$), обхвату ікри ($r_s = 0,093$, $p = 0,355$), довжини стопи ($r_s = -0,17$, $p = 0,863$) та часу ($r_s = -0,006$, $p = 0,952$) з виконанням дотику пальцем ноги в кабадді.

Висновки. У дослідженні зроблено висновок, що на виконання дотику пальцем ноги у чоловіків-гравців кабадді обхват стегна і відстань впливають позитивно, а центр ваги – негативно.

Ключові слова: кабадді, рейдер, навичка, антропометричні змінні, лінійна кінематика.

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ORIGINAL SCIENTIFIC ARTICLE

THE LEVEL OF UNDERSTANDING OF PEDAGOGICAL COMPETENCE OF PHYSICAL EDUCATION, HEALTH AND RECREATION STUDENTS OF SPORTS SCIENCE FACULTY

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Abstract

The study purpose. This study aims to determine the level of understanding of the pedagogical competence of Physical Education, Health and Recreation students of the Faculty of Sports Science, Yogyakarta State University, batch 2016.

Materials and methods. This research method is a survey with a quantitative descriptive approach. The population is 180 physical education students, the sample selection is 52 physical education students using incidental sampling technique. The research instrument is a valid and reliable questionnaire. The data analysis technique is the analysis presented using the percentage.

Results. The results obtained show that the level of understanding of the pedagogic competence of Physical Education, Health and Recreation students of the Faculty of Sports Science, Yogyakarta State University, class 2016 was "very low" 3.85% (2 students), "low" 67.31% (35 students), "medium" 19.23% (10 students), "high" 9.62% (5 students) and "very high" 0% (0 students).

Conclusions. Based on the results of the study, it can be concluded that the level of understanding of the pedagogic competence of Physical Education students is in the low category.

Keywords: level of understanding, pedagogical competence, physical education, health and recreation students.

Introduction

Education is an effort that is made consciously and intentionally to change human behavior both individually and in groups to become mature humans through teaching and training (Gaetano, 2012). Talking about education, of course, cannot be separated from learning and teaching activities, one of the efforts to realize educational expectations requires a teacher.

The teacher is an educator whose job is to guide, direct, teach, train, assess, educate and evaluate students through formal education (Yusnita et al., 2018; Azhary, Handoyo, & Khafid, 2018). As a competent educator, of course, he wants to make a good contribution to the progress of his students (Asari, Fauziyah, & Uchtiawati, 2018; Ahmad & Setyaningsih, 2012). The ability to manage and manage learning and

teaching activities in education is called pedagogic competence (Asari, Fauziyah, & Uchtiawati, 2018).

In particular, pedagogic competencies can be classified as follows: (a) personality is not innate but professional roles developed through tiered training (Liakopoulou, 2011), (b) deepening and mastery of material to save time and teach more important knowledge by referring to research data that refers to the chosen strategy (Beyer, 2002; Oser et al., 2006), (c) special abilities and skills that have an effective impact on teaching practice (Liakopoulou, 2011), (d) attitudes towards teaching and learning activities that are not only able to evaluate, understand and choose knowledge, but how to use and act (Liakopoulou, 2011).

Based on this description, the author states that pedagogic competence is very complex. Therefore, there is a need for a more in-depth study. One of the educational universities in Indonesia, namely Yogyakarta State University, must organize several programs synergistically, including

academic and professional education programs in the field of education (Physical Education, Health and Recreation Curriculum 2014, 2015: 4). The realization of educational institutions, especially the faculty of sports science, cannot be separated from educational programs and curriculum implementation through courses.

Courses have objectives in accordance with the fields of knowledge and skills that are limited by the curriculum. Students of the Physical Education, Health, and Recreation study program who take the Physical Education Teacher Professional Preparation course can be said to have understood the professionalism and competence as a physical education teacher in accordance with the Book of Competency Standards for Beginner Teachers of the Bachelor of Physical Education Study Program.

Based on a preliminary study through observations and interviews with Physical Education students at the time of introduction to the school field, problems were found related to understanding teacher competencies, especially pedagogic competencies, these problems were: (1) some students still had difficulties in designing learning, so the design of learning practices was still copy paste to friends and the internet, this is a problem because the conditions of one school are different from one another, (2) some students teach not in accordance with the lesson plans that have been prepared, this of course can hinder students in developing their talents and potential, (c) in evaluating In learning, some students make assessments based on subjectivity, for example giving good marks to students who have been recognized (d) besides that there are students who have not been able to understand student characteristics, such as difficulties in managing students who do not want to take part in learning n in class.

Based on the investigation of several research literature on this topic, it has often been done, but in particular there are differences in the problems and variables that exist, thus the purpose of this study is to find out and describe the level of understanding of the pedagogic competence of students in Physical Education, Health and Recreation, Faculty of Sports Science, State University Yogyakarta batch 2016.

Materials and methods

Study participants

This research method is descriptive quantitative, which describes the variables studied (Atmowardoyo, 2018). The inclusion criteria in this study were students of physical education, health and recreation class 2016 who were taking field introduction courses at school, then the exclusion criteria were students did not collaborate with researchers. The population is 180 students while the sample is 52 students. The sampling technique is incidental sampling (Ward et al., 2018).

Study organization

The instrument in this study uses the test method (Assarroudi, 2018). The data collection technique was observation using a questionnaire instrument, before being used the instrument was checked by experts and then tested for validity and reliability. The data used is primary data, which

is taken from participants in the field. The data collection mechanism is as follows: (1) Researchers seek data from students of Physical Education, Health and Recreation, Faculty of Sports Science, State University of Yogyakarta batch 2016 who have taken the Field School Introduction course. (2) Researchers determine the number of students who are the subject of research. (3) Researchers distribute instruments in the form of multiple choice tests. (4) The researcher collected the test results and transcribed the results of filling out the test. (5) After that, the data is tabulated and percentage. To find out whether the item is good or not, it is done by analyzing the item using the formula: Difficulty $P = R/T$. Information: R = the number of respondents who answered each item correctly. T = number of respondents who answered the test.

Table 1. Difficulty Level Criteria

Difficulty Index	Information
Less than 0.30	Items in the difficult category
0.31-0.70	Items in the Sufficient category
More thsn 0.71	Easy categorized question items

(Source: Arikunto, 2013:210)

A test can be said to be good if the alternative answers chosen are at least 5% of all respondents who work on the question. Validity test is used to analyze each question item with the help of the product moment correlation formula.

Table 2. Criteria for the Level of Distinguishing Power for the Item Problem

Item Distinguishing Power	Information
0-0.20	Question items have weak distinguishing power
0.21-0.40	Question items have moderate distinguishing power
0.41-0.70	Question items have good distinguishing power
0.71-1.00	Question items have very strong distinguishing power
Signed Negative	The question item has very bad distinguishing power

(Source: Arikunto. 2013: 210)

Statistical analysis

The data analysis technique in this study uses percentage data analysis, which will present statistical descriptive data including tables, graphs, diagrams, circles, pictograms, mean, median, mode, percentile, decile calculation, standard deviation and percentage (Deeks et al., 2019). The calculation is assisted by SPSS 25, then to clarify the analysis process, categorization will be carried out. Categorization consists of very high, high, medium, low, very low. The research basis for determining this ability is to maintain a level of consistency in research, with the following formula (Hox et al., 2017): $P = F/N \cdot 100\%$. Information: P = Percentage sought, F = Frequency, N = Number of Respondents.

Determine the interval using the formula from Arikunto (2013: 207) in table 3 as follows:

Table 3. Assessment Norms

No	Interval	Category
1	81-100	Very High
2	61-80	High
3	41-60	Medium
4	21-40	Low
5	0-20	Very Low

(Source: Arikunto, 2013: 207)

Results

The results of this study aim to describe the level of understanding of pedagogic competence, with the following results: the lowest score (minimum) 12.82, the highest score (maximum) 89.76, the average (average) 37.8, the average score mean (median) 35.89, frequency (mode) 23.07, standard deviation (SD) 16.68.

Table 4. Results of Student Pedagogical Competence Comprehension

No	Interval	Category	Frequency	%
1	81-100	Very High	0	0.00%
2	61-80	High	5	9.61%
3	41-60	Medium	10	19.23%
4	21-40	Low	35	67.31%
5	0-20	Very Low	2	3.85%
Total			52	100.00%

Based on table 4, it is explained that the level of understanding of pedagogic competence is in the “very low” category of 3.85% (2 students), “low” of 67.31% (35 students), “Medium” of 19.23% (10 students), “high” 9.61% (5 students) and “very high” 0% (0 students). Based on these results, the dominant category is included in the low category, the following diagram is presented:

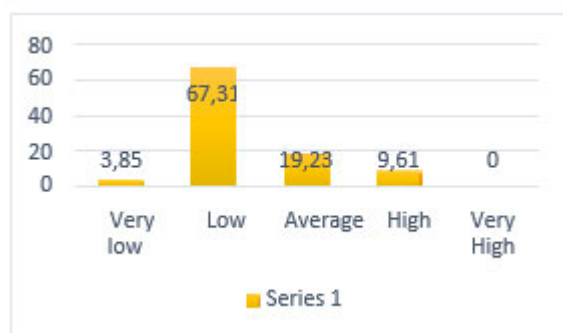


Fig. 1. Bar diagram of the level of understanding of the pedagogic competence

Mastery Factor Characteristics of Students

Based on table 5, the results show that the characteristic completeness factor is in the very low category 5.77% (3 students), low at 30.77%, moderate at 40.38% (21 students), high 19.23% (10 students) and “very high 3.85% (2 students). The most dominant category in the mastery factor of student characteristics is in the “medium” category.

Table 5. Results of Study of Student Characteristics Mastery Factors

No	Interval	Category	Frequency	%
1	81-100	Very High	2	3.85%
2	61-80	High	10	19.23%
3	41-60	Medium	21	40.38%
4	21-40	Low	16	30.77%
5	0-20	Very Low	3	5.77%
Total			52	100.00%

Factor Theory and Principles of Learning

Based on table 6, it was found that the factors of learning theory and learning principles were in the “very low” category of 25.00% (13 students), “low” of 46.15% (24 students), “medium” of 0.00 % (0 students), “high” 23.08% (12 students) and “very high” 5.77% (3 students). The most dominant category of learning theory factors and learning principles is in the “low” category.

Table 6. Research Results of Learning Theory Factors and Learning Principles

No	Interval	Category	Frequency	%
1	81-100	Very High	3	5.77%
2	61-80	High	12	23.08%
3	41-60	Medium	0	0.00%
4	21-40	Low	24	46.15%
5	0-20	Very Low	13	25.00%
Total			52	100.00%

Curriculum Development Factors

Based on table 7, it was found data that the curriculum development factor was in the “very low” category of 5.77% (3 students), “low” of 19.23% (10 students), “medium” of 57.69% (30 students), “high” 9.62% (5 students) and “very high” 7.69% (4 students). The most dominant category in the curriculum development factor is the “medium” category.

Table 7. Research Results of Curriculum Development Factors

No	Interval	Category	Frequency	%
1	81-100	Very High	4	7.69%
2	61-80	High	5	9.62%
3	41-60	Medium	30	57.69%
4	21-40	Low	10	19.23%
5	0-20	Very Low	3	5.77%
Total			52	100.00%

Educating Learning Factors

Based on table 8, it was found that the educational learning factors were in the “very low” category of 21.15% (11 students), “low” of 26.92% (14 students), “medium” of 25% (13 students), “high” 13.46% (7 students) and “very high” 13.46% (7 students). The most dominant category in educational learning factors is in the “low” category.

Table 8. Research Results of Educating Learning Factors

No	Interval	Category	Frequency	%
1	81-100	Very High	7	13.46%
2	61-80	High	7	13.46%
3	41-60	Medium	13	25.00%
4	21-40	Low	14	26.92%
5	0-20	Very Low	11	21.15%
Total			52	100.00%

Information and Communication Technology Utilization Factors

Based on table 9 it is found that the use of information and communication technology is in the “very low” category of 16.46% (7 students), “low” of 0.00% (0 students), “medium” of 38.46% (20 students), “high” 0.00% (0 students) and “very high” 48.08% (25 students). The most dominant category on technology, information and communication factors is in the “high” category.

Table 9. Research Results on Information and Communication Technology Utilization Factors

No	Interval	Category	Frequency	%
1	81-100	Very High	25	48.08%
2	61-80	High	0	0.00%
3	41-60	Medium	20	38.46%
4	21-40	Low	0	0.00%
5	0-20	Very Low	7	13.46%
Total			52	100.00%

Student Potential Development Factors

Based on table 10, it was found that the data on the potential development factors of students were in the “very low” category of 61.54% (32 students), “low” of 0.00% (0 students), “medium” of 32.69% (17 student). students, “high” 0.00% (0 students) and “very high” 5.77% (3 students). The most dominant category in the development of student potential is in the “very low” category.

Table 10. Research Results of Students’ Potential Development Factors

No	Interval	Category	Frequency	%
1	81-100	Very High	3	5.77%
2	61-80	High	0	0.00%
3	41-60	Medium	17	32.69%
4	21-40	Low	0	0.00%
5	0-20	Very Low	32	61.54%
Total			52	100.00%

Effective, Empathic, and Polite Communication Factors

Based on table 11, it was found that the effective, empathic and polite communication factors were in the “very low” category of 61.54% (32 students), “low” of 0.00% (0 students), “medium” of 28, 85 % (15 students), “high” 0.00% (0 students) and “very high” 9.61% (5 students). The most dominant category on effective, empathetic and polite communication factors is in the “very low” category.

Table 11. Research Results of Effective, Empathic and Polite Communication Factors

No	Interval	Category	Frequency	%
1	81-100	Very High	5	9.61%
2	61-80	High	0	0.00%
3	41-60	Medium	15	28.85%
4	21-40	Low	0	0.00%
5	0-20	Very Low	32	61.54%
Total			52	100.00%

Factors for Assessment and Evaluation of Learning Process and Outcomes

Based on table 12, it has been found that the assessment and evaluation factors of learning processes and outcomes are in the “very low” category of 67.31% (35 students), “low” of 17.31% (9 students), “medium” of 9, 61% (5 students), “high” 0.00% (0 students) and “very high” 5.77% (3 students). The most dominant category in the assessment and evaluation process factors as well as learning outcomes are in the “very low” category.

Table 12. Research Results of Assessment and Evaluation Process and Learning Outcomes

No	Interval	Category	Frequency	%
1	81-100	Very High	3	5.77%
2	61-80	High	0	0.00%
3	41-60	Medium	5	9.61%
4	21-40	Low	9	17.31%
5	0-20	Very Low	35	67.31%
Total			52	100.00%

Evaluation Factors for Learning Purposes

Based on table 13, it was found that the evaluation factor for the benefits of learning was in the “very low” category of 44.23% (23 students), “low” of 34.62% (18 students), “medium” of 0% (0 students), “high” 13.46% (7 students) and “very high” 7.69% (4 students). The most dominant category in the evaluation factor for learning purposes is in the “very low” category.

Table 13. Research Results of Evaluation Factors for Learning Interests

No	Interval	Category	Frequency	%
1	81-100	Very High	4	7.69%
2	61-80	High	7	13.46%
3	41-60	Medium	0	0.00%
4	21-40	Low	18	34.62%
5	0-20	Very Low	23	44.23%
Total			52	100.00%

Reflective Action Factors for Improved Learning

Based on table 14, it was found that the reflective action factor for improving the quality of learning was in the “very low” category of 28.85% (15 students), “low” of 38.46% (20 students), “medium” of 0% (0 students), “high” 26.92% (14 students) and “very high” 5.77% (3 students). The most dominant category in the reflective action factor for improving the quality of learning is in the “low” category.

Table 14. Results of Reflective Action Research for Improved Learning

No	Interval	Category	Frequency	%
1	81-100	Very High	3	5.77%
2	61-80	High	14	26.92%
3	41-60	Medium	0	0.00%
4	21-40	Low	20	38.46%
5	0-20	Very Low	15	28.85%
Total			52	100.00%

Discussion

Based on the results of the study, it shows that the level of understanding pedagogical competence Physical Education Health and Recreation Students, Faculty of Sport Sciences, Yogyakarta State University, batch 2016, the most dominant category is in the low category. The low category indicates that the level of understanding of the pedagogic competence of the Physical Education Health and Recreation Student Faculty of Sport Sciences, Yogyakarta State University, batch 2016 has not met the expectations of the faculty and the Competency Standards Regulation of the Minister of National Education No. 16 of 2007 concerning Teacher Qualification and Competency Standards as teacher candidates explaining that teachers are good if they meet competencies the main aspects of which are pedagogical competencies that must be possessed by teachers. The results in the low category are also due to the fact that the respondents have difficulty working on the test questions.

Similar to previous research, it was explained that other difficulties experienced by participants recorded through this study were related to the question model (Höglinger & Diekmann, 2017). This is reinforced by Koo and Li (2016), questions about model descriptions with illustrations frankly make us confused, sometimes for us the relationship between statements and questions is difficult to understand. Based on the factor of the level of understanding pedagogical competence Physical Education Health and Recreation students, Faculty of Sport Sciences, Yogyakarta State University, batch 2016 is described as follows: The level of understanding pedagogical competence Physical Education Health and Recreation students, Faculty of Sport Sciences, Yogyakarta State University, batch 2016 based on the mastery factor of student characteristics, the most dominant category is in the “average” category. A teacher must master the characteristics of students because by understanding and approaching students the teacher can easily provide learning to students and can develop the potential that students have. The teacher has an understanding of the psychology of child development so that he knows exactly the right approach to take on his students. Teachers can guide children through difficult times in

the ages experienced by students. In addition, the teacher has knowledge and understanding of the child's personal background so that they can identify problems faced by students and determine appropriate solutions and approaches. According to Standards Regulation of the Minister of National Education No. 16 of 2007, there are 6 aspects, namely physical, intellectual, socio-emotional, moral, spiritual, and socio-cultural background.

The level of understanding pedagogical competence Physical Education Health and Recreation students, Faculty of Sport Sciences, Yogyakarta State University, batch 2016 is based on the learning theory and learning principles, the most dominant category is in the “low” category. Mastering several learning theories will enrich the methods used by the teacher, making it easier for teachers to form several variations of learning that can increase student motivation.

The level of understanding pedagogical competence Physical Education Health and Recreation students, Faculty of Sport Sciences, Yogyakarta State University, batch 2016 based on curriculum development factors, the most dominant category is in the “average” category. By understanding the curriculum, the teacher can teach directed and focused with the material presented not to deviate from the material to be delivered.

The level of understanding pedagogical competence Physical Education Health and Recreation students, Faculty of Sport Sciences, Yogyakarta State University, batch 2016 is based on educational learning factors, the most dominant category is in the “very low” category. The implementation of educational and dialogical learning, with the teacher carrying out learning that educates the teacher, can create an atmosphere of activity in the classroom and in the field by using multi methods and teaching techniques in learning. According to Amin et al. (2020) technically the implementation of learning activities shows in several things, namely the management of learning places / classrooms, management of learning materials, managing activities and time, managing students, managing learning resources and managing teaching behavior.

The level of understanding pedagogical competence Physical Education Health and Recreation students, Faculty of Sport Sciences, Yogyakarta State University, batch 2016 based on the use of technology, information and communication factors, the most dominant category is in the “high” category. The use of learning technology by utilizing teacher learning technology can be creative and can develop children's potential. In organizing the learning, teachers are using technology as a medium. Providing learning materials and administration using information technology. Familiarize children with interacting using technology. Based on a literature review, it is stated that the use of technology in education and learning (e-learning) provides convenience or makes learning effective for students. This means that teachers are required to prepare and present material on a computer network system that can be accessed by students. Therefore, teachers and prospective teachers are equipped with various competencies related to the use of information and communication technology as learning technology (Hashim, 2018).

The level of understanding pedagogical competency Physical Education Health and Recreation students, Faculty of Sport Sciences, Yogyakarta State University, batch 2016 based on the development factors of potential students, the most dominant category is in the category of “low”. The development of students to actualize the various potentials they have, the teacher

must know the potential of the child so that the teacher can develop the potential that the child has. Teachers have the ability to guide children, create a place for children to recognize their potential and train them to actualize their potential.

The level of understanding pedagogical competency Physical Education Health and Recreation students, Faculty of Sport Sciences, Yogyakarta State University, batch 2016 is based on communication factors that are effective, empathic and polite, the most dominant category is in the "low" category. Effective communication is the key to the success of the lessons to be conveyed. Meanwhile, empathic and polite elements can make communication continuity more meaningful.

The level of understanding pedagogical competency Physical Education Health and Recreation students, Faculty of Sport Sciences, Yogyakarta State University, batch 2016 based on the assessment and evaluation of learning outcomes, the most dominant category is in the "low" category. Assessment and evaluation of learning outcomes, by evaluating teacher learning, can determine the level of children's learning completion and to improve the quality of learning programs in general.

The level of understanding pedagogical competency Physical Education Health and Recreation students, Faculty of Sport Sciences, Yogyakarta State University, batch 2016 is based on the assessment and evaluation results for learning purposes, the most dominant category is in the "low" category. The results of the assessment and evaluation are an effort to improve the quality of the process and learning outcomes.

The level of understanding pedagogical competency Physical Education Health and Recreation students, Faculty of Sport Sciences, Yogyakarta State University, batch 2016 is based on reflective action factors to improve the quality of learning, the most dominant category is in the "low" category. Reflection on learning should be seen as part of the professional performance of the teacher to improve his competence as an educator. In learning reflection, the teacher can choose any technique that allows him to contemplate the learning that he has given and when doing so does not feel like a burden.

Although researchers have tried hard to meet all the requirements required, this does not mean that this research is without weaknesses and shortcomings. Some of the weaknesses and shortcomings that can be stated in this study include: (1) The difficulty of knowing the respondent's seriousness in taking the test. Efforts were made to minimize errors, namely by providing an overview of the aims and objectives of this study. (2) Data collection in this study was only based on the results of filling out the test so that there was an element of less objective in filling the test. In addition, in the filling of tests obtained the nature of the respondent himself such as honesty and fear in answering the question in fact. (3) When collecting research data, namely when distributing research instruments to respondents, it cannot be monitored directly and carefully whether the answer given by the respondent is really in accordance with his opinion or not.

Conclusions

Based on the results and discussion, it was concluded that the level of understanding of students' pedagogic competence was in the "very low" category of 3.85% (2 students), "low" of 67.31% (35 students), "Medium" of 19.23% (10 students), "high" 9.62% (5 students) and "very high" 0% (0 students).

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Conflict of interest

All authors declare that there is no conflict of interest

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РІВЕНЬ РОЗУМІННЯ ПЕДАГОГІЧНОЇ КОМПЕТЕНТНОСТІ СТУДЕНТІВ ФАКУЛЬТЕТУ СПОРТИВНИХ НАУК, ЯКІ СПЕЦІАЛІЗУЮТЬСЯ НА ФІЗИЧНОМУ ВИХОВАННІ, ОЗДОРОВЛЕННІ ТА РЕКРЕАЦІЇ

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

Реферат. Стаття: 7 с., 14 табл., 1 рис., 18 джерел.

Мета дослідження – визначити рівень розуміння педагогічної компетентності студентів факультету спортивних наук Державного університету Джок'якарти, які спеціалізуються на фізичному вихованні, оздоровленні та рекреації, вступу 2016 року.

Матеріали та методи. Методом дослідження було опитування з кількісним описовим підходом. Зі 180 студентів, які спеціалізуються з фізичного виховання, вибрано 52 студенти за методом випадкового відбору. Інструментом дослідження був універсальний та надійний опитувальник. Методом аналізу даних був аналіз, представлений з використанням відсотка.

Результати. Отримані результати свідчать, що рівень розуміння педагогічної компетентності студентів

факультету спортивних наук Державного університету Джок'якарти, які спеціалізуються на фізичному вихованні, оздоровленні та рекреації, вступу 2016 року, був «дуже низьким» 3,85% (2 студенти), «низьким» 67,31% (35 студентів), «середнім» 19,23% (10 студентів), «високим» 9,62% (5 студентів) і «дуже високим» 0% (0 студентів).

Висновки. За результатами дослідження можна зробити висновок, що рівень розуміння педагогічної компетентності студентів, які спеціалізуються на фізичному вихованні, є низьким.

Ключові слова: рівень розуміння, педагогічна компетентність, студенти, фізичне виховання, оздоровлення та рекреація.

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ORIGINAL SCIENTIFIC ARTICLE

MODELING OF APPROPRIATE NORMS OF PHYSICAL READINESS OF PRE-CONSCRIPTION YOUTH FOR SERVICE IN THE ARMY

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Abstract

Research purpose: is a substantiation and modeling of appropriate norms of physical readiness of youth for service in the army.

Materials and Methods. The expert group included 21 specialists (whose field of activity is physical education, special training, physical training in the security and defense forces). The following research methods were used to solve the problem posed in the work: theoretical analysis, comparison, systematization and generalization of materials of scientific, historical, methodical literature and guiding documents; expert evaluation (Delphi and analysis of Saati hierarchies); methods of mathematical statistics.

Results. It is determined that even simple statistical methods in combination with expert information when choosing promising solutions often give better results than accurate calculations with a focus on averages. A comprehensive approach using peer review (Delphi), a method of modern theory of hierarchical systems Saati allowed to determine the structure of the projected model of physical fitness of young people for military service. The structural interconnected components of the predicted model with the corresponding weighting factors are the level of formation and development of general and special physical qualities ($\rho_1 = 0.411$), the level of formation and development of special physical qualities ($\rho_2 = 0.235$), the level of acquisition of military applied motor skills ($\rho_3 = 0.216$), the state of the cardiovascular system ($\rho_4 = 0.138$).

Conclusions. The presented structural predictable model of integrated assessment of physical readiness of youth for service in the army allows to define limits of levels of components and to estimate their level of formation in points from 1 to 12, and also to correct the maintenance of means of physical training depending on such components which lag behind a proper norm.

Keywords: pre-conscription youth, predicted models, proper norms, physical fitness.

Introduction

The real threats to Ukraine's sovereignty and territorial integrity necessitated an increase in the level of readiness of young people to fulfill their patriotic duty and, accordingly, a high level of functional and psychophysical preparedness. In these conditions, the issue of finding an effective system of training pre-conscription youth for service in the Armed Forces of Ukraine became especially relevant (Krutsevich, & Trachuk, 2017).

A high level of physical fitness of young people is relevant, the army needs healthy, well-developed and well-

trained young men, but not every average young man meets the requirements of tomorrow's service (Krutsevych, Sainchuk, Pidleteichuk, 2018).

Physical training, according to experts, is the main means of combat training of servicemen, as well as a structural component that ensures the combat effectiveness of the armed forces as a whole (Military Committee, 2009; Borodin, 2009; Romanchuk, 2012; Bosenko, Sudets, 2017; Aandstad, Sandberg, Hageberg, Kolle, 2020). Physical training is a basic factor for the implementation of technical and mental readiness of troops, a means of adaptation to military-professional activities (Romanchuk, 2013; Olkhovoy, 2012; Romanchuk, C., Anokhin, Oderov, Klymovykh, Pidleteichuk, Dobrovolskii, Tychyna, 2020).

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The management system in physical education is based primarily on the operation of models, and only then – on the transfer of “samples” of pedagogical actions in practice (Priymak, 2003; Loshitska, 2007; Priymak, Krutsevich, Pangelova, Trachuk, Kravchenko, Stepanenko & Ruban, 2020).

Possibilities of creation, construction of models are caused by specific features of its application (Olkhovyi, 2012; Krutsevich, 2017; Krutsevich, Pangelova, Trachuk, 2019). When two phenomena that can be objectively measured are identified and the relationship between them is quantifiable, this provision opens up opportunities for cybernetic modeling of processes (Krutsevich, T. 2017).

The availability of models determines the opportunities for teachers to guide young people to achieve the appropriate level, and the military – the information that young people who meet the model requirements, are characterized by a higher level of physical condition and are able to perform certain duties in the future, accordingly to the appointment, and the military registration and enlistment office, in turn, would be able to plan and direct conscripts to the appropriate regime training zone (Loshitska, 2007).

The aim of the research was to study and modeling of appropriate norms of physical readiness of youth for service in the army.

Materials and method

Study participants

The expert group included 21 specialists (heads of physical training and sports of military units; teachers, heads of departments of physical education of special physical training and sports of higher military educational institutions of Ukraine).

Study organization

Methods of study: theoretical analysis, comparison, systematization and generalization of materials of scientific, historical, methodical literature and guiding documents; expert assessment (Delphi and analysis of hierarchies Saati); methods of mathematical statistics.

Procedure

According to the Delphi expert survey procedure, which was based on practical issues of leadership, organization and physical training of young people, their readiness for military service. Experts were given the main questions directly at the time of the survey, were not allowed to exchange views on problem, which ensured the independence of opinion. The survey procedure took place in stages:

- experts were asked to answer a list of questions formulated in detail on the research problem;
- each participant answered the questions anonymously;
- the results of the expert survey using the principle of pairwise comparisons of the degree of superiority of one component over another determine the weights of the indicators of integrated readiness assessment;
- each expert received a copy of the general document, followed by a discussion of the problem to be solved to adjust the components of the system of physical training and physical readiness of young people for military service.

Results

As a result of processing of data of expert estimations and quantitative comparison of pair comparisons of a degree of advantage of one component over another components of the forecasted model of physical readiness of a conscription contingent of Ukrainians for service in army were defined.

To obtain an objective assessment of the effectiveness of the process of physical training of conscripts for military service, based on the results of our work, we proposed a structural of predicted the model of integrated assessment of physical readiness of youth for service in the security and defense forces of Ukraine (Fig. 1).

In the course of the expert survey 21 experts managed to confirm the expediency and urgency of achieving the appropriate level of physical fitness in the process of conducting forms of physical culture (physical education) in the conscript contingent, which will contribute to the functional readiness of the cardiovascular system, acquisition and formation of military motor skills.

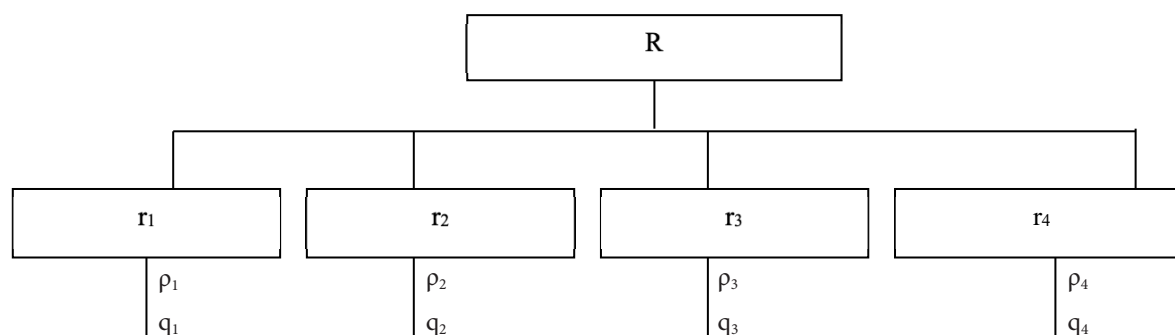


Fig. 1. Structural model of integrated assessment of physical readiness of young people for military service. Note: R – integrated assessment of young people's physical readiness for military service; r_1 – the level of formation and development of general physical qualities; r_2 – the level of formation and development of special physical qualities; r_3 – level of acquisition of military-applied motor skills; r_4 – the state of the cardiovascular system; ρ_1 – ρ_4 – weighting factors of the components of the integrated assessment; q_1 – q_4 – indicators (primary assessments) of the components of the integrated assessment

Using the logical sequence of the structural of predicted the model of integrated assessment of physical fitness, in the presence of numerical values of the levels of indicators of the components of integrated assessment, it is possible to determine the level of overall integrated assessment of physical fitness of youth for military service.

$$R = \sum_{j=1}^4 r_j = \sum_{j=1}^4 q_j p_j \quad (1)$$

where: R – integrated assessment of young people's physical readiness for military service; r_j – levels of indicators of integrated assessment; q_j – indicators (primary assessments) of the components of the integrated assessment; p_j – weighting factors of the components of the integrated assessment.

Assessment (testing) of the level of all components of the integrated assessment of physical fitness should take place in stages during the current and final annual (semester) controls on the subject "Physical Culture" (Peleshenko, 2010).

In order to determine the quantitative measure of the degree of importance and priority of each of the indicators integrated estimation, for the objective determination of the quality of the educational process in the direction of operation of the educational subject "physical culture" and to implement long-term prognosis effectiveness of its results, we analyzed the characteristics of complex components of the studied evaluations received through the feedback channel and with the help of expert evaluation.

To implement a remote forecast of the effectiveness of the forecast model, we conducted a comprehensive analysis

Table 1. Coefficients of weight of components of integrated assessment of physical readiness of youth for military service in security and defense forces

Components of integrated assessment	The value of the components	
	symbol	weighting factor
Level of formation and development of general physical qualities (r_1)	p_1	0.411
Level of formation and development of special physical qualities (r_2)	p_2	0.235
Level of acquisition of military-applied motor skills (r_3)	p_3	0.216
Cardiovascular status (r_4)	p_4	0.138

of certain characteristics with the determination of a quantitative measure of the coefficient of weight (and priority) of each of the indicators of integrated assessment (Tabl. 1).

According to the results of the expert assessment, we obtained the average indicators of weights for all its components of the integrated assessment of the physical readiness of young people for service in the army. The level of formation and development of general physical qualities (r_1) had the highest weighting factor ($p_1 = 0.411$). The state of the cardiovascular system (r_4) by the coefficient of severity was the lowest ($p_4 = 0.138$), although it is generally accepted that the functionality limits the manifestation of physical qualities.

Each of the above components is only conditionally separated in a holistic integrated assessment of the physical readiness of young people for military service, integrates with other indicators and components and is a partial manifestation of this assessment.

Diagnosis of components in our study was carried out by quantifying the degree of their importance, completeness, stability of manifestation, the presence of possible deviations or shortcomings in relation to the purpose and objectives of physical fitness of young people for service in the army. If such deviations occur, it is necessary to analyze what they are, what caused them, what should be done to eliminate them and prevent them in the future. Without evaluative control, and correction of erroneous actions, learning will be "blind", it is impossible to manage, that is, it ceases to be at all "managed", its results will become unpredictable.

The generalized definition of an integrated assessment of the effectiveness of the process of physical education is the physical readiness of young people, which manifests itself in the form of the ability to serve in the army.

All indicators r_1 - r_4 are evaluated in points from 1 to 12. 1-3 points (low level), 4-6 points (medium), 7-9 points (sufficient), 10-12 (high). Using the coefficients p_1 - p_4 determine the limits of the levels of the components q_1 - q_4 of the integrated assessment.

Thus, we can determine the level of formation of individual components of the integrated physical fitness of young people for military service (Table 2), as well as adjust the content of physical education depending on such components that lag behind the appropriate norm.

The basis of physical readiness of young people for service in the army was the understanding that each of the components included in the content of the educational process in the field of "physical culture (education)" is an indicator

Table 2. Assessment of the level of formation of the components of integrated physical fitness (points)

$\sum_n r$	p_j	Score q (points)				
		q_j	12-10 p	9-7 p	6-4 p	3 p and less
r_1	$p_1=0.411$	q_1	4.93-4.11	3.70-2.88	2.47-1.64	1.23
r_2	$p_2=0.235$	q_2	2.82-2.35	2.16-1.64	1.41-0.94	0.71
r_3	$p_3=0.216$	q_3	2.59-2.16	1.94-1.51	1.30-0.87	0.65
r_4	$p_4=0.138$	q_4	1.66-1.38	1.24-0.97	0.83-0.55	0.41
R_{iHT}	$\sum_j^4 r_j$		12-10	9-7	6-4	3

Notes: r_1 – the level of formation of general physical qualities; r_2 – the level of formation of special physical qualities; r_3 – level of applied physical fitness; r_4 – state of operation cardiovascular system; p_1 - p_4 – weighting coefficient of the components of the integrated assessment; q_1 - q_4 – indicators of the components of the integrated assessment.

of the effectiveness of pedagogical influence and is used to achieve a useful end result.

Discussion

To determine the systemic approaches and ways to implement the basic principles of improving the military and physical training of the youth of Ukraine, a comparative analysis of the concepts, content and features of the organization of the physical training of the armed forces of leading NATO member states and Ukraine.

The results of the analysis of organizational and methodological principles of physical training systems of the armed forces of the leading member states of NATO and Ukraine allow us to state (Glazunov, 1978; Olkhovy, 2012; Romanchuk, 2013; Krutsevych, Panhelova, Pidletyichuk, 2021) that the main conceptual directions of modernization of approaches to organization and content in the armed forces of the North Atlantic Block and Ukraine have systems of physical training:

- high initial level of physical fitness of young people serving in the armed forces;
- intensification of the process of physical training;
- increasing the level of general physical fitness of servicemen;
- priority development of military-applied orientation of the process of physical training;
- sports orientation of the process of physical training;
- ensuring the functional readiness of the body of each serviceman to perform official and combat tasks.

According to the results of the analysis of scientific, periodical and documentary sources of reform in the physical training systems of the armed forces of the leading NATO member states, changes in the concepts of physical training were associated (Glazunov, 1978; Knapik, 1989; Bazhukov, 1996; Romanchuk, 2013).

Thus, the long-standing concept of physical fitness "physical fitness" has been replaced by "physical fitness". According to the definitions, "physical fitness" characterizes the adaptation of a serviceman to the content and conditions of activity, and "physical readiness" – the ability of individual servicemen and units to perform long and difficult professional activities in conditions of physical and mental stress (Olkhovy, 2013; Krasota, Olkhovyi, Romanchuk, 2014; Olkhovyi, Finohenov, 2015; Romanchuk, Anokhin, Oderov, Klymovykh, Pidleteichuk, Dobrovolskii, Tychyna, 2020).

There are two levels of physical fitness - full and operational. Full physical readiness is considered to be the ability of troops to mobilize their physical and mental resources to perform tasks, and operational – the readiness of troops to immediately perform their tasks in any environmental conditions (Brovkin, 1990; Magliovany, Petruk, Lesko, Kozhukh, 2015).

Requirements for the physical training systems of the armed forces of the leading NATO member states are conditioned by the main provisions of the general block strategic doctrine and the Concept of combat use of armed forces and methods of combat operations (strategy of "direct confrontation" and the concept of "continuous combat") (Olkhovy, 2013); and air-ground operations (Ignatiev, 2007).

The physical training systems of the leading NATO member states operate on the basis of three different con-

cepts – "preparadness", "readiness" and "mobilization", which are provided by three different areas of physical training – traditional, military and sports (Valeryn, 1992; Romanchuk, 2012).

Today, the armed forces of the world's leading nations do not have a single concept of physical training. This is due to the different socio-economic conditions of each country, which determine the features of the recruitment and combat training of personnel of the armed forces (Borodin, 2009; Bosenko, Sudets, 2017).

In modeling an integrated assessment of physical fitness of young people for military service, complex processes are considered in "pure form" by constructing abstract schemes of real processes necessary for deeper penetration into the patterns of their course and prediction of possible directions of development, which included the following components: physical qualities; the level of formation and development of special physical qualities; the level of formation of military-applied motor skills and abilities; the state of the cardiovascular system.

The level of formation and development of general physical qualities, as a fundamental component of integrated assessment, is assessed by the practical implementation of exercises: pull-ups on the crossbar, running at 100 (60) m, running at 3000 m (Physical Training Manual, 2014).

The level of formation and development of special physical qualities and the acquisition of military-applied motor skills as integral components of integrated assessment, is assessed by the practical implementation of special exercises: "comprehensive dexterity exercise", overcoming obstacles, performing hand-to-hand combat techniques, swimming in clothing weighing 2 kg, diving in length, movement of 5000 m with a weight of 3 kg, "angle" in the focus on the bars, a comprehensive coordination exercise, etc. (Bosenko, Sudets, 2017).

The state of the cardiovascular system is assessed by the Robinson index, which characterizes the energy potential – together with the adaptive potential is the most sensitive marker of the state of the cardiovascular system and the adaptive mechanisms of the human body.

Conclusion

In the literature, recommendations for the assessment of general physical fitness and special physical fitness provide only a list of motor tests with the limits of their manifestation (Physical Training Manual, 2014) and there is no integrated assessment of physical fitness of conscripts for military service.

In our research, for the first time, the contribution of each component (general physical fitness, special physical fitness, military-applied physical fitness and the state of the cardiovascular system) of the integrated assessment of physical fitness of young people was determined. This opens up the possibility of filling this model with concrete results in motor tests to determine the sufficiency or insufficiency of certain aspects of training and the focus of physical training of an individual young man to achieve appropriate standards.

Structural projected model of integrated assessment of physical readiness of youth for service in the army allows to determine the limits of levels of components and to estimate the level of their formation in points from 1 to 12. 1-3 points

(low level), 4-6 points (average), 7-9 points (sufficient), 10-12 (high), relative to the appropriate rate and obtain an objective assessment of the effectiveness of the process of physical training of pre-conscription youth.

Conflict of Interest

The authors declare that there is no conflict of interest.

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МОДЕЛЮВАННЯ НАЛЕЖНИХ НОРМ ФІЗИЧНОЇ ГОТОВНОСТІ ДОПРИЗОВНОЇ МОЛОДІ ДО СЛУЖБИ В АРМІЇ

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

Реферат. Стаття: 6 с., 1 рис., 2 табл., 25 джерел.

Мета дослідження – обґрунтувати та змодельовати належні норми фізичної підготовленості молоді до служби в армії.

Матеріали і методи. До складу експертної групи увійшов 21 спеціаліст (сферою діяльності яких є фізичне виховання, спецпідготовка, фізична підготовка в силах безпеки та оборони). Для розв'язання поставленої в роботі проблеми використано такі методи дослідження: теоретичний аналіз, порівняння, систематизація та узагальнення матеріалів наукової, історичної, методичної літератури та методичних документів; експертна оцінка (Delphi та аналіз ієрархій Saaty); методи математичної статистики.

Результати. Визначено, що прості статистичні методи в поєднанні з експертною інформацією при виборі перспективних рішень часто дають кращі результати, ніж точні розрахунки з орієнтацією на середні значення. Комплексний підхід з використанням експертної оцінки (Delphi), методу сучасної теорії ієрархічних систем Сааті дозволив

визначити структуру прогнозованої моделі фізичної підготовленості молоді до військової служби. Структурними, взаємопов'язаними компонентами прогнозованої моделі з відповідними ваговими коефіцієнтами є рівень сформованості та розвитку загальних і спеціальних фізичних якостей ($\rho_1 = 0,411$), рівень сформованості та розвитку спеціальних фізичних якостей ($\rho_2 = 0,235$), рівень набуття військово-прикладної моторики ($\rho_3 = 0,216$), стан серцево-судинної системи ($\rho_4 = 0,138$).

Висновки. Представлена структурна модель комплексної оцінки фізичної підготовленості молоді до служби в армії дозволяє визначити складові компоненти і оцінити рівень їх сформованості в балах від 1 до 12, а також відкривати зміст засобів фізичної підготовки залежно від тих компонентів, які відстають від належної норми.

Ключові слова: допризовна молодь, прогнозовані моделі, належні норми, фізична підготовленість.

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ORIGINAL SCIENTIFIC ARTICLE

PHYSICAL ACTIVITY MODEL TO DEVELOP BASIC MOVEMENT SKILLS IN KINDERGARTEN STUDENTS BASED ON PHYSICAL LITERACY

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Abstract

The lack of physical activity that is applied in Kindergarten (PAUD) has a bad impact on the future of children. It was revealed that the designed curriculum was more dominant in the development of academic achievement.

The study purpose was to develop basic movement skills in kindergarten students based on physical literacy.

Materials and methods. The method used in this study was research and development methods using quantitative and qualitative settings. With a population of all kindergarten teachers in Cilacap Regency which amounted to 1,387 teachers from 350 kindergartens, the sample used was 52 teachers who were taken by proportional sampling. The data analysis technique used in his study was descriptive quantitative data analysis techniques with percentages.

Results. The research findings show that each item of the statement of physical activity variables in developing students' basic movements can be seen from the average value of 4.205 which is in the very good category scale range. The statement that has the smallest average value in statement number 2 is "Do students have enough physical activity at school?" and has a value of 3.827 with a good category. While the highest average in statement number 1 is "Are Kindergarten students' physical activities held at school?" with an average value of 4.423 very good category.

Conclusions. Therefore, it can be concluded that "kindergarten students' physical activities held in schools" give a very good impression and are beneficial for kindergarten (PAUD) children for their growth and development.

Keywords: physical activity, basic movement skills, kindergarten, physical literacy.

Introduction

Kindergarten education is non-formal education organized in an effort to help in laying the foundation for development in all aspects before entering school. Preschool age is a sensitive age to receive stimuli and is very decisive for the development of children in the future Suherman (2017). Early childhood can be said to be the phase of the early years of life, the biggest role and responsibility lies with parents and the role of pre-school education and Kindergarten Arsana et al. (2019). According to Pangrazi and Beighle (2019), physical education taught to children before basic education will be able to assist in controlling aspects of emotional development, and can stimulate children's growth and development. Preschool education is one form of education as a basis for shaping physical growth and development (gross

and fine motion), cognitive (creativity, emotional intelligence, and spiritual intelligence), social emotional (attitudes and behaviour), language and communication, so it can be concluded that the goal to be achieved is to develop all potential from an early age, so that children develop naturally (Hijriati, 2019). Physical activity can be considered for children as an exercise to strengthen their muscle (Nasrulloh et al., 2020).

Putra, Gustiawati and Julianti (2020) in the practice of physical education, early childhood faces various problems from learning activities, facilities, social conditions and government policies that pay less attention to early childhood physical education. Kindergarten curriculum, states that physical or physical activity is the scope of physical learning programs, sports and health. For students in kindergarten, the form of physical activity that is packaged in the form of play is very important (Sutapa et al, 2020). The tendency of children at this time to experience limitations in movement. Children are more engrossed in their gadgets, more

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engrossed in games or fond of fast food. The causes of overweight and obesity in children are complex. This is confirmed by a study conducted in the United States. Obesity data in the United States from year to year for ages 2-19 years (Skinner et al. 2018). This is in line with previous literature studies. The initial study was conducted by conducting interviews and direct observations with teachers. From the results of interviews and observations made, it was revealed that the curriculum designed was more dominant in the development of academic achievement (Kremer et al. 2016).

Basic movements (fundamental motor skills) which are sought to be learned through physical education. According to Sun and Shen (2017), skills that form the basis of human movement. Ideally, family planning/kindergarten children are given sufficient basic movement experience in accordance with their stage of growth and physical development as well as providing sufficient movement provisions for children to have good mastery of movement. One of the efforts to overcome movement problems for children is to create a correct concept map of the movements that children must do, namely by introducing movement through the concept of physical literacy.

Physical literacy provides insight, experience, competence, motivation in children so that children have sufficient "treasury" of movement as provisions for later active life throughout life. In other words, physical literacy aims to provide movement choices so that they have a lot of movement "vocabulary". One solution that can be done is to develop a physical activity model for kindergarten students based on physical literacy. The results of the product will be packaged in the form of a manual, that it is easy for teachers to understand and implement at school. Donnelly et al. (2016), stated the results of a national study in Australia, showing that the level of physical fitness is significantly correlated with academic achievement. Another opinion was also conveyed by Marttinen et al. (2017), that increasing the level of physical activity has a mutually beneficial effect on the health and academic achievement of students. In addition, participa-

tion in programmed physical activity can improve academic achievement and brain performance, such as: attention and memory. In addition, it will also focus on doing assignments in class and improve the learning experience (Brusseau & Hannon, 2015).

Based on explanation above, to avoid the lack of physical activity in Kindergarten that has a bad impact on the future of children, researchers develop a model to increase the physical activity based on physical literacy. Hopefully, this model can be a role as a balancing part between the development of academic achievement (cognitive) and the development of student's psychomotor. The remaining of this paper is organized as follows. Section 2 reviews all materials and methods. Section 3 presents the result. Section 4 presents the discussion about this study and finally Section 5 concludes with some direction for future work.

Materials and methods

Study participants

The population in this quantitative research is all kindergarten teachers in Cilacap Regency, totalling 1387 teachers from 350 kindergartens, the sample used is 52 teachers taken by proportional sampling.

Study organization

This study uses research and development methods. According to Kristiyanto et al. (2020), there are 10 steps that must be taken in conducting research and development. These steps can be easily seen in the figure as follow:

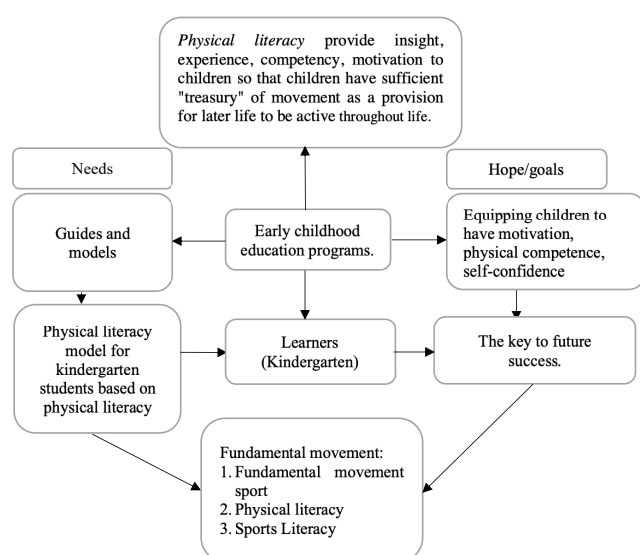


Fig. 1. Conceptual framework Physical activity to develop basic movement skills for kindergarten students based on physical literacy

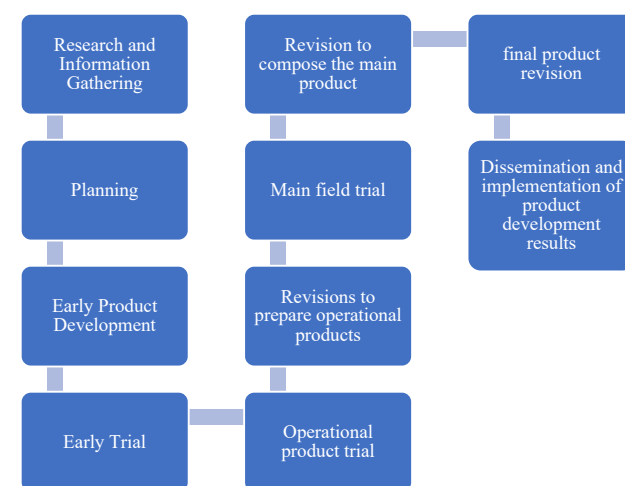


Fig. 2. Research and Development Steps

This study uses quantitative and qualitative methods. The research instruments used in the study were questionnaires, interviews and document studies. Questionnaires are used to determine the needs of kindergarten in learning activities, especially for physical motoric material. Interviews were used to find out the detail of learning implementation in kindergarten. Document Study was used to examine the learning documents in kindergarten such as curriculum, time allocation, and learning facilities.

Statistical analysis

The data analysis technique in this study used descriptive quantitative data analysis techniques with percentages. The method of calculating data analysis is to find the magnitude of the relative frequency of the percentage with the following formula:

$$P = \frac{F}{N} \times 100\%$$

Description
P = Percentage searched
F = Frequency
N = Number of Respondents

Fig. 3. Quantitative descriptive data analysis techniques

Test the validity in the assessment using Aiken's Content validity. This test is to determine the level of item validity between ratters with the formula used.

$$v = \sum s / [n(c - 1)]$$

s = r - lo
r = the number given by the ratter
lo = number of low validity values
n = number of appraisers
c = highest validity rating score

Fig. 4. Validity test with content validity Aiken

Reliability test in the assessment of the draft model using Cronbach's Alpha. This assessment is to test whether the assessment between the averages has a level of consistency with Cronbach's Alpha formula as follows:

$$r_{11} = \left(\frac{n}{n-1} \right) \left(1 - \frac{\sum \sigma_i^2}{n - \sigma_t^2} \right)$$

Description
 r_{11} = sought reliability
n = number of questions
 $\sum \sigma_i^2$ = total variance score for each item
 σ_t^2 = total variance

Fig. 5. Reliability test using Alpha Cronbach

Results

Research data for each question item obtained from questionnaires collected from 52 respondents. The measurement scale used in this study is a Likert scale. Researchers use this scale for this study because the distance or Likert between levels is clear, Data categories have logical rules. Scoring on this Likert scale starting from numbers 1 to 5 with ratings. Therefore, the average categorization of each item of research questions is as follows.

Based on table 1 above, with a sample of 52 people obtained a minimum value of 2.78, maximum value of 5.00,

Table 1. Result Description of Physical Activity

	N	Min	Max	Mean	SD	description
Physical Activity	52	2.78	5.00	4.25	.471	very good
Valid N (listwise)	52					

with a mean value of 4.20, Std. Deviation .471 with the description "very good".

Table 2. Kindergarten students' physical activities are held in schools?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid NT	5	9.6	9.6	9.6
S	20	38.5	38.5	48.1
SS	27	51.9	51.9	100.0
Total	52	100.0	100.0	

Form table 2 above, it can be seen that for Neutral (N) results the frequency is 5, 9.6 for percent, 9.6 for valid percent and cumulative percent is 9.6 then, for the Agree (S) results obtained, the frequency is 20, percent 38.5, valid percent 38.5 and, cumulative percent 48.1. Furthermore, for the results strongly agree (SS) the frequency obtained is 27, percent 51.9, valid percent 51.9, and cumulative percent is 100.0.

Table 3. Specific allocations provided in the curriculum?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid TS	1	1.9	1.9	1.9
NT	4	7.7	7.7	9.6
S	25	48.1	48.1	57.7
SS	22	42.3	42.3	100.0
Total	52	100.0	100.0	

Table 3 shows the results of the specific allocations provided in the curriculum? with answer Disagree (TS), the frequency obtained is 1, percent is 1.9, valid percent is 1.9, and cumulative percent is 1.9. Neutral (NT) obtained frequency as much as 4, percent with a value of 7.7, valid percent 7.7, and cumulative percent 9.6. Agree (S) obtained a frequency of 25, with a percent of 48.1, valid percent of 48.1, and cumulative percent of 57.7. Strongly agree (SS) with a frequency of 22, the percent result is 42.3, the valid percent is 42.3, and the cumulative percent is 100.0.

Table 4. Is the basic movement material delivered in teaching and learning?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid TS	1	1.9	1.9	1.9
NT	4	7.7	7.7	9.6
S	27	51.9	51.9	61.5
SS	20	38.5	38.5	100.0
Total	52	100.0	100.0	

In table 4, the results obtained from the question whether basic movement material is conveyed in teaching? for results Disagree (TS) obtained frequency as much as 1, with 1.9 percent, valid percent of 1.9, and cumulative percent of

1.9. For Neutral (NT) the frequency is 4, with a percent of 7.7, with a valid percent of 7.7, and cumulative percent of 9.6. In Agree (S) the frequency obtained is 27, with a percent of 51.9, a valid percent of 51.9, and a cumulative percent of 61.5. In strongly agree (SS) obtained a frequency of 20, with a percent of 38.5, valid percent of 38.5, and cumulative percent of 100.0.

Table 5. The role of parents in monitoring student movement?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	TS	1	1.9	1.9	1.9
	NT	12	23.1	23.1	25.0
	S	26	50.0	50.0	75.0
	SS	13	25.0	25.0	100.0
	Total	52	100.0	100.0	

In table 5 shows the results Disagree (TS) obtained frequency as much as 1, with a percent of 1.9, with a valid percent of 1.9, and cumulative percent of 1.9. In Neutral (NT) answers, the frequency is 12, with a percent of 23.1, valid percent of 23.1, and cumulative of 25.0. In the Agree (S) answer, the frequency is 26, with percent 50.0, valid percent 50.0, and cumulative percent 75.0.

Table 6. Does the teacher have sufficient knowledge of physical/physical literacy?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	TS	2	3.8	3.8	3.8
	NT	4	7.7	7.7	11.5
	S	24	46.2	46.2	57.7
	SS	22	42.3	42.3	100.0
	Total	52	100.0	100.0	

Table 6 shows that for the disagree (TS) answer, the frequency is 2, with the percent result of 3.8, valid percent of 3.8, and cumulative percent of 3.8. In Neutral (NT) answers, the frequency is 4, with a percent result of 7.7, valid percent of 7.7, and cumulative percent with a result of 11.5. For the Agree (S) answer, the frequency is 24, with a percent of 46.2, a valid percent of 46.2, and a cumulative percent of 57.7. Meanwhile, for Strongly agree (SS) answers, the frequency is 22, percent is 42.3, valid percent is 42.3, and cumulative percent is 100.0.

In table 7 above with the question, is there a guide on physical activities, motoric, basic movement skills?

Table 7. Are there guidelines on basic motor skills physical activities?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	19	36.5	36.5	36.5
	No	33	63.5	63.5	100.0
	Total	52	100.0	100.0	

For the answer yes, the frequency is 19, the percent is 36.5, the valid percent is 36.5, and the cumulative percent is 36.5.

Table 8. Do teachers need guidance on physical motor activities?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	52	100.0	100.0	100.0

In table 8, it can be seen the results of the answers to the questions do teachers need guidance on physical motor activities? The answer is Yes, with a frequency of 52, percent 100, valid percent 100, and cumulative 100.0.

Table 9. Description

	Description
STS	Strongly disagree
TS	Disagree
NT	Neutral
S	Agree
SS	Strongly agree

Discussion

Physical education has an important role in the formation of a whole person because the purpose of physical education is very comprehensive, namely targeting the development of cognitive, affective, and psychomotor aspects of students. In addition, physical education has an objective to obtain better physical condition of the children (Nugroho et al., 2021). Kindergarten is the most important and busy period of growth. At this age, children already have the skills and abilities, although not maximal. The age of the child at this time is a fundamental phase that will determine his life in the future. Physical Literacy (PL) is a skill that must be possessed by students as a result of a shift in the learning achievement of physical education (Physical and Health Education). Physical literacy provides insight, experience, competence, motivation in children so that children have sufficient "treasury" of movement as provisions for later active life throughout life. In other words, physical literacy aims to provide movement choices so that they have a lot of movement "vocabulary". Formulation in the preparation of physical activity models in developing basic movements (Mashud & Abdillah, 2021).

Relevant previous research by Ginanjar et al. (2020). Which discusses the sports education model based on basic movement skills with the aim of testing the difference in the effect of the Sport Education Model (SEM) or sports education model using racquet sports between students who have high Fundamental Movement Skills (FMS) and students who have low FMS on students' sports orientation Junior high school. The results of the study stated that there was an effect of SEM on students with high FMS and low FMS on sports orientation of junior high school students so that this study concluded that SEM had an influence on students' sports orientation. Competitiveness is the subscale that plays the most role in students' sports orientation.

The next relevant previous research is by Andrian et al. (2020) with the title The effectiveness of motor learning models based on movement base games for elementary school students. Which aims to provide alternative learning models that can be chosen by teachers to learn basic movement skills in elementary schools, by discussing the effectiveness of implementing the learning model using MBG in physical education and health sports learning. The results showed that the quality of the learning process was included in the good category, while the learning outcomes before and after learning showed a significant increase ($p < 0.05$). Thus it can be concluded that the MBG development model is effectively applied in learning physical education and health sports.

The last recent relevant previous research by Gustian, Supriatna, and Purnomo (2019) with the title of the effectiveness of modification of traditional games in the development of physical literacy in kindergarten children. This study aims to stimulate children to always be active, have the skills, knowledge, motivation and confidence to carry out physical literacy activities. The results of the study as a whole obtained a value of 10843 (3.02) at the first meeting and 11596 (3.22) at the first meeting and there has been an increase of 753 points (0.21). This increase occurs because traditional games stimulate children to always actively carry out movement activities through playing. This shows that traditional games are effective in developing physical literacy in kindergarten children.

Based on the description above, the importance of physical activity for children to always be active. Ismoko and Putro (2016) states that the introduction of physical activity needs to be given from an early age. This opinion was also added by Haapala (2013), children who have high physical fitness and motor skills can improve their working memory and attention. Moreover, Pusari, and DH (2014), the educational environment can be used as a driving force to develop children's creativity. States that basic movement is the basis for learning and developing various technical skills in sports and physical activities for life. therefore, If the child's basic movement competence is not developed, they fail to use various sports and game skills in their childhood and adolescence (Pangrazi and Beighle, 2019).

The limit of this study is only covering the student's psychomotor. So that for the future research, to improve or develop basic movement skills can be combined with the form of the game. At their age, children prefer to learn while playing because they can discover new things. They can explore, imitate, and practice everyday life as a step in building skills to help themselves. Play is an important activity in child development and is very important for a child to reach his full potential (Moore, 2017). Play is the nature of children (children's work). Play is important for children's development because of its impact on their cognitive, physical, social development and emotional health (Herrington and Brussoni, 2015).

Conclusions

Descriptive analysis of physical activity in developing students' basic movements was carried out with descriptive statistics, namely describing the data that has been obtained with the minimum, maximum, mean and standard deviation values. The minimum value for the buying interest vari-

able is 2.78, the maximum value is 5.00 and the standard deviation value for this variable is 0.47. While the average value for the physical activity variable is 4.205, which if categorized includes physical activity in developing students' basic movements in the very good category. For physical activity variables in developing students' basic movements,

From the results of the analysis, the table results show that each item of the statement of the physical activity variable in developing students' basic movements, the average respondent assesses physical activity in developing students' basic movements with an average value with all the statements submitted, this can be seen from the average value of 4.205 which is in the very good category scale range. The statement that has the smallest average value in statement number 2 is "Students do enough physical activity at school?" has a value of 3.827 with a good category. While the highest average in statement number 1 is "Kindergarten students' physical activities are held at school?" with an average value of 4.423 very good category.

Kindergarten (PAUD) is one form of early childhood education unit in the formal education path for children aged four to six years. The purpose of Kindergarten (PAUD) education is to develop all potential from an early age, so that children develop naturally in achieving success in the future. The reality of education in early childhood is still applying a rote academic approach. Practices that are in accordance with the needs/development of children (developmentally appropriate practice) have not been fully implemented or have not been able to accommodate the needs of each individual to grow optimally or do not sufficiently provide space for the uniqueness of each individual. One way to develop basic movements in early childhood in kindergarten (PAUD) This can be done with physical literacy so that children are able to participate and have advantages in physical activities and sports. The issue of the importance of movement activities in the community around us is still something that is considered lacking. Physical literacy is according to the ability of each individual, physical literacy is physical literacy that can be described as motivation, self-confidence, physical competence, knowledge and understanding to maintain physical activity throughout life. Physical literacy provides insight, experience, competence, motivation in children so that children have sufficient "treasury" of movement as provisions for later active life throughout life. The concept of Physical Literacy is a strong foundation for children to be able to participate and have advantages in physical activities and sports. Literacy on movement will be able to form awareness of the importance of physical activity for the younger generation, become a lifestyle and be able to develop personal potential. It is proven in this study, the physical activity model to develop basic movement skills of kindergarten students gets good results and is very useful for early childhood.

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Conflict of interest

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МОДЕЛЬ ФІЗИЧНОЇ АКТИВНОСТІ ДЛЯ РОЗВИТКУ БАЗОВИХ РУХОВИХ НАВИЧОК У ВИХОВАНЦІВ ДИТЯЧОГО САДКА НА ОСНОВІ ФІЗИЧНОЇ ГРАМОТНОСТІ

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

Реферат. Стаття: 7 с., 5 рис., 9 табл., 24 джерел.

Брак фізичної активності в дитячому садку (у дошкільній освіті) погано впливає на майбутнє дітей. Виявлено, що розроблена навчальна програма приділяє більше уваги розвитку академічної успішності.

Мета дослідження – формування базових рухових навичок у вихованців дитячого садка на основі фізичної грамотності.

Матеріали та методи. У роботі застосовано методи дослідження та розробки з використанням кількісних та якісних параметрів. З-поміж усіх 1387 вихователів із 350 дитячих садків в окрузі Чилачап використовувалася вибірка з 52 вихователів, обраних шляхом пропорційного відбору. У дослідженні використано описові кількісні методи аналізу даних з відсотками.

Результати. Результати дослідження показують, що кожен пункт формулювання змінних фізичної активності у розвитку основних рухів вихованців можна по-

бачити із середнього значення 4,205, що знаходиться в дуже хорошому діапазоні шкали категорій. Пунктом з найменшим середнім значенням у твердженні № 2 є «Чи достатньо учням фізичної активності в школі?», його значення становить 3,827 та відноситься до хорошої категорії. Тоді як найвищим середнім значенням у твердженні № 1 є «Чи проводяться заняття з фізкультури для вихованців дитсадку в школі?», його середнє значення становить 4,423 та відноситься до дуже хорошої категорії.

Висновки. Отже, можна зробити висновок, що «заняття з фізкультури для вихованців дитсадку, які проводяться в школах», справляють дуже гарне враження та є корисними для росту та розвитку дітей дитячого садка (у дошкільній освіті).

Ключові слова: фізична активність, основні рухові навички, дитячий садок, фізична грамотність.

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ORIGINAL SCIENTIFIC ARTICLE

EFFECT OF PSYCHO-YOGIC TRAINING INTERVENTION ON SELECTED PSYCHOLOGICAL VARIABLES OF FEMALE POLICE RECRUITS

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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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Abstract

The purpose of this study was to find the effects of an eight-week psycho-yogic training intervention on the selected psychological parameters of female police recruits.

Materials and methods. Initially, the study involved 200 female police recruits. Out of the 200 participants, 100 participants were screened using the lie score of the revised Eysenck Personality Questionnaire. Participants were then further divided into two groups (i.e., experimental and control) using the stratified random sampling method based on the lie score. The psychological variables selected for the study were aggression (physical aggression, verbal aggression, hostility, and anger), emotional intelligence (self-awareness, managing emotions, self-motivation, empathy, and social skill), anxiety, perceived stress, satisfaction with life, and self-esteem. Tests were conducted pre-training and post-training after eight weeks.

Results. The Friedman's two-way analysis of variance revealed significant difference in verbal aggression ($p = 0.016$), hostility ($p = 0.017$), managing emotions ($p = 0.004$), self-motivation ($p = 0.004$), empathy ($p = 0.017$), social skill ($p = 0.015$), anxiety ($p = <0.001$), perceived stress ($p = <0.001$), satisfaction with life ($p = 0.022$), and self-esteem ($p = <0.001$). Further post-hoc analysis test – Kruskal Wallis revealed that the experimental group improved significantly from pre- to post-test in managing emotions ($p = 0.005$, $d = 0.61$, $\Delta\% = 9$), self-motivation ($p = 0.027$, $d = 0.57$, $\Delta\% = 8.8$), social skill ($p = 0.002$, $d = 0.59$, $\Delta\% = 10.2$), satisfaction with life ($p = 0.036$, $d = 0.5$, $\Delta\% = 11.7$), and self-esteem ($p = <0.001$, $d = 0.94$, $\Delta\% = 17.6$). In addition, the experimental group had reduced anxiety ($p = <0.001$, $d = 1.27$, $\Delta\% = 59.3$) and perceived stress ($p = <0.001$, $d = 1.32$, $\Delta\% = 41.7$) from pre- to post-testing. On the other hand, the control group showed significant deterioration in physical aggression ($p = 0.018$, $d = 0.58$, $\Delta\% = 19.9$), verbal aggression ($p = 0.017$, $d = 0.57$, $\Delta\% = 17$), and hostility ($p = 0.013$, $d = 0.54$, $\Delta\% = 17.8$).

Conclusion. The study findings suggest psycho-yogic training of eight weeks duration to be an effective strategy or method to improve the psychological parameters of female police recruits.

Keywords: emotional intelligence, anxiety, self-esteem, satisfaction, perceived stress, aggression.

Introduction

Police personnel is supposed to be physically and psychologically strong to meet the occupational demands of their profession. The police personnel are also relatively expected to perform, engage and execute a variety of tasks such as maintaining law and order, dealing with criminals, communal riots, prison, and paroling duties, etc. Therefore, to meet such demands and handle such circumstances to maintain law and order in the society, police personnel develops various psychological issues such as high level of anxiety, stress, aggression and a variety of other stressors, which ultimately makes this profession stressful (Akinlabi, 2021;

Anshel, 2000). Prolonged exposure to such psychological situations causes work-life imbalance, emotional imbalance, dissatisfaction with job, depression and sometimes it may also develop suicidal tendencies among police personnel (Akinlabi, 2021).

The magnitude of the stress and its effect on psychological and physical health usually depends on the type of stress (i.e., acute or chronic) (Anderson et al., 2002). The acute stress may be due to sudden and critical incidents, which require immediate response (Evans et al., 1993; Katarina Ahlstrom, 1993). Whereas, chronic stress is the prolonged phase of a stressor which are built over a period of time (Anshel, 2000). These conditions are an inseparable part of the occupation of the police personnel and are very much psychologically challenging.

Previous studies have reported that police personnel are on the higher risk end and suffers from a high level of anxiety, stress, depression, and emotional imbalance state, which may ultimately reduce their productivity in the long run (Agrawal & Mahajan, 2021; Bora et al., 2021; Mann, 2021; Singh et al., 2021). The newly recruited police personnel have to undergo physical training which includes various indoor and outdoor activities.

Psychological training which includes both mind and body has been reported to decrease perceived stress, improves mood and other psychological measures (Abhaydev et al., 2020; Jung et al., 2016; Lane et al., 2007). Yoga-based lifestyle interventions have reportedly been shown to reduce stress (Greeson et al., 2015) and anxiety (Gupta et al., 2006). In addition, various psychological training programs (e.g., mindfulness-based stress reduction and healing arts programs) have reported significant effects on factors such as anxiety, anger, mood disturbances, and overall stress symptoms (Garland et al., 2007). Furthermore, reduction in stress level, improvement in coping and mindfulness have been reported using integrative coping and resiliency programs (Deible et al., 2015; Tarantino et al., 2013).

It has been found that very little or no attention is given to include the self-regulatory psychological and yogic training which is helpful to resolve the psychological challenges; anxiety, stress, anger, loss of energy emotion regulation, associated with their profession (Blumberg et al., 2022; Wang & Liu, 2022). It was also noticed that the responses of male and female police personnel were different to stressful and workplace situations (Jha, 2020). Hence, the joint protocol (psychological interventions and yoga practices) was introduced to test the effectiveness of Psycho-Yogic intervention on female police recruits (FPR).

Materials and methods

Study participants

A total of 200 new female recruits of constable level were initially selected from a police training centre of Gujarat, India. Thereafter the selected participants were asked to fill up the revised Eysenck Personality Questionnaire (Eysenck et al., 1985). A total of 198 participants correctly filled the questionnaire and the responses of two participants were discarded due to incomplete responses. Lie scores were calculated for each subject using the revised Eysenck Personality Questionnaire. Later, the best 100 participants

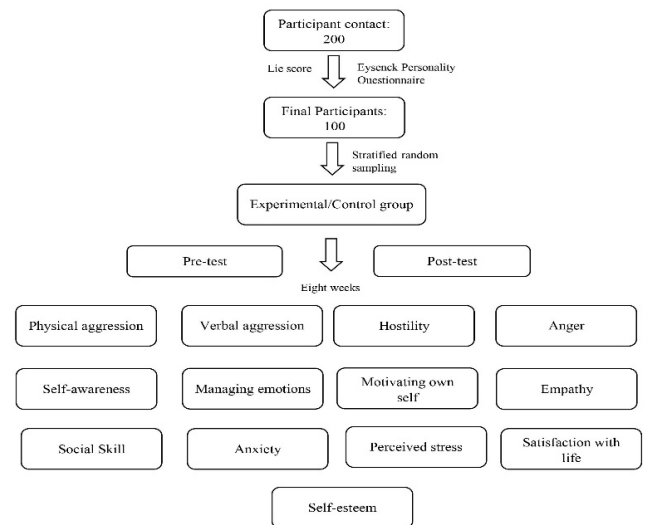


Fig. 1. Graphical representation of the study.

Table 1. Brief description of the psycho-yogic protocols included in this study

Sl. No.	Main Activity	Sub-activity	Benefits
1	Psychological Skill Training	Goal Setting Self – Talk Mental Imagery Mental Rehearsal Relaxation	PST methods have all been proven to improve psychological skills like self-confidence, control activation, arousal, stress, cognitive process.
2	Pranayama	Bhramri Nadishodhan Sahit kumbhak Shitali Pranayama	It is reported to reduce stress and anxiety, improves autonomic functions by triggering neurohormonal mechanisms by the suppression of sympathetic activity.
3	Sudarshan Kriya	Ujjayi Bhastrika Om Chanting Kriya (Breathing)	Alleviate anxiety, depression, everyday stress, post-traumatic stress, and stress-related medical illnesses. Mechanisms contributing to a state of calm alertness include increased parasympathetic drive, calming of the stress response systems.
4	Stretching	Shasangasana Bhujangasana Setubandhasan Pwanmuktasana Pacchimottanasan	Stretching helps improve your range of motion, which may also slow the degeneration of your joints. Stretching major muscles helps keep them loose and lessens the shortening and tightening effect that can lead to post-workout aches and pains.

Table 2. Description of all the psychological tests included in the study

Sl. No.	Variables	Tool	Scoring
1	Aggression	Aggression Questionnaire (Buss & Perry, 1992)	Sum of the Factor Scores
2	Anxiety	GAD 7 Anxiety Scale (Spitzer et al., 2006)	15-21 = Severe Anxiety 10-14 = Moderate Anxiety 5-9 = Mild Anxiety 0-4 = Minimal Anxiety
3	Emotional Intelligence	Emotional Intelligence Questionnaire (Leadership toolkit, (EI) Emotional Intelligence Questionnaire)	35-50 = Strength 18-34 = Giving Attention 10-17 = Development Priority
4	Stress	Perceived Stress Scale (Cohen et al., 1983)	27-40 = High Perceived Stress 14-26 = Medium Perceived Stress 0-13 = Low Perceived Stress
5	Satisfaction with life	Satisfaction with Life Scale (Diener et al., 1985)	31-35 = Extremely Satisfied 26-30 = Satisfied 21-25 = Slightly Satisfied 20 = Neutral 15-19 = Slightly Dissatisfied 10-14 = Dissatisfied 5-9 = Extremely Dissatisfied
6	Self-esteem	Rosenberg Self-esteem Scale (Rosenberg, 2015)	Higher Score Indicates Higher Self-esteem

with a low lie score threshold of ≤ 14 were selected for the study. Further, the subjects were stratified into five classifications based on the lie scores (e.g., 1-3, 4-6, 7-9, 10-12, and 13-14) and lastly, assigned into two groups (i.e., experimental group and control group) using the stratified random sampling.

Study organization

Pre-test – post-test experimental group design was used for the study. The experimental group was subjected to a list of psycho-yogic activities which they performed 3 sessions/week (Table 1). The duration of the study was eight weeks, with the first week focused on the familiarization session (Education phase) followed by seven weeks of training (e.g., acquisition phase, practice phase I, practice phase II). The training sessions lasted between 45 minutes to 60 minutes duration. The data were collected for selected psychological variables using questionnaires (Table 2).

Statistical analyses

Data are presented as mean and standard deviation (SD). The Shapiro-Wilk test revealed that the assumptions of normality were violated and the data were not normal. Therefore, a non-parametric test (i.e., Friedman's two-way analysis of variance) equivalent to its parametric counterpart was used for analysis. Friedman's two-way analysis of variance was used to determine the effect of training on the groups. Further, the post-hoc analyses were conducted using the Kruskal Wallis test (non-parametric) to determine the pre- post-effect in both groups (i.e., experimental group and control group). Percentage change was also calculated for both experimental and control groups using the equation: $[(\text{Meanpost} - \text{Meanpre}) / \text{Meanpre}] \times 100$. Effect sizes

were calculated using Cohen's d to assess changes between pre- to post- measurements in each group. The magnitude of effects for Cohen's d was interpreted as trivial (<0.2), small (0.2-0.6), moderate (>0.6 -1.2), large (>1.2 -2.0), very large (>2.0 -4.0), and extremely large (>4.0) (Hopkins et al., 2009). Statistical significance was set at $p \leq 0.05$.

Results

The mean [SD] for each dependent variable is shown in Table 3. Statistical outcomes for comparisons in each dependent variable are also shown in Table 3. Friedman's two-way analysis of variance revealed significant difference among experimental and control after eight weeks of training program in verbal aggression ($p = 0.016$), hostility ($p = 0.017$), managing emotions ($p = 0.004$), motivating own self ($p = 0.004$), empathy ($p = 0.017$), social skill ($p = 0.015$), anxiety ($p = <0.001$), perceived stress ($p = <0.001$), satisfaction with life ($p = 0.022$), and self-esteem ($p = <0.001$) (Table 3). No significant differences were observed in physical aggression ($p = 0.287$), anger ($p = 0.135$), and self-awareness ($p = 0.20$).

Further post-hoc analysis using the Kruskal Wallis test revealed experimental group improved significantly from pre- to post-test in managing emotion ($p = 0.005$, $d = 0.61$, $\Delta\% = 9$), motivating own self ($p = 0.027$, $d = 0.57$, $\Delta\% = 8.8$), social skill ($p = 0.002$, $d = 0.59$, $\Delta\% = 10.2$), satisfaction with life ($p = 0.036$, $d = 0.5$, $\Delta\% = 11.7$), and self-esteem ($p = <0.001$, $d = 0.94$, $\Delta\% = 17.6$). In addition, the experimental group had also showed reduction in the anxiety level ($p = <0.001$, $d = 1.27$, $\Delta\% = 59.3$) and perceived stress ($p = <0.001$, $d = 1.32$, $\Delta\% = 41.7$) from pre- to post-test. While the control group showed significant deterioration in physical aggression ($p = 0.018$, $d = 0.58$, $\Delta\% = 19.9$), verbal aggression ($p = 0.017$, $d = 0.57$, $\Delta\% = 17$), and hostility ($p = 0.013$, $d = 0.54$, $\Delta\% = 17.8$).

Table 3. Descriptive and inferential statistics of the data

Friedman's Two-way ANOVA p-value												
Variables		Experimental Group					Control Group					
		Pre-	Post-	Pre-Post p-value	Pre-Post Δ%	Pre-Post (ES)	Pre-	Post-	Pre-Post p-value	Pre-Post Δ%	Pre-Post (ES)	
		Mean [SD]	Mean [SD]									
Aggression	Physical Aggression	21.92 [6.45]	22.30 [6.24]	0.714	1.8	0.06	19.76 [5.34]	23.7 [7.93]	0.018	19.9	0.58	0.287
	Verbal Aggression	17.42 [6.61]	16.12 [4.04]	0.615	7.5	0.24	14.12 [3.99]	16.52 [4.48]	0.017	17.0	0.57	0.015
	Hostility	22.1 [7.09]	22.8 [5.97]	0.727	3.2	0.11	20.2 [6.25]	23.8 [7.11]	0.013	17.8	0.54	0.017
	Anger	20.74 [5.16]	20.12 [6.13]	0.582	3.0	0.11	18.06 [4.12]	19.34 [5.54]	0.181	7.1	0.26	0.135
Emotional Intelligence	Self-Awareness	40 [8.57]	43.2 [4.74]	0.278	8.0	0.46	40.3 [6.39]	37.9 [8.30]	0.699	6.0	0.32	0.20
	Managing Emotions	34.28 [6.06]	37.38 [3.78]	0.005	9.0	0.61	33.76 [5.63]	33.16 [5.72]	0.816	1.8	0.11	0.004
	Motivating Own self	37.7 [6.87]	41.0 [4.38]	0.027	8.8	0.57	37.9 [5.44]	36.2 [6.19]	1.31	1.7	0.29	0.004
	Empathy	38.1 [6.54]	39.8 [4.62]	0.081	4.5	0.3	36.4 [7.22]	35.5 [6.97]	0.333	2.5	0.13	0.017
	Social Skill	36.24 [7.65]	39.94 [5.82]	0.002	10.2	0.59	38.1 [5.9]	37.36 [7.17]	0.727	1.9	0.11	0.015
Anxiety		8.1 [4.62]	3.3 [2.69]	<0.001	59.3	1.27	8.2 [5.10]	8.1 [4.28]	0.846	1.2	0.02	<0.001
Perceived Stress		17.02 [5.95]	9.92 [4.73]	<0.001	41.7	1.32	17.64 [7.87]	18.30 [8.05]	0.727	3.7	0.08	<0.001
Satisfaction with Life		22.08 [6.23]	24.66 [3.73]	0.036	11.7	0.50	20.58 [5.55]	22.74 [4.82]	0.088	10.5	0.42	0.022
Self-Esteem		18.32 [4.02]	21.54 [2.69]	<0.001	17.6	0.94	17.04 [4.62]	18.3 [5.43]	0.462	7.4	0.25	<0.001

Note: Δ% – percentage change; ES – effect size (Cohen's d); SD – standard deviation

Discussion

The study focused on finding the effects of an eight weeks psycho-yogic training intervention on various psychological variables. The results suggest psycho-yogic training to be an effective strategy or method to significantly improve various psychological variables such as managing emotions, motivating own self, social skills, satisfaction with life, and self-esteem. In addition, this training program also reduced perceived stress and anxiety as well as optimally maintained physical aggression, verbal aggression, and hostility in experimental group as compared to the control group.

The experimental group performed both training for mind and body (psycho-yogic) for eight weeks. Psycho-yogic training improved three (out of five) factors of emotional intelligence (i.e., managing emotions, motivating own self, social skill). Similar findings were reported in a previous

study (Jung et al., 2016), where the authors suggested that online mind-body training programs improved the emotional intelligence of participants over a period of eight weeks rather than four weeks of duration. A previous study suggests that emotions are related to respiration (Valderas et al., 2015). Since the psycho-yogic training intervention included deep breathing practices, which may have positive impact on physical aspect as well as helped in providing emotional relaxation. The participants included in this study were FPR, who underwent rigorous training regimes and were subjected to emotional labor. The law enforcement officer requires to show the optimum emotions as they have to deal with the society and they are the medium between the citizens and the government. Therefore, the optimal emotional intelligence is highly required to discharge their duties at its best. Thus, psycho-yogic training for emotional release may have been beneficial for the participants.

It has been reported that integrative mind and body training shows improvement in attention and self-regulation (Tang, 2011). The author suggested that this may be due to the interaction between the autonomic nervous system (body) and the central nervous system (brain) (Tang, 2011). Similar findings were also observed in the present study, where the stress level reduced and emotional intelligence increased, which may be due to psycho-yogic intervention of eight weeks. This may contribute to the police personnel efficiency for their profession.

The study also reported reduction in perceived stress among the psycho-yogic training group. One of the crucial factors in stress reduction may be due to the increase in the emotional intelligence after eight weeks of intervention. Jung et al. (2016) reported an inverse correlation between emotional intelligence scores and self-reported stress and suggested that an increase in emotional intelligence and decrease in perceived stress may interact synergistically. Jung et al. (2016) also suggested that mind-body training may induce or increase these dynamics among participants. Thus, the finding of our study suggests that psycho-yogic training may be capable of improving the mental well-being of participants, which further will lead them to channelize their cognitive functioning. In addition, studies with similar findings have reported the inverse relationship between stress and emotional intelligence (Hisli Sahin et al., 2009; Walpole et al., 2008) further supporting our study's result.

It is suggested that, emotional intelligence acts as a moderator between stress level and psychological health (Sharma et al., 2016). It is also known that increased emotional capability contributes to the use of adaptive coping strategies when dealing with stress (Por et al., 2011). Therefore, the improved (enhanced) emotional intelligence among participants performing psycho-yogic training intervention may have led to improved self-esteem and satisfaction with life as well as reduced the perceived stress. Another reason for stress reduction in our psycho-yogic participants may be because meditation is suggested to potentially strengthen neuronal circuits and enhance the cognitive reserve capacity (Xiong & Doraiswamy, 2009), thereby contributing to enhanced brain capacity and plasticity of participant. This may have led to frequent use of adaptive coping strategies thereby reducing the stress among the participants.

The participants in our study showed a reduction in the stress and its associated parameters i.e. aggression and anxiety. A study by Lieberman et al. (2015) has shown that severe stress may induce anger. In our study the psycho-yogic group (Experimental Group) had no significant increase in aggression level after the eight weeks of intervention, which may have been possible due to the significant decrease in the stress level. Further findings in our study also showed that the stress level and aggression level of control group increased, whereas psycho-yogic training of eight weeks duration significantly decreased the stress level and maintained aggression level (physical aggression, verbal aggression, and hostility).

The study also reported a reduction of anxiety levels in the psycho-yogic training group. The previous studies have also reported a negative relationship between emotional intelligence and anxiety (Cejudo et al., 2018; Lu et al., 2010), as well as between stress and anxiety (Jurueña et al., 2020). Involvement in the psycho-yogic program may have induced emotional intelligence and decrease perceived stress which

directly influenced the anxiety level to get reduced among the recruits. In addition, Yoga practices have also reported to lower salivary cortisol level in females (Chen et al., 2017; Gothe et al., 2016). Higher cortisol level is related to stress, anxiety and depression (van Eck et al., 1996; Walvekar et al., 2015).

Conclusion

The findings of the study suggest that psycho-yogic intervention of eight weeks duration to be an effective strategy or method to improve the mental wellbeing among the FPR. The training intervention may be put into practice by law enforcement organizations along with the physical training program for recruits to overcome the psychological pressure and improve their overall mental wellbeing. The physical training program of recruits has been shown to increase aggression level and therefore the authors suggest psycho-yogic intervention to be an effective measure to control it.

Conflict of interest

The authors declare that there is no conflict of interest.

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ВПЛИВ ПСИХО-ЙОГІЧНОГО ТРЕНУВАННЯ НА ВИБРАНІ ПСИХОЛОГІЧНІ ЗМІННІ ЖІНОК-НОВОБРАНЦІВ ПОЛІЦІЇ

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

Реферат. Стаття: 7 с., 5 рис., 9 табл., 24 джерел.

Метою цього дослідження було визначити вплив восьмижидневого психо-йогічного тренування на вибрані психологічні параметри жінок-новобранців поліції.

Матеріали та методи. Спочатку в дослідженні брали участь 200 жінок-новобранців поліції. 100 учасників з 200 були перевірені за допомогою шкали брехні переглянутого Особистісного опитувальника Айзенка. Потім учасників розділили на дві групи (експериментальну та контрольну) за допомогою методу стратифікованої випадкової вибірки на основі шкали брехні. Психологічними змінними, вибраними для дослідження, були агресія (фізична агресія, вербальна агресія, ворожість і гнів), емоційний інтелект (самосвідомість, управління емоціями, самомотивація, емпатія та соціальні навички), тривожність, суб'єктивний стрес, задоволеність життям і самооцінка. Тести були проведені до і після тренування через вісім тижнів.

Результати. Двосторонній дисперсійний аналіз Фрідмана виявив значну різницю у вербальній агресії ($p=0,016$), ворожості ($p=0,017$), управлінні емоціями ($p=0,004$), самомотивації ($p=0,004$), емпатії ($p=0,017$), соціальних навичках ($p=0,015$), тривожності ($p=0,001$), суб'єктивному

стресі ($p=0,001$), задоволеності життям ($p=0,022$) та самооцінці ($p=0,001$). Подальший апостеріорний аналіз – тест Краскала Уолліса показав, що експериментальна група значно покращила показники до та після тестування в управлінні емоціями ($p=0,005$, $d=0,61$, $\Delta\%=9$), самомотивації ($p=0,027$, $d=0,57$, $\Delta\%=8,8$), соціальних навичках ($p=0,002$, $d=0,59$, $\Delta\%=10,2$), задоволеності життям ($p=0,036$, $d=0,5$, $\Delta\%=11,7$) та самооцінці ($p=0,001$, $d=0,94$, $\Delta\%=17,6$). Крім того, в експериментальній групі знизилася тривожність ($p=0,001$, $d=1,27$, $\Delta\%=59,3$) і суб'єктивний стрес ($p=0,001$, $d=1,32$, $\Delta\%=41,7$) до та після тестування. З іншого боку, контрольна група показала значне зниження фізичної агресії ($p=0,018$, $d=0,58$, $\Delta\%=19,9$), вербальної агресії ($p=0,017$, $d=0,57$, $\Delta\%=17$) та ворожості ($p=0,013$, $d=0,54$, $\Delta\%=17,8$).

Висновок. Результати дослідження свідчать про те, що психо-йогічне восьмижидневе тренування є ефективною стратегією або методом для покращення психологічних параметрів жінок-новобранців поліції.

Ключові слова: емоційний інтелект, тривожність, самооцінка, задоволення, суб'єктивний стрес, агресія.

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ORIGINAL SCIENTIFIC ARTICLE

ANALYSIS OF THE EXTERNAL AND INTERNAL LOAD IN 5vs5 LARGE SIDED GAMES: DIFFERENCES BETWEEN DIFFERENT SIZED FIELDS

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Abstract

The study purpose. The purpose of the study is to analyze and understand the internal and external load in Large Sided Games (LSG) exercises carried out on fields of different sizes, defined as Small – Large Sided Games (SLSG) and Big – Large Sided Games (BLSG), according to the different square meters assigned to each player.

Materials and methods. 22 professional soccer players (average age: 23.59 ± 4.87 years, weight: 77.8 ± 7.6 kg, height: 183.5 ± 7.5 cm, age training: 13.1 ± 1.7). The LSG exercises were carried out on a 60×54 m field ($270 \text{ m}^2/\text{player}$), defined as “small” (SLSG) and on a 65×60 m field ($325 \text{ m}^2/\text{player}$) defined as “big” (BLSG). During the two LSG exercises, the internal load and the external load were analyzed. LSG exercises were performed with 4 sets of 5 minutes each, with 2 minutes of passive recovery between each set.

Results. The results of the internal load analysis show how the LSG carried out on a SLSG field provides higher and more significant HR values ($p < 0.0005$) than those emerged during the exercise carried out on a BLSG field. The RPE value is also higher during the SLSG, although statistically no significant difference appears. The analysis of the external load in relation with the observed parameters shows higher values in the BLSG, except for the number of accelerations.

Conclusions. In terms of external and internal load, the results of this study showed how the difference of $55 \text{ m}^2/\text{player}$ can radically change the configuration of the two exercises. These differences allow to use both dimensions within a micro-cycle, but in sessions with different goals. The most appropriate sessions for LSGs are the first post-match session in which the rest day is not gone and the fourth session 3 days before the match.

Keywords: large sided games, external load, internal load, soccer, professional soccer players.

Introduction

Over the years, the specific soccer training has undergone significant changes (Esposito et al., 2019; Raiola & Altavilla, 2020) due to the increasing knowledge and the focus on new exercises, useful for training technical, tactical and physical aspects.

General exercises related to the development of metabolic aspects are often integrated with sport-specific exercises capable of meeting the demands of the ever-changing performance model (Ceruso et al., 2019; D'Isanto et al., 2019).

These sport-specific exercises are called Small-Sided Games (SSG). Over the years, in the literature, SSGs have

been identified with different names, such as skill-based conditioning games (Gabbett, 2006), game-based training (Gabbett et al., 2009), conditioning games on small dimensions (Davids et al., 2013) or simply as modified games (Hill-Haas et al., 2011). These games are soccer-specific exercises played on small fields with modified rules involving fewer players than traditional and official matches (Hill-Haas et al., 2011). The SSGs meet all the specific demands related to soccer and represent a resourceful solution to improve the efficiency of the training process (Beato et al., 2018) in both young and adult soccer players.

Over the years, in the scientific literature numerous articles, reviews and texts have been published, describing what happens both in the internal and in the external load during these exercises carried out on a reduced field (Halouani et al., 2014; Hill-Haas et al., 2011).

Furthermore, the studies and experiences related to the SSGs identified the peculiar characteristics of these exercises, leading to a further internal subdivision that proposes to divide them into small-sided, medium-sided and large-sided games (Clemente et al., 2019; Goto & King, 2019).

This classification offers a precise and detailed organization of a micro-cycle that has a vital meaning for the goal of the entire training session and even in relation to the main objective (technical-tactical or physical) of the exercises carried out with a ball.

Indeed, both the size and spatial configuration constitute variables that clearly characterize and distinguish this type of exercises (Coutinho et al., 2019; Sannicandro, 2019).

The classification of SSGs (small, medium or large) can be related to the field size used for each format (Rampinini et al., 2007a) or just to the format (Clemente et al., 2019; Goto & King, 2019).

According to the size, the distinction related to the square meters assigned to each player allows to train different skills or the same skill but with different intensity.

Instead, according to the format, 1vs1 to 3vs3 games are considered small, 5vs5 and 6vs6 games are considered medium and 8vs8, 9vs9 and 10vs10 games are considered large.

It can be noticed that the 4vs4 and 7vs7 formats have not been mentioned. They are considered intermediate because a 4vs4 game can be both small and medium and a 7vs7 game can be both medium and large.

However, a further classification and distinction can also be found in the scientific literature. Leaving out the 1vs1, 2vs2 formats, some authors (Owen et al., 2014) have modified the different formats, considering the inclusion of the goalkeeper (GK) and adjusting the playing field dimensions considered appropriate according to the research group goals.

The analysis of the SSGs also involves the dimensions attributed to each format: the literature has begun to consider the density of players per square meter, introducing the theme of large-sided games in which each player is assigned approximately 200 square meters (Casamichana et al., 2018; Castagna et al., 2019; Castellano et al., 2015; Castillo et al., 2020; Goto & King, 2019; Riboli et al., 2020; Zurutuza et al., 2020).

However, if we actually consider the size of a playing field, few authors have described what occurs when a player is assigned proper field densities during an official match, i.e. about 325 square meters for professionals (Goto & King, 2019; Riboli et al., 2020) and about 270 square meters for non-professionals (Castagna et al., 2019; Castellano et al., 2015).

When the analysis focused on densities per player exceeding 300 square meters, some authors did not consider the presence of goalkeepers, effectively altering the final result (Casamichana et al., 2018; Riboli et al., 2020).

Only by including the goalkeeper in the square meters computation, due to the position in space occupied and the role in the defence/occupation of the space itself, it is possible to correctly define a large sided game (LSG).

This space must be assigned according to the different official sizes of the playing field for professional and non-professional players.

The purpose of the study is to analyse and understand the internal and external load on LSG exercises carried out on fields of different sizes, defined as Small – Large Sided Games (SLSG) and Big – Large Sided Games (BLSG),

according to the different square meters assigned to each player.

Materials and methods

Study participants

22 professional soccer players (20 movement players and 2 goalkeepers) from Serie C team (season 2020/2021) participated in the study (average age: 23.59 ± 4.87 years, weight: 77.8 ± 7.6 kg; height: 183.5 ± 7.5 cm, age training: 13.1 ± 1.7). The goalkeepers were not considered in the data collection of the external and internal load. The study included all the players who at the time of the survey did not report injuries, had been training and participating in matches for at least 3 weeks. All soccer players were used to work with GPS monitoring systems and heart rate monitors. The study was carried out respecting the principles contained in the Declaration of Helsinki.

Study organization

For the analysis of the internal load, heart rate (HR) and perception of effort (RPE) parameters were measured. The HR detection was conducted with a telemetry system and heart rate monitors (Polar Electro Oy, Kempele, Finland). The analysed values are the average HR and the HR peak, both in beats per minute (bpm) and in percentage referred to the maximum HR.

For the detection of the RPE - Ratings of Perceived Exertion, the Borg scale CR10 was used (Borg, 1982). During the two LSG exercises, the players were monitored using global positioning system (GPS) instrumentation at 18.18 Hz (GPEXE® SYSTEM, EXELIO srl, Udine, Italy) recently validated (Hoppe et al., 2018). The parameters detected and examined are the total distance covered (m), the distance covered per minute (m), the peak speed (km/h), the average metabolic power (W/kg), the average metabolic power (W/kg) expressed during the active phases (MPE avg power) and during the recovery phases (MPE rec avg power), the number of accelerations (> 2 m/s) and decelerations (< -2 m/s) and the equivalent distance (m). The covered distance was also monitored at different speeds: walking (< 7.30 km/h), running at low intensity (7.30-14.50 km/h), running at moderate intensity (14.50-19.90 km/h), running at high intensity (19.90-25.20 km/h) and in sprints with speed > 25.2 km/h (Rampinini et al., 2007b) and the covered distance with different power intensities: low power (< 20.00 W/kg), high power (20.00-35.00 W/kg), very high power (35.00-50.00 W/kg) and maximum power that is > 50 W/kg (Osgnach et al., 2010).

The exercises of LSG 5vs5 + 2 goalkeepers were carried out on a natural grass playing field and the measurements of the two fields used reflected those of the competition fields for professionals (105×68 m, FIFA data) for the big field and non-professionals (100×60 m) for the small field.

Therefore, the SSG exercises were carried out on a 60×54 m field ($270 \text{ m}^2/\text{player}$), defined as “small” (SLSG) and on a 65×60 m field ($325 \text{ m}^2/\text{player}$) defined as “big” (BLSG). For the exercises, No. 5 soccer balls were used, positioned both inside the goal and outside the perimeter of the field to speed up the match when the ball ended out. Regular goals

Table 1. The SSG formats used in the study

Indicator	SMALL LSG	BIG LSG
Number of Bouts	4	4
Bout Duration (min)	5	5
Resting Duration (min)	2	2
Pitch Dimension (m × m)	60 × 54	65 × 60
Relative Pitch Size (m ²)	1:270	1:325
Goalkeeper	YES	YES
Specific Rules	max 3 touches	max 3 touches
Coach Encouragement	YES	YES

(7.32 × 2.44 m) were used. LSG's exercises were carried out with the encouragement from the technical staff and with the limitation of consecutive touches (3) of the ball. The characteristics of the LSGs are summarized in table 1.

After the warm-up, players began with LSG exercises: 4 sets of 5 minutes each, with 2 minutes of passive recovery between each set. During the whole exercise, players were monitored through the use of a heart rate monitor in telemetry and GPS instruments. At the end of each exercise, the RPE value was analysed individually.

The exercises were carried out in different days, with a recovery pause of at least 48 hours, at the same hour and temperature (22.3 °C).

Statistical analysis

Descriptive statistics (M ± SD) was applied to all observed variables; Student's t-test for paired data was used to verify the existence of statistically significant differences between the average values obtained using the Statistical Package for Social Sciences (SPSS 15.0 for Windows) software.

Significance was set at $p < 0.05$. Cohen's d was used to verify the effect size index (Cohen, 1992).

Results

The results of the internal load analysis show how the LSG carried out on a SLSG field provides higher and significant HR values ($p < 0.0005$) than those emerged during the exercise carried out on a BLSG field. Specifically, the peak HR value (bpm) (188.75 ± 5.3 vs 182.5 ± 6.09 , $d = 1.01$), the peak% HRmax (94.75 ± 2 , 33 vs 91.75 ± 2.65 , $d = 1.14$), average HR (bpm) (173.75 ± 7.65 vs 165 ± 8.17 , $d = 1.46$) and average HR of 87 ± 3.77 vs 82.75 ± 3.65 , $d = 1.23$). The RPE value is also higher during the SLSG (8.1 ± 1.21 vs 7.8 ± 1.19) although statistically, no significant difference appears.

On the other hand, the analysis of the external load in relation with the observed parameters shows higher values in the BLSG, except for the number of accelerations. All the parameters show statistically significant differences between the two fields used, except for the distance travelled at low intensity, which did not provide statistical significance. The results of the external load and relative significance are summarized and described in table 2.

Discussion

The study wanted to describe the effects on internal and external load related to two different large sided games formats.

In the literature, this appears to be the first study addressing the issue of SLSG and BLSG in soccer.

From the analysis of the internal and external load of the LSG during the 5vs5 LSG format carried out on two defined fields (SLSG and BLSG), it can be seen that the two exercises are very different, according to the different and statistically

Table 2. Results of external load recorded in the SLSD and in BLSG

Indicator	5vs5 SLSG	5vs5 BLSG	Cohen's d
Total distance (m)	2753.98±135.87	2986.96±244.24***	-1.61
Distance/min (m)	137.69 ± 6.79	149.34 ± 12.21 ***	-1.61
Maximum speed (km/h)	26.25 ± 1.13	27.58 ± .9 ***	-1.9
Avg Metabolic power (W/kg)	11.25 ± .92	12.11 ± 1.3 ***	-1.3
MPE avg power (W/kg)	21.36 ± .9	22.63 ± .87 ***	-0.95
MPE rec avg power (W/kg)	6.72 ± .29	7.16 ± .76 *	-0.58
Acceleration (n°)	30.8 ± 9.95 *	27.6 ± 5.75	0.53
Deceleration (n°)	28 ± 6.35	32.2 ± 4.37 ***	-1.36
Equivalent distance (m)	3223.36 ± 210.73	3501.4 ± 300.24***	-1.99
Walking (m)	722.66 ± 63	676.28 ± 93.73 ***	0.73
Low intensity running (m)	1307.6 ± 98.17	1382.7 ± 173.72	
Moderate intensity running (m)	538.64 ± 83.12	652.82 ± 142.28***	-1.45
High intensity running (m)	176.48 ± 48.57	241.54 ± 73.92 ***	-1.08
Sprint running (m)	8.96 ± 9.29	33.84 ± 20.72 ***	-1.21
Distance low-power (m)	1933.36 ± 26.66	2009.8 ± 77.28 ***	-1.12
Distance high-power (m)	535.26 ± 80.75	619.96 ± 144.26***	-0.77
Distance very high-power (m)	203.92 ± 30.92	248.96 ± 27.58 ***	-1.64
Distance maximum power (m)	81.84 ± 33.41	108.44 ± 30.98 ***	-1.30

* $p < .05$; ** $p < .01$; *** $p < .005$

significant values emerging from the parameters taken into consideration. The 5vs5 on the SLSG field provides a higher and significant HR value ($p < 0.0005$) than the BLSG field even if each player is assigned lower density ($55 \text{ m}^2/\text{player}$).

This difference can be explained following what has already been described during the performance of SSG in small fields, in which the players seem to be more involved in the game (Halouani et al., 2017) and consequently have less time to recover, after an intense effort.

The hypothesis related to the HR is confirmed by the analysis of the RPE in the SLSG, which provides an increasingly higher, albeit non-significant value compared to the BLSG, confirming how the effort perceived is related to the intensity of the exercise.

Analysing the external load, it is clear that the BLSG is an exercise that provides higher values in all the observed parameters, except for the distance travelled at very low intensity and for the number of accelerations that are significantly different ($p < 0.05$), and a $d = 0.53$ effect size medium, in favour of the SLSG.

The distance travelled at moderate ($p < 0.0005$; large $d = -1.45489$), high ($p < 0.0005$; large $d = -1.08689$) and very high intensity ($p < 0.0005$; large $d = -1.21948$) demonstrates how the use of a larger field allows players to reach high running speeds.

The analysis of the power at different intensities follows the same trend seen with speed: both the distance travelled at high power ($p < 0.0005$; medium $d = -0.77257$), the distance travelled at very high power ($p < 0.0005$; large $d = -1.64614$), and the distance travelled at maximum power ($p < 0.0005$; large $d = -1.30109$) are most stressed in a BLSG.

The values of the average metabolic power and of the metabolic power expressed both during the active and the recovery phases, although higher and significant ($p < 0.0005$) in the BLSG, suggest how both exercises are able to produce high power values when compared to those detected during matches played by both adult and young players (Castagna et al., 2017; Hoppe et al., 2017).

As for the total distance travelled, this value is higher and significant in the BLSG ($p < 0.0005$; large $d = -1.6167$).

The results obtained in this study provide higher values than those already present in the literature, both when the same format was analysed but with a different density of $200 \text{ m}^2/\text{player}$ (Castillo et al., 2020) and when different formats were analysed (6vs6 and 8vs8 + goalkeepers) with a density of $300 \text{ m}^2/\text{player}$ (Castellano et al., 2015).

The same values, on the other hand, are lower than those provided by another study that used the same format and the same density of the BLSG but with a total time of the exercise (35 minutes vs 20 minutes), higher than the time calculated in this analysis (Goto & King, 2019).

Considering these disparities, the exercise volumes used and monitored in the literature should be standardized in order to carry out more in-depth comparisons.

The maximum speed detected in this study, both in the SLSG ($26.25 \pm 1.13 \text{ km/h}$) and in the BLSG ($27.58 \pm 0.9 \text{ km/h}$), reveals a significant difference between the two playing fields used ($p < 0.0005$; large $d = -1.9061$), and is higher than what can be found in the literature (Casamichana et al., 2018; Castillo et al., 2020; Zurutuza et al., 2020).

Another interesting fact that emerged from the study is the value related to the meters per minute travelled. Similarly, in this case there is a significant difference between SLSG

and BLSG (137.69 ± 6.79 vs 149.34 ± 12.21 , $p < 0.0005$; large $d = -1.61686$). Both values are higher, compared with those detected by some authors who studied the 7vs7 to 9vs9 formats, with a density between 235 and $272 \text{ m}^2/\text{player}$ (Zurutuza et al., 2020).

They are also higher when compared with results emerging from studies with the same format and a similar density ($330 \text{ m}^2/\text{player}$) (Casamichana et al., 2018).

Probably the sample observed in this study for the relative level of performance (professional soccer players with high age training) are able to express better performance at maximum acceleration.

In both exercises, the distance travelled at moderate intensity ($> 14.50 \text{ km/h}$) appears to be higher than the values shown in another study (Goto & King, 2019) which used the same format, the same density but lasted longer.

The results related to the distance travelled at high power ($> 20 \text{ W/kg}$) appear more complex because the values of the SLSG (821.02 m) and the BLSG (977.36 m) are lower than those found in the literature, where a value equal to 1050 m can be found (Goto & King, 2019): once again, the different duration may have determined these differences in terms of power. Apparently, the metabolic power values are not superimposable with those related to speed.

If we consider the values related to the parameters of % HR max and % average HR, the results obtained in this study ($94.75 \pm 2.33\%$ and $87 \pm 3.77\%$ in the SLSG and $91.75 \pm 2.65\%$, $82.75 \pm 3.65\%$ in the BLSG) are consistent with what has been identified in the literature, with formats where each player was assigned about 300 square meters (Castellano et al., 2015) or slightly higher than other recent studies (Casamichana et al., 2018). The same considerations are to be formulated for the RPE values that are slightly higher than those described in the literature (Casamichana et al., 2018).

Conclusions

In terms of external and internal load, the results of this study showed how the difference of $55 \text{ m}^2/\text{player}$ can radically change the configuration of the two exercises.

These differences allow to use both dimensions within a micro-cycle, but in sessions with different goals.

In fact, in relation to the two dimensions of the field used, it is advisable to use the large field in the first weekly session on the day following the match; while the small field in the fourth weekly session 3 days before the match.

The large sided games considering the square meters per player rather than focusing on the format appear functional if the goal is a game intensity similar to what occurs in the official match.

Further analysis, however, need to be conducted in order to figure out which duration can better meet the demands of the player's performance model. Finally, a further study could also define the differences between the various roles employed in the SSG exercises.

Conflict of interest

The authors declare no conflict of interest.

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АНАЛІЗ ЗОВНІШНЬОГО ТА ВНУТРІШНЬОГО НАВАНТАЖЕННЯ У ІГРАХ ПОВНИМ СКЛАДОМ 5 НА 5: ВІДМІННОСТІ МІЖ ПОЛЯМИ РІЗНОГО РОЗМІРУ

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

Реферат. Стаття: 6 с., 2 табл., 30 джерел.

Мета дослідження – проаналізувати та зрозуміти особливості внутрішнього та зовнішнього навантаження у вправах ігор повним складом (ІПС), які виконуються на полях різного розміру, визначених як малі ігри повним складом (МІПС) та великі ігри повним складом (ВІПС), відповідно до різних квадратних метрів, призначених кожному гравцю.

Матеріали та методи. Учасники: 22 професійних футболіста (середній вік: 23,59 ± 4,87 років, вага: 77,8 ± 7,6 кг; зріст: 183,5 ± 7,5 см, стаж тренувань: 13,1 ± 1,7). Вправи ІПС проводилися на полі розміром 60 x 54 м (270 м²/на гравця), визначеному як «мале» (МІПС) та на полі розміром 65 x 60 м (325 м²/на гравця), визначеному як «велике» (ВІПС). Під час двох вправ ІПС аналізувалися внутрішнє та зовнішнє навантаження. Вправи ІПС виконувалися у 4 підходи по 5 хвилин кожен, з 2 хвилинами пасивного відпочинку між кожним підходом.

Результати. Результати аналізу внутрішнього навантаження показують, як ІПС, проведені на полі МІПС, забез-

печують вищі та більш суттєві значення ЧСС ($p < 0,0005$), ніж ті, які з'являються під час вправи, проведеної на полі ВІПС. Значення суб'єктивно сприйнятої напруженості також вище під час МІПС, хоча істотної статистичної різниці не спостерігається. Аналіз зовнішнього навантаження у співвідношенні з спостережуваними параметрами показує вищі значення у ВІПС, за винятком кількості прискорень.

Висновки. Стосовно зовнішнього та внутрішнього навантаження, результати дослідження показали, як різниця в 55 м²/на гравця може кардинально змінити конфігурацію двох вправ. Ці відмінності дозволяють використовувати обидва виміри в межах мікроциклу, але в тренуваннях з різними цілями. Найбільш підходящими тренувальними сесіями для ІПС є перша післяматчова сесія, до якої не було дня відпочинку, і четверта сесія за 3 дні до матчу.

Ключові слова: ігри повним складом, зовнішнє навантаження, внутрішнє навантаження, футбол, професійні футболісти.

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ORIGINAL SCIENTIFIC ARTICLE

COMPARATIVE ANALYSIS OF MORPHOLOGICAL INDICATORS OF STREET WORKOUT ATHLETES WITH DIFFERENT TRAINING EXPERIENCE

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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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Abstract

Purpose. The purpose of the article is a comparative analysis of the morphological indicators of street workout (StW) athletes with different training experience (TE).

Materials and methods. The study involved StW athletes ($n = 27$). Athletes were divided into two groups: StW-1 ($n = 13$, age 15.15 ± 0.44 years, TE 1.56 ± 0.22 years); StW-2 ($n = 14$, age 16.57 ± 0.48 years, TE 2.64 ± 0.53 years). The body length and body mass were measured; the level and harmony of physical development were evaluated. The regression method was used. The handgrip was evaluated by hand dynamometry indicators Camry EH101 electronic dynamometer (China). The handgrip was measured by the maximum grip frequency in 10 s the electronic device "Kepai" (China). The content of muscle and adipose tissue were determined by the body composition monitor OMRON BF-511 (Japan).

Results. The average value of the strength index in the StW-1 was more than 60%, and in the StW-2 was more than 70%. The StW-2 had a significant excess of the hand dynamometry, power index, impulse index of both hands; index of static and dynamic grip of the left hand; specific weight of muscles. The average level of physical development was observed in $(61.54 \pm 13.49)\%$, above the average was observed in $(23.08 \pm 11.69)\%$ of StW-1. Harmonious physical development had $(38.46 \pm 13.49)\%$. In StW-2, the average level of physical development had $(64.29 \pm 12.81)\%$, above the average had $(21.43 \pm 10.97)\%$. Harmonious physical development had $(50.00 \pm 13.36)\%$. In StW-1 $(46.15 \pm 13.83)\%$ had a normal fat content and a fat level below normal. In StW-2, the normal fat content had $(30.77 \pm 12.80)\%$, and the low adipose tissue content was $(69.23 \pm 12.80)\%$.

Conclusions. All athletes had a high content of muscle tissue. It was confirmed the specific effect of StW on the body of athletes. Grip strength, specific weight of muscle component are predictors of success. The information content of the proposed indices for monitoring the functional state of athletes was confirmed.

Keywords: street workout, physical development, somatotype, bioimpedance method, grip strength.

Introduction

Street workout is currently positioned as a type of health-improving physical culture and a part of urban culture. It is proposed to evaluate its development from the standpoint

of the society development. The analysis of the street workout development concept in Lampung province (Indonesia) makes it possible to assess relations in society, providing opportunities for improving the health of the population (Hanggoro, Kristiyanto, & Doewes, 2018).

The analysis of historical aspects of exercises with own body mass was carried out (Tomczykowska, 2013). The

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popularity of street workout is stipulated by accessibility, freedom of organizing classes, minimal financial costs. The conclusion is made about the development of a specific value system in youths engaged in street workout.

The similar data were obtained in a study of schoolchildren practicing street workout in the city of Neiva (Monje Mahecha, & Vanegas García, 2017). These classes were considered a health-forming activity, an element of social integration, aimed at improving the one's body perception.

Street workout is popular among youth (Nadyrov, Mukhiddinov, & Dayrabayev, 2020). The availability of exercise, the opportunity to train on the open air allows recommending it along with running as a means of a healthy lifestyle development.

The psychosocial profile of street workout athletes is developed (Taïpe-Nasimba, Peris-Delcampo, & Canton Chirivella, 2019). Male students practiced this kind of sport. It is the only type of physical activity for more than half of the participants. The main reasons for training are pleasure, competence and fitness.

The expressed lack of scientific studies devoted to street workout is emphasized (García Herreros, & Seliva Arroyo, 2019). The high popularity of this new sport is driving an increase in the number of athletes. The lack of specific research does not allow providing comprehensive scientific and methodological support for this sport.

It is proposed to use the method of gamification in street workout to improve control during classes (Pratikto, Arifiansyah, & Mulyanto, 2020). The creation of mobile applications will provide increased motivation, sufficient density of classes, regulation of loads and prevention of injuries.

The high popularity of street workout is combined with the extremely insufficient scientific support of this sport (Sanchez-Martinez, Plaza, Araneda, Sánchez, & Almagiá, 2017). A promising direction is the analysis of the morphological characteristics of athletes.

Based on the foregoing, the *purpose of this study* is a comparative analysis of the morphological characteristics of street workout athletes with different training experience.

Materials and methods

Study participants

The study involved 27 street workout (StW) athletes. The athletes were divided into two groups. Group StW-1 consisted of 13 street workout athletes, age (15.15 ± 0.44) years. StW-2 group consisted of 14 street workout athletes, age (16.57 ± 0.48) years. The average training experience of StW-1 was (1.56 ± 0.22) years and (2.64 ± 0.53) years of StW-2 respectively.

Study organization

The study design involved the determination of anthropometric indicators, somatotype components, and the calculation of indices using special formulas. The research program and design were discussed and approved at a meeting of the Commission on Bioethics of the Kharkiv State Academy of Physical Culture.

The evaluation of body mass and body length was conducted in accordance with the international standards

(Marfell-Jones, Olds, Stewart, Lindsay Carter, 2012). Martin's medical anthropometer was used to evaluate body length (cm). Body composition monitor OMRON BF-511 (Japan) was used to evaluate body mass (kg). The level and harmony of physical development was evaluated by the regression method using official standards for children (Serdiuk, 2010) and adults (Tegako, & Marfina, 2003).

The handgrip (kg) was evaluated in a static mode by handgrip dynamometry. CAMRY EH101 electronic handgrip dynamometer (China) was used. The handgrip dynamometry was determined by the maximum grip frequency in the impulse mode (abs). The electronic device "Kepai" (China) was used. The technique assumed the maximum number of device grips in 10 s. One grip was equivalent to a force of 10 kg.

The somatotype was evaluated using the bioimpedance method. The body composition monitor OMRON BF-511 (Japan) was applied. The specific weight of muscle and adipose tissue (%), the visceral fat level (%), the amount of basal metabolism (kcal) was determined. Analysis of somatotype components was evaluated using the Omron Healthcare scale and reference data (Doskin, Keller, & Muraenko, 1997).

The following morphofunctional indices were measured:

The strength index is the ratio of hand dynamometry (kg) to body weight (kg), expressed as a percentage.

The Impulse index is the ratio of the maximum grip frequency in impulse mode in 10 sec (abs) to body mass (kg), expressed as a percentage.

Static and dynamic grip index is the ratio of hand dynamometry (kg) to the maximum grip frequency in the impulse mode in 10 s (abs).

Statistical analysis

Statistical analysis of the data obtained was conducted using licensed MS Excel. Descriptive statistics indicators were determined: arithmetic mean (X), standard deviation (SD) and mean error (m). The significance of the differences was assessed using a nonparametric indicator – the Rosenbaum test (Q), the differences were considered significant at ($p < 0.05$) considering the small size of the groups.

Results

The obtained results are shown in Table 1.

The obtained results illustrate the differences in the morphological parameters of the participants. The StW-2 group was characterized by exceeding many indicators. Differences between the groups in terms of age ($Q = 10$) and training experience ($Q = 8$) are significant ($p < 0.05$).

The value of hand dynamometry was higher in the StW-2 group for the right ($Q = 8$) and left ($Q = 6$) hands ($p < 0.05$).

More experienced participants had better results in strength indices for the right ($Q = 23$) and left ($Q = 21$), impulse indices for the right ($Q = 9$) and left ($Q = 14$), static and dynamic left hand grip index ($Q = 14$), ($p < 0.05$).

The specific weight of muscles was higher in the StW-2 group ($Q = 6$, $p < 0.05$).

The individual analysis of the physical development of the participants made it possible to assess its level and harmony using official standards. The participants with an average level prevailed in group StW-1 (61.54 ± 13.49)%. The level above average had (23.08 ± 11.69)% of athletes. A high

Table 1. Indicators of physical development and somatotype

Indicators	StW-1 (n=13)		StW-21 (n=14)		Q	p
	X	SD	X	SD		
Body length, cm	172.00	9.44	176.50	5.90	4	p>0.05
Body mass, kg	67.14	14.21	66.10	7.36	4	p>0.05
The handgrip of the right hand, kg	42.38	9.29	51.26	11.21	8	p<0.05
The handgrip of the left hand, kg	40.09	8.78	46.04	9.51	6	p<0.05
The maximum grip frequency in impulse mode of the right hand, the number of times	29.15	6.89	30.36	4.94	2	p>0.05
The maximum grip frequency in impulse mode of the left hand, the number of times	27.62	7.57	26.07	7.30	2	p>0.05
Specific weight of adipose tissue, %	13.05	7.02	10.13	3.95	3	p>0.05
Specific weight of muscle tissue, %	42.02	3.26	44.11	1.91	6	p<0.05
Basal metabolic rate, kcal	1727.62	154.59	1702.62	104.25	3	p>0.05
Specific weight of visceral fat, %	0	0	0.46	1.20	0	p>0.05
Right hand strength index, %	64.15	13.19	77.75	16.92	23	p<0.01
Left hand strength index, %	60.93	13.57	70.01	14.87	21	p<0.01
Right hand impulse index, kg-1	44.65	11.41	46.19	7.16	9	p<0.01
Left hand impulse index, kg-1	41.37	10.11	39.90	12.18	14	p<0.01
Index of static and dynamic grip of the right hand, kg	1.47	0.25	1.73	0.51	14	p<0.01
Index of static and dynamic grip of the left hand, kg	1.51	0.32	2.01	1.22	4	p>0.05

level and a level below the average had (7.69 ± 7.39)% of athletes. The proportion of overweight participants in this group was (61.54 ± 13.49)%. The harmonious physical development had (38.46 ± 13.49)% of athletes.

In a group of experienced street workout athletes, the following results were determined. The average level of physical development had (64.29 ± 12.81)% participants. The level above average had (21.43 ± 10.97)% of participants. The high level and a level below the average had (7.14 ± 6.88)% of athletes. The harmonious physical development had (50.00 ± 13.36)% of athletes in this group. Overweight had (42.86 ± 13.23)% of the participants. The body mass deficit had (7.14 ± 6.88)% of athletes. There were no significant differences between the groups in terms of the prevalence of various-grade levels and the harmony of physical development.

The analysis of the characteristics of the somatotype was conducted using the Omron Healthcare scale. It was found that in the group StW-1 (46.15 ± 13.83)% had a normal fat content and a level below normal. A high specific weight of fat had (7.69 ± 7.39)% of athletes. In the group StW-2, normal fat content had (30.77 ± 12.80)% of the participants. A low content of adipose tissue had (69.23 ± 12.80)% of athletes. All participants had a high content of muscle tissue.

Basal metabolic results in the groups did not differ significantly.

Discussion

One of the leading tasks of sports science is the substantiation and development of prediction methods. The purpose of these methods is to determine the probability of achieving success and increasing sportsmanship. Methods of analysis of physical development (Podrigalo, Cynarski, Rovnaya, Volodchenko, Halashko, & Volodchenko, 2019; Joksimović, Skrypchenko, Yarymbash, Fulurija, Nasrolahi, & Pantović, 2019; Lilić, Joksimovic, D'Angelo, Karišik, Hamad, & Gardašević, 2020), psychophysiological characteristics (Volodchenko, Podrigalo, & Aghyppo, 2017; Wolska et

al., 2019), biochemical criteria (Volodchenko, Podrigalo, Iermakov, Żychowska, & Jagiełło, 2019) can be used for this purpose. The development of predictive techniques is based on various statistical methods (Rovniy, Mulyk, & Perebeynos, 2018; Kozina, Chebanu, & Prokopenko, 2018).

Street workout is a new sport. High popularity among youth increases the number of athletes and requires the provision of scientific and methodological support. There are no developed qualification standards in this form. Competitions are primarily a demonstration of various techniques.

The main criteria for dividing street workout athletes are age and training experience. In our opinion, the training experience is the most important. It allows quantitatively assess the skill's level of athletes. An increase in experience increases the technical readiness of athletes, contributes to the development of the necessary technical elements. The established differences according to these criteria make it possible to consider the skill level different and to consider the StW-2 group higher according to this criterion.

The design used – comparing athletes who differ in skill level – is widely used in sports science. A similar approach was used in works (Podrigalo et al., 2020; Volodchenko et al., 2017; Elezi et al., 2021). It allows us to highlight factors and qualities of a higher level. It is they who ensure the achievement of success.

A similar study design was used in works (Kharisov, Nenasheva, & Aminov, 2017; Kharisov & Nenasheva, 2018). The authors compared the anthropometric indicators and the composition of the somatotype of students in powerlifting and workout.

The selection of techniques was determined by the goal. A similar set of methods was used to predict metabolic risks by anthropometric parameters and somatotype components (de-Mateo-Silleras et al., 2019; Podrihalo et al., 2020; Kami-onka et al., 2020). It coincides with the goal set in this study.

The amount of hand dynamometry should be recognized as an important predictor of success in street workout. A strong grip allows you to perform complex technical elements, provides injury prevention during training.

The values of the power index clearly show a high level of hand muscles development. All participants had high values of this indicator. It is an important predictor of street workout success and can be used to monitor the health of athletes.

The use of the index method in the analysis of physical development is due to their simplicity, accessibility and information content. The available information allows us to recommend the indices of physical development as screening tests when monitoring the condition of athletes and physically active athletes.

The determined differences in the indices confirm the assumptions made. The methods and indices that we used were tested in works (Podrihalo et al., 2020; Podrihalo et al., 2021). Comparative analysis of street workout and armwrestling athletes confirmed their information content and adequacy for predicting success in these sports. The specificity of the street workout is the need for a strong and fast grip for the implementation of technical elements. In this way, street workout is similar to martial arts (various types of wrestling and arm wrestling). Analysis of hand strength in different modes allows predicting the ability of muscles to perform static and impulse gripping. The use of indices standardizes the factors studied. It is because the indices are relative values.

The similarity of the results of assessing physical development reflects the same orientation of training. The predominance of persons with an average level of development among the participants shows the absence of specific requirements for body length in street workout. The execution of technical elements on sports equipment is most convenient for persons with an average body length. The prevalence of overweight persons among the participants confirms the specificity of the effect of training on the body of athletes. The established disharmony is due to an increase in the specific weight of muscles. An increase in the muscle component of the somatotype occurs because of intense strength training.

The analysis of the characteristics of the somatotype is widely used in sports science to monitor and evaluate the effectiveness of training. It is proposed to determine the profile of a volleyball player by body composition parameters (Campa, & Toselli, 2018). The dependence of the somatotype on the level of skill was determined. Elite players had more fat-free mass (FFM) and total body water (TBW), and lower fat mass (FM). It coincides with the results of our study.

Similar results were obtained when studying the body composition of judo athletes (da Silva Morais, Mendes Silva Santos, & de Sousa Sa, 2017). It is concluded that the features of the somatotype are of fundamental importance for increasing physical activity.

The aim of the study (Delaney et al., 2016) was to determine the most effective method for quantifying changes in muscle mass in rugby athletes. The high information content of the analysis of bioelectrical impedance, determination of the muscle mass index and prediction equations based on the thickness of the skinfold has been confirmed.

The results of the bioimpedance method confirm the assumptions made in the analysis of morphological parameters. All participants had a high content of muscle tissue. Most street workout athletes had low or moderate body fat.

Our data are close to the results (Salazar Martinez, & Jimenez, 2018). The authors analyzed the functional state of young soccer players. The study design also included the determination of the specific weight of body fat using an

OMRON analyzer. It was found that young athletes had an average level of fat typical for this age group (6%-14%).

Our results support the available data. Street workout athletes had balanced mesomorphic somatotype, low fat mass and high muscle development. A high level of strength of the muscles of the shoulder girdle and body trunk was determined.

A comparative analysis of street workout athletes and powerlifters is given at (Kharisov et al., 2017, 2018). Street workout athletes had a more proportional body. Powerlifters are characterized by an increase in the circumference of the chest, biceps, shoulders and legs, high values of the body mass index. Somatotype analysis showed that powerlifting athletes have a higher body fat content.

Simultaneously, the comparison allows us to conclude about the importance of using the bioimpedance method. The bioimpedance method confirms the assumptions made in the analysis of physical development, and significantly deepens them. It is consistent with the available literature data (Nascimento-Carvalho et al., 2018). The prospects of using the bioimpedance method for assessing the fitness of athletes in single combats have been confirmed.

The basal metabolic rate reflects the energy expenditures for maintaining the body's homeostasis. The proximity of these values in groups should be assessed as evidence of the stability of the state, the absence of violations. The absence of differences in the values of the basal metabolic rate illustrates the similarity of the metabolism of the participants. Most of the participants are adolescents. This period is characterized by a gradual stabilization of the intensity of growth and development processes.

Conclusions

The analysis of morphological indicators and somatotype features of street workout athletes with different training experience confirmed the specific effect of the sport on the body of athletes. Athletes with more experience in training have better indicators of hand dynamometry, higher indices of grip strength in various modes. The somatotype is characterized by a decrease in the specific weight of adipose tissue and a high level of muscle tissue. Grip strength, specific weight of muscle and fat components of the somatotype are predictors of success in this type. The information content of the proposed indices, characterizing the grip strength in static and impulse modes, for monitoring the functional state of athletes was confirmed.

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Conflict of interests

The authors declare no conflict of interest.

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ПОРІВНЯЛЬНИЙ АНАЛІЗ МОРФОЛОГІЧНИХ ПОКАЗНИКІВ АТЛЕТІВ ВУЛИЧНОГО ВОРКАУТУ ІЗ РІЗНИМ ТЕРМІНОМ ЗАНЯТЬ

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

Реферат. Стаття: 7 с., 1 таб., 31 джерело.

Мета роботи – здійснити порівняльний аналіз морфологічних особливостей атлетів вуличного воркауту з різним стажем занять.

Матеріали і методи. У дослідженні брали участь 27 атлетів вуличного воркауту (StW). Група StW-1 – 13 атлетів (15,15 ± 0,44) років, стаж занять (1,56 ± 0,22) років; StW-2 – 14 атлетів (16,57 ± 0,48) років, стаж занять (2,64 ± 0,53) років. Визначали довжину та масу тіла, рівень та гармонійність фізичного розвитку регресійним методом. Силу хвату визначали кистьовим динамометром Camry EH101 (China). Динамічну силу хвату визначали за максимальною частотою хвату за 10 сек пристроєм “Kerai” (China). Визначали вміст м'язової та жирової тканини монітором складу тіла OMRON BF-511 (Японія).

Результати. Встановлено, що силовий індекс у StW-1 був понад 60%, у StW-2 – понад 70%. У StW-2 була достовірно вище кистьова динамометрія, силовий та імпульсний індекси обох руки, індекс статичного та динамічного

хвату лівої руки, питома вага м'язів. У StW-1 середній рівень фізичного розвитку мали (61,54 ± 13,49)%, вище середнього – (23,08 ± 11,69)%. Гармонійний фізичний розвиток встановлено у (38,46 ± 13,49)%. У StW-2 середній рівень фізичного розвитку мали (64,29 ± 12,81)%, вище середнього – (21,43 ± 10,97)%. Гармонійний фізичний розвиток встановлено у (50,00 ± 13,36)% учасників. У StW-1 (46,15 ± 13,83)% мали нормальний вміст жиру і рівень жиру нижче норми. У групі StW-2 нормальний вміст жиру мали (30,77 ± 12,80)%, низький вміст – (69,23 ± 12,80)%.

Висновки. Усі учасники характеризувалися високим вмістом м'язової тканини. Підтверджено специфічний вплив виду спорту на організм атлетів. Сила хвату, питома вага м'язового компонента є предикторами успіху. Запропоновані індекси є інформативними для моніторингу функціонального стану атлетів.

Ключові слова: вуличний воркаут, фізичний розвиток, соматотип, біоімпедансний метод, сила стиснення.

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ORIGINAL SCIENTIFIC ARTICLE

MOTOR SKILLS DEVELOPMENT: PECULIARITIES OF PROGRAMMED TEACHING OF ACROBATIC EXERCISES TO GIRLS AGED 15

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Abstract

The purpose of the study was to determine the peculiarities of programmed teaching of a cartwheel to girls aged 15.

Materials and methods. The study participants were 20 girls aged 15. The children and their parents were fully informed about all the features of the study and gave their consent to participate in the experiment. To solve the tasks set, the following research methods were used: study and analysis of scientific and methodological literature; pedagogical observation, timing of training tasks; pedagogical experiment, methods of mathematical statistics, factor analysis, nearest neighbor analysis.

Results. The analysis of similarities revealed that the program components are interrelated. Series of training tasks IV, V and VI have the highest correlation. Series of training tasks I, III and IV are combined into one group and provide conditions for teaching girls aged 15 the cartwheel.

Conclusions. The study obtained factor models of the teaching program, which explain 70.645% and 68.468% of the variation of results. The models characterize the two-factor structure of the teaching program where training tasks are closely connected with one another, which indicates their effective selection. It was found that the tasks of series I, II and III, and the tasks of series III, IV and V are most connected with one another, which confirms the combined nature of the method of algorithmic instructions. Optimization of the number of repetitions of the entire exercise (series of tasks VI) depends on the amount of exercises of the second and fifth series of training tasks.

Keywords: programmed teaching, method of algorithmic instructions, acrobatic exercises, girls.

Introduction

Developing technological approaches to motor skills development and studying their effectiveness is one of the relevant problems of schoolchildren's physical education. (Ivashchenko, 2020; Khudolii, Iermakov, & Bartik, 2020; Marchenko, & Kovalenko, 2020). The educational process uses linear, branching (Gavardovskii, 2007; Ivashchenko, V. P., 2004; Yanchenko, 2016), and combined materials of programmed instruction (Shlemin, 1973; Khudolii, 2008; Ivashchenko, 2016).

Programmed instruction was developed in the 1970s and was based on the ideas of behaviorism (Skinner, 1965, 1984a,b; Fishman, Keller, & Atkinson, 1968). In physical education, studies in the field of programmed teaching aimed to develop teaching programs and determine their effectiveness (Berg, & Tikhonov, 1968; Golubev, 1969; Malinovskii,

1972). The following rules for building programs were defined: a) material is sequentially dosed in the form of appropriate portions; b) transition to the next portion is made after reaching a certain level; c) the program is presented in the form of a series of "steps" having a certain focus; d) materials of each "step" are presented in the form of "frames" (operational, informative, control frames) (Shlemin, 1973; Laputin, 1986).

One of the effective methods of programming is the method of algorithmic instructions. It belongs to combined methods of programmed instruction and has all the features of technology (Shlemin, 1973; Khudolii, 2008; Ivashchenko, 2016).

Therefore, the study of the peculiarities of using the method of algorithmic instructions when teaching physical exercises is relevant.

The purpose of the study was to determine the peculiarities of programmed teaching of a cartwheel to girls aged 15.

Material and methods

Study participants

The study participants were 20 girls aged 15. The children and their parents were fully informed about all the features of the study and gave their consent to participate in the experiment.

Organization of the study

To solve the tasks set, the following research methods were used: study and analysis of scientific and methodological literature; pedagogical observation, timing of training tasks; pedagogical experiment, methods of mathematical statistics, factor analysis, nearest neighbor analysis.

The pedagogical experiment examined the influence of 6 and 12 repetitions with a 60-second rest interval during a physical education class on the number of repetitions of training tasks to the 100% level of proficiency. In the first

group (n = 10), the girls repeated the tasks 6 sets 1 time each with a rest interval of 60 s, in the second group (n = 10) – 6 sets 2 times each with a rest interval of 60 s.

During teaching, the method of algorithmic instructions was used (Shlemin, 1973). The program of teaching the cartwheel included the training tasks given in Table 1. It was developed based on the data of Shlemin (1973), Khudolii (2008). The next exercise started on condition of correct performance of the previous exercise on three consecutive attempts. The number of repetitions required for correct performance on three consecutive attempts was recorded.

Statistical analysis

The study materials were processed using the IBM SPSS 20 statistical analysis program. Factor analysis and nearest neighbor analysis were used.

The study protocol was approved by the Ethical Committee of the University. In addition, the children and their

Table 1. Program of teaching the cartwheel to girls aged 15 (Shlemin, 1973, Khudolii, 2008)

Informative frame (what is performed)	Operational frame (how it is performed)	Control frame (transition to training the next exercise)
<i>The first series of training tasks – exercises to develop motor abilities</i>		
From normal standing position, lean forward, touch the floor with the hands and, moving the hands forward on the floor, adopt a push-up position, return to starting position in the same way	When performing the exercise, do not bend the knees	If the student performs three times in 10 seconds, proceed to the next exercise
Perform push-ups as quickly as possible (5 times in 3-4 s)	Perform the exercise as quickly as possible, maintaining a gymnastic style	If the student performs the exercise in 3-4 seconds, proceed to the next exercise
<i>The second series of training tasks – exercises to master starting and ending positions</i>		
From standing position with raised arms, step forward and perform a switch leg handstand with assistance	Switch leg handstand	Correct performance on 3 consecutive attempts
Handstand with legs apart with assistance	Switch leg handstand, maintaining balance for 3-4 seconds	Correct performance on 3 consecutive attempts
<i>The third series of training tasks – actions without which it is impossible to perform the target exercise</i>		
Standing on hands with legs apart with assistance, shift the body weight from one hand to the other	Perform everything only with assistance	Correct performance on 3 consecutive attempts
<i>The fourth series of training tasks – teaching the ability to assess movements in space, by time and muscular effort</i>		
Arriving to handstand quickly with assistance	Pay attention to the technique of performance	Correct performance on 3 consecutive attempts
Arriving to handstand slowly with assistance	Pay attention to the technique of performance	Correct performance on 3 consecutive attempts
<i>The fifth series of training tasks – preliminary exercises</i>		
Arriving to handstand quickly with the wall support	Maintain balance for 3-4 seconds	Correct performance on 3 consecutive attempts
Handstand with legs apart with 90-degree rotation with assistance	Perform all exercises for this element only with assistance	Correct performance on 3 consecutive attempts
<i>The sixth series of training tasks – the entire exercise</i>		
Cartwheel with assistance	Pay attention to the technique of performance	Correct performance on 3 consecutive attempts
Cartwheel without assistance	Maintain a gymnastic style	Correct performance on 3 consecutive attempts

Table 2. Analysis of the effectiveness of the program of teaching girls aged 15 the cartwheel, using different repetition modes (1 – mode of 6 sets 1 time each with a rest interval of 60 s; 2 – mode of 6 sets 2 times each with a rest interval of 60 s)

Indicator	n	M	SD	t-test for Equality of Means					
				t	p	MD	SED	95% Confidence Interval of the Difference	
								Lower	Upper
Total number of repetitions	1	10	52.1	0.424	0.05	0.5	1.179	-2.99327	1.99327
	2	10	52.6						

parents or legal guardians were fully informed about all the features of the study, and a signed informed consent document was obtained from all the parents.

Results

Table 2 shows the results of a comparative analysis of the effectiveness of the program of teaching girls aged 15 the cartwheel, using different repetition modes. The null hypothesis about equality of learning outcomes is accepted ($p < 0.05$).

Structural analysis of the program of teaching girls aged 15 the cartwheel (mode of 6 sets 1 time each with a rest interval of 60 s)

As a result of analysis, two factors that explain 70.645% of the variation of results were identified (Table 3). The first factor explains 41.531% of the variation of learning outcomes. The series that are most correlated with the factor are: Series 6 – the entire exercise ($r = 0.967$), Series 2 – exercises to master starting and ending positions ($r = -0.788$), Series 5 – preliminary exercises ($r = -0.718$). The factor is bipolar and indicates that optimization of the number of repetitions

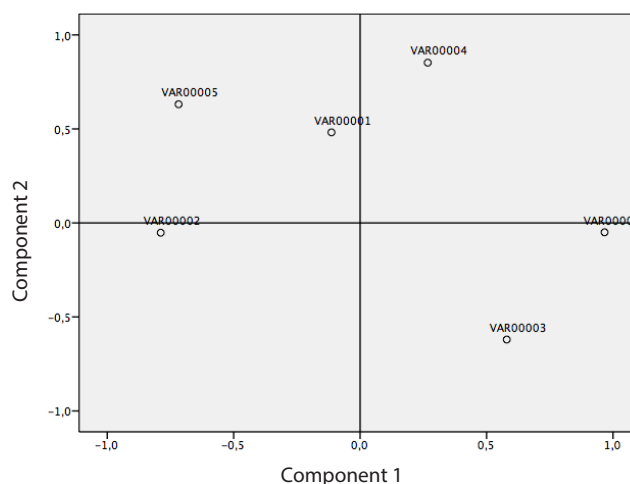
Table 3. Results of factor analysis of the teaching program (6 repetitions, rest interval of 60 s). Rotated Component Matrix

Series of training tasks	Component		h ²
	1	2	
Series I – exercises to develop motor abilities		0.482	0.245
Series II – exercises to master starting and ending positions	-0.788		0.624
Series III – actions without which it is impossible to perform the target exercise	0.580	-0.620	0.721
Series IV – exercises to master the ability to control movements		0.852	0.798
Series V – preliminary exercises	-0.718	0.631	0.914
Series VI – the entire exercise	0.967		0.937

Table 4. Total Variance Explaineda

Component	Rotation Sums of Squared Loadings	
	% of Variance	Cumulative %
1	41.531	41.531
2	29.114	70.645

Component Plot in Rotated Space

**Fig. 1.** Results of factor analysis of the teaching program (6 repetitions, rest interval of 60 s)

of the entire exercise depends on the amount of exercises of the second and fifth series of training tasks.

The second factor explains 29.114% of the variation of learning outcomes. The series that are most correlated with the factor are: Series 4 – exercises to master the ability to control movements ($r = 0.852$), Series 5 – preliminary exercises ($r = 0.631$), Series 3 – actions without which it is impossible to perform the target exercise ($r = -0.620$). The factor can be interpreted as movement control.

The analysis of similarities revealed that the program components are interrelated (Table 3). Series of training tasks IV, V and VI have the highest correlation and provide conditions for teaching girls aged 15 the cartwheel (Fig. 1).

Structural analysis of the program of teaching girls aged 15 the cartwheel (mode of 6 sets 2 times each with a rest interval of 60 s)

As a result of analysis, two factors that explain 68.468% of the variation of results were identified (Table 5). The first factor explains 42.092% of the variation of learning outcomes. The series that are most correlated with the factor are: Series I – exercises to develop motor abilities ($r = 0.858$), Series III – actions without which it is impossible to perform the target exercise ($r = 0.869$), Series IV – exercises to master the ability to control movements ($r = 0.752$). The factor characterizes the use of the following methods: combination (Series I), method of solving separate tasks (Series III), and method of immediate information about the exercise performance (Series IV).

Table 5. Results of factor analysis of the teaching program (12 repetitions, rest interval of 60 s). Rotated Component Matrix

Series of training tasks	Component		h ²
	1	2	
Series I – exercises to develop motor abilities	0.858		0.796
Series II – exercises to master starting and ending positions		-0.758	0.591
Series III – actions without which it is impossible to perform the target exercise	0.869		0.769
Series IV – exercises to master the ability to control movements	0.752	-0.306	0.658
Series V – preliminary exercises	-0.449	0.692	0.681
Series VI – the entire exercise	0.500	0.602	0.612

Table 6. Total Variance Explained

Component	Rotation Sums of Squared Loadings	
	% of Variance	Cumulative %
1	42.092	42.092
2	26.377	68.468

The second factor explains 26.377% of the variation of learning outcomes. The series that are most correlated with the factor are: Series II – exercises to master starting and ending positions ($r = -0.758$), Series V – preliminary exercises ($r = 0.692$), Series VI – the entire exercise ($r = 0.602$). The factor can be interpreted as movement control. The factor characterizes training tasks that are directly related to the cartwheel technique.

The analysis of similarities revealed that the program components are interrelated (Table 5). Series of training

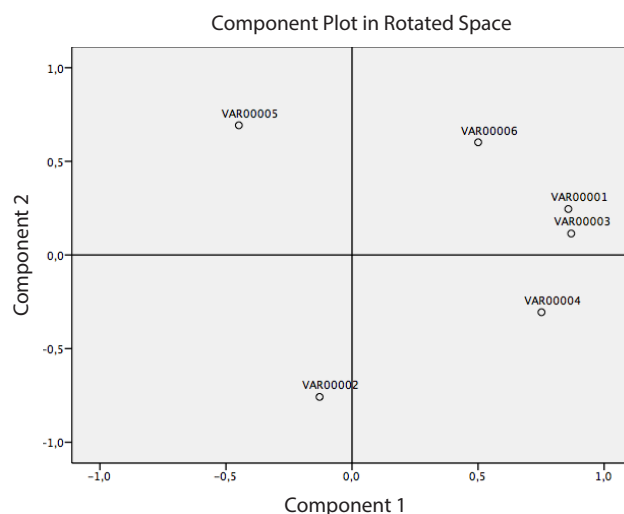


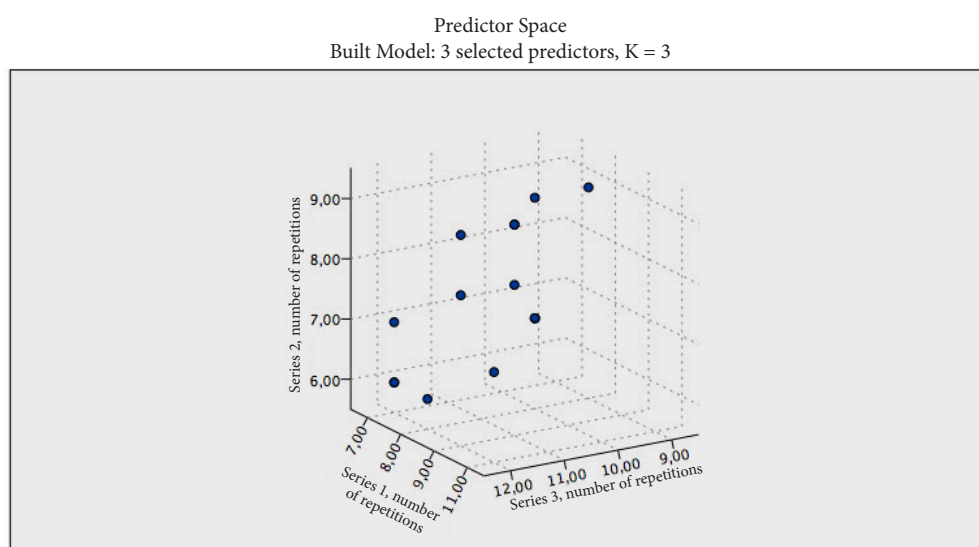
Fig. 2. Results of factor analysis of the teaching program (12 repetitions, rest interval of 60 s)

tasks I, III and IV are combined into one group and provide conditions for teaching girls aged 15 the cartwheel (Fig. 2).

The analysis of implementation of the teaching program under the conditions of two exercise modes using the nearest neighbor analysis showed that the tasks of series 1, 2 and 3 (Table 7, Fig. 3), and the tasks of series 3, 4 and 5 are most connected with one another (Table 8, Fig. 4).

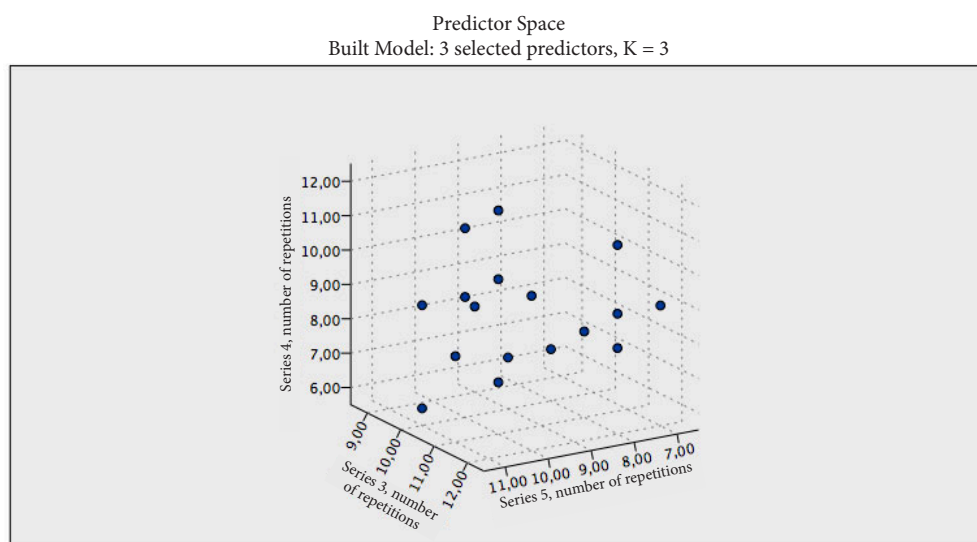
Table 7. Analysis results

Case Processing Summary		N	Percent
Sample	Training	15	83.3%
	Holdout	3	16.7%
Valid		18	100.0%
Excluded		2	
Total		20	



Select points to use as focal records
This chart is a lower-dimensional projection of the predictor space, which contains a total of 7 predictors

Fig. 3. Analysis results. Nearest neighbor analysis



Select points to use as focal records
This chart is a lower-dimensional projection of the predictor space, which contains a total of 4 predictors

Fig. 4. Analysis results. Nearest neighbor analysis

Table 8. Analysis results. Nearest neighbor analysis

Case Processing Summary		N	Percent
Sample	Training	17	85.0%
	Holdout	3	15.0%
Valid			100.0%
Excluded			
Total			

Discussion

As a result of the pedagogical experiment, the peculiarities of using the method of algorithmic instructions when teaching girls aged 15 the cartwheel were determined. The study obtained factor models of the teaching program, which explain 70.645% and 68.468% of the variation of results. The models characterize the two-factor structure of the teaching program where training tasks are closely connected with one another, which indicates their effective selection. It was found that the tasks of series 1, 2 and 3, and the tasks of series 3, 4 and 5 are most connected with one another, which points to the combined nature of the method of algorithmic instructions. Optimization of the number of repetitions of the entire exercise (series of tasks VI) depends on the amount of exercises of the second and fifth series of training tasks.

The obtained data supplement the results of the study on the patterns of motor skills development (Ivashchenko, 2016, 2020; Khudolii, Iermakov, & Bartik, 2020) and indicate the effectiveness of using the method of algorithmic instructions when teaching physical exercises (Marchenko, & Taranenko, 2020; Marchenko, Jagiello, Iermakov, Ivashchenko, & Khudolii, 2021; Slotte, Sääkslahti, Kukkonen-Harjula, & Rintala, 2017). The study confirmed the combined nature of the method of algorithmic instructions (Shlemin, 1973; Khudolii, 2008; Ivashchenko, 2016).

The obtained data confirm that the method of algorithmic instructions is based on the teaching methods and techniques that exist in physical education and at the same time complements and extends them. In the exercises of the first series of training tasks related to special physical fitness, the method of combination is used; in the second series – the method of separated training and the technique of fixing separate positions; in the third – the method of solving separate motor tasks; in the fourth – the method of immediate and current information about the accuracy of the movements performed; in the fifth – the method of preliminary exercises and separation; in the sixth – the method of holistic training (Shlemin, 1973; Khudolii, 2008).

Since the decision to proceed to the next series is made depending on the level of motor fitness (series of training tasks I), the programming of motor abilities development is a necessary element of the teaching program (Khudolii, Ivashchenko, & Titarenko, 2013; Khudolii, Iermakov, Ivashchenko, & Nosko, 2020; Iermakov, Ivashchenko, Khudolii, & Chernenko, 2020).

Thus, the use of the method of algorithmic instructions can be seen as a technological process with a guaranteed result, which is a step towards improving the effectiveness of school physical education (Samsudin, Setiawan, Taufik, & Solahuddin, 2021; Khudolii, Kapkan, Harkusha, Marchenko, & Veremeenko, 2020; Tkachenko, 2020; Tomaczkowski & Klonowska, 2020).

The study found that factor analysis and nearest neighbor analysis can be used to substantiate the teaching program, which allows determining the relationship of each factor with the result of teaching series of training tasks and the structure of the program.

Conclusions

As a result of the pedagogical experiment, the peculiarities of using the method of algorithmic instructions when teaching girls aged 15 the cartwheel were determined.

The study obtained factor models of the teaching program which explain 70.645% and 68.468% of the variation of results. The models characterize the two-factor structure of the teaching program where training tasks are closely connected with one another, which indicates their effective selection. It was found that the tasks of series 1, 2 and 3, and the tasks of series 3, 4 and 5 are most connected with one another, which confirms the combined nature of the method of algorithmic instructions. Optimization of the number of repetitions of the entire exercise (series of tasks VI) depends on the amount of exercises of the second and fifth series of training tasks.

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Conflict of interest

The authors declare that there is no conflict of interest.

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ФОРМУВАННЯ РУХОВИХ НАВИЧОК: ОСОБЛИВОСТІ ПРОГРАМОВАНОГО НАВЧАННЯ АКРОБАТИЧНИХ ВПРАВ ДІВЧАТ 15 РОКІВ

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Реферат. Стаття: 7 с., 8 табл., 4 рис., 27 джерел.

Мета дослідження – визначити особливості програмованого навчання перевороту убік дівчат 15 років.

Матеріали і методи. У дослідженні прийняли участь 20 дівчат 15 років. Діти та їхні батьки були інформовані про всі особливості дослідження і дали згоду на участь в експерименті. Для вирішення поставлених завдань були використані методи дослідження: вивчення та аналіз науково-методичної літератури; педагогічне спостереження, хронометраж навчальних завдань; педагогічний експеримент, методи математичної статистики, факторний аналіз, метод найближчих сусідів.

Результати. Аналіз спільностей дозволив встановити, що компоненти програми взаємозв'язані. Найбільшу кореляцію мають IV, V та VI серії навчальних завдань. I, III та IV серії навчальних завдань об'єднуються в одну плеяду і

забезпечують умови для навчання перевороту убік дівчат 15 років.

Висновки. У дослідженні отримано факторні моделі програми навчання які на 70,645% та 68,468% пояснюють варіацію результатів. Моделі характеризують двох факторну структуру програми навчання у якій кожне навчальне завдання має тісний зв'язок між собою, що свідчить про їх ефективний підбір. Встановлено що найбільш зв'язані між собою є завдання I, II та III серії і завдання III, IV та V серії, що підтверджує комбінований характер методу алгоритмічних розпоряджень. Оптимізація кількості повторень вправи в цілому (VI серія завдань) залежить від обсягу виконання вправ другої і п'ятої серії навчальних завдань.

Ключові слова: програмоване навчання, метод алгоритмічних розпоряджень, акробатичні вправи, дівчата.

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ORIGINAL SCIENTIFIC ARTICLE

DIFFERENCES OF MOTOR PROFICIENCY IN PRESCHOOL GIRLS RELATED TO ORGANIZED PHYSICAL ACTIVITY

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Abstract

This study purpose was to determine the level of motor competence and differences in motor skills of preschool girls aged 5 to 7 from Serbia according to participation in organized physical activities.

Materials and methods. Ninety-one girls aged 5-7 years (mean $\pm$ 6.4) were divided into three subsamples: control group, rhythmic gymnastics and sports school. Girls were assessed with the MABC-2 test. Descriptive statistics analyzed the basic characteristics of participants according to the level of motor competence. Furthermore, Pearson's χ^2 test for contingency tables, MANOVA and discriminant analysis were employed to find differences in motor proficiency among groups.

Results. Significant differences have been found in girls attending rhythmic gymnastics in aiming & catching on the upper bound of moderate effect size ($p < 0.001$, $\eta^2 = 139$), and total test score moderate effect size ($p = 0.006$, $\eta^2 = 0.105$) compared to girls who did not participate in organized physical activity. The discrimination coefficient explained the differences in girls in aiming and catching, with a contribution of 41.4%, balance skills with 24%, and a total test score of 22.9%. According to the level of motor competence, 61% from the control group and 40% from the sports school group scored below average in aiming & catching. The total test score of ≥ 50 percentile was achieved by 68.3% of girls in the control group, 84% in the sports school group, and 96% in rhythmic gymnastics.

Conclusion. This study confirms that sports practice contributes to the development of motor capabilities and influences individual differences in children's scores. Our findings can contribute to understanding how important it is to promote object control skills games for girls and older preschoolers generally.

Keywords: motor competence, preschool, girls, organized physical activity, MABC-2.

Introduction

The characteristics of preschool children in terms of integrity mean that the motor, physical, cognitive and conative aspects of child development are closely related. Development in one domain of physical abilities affects development in another domain. Motor development is understood as changes in motor behaviour along the life span and increased capacity to perform specific skills (Sugden & Wade, 2013). Such changes are continuous and provided by the interaction among constraints over the body, the environment and the task (Newell, 1986). Motor skills development during the growth process is influenced by various internal and external factors such as gender, age, and physical activity (Giagazolou et al., 2011; Venetsanou & Kambas, 2010). Motor pro-

ficiency develops during preschools through various forms of physical activity such as running, jumping, catching, and throwing. According to the authors, Gallahue and Ozmun (2006) and MacNamara et al. (2011), these motoric skills used in everyday recreational activities can be the basis for creating more complex movements. In addition, executing different motor acts, including balance coordination, constitutes motor skills (Henderson, Sugden, & Barnett, 2007). Typically developing children will acquire an entire range of fundamental movement skills that naturally occurs throughout development till the end of preschool (Hardy, King, Farrell, Macniven, & Howlett, 2010).

Motor competence can be viewed as a determinant of participation and levels of physical activity (Stodden et al., 2008; Wrotniak, Epstein, Dorn, Jones, & Kondilis, 2006). Consequently, poor motor performance may cause ad-

verse influence in preschool children on everyday life tasks, educational settings, and participation in sport-related PA (Henderson, Sugden, & Barnett, 2007). Longitudinal studies have shown that children with low motor competence tend to be less physically active than children with higher motor competence, and that trend continues through adolescence and adulthood (Barnett et al., 2008; Hands, 2008). Furthermore, motor competence has been related to physical fitness (Ivashchenko, Nosko, Bartik, & Makanin, 2020; Haga, 2008a; Hands, 2008) and self-perception (Barnett, Morgan, van Beurden, & Beard, 2008; Vedul-Kjelsås, Sigmundsson, Stensdotter, & Haga, 2012). On the contrary, reduced physical activity in children with low motor competence may be associated with lower performance levels on several components of physical fitness, such as cardiovascular endurance, muscular strength and endurance, and speed (Haga, 2008b; Hands, 2008; Tsiotra, Nevill, Lane, & Koutedakis, 2009).

Recent studies show a significant relationship between actual motor competence and perceived competence (LeGear et al., 2012; Robinson, 2010). Young children usually have positive perceptions of their physical competence, although their actual competence might be different and usually low. LeGear et al. (2012) said that these positive perceptions at preschool age provide “a window of opportunity” for fostering skillfulness.

Many children participate in organized sports to build physical and social skills (Patel, Soares, & Wells, 2017; Washington et al., 2001). Playing sports depends on the child's physical growth and neurodevelopmental readiness (Patel et al., 2017). Therefore, working with children tends awareness of the child's level at different stages of development and needs specific strategies to optimize his abilities in each age group (Patel et al., 2017). Different types of PA can be very stimulating in the preschool-age by organizing various forms of play and socializing with other children, promoting learning, memory and motor patterns. Gallahue, Ozmun & Goodway (2011) thinks that physical activity positively affects fundamental movement patterns and encourages learning the sports technique of performing some elements. Furthermore, attending institutions in early childhood such as kindergarten (Sabo, 2003, 2004; Venetsanou & Kambas, 2010), recreational and sports clubs (Radošević, Gavrilović, Veselinović, & Parčina, 2018; Temple, Crane, Brown, Williams, & Bell, 2016), and family indoor and outdoor activities (Barnett, Hinkley, Okely, & Salmon, 2013) have a positive impact on child motor learning and development. Temple et al. (2016) have found that the more active categories of physical activities, active recreation and organized sports predict at least one subtype of motor skill in preschool children. However, since the girls were associated only with stork balance, the same study indicates that light needs to be shed on optimally portraying young girls' motor skill proficiency and the relationships between their participation and motor skills (Temple et al., 2016). Also, Olesen, Kristensen, Ried-Larsen, Grøntved, & Froberg (2014) emphasize the large variation of PA among preschool ages, indicating that girls, in particular, are susceptible to the environment offered for PA during the preschool period.

This study purpose was to determine differences in motor skills of preschool girls aged 5 to 7 from Serbia according to participation in organized physical activities divided into three groups: rhythmic gymnastics, sports school and

control group. Specific tasks of this research were related to establishing the characteristics of each group according to the level of motor competence in manual dexterity, aiming and catching, balance and total test score. Furthermore, to determine which motor skill best discriminates between groups, homogeneity and distance between groups will be determined.

Materials and methods

Study participants

Ninety-one girls aged 5-7 years (mean $\pm$ 6.4) were selected in the city of Niš, Republic of Serbia. The sample of participants was divided into three subsamples: Control group ($n = 41$), rhythmic gymnastics ($n = 25$) and sports school ($n = 25$).

The control group were children from kindergarten who did not participate in sports activities except for those in PE of the kindergarten curriculum. Rhythmic gymnastics has a program basic of rhythmic gymnastics and learning group choreography without requisites. Girls were also introduced to the basic apparatus of a ball, hoop and rope. The sports school program has been designed with various activities for preschoolers to learn and improve fundamental motor skills properly. Since the data was collected in May, the criterion was to have attended at least 75% of classes since September. Classes were three times per week for 60 minutes. All programs are supervised by physical educators and coaches who have 30 years of experience working with children. It should be noted that there is an exact reason we can compare these different programs – fundamental movement skills are practised in all sports schools.

Study organization

Motor development was assessed using the Movement Assessment Battery for Children-2 (MABC-2 test) proposed by Henderson et al., 2007. The MABC-2 test assesses in the three motor domains: Manual Dexterity (MD), Aiming & Catching (AC), and Balance (BAL) within eight test items that differ from age bands (ABs); 3-6 years old (AB1), 7-10 years old (AB2), and 11-16 years (AB3). AB1 for 5 to 6 years and AB2 for 7 years old are used for this study. The performance test, used in this study as a research tool, is also used in clinical settings to identify children with motor difficulties or “at-risk” of or have developmental coordination disorder.

Children were tested individually. The assessment required a quiet environment not to disturb participants during the testing. Manual dexterity tasks took place in the classroom while aiming & catching and balance tasks were performed in the gym. All tasks were clearly explained and demonstrated. The child had two attempts for each task.

The study was approved by the Ethical Commission of Faculty of Physical Culture, Palacky University Olomouc, following the principles established by the Helsinki Declaration of the World Medical Association (WMA). Furthermore, principals, teachers and parents were informed about the research goal. In addition, all parents and guardians have signed a written form confirming participation. Data were collected during the internship in cooperation with the Faculty of Sport and Physical Education University of Niš,

Table 1. Descriptive statistics contingency tables for motor proficiency between girls oriented to organized physical activity

MABC-2		Below average		Average		Above average		p	c
		n	%	n	%	n	%		
MD	Control group	9	22.0	12	29.3	20	48.8	.742	.145
	R.gymnastics	5	20.0	8	32.0	12	48.0		
	Sports school	3	12.0	11	44.0	11	44.0		
AC	Control group	25	61.0*	12	29.2	4	9.8	.001	.354
	R.gymnastics	6	24.0	8	32.0	11	44.0*		
	Sports school	10	40.0	9	36.0	6	24.0		
BAL	Control group	14	34.1	11	26.9	16	39.0	.273	.231
	R.gymnastics	5	20.0	6	24.0	14	56.0*		
	Sports school	6	24.0	11	44.0	8	32.0		
TTS	Control group	13	31.7*	16	39.0	12	29.3	.042	.313
	R.gymnastics	1	4.0	9	36.0	15	60.0*		
	Sports school	4	16.0	10	40.0	11	44.0		

Note: MD – manual dexterity; AC – aiming and catching; BAL – balance; TTS – Total test score; Below Average score ≤ 37 percentiles; Average 50-75 percentiles, and Above average ≥ 84 at MABC-2 test, c – Pearson's coefficient of contingency, p-probability χ^2 test

Serbia. The examiners were PhD students, postgraduate in Adapted Physical Activity from Czech and Serbia.

Statistical analysis

First, for this study, different cut off points are made to categorize children according to results of MABC-2 test component scores: below-average (scores ≤ 37 percentile), average (50 to 75 percentile), and above-average (scores ≥ 84 percentile). Second, descriptive statistics were analyzed to determine the basic characteristics of participants according to the level of motor competence, Pearson's χ^2 test for contingency tables and proportions between and within groups association. Therefore, Multivariate analysis of variance (MANOVA) and discriminant analysis was applied on scaled data. Univariate procedures follow up with the univariate Roy test and Post Hoc Bonferroni. The Pearson contingency coefficient (c) from 0-1 and eta square (η^2) are estimated effect sizes 0.01, 0.06, 0.14 as small, medium, large. In addition, a discriminant coefficient was calculated to identify potentially significant contributors among variables. An indicator of the similarity and difference between groups has been presented by Mahalanobis distance and Cluster tree. The statistical significance was set at $p < 0.05$. The data were analyzed in IBM SPSS Statistics for Windows, Version 21.0. and the statistical program of Smartline agency (Dolga, Novi Sad, Serbia).

Results

Table 1 shows the level of motor skills Manual Dexterity, Aiming & Catching, Balance and Total Test Score in percentage (%). In addition, descriptive statistics crosstabs show the level of motor proficiency for each group concerning their scores. Attention is being drawn to significant differences between and within groups based on proportions. The descriptive procedure can only suggest some individual motor skills characteristics, while the significant differences

between groups related to motor proficiency will be analyzed further.

Manual dexterity. Most of the girls had excellent manual dexterity scores. Above the average range from 44%-48.8%, and average range from 29.3% to 44%. Below average scored 12%-22% of participants. Association between groups related to fine motor skills has not been found [$\chi^2(4) = 1.967$, $p = 0.742$] Pearson's coefficient of contingency was very low $c = 0.145$.

Aiming and catching. In total, 29 girls score on average, ranging in groups from 29.3% - 36%. The majority of girls from the control group, 61% and 40% from the sports school group, score below average. Based on proportion, this frequency was statistically significant in the control group than the frequency of average ($n = 12$, 29.3% $p = 0.005$) and above-average ($n = 4$, 9.8% $p = 0.000$). The Rhythmic gymnastics (44%) were more likely to score above average than girls from the control group. There is an association between aiming and catching tasks and girls groups since the $\chi^2(4) = 13.034$, $p = 0.011$, Pearson's coefficient of contingency showed a low correlation $c = 0.354$.

Balance. There is not enough evidence to suggest an association between groups and balance $\chi^2(4) = 5.142$, $p = 0.273$, Pearson's coefficient of contingency $c = 0.231$ correlation is low. However, 56% of the girls who attended rhythmic gymnastics reached an above-average score, and that frequency was significantly higher than average scores ($n = 6$, 24.0% $p = 0.025$) and below-average scores ($n = 5$, 20.0% $p = 0.012$). They were slightly better than girls from the control group and sports school.

Total test score. Based on the final results, 31.7% of girls from the control group scored below average, significantly higher than the rhythmic group (4.00% $p = 0.016$). Average scores range from 36% to 40%. The 96% of rhythmic gymnastics scored above 50 percentile. Since only one girl scored below the norm, they were more likely to score ≥ 84 percentile $p = 0.010$. 84% of girls from sports school score 50 percentile and above, frequency above average was signif-

ificant $p = 0.036$ since four respondents scored on and below 37 percentile. Association has been found between groups and total test score since $\chi^2(4) = 9.889$, $p = 0.042$, $c = 0.313$ correlation is low.

According to their participation in organized physical activity, the significant difference in motor competence of girls aged 5-7 years are presented in Tables 2 and 3.

Significant Manova $F_{(8,170)} = 2.719$, $p = 0.008$ and discriminant analysis $F_{(8,170)} = 2.686$, $p = 0.008$ means that there is a significant difference and a clearly defined boundary in motor competence between preschool girls according to their participation in organized physical activity. Follow up univariate test has found a significant difference in aiming & catching $F_{(2,88)} = 7.277$, $p < 0.001$, $\eta^2 = 0.139$ and TTS $F_{(2,88)} = 5.394$, $p = 0.006$, $\eta^2 = 0.105$. Girls attending rhythmic gymnastics were significantly better in aiming & catching $p < 0.001$, and the Total test score $p = 0.006$ than girls from the control group. The coefficient of discrimination indicates the most potent contribution to discrimination between groups in aiming and catching (0.074), balance (0.043), total test score (0.041).

Table 4 shows characteristics and homogeneity of girls from the control group, rhythmic gymnastics and sports school, related to MD, AC, BAL, and TTS. According to participation in organized physical activity, preschool girls were significantly different in some domains of motor competence. Once again transferred to percentage, specific skills

Table 2. MANOVA and discriminant analysis significant differences in motor competence between preschool girls according to their participation in organized physical activity

Analysis	n	F _(8,170)	p
MANOVA	4	2.719	0.008
Discriminant	4	2.686	0.008

Table 3. Univariate Roy test significant differences between groups related to manual dexterity, aiming and catching, balance, and total test score

Indicators	F _(2,88)	p	η^2	c. disc.
MD	0.983	0.378	0.001	0.021
AC	7.277	0.001	0.139	0.074
BAL	1.739	0.182	0.027	0.043
TTS	5.394	0.006	0.105	0.041

Note: MD – manual dexterity; AC – aiming and catching; BAL – balance; TTS – total test score; η^2 – effect size coefficient; c. disc – discriminative coefficient

Table 4. Characteristics and homogeneity of girls from the control group, rhythmic gymnastics, and sports school related to manual dexterity, aiming and catching, balance, and total test score

Indicators	Control group	Rhythmic gymnastics	Sports school	Contribution %
AC	lower *	higher *	–	41.4
BAL	–	higher *	–	24.0
TTS	lower *	higher *	–	22.9
MD	–	–	–	11.7
n/m	26/41	18/25	14/25	
%	63.4	72.0	56.0	

appeared to be the best discriminators, aiming and catching with 41.4%, balance skills with 24%, and total test score with 22.9%.

Table 5 shows the distance between the control group, rhythmic gymnastics, and sports to motor proficiency.

By calculating the Mahalanobis distance between the groups, another indicator of similarities or differences was

Table 5. Distance (Mahalanobis) between the control group, rhythmic gymnastics, and sports school to motor proficiency

Indicators	Control group	Rhythmic gymnastics	Sports school
Control group	0.00	1.05	0.78
Rhythmic gymnastics	1.05	0.00	0.73
Sports school	0.78	0.73	0.00

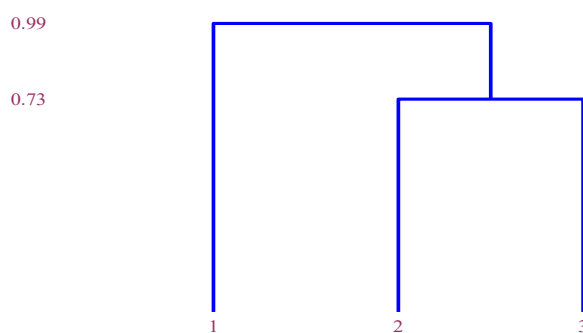


Fig. 1. Control group (1), Rhythmic gymnastics (2), Sports school (3)

obtained – distances of different spaces (D^2) can be compared. For example, the distances from Table 5 indicate that the slightest differences are between girls from sports school

and rhythmic gymnastics $D^2 = 0.73$ (moderate). The more significant differences are between rhythmic gymnastics and control group $D^2 = 1.05$ (greatest distance).

Discussion

The purpose of this study was to determine differences in motor skills of preschool girls according to participation in organized physical activities. Specific tasks of this research were related to establishing the characteristics of each group according to the level of motor competence and determining which motor skill the best discriminate between groups.

Multivariate ANOVA and discriminative analysis were significant at $p = 0.008$. Significant differences have been found in girls attending rhythmic gymnastics in aiming & catching on the upper bound of moderate effect size ($\eta^2 = 139$), and total test score moderate effect size ($\eta^2 = 0.105$) compared to girls who did not participate in organized physical activity.

Based on Table 4, it can be concluded that the control group's homogeneity is 63.4% (higher), which means that 15 of 41 girls have other characteristics than the characteristics of their group. However, girls from the control group mainly had achieved scores significantly lower in aiming & catching and total test score. Moreover, 61% expressed lower than average aiming and catching skills. The homogeneity of the rhythmic gymnastics group was higher (72.0%). Seven girls of 25 had other characteristics. They had achieved scores significantly higher aiming & catching and total test score. In addition, a higher amount of the girls who practised rhythmic gymnastics scored above 50 percentile on balance (80%). Characteristics of sports schools have 14 out of 25 girls. Homogeneity was 56.0% (smaller). They mostly had resulted from the average and above average. The total test score norm of ≥ 50 percentile meet 68.3% girls in the control group, 84% in the sports school group, and 96% in rhythmic gymnastics.

Based on the presented dendrogram in Figure 1, it can be noticed that the closest are rhythmic gymnastics and sports school with a distance of 0.73, and the most significant difference is between the control group and rhythmic gymnastics, with a distance of 0.99.

Our results confirm our expectations and previous findings that children involved in structured and organized physical activity have better-developed motor competence, gross motor skills and manipulative skills (Djordjević, Valková, Nurkić, Djordjević, & Dolga, 2021; Hardy, O'Hara, Rogers, St George, & Bauman, 2014; Krombholz, 2006; Šalaj, Krmpotić, & Stamenković, 2016). Moreover, children who consistently engage in sports from 6-7 years of age during the following years showed better levels of coordination than children who only partially participated or did not participate in the sports-recreational environment (Vandorpe et al., 2012). Our results align with Ribeiro-Silva (2016) study, where girls who practised rhythmic gymnastics had higher scores in the object control subtest and motor quotient than girls who practised swimming. Furthermore, this difference in the performance of object control skills in girls impacted the motor quotient measure (Ribeiro-Silva, 2016). Those findings were similar to our results, as specific skills appeared to be the best discriminators, aiming and catching with 41.4%, balance skills with 24%, and total test score 22.9%.

Apart from regular training, the probable reason why girls from rhythmic gymnastics have improved scores in aiming and catching is the perception of this aesthetic-co-ordinative sport. Practising rhythmic gymnastics in girls encourage the need to learn new skills with apparatus, such as throwing a ball in the air and catching, manipulating a hoop and a ribbon, skipping a rope in free time. Šalaj et al. (2019) found significant differences in gross motor quotient and locomotor skills in the selected girls compared to the non-selected girls from artistic gymnastics. However, results from this study suggest that the female competition program in preschool-age favourites the development of locomotor but not manipulative motor skills, and they propose a multi-lateral exercise program (Šalaj et al., 2019). This conclusion can be applied to our girls from sports school, although 84% had good results on the total test score, 40% of girls had aiming and catching skills below average.

The control group of girls, as could be assumed, had the statistical significance of the differences because that group did not have additional physical activities to improve the overall result. Different studies have shown that preschool children spend their school time in three different contexts: traditional classes, physical education (PE), and free schoolyard play (Flôres, Rodrigues, Copetti, Lopes, & Cordovil, 2019). Physical education classes or schoolyards play at preschool are the only environmental opportunity to play sports, games, gymnastics, and dance for many children. However, since motor competence does not develop naturally (Drenowatz, 2021); instead, it requires instruction and purposeful practice, feedback, in addition to free play (Logan et al., 2019). Our research indicates preschool PE should propose more physical activity in girls and skill practice time, especially on-task regarding object control or ball skills. As Drenowatz (2021) stated, children may not be exposed to movements that promote the development of manipulative skills during daily activities, and facility control skills may not be as integrated with daily PAs as locomotor skills and stability skills.

Exercise is an essential condition for the creation of motor habits. Therefore, starting with children on some sports activities is recommended, of course, very carefully chosen for young children (Parízková, 2016). When proper motor habits and skills are introduced on time, a sound basis for later performance and interest in exercise is created.

Conclusion

To improve balance and fine and gross motor coordination during early childhood is challenging, and to make progress, children at that young age can only do it through the tasks and vigorous play that sports schools can provide (Djordjević et al., 2021). In this study, the coefficient of discrimination found the most significant contribution to differences between girls in aiming and catching, balance and total test score. Furthermore, girls from rhythmic gymnastics significantly differ from control group girls in aiming & catching and total test score with a moderate effect size. According to the level of motor competence, 61% from the control group and 40% from the sports school group scored below average on aiming & catching. The total test score of ≥ 50 percentile achieved 68.3% of girls in the control group, 84% in the sports school group, and 96% in rhythmic gymnastics.

Our results confirm that sports practice contributes to the development of motor capabilities and influences individual differences in children's scores. Additionally, as Berk (2008), we notice that the children's sports school program improves and upgrades previously acquired motor experiences. Further, our findings can contribute to understanding how important it is to promote object control skills games for girls and older preschoolers generally. The implications are addressed for parents, physical education teachers, early childhood educators and early childhood and physical activity policymakers and recommend structured physical activity experiences that promote motor competence in preschoolers.

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Conflict of interest

The authors declare no conflict of interest.

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ВІДМІННОСТІ У РУХОВІЙ ПІДГОТОВЦІ ДІВЧАТ ДОШКІЛЬНОГО ВІКУ, ПОВ'ЯЗАНІ З ОРГАНІЗОВАНОЮ ФІЗИЧНОЮ АКТИВНІСТЮ

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

Реферат. Стаття: 7 с., 4 табл., 1 рис., 38 джерел.

Мета дослідження – визначити рівень рухової компетентності та відмінності у моторних навичках дівчат дошкільного віку від 5 до 7 років із Сербії залежно від участі в організованій фізичній активності.

Матеріали та методи. 91 дівчинку 5-7 років (середнє значення $\pm 6,4$) було розділено на три підвибірки: контрольну групу, групу художньої гімнастики та групу спортивної школи. Дівчаток оцінювали за допомогою тесту

МABC-2. Використовуючи описову статистику, проаналізовано основні характеристики учасниць за рівнем рухової компетентності. Крім того, були застосовані критерій χ^2 Пірсона для факторних таблиць, MANOVA та дискримінантний аналіз, щоб знайти відмінності у руховій підготовці груп.

Результати. У дівчат, які відвідують художню гімнастику, були виявлені значні відмінності у прицілюванні та

ловлі на верхній межі помірної величини ефекту ($p < 0,001$, $\eta^2 = 139$) та помірної величини ефекту у загальному результаті тесту ($p = 0,006$, $\eta^2 = 0,105$) порівняно з дівчатами, які не брали участі в організованій фізичній активності. Коефіцієнт дискримінації пояснив відмінності у дівчат у прицілюванні та ловлі із внеском 41,4%, у навичках рівноваги – 24%, та загальному результаті тесту – 22,9%. За рівнем рухової компетентності 61% з контрольної групи та 40% з групи спортивної школи набрали нижчу середню оцінку з прицілювання та ловлі. Загальний бал тесту ≥ 50 процентилів досягли 68,3% дівчат у контрольній групі, 84% у групі спортивної школи та 96% у групі художньої гімнастики.

Висновок. Дане дослідження підтверджує, що заняття спортом сприяють розвитку рухових здібностей та впливають на індивідуальні відмінності у результатах дітей. Результати дослідження допомагають зрозуміти важливість популяризації ігор для розвитку навичок керування предметом серед дівчаток та дітей старшого дошкільного віку загалом.

Ключові слова: рухова компетентність, дошкільний навчальний заклад, дівчата, організована фізична активність, МАВС-2.

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ORIGINAL SCIENTIFIC ARTICLE

AWARENESS AND USE OF CURRENT SPORTS INJURY PREVENTION PROGRAMS AMONG PHYSIOTHERAPISTS WORLDWIDE

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Abstract

Purpose. Physiotherapists are trained to prevent, assess, and rehabilitate all kinds of injuries including sports injury. The goal of the physical physiotherapist should be making sure that the athlete is in optimal shape to perform, with a minimal risk for developing an injury. This study aims to assess the physiotherapists' awareness, implementation, and views of sports injury prevention programs (IPPs) from an international perspective.

Materials and methods. A self-administered questionnaire was developed and distributed to physiotherapists worldwide through World Physiotherapy member organizations. The study targeted physiotherapists at an international level. The study included 484 participants, of whom 44.4% were male and 55.6% were female physiotherapists.

Results. A total of 287 (59.3%) of the participants were aware of the current sports IPPs, 177 (36.6%) were implementing sports IPPs in their current practice. Participants who implemented the sports IPPs reported a positive opinion about the program efficacy, with a score of 7.3 ± 2.11 out of 10.

Conclusions. Globally, physiotherapists have average awareness and low implementation levels of IPPs. Physiotherapists showed a positive score regarding the effectiveness of IPPs, especially the KIPP and the iSPRINT.

Keywords: athletes, injuries, sports, physical therapy, surveys and questionnaires, internationality.

Introduction

A real growing interest in the sports industry is currently being witnessed globally, attributable to a highly profitable and competitive nature. As a result, many athletes try to reach the high-standard, professional level of elite professional sport. However, one of the challenges they may have to contend with is sustaining an injury through either contact or non-contact sports. These injuries may be acute, occurring suddenly, or due to repeated actions, known as overuse injuries (Dhillon et al., 2017). Case history data of all adolescents presenting to sports clinics in Europe due to sports injuries, spanning over ten years, was systematically recorded

on a purpose-built software program (Habelt et al., 2011). A total of 17,397 individuals sought treatment, from 19,530 injuries. Just over one-quarter of all injuries (25.68%, 4,468) were in those aged between 10-19 years. Over one third were males (66.97%), and 32.88% were females, while the remaining 0.16% were classified as other gender categories (Habelt et al., 2011). Soccer was the most common cause of injury (31.13%), reflecting general popularity throughout Europe. Handball, school sport-related activities, skiing, and biking accounted for 8.89%, 8.77%, 5.95%, and 5.71% of other injuries, respectively (Habelt et al., 2011). Most injuries occurred in the lower limbs (68.71%), followed by the upper limbs (25.27%), with the spine and head being injured in 2.57% and 1.99% of the cases, respectively. Upper extremity injuries occurred in all areas, but fingers, metacarpus, and wrist injuries were the most common accounting for 8.12%, 3.13%, and

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3.54%, respectively. Knee (29.79%) and ankle joint (24.02%) injuries were most common in lower extremities. In contrast, injuries to the shoulder (5.42%) and elbow joint (2.84%) were the lower occurrences (Habelt et al., 2011).

Currently, athletes who are engaged in competitive sports are getting injured frequently, and they may feel compelled to return to their activity without delay. Such pressure may emanate from themselves or their management team. Within the context of a highly competitive sporting environment, inevitably the fear of losing their place on the team may spur them into resuming activity more quickly (Dhillon et al., 2017). The length of recovery time required being away from a competitive play or training is usually a good indicator of the injury's severity (Ekegren et al., 2015). This can range from a non-reportable injury where no time off is required, to severe injury leading to a permanent absence, with minor losses (1-7 days), moderate losses (8–21 days), and severe losses (over 21 days) occurring along this continuum (Ekegren et al., 2015). Other elements can also be taken into account when classifying the injury severity. This will help determine remediation time, sick leave days and cost of remediation (Patel et al., 2017).

Rehabilitation following a sports injury plays an essential role in supporting a full recovery and reducing the length of absence after injury. Moreover, rehabilitation aims to prevent re-injury in the future. While every effort is made to ensure that the athlete can return to play (RTP) at the earliest possible opportunity, with sports clinicians carefully overseeing this safe transition process, ultimately, the athlete makes the final decision for readiness to return (Dhillon et al., 2017). A number of measures may be recommended to ensure that athletes return to their previous fitness levels while remaining injury-free. These measures include surgery, pharmacological interventions, use of dietary supplements, and psychological support. However, regardless of the treatment provided, the rehabilitation plays a key role in the recovery process (Dhillon et al., 2017).

Sports Injury prevention programs (IPPs) have several benefits. These include minimizing the likelihood of injury occurrence, promoting athletes' health and fitness levels, enhancing performance potential, and decreasing the costs associated with medical care. There is strong evidence to indicate that a previous injury increases the likelihood of re-injury (Dhillon et al., 2017). Consequently, this highlights the benefits of ensuring that athletes are monitored carefully, resuming full participation in their sporting activities (Dhillon et al., 2017). Furthermore, a meta-analysis examining IPPs among an adolescent cohort participating in team sports found that IPPs significantly reduced injury rates (Soomro et al., 2016). As a result, these programs have attracted significant attention within the field of sports medicine in recent years (Al Attar et al., 2015). In addition, several IPPs have been implemented to either prevent entirely or minimize the risk of acquiring severe injuries (Patel et al., 2017). The current study has selected eleven such programs to assess physiotherapists' awareness, implementation, and opinions.

As the lead agency, the Federation Internationale Football Association (FIFA) Medical Assessment and Research Centre worked in partnership with the Oslo Sports Trauma Research Center and the Santa Monica Orthopaedic and Sports Medicine Center to develop an IPP known as the FIFA 11+, which was launched in 2006 (Al Attar et al., 2017; Sadigursky

et al., 2017). It is easy to implement a three-stage program containing a comprehensive warm-up activity procedure and 15 structured exercises that follow a particular sequence (Sadigursky et al., 2017). A review of the program highlighted that the recommended activities could be classified into three broad types: running and active stretching; core and leg strengthening; and high-speed planting and cutting tasks (Al Attar & Alshehri, 2019). The program places particular focus on the importance of carrying out the techniques outlined correctly. Accordingly, it has set out how to ensure that good posture and body control are maintained, particularly, with smooth landings, knee-over-foot tip positioning, and leg alignment (Sadigursky et al., 2017). A systematic review was undertaken to assess the FIFA 11+ program's effectiveness in the prevention of injuries in a mixed-gender cohort of soccer players, who were aged 13 years or older (Sadigursky et al., 2017). All the studies selected for inclusion are randomized clinical trials. That was the first systematic review to do so. Results revealed that the warm-up program reduced injury risk by 30% in soccer players.

The FIFA 11+ Kids IPP's primary aim is to prevent and minimize both the frequency and level of severity of football injuries. This is achieved by implementing several evidence-based activities, which seek to improve basic and specific sports-related motor skills in young athletes (Pomares-Noguera et al., 2018). Therefore, the program places particular emphasis on three key areas. The first area is spatial orientation, anticipation, and attention, where players are required to perform two tasks simultaneously while avoiding contacting other players or objects unintentionally. The second area involves general coordination of the movement as opposed to neuromuscular or proprioceptive training, as well as body stability. Third, the program teaches players specific fall techniques to reduce the potential risks associated with unavoidable falls (Pomares-Noguera et al., 2018). Research undertaken involving one large cluster-randomized controlled trial sought to determine this program's effectiveness (Pomares-Noguera et al., 2018). They reported a 38% reduction in injuries among the target cohort, while severe injuries were found to decrease by more than 50% compared to the control group.

Developing the FIFA 11+ Referees, IPP was an acknowledgement of modern game football refereeing demands, particularly for those working with elite athletes. Consequently, they may be more susceptible to lower extremity injuries due to heavy training regimes and match schedules (Bizzini & Dvorak, 2015). Analysis of injury data for this specific cohort, used in combination with the learning from the already well-established FIFA 11+ program, led to the development and pilot testing of the FIFA 11+ Referees' IPP for referees and assistant referees (Bizzini & Dvorak, 2015). It was subsequently launched in 2013 and has now been integrated into the FIFA refereeing training courses. More recently, the Italian Referee Association has begun a study to assess its effects on match officials, officiating in games ranging from high to low level (Bizzini & Dvorak, 2015).

In Ireland, the Gaelic Athletic Association (GAA) is the country's largest sporting organization. An amateur association actively promotes indigenous games, particularly Gaelic football, and hurling (a stick and ball sport) (O'Malley et al., 2017). The program included a 15-minute injury prevention warm-up program known as the GAA 15 (Galic Athletic Association, 2015). This program's dual advantages are that

it can be integrated into existing training regimes without additional equipment to carry out these activities. A well-established partnership formed in 2006 between the GAA Medical, Scientific, and Welfare Committee and physiotherapy department in the University College Dublin is continuing to support the preparation of a framework for injury prevention among GAA players (Galic Athletic Association, 2015).

Before developing the FIFA 11 program, some researchers and athletes implemented a program known as the Prevent Injury and Enhance Performance (PEP) (Rahnama, 2012). It comprises a range of activities, including warm-ups, stretching, and strengthening exercises, plyometrics, and agility skills which seek to remedy any potential weaknesses in terms of the strength and coordination capability of stabilizing muscles surrounding the knee joint (Santa Monica Sports Medicine Research Foundation, 2011). Ideally, this program should be implemented three times weekly and usually requires 15-20 minutes to fully complete. However, novice users may need additional time to become more familiar with their content and the transitioning process (Santa Monica Sports Medicine Research Foundation, 2011). It is also recommended that athletes aged twelve years or younger should carry out their plyometric exercises over a visual line placed on the field or the flat 2" cone, were following each jump they would land on both feet. It was also advised not to undertake single leg plyometrics with young athletes until such time, as they can demonstrate that they have established substantial control (Santa Monica Sports Medicine Research Foundation, 2011). The PEP has been found to produce direct positive outcomes in reducing anterior cruciate ligament (ACL) injury rates among female football players (Rahnama, 2012). Similarly, it was also shown to effectively prevent or reduce injury in a wider general population (Yarsiasat et al., 2019).

Focusing on neuromuscular training (NMT), the Knee IPP (KIPP) integrates various skills. These include progressive strengthening, balance, plyometrics, and agility exercises, creating awareness of the importance of avoiding dynamic knee valgus, associated with increased ACL injury risk. It also highlights that activities such as landing from jumps with flexed hips and knees will decrease ACL-related strain (LaBella et al., 2011). The program is normally led by a coach and requires 20 minutes to complete in full. Implementing the KIPP as part of either preseason or in-season warm-ups decreased lower extremity injuries in female adolescent soccer and basketball players (LaBella et al., 2011).

Compared to other international sports, rugby players demonstrated a higher injury risk (Sewry et al., 2017a,b). In response to this, the South African Rugby Union (SARU) devised and introduced BokSmart, an evidence-based program that sought to reduce injury-related burden (Sewry et al., 2017). An evaluation of this program was also revealed to prevent injuries from occurring in the first instance, reducing the overall injury rate (Sewry et al., 2017). A further benefit was found to reduce the risk of junior South African team members who sustain a catastrophic injury (Sewry et al., 2017). These positive outcomes led to further development of the BokSmart program, whereby the safe six programs were introduced in 2014 (Sewry et al., 2017), which is an IPP, including six targeted exercises. While the exercises are fairly demanding, overall, the program is relatively easy to carry out and could, potentially, be integrated into a

warm-up regime. It can be undertaken within a reasonably short period, and it does not require any specific equipment. It is focused specifically on joint stability, strength, achieving balance, and control skills (Sewry et al., 2017).

In Sweden, a commercial IPP, known as the Knäkontroll, was specifically designed in 2005 to aid coaches involved in team sports with children and adolescents (Hägglund et al., 2009). It includes six structured warm-up exercises, which concentrated on core stability and neuromuscular knee control (Hägglund et al., 2009).

The iSPRINT is an NMT warm-up program of fifteen-minute duration. It contains a range of exercises that focus on agility, strength, balance, and aerobic skills (Voight & Esculier, 2019). It has been recommended as the best practice in injury prevention among younger athletes involved in sport and recreational (S&R) activities (Voight & Esculier, 2019).

The Accident Compensation Corporation (ACC) aims to decrease the frequency as well as the severity of sport-related injuries (ACC SportSmart 2016). In order to achieve this, they have to work closely in partnership with various sporting organizations to devise and introduce a range of injury prevention approaches (ACC SportSmart 2016). For example, in New Zealand, the ACC SportSmart framework was developed, along with accompanying resource material. Their primary goal was to ensure that the advice they provided becomes integrated into practice, thus reducing the likelihood of injury occurring for those who were involved in organized sports (ACC SportSmart 2016). A further associated advantage was performing to the highest possible level (ACC SportSmart 2016). This framework also identifies specific populations with particular injury prevention requirements, namely, young people, older people, females, and those with physical or intellectual disability (ACC SportSmart 2016). It was also noticed individuals to other organizations may provide additional information and support (ACC SportSmart 2016).

Given the complex interaction of multiple risk factors associated with sports injuries, no single intervention or approach will be sufficient to address these problems. Therefore, a number of different strategies need to be adopted to ensure that sports safety frameworks are implemented effectively and take various multidimensional aspects into account. Therefore, this study aims to assess physiotherapists' awareness, implementation, and opinion of sports IPPs, from an international perspective.

Materials and methods

Study design and questionnaire

This study utilized a repeated measures design to survey worldwide physiotherapists' in IPPs. The study authors developed the questionnaire to collect information about the awareness, knowledge, of worldwide physiotherapists' in IPPs. To our knowledge, no validated questionnaires addressed physiotherapists' experience with IPPs. The survey was distributed to physiotherapists' who were felt to represent the final testing cohort due to their varying experience. Each question was rated by external validation for clarity, comprehension, and appropriateness on a scale of 1 to 5. Questions scoring an average below 4.0 on any of the parameters were discarded; however, all questions scored 5 and were considered suitable for this study. The study was

Table 1. Participant Characteristics

Indicators	Frequency (%)
World Confederation for Physiotherapy Regions	
Europe	205 (42.4%)
South American	15 (3.1%)
Asia	169 (34.9%)
Africa	27 (5.6%)
North, Central America and Caribbean	48 (9.9%)
Oceania	20 (4.1%)
Gender	
Male	215 (44.4%)
Female	269 (55.6%)
Age group	
18-25	62 (12.8%)
26-30	120 (24.8%)
31-35	117 (24.2%)
36-40	84 (17.4%)
41-45	38 (7.9%)
46-50	22 (4.5%)
51-55	24 (5.0%)
56-60	10 (2.1%)
61 +	7 (1.4%)
Experience (Years)	
< 6	165 (34.1%)
6-10	124 (25.6%)
11-15	78 (16.1%)
16-20	54 (11.2%)
21-25	25 (5.2%)
26-30	15 (3.1%)
31-35	12 (2.5%)
36-40	7 (1.4%)
41 +	4 (0.8%)
Title	
Professor	9 (1.9%)
Associate Professor	11 (2.3%)
Assistant Professor	20 (4.1%)
Lecturer	23 (4.8%)
Demonstrator	6 (1.2%)
Consultant	27 (5.6%)
Senior Specialist	107 (22.1%)
Specialist	210 (43.4%)
Technician	53 (11.0%)
Intern	18 (3.7%)
Specialized (Sports)	
Yes	195 (40.3%)
No	289 (59.7%)
Degree	
B.Sc.	130 (26.9%)
Dip	58 (12.0%)
DPT	61 (12.6%)
M.Sc.	160 (33.1%)
PhD	36 (7.4%)
PT Fellow	39 (8.1%)

PhD = Doctor of Philosophy; MSc = Master of Science; PT Fellow = Physiotherapy Fellowship; DPT = Doctor of Physiotherapy; BSc = Bachelor of Science; Dip = Diploma

a cross-sectional survey that targeted physiotherapists from different countries. This survey consisted of 10 questions covering physiotherapists' socio-demographics, including gender, age, if they are specialized in sports medicine, years of experience, highest educational degree, main job, and the country. The second section was about awareness, where participants were asked if they are aware of the eleven

IPPS. The third section was about the implementation. Participants who reported implementing IPP were asked about their opinion regarding IPP effectiveness in the prevention of injuries on a 10-points Likert scale of 1 (ineffective) to 10 (very effective). The Biomedical Ethics Committee at Umm Al Qura University reviewed and approved the study. Approval No. (HAPO02K012202011497). All participants in this study provided consent to take part in the study.

Survey software and administration

The survey was uploaded to recognized online survey software (Survey Monkey SurveyMonkey Inc. San Mateo, California, USA). Respondents were provided with the link, and once a respondent had submitted the survey, they could not respond again. Results were compiled using the Survey Monkey software. All responses were voluntary, anonymous, confidential, and for research purposes only. Responses were collected from September 2018 to April 2020.

Sample Size and Statistical analysis

There are 625,000 physiotherapy members in the World Physiotherapy around the world (World Physiotherapy 2020). Considering a 5% margin of error at a 95% confidence level, the target number of physiotherapists was 384

Table 2. Awareness and implementation

Indicators	Frequency (%)
Awareness	
11 +	219 (45.2%)
11+ K	102 (21.1%)
11 + R	59 (12.2%)
11 + S	76 (15.7%)
GAA15	31 (6.4%)
PEP	68 (14.0%)
KIPP	102 (21.1%)
Boksmart	15 (3.1%)
Knäkontroll	11 (2.3%)
iSPRINT	18 (3.7%)
ACC	23 (4.8%)
N/A	197 (40.7%)
Implementation	
11+	108 (22.3%)
11+K	37 (7.6%)
11+R	18 (3.7%)
11+S	41 (8.5%)
GAA15	15 (3.1%)
PEP	38 (7.9%)
KIPP	53 (11.0%)
Boksmart	5 (1.0%)
Knäkontroll	6 (1.2%)
iSPRINT	12 (2.5%)
ACC	14 (2.9%)
N/A	307 (63.4%)

11+ = FIFA 11+ Soccer Injury Prevention Program; 11+K = FIFA 11+ Kids Injury Prevention Program; 11+R = FIFA 11+ Referees Injury Prevention Program; 11+S = FIFA 11+ Shoulder Injury Prevention Program for goalkeepers; GAA 15 = The Gaelic Athletic Association 15 Injury Prevention Program; PEP=Prevent injury and Enhance Performance Program; KIPP = Knee Injury Prevention Program; Boksmart = Boksmart Rugby Injury Prevention Program; Knäkontroll = Knäkontroll Injury Prevention Program; iSPRINT = iSPRINT Injury Prevention Program; ACC = ACC SportSmart Program; N/A = None of the Above

(Calculator.net, 2020). To achieve the target number of physiotherapists, all associations registered in the WPT were contacted to distribute the survey among their members.

Responses were organized in Microsoft Excel 2019 (Microsoft Corp. Redmond, Washington, United States). Data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 24.0 (IBM Corp., Armonk, New York, United States). Descriptive statistics were presented as percentages. Chi-square test was used to compare Awareness and Implement among the different continents. However, ANOVA was used to compare the opinion score among the different continents. A p-value of 0.05 was set for statistical significance.

Results

This cross-sectional survey study was set to assess physiotherapists' awareness, implementation, and opinion of the 11 sports IPPs. The socio-demographic characteristics of the study participants are shown in Table 1. More than half of the study respondents were females 55.6%, 24.8% were in the age group of 26-30 years, and 43.4% were physiotherapists. European participants represented the highest proportion at 42.4%, followed by 34.9% from Asia, while the lowest participation was from South America at 3.1%. More than half (59.7%) of the participants have an experience of ≤ 10 years, 40.3% were specialized in sports medicine, and 33.1% had a master's degree.

Overall, all the assessed 11 prevention programs' awareness level was less than 50%, the highest for the 11+ at 45.2%, followed by the 11+K and KIPP at 21.1% for each, while the awareness levels about the remaining eight seven programs were $< 20\%$. For implementation, 22.3% of the participated physiotherapists were implementing the 11+ program, while for the nine programs, the implementation level was less than 10 % except the KIPP was at 11%. Data are shown in Table 2

According to the world confederation for physiotherapy regions, the awareness level difference is shown in Table 3. Generally, there were statistically significant differences between the six regions in the awareness of 11+, 11+K, and KIPP. On the other hand, there wasn't a statistically significant difference between the physiotherapy confederation regions in the awareness of 11+R, 11+S, GAA15, PEP, and Boksmart. Oceania showed the highest awareness of the 11+, 11+K programs at 80%, and 40%, respectively. The 11+R and 11+S highest awareness level was 22.2% for each in Africa. For the GAA15, the highest awareness prevalence was among the South American at 13.3%, while none of the Oceanian was aware of it.

For the difference in the implementation rates according to the different physiotherapy confederation regions, there was a statistically significant difference only in the 11+S, being the highest among the African physiotherapists at 14.8%, and the lowest among the North, Central America,

Table 3. The difference in the awareness level according to the world confederation for physiotherapy regions

Indicators	Europe (n = 205)	South American (n = 15)	Asia (n = 169)	Africa (n = 27)	North, Central America and Caribbean (n = 48)	Oceania (n = 20)	p-value
11+	109 (53.2%)	6 (40.0%)	55 (32.5%)	12 (44.4%)	21 (43.8%)	16 (80.0%)	< 0.0001
11+K	51 (24.9%)	2 (13.3%)	21 (12.4%)	7 (25.9%)	13 (27.1%)	8 (40.0%)	0.008
11+R	27 (13.2%)	2 (13.3%)	16 (9.5%)	6 (22.2%)	4 (8.3%)	4 (20.0%)	0.335
11+S	26 (12.7%)	3 (20.0%)	30 (17.8%)	6 (22.2%)	9 (18.8%)	2 (10.0%)	0.571
GAA15	19 (9.3%)	2 (13.3%)	7 (4.1%)	2 (7.4%)	1 (2.1%)	0 (0%)	0.138
PEP	24 (11.7%)	3 (20.0%)	25 (14.8%)	4 (14.8%)	7 (14.6%)	5 (25.0%)	0.630
KIPP	31 (15.1%)	2 (13.3%)	47 (27.8%)	8 (29.6%)	7 (14.6%)	7 (35.0%)	0.014
Boksmart	7 (3.4%)	1 (6.7%)	5 (3.0%)	0 (0%)	1 (2.1%)	1 (5.0%)	0.851
Knäkontroll	4 (2.0%)	0 (0%)	6 (3.6%)	0 (0%)	1 (2.1%)	0 (0%)	0.733
iSPRINT	5 (2.4%)	0 (0%)	5 (3.0%)	3 (11.1%)	4 (8.3%)	1 (5.0%)	0.115
ACC	10 (4.9%)	0 (0%)	8 (4.7%)	1 (3.7%)	1 (2.1%)	3 (15.0%)	0.286

11+= FIFA 11+ Soccer Injury Prevention Program; 11+K= FIFA 11+ Kids Injury Prevention Program; 11+R= FIFA 11+ Referees Injury Prevention Program; 11+S= FIFA 11+ Shoulder Injury Prevention Program for goalkeepers; GAA 15= The Gaelic Athletic Association 15 Injury Prevention Program; PEP=Prevent injury and Enhance Performance Program; KIPP=Knee Injury Prevention Program; Boksmart =Boksmart Rugby Injury Prevention Program; Knäkontroll =Knäkontroll Injury Prevention Program; iSPRINT =iSPRINT Injury Prevention Program; ACC =ACC SportSmart Program; N/A= None of the Above; #: Chi-square test * P < 0.05 (significant)

Table 4. The difference in the implementation level according to the world confederation for physiotherapy regions

Indicators	Europe (n = 205)	South American (n = 15)	Asia (n = 169)	Africa (n = 27)	North, Central America and Caribbean (n = 48)	Oceania (n = 20)	p-value
11+	49 (23.9%)	4 (26.7%)	29 (17.2%)	10 (37.0%)	8 (16.7%)	8 (40.0%)	0.053
11+K	13 (6.3%)	1 (6.7%)	13 (7.7%)	4 (14.8%)	2 (4.2%)	4 (20.0%)	0.178
11+R	5 (2.4%)	1 (6.7%)	9 (5.3%)	2 (7.4%)	0 (0%)	1 (5.0%)	0.359
11+S	10 (4.9%)	2 (13.3%)	22 (13.0%)	4 (14.8%)	2 (4.2%)	1 (5.0%)	0.047
GAA15	10 (4.9%)	0 (0%)	5 (3.0%)	0 (0%)	0 (0%)	0 (0%)	0.338
PEP	12 (5.9%)	1 (6.7%)	16 (9.5%)	1 (3.7%)	6 (12.5%)	2 (10.0%)	0.553
KIPP	14 (6.8%)	0 (0%)	31 (18.3%)	5 (18.5%)	2 (4.2%)	1 (5.0%)	0.002
Boksmart	3 (1.5%)	0 (0%)	2 (1.2%)	0 (0%)	0 (0%)	0 (0%)	0.906
Knäkontroll	4 (2.0%)	0 (0%)	2 (1.2%)	0 (0%)	0 (0%)	0 (0%)	0.816
iSPRINT	3 (1.5%)	0 (0%)	5 (3.0%)	2 (7.4%)	2 (4.2%)	0 (0%)	0.392
ACC	5 (2.4%)	0 (0%)	7 (4.1%)	0 (0%)	1 (2.1%)	1 (5.0%)	0.736

11+ = FIFA 11+ Soccer Injury Prevention Program; 11+K = FIFA 11+ Kids Injury Prevention Program; 11+R = FIFA 11+ Referees Injury Prevention Program; 11+S = FIFA 11+ Shoulder Injury Prevention Program for goalkeepers; GAA 15 = The Gaelic Athletic Association 15 Injury Prevention Program; PEP = Prevent injury and Enhance Performance Program; KIPP = Knee Injury Prevention Program; Boksmart = Boksmart Rugby Injury Prevention Program; Knäkontroll = Knäkontroll Injury Prevention Program; iSPRINT = iSPRINT Injury Prevention Program; ACC = ACC SportSmart Program; N/A = None of the Above; #: Chi-square test * P < 0,05 (significant)

and Caribbean region at 4.2%, with a p-value of 0.047. Similarly, there was a significant difference in the KIPP program's implementation rate that ranged from 0% to 18.3% with a p-value of 0.002. A mention of the statistical analysis, statistically significant difference ($P = 0.05$) was shown compared to the level of implementation of the 11+ IPP. Only 4.9% and 3% of Europe and Asia participants reported that they are implementing the GAA15. Simultaneously, none of the other regions knows about this IPP, with a non-significant difference of ($P = 0.33$) mention in the statistical test. Regarding the other IPPs, the difference in the implementation rates wasn't statistically significant, as shown in Table 4.

Table 5 shows the opinion of the physiotherapists who implemented the IPPs in their practice. The mean ($\pm$ SD) of the effectiveness was the highest for the KIPP at 7.797 ($\pm$ 1.944) followed by the iSPRINT at 7.483 ($\pm$ 2.339), while it was the lowest for the GAA15 at 6.775 ($\pm$ 2.315). However, the difference between the scores of the effectiveness of the IPPs wasn't statistically significant.

Discussion

In a cross-sectional survey of 484 physiotherapists worldwide, the level of awareness, implementation, and effectiveness of IPPs was assessed, and the results revealed

overall poor awareness and implementation levels. In addition, to the best of our knowledge, this is the first study to assess the awareness and implementation of IPPs among physiotherapists, globally, which makes it difficult to compare our results.

It was recently reported that the best IPP is the one that can and will be adopted and sustained by athletes, coaches, and sporting bodies (Emery & Pasanen, 2019). IPPs are being used in real-world settings, but the challenge is implementing cost-effective injury prevention strategies in real-life circumstances (Timpka et al., 2006).

Being the highest, reaching a rate of 45.2% awareness of the 11+ among physical therapist in the current study is lower than the level of awareness of the 11+ IPP among coaches of adolescent female football teams at 58% (Donaldson et al., 2018), and lower than the level of awareness of lower limb IPPs among coaches of young football players in other international studies reaching more than 50% (Morgan et al., 2017; Norcross et al., 2016; O'Brien & Finch, 2016). Additionally, a far higher awareness level at 80% was reported from coaches of Swedish amateur players of the 11 (a precursor to the 11+) program (Junge et al., 2011).

In the cluster-randomized controlled trial by O'Malley et al. (2017), they found that over eight weeks of training, the GAA 15 had a positive effect on neuromuscular control

Table 5. The difference in opinion of the physiotherapist

Opinion	Programs										
	11+ n = 140	11+K n = 68	11+R n = 45	11+S n = 57	GAA15 n = 40	PEP n = 62	KIPP n = 74	Boksmart n = 31	Knäkontroll n = 32	iSPRINT n = 29	ACC n = 36
1	1 0.2				1 0.2		1 0.2			1 0.2	
2	3 0.6		1 0.2	3 0.6	2 0.4	1 0.2		1 0.2	2 0.4	1 0.2	
3	4 0.8	5 1	5 1	1 0.2		2 0.4	2 0.4				1 0.2
4	6 1.2	3 0.6	1 0.2	4 0.8	2 0.4		1 0.2	1 0.2	4 0.8	1 0.2	1 0.2
5	14 2.9	8 1.7	3 0.6	4 0.8	6 1.2	6 1.2	5 1	5 1	2 0.4	2 0.4	4 0.8
6	20 4.1	10 2.1	6 1.2	5 1	6 1.2	10 2.1	7 1.4	3 0.6	3 0.6	2 0.4	6 1.2
7	33 6.8	14 2.9	6 1.2	13 2.7	8 1.7	10 2.1	12 2.5	5 1	7 1.4	5 1	7 1.4
8	30 6.2	9 1.9	6 1.2	12 2.5	6 1.2	14 2.9	15 3.1	4 0.8	3 0.6	6 1.2	6 1.2
9	9 1.9	5 1	5 1	5 1	2 0.4	8 1.7	15 3.3	5 1	3 0.6	5 1	4 0.8
10	20 4.1	14 2.9	12 2.5	10 2.1	7 1.4	11 2.3	16 3.3	7 1.4	8 1.7	6 1.2	7 1.4
Mean ± SD	7.036 ± 1.99	7.088 ± 2.128	7.267 ± 2.44	7.14 ± 2.191	6.775 ± 2.315	7.452 ± 1.914	7.797 ± 1.944	7.452 ± 2.142	7.125 ± 2.433	7.483 ± 2.339	7.389 ± 1.902
Min. – Max.	1 – 10	3 – 10	2 – 10	2 – 10	1 – 10	2 – 10	1 – 10	2 – 10	2 – 10	1 – 10	3 – 10
P-value	0.405										

11+ = FIFA 11+ Soccer Injury Prevention Program; 11+K = FIFA 11+ Kids Injury Prevention Program; 11+R = FIFA 11+ Referees Injury Prevention Program; 11+S = FIFA 11+ Shoulder Injury Prevention Program for goalkeepers; GAA 15 = The Gaelic Athletic Association 15 Injury Prevention Program; PEP = Prevent injury and Enhance Performance Program; KIPP = Knee Injury Prevention Program; Boksmart = Boksmart Rugby Injury Prevention Program; Knäkontroll = Knäkontroll Injury Prevention Program; iSPRINT = iSPRINT Injury Prevention Program; ACC = ACC SportSmart Program; N/A = None of the Above; #: One way ANOVA * P < 0,05 (significant)

among collegiate level in Gaelic football, regionally, and hurling male players, and supported the application and evaluation of the GAA 15 in other athletic groups. Despite this, an extremely low percentage of the physiotherapists' knowledge about this program, adding to that only half of them were implementing it (6.4%, and 3.1%, respectively). Our finding agrees with a previously published study in 2017, which found that despite all coaches utilized selected components of IPPs, only 2 (out of 26) GAA coaches reported using the 'GAA 15 (Reilly & Kipps, 2017). The low implementation rate in their study was explained by not getting enough support from the GAA and their county boards regarding injury prevention strategies.

It was stated that the PEP program should be considered as a part of women's soccer regular training as it helps in reducing the incidence of severe knee injuries (Rodríguez et al., 2018). Additionally, it was reported that KIPP significantly reduced the risk of non-contact lower limb injuries and over-

use injuries in young amateur female football and basketball players (Herman et al., 2012). The awareness and implementation rates of such programs were very low in our study. The reason for that might be either low educational programs that are addressing them or might be due to those coaches or physiotherapists who don't believe in their effectiveness.

A study that addressed the BokSmart Safe Six IPP's effectiveness and implementation found that players' awareness about the program was associated with their coaches' awareness, and the awareness increased during the targeted marketing approach. Therefore, the authors concluded that the BokSmart Safe Six program was associated with minimal significant improvements in injury risk profiles (Sewry, 2018). The awareness level of the BokSmart (3.1%) in the current study was lower than that what reported among coaches (78%) and players (34%) in the 2014–2016 South African rugby union youth week tournaments (Sewry et al., 2017).

Our results revealed that even with extremely low percentages of physiotherapists' awareness of the IPPs, not all of them were implementing them. This supports the need to operationalize implementation efforts of sport IPPs in real-world contexts and provide a foundation for the ongoing adaptation and improvement of the successful programs. Like mobile applications and group training programs, online resources could help increase the awareness and implementation of such programs. Besides, and as with what has been suggested for increasing the awareness of the 11+ (Donaldson et al., 2018), using governing association communication channels like websites, e-newsletters, and social media platforms, as well as influences informal learning networks of opinion for leaders and peers could be effective in raising the awareness of the other IPPs among physiotherapists (Poulos & Donaldson, 2012). Additionally, there is a need for further research studies addressing the causes behind low awareness and non-usage of the IPPs among physiotherapists worldwide.

The results of this study provide valuable information on the knowledge, implementation, and views of physiotherapists regarding IPPs globally. This information should be used to optimize access to education and the delivery of such programs.

The current study has some limitations, including the variable 'implement', and 'effective', which were assessed in our study, are only facets. However, we assessed the level of awareness and implementation of IPPs in different countries, indicating the generalizability of the results, and this can be the base for future research in this area. A further research study should aim to define and allocate the different factors contributing to concepts such as program usage, and feasibility or suitability. In addition, as this study is cross-sectional, the associations are temporary, and the effect of confounder variables is high. Other limitations include the effect of modification by clinical practice context and region, measurement bias, selection bias and type 1 error as well as generalizability.

Conclusions

Globally, physiotherapists have poor awareness and implementation levels of IPPs. Physiotherapists showed a positive score regarding the effectiveness of IPPs, especially the KIPP and the iSPRINT. There is a need for further efforts and research studies to increase the awareness and usage of IPPs among physiotherapists worldwide. From a present study, if physiotherapists need to increase their awareness and implementation of IPPs, it is recommended that IPPs should have further support, including media and resources.

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Conflict of interest

The authors declared no conflicts of interest.

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ОБІЗНАНІСТЬ ЩОДО ІСНУЮЧИХ ПРОГРАМ ПРОФІЛАКТИКИ СПОРТИВНИХ ТРАВМ ТА ЇХ ВИКОРИСТАННЯ ФІЗІОТЕРАПЕВТАМИ В УСЬОМУ СВІТІ

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Реферат. Стаття: 10 с., 5 табл., 35 джерел.

Мета дослідження. Фізіотерапевтів навчають запобіганню, оцінці та реабілітації після всіх видів травм, включаючи спортивні. Мета фізіотерапевта – це переконатися, що спортсмен знаходиться в оптимальній формі для заняття спортом з мінімальним ризиком отримання травми. Це дослідження має на меті оцінити обізнаність, рівень впровадження та погляди фізіотерапевтів на програми профілактики спортивних травм (ППТ) з міжнародної точки зору.

Матеріали та методи. Анкета для самостійного заповнення була розроблена та поширена серед фізіотерапевтів в усьому світі за допомогою членських організацій Всесвітньої фізіотерапії. Дослідження було орієнтоване на фізіотерапевтів на міжнародному рівні. У дослідженні взя-

ли участь 484 фізіотерапевти, зокрема чоловіки – 44,4% та жінки – 55,6%.

Результати. Всього 287 (59,3%) учасників були обізнані про діючі ППТ, 177 (36,6%) впроваджували їх у своїй поточній практиці. Учасники, які впроваджували програми, повідомили про позитивну думку щодо їх ефективності з оцінкою $7,3 \pm 2,11$ з 10.

Висновки. В усьому світі фізіотерапевти мають середню обізнаність та низький рівень впровадження ППТ. Фізіотерапевти дали позитивну оцінку ефективності ППТ, особливо KIPP та iSPRINT.

Ключові слова: спортсмени, травми, спорт, фізіотерапія, опитування та анкетування, інтернаціональність.

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ORIGINAL SCIENTIFIC ARTICLE

EVOLUTION OF EXPLOSIVE STRENGTH DATA IN YOUTH VOLLEYBALL PLAYERS BEFORE AND AFTER PANDEMIC

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Abstract

Study purpose. This study aims to verify if there are significant differences and which type of correlation is between anthropometric and jumping ability variables by testing a group (elite) of Italian volleyball players (under 16), just after a month of training, applying a specific protocol.

Materials and methods. In all subjects, the following anthropometric and jumping ability parameters were assessed: height, weight, body mass index, height with a stretched arm (Reach1) and height with two extended arms (Reach2). The jumping ability was measured with the Squat jump (SJ) and Run-Up (RU) test. All data on anthropometric and jumping ability parameters were presented as mean and standard deviation (Mean $\pm$ SD).

Results. The results of the jumping ability parameters (Squat Jump and Run-Up) showed significant differences between treatment initial-final: Run-Up with $p = 0.000$ and Squat Jump with $p = 0.001$; and these showed a higher correlation, especially the variables linked to the ability to jump, evident differences compared to the initial period of treatment.

Conclusions. In high-level youth volleyball, the anthropometric and jumping ability profile is directly linked to the evaluation and continuous monitoring of physical qualities, and jumping ability becomes an important aspect for the control of performance.

Keywords: Jumping ability, testing, protocol training, performance.

Introduction

The SARS-CoV-2 pandemic has changed the habits of coaches and players during sports training and the management of stress and experience (Raiola, Aliberti, Esposito, Altavilla, D'Isanto & D'Elia, 2020). There have been young players that abandoned the practice of training for poor motivation (Yanguas, Dominguez, Ferrer, Florit, Mourtabib & Rodas, 2020). Others have used physical activity to manage the stress of the pandemic and who has managed their stress with food (Gallo, Gallo, Young, Moritz & Akison, 2020). The scenario has changed at the beginning of 2020 (Altavilla, Macri & Esposito, 2021; D'Elia & D'Isanto, 2021). The explosive strength in the final period of the pandemic (August 2021) was compared after one month of training (September 2021) using a specific protocol. Volleyball is classified as an activity with alternating aerobic and anaerobic engagement (Forte, Ceciliani, Izzo & Altavilla, 2019) with a high percentage of body muscle mass and district demands for increased

strength (D'Isanto, Di Tore & Altavilla, 2018). The performance is characterized by technical gestures (jumps, attack shots, etc.) at high intensities (Ferrara, Fattore, Pignato & D'Isanto, 2019). Volleyball is a sport considered of attack (Raiola, Altavilla, De Luca & Di Tore, 2016) with technical and physical characteristics, where the vertical jump is adopted (Forte, Ferrara & Altavilla, 2019) generally aimed at increasing its effectiveness to obtain a winning action (D'Isanto, Altavilla & Raiola, 2017). In modern volleyball, the use of the jump and the speed of play is a clear sign of greater demand for physical strength (Alminni, Altavilla, Scurati & D'Elia, 2019) and the speed of the technical gesture. The explosive dynamic strength, the elevation, and the speed of displacement are selective and determining (Forte & Altavilla, 2018), while physical demands during training or the match differ from each playing position (Altavilla, Di Tore, Riela & D'Isanto, 2017). The main objective of athletic training and sports participation has always been to improve players' performance; therefore, the ability to jump together at the anthropometric parameters represents fundamentals quality in this type of sport (Aquino, Marra & Altavilla,

2019; Gabbett & Georgieff, 2007). In most team sports, explosive strength is an important quality because it determines the quantity and quality of the athlete's movement. Furthermore, increasing or maintaining optimal strength levels is useful both for preventive and stabilization purposes and for performance purposes; the objectives and means in these cases vary greatly (Mencarelli, 2012). In this study, the anthropometric and explosive strength data relating to a male volleyball group (August 2021) have been analyzed, discussed and compared with the data of the same group collected after one month of training (September 2021).

The study purpose was to investigate whether this pandemic has negatively affected some physical skills, such as the explosive strength, of a group of young volleyball players, at the restart of workouts. It has been verified if there were significant differences and which type of correlation between anthropometric variables and jumping ability, just after one month of training, applying a specific protocol.

Materials and methods

Study participants

The sample of subjects included young male volleyball players ($n = 14$), with an age (years) = 15.8 ± 0.5 ; height (cm) = 180.1 ± 6.5 ; weight (kg) = 74.4 ± 6.0 and BMI (kg/m^2) = 22.9 ± 0.2 . The players had at least four years of training experience and participated in the Italian volleyball Under-16 Championship (Elitè). For young volleyball players, the inclusion criteria considered was five years of training experience and participated on average 10 months training sessions. In contrast, the exclusion criteria were no history of injuries in the last year (i.e. muscles, tendons, bones).

Study organization

The variables investigated were: height (cm); weight (kg); BMI (kg/m^2); height with a stretched arm (Reach1, cm); height with two extended arms (Reach2, cm); Squat jump (SJ, cm) and Run-Up (RU, cm). The tests were carried out in August before applying the training protocol. Subsequently, after having subjected all the group to the same training protocol 4 times a week for one month, the tests were carried out again. Each player simulated the attack actions with a Run-Up step (RU) and the Squat Jump (SJ). Three trials were performed for each test: only the best result was considered for the statistical analysis from the jumps performed. It was possible to calculate the different elevations obtained by the various players by jumping with and without run-up (Table 1). Other data has been obtained by evaluating the difference (Pre and Post protocol training) between the measurement of the attack action with a run-up step and the maximum measure reached by extending the dominant arm (Reach1), between the squat jump action from a standstill and the maximum measure reached by completely extending the upper limbs (Reach2).

The method of detection and analysis of data required the use of the following tests and devices: the height in centimeters, the one-handed and two-handed reach, the maximum contact point of three squat jumps performed in succession and the maximum contact point of three attack runs also performed in sequence were measured. One meter by

hand with a millimeters rod was used to identify the contact points to collect the data. For measurement convenience, the athletes' fingers were made to moisten to identify and specify the height reached.

- One-hand reach: the athlete with the right side adhering to the wall (left for left-handers) and with the feet close and parallel extends the arm as high as possible on the marked wall.
- Two-handed reach: the athlete places his feet perpendicular to the wall, face facing the wall, extends his arms as high as possible on the marked wall, and the measurement is calculated on the maximum height reached by the lower hand.
- Squat Jump: consists of a vertical jump with feet together with the lower limbs bent with the hands at the hips. It is used to evaluate the ability to perform a concentric motion without countermovement. In the case of this group, the upper limbs are also used to obtain data as similar as possible to the technical objective of the wall.
- Run-up attack: is the specific technical gesture of volleyball that allows winning a point. It consists «in the succession of a step and a leap that culminates in the detachment position or of two steps and a leap». It is essential to know the athletes' heights to understand where they will hit the ball.

Training protocol performed

The activities always began with a joint mobilization session for the upper limbs using rubber bands and dynamic stretching for the lower limbs lasting 10 minutes. At the end of the activation session, a gentle warm-up of aerobic running was performed with an intensity not exceeding 60% for a maximum duration of 15 minutes to allow athletes to increase their body temperature and prepare their bodies for physical effort.

First week

- Strength exercises based on squats, bodyweight lunges with medium-high intensity and low recoveries (below 90 sec.) followed by push-ups on the upper limbs and work with elastic at the station.
- Speed exercises based on mixed sprints with different types of gaits. The distance covered was never greater than the total length of the field, i.e. 18 meters, in order to remain in an anaerobic alactacid metabolism.
- Exercise of jumping recalling attack and block techniques with medium recoveries without tiring them too much.
- The training session ended with a 5-minute relaxing run at a slow pace, followed by a strengthening session of the abdominal core and closed by a static stretching session.

Second week

- Strength exercises based on combinations of lunges, squat jumps and attack run performed in succession. The repetitions were high and the recoveries set below 60 sec.
- Mixed speed exercises that are combined with lateral movements, jumps and dips.
- Normal jumping exercises combined with attack runs in conditions of physical and psychological stress.

Third week

- Very intense speed exercises with very short recoveries (30 sec)
- Strength exercises for the lower limbs with station circuits consisting of: Push-ups on the lower limbs with a barbell, Lunges with dumbbells, Bulgarian squat, Step up and a squat jump.
- Strength exercises for the upper limbs performed in the gym were characterized by low repetitions and a number of series between 5-6. The percentage of the load fluctuated between 60 and 80% of the ceiling. The recovery was around 60 sec. The exercises used were: pectorals on a flat bench and cable crosses, Lat machine and rowing machine, biceps flexion with dumbbells and barbell, Push Down with rope and French Press, Push up and Front Raises.

Fourth week

- Strength exercises for the lower limbs in the gym are characterized by an average number of repetitions and a number of sets between 5-6. The percentage of the load fluctuated between 70 and 80% of the ceiling. The recovery was 60 seconds. The exercises used were: Dumbbell Lunges, Barbell Squats, Leg Press, Leg Curl and Leg Extension and Weighted Squat Jumps, Deadlifts.
- Strength exercises for the upper limbs performed with station circuits consisting of Push-ups on the arms, throwing a medicine ball to the partner or on a mat. Biceps and back curls with elastic bands.
- Jumping exercises with the impact method based on a few series and a high number of repetitions (greater than 12): jumps upwards followed by 3 running steps, jump forward and subsequent high jump; Push-ups on the lower limbs, 3 running steps, jump forward and subsequent jump upwards; jump down from a

height of 50 cm, run 2-3 steps, jump forward and then jump upwards.

Fifth week

- Insertion of technical work with specific analytical and synthetic exercises on all the fundamentals.
- Continuation of the plyometric work based on: jumps down from a height of 0.70 m, 2-3 running steps, jump forward and subsequent jump upwards; push-ups on the lower limbs, high jump, low jump and attack run with deadlift; continuous sequence of high jumps and consecutive low jumps.

Statistical analysis

All data were presented as mean and standard deviation (Mean $\pm$ SD). Before the parametric analysis, the normality of data distribution was verified by the using Shapiro-Wilk test. A Test-t for paired samples was conducted to check the differences between pre and post jumping ability variables, while the homogeneity of variances was checked with Levene's test. The correlations between all the variables considered were calculated using the Pearson correlation coefficient. Type I error was set at $\alpha=5\%$, and all statistical analyses were performed with the software IBM SPSS Statistics 23.

Results

Table 1 shows the mean and standard deviation of the anthropometric values and the jumping ability of all the volleyball players considered. Furthermore, differences between RU-Reach1 (43.2 – 50.5 = + 7.3) and SJ-Reach2 (22.9 – 29.8 = + 6.9) show evident levels of improvement, between the first and the second training period.

The comparison (Pre and Post) of the anthropometric parameters and the jumping ability are shown in table 2.

Table 1. Anthropometric and jumping ability values of all players

Variables	Mean $\pm$ SD (N=14) August (pre-training)	Mean $\pm$ SD (N=14) September (post-training)
Age (years)	15.8 $\pm$ 0.5	15.8 $\pm$ 0.5
Height (cm)	180.1 $\pm$ 6.5	180.1 $\pm$ 6.5
Weight (kg)	74.4 $\pm$ 6.0	74.4 $\pm$ 6.0
BMI (kg/m ²)	22.9 $\pm$ 0.2	22.9 $\pm$ 0.2
Reach1 (cm)	238.4 $\pm$ 7.8	238.4 $\pm$ 7.8
Reach2 (cm)	233.4 $\pm$ 6.9	233.4 $\pm$ 6.9
Squat Jump (cm)	256.3 $\pm$ 21.7	263.2 $\pm$ 19.6
Run-Up (cm)	281.6 $\pm$ 18.0	288.9 $\pm$ 16.8
Differences between RU-Reach1	281.6 - 238.4 = + 43.2	288.9 - 238.4 = + 50.5
Differences between SJ-Reach2	256.3 - 233.4 = + 22.9	263.2 - 233.4 = + 29.8

Table 2. Test-t for paired samples on the Run-Up and Squat Jump (treatment pre-post)

Indicators	Average	Std. dev.	Average standard error	95% confidence interval difference		t	df	p
				Lower	Higher			
RU Pre - RU Post	-6,857	4,655	1,244	-9,544	-4,169	-5,512	13	0.000
SJ Pre - SJ Post	-6,857	5,829	1,557	-10,22	-3,491	-4,402	13	0.001

Table 3. Correlation matrix: anthropometric and jump ability (Pre and Post training)

PRE	Height	Weight	Reach 1	Reach 2	Run-Up	Squat Jump	POST	Height	Weight	Reach 1	Reach 2	Run-Up	Squat Jump
Height	-						Height	-					
Weight	0.996	-					Weight	0.996	-				
Reach 1	0.931	0.936	-				Reach 1	0.931	0.936	-			
Reach 2	0.834	0.860	0.948	-			Reach 2	0.834	0.860	0.948	-		
Run-Up	0.905	0.919	0.889	0.810	-		Run-Up	0.923	0.943	0.961	0.928	-	
Squat Jump	0.901	0.910	0.936	0.867	0.985	-	Squat Jump	0.906	0.917	0.981	0.959	0.987	-

To detect the differences between the several variables considered, a Test-t for paired samples was used in the initial and final period. The results of this comparison, between pre and post training, on the jumping ability variables considered (Run-Up and Squat Jump) shown significant differences: RU ($t = -5.512$; $p = 0.000$) and SJ ($t = -4.402$, $p = 0.001$).

The results of the correlation matrix of the different variables considered are shown in table 3. The correlations between the variables related to jumping ability show further improvements, while the other variables anthropometric are the same or almost the same in terms of correlation.

Discussion

From the statistical analysis of results, we can say that the group considered ($n=14$) recorded better values regarding the values of ability jumping, after a period of training, following a specific protocol. These analyses show that different elements such as the arm length, the push of the arms in the attack and block jumps, the strength developed by the lower limbs, the use of an effective run-up in the jump phase and the coordination between the movements of the arms and legs, can be decisive for having talented players. After the specific training (5 weeks period), the correlations between the variables related to jumping ability show further improvements, while the other variables are the same or almost the same in terms of correlation. The high correlation between RU and the other variables could indicate an athlete's ability to transform the accumulated kinetic energy during the run-up phase into potential energy. The correct identification of the morphological characteristics and the close connection of these with the technical role becomes decisive for obtaining excellent results. These results confirm the link between the morphological characteristics, the orientation towards specialization and the training of muscular qualities (Sands, Smith, Kivi, McNeal, Dorman, Stone & Cormieet, 2005). These qualities result be fundamental for the development and the choice of the player of talent. Finally, in agreement with the findings in the literature, a study by Sheppard et al., (2008) examined the potential strength, power, and anthropometric contributors to vertical jump performances that are considered specific to volleyball success. Another study by Aouadi et al. (2012) showed that age, weight, standing height, and fat-free mass were the predictors of jumping performance. Thus, measuring anthropometric characteristics, such as stature and lower limb length,

may assist coaches in the early phases of talent identification in volleyball. The results may help in verifying the effectiveness of a specific training program and detecting highly talented athletes. This study presents a limited sample. Instead, it could come to stronger conclusions with a much more wide sample. Finally, future research might be to repeat the study on a female sample and then compare the data obtained with the male sample to detect performance and abilities differences in quantitative and qualitative terms.

Conclusions

After a pandemic period in which training was scarce or autonomous, the resumption of scheduled and monitored workouts showed significant jumping performance differences. The results show significant differences between the two periods (Pre and Post training), mainly in jumping ability. In modern volleyball, due to the reduced duration of the game and the greater intensity of the rhythm; therefore, we increasingly need tall, fast and powerful athletes. The evaluation, training, and continuous monitoring of physical qualities and jumping ability are important for controlling performance and selecting talented players. In high-level youth volleyball, the anthropometric and ability jump profile is directly linked to the evaluation and continuous monitoring of physical qualities and jumping ability become an essential aspect for the control of performance.

Conflict of interest

The authors declare that they have no conflict of interest.

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ЗМІНИ ДАНИХ ПРО ВИБУХОВУ СИЛУ У ЮНИХ ВОЛЕЙБОЛІСТІВ ДО ТА ПІСЛЯ ПАНДЕМІЇ

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

Реферат. Стаття: 7 с., 3 табл., 20 джерел.

Мета дослідження – перевірити наявність значних відмінностей та визначити тип кореляції між антропометричними та стрибковими змінними шляхом тестування групи (професійний рівень) італійських волейболістів

(до 16 років) одразу після місяця тренувань із застосуванням спеціального протоколу.

Матеріали та методи. У всіх досліджуваних оцінювали такі антропометричні та стрибкові параметри: зріст,

вага, індекс маси тіла, зріст з витягнутою рукою (Reach1) та зріст з двома витягнутими руками (Reach2). Здатність до стрибків вимірювалася за допомогою тестів «Присідання з вистрибом» (ПВ) та «Розбіг» (Р). Усі дані про антропометричні та стрибкові параметри були представлені як середнє значення та стандартне відхилення (середнє значення $\pm$ SD).

Результати. Результати стрибкових параметрів (присідання з вистрибом та розбіг) показали значні відмінності між початковими та фінальними даними: розбіг ($p = 0,000$) та присідання з вистрибом ($p = 0,001$); вони також показа-

ли вищу кореляцію, особливо змінні, пов'язані зі здатністю стрибати, що є очевидними відмінностями порівняно з початковим періодом дослідження.

Висновки. У професійному юнацькому волейболі антропометричний та стрибковий профіль безпосередньо пов'язаний з оцінкою та безперервним моніторингом фізичних якостей, а стрибкові здібності стають важливим аспектом для контролю ефективності.

Ключові слова: стрибкові здібності, тестування, протокольне навчання, ефективність.

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ORIGINAL SCIENTIFIC ARTICLE

DIDACTICS: PECULIARITIES OF MOTOR SKILLS DEVELOPMENT IN BOYS AGED 14-15

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Abstract

The purpose of the study was to determine the peculiarities of motor skills development in boys aged 14-15.

Materials and methods. The study participants were boys aged 14 (n = 20) and 15 (n = 20). The children and their parents were fully informed about all the features of the study and gave their consent to participate in the experiment. To solve the tasks set, the following research methods were used: study and analysis of scientific and methodological literature; pedagogical observation, timing of training tasks; pedagogical experiment, methods of mathematical statistics, discriminant analysis, nearest neighbor analysis.

Results. The study made an assumption about a significant influence of the modes of alternating exercise repetitions and the rest interval on the effectiveness of motor skills development in boys aged 14 and 15. The standardized canonical discriminant function coefficients helped to determine age peculiarities and the peculiarities of influence of exercise modes on the effectiveness of motor skills development. They showed that the components of motor fitness are a priority in developing motor skills. The structure canonical discriminant function coefficients indicate the importance of movement control skills for mastering the entire exercise.

Conclusions. Discriminant analysis revealed the peculiarities of motor skills development in boys aged 14 and 15, depending on age and exercise modes. With the first exercise mode, boys aged 15 master the first, second, and fourth series of training tasks more quickly. Boys aged 14 – the sixth series (exercise mode: 6 repetitions, rest interval of 60 s). With the second exercise mode, boys aged 14 master the first and fourth series of training tasks more quickly. Boys aged 15 – the second series (exercise mode: 12 repetitions, rest interval of 60 s).

The coordinates of centroids for four groups indicate a significant difference in the influence of exercise repetition modes on the number of repetitions required for motor skills development in boys aged 14-15 during physical education classes. The results of group classification show that 87.5% of the original grouped cases were classified correctly.

Keywords: discriminant analysis, boys, acrobatic exercises, exercise mode, training.

Introduction

Physical education of schoolchildren is considered as a factor of children's health protection (Krutsevich, Marchenko, Trachuk, Panhelova, Napadij, & Dovgal, 2021; Prystynskyi, Babych, Zaytsev, Boychuk, & Taymasov, 2020; Freitas, Lausen, Maia, Gouveia, Antunes, Thomis, Lefevre, & Malina, 2018). In all regions of the world, attention is given to motor activity of children and improvement of physical education at school (Gastin, Tangelos, Torres, & Robertson, 2017; Lopes, Saraiva, Gonçalves, & Rodrigues, 2018; Fame- lia, Tsuda, Bakhtiar, & Goodway, 2018).

Studies aimed at substantiating fundamental movement skills stand out (Klingberg, Schranz, Barnett, Booth, & Ferrar, 2019; Newell, 2020; Nobre, Valentini, & Rusidill, 2020). Fundamental movement skills are a prototype of skills such as posture, locomotor and object control skills, and appear in childhood. The development of fundamental movement skills is associated with motor learning and motor control (Newell, 2020). The Functional Movement Screen includes the assessment of seven movements, namely: deep squat, hurdle step, in-line lunge, shoulder mobility, active straight leg raise, push-up, and rotary stability (Cook, Burton, Hoogenboom, & Voight, 2014ab).

In the context of developing fundamental movement skills, the process of teaching physical exercises at school

is a priority task. The studies by Samsudin, Setiawan, Taufik, and Solahuddin (2021); Listyarini, Alim, Oktaviani, Putro, Kristiyanto, Margono, and Pratama (2021); Abhaydev, Bhukar, and Thapa (2020) focus on the patterns of motor skills development. Research revealed the influence of exercise modes and rest intervals on the effectiveness of teaching (Ivashchenko, 2020; Kapkan, Khudolii, & Bartik, 2019; Marchenko, Jagiello, Iermakov, Ivashchenko, & Khudolii, 2021). Therefore, it is relevant to study the peculiarities of motor skills development in boys aged 14-15, depending on age and exercise modes.

The purpose of the study was to determine the peculiarities of motor skills development in boys aged 14-15.

Material and methods

Study participants

The study participants were 40 boys aged 14-15 (20 boys – 14 years, 20 boys – 15 years). The children and their parents were fully informed about all the features of the study and gave their consent to participate in the experiment.

Organization of the study

To solve the tasks set, the following research methods were used: study and analysis of scientific and methodological literature; pedagogical observation, timing of training tasks; pedagogical experiment, methods of mathematical statistics, discriminant analysis, nearest neighbor analysis.

The pedagogical experiment examined the influence of 6 and 12 repetitions with a 60-second rest interval during a physical education class on the number of repetitions of training tasks to the 100% level of proficiency. In the first and third groups (10 boys – 14 years, 10 boys – 15 years), the boys repeated the tasks 6 sets 1 time each with a rest interval of 60 s, in the second and fourth groups (10 boys – 14 years, 10 boys – 15 years) – 6 sets 2 times each with a rest interval of 60 s.

During teaching, the method of algorithmic instructions was used (Shlemin, 1973). The program of teaching the cartwheel was developed based on the data of Shlemin (1973), Khudolii (2008) and included the following training tasks:

The first series of training tasks – exercises to develop motor abilities

1. From normal standing position, lean forward, touch the floor with the hands and, moving the hands forward on the floor, adopt a push-up position, return to starting position in the same way
2. Perform push-ups as quickly as possible (5 times in 3-4 s)

The second series of training tasks – exercises to master starting and ending positions

1. From standing position with raised arms, step forward and perform a switch leg handstand with assistance
2. Handstand with legs apart with assistance

The third series of training tasks – actions without which it is impossible to perform the target exercise

1. Standing on hands with legs apart with assistance, shift the body weight from one hand to the other

The fourth series of training tasks – teaching the ability to assess movements in space, by time and muscular effort

1. Arriving to handstand quickly with assistance

2. Arriving to handstand slowly with assistance

The fifth series of training tasks – preliminary exercises

1. Arriving to handstand quickly with the wall support
2. Handstand with legs apart with 90-degree rotation

with assistance

The sixth series of training tasks – the entire exercise

1. Cartwheel with assistance
2. Cartwheel without assistance

The next exercise started on condition of correct performance of the previous exercise on three consecutive attempts. The number of repetitions required for correct performance on three consecutive attempts was recorded. The level of proficiency in the exercises was determined by the alternative method: “performed” or “failed”. A technically correct performance of the exercise gave the students “1” point; a failure to perform the exercise gave them “0” entered in the protocol.

Statistical analysis

The study materials were processed using the IBM SPSS 20 statistical analysis program. Discriminant analysis was conducted. For each canonical discriminant function, the study calculated the following: eigenvalue, variance percentage, canonical correlation, Wilks’ lambda, Chi-square. For each step: prior probabilities, Fisher’s function coefficients, unstandardized function coefficients, Wilks’ lambda for each canonical function.

The study protocol was approved by the Ethical Committee of the University. In addition, the children and their parents or legal guardians were fully informed about all the features of the study, and a signed informed consent document was obtained from all the parents.

Results

A comparative analysis of learning outcomes revealed the peculiarities in mastering series of training tasks by boys aged 14-15. With the first mode of training (6 repetitions, rest interval of 60 s), boys aged 15 master the first, second, and fourth series of training tasks more quickly. Boys aged 14 – the sixth series. With the second mode of training (12 repetitions, rest interval of 60 s), boys aged 14 master the first and fourth series of training tasks more quickly. Boys aged 15 – the second series (Table 1).

To determine the peculiarities of motor skills development, discriminant analysis was performed.

The first canonical function explains 60.2% ($r_1 = 0.929$) of the variation of results, the second function – 36.8% ($r_2 = 0.892$), the third function – 3% ($r_3 = 0.892$), which indicates their high informativity (see Table 2). The analysis of the canonical functions shows their statistical significance ($\lambda_1 = 0.021$; $p_1 = 0.001$; $\lambda_2 = 0.156$; $p_2 = 0.001$; $\lambda_3 = 0.759$; $p_3 = 0.052$). These functions have a high discriminative ability and value in interpretation of the general population (Table 3).

The analysis of standardized canonical discriminant function coefficients showed that the results of the fourth, sixth, third, and first series of training tasks make the largest contribution to the first canonical function. The results of the fourth, first, and second series of training tasks – to the

Table 1. Group Statistics

Series of tasks	Exercise Mode	Age	N	Mean	SD	t-test for Equality of Means					
						t	Sig. (2-tailed)	MD	SED	95% Confidence Interval of the Difference	
										Lower	Upper
1 series	6 repetitions, rest interval of 60 s	14	10	13.9	2.33	8.217	0.000	7.6	0.924	5.657	9.543
		15	10	6.3	1.767						
	12 repetitions, rest interval of 60 s	14	10	8.0	2.44	-2.046	0.056	-2.0	0.977	-4.053	0.053
		15	10	10.0	1.88						
2 series	6 repetitions, rest interval of 60 s	14	10	10.5	2.718	7.039	0.000	6.3	0.895	4.419	8.180
		15	10	4.2	0.788						
	12 repetitions, rest interval of 60 s	14	10	6.6	2.83	2.088	0.051	1.9	0.909	-0.011	3.811
		15	10	4.7	0.48						
3 series	6 repetitions, rest interval of 60 s	14	10	6.2	1.813	-0.379	0.709	-0.4	1.054	-2.614	1.814
		15	10	6.6	2.796						
	12 repetitions, rest interval of 60 s	14	10	7.9	3.54	1.315	0.205	1.7	1.293	-1.016	4.416
		15	10	6.2	2.04						
4 series	6 repetitions, rest interval of 60 s	14	10	9.9	1.663	6.947	0.000	5.1	0.734	3.557	6.642
		15	10	4.8	1.619						
	12 repetitions, rest interval of 60 s	14	10	4.8	1.61	-8.421	0.000	-8.5	1.009	-10.620	-6.379
		15	10	13.3	2.75						
5 series	6 repetitions, rest interval of 60 s	14	10	5.8	1.135	1.018	0.322	0.8	0.785	-0.851	2.451
		15	10	5.0	2.211						
	12 repetitions, rest interval of 60 s	14	10	7.7	1.25	1.109	0.282	1.1	0.991	-0.983	3.183
		15	10	6.6	2.87						
6 series	6 repetitions, rest interval of 60 s	14	10	6.0	0.666	-7.829	0.000	-3.7	0.472	-4.692	-2.707
		15	10	9.7	1.337						
	12 repetitions, rest interval of 60 s	14	10	9.4	2.67	1.221	0.238	1.4	1.146	-1.009	3.809
		15	10	8.0	2.44						

Table 2. Eigenvalues for Developing Discriminant Model (Canonical Correlation). Boys Aged 14-15

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	6.349	60.2	60.2	0.929
2	3.877	36.8	97.0	0.892
3	0.318	3.0	100.0	0.491

Table 3. Outcomes of Calculated Wilks' Lambda of Discriminant Function. Boys Aged 14-15

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1 through 3	0.021	131.075	18	0.000
2 through 3	0.156	63.260	10	0.000
3	0.759	9.389	4	0.052

second canonical function. The results of the fifth series of training tasks – to the third canonical function (Table 4).

The analysis of structure canonical discriminant function coefficients shows that the first function is most closely connected with the number of repetitions of exercises of the fourth, first, and sixth series of training tasks ($r_{14} = 0.696$; $r_{11} = 0.494$; $r_{16} = -0.284$). The second function – with the

number of repetitions of exercises of the second series of training tasks ($r_{22} = 0.558$). The third function – with the number of repetitions of exercises of the fifth and third series of training tasks ($r_{35} = 0.929$; $r_{33} = 0.307$) (Table 5).

The coordinates of centroids for four groups make it possible to interpret the canonical function in relation to the role in classification. At the positive pole of the first

Table 4. Standardized Canonical Discriminant Function Coefficients. Boys Aged 14-15

Series of tasks	Function		
	1	2	3
1 series	0.465	0.828	-0.292
2 series	0.157	0.626	0.203
3 series	-0.484	-0.092	0.278
4 series	0.777	-0.912	0.130
5 series	-0.262	0.025	0.955
6 series	-0.504	-0.185	-0.146

Table 5. Structure Matrix. Boys Aged 14-15

Series of tasks	Function		
	1	2	3
4 series	0.696*	-0.391	0.361
1 series	0.494*	0.322	0.219
6 series	-0.284*	-0.163	0.063
2 series	0.265	0.558*	0.263
5 series	-0.019	-0.002	0.929*
3 series	-0.082	0.034	0.307*

discriminant function are centroids for the exercise mode of 6 repetitions (boys aged 14) and 12 repetitions (boys aged 15), at the negative — centroids for the exercise mode of 6 repetitions (boys aged 15) and 12 repetitions (boys aged 14) (see Table 6, Fig. 1). This indicates a significant difference in the influence of exercise repetition modes on the number of repetitions required for motor skills development in boys

Table 6. Functions at Group Centroids. Boys Aged 14-15

Exercise Mode	Age	Function		
		1	2	3
6 repetitions, rest interval of 60 s	14	2.673	2.376	-0.194
12 repetitions, rest interval of 60 s	14	-2.360	0.870	0.719
6 repetitions, rest interval of 60 s	15	-2.403	-0.553	-0.738
12 repetitions, rest interval of 60 s	15	2.090	-2.692	0.213

Table 7. Classification Results^a

Exercise Mode		Age	Predicted Group Membership				Total	
		1	2	3	4			
Original	Count	1 – 6 repetitions, rest interval of 60 s	14	10	0	0	0	10
		2 – 12 repetitions, rest interval of 60 s	14	0	7	3	0	10
		3 – 6 repetitions, rest interval of 60 s	15	0	1	9	0	10
		4 – 12 repetitions, rest interval of 60 s	15	0	0	1	9	10
	%	1 – 6 repetitions, rest interval of 60 s	14	100.0	.0	.0	.0	100.0
		2 – 12 repetitions, rest interval of 60 s	14	.0	70.0	30.0	.0	100.0
		3 – 6 repetitions, rest interval of 60 s	15	.0	10.0	90.0	.0	100.0
		4 – 12 repetitions, rest interval of 60 s	15	.0	.0	10.0	90.0	100.0

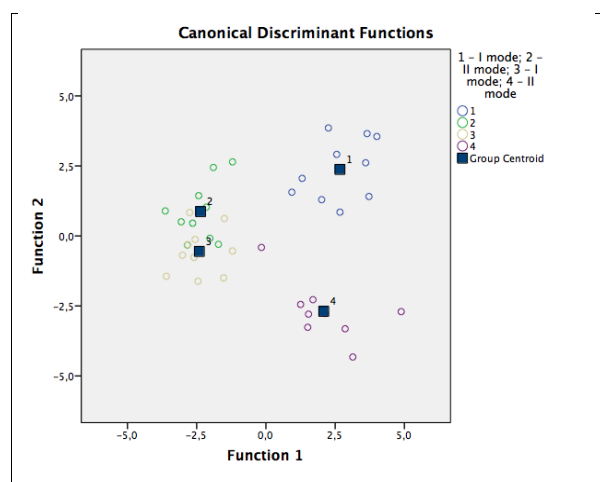
a. 87.5% of original grouped cases correctly classified.

Table 8. Analysis Results. Nearest Neighbor Analysis

		N	Percent
Sample	Training	32	97.0%
	Holdout	1	3.0%
Valid		33	100.0%
Excluded		7	
Total		40	

Table 9. Analysis Results. Nearest Neighbor Analysis

		N	Percent
Sample	Training	27	69.2%
	Holdout	12	30.8%
Valid		39	100.0%
Excluded		1	
Total		40	

**Fig. 1.** Graphic representation of classification results. Boys aged 14: 1 – 6 repetitions, rest interval of 60 s; 2 – 12 repetitions, rest interval of 60 s. Boys aged 15: 3 – 6 repetitions, rest interval of 60 s; 4 – 12 repetitions, rest interval of 60 s

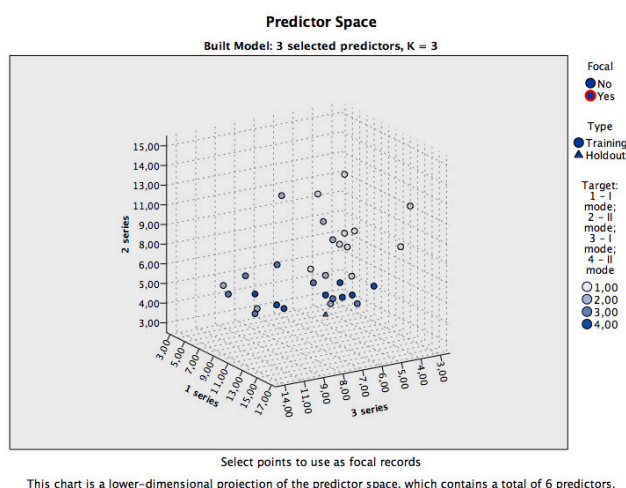


Fig. 2. Analysis Results. Nearest Neighbor Analysis

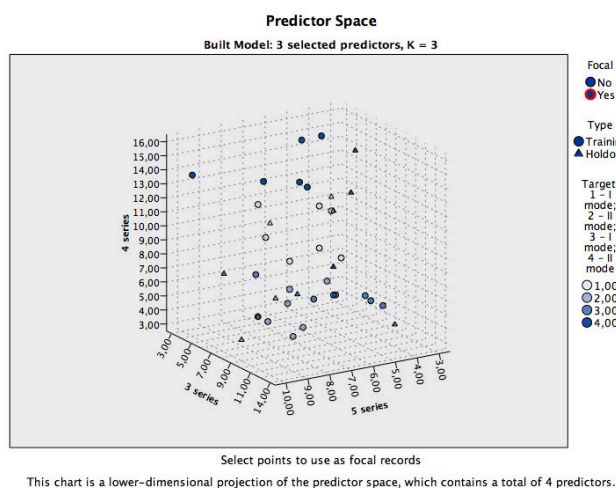


Fig. 3. Analysis Results. Nearest Neighbor Analysis

aged 14-15 during physical education classes. The results of group classification show that 87.5 % of the original grouped cases were classified correctly (Table 7).

The analysis of learning outcomes of boys aged 14-15 under the conditions of two exercise modes, using the nearest neighbor analysis showed that learning outcomes of the tasks of series 1, 2, and 3 are 97% similar (Table 8, Fig. 2), and the tasks of series 3, 4, and 5 – 69.2% (Table 9, Fig. 3).

Discussion

The study made an assumption that the process of motor skills development in boys aged 14 and 15 had its own peculiarities. The study found that the peculiarity of learning is the speed of mastering the exercises of different series of training tasks, as well as the influence of the mode of physical exercises on motor skills development in boys aged 14 and 15. The obtained data supplement the information about motor skills development in schoolchildren (Samsudin, Setiawan, Taufik, & Solahuddin, 2021; Listyarini, Alim, Oktaviani, Puro, Kristiyanto, Margono, & Pratama, 2021; Abhaydev, Bhukar, & Thapa, 2020), about the influence of exercise modes on the effectiveness of teaching (Ivashchenko, 2020; Kapkan,

Khudolii, & Bartik, 2019; Marchenko, Jagiello, Iermakov, Ivashchenko, & Khudolii, 2021).

The study performed a discriminant analysis of the learning outcomes of six series of training tasks in four groups of boys aged 14-15. The influence of two exercise modes was studied. Eigenvalues indicate the predictive value of the discriminant model. Wilks' lambda values confirm a high discriminative ability of the canonical functions and their value in interpretation of the general population. The obtained data complement the results of studies on the use of discriminant analysis in the learning process (Khudolii, Ivashchenko, Iermakov, Veremeenko, & Lopatiev, 2019; Kapkan, Khudolii, & Bartik, 2019; Marchenko, Jagiello, Iermakov, Ivashchenko, & Khudolii, 2021) and motor abilities development (Ivashchenko, Khudolii, & Jagiello, 2021; Iermakov, Ivashchenko, & Khudolii, 2021).

The standardized canonical discriminant function coefficients helped to determine age peculiarities and the peculiarities of influence of exercise modes on the effectiveness of motor skills development. They showed that the components of motor fitness are a priority in developing motor skills. The data presented supplement the results of studies on the peculiarities of the learning process (Ivashchenko, Iermakov, & Khudolii, 2021; Hakman, Nakonechniy, Moseychuk, Liasota, Palichuk, & Vaskan, 2017; Hulteen, Morgan, Barnett, Stodden, & Lubans, 2018) and the development of motor function in children (Rudd, Barnett, Farrow, Berry, Borkoles, & Polman, 2017; Kavanagh, Issartel, & Moran, 2020).

The structure canonical discriminant function coefficients indicate the importance of movement control skills for mastering the entire exercise. The findings supplement the results of research on the structure of the learning process (Slade, Martin, & Watson, 2019; D'elia, Tortella, Sannicandro, & D'isanto, 2020; dos Santos, Nevill, Buranarugsa, Pereira, Gomes, Reyes, Barnett, & Maia, 2018) and the peculiarities of developing the system of movements in children (Barnett, Lubans, Timperio, Salmon, & Ridgers, 2018; Barnett, Telford, Strugnell, Rudd, Olive, & Telford, 2019; Bolger et al., 2021).

The centroids for four groups show the age peculiarities of motor skills development in boys aged 14-15. They indicate the difference in the impact of exercise modes, depending on age. The obtained data supplement the information about the age peculiarities of the learning process at school (Krutsevich, Marchenko, Trachuk, Panhelova, Napadij, & Dovgal, 2021; Prystynskyi, Babych, Zaytsev, Boychuk, & Taymasov, 2020; Tkachenko, 2020).

The nearest neighbor analysis provided data on the structure of training tasks, identified the tasks that have the same speed of mastering. This is of practical importance for the organization and planning of the learning process during physical education lessons, when children with a 1-year age gap study in the class.

Conclusions

Discriminant analysis revealed the peculiarities of motor skills development in boys aged 14 and 15, depending on age and exercise modes. With the first exercise mode, boys aged 15 master the first, second, and fourth series of training tasks more quickly. Boys aged 14 – the sixth series (exercise mode: 6 repetitions, rest interval of 60 s). With the second

exercise mode, boys aged 14 master the first and fourth series of training tasks more quickly. Boys aged 15 – the second series (exercise mode: 12 repetitions, rest interval of 60 s).

The coordinates of centroids for four groups indicate a significant difference in the influence of exercise repetition modes on the number of repetitions required for motor skills development in boys aged 14-15 during physical education classes. The results of group classification show that 87.5% of the original grouped cases were classified correctly.

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Conflict of interest

The authors declare that there is no conflict of interest.

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ДИДАКТИКА: ОСОБЛИВОСТІ ФОРМУВАННЯ РУХОВИХ НАВИЧОК У ХЛОПЦІВ 14-15 РОКІВ

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

Реферат. Стаття: 8 с., 9 табл., 3 рис., 34 джерела.

Мета дослідження – визначити особливості формування рухових навичок у хлопців 14-15 років.

Матеріали і методи. У дослідженні прийняли участь хлопці 14 (n = 20) та 15 (n = 20) років. Діти та їхні батьки були інформовані про всі особливості дослідження і дали згоду на участь в експерименті. Для вирішення поставлених завдань були використані методи дослідження: вивчення та аналіз науково-методичної літератури; педа-

гогічне спостереження, хронометраж навчальних завдань; педагогічний експеримент, методи математичної статистики, дискримінантний аналіз, метод найближчих сусідів.

Результати. Приймається припущення про суттєвий вплив режимів чергування повторень вправ та інтервалу відпочинку на ефективність формування рухових навичок у хлопців 14 та 15 років. Нормовані коефіцієнти канонічної дискримінантної функції дозволили встановити вікові

особливості та особливості впливу режимів виконання фізичних вправ на ефективність формування рухових навичок. Визначити, що компоненти рухової підготовленості є пріоритетними у формуванні рухових навичок. Структурні коефіцієнти канонічної дискримінантної функції вказують на важливість умінь управляти рухами для оволодіння вправою в цілому.

Висновки. Дискримінантний аналіз дозволив виявити особливості формування рухових навичок у хлопців 14 та 15 років у залежності від віку та режимів виконання вправ. При першому режимі виконання вправ хлопці 15 років швидше оволодівають першою, другою і четвертою серією навчальних завдань. Хлопці 14 років – шостою серією (ре-

жим вправи: 6 повторень, інтервал відпочинку 60 с). При другому режимі виконання вправ хлопці 14 років швидше оволодівають першою і четвертою серією навчальних завдань. Хлопці 15 років – другою серією (режим вправи: 12 повторень, інтервал відпочинку 60 с).

Координати центроїдів для чотирьох груп свідчать про суттєву різницю впливу режимів повторення вправ на кількість повторень необхідних для формування рухових навичок на уроках фізичної культури у хлопців 14 та 15 років. Результати класифікації груп показують, що 87,5 % вихідних згрупованих спостережень класифіковано правильно.

Ключові слова: дискримінантний аналіз, хлопці, акробатичні вправи, режим виконання вправ, навчання.

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ORIGINAL SCIENTIFIC ARTICLE

FORMATION OF NATIONAL TEAMS TAKING INTO ACCOUNT THE FACTORS OF FOOTBALL PLAYERS' CLUB MIGRATION

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Abstract

Purpose. To determine the parameters of club migration of highly skilled legionary footballers when forming national teams for participation in official international competitions.

Materials and methods. Population: 496 highly skilled football players – participants of the 2022 World Cup group stage qualifiers.

Results. The winning national teams with high UEFA coefficients have a smaller percentage of legionnaires than the group of winning teams with lower UEFA coefficients: 45.05% (coefficient 3.8) and 85.94% (coefficient 14.8), respectively. The indicators of dual citizenship have no significant impact on the formation of national teams, although the national teams of Wales, Turkey, and Scotland showed rather high values – 9 (32.14%), 7 (28.00%), and 5 (20.00 %) of football players, respectively. Legionary footballers from the top six European leagues (England, Spain, Italy, Germany, France, Portugal) account for 87.50% of the total number of legionnaires who participated in the 2022 World Cup group stage qualifiers.

Conclusions. Migration processes have an impact on the development of football at various levels of functioning: children and youth, reserve, student, amateur, semi-professional, and professional. Club migration, which is typical of highly skilled legionary footballers, has an indirect impact on the formation of national teams.

Keywords: football, migration, ranking, formation, national team.

Introduction

Modern problems of training highly skilled football players are inextricably linked with the nature of their development at various levels of functioning: children and youth, reserve, amateur, semi-professional, and professional. Researchers note a significant influence of migration factors, which are caused by football players' desire to continue athletic training in a top professional club or league, on the processes of their training (Borysova, 2013; Sushko, 2018). Today, footballers' migration is widespread at the reserve and professional levels. In addition, in modern European football and in the United States, footballers' migration has become widespread at the semi-professional level – in youth teams, minor professional leagues, student championships, etc.

Naturally, these processes have an impact on the formation of teams, both at the club and national team levels. This,

in turn, increases the relevance of correcting the training of national teams, taking into account the ratio of football players representing professional clubs of national and foreign championships (leagues) in their composition. In this context, the most informative indicators for selecting candidates for national teams are those of presence (absence) of constant competitive practice in a club, its level and intensity. It is also important to take into account the athlete's individual characteristics, which are related to the nature and speed of recovery processes in their body (Mykhaliuk, Sivolap, Horokhovskiy, Potapenko, 2021).

The problematic issues of training football players, which are associated with migration processes, have relatively recently become the subject of study by specialists. The studies by Poli (2006, 2010, 2019) analyzed in detail the historical, geographical, and socio-cultural prerequisites for the emergence of African footballers' migration to European professional leagues and national championships. The author emphasizes the importance of migration processes,

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which are closely connected with the management, training and competitive performance of a professional club. Similar results were obtained in a sociological study (Storey, 2019) investigating the national allegiance and sporting citizenship as factors of identity choices of African footballers.

In modern football, there is a concentration of highly qualified athletes in top European championships and professional leagues: "Barclays Premier League" (England), "Liga de Fútbol Profesional, Primera División" (Spain), "Lega Nazionale Professionisti Serie A TIM" (Italy), "Fußball-Bundesliga" (Germany), and "Le championnat de France de football" (France).

Economic studies (Gubaydullina, 2018; Solntsev, 2020) testify that football is a global brand more than other sports. In addition, the global factors of migration of highly skilled football players are the economic basis for the development of football as the number one sport.

The study by Campenhout, Sterkenburg, and Oonk (2019) analyzed the data of 4,761 football players from fifteen national teams that took part in World Cups (1930-2018), including the data of 301 foreign-born footballers. The results of the study show that the absolute number of foreign-born footballers who have participated in World Cups is constantly increasing. This testifies to the intensification of migration processes among highly skilled football players for participation in official international competitions.

The study by Campenhout and Sterkenburg (2019) examines the diversification of the compositions of national football teams. In particular, it proposed and described the idea of using "migration corridors" for changing athletes' nationality (naturalization) with a further opportunity to play for the national team of a country.

The study by Lago-Peñas C., Lago-Peñas S., Lago I. (2019) investigated the relationship between the factors of football players' migration and the performance of certain athletes and teams. The authors focus on positive and negative psychological factors in sports teams comprising foreign footballers (migrants). In particular, the authors highlight the need to use psychodiagnostic and corrective techniques to create an optimal psychological climate in a team that consists of footballers playing in national and foreign championships (leagues).

The problems of globalization of student football in the United States are examined in the study by Kirk and Weaver (2019). The authors highlight the peculiarities associated with talented football players' migration to North American student football leagues – a high development level of infrastructure and financial support, on the one hand, and the complex legal procedure of implementing a full or partial "naturalization" in the US migration system, on the other hand. In addition, the results of the study which examines students' motivation to attend student football matches and focuses on additional interest of young people in the games of teams comprising migrant footballers seem promising (Namethe, Naido, & Heerden, 2021).

The studies by Esposito, D'Elia, Raiola (2020), Sulistiyo, Akhiruyanto, Primasoni (2021) show that the integrated use of methods for developing athletes' intelligence, personal qualities and game skills of team interactions in youth football can, indirectly, contribute to the intensification of physical fitness, manifestations of early game specialization and, as a result, promote young football players' migration at the national and international level.

From the point of view of the general theory of sports and the system of athletic training (Platonov & Essentaev, 2015; Platonov, 2016, 2018), the processes of athletes' migration are among extra-training and out-of-competition factors. However, it is the factors of migration that increase the level of sports competition and, as a result, improve the effectiveness and spectacularity of the competitive process. This concept is especially relevant for team sports, including football (Kostiukevych, Imas, & Borysova, 2018). Additionally, there is a need to correct the traditional approaches in the management of training and competitive activity of highly skilled football players, taking into account migration factors (Kostiukevych, Shchepotina, & Vozniuk, 2020; Shchepotina, Kostiukevych, Asauliuk, et al., 2021).

This concept increased the interest of researchers in the problems of athletes' migration (Sushko & Doroshenko, 2016), they focused on the need to correct the traditional approaches in the training process in team sports, taking into account the following factors:

- peculiarities of the formation of sports teams (Doroshenko, Sobol, & Doroshenko, 2018);
- migration of highly skilled athletes and coaches (Doroshenko & Sobol, 2018; Sushko & Melnik, 2019);
- financial and logistical support of migration processes at the level of national championships and professional football leagues (Sobol, Svatyev, & Doroshenko, 2021);
- financial and logistical support of migration processes at the level of participation of athletes of national teams in the European (UEFA), world (FIFA) championships, international tournaments (UEFA Champions League, UEFA Europa League, UEFA Europa Conference League) and compliance of their participants with the Financial Fair Play Regulations (Sobol, Svatyev, & Doroshenko, 2021).

In our opinion, despite a significant number of studies devoted to addressing the topical issues of migration of highly skilled football players in the context of the formation of national teams, the following problems have not been finally resolved:

- the principles of forming the national team, taking into account the differentiation of athletes into typological groups – first team, extended team, promising reserve;
- taking into account the peculiarities of the competitive practice of athletes – candidates for the national team at the club level – championship ranking, quantitative indicators of the competitive practice, possibility of differentiating the game specialization, etc.

That is why this study focuses on investigating the processes of migration of highly skilled football players – candidates for national teams.

Hypothesis. Taking into account the indicators of club migration of highly skilled football players is a criterion for the formation of national teams that will help to efficiently correct the training process when there is a lack of time for full preparation.

The purpose of the study is to determine the parameters of club migration of highly skilled legionary footballers when forming national teams for participation in official international competitions.

Material and methods

Study participants

The ascertaining experiment examined the parameters of the competitive activity of highly skilled football players (496 athletes) – members of the national teams that won the 2022 World Cup group stage qualifiers (10 teams). In addition, the parameters of the competitive activity of players of the national teams that placed second in the group stage qualifying tournaments (10 teams) were studied. This gives the right to participate in further qualifying games.

Organization of the study

Experimental studies were carried out from March 24 to November 16, 2021 during the group stage of the 2022 World Cup qualifiers. The study examined the entry forms, the indicators of presence in the national teams of legionary footballers participating in competitions of foreign professional leagues (championships), considered the factors of presence or absence of dual citizenship among athletes. Based on data from the open sources and official websites of UEFA (www.uefa.com), the national professional leagues of England (www.premierleague.com), Spain (www.laliga.es), Italy (www.legaseriea.it), Germany (www.bundesliga.com), France (www.ligue1.fr), etc., the study determined the indicators of football players' club migration in the context of the formation of national teams, analyzed the quantitative indicators of migration processes, taking into account the factors of dual citizenship of athletes. On the basis of the obtained experimental data, the study considered the possibilities of efficient correction of the training of highly qualified football players, taking into account the quantitative

and qualitative indicators of the club competitive practice of athletes.

Methods of research

Analysis and generalization of data from scientific and methodological literary sources and the Internet, pedagogical observations, content analysis of materials from the official websites of national professional football leagues (associations), the official website of UEFA, pedagogical ascertaining experiment, methods of mathematical statistics.

Statistical analysis

During the experimental research, the methods of mathematical statistics were used to determine the following calculated indicators: arithmetic mean, percentage, calculated ratios (scored and missed goals).

Results

To analyze and interpret the experimental data, the study defined the statistical indicators of 10 national teams that won the 2022 World Cup group stage qualifiers and earned the right to participate in the final tournament. In addition, the study defined the statistical indicators of 10 national teams that placed second in the 2022 World Cup group stage qualifiers and earned the right for further participation in qualifying matches. The data obtained, taking into account the UEFA coefficients, are given in Table 1.

The study determined the percentage of highly skilled footballers with dual citizenship ("naturalized" athletes) in the national teams, and the percentage of highly skilled le-

Table 1. Key performance indicators of technical and tactical actions of highly skilled footballers (legionnaires) and the UEFA club ranking of national teams in the 2022 World Cup qualifiers, n = 496

UEFA Country Ranking	G	Pts	P/G	GS	GM	S/M
1. England	10	26	2.6	39	3	13
2. Spain	8	19	2.4	15	5	3
3. Italy	8	16	2.0	13	2	6.5
4. Germany	10	27	2.7	36	4	9
5. France	8	18	2.3	18	3	6
6. Portugal	8	17	2.1	17	6	2.8
7. Netherlands	10	23	2.3	33	8	4.1
9. Scotland	10	23	2.3	17	7	2.4
10. Russia	10	22	2.2	19	6	3.2
11. Ukraine	8	12	1.5	11	8	1.4
12. Serbia	8	20	2.5	18	9	2
13. Belgium	8	20	2.5	25	6	4.2
14. Switzerland	8	18	2.3	15	2	7.5
15. Croatia	10	23	2.3	21	4	5.3
18. Turkey	10	21	2.1	27	16	1.7
20. Denmark	10	27	2.7	30	3	10
23. Sweden	8	15	1.9	12	6	2
27. Poland	10	20	2.0	30	11	2.7
47. North Macedonia	10	18	1.8	23	11	2.1
50. Wales	8	15	1.9	14	9	1.6

Note: G – games; Pts – points; P/G – points per game; GS – goals scored; GM – goals missed; S/M – ratio of scored and missed goals.

Table 2. Indicators of club migration of highly skilled football players in the context of the formation of national teams in the 2022 World Cup qualifiers, n = 496

UEFA Country Ranking (*)	Group	F	Q	E	Dual Citizenship		Legionnaires	
					n	%	n	%
Serbia: 29.375 (12)	A	+	-	26	4	15.38	24	92.31
Portugal: 47.549 (6)	A	-	+	24	4	16.67	18	75.00
Spain: 85.713 (2)	B	+	-	23	1	4.35	12	52.17
Sweden: 22.875 (23)	B	-	+	26	2	7.69	17	65.38
Switzerland: 27.925 (14)	C	+	-	25	1	4.00	21	84.00
Italy: 69.045 (3)	C	-	+	23	2	8.70	4	17.39
France: 49.915 (5)	D	+	-	23	2	8.70	16	69.57
Ukraine: 31.400 (11)	D	-	+	25	0	0.00	7	28.00
Belgium: 29.000 (13)	E	+	-	24	1	4.17	21	87.50
Wales: 5.500 (50)	E	-	+	28	9	32.14	18	64.29
Denmark: 24.175 (20)	F	+	-	22	0	0.00	20	90.91
Scotland: 32.700 (9)	F	-	+	25	5	20.00	16	64.00
Netherlands: 39.900 (7)	G	+	-	26	1	3.85	16	61.54
Turkey: 25.100 (18)	G	-	+	25	7	28.00	13	52.00
Croatia: 25.400 (15)	H	+	-	24	3	12.50	18	75.00
Russia: 32.682 (10)	H	-	+	27	2	7.41	4	14.81
England: 95.096 (1)	I	+	-	26	0	0.00	3	11.54
Poland: 15.875 (27)	I	-	+	26	0	0.00	25	96.15
Germany: 66.784 (4)	J	+	-	23	1	4.35	7	30.43
North Macedonia: 7.000 (47)	J	-	+	25	2	8.00	8	32.00

Note: * – current position in the ranking; F – first place in the group; Q – second place in the group (participation in qualifying matches); E – entry form; Legionnaires – footballers of the national team who play in foreign championships (leagues)

gionary footballers who play in foreign national championships (professional leagues). The results are presented in Table 2, taking into account the quantitative indicators of the UEFA ranking.

The percentage of the internal structure of club migration of highly skilled legionary footballers was determined, taking into account the indicators of the current UEFA ranking (for national championships or professional leagues).

Group A. The Serbia national team: in the entry form, there are 24 legionnaires representing professional football clubs of different countries (Italy (3) – 7 (29.20%); Spain (2) – 6 (25.00%); Portugal (6) – 3 (12.50%); France (5) – 3 (12.50%); England (1) – 1 (4.16%), Germany (4) – 1 (4.16%), the Netherlands (7) – 1 (4.16%), Poland (27) – 1 (4.16%), Russia (10) – 1 (4.16%)). The Portugal national team: in the entry form, there are 18 legionnaires who represent professional football clubs (England (1) – 9 (50.00%); France (5) – 3 (16.67), Spain (2) – 3 (16.67%); Germany (4) – 2 (11.11%); Italy (3) – 1 (5.55%)).

Group B. The Spain national team: 12 legionnaires (England (1) – 10 (83.33%); Portugal (6) – 2 (16.67%)). The Sweden national team: 17 legionnaires (England (1) – 5 (29.41%); Italy (3) – 4 (23.53%); Germany (4) – 2 (11.77%), Spain (2) – 2 (11.77%); Scotland (9) – 1 (5.88%), the Netherlands (7) – 1 (5.88%), Norway (21) – 1 (5.88%), Russia (10) – 1 (5.88%)).

Group C. The Switzerland national team: 21 legionnaires (Germany (4) – 12 (57.14%); France (5) – 2 (9.53%), Italy (3) – 2 (9.53%); Turkey (18) – 1 (4.76%), Greece (19) – 1 (4.76%), Portugal (6) – 1 (4.76%), Scotland (9) – 1 (4.76%), England (1) – 1 (4.76%)). The Italy national team: 4 legionnaires (France (5) – 3 (75.00%); England (1) – 1 (25.00%)).

Group D. The France national team: 16 legionnaires (England (1) – 5 (31.25%); Germany (4) – 4 (25.00%), Italy (3) – 4 (25.00%); Spain (2) – 3 (18.75%)). The Ukraine national team: 7 legionnaires (England (1) – 2 (28.60%); Belgium (13) – 1 (14.28%), Hungary (28) – 1 (14.28%), Italy (3) – 1 (14.28%), Portugal (6) – 1 (14.28%), Poland (27) – 1 (14.28%)).

Group E. The Belgium national team: 21 legionnaires (England (1) – 6 (28.58%); Germany (4) – 4 (19.04%); Spain (2) – 3 (14.29%), France (5) – 3 (14.29%); Italy (3) – 2 (9.52%); Portugal (6) – 1 (4.76%), Turkey (18) – 1 (4.76%), Qatar – 1 (4.76%)). The Wales national team: 18 legionnaires (England (1) – 15 (83.33%); Italy (3) – 2 (11.11%); Germany (4) – 1 (5.56%)).

Group F. The Denmark national team: 20 legionnaires (England (1) – 7 (35.00%); Italy (3) – 5 (25.00%); Germany (4) – 3 (15.00%); Spain (2) – 2 (10.00%); France (5) – 1 (5.00%), the Netherlands (7) – 1 (5.00%), Turkey (18) – 1 (5.00%)). The Scotland national team: 16 legionnaires

Table 3. Summary indicators of participation of highly skilled legionary footballers in the 2022 World Cup group stage qualifiers, n = 288

Championship (league, association), UEFA ranking (*)	Legionnaires, n	Legionnaires, %
England (1)	96	33.22
Spain (2)	26	8.99
Italy (3)	51	17.65
Germany (4)	39	13.49
France (5)	24	8.30
Portugal (6)	16	5.54
Total:	252	87.50

(England (1) – 14 (87.50%); Belgium (13) – 1 (6.25%), Cyprus (17) – 1 (6.25%)).

Group G. The Netherlands national team: 16 legionnaires (Italy (3) – 5 (31.25%); England (1) – 3 (18.75%); Spain (2) – 3 (18.75%), Germany (4) – 3 (18.75%); France (5) – 1 (6.25%), Belgium (13) – 1 (6.25%)). The Turkey national team: 13 legionnaires (France (5) – 4 (30.77%), Italy (3) – 4 (30.77%); England (1) – 3 (23.08%); Belgium (13) – 1 (7.69%), the Netherlands (7) – 1 (7.69%)).

Group H. The Croatia national team: 18 legionnaires (Germany (4) – 6 (33.34%); Italy (3) – 4 (22.24%); England (1) – 3 (16.67%); France (5) – 1 (5.55%); Spain (2) – 1 (5.55%), Russia (10) – 1 (5.55%), Scotland (9) – 1 (5.55%), Turkey (18) – 1 (5.55%)). The Russia national team: 4 legionnaires (Germany (4) – 1 (25.00%), Italy (3) – 1 (25.00%), France (5) – 1 (25.00%), Turkey (18) – 1 (25.00%)).

Group I. The England national team: 3 legionnaires (Italy (3) – 2 (66.67%); Spain (2) – 1 (33.33%)). The Poland national team: 25 legionnaires (Italy (3) – 8 (32.00%); England (1) – 7 (28.00%); Germany (4) – 4 (16.00%); Greece (19) – 2 (8.00%); France (5) – 1 (4.00%), the USA – 1 (4.00%), Ukraine (11) – 1 (4.00%), Russia (10) – 1 (4.00%)).

Group J. The Germany national team: 7 legionnaires (England (1) – 4 (57.13%); France (5) – 1 (14.29%), Spain (2) – 1 (14.29%), Austria (8) – 1 (14.29%)). The North Macedonia national team: 8 legionnaires (Croatia (15) – 2 (25.00%); Spain (2) – 1 (12.50%), Italy (3) – 1 (12.50%), Ukraine (11) – 1 (12.50%), Moldova (33) – 1 (12.50%), Turkey (18) – 1 (12.50%), Sweden (23) – 1 (12.50%)).

Based on the obtained results, the summary indicators of highly skilled legionary footballers were calculated, taking into account their participation in foreign national championships (professional football leagues) (Table 3).

In addition, 36 legionnaires who participated in the 2022 World Cup group stage qualifying matches represent professional football leagues from 17 countries: the Netherlands, Austria, Scotland, Russia, Ukraine, Belgium, Croatia, Cyprus, Turkey, Greece, Norway, Sweden, Poland, Hungary, Moldova, Qatar, the USA. In these championships (professional football leagues), there are from one to six athletes, which is a range of values from 0.34 to 2.08%.

Discussion

The experimental data given in Table 1 may point to a statistical relationship between the indicators of the UEFA ranking for the national championship (professional league,

association) and the indicators of the competitive activity of highly skilled footballers – participants of the 2022 World Cup group stage qualifiers. Most of the national teams that placed first in their qualifying groups (Table 2) have a high UEFA coefficient for the national championship: national teams of England (95.096; ranking – 1); Spain (85.713; ranking – 2); Germany (66.784; ranking – 4); France (49.915; ranking – 5); the Netherlands (39.900; ranking – 7). In addition to them, the winners of the group stage qualifiers are the teams with lower UEFA coefficients for the national championship: Serbia (29.375; ranking – 12), Belgium (29.000; ranking – 13), Switzerland (27.925; ranking – 14), Croatia (25.400; ranking – 15), and Denmark (24.175; ranking – 20). At the same time, the following tendency is observed: in the entry forms of national teams with high UEFA coefficients, there is, as a rule, a smaller percentage of highly skilled legionary footballers: the average number of legionnaires in the teams of England, Spain, Germany, France, and the Netherlands is 45.05% (with an average UEFA coefficient – 3.8). In the group of winning teams of the 2022 World Cup group stage qualifiers with a lower UEFA coefficient (Serbia, Belgium, Switzerland, Croatia, and Denmark), the average number of legionnaires is 85.94% (with an average UEFA coefficient – 14.8).

From the group of teams with a high UEFA coefficient, the national teams of Italy (69.045; ranking – 3), Portugal (47.549; ranking – 6), Scotland (32.700; ranking – 9), Russia (32.682; ranking – 10), Ukraine (31.400; ranking – 11) won second places in the qualifying tournaments and received the right to participate in further qualifying matches. The Austria national team (34.650, ranking – 8) failed in the qualifying group stage. The teams with lower UEFA coefficients for national championships (professional leagues) also placed second in the 2022 World Cup group stage qualifiers: Turkey (25.100; ranking – 18), Sweden (22.875; ranking – 23), Poland (15.875; ranking – 27), North Macedonia (7.000; ranking – 47), Wales (5.500; ranking – 50). There is a tendency: in the entry forms of the group of national teams with higher UEFA coefficients, there is a smaller percentage of highly skilled legionnaires: the average number of legionnaires in the teams of Italy, Portugal, Scotland, Russia, Ukraine is 39.84% (with an average UEFA coefficient – 7.8). In the group of teams that placed second in the 2022 World Cup group stage qualifiers with a lower UEFA coefficient (Turkey, Sweden, Poland, North Macedonia, Wales), the average number of legionnaires is 61.96% (with an average UEFA coefficient – 33).

According to the indicators of dual citizenship among highly skilled football players – participants in the 2022 World Cup group stage qualifiers, there were no statistically significant differences or linear trends. The highest indicators were observed in the national teams of Wales (9 athletes), Turkey (7 athletes), and Scotland (5 athletes).

In addition, the quantitative and qualitative indicators of highly skilled legionary footballers who represent the top European championships (professional leagues) are of importance. Table 3 shows the indicators of six European championships (professional leagues), whose players account for 87.50% of the total number of legionary footballers. Worthy of note are the indicators of the leading European professional league: Barclays Premier League (England) – 96 highly skilled players out of 288 (33.22%) legionnaires. It is likely that these indicators determine successful performance of the English professional football clubs and the England national team in official international competitions. Today, Barclays Premier League (England) has the highest concentration of highly qualified football players in European football championships (professional leagues), which, indirectly, contributes to an increase in the level of internal competition and, as a result, an increase in the level of athletic proficiency and effectiveness of the competitive process (Sobol, Svatyev, & Doroshenko, 2021).

In connection with the above, the controversial issues regarding the correction of the training of highly skilled legionary footballers seem relevant. The study by Sushko (2018) focuses on the need to differentiate legionary footballers into typological groups when forming national teams: first team, regular substitution, extended team, promising reserve. In turn, this differentiation requires taking into account the factors of the competitive practice of highly skilled legionnaires at the club level, its quantitative and qualitative indicators: the level of the championship (professional league), performances in official international competitions (UEFA Champions League, UEFA Europa League, UEFA Europa Conference League). A comprehensive analysis of these factors, taking into account the level of competitive loads and individual indicators of athletes' recovery, creates prerequisites for efficient correction of the national team training (Platonov, 2016, 2018). In addition, this helps to define a set of information characteristics to specify the starting lineup and players to come off the bench in case a quick correction of the competitive process is needed (Sushko & Melnik, 2019). The study by Shchepotina et al. (2021) shows that this set of information characteristics creates opportunities for managing not only the competitive process, but also the training of football players in professional football clubs. This is of relevance when forming national teams.

Conclusions

The analysis of literature data and other information sources shows that migration processes have an impact on the development of football at various levels of functioning: children and youth, reserve, student, amateur, semi-professional, and professional.

Club migration processes, which are typical of highly skilled legionary footballers, have an indirect impact on the formation of national teams.

Based on the analysis of the materials of the 2022 World Cup group stage qualifiers, the following trends were identified: the winning national teams with high UEFA coefficients have a smaller percentage of legionnaires than the group of winning teams with lower UEFA coefficients: 45.05% (coefficient 3.8) and 85.94% (coefficient 14.8), respectively. The indicators of dual citizenship have no significant impact on the formation of national teams, although the national teams of Wales, Turkey, and Scotland showed rather high values – 9 (32.14%), 7 (28.00%), and 5 (20.00%) of football players, respectively.

Legionary footballers from the top six European leagues (England, Spain, Italy, Germany, France, Portugal) account for 87.50% of the total number of legionnaires who participated in the 2022 World Cup group stage qualifiers.

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Conflict of interest

The authors state no conflict of interest.

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КОМПЛЕКТАЦІЯ НАЦІОНАЛЬНИХ ЗБІРНИХ КОМАНД З ОБЛІКОМ ФАКТОРІВ КЛУБНОЇ МІГРАЦІЇ ФУТБОЛІСТІВ

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Реферат. Стаття: 8 с., 3 табл., 28 джерел.

Мета дослідження – визначити параметри клубної міграції висококваліфікованих футболістів-«легіонерів» у процесі комплектування національних збірних команд для участі в офіційних міжнародних змаганнях.

Матеріали та методи. Контингент: 496 висококваліфікованих футболістів – учасників групового відбіркового турніру чемпіонату світу 2022 року.

Результати. У складах національних збірних команд-переможців із високими показниками рейтингу UEFA – менше відсоткового співвідношення футболістів-«легіонерів», ніж у групи команд-переможців із нижчими показниками рейтингу UEFA: 45,05% (рейтинг 3,8) та 85,94% (рейтинг 14,8) відповідно. Показники подвійного громадянства не мають значного впливу на комплектацію національних збірних команд, хоча у збірних команд Уельсу, Туреччини та Шотландії зафіксовано досить високі

значення – 9 (32,14%), 7 (28,00%) та 5 (20,00%) футболістів відповідно. Футболісти-«легіонери» з шести найрейтинговіших європейських чемпіонатів (Англія, Іспанія, Італія, Німеччина, Франція, Португалія) становлять 87,50% від загальної кількості футболістів-«легіонерів», які брали участь у групових відбіркових турнірах чемпіонату світу 2022 року.

Висновки. Процеси міграції впливають на розвиток футболу на різних рівнях функціонування: дитячо-юнацького, резервного, студентського, аматорського, напівпрофесійного та професійного. Клубна міграція, яка характерна для висококваліфікованих футболістів-«легіонерів», опосередковано впливає на комплектацію національних збірних команд.

Ключові слова: футбол, міграція, рейтинг, комплектація, збірна.

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КЕРІВНИЦТВО ДЛЯ АВТОРІВ

Редакція приймає до друку оригінальні експериментальні й оглядові статті з проблем фізичного виховання і спортивного тренування за напрямками:

- фізична культура в школі;
- фізичне виховання дітей та підлітків;
- фізичне виховання різних груп населення;
- теорія та методика навчання рухам;
- спортивне тренування дітей та молоді;
- фізична культура в профілактиці і лікуванні захворювань у дітей та підлітків;
- теорія і методика професійної підготовки учителя фізичної культури;
- моделювання, інформаційні і комп'ютерні технології у фізичному вихованні і спорті.

Обсяг оригінальної статті — до 3000 слів (окрім назви, рефератів, таблиць/малюнків, легенд малюнків, подяки, заяви щодо конфлікту інтересів та посилань), оглядових — до 6000 слів, коротких повідомлень — до 1000 слів. Мова статті — англійська або українська.

Оригінальні статті пишуться за схемою:

- назва статті (рекомендована довжина не більше 15 слів);
- автор (ім'я, прізвище); університет (інститут, академія);
- вступ (постановка проблеми, аналіз останніх досліджень і публікацій, гіпотеза дослідження, мета дослідження);
- матеріали і методи (учасники дослідження, організація дослідження, статистичний аналіз);
- результати дослідження;
- обговорення результатів дослідження;
- висновки;
- вдячності;
- заява щодо конфлікту інтересів;
- список літератури;
- анотація статті (українською, російською та англійською мовами) за схемою: назва роботи, прізвище та ім'я автора (ів), назва установи, мета дослідження, матеріали і методи, головні результати дослідження, висновки, ключові слова. Обсяг — 200–300 слів;
- відомості про авторів.

Вимоги до розділів рукопису

Титульна сторінка

Зазначається заголовок статті, перелік авторів, їх приналежність до навчального закладу, авторський вклад у рукопис, інформація про автора-кореспондента. Вимоги до оформлення перелічених елементів такі:

Назва. Заголовок рукопису повинен бути коротким та інформативним. Рекомендована довжина заголовка не більше 15 слів.

Автори. Форма імені автора – ім'я, по батькові (ініціал) та прізвище. В одному рядку подається список авторів з повними іменами, розділеними комою. Після прізвища автора має бути номер, що позначає його приналежність до інституції, та позначення авторського вкладу.

Приналежність до навчального закладу. З окремого рядка подається офіційна назва навчального закладу, з яким афільований автор.

Автор кореспондент. Вказується ім'я прізвище, електронна пошта

Наприклад:

ОСОБЛИВОСТІ ВІДНОВЛЕННЯ СПОРТСМЕНІВ
ЗАСОБАМИ МАСАЖУ

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Вступ

Постановка проблеми. Вказується основне протиріччя, яке буде досліджено в роботі. Аналіз останніх досліджень і публікацій. Гіпотеза і мета дослідження.

Матеріали і методи

Для оригінальних статей

Учасники дослідження. Вказується контингент досліджуваних.

Організація дослідження. Вказуються методи і з якою метою вони були використані; процедури дослідження і алгоритм проведення педагогічного експерименту.

Статистичний аналіз. Вказуються методи математистики і з якою метою вони були використані.

Дослідження повинно мати етичне схвалення відповідної установи з підписами комітету з питань етики. Для експериментів, проведених у галузі фізичного виховання та спорту, автор(и) повинен мати схвалення установи для публікації експериментальних даних.

Для оглядових статей

Матеріали для аналізу. Вказуються характеристики досліджень, що будуть відібрані для аналізу. Зазначаються усі джерела інформації (наприклад, бази даних з датами висвітлення) під час пошуку та дати останнього пошуку. Надається повна стратегія електронного пошуку щонайменше для однієї бази даних, щоб її можна було повторити.

Організація дослідження. Формулюються правила відбору досліджень. Описується спосіб вилучення даних. Перераховуються та визначаються всі змінні, для яких шукалися дані.

Методи аналізу. Описуються методи обробки даних та об'єднання результатів досліджень.

Результати дослідження

Для оригінальних статей

Результати дослідження повинні бути представлені у таблицях і описані в логічній послідовності в тексті. У

таблицях наводяться у першому стовбчику номер тесту (1) далі назва тесту (2), умови тестування (3), кількість учасників дослідження (4), середнє арифметичне (5), стандартне квадратичне відхилення (6) експериментальної групи, середнє арифметичне (7), стандартне квадратичне відхилення (8) контрольної групи, середнє арифметичне різниці результатів тестування експериментальної і контрольної групи (9), фактичне значення t -критерію (або іншого показника) (10), фактичне значення p (11).

У тексті посилання на таблиці обов'язкові. Не слід повторювати в тексті всі дані з таблиць або графіків. Необхідно акцентувати увагу на статистично достовірних змінах результатів тестування та показати характерні тенденції динаміки. Вказуйте фактичні значення p у двох десяткових знаках, записуйте " $p = 0,25$ ", а не " $p > 0,05$ ". Результати аналізу статистичної значущості динаміки результатів повинні супроводжуватися показниками, що вказують на величину ефекту втручання (9) або довірчі інтервали різниці.

Слід обмежити кількість таблиць і малюнків (графіків) до шести.

Для оглядових статей

Наводиться кількість перевірених досліджень, оцінених на придатність та включених до огляду. Для кожного дослідження подаються характеристики, за якими були вилучені дані та наводяться цитати. Для всіх розглянутих результатів, для кожного дослідження наводяться: прості підсумкові дані для кожної групи аналізу та оцінки можливих наслідків.

Обговорення результатів дослідження

Для оригінальних статей

- огляд основної гіпотези;
- обговорення висновків: порівняння з даними публікацій, дотичними до теми статті наведеними у вступі рукопису;
- міркування щодо можливості практичного застосування результатів;
- обґрунтування і коментарі щодо важливості викладених результатів дослідження;
- висновок про перспективи подальших досліджень, який ґрунтується на матеріалах дискусії.

Для оглядових статей

Узагальнення основних висновків з врахуванням надійності доказів для кожного головного результату. Обговорення обмеження на рівні дослідження та результатів.

Висновки

Висновки повинні відображати результати і бути пов'язані з метою дослідження. Слід уникати висновків, які не підтверджуються отриманими даними.

Вдячності

Вказується тема дослідження за якою виконана робота, номер державної реєстрації. Наприклад: Дослідження виконано згідно плану науково-дослідної роботи Міністерства освіти і науки, молоді і спорту України

за темою 13.04 «Моделювання процесу навчання та розвитку рухових здібностей у дітей і підлітків» (2013—2014 рр.) (номер державної реєстрації 0113U002102).

Конфлікт інтересів

Наприклад: Автори заявляють про відсутність конфлікту інтересів.

Література

Кількість посилань — не менше 30. Переважна більшість посилань повинна включати в себе дослідження, опубліковані в наукових журналах, будь ласка, обмежте кількість інших типів посилань (книг, матеріалів конференцій тощо) до 5 і менше. Будь ласка, зменшіть кількість посилань, не опублікованих англійською мовою, і, як правило, уникайте тих, що не мають, принаймні, англійського тексту. Ідентифікатори DOI необхідні для всіх онлайн-публікацій. Для DOIs використовуйте повну форму URL-адреси (наприклад, <https://doi.org/10.17309/tmfv.2018.3.01>).

Посилання оформляються за стандартом APA, подається у порядку цитування, не нумерується.

Наприклад:

Мороз, Ю.В. (2015). Особливості розвитку рухових здібностей у школярів 7-8 класів. Теорія та методика фізичного виховання, (3), 15-31. <https://doi.org/10.17309/tmfv.2015.3.1145>

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Дублюється список літератури. Для статей кирилицею здійснюється транслітерація на латиницю. Оформляється за стандартом APA, подається за алфавітом або у порядку цитування, не нумерується.

Транслітерація для видань російською мовою: <http://translit.net>

Транслітерація для видань українською мовою: <http://ukrlit.org/transliteratsiia>

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Iermakov, S. (2001). Modeli biomekhanicheskikh sistem v organizatsii effektivnogo deystviya sportsmenov.

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Бібліографічні посилання у тексті

У рукописі повинні використовуватися посилання на не нумерований список. У тексті посилання вказувати не більше 2–3 джерел.

Відомості про авторів

Подаються у такому форматі: Прізвище, ініціали: електронна адреса; ORCID iD; назва підрозділу, назва навчального закладу, адреса навчального закладу.

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Надсилання статті передбачає п'ять кроків.

Крок 1. Надати попередню інформацію про ваш матеріал. Щоб перейти до кроку 2 натисніть на кнопку «Зберегти та продовжити».

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Крок 3. Необхідно додати метадані українською, російською і англійською мовами. Заголовок, анотація, автори, ключові слова, посилання (перше поле – латиниця, друге поле – кирилиця)

Автори. Для всіх авторів статті додають таку інформацію: Ім'я, прізвище; контактна інформація; ORCID ID; місце роботи та біографічна довідка (підрозділ, адреса навчального закладу, електронна адреса автора) – українською, російською та англійською мовами.

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