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Morpho-functional conditioning of the effectiveness of defensive actions of young football players at the stages of preliminari and specialised basic training

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Abstract. The need for a sufficient level of functional training and the influence of individual morphological features on the effectiveness of tactical actions is urgent. Since the assimilation and improvement of tactical activity takes place at the stages of preliminary and specialised basic training (11-13 and 13-15 years old), the determination of the morpho-functional conditioning of the effectiveness of defensive actions by young football players will allow improving the process of their tactical training. The purpose of the study was to determine the relationship between morpho-functional features and the effectiveness of defensive actions by young football players at the stages of preliminary and specialised basic training. The level of functional capabilities was determined by indirect methods: aerobic – by heart rate indicators after performing a standard 5-minute exercise; anaerobic – according to jump ergometry indicators. In all groups, reliable relationships were established between the length of the body in the standing position and the efficiency coefficient of the head game in defence. High values of the correlation coefficients between the indicators of the length of the lower limbs and the coefficient of efficiency of interceptions (except for 12-year-olds) were revealed. The presence of statistically significant relationships between all characteristics of the effectiveness of actions in defence and the aerobic capabilities of young athletes was established. It was found that at the age of 14, absolute anaerobic phosphagen capacity indicators are significantly correlated with efficiency coefficients of interceptions, defensive headers and counterattacks. It was determined that the effectiveness of actions in protection is related to the ability to maintain a high power of jumping work, which characterises anaerobic capacity. The established dependencies of the effectiveness of defensive actions on the studied morphological features and functional characteristics should be used by coaches of children's and youth football teams when determining the propensity of young football players to perform certain tactical functions, team composition and rational application of training of different (aerobic and anaerobic) orientations

Keywords: aerobic capacity; anaerobic capabilities; age changes; correlation analysis; morphological features

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Introduction

The commercialisation of modern sports, in particular football, caused a significant increase in competition in achieving high sports results. This provision determines the need to constantly search for scientifically based ways of improving the system of training the sports reserve. The system-forming factor of the effective competitive activity of football players is the sports result, which is determined by the components of provision and implementation. The components of ensuring effective competitive activity are the morphofunctional and psychophysiological capabilities of the body of football players (Sarmento *et al.*, 2018). They are implemented at the level of technical and tactical skill, physical and mental preparedness (King, 2018).

According to S. Barrett *et al.* (2018), improving the technical and tactical skill of football players is a complex multifactorial process, and due to the fact that the specifics of the conditions of the modern game require each player to alternately perform defensive and attacking actions, the effectiveness of the game in defence and attack has equal importance for the final result. However, R. Oliveira *et al.* (2022) noted that, despite the increasing role of group methods of play in defence, such as pressing, counter selection, numerical advantage in parts of the field, when studying the features of technical and tactical activity and the factors that determine its effectiveness, priority is given to the attacking actions of football players, and assessment of their effectiveness is carried out by registration of accurate and inaccurate actions followed by calculation of the corresponding coefficients.

Such attention is caused mainly by the commercial component, due to the spectacle of attacking actions, as J.L. Delgado & J.A. Mendez Villanueva (2018) noticed. But it is necessary to pay attention to the fact that it is impossible to attribute the incomplete selection of the ball, when the opponent's attack is interrupted, but the ball remained under his control, to accurately performed or inaccurately performed defensive actions. Thus, the use of generally accepted efficiency coefficients in this case is not correct. This necessitates the use of a balanced assessment of defensive actions in competitive activities. This approach consists in evaluating defensive tactical actions on a special scoring scale that takes into account the results of the defensive action that was performed. At the same time, the zone and situation in which this or that game action is performed is taken into account.

T. Modric *et al.* (2021) highlighted the need for a high level of functional characteristics (aerobic and anaerobic capabilities) for high-quality performance of tactical actions by high-class football players. A.H. Roberts *et al.* (2019) established that the presence of certain morphological features in qualified football players (length of the body and lower limbs, body mass and hip girth) selectively determines the effectiveness of certain tactical actions (heading in defence, interceptions and ball selection). In addition, G. Lisenchuk & V. Tyshchenko (2019) suggested that due to morpho-functional differences, the specificity of interdependencies in qualified and young football players may have different conditioning. Therefore, the significance of the impact of individual functional features and morphological features on the effectiveness of defensive actions by young football players needs additional study.

According to V. Nikolaienko *et al.* (2021), it is the stages of preliminary and specialised basic training that are the beginning of training and the improvement of tactical actions of young football players continues, and any miscalculations in the training and selection process (along with the orientation towards the performance of certain game functions and team composition) lead to a decrease in the quality of training reserve. Thus, mastering modern methods of conducting the game in defence requires high individual playing skills of the players, which also confirms the importance of improving the process of learning defensive tactical actions, taking into account the special features of young athletes. The above made it necessary to carry out specialised studies aimed at determining the specificity of the relationships between morpho-functional features and indicators of the effectiveness of defensive tactical actions of young football players at the stages of preliminary and specialised basic training.

Materials and Methods

The method of analysis of scientific and methodological literature was used in order to study the state of the research problem. The method of pedagogical control is used to assess the level of tactical skill when performing defensive actions during competitions. The coefficients of the efficiency of tackles, interceptions, head play in defence, opposition to passes, driving, shots, and the integral coefficient of the efficiency of defensive actions were determined. The evaluation scale of protective actions is presented in the work of V. Stepanenko & V. Pogrebnyi (2022). At the same time, the zone and situation in which this or that game action is performed is taken into account. Efficiency coefficients (EC) were also calculated by the formula of V. Stepanenko & V. Pogrebnyi (2022).

Morphological characteristics (body weight, kg; hip circumference, cm; body length in standing position, cm; length of lower limbs, cm) were determined in accordance with generally accepted methods of anthropometric measurements. Aerobic capacity was determined using an indirect method. Subjects climbed a bench 35 cm high for 5 minutes at a pace of 25 times per minute. At the end of the work, the heart rate was measured for the last 30 seconds of work. Then the *MOC* (maximum oxygen consumption) was calculated according to the following formula:

$$MOC = 1.29 \times \sqrt{\frac{h \times p \times n \times 1.3 \times e^{-0.000884 \times t}}{F-60}}, \qquad (1)$$

where h – the bench height; n – the number of ascents per minute; e – the base of the natural logarithm; f – heart rate per minute; p – body mass; t – age. Anaerobic capacity was determined by the jumping ergometry method on the contact area. Subjects performed three maximal upward jumps with sufficient rest pauses. An electronic millisecond meter recorded the time of the unsupported phase of the jump (the best indicator was taken into account). After a rest pause, the subjects performed a 60-second series of upward jumps with a frequency of 1 jump per 2 seconds. With the help of a millisecond meter, the total time of the resistance-free phase was recorded in each of the 10-second segments of jumping work, which made it possible to

determine the dynamics of the change in anaerobic power during the test. From the 60-second jumping test, the average indicators of anaerobic power of the first and last 10 seconds of jumping work were used to calculate the correlation coefficients. The height of the jump was calculated according to the formula:

$$h = \frac{9.8 \times \left(\frac{T}{2}\right)^2}{2}, \quad (2)$$

where h – the height of the jump, m; 9.8 – speed of free fall, m/s^2; T – the time of the jump, s. The power of the jump was calculated according to the formula:

$$N = (hm/(t/2))/0.102, \quad (3)$$

where N – power, W; h – jump height, m; m – mass, kg; t – jump time, s. The absolute anaerobic phosphagen power, the power of each 10-second segment of work in the 60-second jump test, and the index of the decrease in anaerobic power were calculated according to the following formula:

$$ACRE = \frac{W1 - W6}{W1} \times 100\%, \quad (4)$$

where $ACRE$ – anaerobic capacity reduction index, conditions unit; $W1$ – power of the first 10-second segment of work, W; $W6$ – power of the sixth 10-second segment of work, W. Digital data obtained in the study were processed using traditional methods of descriptive statistics. Determination of the probability of differences between parameters was carried out according to the Student's criterion, according to the formula for independent samples with unequal variances. Evaluation of the relationship between the studied parameters and indicators of the effectiveness of defensive tactical actions in the process of competitive activity, as well as the significance (determinism) of individual parameters was carried out using a multivariate correlation-regression analysis with the calculation of paired correlation coefficients and subsequent calculation of the multiple correlation coefficient. The values of r and p for the studied groups were as follows: $p \le 0.05$ with $r \ge 0.54$; $p < 0.001$ with $r \ge 0.76$ – 11 years; $p \le 0.05$ with $r \ge 0.48$; $p \le 0.001$ with $r \ge 0.72$ – 12 years; $p \le 0.05$ with $r \ge 0.54$; $p \le 0.001$ with $r \ge 0.76$ – 13 years; $p \le 0.05$ with $r \ge 0.45$; $p \le 0.001$ with $r \ge 0.69$ – 14 years; $p \le 0.05$ with $r \ge 0.49$; $p \le 0.001$ with $r \ge 0.74$ – 15 years. The method of finding determinants is presented in the special literature (Antomonov *et al.*, 2021). Statistical processing of the results was carried out using MS EXCEL, STATISTICA 6.0.

The confirmatory experiment was conducted during two competitive mesocycles of the children's and youth football league of the Kyiv Region of the 2023 season. Football players aged 11-13 years (stage of preliminary basic training) and 13-15 years old (stage of specialised basic training) took part in the study, who studied at the football department of the lyceum of the Shchaslyve Village of the capital's village council of the Boryspil District, Ukraine. Consent for the study was obtained from the parents of the children, and they were informed about the purpose and methods of using the obtained data. Anonymity of research participants and compliance with ethical standards were ensured (Declaration of Helsinki, 2013). The age of the group of 11-year-old football players was 11 ± 0.3 years, 12 years – 12 ± 0.1 years, 13 years – 13 ± 0.2 years, 14 years – 14 ± 0.1 years, and 15 years – 15 ± 0.1 years old. The total number of research participants was 82 ($N = 82$).

Results and Discussion

It is necessary to note the uneven development of the morphological features of the body of young football players at the stages of preliminary and specialised basic training (11-13 and 13-15 years, respectively). Irregularity of development is due to the onset of puberty in this age period. Standing height increases significantly from 12 to 13 and from 13 to 14 years ($p \le 0.05$), and leg length increases significantly from 12 to 13, from 13 to 14 and from 14 to 15 years ($p \le 0.05$) (Fig. 1).

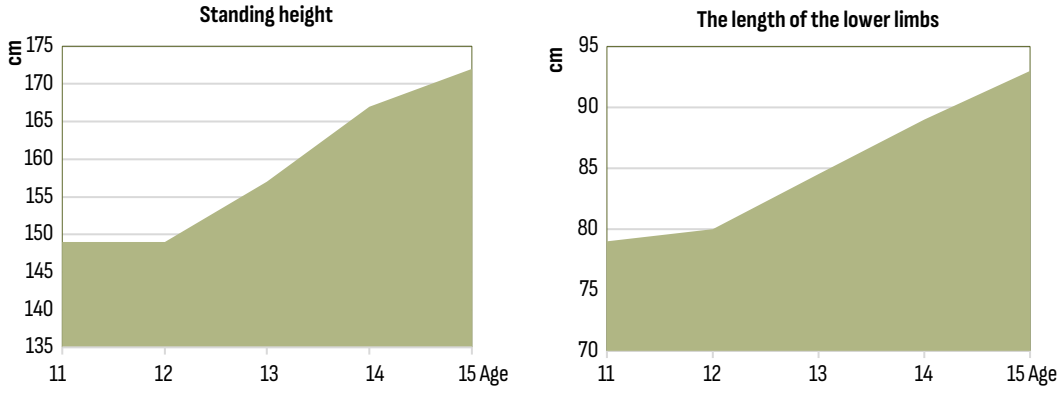

Figure 1. Indicators of height, standing and length of lower limbs of young football players, $\bar{x}$
Source: created by the authors

The above data allowed to establish two periods of significant growth in body length and lower limbs from 12 to 13 and from 13 to 14 years. Body mass and hip girth indicators have a similar tendency to increase: slight – from 11 to 12 years, jump-like increase – from 12 to 13 years, and most likely – from 13 to 14 years ($p \le 0.05$) (Fig. 2).

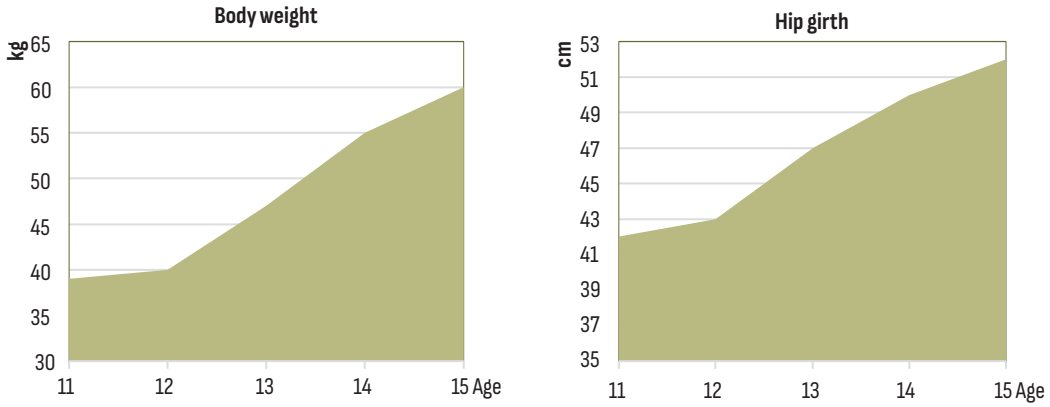

Figure 2. Indicators of body weight and hip girth of young football players, $\bar{x}$

Source: created by the authors

The obtained data allowed to generalise the following: the most reliable growth of the studied morphological features occurs from 12 to 13 and from 13 to 14 years. The analysis of age-related changes in the development of functional features allowed to establish the greatest increase in aerobic capacity (according to MOC indicators) in the period from 13 to 14 years ($p \leq 0.05$) (Fig. 3). A significant increase in anaerobic phosphagen capacity occurs from 12 to 13 and from 13 to 14 years ($p \leq 0.05$). Indicators of relative anaerobic phosphagen power significantly increase from 11 to 12, from 13 to 14 and from 14 to 15 years ($p \leq 0.05$) (Fig. 4).

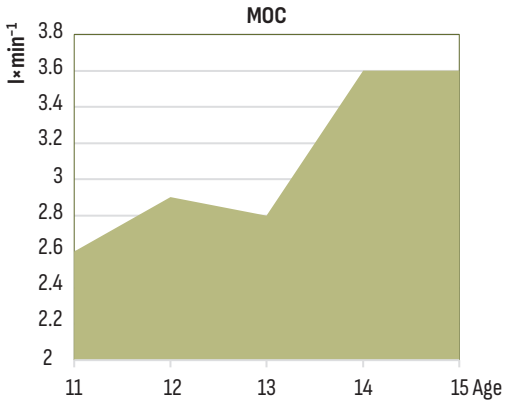

Figure 3. Indicators of MOC of young football players, $\bar{x}$

Source: created by the authors

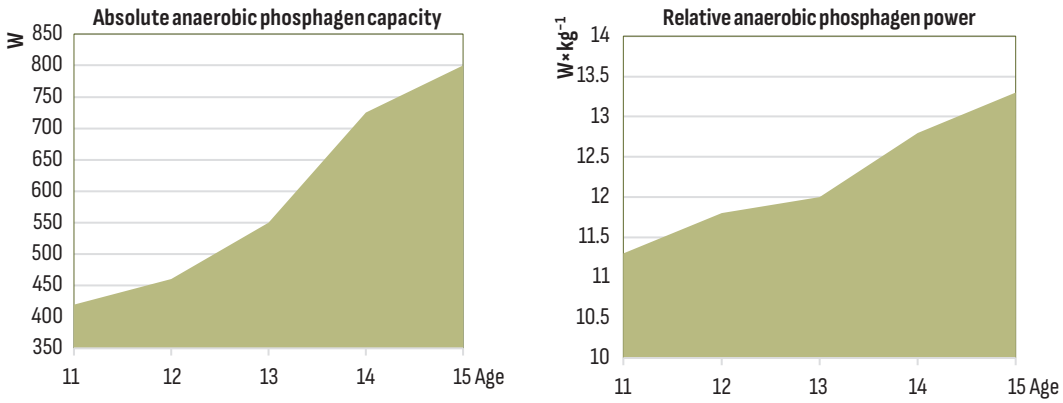

Figure 4. Indicators of absolute and relative anaerobic phosphagen capacity of young football players, $\bar{x}$

Source: created by the authors

Research has established that the effectiveness of protective measures increases slightly with age. Only at the age of 14, the integral EC of defensive actions, EC of interceptions and head games in defence are likely to increase ($p \le 0.05$). The significant growth of the specified characteristics coincides with significant increases at this age in such morphological features as body length and length of the lower limbs. Correlation analysis of the studied characteristics made it possible to establish that body mass has a relationship with the EC of head play in defence only in 11-year-old football players ($r = 0.56$, $p \le 0.05$). Indicators of hip circumference correlate with the EC of selections in 15-year-old athletes ($r = 0.58$, $p \le 0.05$). All age groups are characterised by reliable connections between body length and EC of head play in defence. In 13- and 14-year-olds, body length indicators significantly coincide with EC intercepts ($r = 0.54$, $r = 0.56$, $p \le 0.05$, respectively). All groups of subjects (except 12-year-olds) are characterised by the presence of high correlation coefficients between indicators of the length of the lower limbs and EC intercepts (Table 1).

Table 1. Correlation relationships between morphological features and indicators of the effectiveness of protective actions

Age	Indexes	EC			
		selections	interceptions	head games in defence	opposition
11	Body weight	0.31	0.43	0.56	0.05
	Standing height	0.38	0.49	0.61	0.07
	The length of the lower limbs	0.33	0.55	0.56	0.24
12	Standing height	−0.02	0.37	0.49	−0.23
13	Standing height	0.04	0.54	0.55	0.17
	The length of the lower limbs	0.13	0.58	0.39	0.28
14	Standing height	−0.06	0.56	0.58	−0.08
	The length of the lower limbs	0.29	0.52	0.38	0.31
15	Hip girth	0.58	0.34	0.32	0.15
	Standing height	−0.63	0.47	0.49	−0.19
	The length of the lower limbs	0.09	0.53	0.28	0.04

Source: created by the authors

Determining the playing functions of young football players and the composition of teams must be carried out in accordance with the established dependencies of the effectiveness of defensive actions on the investigated morphological features. To perform the functions of central defenders and midfielders, young players with high indicators of body length and lower limbs should be set up, due to the fact that, first of all, the middle part of the football field is characterised by interceptions and head play in defence, and the specified morphological characteristics, according to the obtained results, determine their effectiveness. Since the ball is most often collected on the flanks, young football players with shorter body length and lower limbs, but with a larger hip girth, should be oriented to perform the functions of full backs and midfielders.

Studies have shown that in almost all groups of subjects (except for the group of 12-year-old football players) there are statistically significant relationships between the characteristics of the effectiveness of defensive actions and aerobic capabilities. Therefore, a high level of development of general endurance determines the effective performance of protective actions. Indicators of absolute anaerobic phosphagen power of 11-year-old athletes are positively correlated with EC of interceptions and head play in defence ($r = 0.58$ and $r = 0.64$, $p \le 0.05$, respectively) (Table 2).

Table 2. Correlation relationships between functional characteristics and indicators of the efficiency of defensive actions, 11 and 12 years old

Age	Indexes	EC			
		selections	interceptions	head games in defence	opposition
11	MOC	0.67	0.72	0.76	0.69
	Absolute anaerobic phosphagen power	0.48	0.58	0.64	0.22
	Relative anaerobic phosphagen capacity	0.43	0.32	0.36	0.55
	Anaerobic power (1-10 s of work)	0.50	0.59	0.67	0.25
	Anaerobic power (51-60 s of work)	0.46	0.57	0.63	0.21
	Anaerobic power reduction index	−0.48	−0.36	−0.59	−0.39
12	Anaerobic power reduction index	−0.33	−0.28	−0.35	−0.58

Source: created by the authors

In 13-year-old players, interdependencies are observed only with EC of interceptions and with EC of head play in defence ($r = 0.54$, $r = 0.56$, $p \le 0.05$, respectively). Positive correlations of 14-year-old athletes were found regarding the absolute anaerobic phosphagen power, on the one hand, and EC of interceptions ($r = 0.54$, $p \le 0.05$), EC of head play in defence ($r = 0.50$, $p \le 0.05$), EC counteraction ($r = 0.58$, $p \le 0.05$), on the other hand. However, in 15-year-old young football players, this indicator correlates only with the EC of tackles and interceptions ($r = 0.69$, $r = 0.50$, $p \le 0.05$, in accordance).

Relative anaerobic phosphagen power in eleven-year-old football players is positively correlated with EC of oppositions ($r = 0.55$, $p \leq 0.05$). However, in 12- and 13-year-old football players, there is no significant correlation of this characteristic with indicators of the effectiveness of defensive actions. It was also established that there is a significant relationship between the relative anaerobic phosphagen capacity and all indicators of the effectiveness of defensive actions in 14-year-old athletes. But for 15-year-old players, this indicator correlates with the EC of selections and countermeasures ($r = 0.52$ and $r = 0.51$, $p \leq 0.05$, in accordance) (Table 3).

Table 3. Correlation relationships between functional characteristics and indicators of the effectiveness of defensive actions, 13, 14, and 15 years old

Age	Indexes	EC			
		selections	interceptions	head games in defence	opposition
13	MOC	0.42	0.78	0.63	0.55
	Absolute anaerobic phosphagen power	0.14	0.54	0.56	0.21
	Anaerobic power (51-60 s of work)	0.27	0.57	0.54	0.36
	Anaerobic power reduction index	−0.55	−0.58	−0.35	−0.58
14	MOC	0.52	0.52	0.36	0.58
	Absolute anaerobic phosphagen power	0.44	0.54	0.50	0.58
	Relative anaerobic phosphagen capacity	0.55	0.53	0.51	0.59
	Anaerobic power (1-10 s of work)	0.55	0.31	0.39	0.58
	Anaerobic power (51-60 s of work)	0.20	0.38	0.48	0.70
	Anaerobic power reduction index	−0.69	−0.47	−0.40	−0.72
15	MOC	0.45	0.55	0.57	0.52
	Absolute anaerobic phosphagen power	0.69	0.50	−0.30	0.33
	Relative anaerobic phosphagen capacity	0.52	0.27	−0.36	0.51
	Anaerobic power (1-10 s of work)	0.49	0.21	−0.33	0.02
	Anaerobic power (51-60 s of work)	0.39	0.52	0.51	0.28

Source: created by the authors

In 11-year-old athletes, correlational dependences of the first and last 10 seconds of jumping work with EC interceptions and head play in defence were revealed. With regard to 13-year-olds, indicators of the power of their work in the first 10 seconds do not have a relationship with all characteristics of the efficiency of defensive actions, and the last 10 seconds of jumping work are correlated with the EC of interceptions and head play in defence ($r = 0.57$ and $r = 0.54$, $p \leq 0.05$, respectively). In 14-year-old football players, the power of the first 10 seconds of work correlates with the EC of tackles and counterattacks ($r = 0.55$ and $r = 0.58$, $p \leq 0.05$, respectively), and the power of the last 10 seconds of work correlates with the EC of head play in defence and counteraction ($r = 0.48$, $p \leq 0.05$, $r = 0.70$, $p \leq 0.001$, in accordance).

The indicator of the power of the first 10 seconds of work in 15-year-old players has correlations with the EC of tackles ($r = 0.49$, $p \leq 0.05$), and the power of the last 10 seconds of work – with the EC of interceptions and head play in defence ($r = 0.52$, $r = 0.51$, $p \leq 0.05$, in accordance). It should be noted that the higher the power of the last 10 seconds of jumping work, the better are almost all indicators of the effectiveness of defensive actions of young football players. The index of decrease in jumping power is inversely proportionally correlated with all indicators of the effectiveness of defensive actions in 13- and 14-year-old athletes; the exception is the EC of head games in defence. As for 11-year-old players, the indicator of the decrease in their anaerobic power is negatively correlated with the EC of head play in defence ($r = -0.59$, $p \leq 0.05$). However, in 12-year-old athletes, this indicator correlates with the EC of countermeasures ($r = -0.58$, $p \leq 0.05$), and in 15-year-old athletes, only a weak connection of this component is observed with all indicators of the effectiveness of defensive actions.

The analysis of scientific and methodical literature shows that the improvement of children's football occurs due to the increase in requirements for all aspects of the training of young athletes (including tactical), as noted by A. Dulibskyi (2021). It has been established that only an optimal level of tactical preparation can ensure the achievement of high sports results (Ulderink *et al.*, 2017). Since the effectiveness of offensive and defensive actions is equal to achieving victory over the opponent, giving preference to attacking actions in terms of game organisation is not a rational approach. However, the majority of the attention of scientists and practitioners is directed to the search for ways to improve the attacking tactical actions of both qualified and young football players, as written by J.R. Tarragó *et al.* (2019).

In a general sense, the term "football tactics", as E. Valcárcel (2020) wrote, means the team's ability to use all its playing capabilities (technical, physical, psychological) with the greatest efficiency to achieve victory over a given specific opponent. It should be noted that the manifestation of physical capabilities is conditioned by the morpho-functional features of the human body. Taking into account the analysed theoretical data, one of the directions for improving tactical preparedness is the determination of the morpho-functional features of football players, which determine the quality of the performance of defensive tactical actions. According to trainers R. Schomann *et al.* (2014), for practicing sports within the framework of multi-year improvement, adolescence is considered the most favourable for basic and specialised training. Therefore, miscalculations made at the specified stages of preparation will exclude opportunities to make up for what was lost in the future. Agreeing with this statement, the authors conducted

research at the stages of preliminary and specialised basic training. M. Krespi *et al.* (2019) noted that when determining the characteristics that determine the effectiveness of defensive actions, both in young and in qualified football players, only the selection of the ball and its interception are taken into account. While monitoring the effectiveness of defensive actions, this article used a balanced assessment and covered the registration of countermeasures (driving, passes, strikes), which made it possible to expand the range of information received and increase its informativeness.

Specialists like K. Johnston & J. Baker (2020) paid considerable attention to morphological features, because in sports games, weight and height data are of great importance for the performance of certain game functions. Such indicators as the height and weight of an athlete are largely determined by heredity (body length – by 90-95%, body weight by 72-76%). The results of the research on the morphofunctional state of young football players carried out, in accordance with the set goal, are partially confirmed by the data of the literature. According to D. Bujnovky *et al.* (2019), the greatest increase in the length of the body in the standing position and the length of the lower limbs in young football players occurs from 11 to 12 and from 13 to 14 years. The same study showed a slight increase in the specified signs from 11 to 12 years, and a significant increase from 12 to 13, and from 13 to 14 years. Also, the largest increase in body weight and hip girth, which falls on this age period, has been established. According to A. Terzis (2020), in highly qualified football players, the efficiency of head play in defence is determined by the length of the body in a standing position, and the efficiency of interceptions is determined by the length of the lower limbs. The authors observed the same specificity of addictions in young football players based on the analysis of the data of this study, which indicates the high informativeness of these indicators in the process of orientation towards the performance of certain game functions.

N. Jayanthi *et al.* (2022) noted that the ability of athletes to perform long-term non-specific physical activity is determined by the level of the body's aerobic capacity (due to MOC) and is positively influenced by the improvement of specific components of playing skill. The correlation analysis performed by the authors confirmed the need for high indicators of MOC characteristics for the effective performance of protective actions. However, the data obtained in this study had a certain specificity. In particular, high correlation activity between the integral and separate EC of defensive actions and MOC indicators was found in all age groups, with the exception of 12-year-old football players. It was also established that with age the number of correlations decreases and their numerical values decrease. This indirectly indicates that with age and an increase in the level of special training, the role of anaerobic sources of energy supply increases. But according to the results of these studies, aerobic energy production and general endurance are leading to the effective performance of defensive actions by young football players.

In sports, effective competitive activity is also ensured by the ability to productively perform anaerobic work, as written by P. Kunz *et al.* (2019). The data obtained by the authors partially confirm this statement, but also indicate that at this age stage of the training of football players, anaerobic processes of energy supply are not exclusively decisive for effective defensive activity. Thus, only in young players aged 11 and 14, the strongest relationship between the indicators of absolute and relative anaerobic phosphagen capacity with individual indicators and integral EC of defensive actions was found. In 12-, 13-, and 15-year-old athletes, correlations of this indicator with individual EC of defensive actions are episodic. Also, a significantly higher correlation activity of the anaerobic power indicators of the last 10 seconds of work in the test and the index of its decrease than the first 10 seconds of jumping work was established. This indicates the importance of the capacity of anaerobic pathways of energy supply for the successful performance of protective actions. Therefore, this study demonstrated the predominant importance of aerobic energy production for the effective performance of defensive actions, but indirectly showed that as the level of playing skill increases and the intensity of competitive loads increases, the importance of anaerobic sources of energy supply will increase.

Conclusions

The conducted research made it possible to determine the specificity of the morpho-functional conditioning of the effectiveness of the defensive actions of young football players at the stages of preliminary and specialised basic training. The analysis of the age characteristics of the indicators of the effectiveness of defensive actions demonstrates the gradual formation of tactical skills in young football players in the period from 11 to 15 years. The investigated morphological features significantly increase from 12 to 13 and from 13 to 14 years ($p \leq 0.05$). The greatest increase in aerobic capacity (MOC) was noted from 13 to 14 years ($p \leq 0.05$). A significant increase in the indicators of anaerobic phosphagen power occurs from 12 to 13 and from 13 to 14 years ($p \leq 0.05$), and the indicators of relative anaerobic phosphagen power increase reliably from 11 to 12, from 13 to 14 and from 14 to 15 years ($p \leq 0.05$).

The established dependences of the effectiveness of defensive actions on the investigated morphological features must be used when determining the game functions of young football players and team selection. Thus, young football players with relatively high indicators of body length and lower limbs should be oriented to perform the functions of central defenders and midfielders due to the fact that it is in the middle part of the football field that interceptions and head plays in defence are most often performed, and the indicated morphological characteristics in young football players 11-15 years old, as confirmed in the course of research, determine their effectiveness. Young football players with relatively lower indicators of body length and lower limbs, and with a relatively larger hip girth, should be oriented to perform the functions of wing players due to the fact that on the wings, such a defensive action as ball retrieval is most often performed.

Reliable dependencies between aerobic and anaerobic capabilities, on the one hand, and the effectiveness of protective actions, on the other, determine the need for a balanced combination of aerobic and anaerobic exercises in the process of sports training. It can be argued that the ability of young athletes to maintain a high power of jumping work, which characterises the level of anaerobic capacity, is

related to their effective performance of protective actions. Prospects for further research are determined by the need to improve the system of complex control, taking into account the morpho-functional conditioning of the effectiveness of defensive tactical actions of young football players.

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Conflict of Interest

None.

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Морфофункціональна обумовленість ефективності захисних дій юних футболістів на етапах попередньої та спеціалізованої базової підготовки

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Анотація. Актуальною є необхідність достатнього рівня функціональної підготовленості та впливу окремих морфологічних ознак на ефективність тактичних дій. Оскільки засвоєння та удосконалення тактичної діяльності відбувається на етапах попередньої та спеціалізованої базової підготовки (11-13 та 13-15 років), визначення морфофункціональної обумовленості ефективності виконання захисних дій юними футболістами дозволить вдосконалити процес їх тактичної підготовки. Мета дослідження – визначити взаємозв'язок морфофункціональних особливостей з ефективністю виконання захисних дій юними футболістами на етапах попередньої та спеціалізованої базової підготовки. Рівень функціональних можливостей визначено непрямими методами: аеробні – за показниками частоти серцевих скорочень після виконання стандартного 5-хвилинного навантаження; анаеробні – за показниками стрибкової ергометрії. У всіх групах встановлено достовірні зв'язки між довжиною тіла в положення стоячи та коефіцієнтом ефективності гри головою у захисті. Виявлено високі значення коефіцієнтів кореляції між показниками довжини нижніх кінцівок та коефіцієнтом ефективності перехоплень (окрім 12-річних). Встановлено наявність статистично значущих взаємозв'язків між усіма характеристиками ефективності дій у захисті та аеробними можливостями юних спортсменів. Виявлено, що у віці 14 років показники абсолютної анаеробної фосфагенної потужності значуще корелюють із коефіцієнтами ефективності перехоплень, гри головою в захисті та протидій. Визначено, що ефективність дій у захисті пов'язана зі спроможністю підтримувати високу потужність стрибкової роботи, яка характеризує анаеробну ємність. Встановлені залежності ефективності захисних дій від досліджуваних морфологічних ознак і функціональних характеристик мають використовуватися тренерами дитячо-юнацьких футбольних команд при визначенні схильності юних футболістів на виконання певних тактичних функцій, комплектуванні команд та раціональному застосуванні тренувань різної (аеробної й анаеробної) спрямованості

Ключові слова: аеробні можливості; анаеробні можливості; вікові зміни; кореляційний аналіз; морфологічні ознаки