

Monitoring of morphological and functional indicators of taekwondo athletes aged 14–15 years

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Abstract

Purpose: comparative analysis of the manifestation of morphological and functional indicators of taekwondo athletes aged 14–15 years.

Material and Methods: The study involved 60 taekwondo athletes aged 14–15 years. Athletes' qualification 1-2 category. At least 5 years of experience in Taekwondo WTF. The assessment of morphological and functional indicators of taekwondo athletes was carried out at the age of 14 and 15 years.

Research methods: analysis and generalization of scientific, methodological and special literature, information on the Internet; anthropometric methods; index method; methods of mathematical statistics.

Results: The average body weight of taekwondo athletes aged 14-15 increased by 16,5%, and body length by 4,7%. The indicator of chest excursion increased by 4,8%, carpal dynamometry indicators of the left hand increased by 15,2%, the right hand - by 15,3%. 33,6% of 15-year-old athletes are underweight in terms of body mass index, 2,9% are overweight; 14 year olds: 21,56% underweight, 13,7% overweight. Athletes aged 14–15 have a normosthenic body type. According to the constitution of the physique, 7,84% of 14 year old athletes have a strong physique, 15,68% have a good physique, 5,88% have an average physique, 27,45% have a weak physique, 43,15% have a very weak one. 12,12% of 15-year-old taekwondo athletes have a strong physique, 24,24% have a good physique, 9,1% have an average physique, 24,24% have a weak body, and 30,3% have a very weak body. 13,7% of 14-year-old taekwondo athletes have good physical development, 3,9% - average, 76,4% - weak 15-year-old athletes: 17,6% - good physical development, 14,8% - average, 67,6% - weak.

Conclusions: The study of morphological and functional indicators is one of the important criteria for the training of taekwondo athletes, the use of indices allows you to move on to relative indicators, that is, to standardize anthropometric indicators and supplement them. This will contribute to the rational selection of means and methods of training athletes, taking into account their personal characteristics. Our research can be used in monitoring the functional state of athletes involved in taekwondo WTF.

Анотація

Ігор Пашков, Володимир Потоп, Вікторія Пашкова. Моніторинг морфофункціональних показників тхеквондистів 14–15 років. Мета: порівняльний аналіз прояву морфофункціональних показників тхеквондистів 14–15 років. **Матеріал і методи:** у дослідженні взяли участь 60 тхеквондистів у віці 14–15 років. Кваліфікація спортсменів 1–2 розряд. Стаж занять тхеквондо WTF не менш 5 років. Оцінка морфофункціональних показників тхеквондистів здійснювались у віці 14 та 15 років. **Методи дослідження:** аналіз і узагальнення науково-методичної та спеціальної літератури, інформації в мережі Internet; антропометричні методи; метод індексів, методи математичної статистики. **Результати:** Середній показник маси тіла тхеквондистів 14–15 років зріс на 16,5 %, а довжина тіла на 4,7 %. Показник екскурсії грудної клітини збільшився на 4,8 %, Показники кистьової динамометрії, лівої руки збільшилися на 15,2%, правої – 15,3%. 33,6 % 15 річних спортсменів мають недостатню масу тіла за показником індексу маси тіла, 2,9 % – надлишкову; 14 річні: 21,56 % недостатню масу тіла, 13,7 % – надлишкову масу тіла. Спортсмени 14–15 років мають нормостенічний тип статури. За конституцією будови тіла 7,84 % 14 річних спортсменів мають міцну статуру, 15,68 % – добру статуру, 5,88 % – середня, 27,45 % – слабку, 43,15 % дуже слабку. 12,12 % 15 річних тхеквондистів мають міцну статуру, 24,24 % – добру статуру, 9,1 % – середню, 24,24 % слабку, 30,3 % – дуже слабку. 13,7 % 14 річних тхеквондистів мають гарний фізичний розвиток, 3,9 % – середній, 76,4 %

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кистьова динамометрія

– слабкий 15 річні спортсмени: 17,6 % – гарний фізичний розвиток, 14,8 % – середній, 67,6 % – слабкий. **Висновки:** Дослідження морфофункціональних показників є одним із важливих критеріїв підготовки тхеквондистів, застосування індексів дозволяє переходити до відносних показники, тобто стандартизувати антропометричні показники та доповнити їх. Це сприятиме раціональному підбору засобів та методів підготовки спортсменів з урахуванням їх індивідуальних особливостей. Наші дослідження можуть використовуватися у моніторингу функціонального стану спортсменів які займаються тхеквондо ВТФ.

Introduction

In the scientific and methodological literature, there are a large number of works devoted to the problem of analyzing the morphological and functional characteristics of athletes in martial arts, which is widely used in the analysis of the physical development of martial arts athletes (Banik, 2022; Holyaka & Hlukhov, 2018; Podryhalo et al., 2016; Podrihalo et al., 2020; Rovnyy et al., 2013).

The results of modern research allow us to conclude that the study of the morphological and functional characteristics of athletes should take into account the specifics of the sport. This will optimize the selection procedure and significantly increase the effectiveness of monitoring and predicting the success of performance in competitions (Holyaka & Hlukhov, 2018; Kotko et al., 2021; Platonov, 2020; Podryhalo et al., 2016; Rovnyy et al., 2013).

The study of the morphological and functional characteristics of athletes is common not only in martial arts: boxing, wrestling, taekwondo (Banik, 2022; Holyaka & Hlukhov, 2018; Hrubar, 2018; Podryhalo et al., 2016; Rovnyy et al., 2013; Strelchuk et al.,) but also in many sports: athletics, arm wrestling, football, etc. (Hrubar & Hrabyk, 2020; Kotko et al., 2021; Podrihalo et al., 2020; Podrigalo et al., 2017).

According to the results of the study (Rovnyy et al., 2013), anthropometric indicators (body length, body weight, arm span, leg length, chest coverage at rest, on inhalation, on exhalation) are the leading factors for athletes involved in taekwondo WTF. For example - an advantage in height and length of the limbs, allows you to conduct a sports fight at a long distance, effectively attack and be invulnerable to opponent's attacks.

Improving the quality of training of football players, the introduction into practice of effective means and methods of training indicate the need for special study and search for fundamentally new approaches to the organization of the training process. First of all, it is necessary to focus on stable, little-variable factors in the course of development, which correspond to morphological indicators (Hrubar & Hrabyk, 2020).

The results obtained allow us to state that the level of sportsmanship in armwrestling and kettlebell lifting is largely determined by the anthropometric features of development. The most convenient method is the calculation of physical development indices, which fairly quickly and objectively assess the level of physical development of athletes. The use of such indices can be used for preliminary selection of athletes in the section of strength sports, control of the level of physical preparedness (Podryhalo et al., 2007).

The data of morphological and functional indicators of athletes of different types of body constitution are of decisive importance in terms of solving the problem of improving various aspects of the sports training of wrestlers and rowers, taking into account their individual characteristics of physical develop-

ment (Serhiy Holyaka & Ivan Hlukhov 2018).

Without the use of morphological indicators, it is impossible to ensure the effectiveness of such components of the training process as: forecasting, control, reliability of selection and organization of various stages of long-term training of athletes. For the formation of motor skills of karatekas, their anthropometric data, primarily the longitudinal links of the body, are of great importance. The absolute and relative dimensions of individual parts of the body are of decisive importance for the improvement of sportsmanship and effective performance during sports competitions (Hrubar, 2018).

Determining the morphological and functional indicators of taekwondo athletes aged 14–15 years is important for building the training process and predicting the success of athletes in competitions.

Relationship of research with scientific or practical tasks, plans, programs. The study is carried out in accordance with the topic of the research work of the Kharkiv State Academy of Physical Culture for 2021–2025, “Optimization of the training process in martial arts” (state registration number 0121U112873).

Purpose of the study: a comparative analysis of the morphological and functional indicators of taekwondo athletes aged 14–15 years.

Material and Methods of the research

Members. The study involved 60 taekwondo athletes aged 14–15 years. Qualification of athletes 1-2 category. At least 5 years of experience in Taekwondo WTF. All participants agreed to participate in the study. Assessment of morphological and functional indicators of taekwondo athletes was carried out at the age of 14 and 15 years.

To solve the tasks set, the following **research methods** were used: analysis and generalization of scientific and methodological and special literature, information on the Internet; anthropometric methods; index method, methods of mathematical statistics.

To assess morphological and functional indicators, surveys were conducted in compliance with the basic requirements of unified anthropometric research methods, taking into account the recommendations of international standards for anthropometric assessment ISAK (Marfell-Jones et al., 2012).

During the study, morphological parameters were measured. For comparative analysis, anthropometric indicators were determined, traditionally used in the analysis of the physical development of athletes: body length (cm), body weight (kg), chest circumference (cm), inhalation and exhalation circumference and their difference (excursion) (cm), wrist dynamometry with both hands (kg).

To assess the physical development of taekwondo athletes, we used anthropometric indices: strength index of the right and left hands (%), body mass index (kg/m²), Pinier index (c.u.), Erisman index (cm), Verweck index (c.u.).

Statistical analysis of the obtained data was performed using the MS Excel (2010) licensed program. Descriptive statistics indicators were determined: arithmetic mean, standard deviation, error of the arithmetic mean (Antomonov, 2006).

Results of the research

An analysis of the morphofunctional parameters of taekwondo athletes aged 14–15 years (Table 1) showed that the average body weight of athletes increased by 16,5%, and body

length by 4,7%, which reflects the rapid period of development of athletes inherent in adolescence.

The indicators of development of the thorax of taekwondo athletes increase over the year, in particular: the circumference of the chest on inhalation increased by 5,4%, on exhalation – 4,5%, the difference between the circumference on inhalation and exhalation (excursion) increased by 4,8%, this is a reflection the fact that 15-year-old athletes have a more developed and mobile chest. This contributes to better ventilation of the lungs, so that athletes can endure a greater load.

Wrist dynamometry indicators in 15-year-old taekwondo athletes are higher compared to 14-year-olds, the left hand is 15,2% and the right hand is 15,3%.

Due to the fact that, according to many experts in the field of physical education and sports, anthropometric indicators do not fully reflect the physical development of athletes, therefore, we applied the index method. (Po dryhalo et al., 2021, Hrubar. 2018, Rovnyy et al., 2013).

The analysis of indices of physical development of taekwondo athletes (Table 2) showed that the average body mass indices of taekwondo athletes aged 14 and 15 are within the normal range. 33,6% of 15-year-old athletes are underweight, 2,9% are overweight, and 14-year-olds: 21,56% are underweight, 13,7% are overweight.

We have found that over the course of 14-15 years, athletes have a decrease in the strength index by 1,7% of the left and 1,2% of the right hand.

These indicators characterize a more rapid increase in body length in relation to body weight, with a tendency to stretching processes, in athletes 15 years old.

According to the average indicators of the Verweck index, where it is $0,87 \pm 0,01$ for 15-year-old taekwondo athletes and $0,93 \pm 0,01$ for cadets, both groups of athletes have a normosthenic body type.

In 14-year-old athletes, the value of the Pinier index corresponds to such an assessment of the constitution of the physique: 7,84% have a strong physique, 15,68% have a good physique, 5,88% have an average physique, 27,45% have a weak, 43,15% have a very weak. In 15 year old athletes, the following indicators were revealed: 12,12% have a strong physique, 24,24% have a good physique, 9,1% have an average physique, 24,24% have a weak constitution, 30,3% have a very weak one.

The Erisman Index indicates that 14-year-old taekwondo athletes have a good physical development of 13,7%, 3,9% - average, 76,4% - weak. In 15-year-old athletes, these indicators are better: 17,6% good physical development, 14,8% - average, 67,6% - weak.

Discussion

The greatest contribution to the formation of the growth of the functional system of sportsmanship is characterized by anthropometric indicators (length and weight of the body, chest circumference, wrist dynamometry, shoulder width) (Podryhalo et al., 2016).

One of the important criteria for the preparation of athletes in any sport is anthropometric indicators, and the level of sportsmanship is determined by a large number of factors, among which a special place belongs to the structure of the athlete's body (Hrubar & Hrabyk, 2020; Rovnyy et al., 2013).

Achieving great sports results in WTF taekwondo depends on the physical development and morphological and functional indicators of athletes. This is reflected in the work of Hrubar & Hrabyk, 2020, which states that one of the important criteria for the preparation of athletes in any sport is anthropometric data, and the level of sportsmanship is determined by a large

Table 1

Morphological and functional indicators of taekwondo athletes

№	Indicators	Taekwondo athletes 14 years old		Taekwondo athletes 15 years old		
		$\bar{X} \pm m$	σ	$\bar{X} \pm m$	σ	
		1.	Body weight, kg	45,77±2,18	15,55	53,32±2,57
2.	Body length, cm	152,72 ±0,02	0,13	159,98 ±1,65	11,82	
3.	Chest circumference, cm	Inhale	81,31 ±1,29	9,19	85,86 ±1,26	9,06
		Exhale	74,09 ±1,16	9,19	78,29 ±1,09	7,83
		Excursion	7,19 ±0,22	1,58	7,54 ±0,24	1,77
		Pause	76,08 ±1,24	8,84	80,63 ±1,17	8,38
4.	Wrist dynamometry, kg	Right	20,31 ±0,89	6,36	23,42 ±0,91	6,45
		Left	17,89 ±0,93	6,68	20,61 ±1,54	7,53

Table 2

Indicators of indices of physical development of taekwondo athletes

№	Indicators	Taekwondo athletes 14 years old		Taekwondo athletes 15 years old		
		$\bar{X} \pm m$	σ	$\bar{X} \pm m$	σ	
1.	Body mass index, kg/m ²	19,11± 0,49	3,52	20,54 ±0,47	3,37	
2.	Pinier index, c.u.	30,86± 2,02	14,48	26 ±2,12	15,21	
3.	Erisman index, cm	-0,27± 0,75	5,42	0,65± 0,82	5,87	
4.	Strength Index, %	Right	45,49± 1,28	9,19	44,92± 1,34	9,59
		Left	40,11± 1,49	10,68	39,41± 1,63	11,68
5.	Verweck index, c.u.	0,93± 0,01	0,12	0,87± 0,01	0,11	

number of factors, among which a special place belongs to the physique of an athlete. Burdukiewicz et al., 2018, confirmed the effectiveness of the study of morphometric and somatotype characteristics for assessing success in martial arts.

Studies have found that taekwondo athletes have an increase in body length by 4.7% over the course of 14–15 years, and is reflected in the fact that 15-year-old athletes are 12.04% underweight compared to 14-year-olds. It is also a manifestation of the influence of physical activity and the specifics of the sport on the morphological parameters of taekwondo athletes. This coincides with the statement of Podrihalo et al., 2020, that the proximity of morphological and functional indicators is determined by the level of physical preparedness of athletes and is the result of specialized training. Anthropometric, physiological and physical characteristics, anaerobic and aerobic power, body length, body weight, body mass index and body fat percentage, speed and agility are significantly associated with success and are of greater importance for taekwondo athletes (Arazi et al., 2016).

33,6% of athletes, 15 years old, are underweight in terms of body mass index, 63,5% are normal. This coincides with the studies of Cular et al., 2021., which indicate that the parameters of anthropometric characteristics and body composition of junior athletes Croatian taekwondo, by weight categories, there is a proportional increase in average values for almost all morphological and functional indicators in all weight categories, with the exception of total body water (%), which decreases in heavy categories. In addition, the higher categories were significantly heavier, taller, and with a higher body mass index than the lower ones ($p < 0,01$). In WTF taekwondo, indicators of morphological and functional features are partly related to weight categories; however, in the same weight category, athletes with different body lengths can succeed. A body mass index of about 21 kg/m² for men is associated with the performance of highly skilled taekwondo athletes (Agopyan et al., 2022; Bridge et al., 2014; Cular et al., 2021). The absolute values of anthropometric measurements of body length, body weight, body fat percentage, and body mass index in elite and non-elite athletes indicate that elite athletes tend to be taller and leaner than non-elite athletes (Norjali et al., 2019).

Prospects for further research will be aimed at developing a training program for 15-year-old taekwondo athletes in the annual macrocycle, taking into account morphological and functional features.

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Conclusions

The study of morphological and functional indicators is one of the important criteria for the training of taekwondo athletes, the use of indices allows you to move on to relative indicators, that is, to standardize anthropometric indicators and supplement them. This will contribute to the rational selection of means and methods of training athletes, taking into account their personal characteristics. Our research can be used in monitoring the functional state of athletes involved in taekwondo WTF.

Studies have established that the age of 14-15 years in athletes specializing in taekwondo is characterized by a rapid period of development, which is reflected in an increase in body weight by an average of 7.55 kg and height - 7.26 cm, this reflects the physiological period of development of athletes inherent in adolescence.

According to the results of the study, it was found that in terms of body mass index, 33,6% of 15-year-old athletes are underweight, 2,9% are overweight, and 14-year-olds: 21.56% are underweight, 13,7% are overweight. 14 year old athletes have: 7,84% strong physique, 15,68% good, 5,88% average, 27,45% weak, 43,15% very weak. 15 year old athletes: 12,12% have a strong physique, 24,24% are good, 9,1% are average, 24,24% are weak, 30,3% are very weak. 13,7% of 14-year-old taekwondo athletes have good physical development, 3,9% - average, 76,4% - weak. 15 year old athletes have the best physical development: 17,6% good, 14,8% average, 67,6% weak.

Author Contributions

Igor Pashkov: collection, input, data analysis, manuscript preparation, statistics. Vladimir Potop: design, data interpretation. Viktoriia Pashkova: analysis of scientific and methodological literature and the Internet, data interpretation, manuscript preparation, statistics.

Conflicts of Interest

The authors declare no conflict of interest.

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