



MORPHO-GENETIC TRAITS OF RUNNING LIGHT ATHLETES AS SELECTION CRITERIA IN SPORTS

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Abstract: The study conducted a comparative assessment of the physical development of track and field runners, depending on their distance specialization. Assessment of physical development was carried out based on the anthropometric indicators of athletes aged 17-21, who have sports qualifications from kms to masters of sports. Body type was determined according to the modified Heath-Carter method, 1989. Associative relationships were established between such absolute genetic markers as dermatoglyphic indicators of track and field sprinters with an elevated level of speed development. The fingerprints and palm impressions of the examined athletes were processed according to the method of T.D. Gladkova, 1966. Analysis of dermatoglyphic features showed the predominance of complex finger patterns; curls and loops; high SGS values (189.3) in Uzbek track and field athletes compared to the general population SGS value (150-160 ridges), which can be used as criteria for predicting an increased level of motor quality development. In terms of physical development, track and field athletes and sprinters belong to the "middle" type, and with a decrease in the level of sports mastery, there is a tendency towards minimization of anthropometric indicators. Differences in the component composition of body mass in athletes specializing in short and long distances were revealed. Despite the identified features, a dominant ecto-mesomorphic somatotype was identified.

Keywords: physical development, somatotype, speed qualities, dermatoglyphics, sports selection, anthropometric characteristics, runners of various distances.

Relevance: Physical activity places specific demands on the athlete's morphological organization, being the material basis for physical qualities. Moreover, at the level of the highest achievements, the features of body structure can prove to be a decisive factor in the struggle for victory. The term "somatotype" is used to describe a complex of morphological and functional characteristics, inherited and acquired, that determine the uniqueness of the body's response to exogenous and endogenous influences. The athlete's somatotype can be considered as an integral characteristic of his morphological features that determine athletic performance at different stages of sports activity. Thus, at the initial stage – early sports orientation – the somatotype is considered as a factor that determines not only the magnitude of absolute body size, but also the rate of ontogenesis, which is so important for sports selection (Dorokhov R.N., 2001, Panasyuk T.V., Tambovtseva R.V., 2003, O.I. Pavlova, 2004, Safarova D.D., 2008). The somatotype of athletes who have achieved the highest level of mastery can serve as a basis for constructing standard characteristics of a sport, and, at the same time, be used as a criterion for assessing the effectiveness of the training process.

Analysis Of Recent Research And Publications

The somatotype is the anatomical passport of a person's constitution. The existing diversity of somatotypes is characterized not only by morphological differences, but also by specific metabolic patterns, the range of functional capabilities, hormonal balance, and the level of motor development. (Zouras E., Singli S.H., 1980, Kova E.P. 1981, Nikityuk B.A., 1989, T.V. Panasyuk, R.V. Tambovtseva, 2003, Safarova D.D. et al. 2003, 2012). According to B.A. Nikityuk, 1989, somatotype determines the level of development of motor skills. The latter depend on the characteristics of digital dermatoglyphics. This means that dermatoglyphic features are included in the constitution. Developing the ideas of I.S. Guseva (1986) on the genetic determination of finger patterns, B.A. Nikityuk and V.I. Filippov (1989) were the first to establish links between finger dermatoglyphics and speed. In their opinion, the increase in the quality of speed qualities in the population is facilitated by the simplification of finger patterns such as arches and loops, as well as a decrease in the value of the ridge count, and the values of these indicators simultaneously influence the slowing down or acceleration of the rate of individual development. However, our research yielded diametrically opposed results. It is generally accepted that genetic studies should be conducted on a homogeneous sample, which we emphasized, and the study was conducted on athletes from the Uzbek population. We have established a correlation between high comb counts and, conversely, increased complexity of digit patterns, particularly the predominance of whorls and loops. This means that every genetic marker is conditional and operates within a specific population and even within a specific region. The results of our research are presented in detail in this publication.

Dermatoglyphic traits are also highly heritable and are considered absolute genetic markers. In population and medical genetics, they are used to solve problems of kinship, diagnosis, and disease prognosis. Reliable data correlating these characteristics with pathology have been obtained, confirming their value as genetic markers. In sports, as mentioned above, dermatoglyphic characteristics are used as criteria for diagnosing the level of motor development (B.A. Nikityuk, 1989, 1991; L.I. Tegako, 1989; Safarova, D.D.; Mirzaeva, U.N., 2021). It seems promising to study the morphological characteristics of athletes specializing in one sport but differing in the focus of the training process.

Study objective: Comparative characteristics of morphological indicators of runners' body build, depending on distance specialization and identification of connections between dermatoglyphic indicators and motor qualities. This study aims to solve the following problems:

1. To establish differences in total and partial dimensions of body mass of track and field athletes specializing in different running distances.
2. Dermatoglyphic features, being structural derivatives of the skin, exhibit a high degree of heritability and belong to the category of absolute genetic markers. It is of interest to identify the characteristics of dermatoglyphic indicators in athletes specializing in running types of athletics, with the identification of the most informative indicators suitable for predicting the level of development of speed qualities.

Research methods:

1. The physical development was assessed based on anthropometric indicators and body mass component composition of 81 Uzbek track and field athletes, aged 17-21 years, with sports qualifications ranging from 2nd rank to Master of Sports (CMS), Master of Sports (MS). The track and field athletes were divided into three groups based on their distance



specialization (sprinters, middle-distance runners, and long-distance runners). Total and partial body measurements were taken. Total body measurements were used to determine weight, body length, and chest circumference. From the partial dimensions, the length, width, and girth dimensions of body segments or links were determined. Anthropometric studies were conducted according to the rules and requirements set forth in the Sports Morphology Manual (Safarova D.D., 2021).

2. Body type was determined using a modified Heath-Carter method, 1989. Initially, standard anthropometric measurements were taken for 7 dimensional characteristics: Body length, weight, diameter of the distal part of the shoulder in a tense state, calf circumference were determined, and the thickness of skin-fat folds in 4 regions of the body were measured using a caliper. Somatotype was diagnosed in quantitative terms of three somatic components: I. F - fat component - endomorphy; II. M - muscle component - mesomorphy; III. The weight-height ratio was determined using the formula: $L\sqrt[3]{P}$. Components were calculated using special formulas, which were used to determine not only body mass composition but also to diagnose somatotype using the Heath-Carter somatogram.

3. Dermatoglyphic method. Fingerprints and palm prints from 81 athletes and a control group of 50 phenotypically healthy adolescents not involved in sports were obtained using the conventional rolling method using printing ink (T.D. Gladkova, 1966). Dermatoglyphic analysis in the examined groups was carried out according to the main significant indicators and included the following parameters:

1. Diagnostics of finger pattern types – arches A, ulnar loops - L_u , radial loops - L_r , 2L - double loops; W - curls. - \angle
2. Determining angles - \angle_{atd} .
3. Calculating the total ridge count (TRC) and delta index.
4. Calculating the total ridge count (TRC).
5. Methods of mathematical statistics - calculating the main statistical parameters, including errors – the arithmetic mean, standard deviation, and variation coefficients.

Study results and discussion: Average body length values for all subjects varied slightly, ranging from 173.07 ± 1.14 cm for long-distance runners to 176.50 ± 0.80 cm for sprinters. Lower values for body weight, chest circumference, and absolute body surface area were found for long-distance runners (8000 m). Athletes have a greater body length and greater body mass, with the increase in body mass being correlated with muscle mass rather than fat mass. Literature data indicate that the average height of the world's strongest sprinters is 179.8 ± 0.9 cm ($\delta=7.0$ cm), while the average height of 9-10-year-old schoolchildren is 140.22 ± 0.5 cm ($\delta=5.2$ cm).

Table №1

Comparative characteristics of total body measurements of track and field athletes depending on distance specialization

Signs	Options	Short-distance runners 100 m. p=30	Middle-distance runners 400m. p=28	Long-distance runners 8000m. p=23
Body length	$M \pm m$ $\delta \pm m$	$176,50 \pm 0,80$ $4,80 \pm 0,51$	$175,84 \pm 0,74$ $5,45 \pm 0,50$	$173,07 \pm 1,14$ $6,38 \pm 0,41$



	V±m	2,74±0,31	3,01±0,29	2,31±0,20
Body weight	M±m	73,72±0,81	71,06±1,01	69,03±1,12
	δ±m	5,29±0,52	6,70±0,52	6,06±0,
	V±m	7,04±0,90	8,7±0,81	7,92±0,75
Chest circumference	M±m	94,33±0,59	95,10±5,89	91,16±0,74
	δ±m	3,68±0,44	3,93±0,42	4,16±0,30
	V±m	3,82±0,43	3,9±0,46	4,25±0,39
Absolute surface area of the body	M±m	1,92±0,02	1,90±0,02	1,78±0,01
	δ±m	0,08±0,01	0,10±0,01	0,1±0,015,3±
	V±m	5,70±0,51	5,75±0,51	0,5

The results allow for an objective approach to the selection process for sprinting sections. To be accepted into the sprinting section, students must have a high stride rate (more than 4.7 steps/s), and sprinters' body length always correlates with their body weight. Boys selected for long-distance running, such as the marathon, must also have a high frequency of movements, but their height should not be less than 145 cm (Samsonova A.V., 1988). The coefficients of variation appear to be uniform for body length, chest circumference, and body weight (from 7.04 to 8.7).

Table №2

Comparative characteristics of partial body sizes of runners, depending on distance specialization

Length	Options	Short-distance runners 100m. p=30	Middle-distance runners 400m. p=28	Long-distance runners 8000 p=23
Frame	M±m	82,02±0,40	80,12±0,20	78,25±0,25
	δ±m	2,80±0,33	3,8±0,21	2,36±0,20
	V±m	3,53±0,30	3,39±0,27	3,02±0,30
Torso	M±m	54,56±0,34	54,20±0,29	52,55±0,30
	δ±m	2,30±0,20	2,48±0,27	2,18±0,21
	V±m	4,20±0,45	4,80±0,55	4,300,40
leg length	M±m	94,10±0,50	92,08±0,50	91,28±0,50
	δ±m	3,10±0,30	3,79±0,31	3,48±0,42
	V±m	3,40±0,31	4,01±0,35	3,80±0,50
Hips	M±m	46,61±0,20	45,45±0,41	45,79±0,40
	δ±m	2,29±0,22	3,24±0,31	2,32±0,28
	V±m	4,270,40	3,37±0,33	3,70±0,45
Shin	M±m	43,60±0,45	41,20±0,41	40,04±0,33
	δ±m	3,24±0,31	3,59±0,34	3,08±0,40
	V±m	3,27±0,42	4,01±0,39	3,78±0,51
Arm length	M±m	88,58±0,69	86,24±0,45	85,84±0,38
	δ±m	3,88±0,30	3,70±0,30	2,40±0,20
	V±m	4,02±0,24	4,25±0,34	3,90±0,55
Shoulder	M±m	40,20±0,36	37,20±1,02	38,20±0,22
	δ±m	2,03±0,22	3,24±0,33	2,42±0,20
	V±m	3,41±0,30	3,71±0,41	4,10±0,55
Forearm	M±m	30,33±0,34	29,33±0,57	28,40±0,34
	δ±m	4,92±0,21	3,80±0,41	3,58±0,43
	V±m	1,9±0,22	3,40± 0.31	3,8±0,22

Thus, of the total body measurements for the three compared groups of athletes, body mass proved to be the most variable. Characterizing longitudinal body measurements, it should



be noted that sprinters have the longest legs relative to their body size. With practically the same body length in the examined group of track and field athletes, the average leg length of sprinters is significantly greater than that of the others. According to G.I. Kovalchuk (2003), highly qualified 300m runners with a training speed of 10-11 m/sec. showed opposite-sign correlations between the speed components – length, frequency of running movements and the following indicators: external and internal balance, the ratio of the step length to the body length, as well as to the length of the leg. 8,000-meter runners have average upper arm and forearm lengths, long femurs, and average calf lengths. Despite virtually identical body lengths, all compared groups of runners exhibited high lower limb lengths. The ratios of the lengths of the lower limb segments are probably related to the biomechanical mechanisms of track and field running. In order to create a morphological portrait of an athlete of a specific type of sports specialization, it is not enough to rely only on anthropometric indicators reflecting the level of physical development; more informative features are needed, based on the study of the component composition of body mass, which also allow for the diagnosis of a specific somatotype. Despite the well-known diversity of somatotyping schemes, as well as approaches to interpreting the material in determining somatic types, the Heath-Carter method appears to be the most rational compared to other somatotyping schemes. 1989 because it is based on precise measurement parameters and eliminates subjectivity. The leading factors in body composition assessment, reflecting individual variations in body shape and composition, are components such as endomorphy, mesomorphy, and ectomorphy. Endomorphy characterizes the degree of obesity, i.e. the development of adipose tissue; mesomorphy determines the relative development of skeletal muscles; and ectomorphy reflects the relative elongation of the human body. The results of somatotyping showed that the component composition of the body of sprinters is presented in points, and the diagnosed somatotype belongs to the category of ecto-mesomorphic type (3.6 points - indicator of ectomorphy or weight-height indicator, points - mesomorphy - 2.9 - characterizes the degree of development of muscle mass, 1.9 points - endomorphy or indicator of development of adipose tissue, which in general is expressed as 3.6: 2.9: 1.9. Middle-distance track and field athletes occupy an intermediate position in muscle mass between sprinters and long-distance runners. Long-distance runners have significantly higher thigh muscle mass than sprinters. Long-distance runners also exhibit a pronounced ectomorphic component, as well as a highly developed muscular or mesomorphic component. The numerical symbolism of the body mass component composition of long-distance runners is determined as 3.3:3.6:2.3. Ectomorphic indices indicate the intensity of ongoing growth processes. In our opinion, a differentiated analysis of individual components of body mass in athletes of various specializations at the stage of improving athletic skills allows us to take into account not only morphological but also functional changes under the influence of the training process. When comparing the physical performance of muscular activity of sprinters and long-distance athletes using bicycle ergometry testing, E.A. Lazerova (2003) found that young men aged 17-21 years have 3 types of energy supply: anaerobic, mixed and aerobic. The dominant energy type in track and field sprinters is anaerobic, which determines their highest performance in the maximum power zone, while long-distance runners perform best in the moderate to high power zones. However, long-distance runners have higher overall physical performance than sprinters. Higher performance indicators in long-distance runners are determined by the greater contribution of the aerobic source to the overall energy production,

while low performance indicators in sprinters are associated with the predominance of anaerobic energy-supplying processes, which are less productive. From the analysis of the values of standard deviations and the coefficient of variation of body proportions, it can be concluded that all subjects are quite homogeneous in their composition. The coefficient of variation ranges from 2.4 to 4.8, indicating stable body proportions. It should be noted that in all athlete groups studied, the somatotype falls into the ecto-mesomorphic category. By comparing the anthropometric indicators of the world's strongest sprinters with the indicators of the surveyed sample of athletes, it was revealed that that in terms of physical development, Uzbek sprinters belong to the "average" type, and with a decrease in the level of athletic skill, a tendency towards minimization of anthropometric indicators is observed. This is confirmed by the results of somatotyping, which revealed four distinct somatotypes among the athletes surveyed, 53.9% of which were ecto-mesomorphic. A balanced type, endo-mesomorphs, and meso-ectomorphs were also identified. The results of the conducted studies showed that in order to establish the general morphological status of track and field athletes, it is possible to limit ourselves to an analysis of total characteristics, the ratio of the length of the lower limbs to the length of the body, and the circumference sizes of the segments of the lower limbs. These characteristics have prognostic value and retain their informative value as athletic skill improves. The range of morphological characteristics we identified demonstrates the performance effectiveness of the specific body types of track and field athletes specializing in various distances. However, the analyzed morphological indicators are phenotypic traits that indicate the state of the physique at a given time, and in order to conduct predictive sports selection, it is necessary to rely on genotype indicators. Since 81 track and field athletes belong to the category of individuals with increased physical activity, the control group consisted of 50 phenotypically healthy adolescents of Uzbek nationality. In Uzbek girls, arches are found in 1.5% of cases, ulnar loops in 58.9%, radial in 3.1%, bideltoid patterns in 36.1%, the total ridge count (TRC) is 132.2. In boys, the frequency of the same patterns is respectively: 4.5%: 48.7%: 2.9%: 43.8%; TRC is 157.7. The main palmar lines A, B, C, D are the most variable, have the formula 5.7. (5) 9. (X). 11, while the lines of the left hand are the most variable. Line A is somewhat more common and more frequently found in field 5, for both hands less often than 4%. Line B is somewhat more common in 7 than in 5 - in boys, in girls the opposite relationship. Line C is the most variable, ending in field 7 with almost equal frequency. In girls, line D most often goes to field 11, a little less often for the left hand, for the right hand it is the most common, and in boys for both hands it is most often in field 11. Palmar patterns of varying configurations are most often found on the hypothenar, and rarely on the thenar of the first interdigital pad. Moreover, whorls and true loops are more common on the palmar surfaces of Uzbeks than in Europeans. The axial triradius is usually single; combinations of two and three triradii are rare. In the position of the axial triradius, bilateral variations and gender differences are observed: in girls, on the right hand, up to 75.5%, in boys - 56.2%. The conducted analysis of the quantitative distribution of the types of patterns of the entire surveyed contingent, and in particular, track and field athletes - runners, revealed that among Uzbek athletes, arcs make up 2.4%, ulnar loops 56.1%, radial loops 3.8%, and whorls 38.7%. A predominance of whorl patterns was noted on the right hand and ulnar loops on the left hand; no differences were found in the distribution of arc patterns. Asymmetries were observed in the distribution of finger patterns, the course of the main palmar lines, and the distribution of axial palmar triradii

on the right and left hands. The average ATD angle for track and field athletes ranges from 38° to 50°, with a significant difference between the right and left arms. The CR (total ridge score) for speed athletes is 189.3, while the CR (total ridge score) for the Uzbek population averages 150-160. As can be seen from the data presented, the most informative is the SGS, whose values are approximately 30 combs higher. The distribution of finger patterns shows a predominance of complex patterns, including whorls and loops, which accounts for the high comb count values. Thus, specific dermatoglyphic structures have been identified that are associated not only with the formation of certain body types, but also determine an increased level of motor skills. The established morphogenetic criteria are reliable, objective and can be used to predict motor qualities and assess the athletic potential of track and field athletes.

Conclusion

1. Differences in body mass composition were identified between track and field athletes specializing in short and long distance events. Despite the four somatotype categories identified, 53.9% of the athletes surveyed had an ecto-mesomorphic somatotype, which is dominant.

2. Among the dermatoglyphic indicators, the predominance of complex patterns; curls and loops, high SGS values (189.3) in Uzbek track and field athletes relative to the general population SGS (150-160) can be used as criteria for predicting an increased level of motor skills

Literature:

- 1.Абрамова Т.Ф., Никитина Т.М., Кочеткова Н.И., Арьков В.В. и др. Особенности телосложения в оценке функционального состояния спортсменов / Межд. Конф. Проблемы современной морфологии человека М., 2008, стр. 127-129.
- 2.Гладкова Т.Д. - Кожные узоры кисти и стопы обезьян. - М.,1966, 166с.
- 3.Гусева И.С. - Морфогенез и генетика гребешковой кожи - Минск: Беларусь, 1986 г
- 4.Дорохов Р.Н. - Основа и перспектива возрастного соматотипирования. // «Теория и практика физической культуры», Москва, 2000, №9, с. 10.
- 5.Ковальчук Г.И. - Прогнозирование двигательных способностей бегунов на короткие дистанции. // «Теория и практика физической культуры», Москва, 2003, №9, с. 31-55.
- 6.Лазарева Э.А. - Взаимобусловленность общей физической работоспособности и типов энергообеспечения мышечной деятельности легкоатлетов спринтеров и стайеров. // «Теория и практика физической культуры», Москва, 2003, №9, с. 42-44.
- 7.Никитюк Б.А. - Адаптация, конституция, моторика //Теория и практика физической культуры №1, 1989, стр. 40 - 42.
- 8.Павлова О.И. Комплексная система подготовки квалифицированных легкоатлетов на этапах становления спортивного мастерства, Москва, 2003, -119 стр.
- 9.Панасюк Т.В., Тамбовцева Р.В. - Конституциональные особенности физической работоспособности подростков. В сб. VII Международный науч. конгресс «Современный Олимпийский спорт и спорт для всех», том 2, Москва 2003, с. 135-136.
10. Safarova D.D., Yadgarov B.Zh., Valikhanov U.Sh. Association of antigens of the HLA system with a predisposition to the development and manifestation of speed and strength qualities / In the collection of the International Conference "Problems of Modern Human Morphology" Moscow, 2008 - pp. 147-149.

- 11.Сафарова Д.Д. Спортивная морфология «Ilmiy texnika axboroti» - Ташкент, 2021, 248 с.
- 12.Терако Л.И. - Дерматоглифика населения Белоруссии - Минск: Наука и техника, 1989. – 182 с.
- 13.J.E. Lindsay Carter, Barbara Howeyman Heath - Somatotyping - development and applications./Department of physical Education San-Diego California, USA, Department of Antropology, Pennsylvania, USA. (Cambridge university press, 1989). – 320 с.
- 14.Cova E. P. - Human variation in motor abilities and its genetic analisis – Cherles Univ. 1981, Pragaе, 178 p
- 15.Zouras E., Singli S.H. Groth rate and its possible explantion Evolution 1980, v. 34 - №5 – p. 856 -867/.