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Goniometric body profile of men 26–31 years old engaged in health-improving fitness

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Abstract

Purpose. The purpose of the study was to determine the distinctive features of the goniometric body profile of men aged 26-31 years old engaged in health-improving fitness.

Material & Methods. The study involved men aged 26–28 (n=16) and 29–31 (n=17). The studies were conducted in compliance with the requirements of the Helsinki Declaration of the World Medical Association "Ethical Principles for Medical Research Involving Human Subjects". Research methods: analysis of literary sources, ascertaining pedagogical experiment. The Torso program was used to determine the distinctive features of the goniometric profile of the male body. All data obtained in the empirical study were processed using mathematical statistics methods.

Results. It has been established that there are no statistically significant differences in the measured goniometric indices between men of the 26-28 and 29-31 age groups. The values of these angles for these two groups are similar, and the age factor does not affect their values. That is, the position of the head, frontal bone and spine in men in the period from 26 to 31 years remains stable. This conclusion is quite understandable, since in the first period of mature age, the main physiological changes in the body are completed and the body is in a state of stability. And given the fact that the age difference between group members is small, this is not enough to show significant changes associated with age-related changes.

Conclusions. It was found that all the studied goniometric characteristics of men aged 26-31 years have significant differences from the norm, indicating an incorrect head tilt (angle α1 is less than the norm), excessive flexion of the spine (angle α3 is greater than the norm), which indicates a systemic violation of the biogeometric state of posture, requiring correction. It was also found that there are no significant differences in the body goniometry of men aged 26-28 and 29-31 years. Therefore, the development and implementation

of special programs for the correction of posture disorders aimed at correcting the tilt of the head and reducing excessive flexion of the spine, maintaining normal body weight, taking into account the individual characteristics of anthropometric indicators for the development of personalized training programs and the correction of violations of the biogeometric parameters of posture are quite capable of improving the physical development indicators of men in the first period of mature age.

Key words: health, men, mature age, physical development, goniometric profile, health-improving fitness.

Introduction

Many factors influence the extension of the active period of life: material, social, psychological, biological, genetic (Asaulyuk et al. 2023). However, the most significant motivation is for active and creative longevity (Grigus et al. 2024), which depends on the physical and psychological health of a person (Stopa et al. 2024).

In recent years, the problem of prevention and correction of pre-pathological and pathological deviations in the functioning of the musculoskeletal system of the adult population has acquired increasing socio-economic significance (Kashuba et al. 2021; Asaulyuk et al. 2023). In the course of conducting numerous studies, it became obvious that the basis for a holistic and comprehensive understanding of a person's physical status is the study of his morphofunctional parameters, in particular the state of his posture (Kashuba et al. 2018; Hakman et al. 2021). Despite the rationality of the above vision, an analysis of the professional literature (Vatamanyuk et al. 2021) allows us to state that it does not adequately reflect the theoretical and methodological foundations of the technology for increasing the level of the biogeometric profile of the posture of men in the first period of adulthood in the process of practicing health-improving fitness. This reveals the contradiction between the need to correct the goniometry of the body of men aged 26–31 years and insufficient attention to the theoretical and methodological foundations of its implementation in the context of health fitness classes.

Material and methods of research

Study Design

The research was conducted at the Department of Theory and Methodology of Physical Education of the Educational and Scientific Institute of Health of the National University of Water and Environmental Engineering.

Subjects

The study involved men aged 26–28 (n=16) and 29–31 (n=17). The studies were conducted in accordance with the requirements of the World Medical Association Declaration of Helsinki "Ethical Principles for Medical Research Involving Human Subjects".

Research methods. Analysis of literary sources. Pedagogical experiment At the stage of the ascertaining experiment, it was envisaged to study the parameters of body goniometry of the men involved in the experiment in the first period of mature age (33 people). Photography. Analysis of body goniometry of men in the first period of mature age. Recording of quantitative parameters of body goniometry of men in the first period of mature age is possible using a digital video camera connected to a personal computer with the loaded program "Torso" (Kashuba et al. 2018). The video recording process involves meeting these most important biomechanical requirements (Kashuba et al. 2018). To process a goniometry photogram of the body of men in the first period of adulthood, it is advisable to use the Torso program (Kashuba et al. 2018), which involves setting three angular characteristics, namely: α_1 - the angle of inclination of the head, forming a vertical and a line, the

spinous process of the seventh cervical vertebra C_7 and center of mass (CM) of the head; α_2 – the angle of view formed by the horizontal and the line connecting the most prominent part of the frontal bone and the chin protrusion; α_3 – the angle of inclination of the body formed by the vertical and the line connecting the spinous process of the seventh cervical vertebra (C_7) (the part of the spine that is most prominent at the junction of the cervical and thoracic regions) and the spinous process of the fifth transverse vertebra (L_5) (the most lordically deepened mark of the transverse lordosis (the center of the somatic coordinate system).

Statistical data analysis

In our study, we used a wide range of mathematical statistics methods (Kashuba et al. 2020). Below is a description of the main methods used in our study.

Initial statistics. It included the calculation of mean values, medians, modes of distributions, determination of minimum and maximum values, standard deviations, which made it possible to obtain a general picture of the initial level of goniometry of men aged 26-31 years.

Normality check. Frequency distribution graphs were analyzed for visual assessment and detection of possible deviations from normal distribution. For a deeper understanding of data distribution, different measures of central tendency were compared: arithmetic means, medians, modes. Variation coefficients were used to assess the relative variability of data, which allowed comparing distributions with normal, for which the V index is approximately 33,3%. Also, to check the normality of data distribution, asymmetry and excess were calculated. The first indicator showed the level of symmetry of data distribution, the second characterized the "sharpness" or "flatness" of the distribution compared to normal. Finally, the Shapiro-Wilk criterion was used for formal testing of data distribution for normality.

Methods of group comparison. From this category, the method of comparison with similar studies (Student's one-sample t-coefficient and Wilcoxon's one-sample signed-rank test) was applied, which made it possible to identify the characteristics of the studied samples. In addition, to assess the differences in physical development, body goniometry and physical qualities of men aged 26-28 and 29-31, methods of comparing independent samples were used using Student's t-test for independent samples and Mann-Whitney U-test.

These calculations were performed using the IBM SPSS Statistics 21 statistical package.

The purpose of the study was to determine the distinctive features of the goniometric body profile of men aged 26-31 years old engaged in health-improving fitness.

Results of the study

The study also examined the features of body goniometry in men aged 26-31, the results of which we first assessed for normality. If we study the constructed histograms of frequency distributions, we can see that the frequency distribution of the angle α_1 between the vertical and the line connecting the spinous process of the C_7 vertebra and the CM of the head in the group of men aged 26-28 was symmetrical, close to normal, between 30 and 31 degrees with a peak in the center equal to 31 degrees.

The distribution of the angle α_2 between the horizontal and the line connecting the most prominent point of the frontal bone and the protrusion of the chin appeared asymmetrical, with a right-hand shift, the values had a longer right tail, indicating a deviation from the normal distribution. Most of the results were concentrated between 89 and 90 degrees, and 90 degrees was measured most often. For the angle α_3 between the vertical and the line connecting the spinous processes of the C_7 and L_5 vertebrae, the distribution by shape deviated from the normal, the bulk of the values were concentrated between 2,9 and 3 degrees, the peak at point 3.

Thus, the frequency distributions of goniometric indices of men aged 29-31 years more

often resemble a normal distribution compared to men aged 26-28 years, especially for angles α_2 and α_3.

Let us consider the main indices of central tendency, variability and other characteristics of the distribution of goniometric indices in groups of men aged 26-28 years and 29-31 years (Table 1).

The table shows that in both groups the medians and modes are close to the average values, the asymmetry and excess values by module are less than critical, which indicates the normality of the distribution for this indicator. However, certain doubts that arose on the basis of the analysis of frequency histograms entailed the need to turn to the Shapiro-Wilk criterion. The results of the corresponding test showed that only the distributions of the angle α_3 was consistent with the normal ones (W_{26-28}=0,929; W_{29-31}=0,897). Therefore, we will characterize it only by means of average values and standard deviations and compare groups using Student's t-test. The other two angles will be analyzed by quartiles of distributions, and nonparametric criteria will be used to assess the reliability of differences.

Table 1. Primary statistics of distributions of body goniometry characteristics in groups of men aged 26-28 (n=16) and 29-31 (n=17)

Goniometric indicators	Groups	Primary statistics						
		$\bar{x}$	Me	Mo	s	V	A	E
Angle α_1, degrees	26-28 years old	30,19	30	31	0,91	3,02	-1,019	0,629
	29-31 years old	29,88	30	29	0,86	2,87	0,245	-1,628
Angle α_2, degrees	26-28 years old	89,50	90	90	0,82	0,91	-0,420	-0,122
	29-31 years old	89,29	89	89	0,77	0,86	0,333	0,293
Angle α_3, degrees	26-28 years old	2,91	2,9	3	0,14	4,78	-0,638	0,091
	29-31 years old	2,92	2,9	3	0,11	3,68	-0,392	-0,624

Notes: 1. Angle α_1 is the angle formed by the vertical and the line connecting the spinous process of the C_{7I} vertebra and the CM of the head; Angle α_2 is the angle formed by the horizontal and the line connecting the most protruding point of the frontal bone and the protrusion of the chin; Angle α_3 is the angle formed by the vertical and the line connecting the spinous processes of the C_7 and L_5 vertebrae.

2. $\bar{x}$ – arithmetic mean; Me – median; Mo – mode; s – standard deviation; V – coefficient of variation; A – asymmetry; E – excess.

3. The distribution is close to normal if A and E are less than such critical values in absolute value: A_{cr} (16) = 1,199; A_{cr} (17) = 1,165; E_{cr}(16) = 2,401; E_{cr}(17) = 2,329.

Then the results of our study showed that, in general, men aged 26-31 years at the ascertaining stage of the study had the following angular characteristics of the biogeometric profile of posture: the value of the angle α_1 belonged to the range from 28 to 31 degrees with a median of 30 degrees and an interval between the first and third quartiles - from 29 to 30 degrees. If we compare the obtained angle values with the norms determined by V. Kashuba (2018) (30,93 degrees), we can say that our median does not reach the lower limit of the norm, and therefore the position of the head of men has a less than normal tilt. Checking the deviation from the norm using the one-sample Wilcoxon test showed that the deviation of the median was 1 degree and it was statistically significant (Z=-4,112; p<0,001).

Regarding the angle α_2, the data were distributed in the range from 88 to 91 degrees, the median was 89 degrees, and the values of the first

and third quartiles covered the range of 89-90 degrees. Compared with the normative value (89,61 degrees), our median was relatively close to it. However, it turned out to be slightly less than the norm, since according to the Wilcoxon criterion, the difference was at the level of the tendency to underestimated values (Z=-2,408; p<0,05).

The results for the α_3 angle was distributed from 2,6 to 3,1 degrees, the mean value was 2,91 degrees, and the standard deviation was 0,12 degrees. Accordingly, the variation coefficient was small (V = 4,12%). Compared with the norm (2,05 degrees), these values were too large, indicating deviations in the position of the spine. The use of one-sample t statistics confirmed that the difference of 0.86 degrees in this case is significant (t = 40,64; p <0,0001). These data show that all goniometric indicators were different from the norm, indicating an incorrect head tilt and excessive flexion of the spine.

The study of the angular characteristics of the sagittal profile of posture in the male subjects of the two compared groups showed that angle α_1 formed by the vertical and the line connecting the spinous process of the C_7 vertebra and the center of mass of the head in both groups was approximately 30 degrees (Me=30), that is, most of the subjects were characterized by the same changes in the position of the head, which indicated possible disturbances in the spatial organization of the body. Angle α_2 formed by the horizontal and the line, the protrusion of the frontal bone and the chin protrusion in men aged 26-28 years according to the median was slightly larger than the norm (Me=90), and in men aged 29-31 years, it did not reach the normative value (Me=89), and this fact indicates possible differences between the groups.

An examination of the results of measuring the angle α_3 formed by the vertical and the line connecting the spinous processes of the vertebrae C_7 and L_5 did not reveal any significant differences between the mean values, since in both groups they were 2,9 degrees, which demonstrated an increase in this angle. with the norm, and therefore a tendency to functional disorders of posture. However, if we visually depict the average profiles of the angular characteristics of the body in these groups, we can see that in both groups there is an identical tendency to vary the data with centers below the medians in the overall sample.

It was found that the groups of men aged 26-28 and 29-31 differed in two of the three goniometric characteristics, i.e. in the angles α_1 and α_2, the profile points of which in men aged 26-28 are located above the corresponding marks on the profile of men aged 29-31. It is also obvious that there was no significant difference in the angles α_3 between the groups. However, we should pay attention to the fact that all the average values of the calculated percentiles in both groups are located below the median line, i.e. the visualized distances in size are small. Therefore, it is necessary to apply appropriate statistical tests to compare the two groups for each of the goniometric characteristics. The results of their implementation are presented in Table 2.

The data in the table show that there are no statistically significant differences in the measured goniometric indices between men in the 26–28 and 29–31 age groups. The values of these angles are similar for these two groups, and the age factor does not affect their values. That is, the position of the head, frontal bone, and spine in men in the period from 26 to 31 years remains stable.

This conclusion is quite understandable, since in the first period of mature age the main physiological changes of the body are completed and the organism is in a state of stability. And considering the fact that the age difference between the members of the groups is small, this is not enough for the manifestation of significant changes associated with age-related changes.

Table 2. Differences in body goniometry characteristics of men aged 26–28 and 29–31

Groups	Statistical indicators	Goniometric indicators		
		Angle α_1, degrees	Angle α_2, degrees	Angle α_3, degrees
26-28 years old (n=16)	$\bar{x}$	30,2	89,5	2,91
	s	0,91	0,82	0,14
	Me	30	90	2,9
	25%	30	89	2,8
	75%	31	90	3
29 – 31 years old (n=17)	$\bar{x}$	29,9	89,3	2,92
	s	0,86	0,77	0,11
	Me	30	89	2,9
	25%	29	89	2,8
	75%	31	90	3,0
Reliability of differences	t	-	-	0,265
	U	108,5	113	-
	p	p>0,05	p>0,05	p>0,05

Notes: 1. Angle α_1 is the angle formed by the vertical and the line connecting the spinous process of the C_{7I} vertebra and the CM of the head; Angle α_2 is the angle formed by the horizontal and the line connecting the most protruding point of the frontal bone and the protrusion of the chin; Angle α_3 is the angle formed by the vertical and the line connecting the spinous processes of the C_7 and L_5 vertebrae.

2. $\bar{x}$ – arithmetic mean; s – standard deviation Me, 25%, 75% – median and quartiles of distribution; t – value of Student's t-test; U – value of Mann-Whitney test; r – level of significance of differences.

3. Differences are statistically significant if U is less than critical value U_{cr} (16;17; 0,05) = 81, and t exceeds the critical value t_{cr}(31; 0,05)=2,04.

Discussion.

The findings of a wide range of scientific studies (Vatamanyuk et al. 2021; Kashuba et al. 2022) suggest that men first encounter health problems during the first period of mature age. Despite this, at this age, they maintain a high level of training of motor functions, have favorable prerequisites for achieving high results in the field of not only health, but also sports (Grigus et al. 2024).

Recent studies show that regular moderate physical activity has a stimulating and strengthening effect on the condition of the musculoskeletal system (Kashuba et al. 2021; Asaulyuk et al. 2023). Modern research in the field of biomechanics of posture has accumulated a large amount of scientific and methodological material (Kashuba et al. 2018; Hakman et al. 2021) about the main structural, metabolic and functional changes during ontogenesis. The results of the authors' study supplemented the data of specialists (Kashuba et al. 2018; Hakman et al. 2021; Vatamanyuk et al. 2021;) on the features of body goniometry in mature adults.

Conclusions. It was found that all the studied goniometric characteristics of men aged 26-31 have significant differences from the norm, indicating an incorrect head tilt (angle α_1 is less than the norm), excessive flexion of the spine (angle α_3 is greater than the norm), which indicates a systemic violation of the biogeometric state of posture, requiring correction. It was also found that there were no significant differences in the body goniometry of men aged 26-28 and 29-31. Therefore, the development and implementation of special programs for the correction of posture disorders aimed at correcting the tilt of the head and reducing excessive flexion of the spine,

maintaining normal body weight, taking into account the individual characteristics of anthropometric indicators for the development of personalized training programs and the correction of violations of the biogeometric parameters of posture are quite capable of improving the physical development indicators of men in the first period of mature age.

Author's contribution

Conceptualization, I. G.; methodology, I. G.; software, M.D.; check, M.D.; formal analysis, I. G.; investigation, M.D.; re-sources, V. R.; data curation, V. R.; writing – rough preparation, V. R.; writing – review and editing, V. R.; visualization, V. R.; supervision, M.D.; project administration, M.D. All authors have read and agreed with the published version of the manuscript.

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References

Asaulyuk I., Afanasyev S., Kozlovska S., Marinchuk P. (2023). The current state puts a special emphasis on the mature age, as a change of mind in the development of preventive health care. Physical culture, sports and the health of the nation. №.15 (34). P.394-405. https://doi.org/10.31652/2071-5285-2023-15(34)-394-405

Asaulyuk I., Nosova N., Demjokhin D., Pokropivny O., Marinchuk P. (2023). Set biomechanics as a criterion for differentiation in the process of physical culture and sports rehabilitation. *Physical culture, sports and the health of the nation.* №. 15 (34). pp. 406-420. https://doi.org/10.31652/2071-5285-2023-15(34)-406-420

Correction of physical rights of people in the process of taking physical rights: theoretical and practical aspects/ (2022). [Text]: count. monograph / for science ed. A. I. Aloshinoj, I. P. Vipasnyaka, V. O. Kashubi. Lutsk: Vezha-Druk, 536 p.

Grigus I., Dolishniy M. (2024). Social-pedagogical profile and motivation of people 26–31 years old to engage in healthy fitness. *Physical culture, sports and the health of the nation.* №. 17(36). pp. 40-53. https://doi.org/10.31652/2071-5285-2024-17(36)

Hakman A., Andrieieva O., Kashuba V., Nakonechnyi I., Cherednichenko S., Khrypko I., Tomilina Yu., Filak F. (2020). Characteristics of Biogeometric Profile of Posture and Quality of Life of Students During the Process of Physical Education. *Journal of Physical Education and Sport.* 20(1), pp. 79-85. https://doi.org/10.7752/jpes.2020.01010

Kashuba V., Grigus I., Rudenko Y. (2023). The state of spacious organization of the body in a mature age: a current publication. Influence of physical culture and sports on the formation of an individual healthy lifestyle: scientific monograph. Riga, Latvia: Baltija Publishing. pp. 56–68. https://doi.org/30525/978-9934-26-280-7-3

Kashuba V., Khmelnitska I., Andrieieva O., et al. (2021). Biogeometric Profile of the Posture as a Factor of Men's Functional Assessment of Movements in the Early Middle Age. *Sport Mont.* №. 19(2). pp. 35-39.

Kashuba V., Rudenko Y., Khabynets T., Nosova N. Use of correctional technologies in the process of health-recreational fitness training by men with impaired biogeometric profile of posture. *Pedagogy and Psychology of Sport.* (2020). №. 6(4): pp. 45-55. elSSN 2450-6605. http://dx.doi.org/10.12775/PPS.2020.06.04.005

Kashuba V., Stepanenko O., Byshevets N., Kharchuk O., Savliuk S., Bukhovets B., Grygus I., Napierała M., Skaliy T., Hagner-Derengowska M., Zukow, W. (2020). Formation of Human Movement and Sports Skills in Processing Sports-pedagogical and Biomedical Data in Masters of Sports. *International Journal of Human Movement and Sports Sciences*, 8(5), 249-257. https://doi.org/10.13189/saj.2020.080513/

Kashuba V., Vatamanyuk S., Khabinets T. (2022). Assessment will put people in the first period of adulthood who engage in healthy fitness. *Bulletin of the Carpathian University.* Series: Physical culture. №. 38. pp. 22-34. https://doi.org/10.15330/fcult.1.59-68

Kashuba V.O., Lopatsky S.V. (2018). Theoretical and practical aspects of monitoring the spatial organization of the human body. Ivano-Frankivsk: Vidavets Kushnir G. M.; 232 p.

Rudenko Y., Litvinenko Y., Khabinets T., Domashenko N., Vatamanyuk S., Sobotyuk S. (2019). A range of health-

conscious knowledge of mature people who engage in healthy fitness. News of Prykarpattia. un-tu. Series: Physical culture. №. 34. pp. 33-39. https://doi.org/10.15330/fcult.34.33-39

Stopa M. (2024). Features of the spatial organization of the body of women 23-26 years old. *Physical culture, sports and the health of the nation.* №. 17 (36). pp. 406-420. https://doi.org/10.31652/2071-5285-2023-15(34)-406-420

Vatamanyuk S. (2021). Features of the spatial organization of the body of people in the first period of adulthood who engage in healthy fitness. *Sports newsletter of the Dnieper region.* №. (2). pp. 18-24. https://doi.org/10.32540/2071-1476-2021-2-018

Vatamanyuk S.V., Khabinets T.O., Dovgal V.I., Kedrich G.V., Sirotyuk S.M. (2021). Characteristics of physical development and physical preparedness of people 26–35 years from different types of activities involved in healthy fitness. Rehabilitation and sports and recreational aspects of human development. №. (9). pp. 29-36. https://doi.org/10.32782/2522-1795.2021.9.44

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