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Establishing of Upper Extremities Length of Students of Higher Education Institutions of Bukovyna Depending on the Sport Type

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The purpose of the study was to establish of upper limbs length of students of higher educational institutions of Bukovyna depending on the sport type with the further construction of forecasting model.

Materials and methods. The research was conducted on 132 students of the first and second years of higher education institutions of Bukovyna aged from 16 to 18. Of them, 86 (65.15%) were boys and 46 (34.85%) girls. The main group consisted of 92 (69.70%) students and the control group – 40 (30.30%) students. Among the students of the main group, there are 65 (70.65%) boys and 27 (29.35%) girls. The control group consisted of 21 (52.5%) boys and 19 (47.5%) girls.

Students of the main group were engaged in the following sport types: football, volleyball, handball, basketball. Students of the control group did not additionally do sports, except for hours of physical education, in accordance with the curriculum. All students were subjected to an anthropometric study according to the method of V. V. Bunak modified by P. P. Shaparenko. Anthropometric examination included determination of total and partial parameters.

Results and discussion. According to the results of the study, that included the distribution of the length of the right and left upper limbs for gender, there was a significant difference in the average length of young boys and young girls in the main group. This is also evidenced by Welch's t-test: $t(49.3) = -7.253$, $p < 0.05$. The result of the distribution of the length of the right and left upper limbs in the control group for gender also indicates that there was a significant difference in the length of the upper limb of young boys and young girls of the control group on average. This was also confirmed by Welch's t-test: $t(25.971) = -5.670$, $p < 0.05$ (right upper extremity) and $t(26.175) = -5.754$, $p < 0.05$ (left upper extremity). Taking into account the results of the distribution of the lengths of the upper limbs depending on the sport type, it shows that there was a significant difference in the average value of the length depending on the sport type. Since $p = 0.25 < 0.05$, the difference

between the medians of the groups is statistically significant. When comparing the lengths of both upper limbs of the studied young boys and young girls, no significant difference in the average length of the right and left upper limbs was found $t(255.92) = -0.172$, $p = 0.864$.

Conclusion. By comparing the length of the right and left upper limbs of the studied students of the main group, depending on the sport type, there was a significant difference in the average value (football players have the smallest length of the upper limbs: right – 69.77 ± 2.0 cm, of them 70.39 ± 2.00 cm in young boys and 67.90 ± 2.00 cm in young girls, left – 70.28 ± 2.0 cm, of them 71.41 ± 2.00 cm in young boys and 68.72 ± 2.00 cm in young girls, while volleyball players have the largest: right – 76.20 ± 2.0 cm, of them 77.32 ± 2.00 cm in young boys and 74.22 ± 2.00 cm in young girls, and left – 77.00 ± 2.0 cm, of them 78.43 ± 2.00 cm in young boys and 75.92 ± 2.00 cm in young girls). A significant factor for the length of both upper limbs is height. A model for predicting the length of the upper limbs was derived: $y = 0.422 * x$, (where y – the length of the right upper limb, x – height).

Keywords: students, anthropometric parameters, upper extremities length.

Connection of the study with scientific programs, plans, topics. The work is a fragment of the planned complex research work of the Department of Anatomy, Clinical Anatomy and Operative Surgery and the M. G. Turkevich Department of Human Anatomy of the Bukovynian State Medical University "Regularities of sex-age structure and topographic-anatomical transformations of organs and structures of the body at the pre- and postnatal stages of ontogenesis. Peculiarities of perinatal anatomy and embryotopography". State registration number of the study is 0120U101571.

Introduction. An important indicator of the adaptation of the athlete's body to the external conditions of the environment is the state of physical and mental

health [1-3]. In order to assess the state of health of an individual, it is necessary to have an idea of those indicators that can be considered normal for him/her. Anthropometric parameters characterizing the athlete's physical development, the intensity of growth processes, and the level of morphofunctional maturity are essential for assessing the state of health at any age [4-8].

One of the means of studying an athlete's state of health is the assessment of anthropometric parameters with the determination of overall and component indicators. In addition, these standards require periodic renewal due to acceleration processes occurring in society, especially among future athletes [9-12].

Therefore, the establishment of anthropometric parameters depending on the type of sport is a current issue in modern sports and requires further study in order to solve the issue of sports orientation and professional selection of future athletes [13-17].

The purpose of the study was to establish the upper limbs length of students of higher educational institutions of Bukovyna depending on the sport type with the further construction of forecasting model.

Materials and methods. The research was conducted on 132 students of the first and second years of higher educational institutions of Bukovyna aged from 16 to 18. Of them, 86 (65.15%) were young boys and 46 (34.85%) – young girls. All studied young boys and young girls were divided into two groups: the main group consisted of 92 (69.70%) students and the control group – of 40 (30.30%) students. Among the students of the main group, there were 65 (70.65%) young boys and 27 (29.35%) young girls. The control group consisted of 21 (52.5%) young boys and 19 (47.5%) young girls.

Conducting the research does not contradict the norms of Ukrainian legislation and meets the requirements of the Law of Ukraine "On Scientific and Scientific-Technical Activities" dated November 26, 2015 No. 848-VIII. Each participant signed an informed consent to participate in the study, and every effort was made to ensure participant anonymity.

Students of the main group were engaged in the following sports: football players – 46 (50.00%), of them 38 (41.30%) were young boys and 8 (8.70%) were young girls; volleyball players – 19 (20.65%), of them 10 (10.86%) young boys and 9 (9.78%) young girls; handball players – 14 (15.21%), of them 8 (8.69%) young boys and 6 (6.52%) young girls; basketball players – 13 (14.14%), of them 9 (9.78%) young boys and 4 (4.43%) young girls. Students of the control group did not additionally do sports, except for hours of physical education, in accordance with the curriculum.

The height of the studied students of the main group: young girls – 173.92 ± 2.03 cm, young boys –

179.98 ± 2.03 cm. Basketball players were 180.00 ± 2.03 cm high, of them 182.85 ± 2.03 cm – young boys and 178.10 ± 2.03 cm – young girls; volleyball players – 178.94 ± 2.03 cm, of them 179.32 ± 2.03 cm – young boys and 177.22 ± 2.03 cm – young girls; football players – 176.87 ± 2.03 cm, of them 176.87 ± 2.03 cm – young boys and 171.51 ± 2.03 cm – young girls; handball players – 175.30 ± 2.03 cm, of them 174.82 ± 2.03 cm – young boys and 174.15 ± 2.03 cm – young girls. The height of students of the control group was 172.25 ± 2.03 cm, of them 179.47 ± 2.03 cm – young boys and 164.26 ± 2.03 cm – young girls.

The length of the right upper limbs of the studied students of the main group: volleyball players – 76.20 ± 2.0 cm, of them 77.32 ± 2.00 cm – in young boys and 74.22 ± 2.00 cm – in young girls; basketball players – 74.85 ± 2.0 cm, of them 75.35 ± 2.00 cm – young boys and 73.28 ± 2.00 cm – young girls; handball players – 74.60 ± 2.0 cm, of them 76.87 ± 2.00 cm – young boys and 75.83 ± 2.00 cm – young girls; football players – 69.77 ± 2.0 cm, of them 70.39 ± 2.00 cm – young boys and 67.90 ± 2.00 cm – young girls. The average length of the right upper limbs of students in the control group is 73.30 ± 2.0 cm, of them 74.54 ± 2.00 cm – young boys and 71.20 ± 2.00 cm – young girls.

The length of the left upper limbs of the studied students of the main group was: volleyball players – 77.00 ± 2.0 cm, of them 78.43 ± 2.00 cm – young boys and 75.92 ± 2.00 cm – young girls; basketball players – 74.92 ± 2.0 cm, of them 75.30 ± 2.00 cm – young boys and 74.12 ± 2.00 cm – young girls; handball players – 74.50 ± 2.0 cm, of them 76.55 ± 2.00 cm – young boys and 75.82 ± 2.00 cm – young girls; football players – 70.28 ± 2.0 cm, of them 71.41 ± 2.00 cm – young boys and 68.72 ± 2.00 cm – young girls. The average length of the left upper limbs of students of the control group is 73.30 ± 2.0 cm, of them 74.15 ± 2.00 cm – young boys and 71.98 ± 2.00 cm – young girls.

All students were subjected to an anthropometric study, according to the method of V. V. Bunaka in the modification of P. P. Shaparenka [18]. Anthropometric examination included determination of total (height) and partial (upper limbs length) parameters.

A vertical height gauge was used to measure height. The length of the upper limbs was determined between two points: the upper point (shoulder) is located within the deltoid area and corresponds to the point located on the surface of the suprahumeral process of the scapula, the lower point corresponds to the finger point, which is located on the hump of the head of the terminal phalanx of the third finger. This is a line that connects two points and passes through a spike-like radial point [18].

The Welch test was used to distribute the length of the upper limbs in both groups by gender. When distributing the length of the upper limbs of students of the main group by sport, the Kruskal-Wallis test (non-parametric ANOVA) was used to identify a significant difference in the average length of the upper limbs depending on the sport [19]. To establish for which pairs of age groups there is a statistical difference in the medians, the Conover-Iman test was used [20].

Statistical analysis of the obtained data was carried out using the licensed program RStudio.

Research results. For the results of the study, which included the distribution of the length of the right upper limb by gender in the main group (Fig. 1), it is obvious that there is a significant difference in the length of the right upper limb of young boys and young girls of the main group on average. This is also evidenced by Welch's t-test: $t(49.3) = -7.253$, $p < 0.05$.

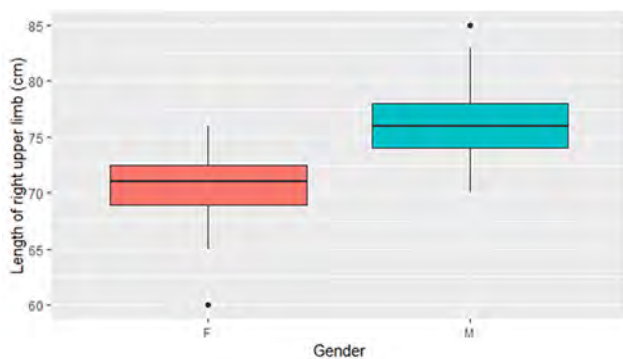


Fig. 1 – Distribution of the length of the right upper limb of respondents of the main group by gender

For the results of the distribution of the length of the right upper limb in the control group by gender indicates that there is also a significant difference in the length of the right upper limb of young boys and young girls of the control group on average. This is also evidenced by Welch's t-test: $t(25.971) = -5.670$, $p < 0.05$ (Fig. 2).

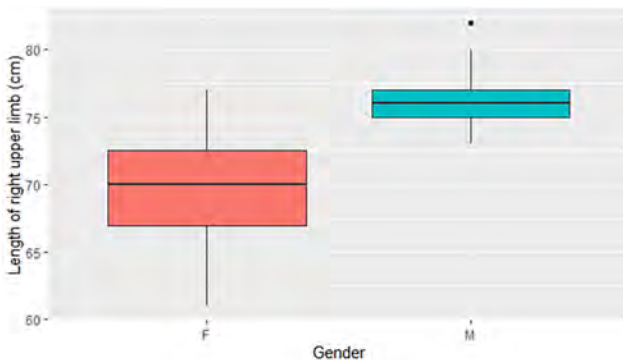


Fig. 2. – Distribution of the length of the right upper limb of respondents of the control group by gender

For the results of the distribution of the length of the right upper limb of the students of the main group according to the sport type, it is obvious that there is a significant difference in the average value of the length of the right upper limb depending on the sport type, taking into account the control group as well.

Kruskal-Wallis test results were ($\chi^2(6) = 13.592$, $p = 0.035$). Since $p = 0.035 < 0.05$, the difference between the group medians is statistically significant.

Let's establish for which pairs of age groups there is a statistical difference in the medians. To do this, we will conduct the Conover-Iman test. As a result, the length of the right upper limb of those respondents whose sport is football differs significantly from all others. No significant differences were found for other groups.

The distribution of the length of the left upper limb in the main group by gender shows that there is a significant difference in the length of the left upper limb of young boys and young girls on average. This is also evidenced by Welch's t-test: $t(49.3) = -7.253$, $p < 0.05$ (Fig. 3).

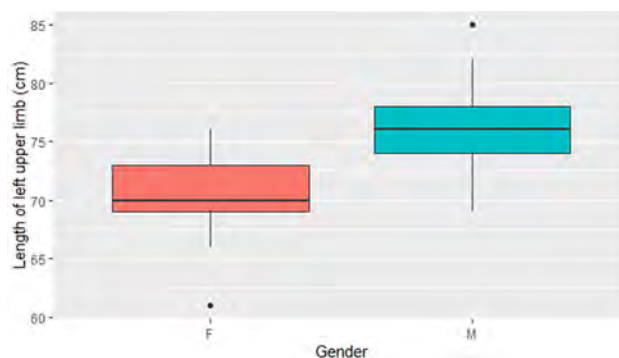


Fig. 3 – Distribution of the length of the left upper limb of respondents of the main group by gender

The distribution of the length of the left upper limb in the control group by gender shows that there is a significant difference in the length of the left upper limb of young boys and young girls on average. This is also evidenced by Welch's t-test: $t(26.175) = -5.754$, $p < 0.05$ (Fig. 4).

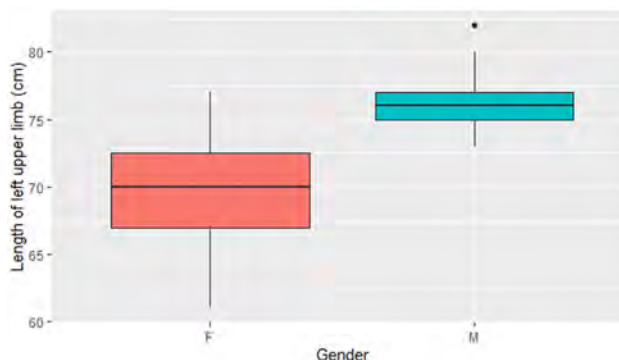


Fig. 4 – Distribution of the length of the left upper limb of respondents of the control group by gender

Let's establish for which pairs of age groups there is a statistical difference in the medians. To do this, we will conduct the Conover-Iman test.

So, the length of the left upper limb of those respondents whose sport is football is significantly different from all others. No significant differences were found for other groups.

Discussion of research results. So, the length of the upper limbs can have a significant impact on sports selection and sports orientation. There are almost no works devoted specifically to the study of partial parameters, namely the length of the upper limbs for sports belonging. Taking into account the scientific achievements of authors such as Sara Jane Cullen et al. (2022), who studied the anthropometric profiles of elite athletes and concluded that there are differences in anthropometric profiles between different athletes and different sports type, which emphasizes the need to have available normative ranges for specific types of sports to ensure optimal monitoring of individual athletes, which are particularly distinct between sports, as well as age and training [1].

Our obtained data show that there is a significant difference in the length of the right upper limb of young boys and young girls of the main and control groups on average (**Fig. 1, 2**).

The conducted regression analysis shows that height is a significant factor for the length of the right upper limb.

The model for predicting the length of the upper limb is $y = 0.422 * x$, where y is the length of the upper limb, x – height. The coefficient of determination is 0.999.

The distribution of the length of the left upper limb in the main and control groups by gender showed that there is also a significant difference in the length of the left upper limb of young boys and young girls on average (**Fig. 3, 4**).

The conducted regression analysis shows that height is a significant factor for the length of the left upper limb [19].

The model for predicting the length of the left upper limb is $y = 0.422 * x$, where y is the length of the left upper limb, x is the height. The coefficient of determination is 0.999.

Considering the results of the distribution of the lengths of the upper limbs depending on the type of sport, it shows that there is a significant difference in the mean value depending on the sport type. Since $p = 0.25 < 0.05$, the difference between the medians of the groups is statistically significant [19].

The result of the Conover-Iman test significantly differs from all other lengths of upper limbs of football players [20].

When comparing the lengths of both upper limbs of the studied young boys and young girls, no significant difference in the average length of the right and left upper limbs was found $t(255.92) = -0.172$, $p = 0.864$.

Conclusion

1. A comparison of the length of the right and left upper limbs of young boys and young girls shows that on average there is a difference among the studied students of both groups (for young boys the length of the upper limbs is greater by ± 2.0 cm in the control and by ± 3.50 cm in the main groups).

By comparing the length of the right and left upper limbs of the studied students of the main group, depending on the sport type, there is a significant difference in the average value (football players have the least length of the upper limbs: the right – 69.77 ± 2.0 cm, of them 70.39 ± 2.00 cm – in young boys and 67.90 ± 2.00 cm – in young girls, left – 70.28 ± 2.0 cm, of them 71.41 ± 2.00 cm – in young boys and 68.72 ± 2.00 cm – in young girls, while volleyball players have the largest: the right – 76.20 ± 2.0 cm, of them 77.32 ± 2.00 cm – in young boys and 74.22 ± 2.00 cm – in young girls, and the left – 77.00 ± 2.0 cm, of them 78.43 ± 2.00 cm – in young boys and 75.92 ± 2.00 cm – in young girls).

2. There was no significant difference in the average length of the right and left upper limbs of both studied groups (main group: right – 73.89 ± 2.0 cm, of them in young boys – 74.98 ± 2.0 cm, in young girls – 72.80 ; control group – 73.30 ± 2.0 cm, of them in young boys – 74.54 ± 2.0 cm, in young girls – 72.80 ; left – 73.89 ± 2.0 cm, of them in young boys – 75.42 ± 2.0 cm, in young girls – 73.64 ; control group – 73.30 ± 2.0 cm, of them young boys – 74.15 ± 2.0 cm, young girls – 71.98).
3. A significant factor for the length of both upper limbs is height (based on the conducted regression analysis).
4. The model for predicting the length of the upper limbs is derived as: $y = 0.422 * x$, (where y is the length of the right upper limb, x – height).

Perspectives of further research. Further study of anthropometric parameters of students will be devoted to solving problems of sports selection and sports orientation.

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**ВСТАНОВЛЕННЯ ДОВЖИНИ ВЕРХНІХ КІНЦІВОК У СТУДЕНТІВ
ЗАКЛАДІВ ВИЩОЇ ОСВІТИ БУКОВИНИ ЗАЛЕЖНО ВІД ВИДУ СПОРТУ****Каратєєва С. Ю., Слободян О. М., Слободян К. В., Музика Н. Я.**

Резюме. Мета дослідження – встановити довжину верхніх кінцівок студентів вищих навчальних закладів Буковини залежно від виду спорту з наступною побудовою моделі прогнозування.

Матеріали та методи. Проведено дослідження на 132 студентах першого та другого курсів вищих навчальних закладів Буковини віком від 16 до 18 років. З них 86 (65,15 %) юнаків та 46 (34,85 %) дівчат. Основну групу склали 92 (69,70 %) студентів та контрольну групу – 40 (30,30 %) студентів. Серед студентів основної групи – 65 (70,65 %) юнаків та 27 (29,35 %) дівчат. Контрольну групу склали 21 (52,5 %) юнак та 19 (47,5 %) дівчат. Студенти основної групи займалися такими видами спорту: футбол, волейбол, гандбол, баскетбол. Студенти контрольної групи додатково спортом не займалися, окрім годинами фізкультури, відповідно до навчальної програми. Усім студентам було проведено антропометричне дослідження, за методикою В.В. Бунака у модифікації П.П. Шапаренка [1]. Антропометричне обстеження містило у собі визначення тотальних (зріст) та парціальних (довжину верхніх кінцівок) параметрів.

Результати. За результатами проведеного дослідження, яке включало розподіл довжин правої та лівої верхньої кінцівки за гендером в основній групі є значима різниця довжин юнаків і дівчат в середньому. Про це також свідчить проведений t-тест Уелча: $t(49,3) = -7,253, p < 0.05$. Результат розподілу довжин правої та лівої верхніх кінцівок в контрольній групі за гендером теж вказує, що є значима різниця довжин верхньої кінцівки юнаків і дівчат контрольної групи в середньому. Про це також свідчить проведений t-тест Уелча: $t(25,971) = -5,670, p < 0.05$ (права верхня кінцівка) та $t(26,175) = -5,754, p < 0.05$ (ліва верхня кінцівка). Враховуючи результати розподілу довжин верхніх кінцівок залежно від виду спорту, показує, що є значима різниця середнього значення довжини залежно від виду спорту. Оскільки $p = 0,25 < 0,05$, то відмінність між медіанами груп є статистично значимою. В результаті проведеного тесту Коновера-Імана, значимо відрізняється від усіх інших довжина верхніх кінцівок футболістів. При порівнянні довжин обох верхніх кінцівок досліджуваних юнаків і дівчат значимої різниці середньої довжини правої і лівої верхніх кінцівок не виявлено $t(255,92) = -0,172, p = 0,864$.

Висновки. При порівнянні довжин правої та лівої верхніх кінцівок досліджуваних студентів основної групи, залежно від виду спорту є значима різниця середнього значення (футболісти мають найменшу довжину верхніх кінцівок: права – $69,77 \pm 2,0$ см, з них $70,39 \pm 2,00$ см у юнаків та $67,90 \pm 2,00$ см у дівчат, ліва – $70,28 \pm 2,0$ см, з них $71,41 \pm 2,00$ см у юнаків та $68,72 \pm 2,00$ см у дівчат, в той час, як волейболісти мають найбільшу: права – $76,20 \pm 2,0$ см, з них $77,32 \pm 2,00$ см у юнаків та $74,22 \pm 2,00$ см у дівчат та ліва – $77,00 \pm 2,0$ см, з них $78,43 \pm 2,00$ см у юнаків та $75,92 \pm 2,00$ см у дівчат). Значимим фактором для довжини обох верхніх кінцівок є зріст (на основі проведеного регресійного аналізу). Виведено модель для прогнозування довжини верхніх кінцівок: $y = 0,422 * x$, (де y – довжина правої верхньої кінцівки, x – зріст).

Ключові слова: студенти, антропометричні параметри, довжина верхніх кінцівок.

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