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REGRESSION MODELS OF THE UPPER RESPIRATORY AREA IN YOUNG WOMEN AND YOUNG MEN WITHOUT AND TAKING INTO ACCOUNT THE TYPE OF FACE IN DEPENDENCE ON TELEROENTGENOMETRIC INDICES

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In Ukrainian young women and young men with an orthognathic bite without and taking into account the type of face, reliable ($p<0.001$ in all cases) regression models of the area of the upper respiratory tract depending on the total complex of teleroentgenometric indices of the upper respiratory tract were constructed and analyzed. All models of the upper respiratory area in young women without taking into account the type of face, with very wide and wide face types and in young men without taking into account the type of face and with a wide face type depend on the determined total complex of teleroentgenometric indices of the upper respiratory tract by more than 50 % (respectively, R^2=from 0.894 to 0.918 in young women and R^2=0.905 and 0.917 in young men).

Key words: teleroentgenography, cephalometry, respiratory tract, modeling, young men, young women, orthognathic bite, facial types.

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РЕГРЕСІЙНІ МОДЕЛІ ПЛОЩІ ВЕРХНЬОЇ ДИХАЛЬНОЇ ДІЛЯНКИ У ДІВЧАТ ТА ЮНАКІВ БЕЗ І З УРАХУВАННЯМ ТИПУ ОБЛИЧЧЯ В ЗАЛЕЖНОСТІ ВІД ТЕЛЕРЕНТГЕНОМЕТРИЧНИХ ПОКАЗНИКІВ

В українських дівчат і юнаків із ортогнатичним прикусом без і з урахуванням типу обличчя побудовані та проведено аналіз достовірних ($p<0,001$ в усіх випадках) регресійних моделей площі верхньої дихальної ділянки в залежності від сумарного комплексу телерентгенометричних показників верхніх дихальних шляхів. Усі моделі площі верхньої дихальної ділянки у дівчат без урахування типу обличчя, з дуже широким і широким типами обличчя та в юнаків без урахування типу обличчя та з широким типом обличчя залежать від визначеного сумарного комплексу телерентгенометричних показників верхніх дихальних шляхів більше, ніж на 50 % (відповідно, R^2=від 0,894 до 0,918 у дівчат і R^2=0,905 і 0,917 в юнаків).

Ключові слова: телерентгенографія, цефалометрія, дихальні шляхи, моделювання, юнаки, дівчата, ортогнатичний прикус, типи обличчя.

The study is a fragment of the research project "Teleroentgenographic characteristics of the upper respiratory tract in practically healthy young people", state registration No. 0121U113152.

The respiratory tract is a complex and heterogeneous complex of anatomical structures that provide a number of critically necessary functions of the body, such as gas exchange, filtration, air heating, etc., but also a number of other equally important things in our time, such as speech. The upper respiratory tract as a component of this system is an example of the multi-stage interaction of several regulatory mechanisms at once. Thus, the muscles of the upper respiratory tract respond to changes in pressure in the respiratory tract. Some muscles, such as the genioglossus muscle, also receive signals from the brainstem in the presence of hypo- or hypercapnia. In addition, changes in the size of the respiratory tract are influenced by

lung volume, air temperature, and hormonal background [6]. This system is also sensitive to somatotypological features of the human body, such as increased body weight, obesity, retrognathia. All these factors can lead to an increase in the probability of the collapse of the upper respiratory tract, which is the primary link in the occurrence of pathological processes, among which obstructive sleep apnea is the most dangerous and widespread [5].

Taking into account a person's ethnicity, sex and other parameters plays an equally decisive role and is critical for establishing a norm [8]. It is a proven fact that there are differences in the indices of the upper respiratory tract in people of different nationalities, regions of countries, etc. [4, 10]. One of the ways to assess the parameters of the upper respiratory tract, which has found its wide application in clinical and theoretical medicine, is teleroentgenometric research. Despite the progress of modern technologies, research data confidently indicate that lateral cephalograms are in no way inferior in accuracy to data obtained by computer tomography [9].

Thus, the search for normative indices and relationships between teleroentgenometric parameters depending on the type of face, gender and age is a priority direction, which will allow us to better understand not only the ways of treating pathology, but also the causes of their occurrence.

The purpose of the study was the construction and analysis of regression models of the area of the upper respiratory tract in Ukrainian young women and young men with an orthognathic bite without and taking into account the type of face, depending on the total complex of teleroentgenometric indices of the upper respiratory tract.

Materials and methods. Primary lateral radiographs of 49 Ukrainian young men (YM) (aged 17 to 21 years) and 76 Ukrainian young women (YW) (aged 16 to 20 years) with an orthognathic bite and absence of upper respiratory tract pathology were taken from the research database Center and Department of Pediatric Dentistry National Pirogov Memorial Medical University, Vinnytsya. Teleradiographic examination of YM and YW (effective radiation dose up to 0.001 mSv) was carried out on the basis of the private dental clinic “Vinintermed” using a Veraviewepocs 3D Morita (Japan) dental cone-beam tomograph.

Committee on Bioethics of National Pirogov Memorial Medical University, Vinnytsya (protocol № 8 From 30.09.2021) found that the studies do not contradict the basic bioethical standards of the Declaration of Helsinki, the Council of Europe Convention on Human Rights and Biomedicine (1977), the relevant WHO regulations and laws of Ukraine.

Face types in YM and YW were determined using Garson's morphological index [1].

Cephalometric analysis of the upper respiratory tract (upper respiratory tract itself, hyoid bone and tongue) (Figs. 1, 2) was carried out using the licensed medical software OnyxCeph³™, version 3DPro (Image Instruments GmbH, Germany) and the diagnostic program “UniqCeph” (created at the National Pirogov Memorial Medical University, Vinnytsya).

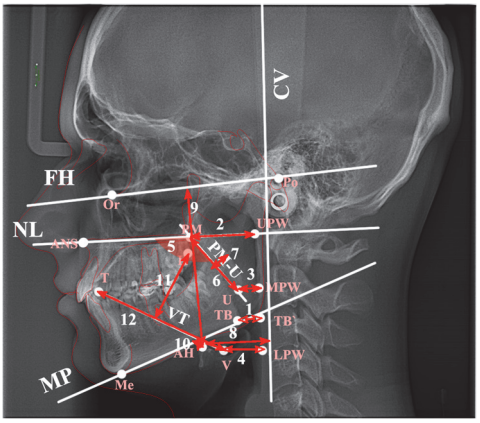

Fig. 1. Cephalometric linear and angular characteristics used in cephalometric examination of the upper respiratory tract. 1 – distance PASmin, 2 – distance PM-UPW, 3 – distance U-MPW, 4 – distance V-LPW, 5 – angle NL/PM-U, 6 – distance PM-U, 7 – distance SPT, 8 – distance AH-CV, 9 – AH-FH distance, 10 – AH-MP distance, 11 – H-VT distance, 12 – VT distance, CV – cervical plane; FH – Frankfurt plane; MP – mandibular plane; NL – nasal plane; PM-U – longitudinal axis of the soft palate; VT – longitudinal axis of the tongue.

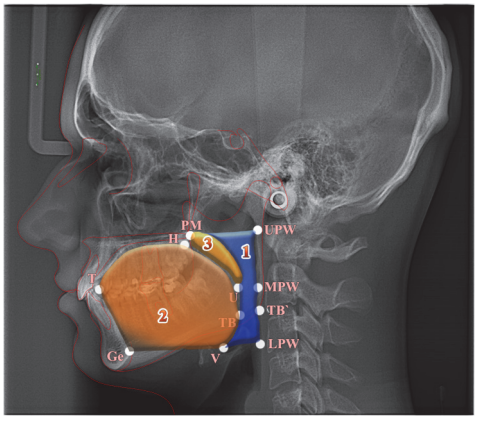

Fig. 2. Cephalometric characteristics of the area used in the cephalometric study of the upper respiratory tract. 1 – area UAA (area of the upper respiratory area), 2 – area TA (area of the tongue), 3 – area SPA (area of the soft palate).

Regression models of the area of the upper respiratory tract depending on teleroentgenometric indices of the upper respiratory tract were built using the license package "Statistica 6.0". When conducting

a step-by-step regression analysis, the following algorithm was followed: the coefficient of determination of the regression polynomial R^2 (indicates the dependence of the corresponding indicator on a set of other indices) should be at least 0.50; the value of Fisher's criterion (F-criterion) should exceed 3.0; the number of free members (Intercpt) in the equation should be minimal; simulations should be carried out under constant logical control to prevent equations based on random unclear connections.

Results of the study and their discussion. Given our established distribution of YW and YM by face types (YW – very wide face 25, wide face 25, medium face 10, narrow face 12; YM – very wide face 5, wide face 22, medium face 11, with a narrow face 8), modeling of teleroentgenometric indices of the area of the upper respiratory area in YW with medium and narrow face types, as well as in YM with very wide, medium and narrow face types was not performed.

Regression models constructed in Ukrainian YW and YM with an orthognathic bite have the form of the following linear equations:

– upper respiratory area *(YW without taking into account the type of face)* =-760.9 + 26.14×PASmin + 14.85×U-MPW + 9.208×AH-FH + 14.62×PM-UPW - 18.18×SPT (R^2=0.894, F(5.70)=118.3, p<0.001);

– upper respiratory area *(*YW with very wide face type*)* =-911.9 + 44.53×U-MPW + 18.32×PM-U + 6.737×AH-FH (R^2=0.898, F(3.21)=61.40, p<0.001);

– upper respiratory area (YW with a wide face type*)* =38.87 + 26.90×PASmin + 20.96×U-MPW + 5.786×AH-MP (R^2=0.918, F(3.21)=78.56, p<0.001);

– *upper respiratory area (*YM without taking into account the type of face*)* =-200.8 + 25.61×U-MPW + 21.87×V-LPW + 8.706×AH-MP + 15.21×PM-UPW - 28.95×SPT (R^2=0.905, F(5.70)=118.3, p<0.001);

– upper respiratory area *(*YM with a wide face type*)* =-447.7 + 37.14×V-LPW + 9.663×AH-MP + 17.22×U-MPW + 10.26×PM-UPW (R^2=0.917, F (4.17) =46.81, p<0.001);

where, the area of the upper respiratory tract – in mm^2; PASmin – distance known as Retroglossal oropharyngeal airway space (mm); U-MPW – distance known as Retropalatal oropharyngeal airway space (mm); AH-FH – distance known as Vertical position of the hyoid with respect to the Frankfort plane (mm); PM-UPW – distance known as Nasopharyngeal airway space (mm); SPT – distance known as Maximum soft palate thickness (mm); PM-U – distance known as Soft palate length (mm); AH-MP – distance known as Vertical position of the hyoid with respect to the mandible (mm); V-LPW – distance known as Hypopharyngeal airway space (mm); R^2 – coefficient of determination; F – Fisher's test; p-level – confidence level.

When analyzing the models of the upper respiratory area, it was established: in *YW*, regardless of face type, with very wide and wide face types, all reliable models were built (R^2=from 0.894 to 0.918; p<0.001 in all cases), which most often include the size of the retroglossal oropharyngeal space (27.3 % of all independent variables), the size of the glossopharyngeal space and the position of the hyoid bone relative to the vertical Frankfurt plane (18.2 % of all independent variables each); in *YM*, regardless of face type and with a wide face type, all reliable models were built (R^2=0.905 and 0.917; p<0.001 in both cases), which most often include the size of the nasopharyngeal space, the size of the retroglossal oropharyngeal space, the size of the lower oropharyngeal space, and the size of the position hyoid bone relative to the mandibular plane vertically (22.2 % of all independent variables).

The specific features of cephalometric indices for the population of the Podilia region of Ukraine have already been presented using the method of the Charles H. Tweed International Foundation. When performing this study, the team of authors established not only differences in indices between boys and girls, but also differences with standard indices, namely: the value of the FMA and POr_OcP angles and a larger value of the IMRA angle and a higher value of the PFH distance in boys and a smaller value of the AFH distance in girls [11].

The results of foreign research conducted in this direction are also reliable. Thus, the study of Mislik B. with co-authors [12] is noteworthy regarding the influence of age on cephalometric parameters of the upper respiratory tract. They revealed the effect of age on changes in the shortest distance between the soft palate and the back wall of the pharynx (p=0.034) when analyzing 880 cephalograms of boys and girls aged 6-17 years who had no history of dental or surgical interventions.

Cephalograms of 45 individuals with different facial types (brachyfacial, mesofacial, and dolichofacial) were examined for upper respiratory tract indices. As a result of statistical data processing, a statistically significant difference between the groups was established for the measurement of the median posterior-palatal space between the brachyfacial and dolichofacial groups. At the same time, no statistically significant difference was found for other indices [15].

The same trends are observed in relation to the skeletal class of the face. Individuals with class II had statistically significant differences in upper respiratory tract volumes compared to classes I and III. The minimum volume values were lower in individuals with class II compared to class III. In particular, a tendency to decrease the volume of the airways with an increase in the ANB angle in the lower pharyngeal part was noted. At the same time, in relation to the parameters of the upper part of the pharynx, nasopharynx, no connection with the skeletal structure of the face was found [7].

Ansar J. [2] with co-authors carried out an examination of 60 people aged 16-25 years with the determination of face type according to the angle of the lower jaw. Individuals with a hyperdivergent face type compared to other face types have significantly smaller values of the area of the nasopharynx ($p<0.001$) and oropharynx ($p<0.05$). At the same time, the oropharyngeal area was smaller in the group with a normodivergent type of face compared to the hypodivergent group ($p<0.05$). In another study, he and his co-authors analyzed the differences in upper respiratory tract indices in people with different types of facial growth. To achieve the goal, an analysis of 90 lateral cephalograms of people aged 16-25 years who had no history of dental treatment was carried out. As a result, data were obtained that persons with a hyperdivergent type of facial growth have a statistically significantly narrower upper and lower pharyngeal width compared to persons with a normodivergent and hypodivergent type of growth ($p<0.05$) [3].

Park J. E. and others [14] carried out a cephalometric analysis of radiographs of 28 people with a hyperdivergent type of facial growth and 30 people with a hypodivergent type of facial growth aged from 4 to 13 years. The authors of the study found that over 9 years, an increase in the average distance between the sphenoid bone and the posterior nasal shaft increased to 5.3 mm (95 % CI, 4.1-6.5 mm; $p<0.001$). Individuals with different types of facial growth differed in the mean distance between the sphenoid bone and the posterior nasal axis ($p=0.029$).

Meta-analysis data indicate the presence of specific cephalometric indices of the upper respiratory tract in persons with obstructive sleep apnea. In particular, this concerns the size of the pharyngeal airway space (PNS-Phw 1.55 mm, pharyngeal space 495.7 mm^2 and oropharyngeal region 151.2 mm^2) [13].

Thus, taking into account the data of other domestic authors and the results of foreign studies, it is possible to assert the complete consistency of the aggregated data and the logical justification of the results obtained by us, which fit into the general picture of the revealed relationships.

Conclusions

1. Constructed regression models of the area of the upper respiratory area depending on the total complex of teleroentgenometric indices of the upper respiratory tract in YW with an orthognathic bite without taking into account the type of face, with very wide and wide types of face (R^2=from 0.894 to 0.918, $p<0.001$ in all cases) and in YM with an orthognathic bite regardless of facial type and with a wide facial type (R^2=0.905 and 0.917, $p<0.001$ in both cases).

2. In YW, the size of the retroglossal oropharyngeal space (27.3 %), the translingual oropharyngeal space, and the position of the hyoid bone relative to the vertical Frankfurt plane (18.2 % each) are most often included in the models of the area of the upper respiratory area; in YM – the size of the nasopharyngeal space, the retroglossal oropharyngeal space, the lower oropharyngeal space and the position of the hyoid bone relative to the mandibular plane vertically (22.2 % each).

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STUDY OF THE PREVALENCE OF EXCESS BODY WEIGHT AMONG MILITARY PERSONNEL AS A LEADING RISK FACTOR OF DISEASES OF THE CARDIOVASCULAR SYSTEM

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A high prevalence of overweight 40.9±4.3 % and obesity (26.0±3.8 %) was established in military personnel with diseases of the cardiovascular system. A significantly higher difference in the majority of cases of obesity was established – 26.0 % in comparison with the corresponding frequency of obesity in the male population of Ukraine – 13.2 %. It was found that obesity of the III degree occurred significantly more often in the experimental group – 3.03 %, according to the group control – 0.4 %. The value of the additional risk of developing cardiovascular diseases in military personnel indicates that obesity increases the risk of developing a disease of the cardiovascular system by 2.31 times, and the presence of third-degree obesity. 7.58 times.

Key words: diseases of the cardiovascular system, servicemen, excess body weight, obesity, body mass index.

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ВИВЧЕННЯ ПОШИРЕНОСТІ НАДЛИШКОВОЇ МАСИ ТІЛА ЯК ПРОВІДНОГО ФАКТОРУ РИЗИКУ ХВОРОБ СИСТЕМИ КРОВООБІГУ У ВІЙСЬКОВОСЛУЖБОВЦІВ

Встановлена висока розповсюдженість надлишкової маси тіла (40,9±4,3 %) та ожиріння (26,0±3,8 %) у військовослужбовців з хворобами системи кровообігу. Встановлено достовірно вищу різницю кількості випадків ожиріння – 26,0 % у порівнянні з відповідною частотою ожиріння чоловічого населення України – 13,2 %. З'ясовано, що ожиріння ІІІ ст. зустрічалося достовірно частіше в дослідній групі – 3,03 % порівняно з групою контролю – 0,4 %. Значення відносного ризику розвитку ХСК у військовослужбовців, вказують, що наявність ожиріння підвищує ризик розвитку хвороб системи кровообігу у 2,31 рази, а наявність ожиріння ІІІ ст. у 7,58 разів.

***Ключові слова*:** хвороби системи кровообігу, військовослужбовці, надлишкова маса тіла, ожиріння, індекс маси тіла.

The study is a fragment of the research project "To develop and improve the organizational model of providing cardiosurgical care in the conditions of martial law in Ukraine", state registration No. 0123U100166.

According to the data of the World Health Organization (WHO), cardiovascular diseases (CVD) are the most common cause of death in the world since 1998. According to the forecasts of WHO experts until 2030, the future of ischemic heart disease (IHD) and cerebral stroke will become the main causes of death and disability in the entire world, and the mortality rate will reach 23.4 million cases in the world [3, 9]. When assessing the risk of development of CVD, medical and social factors (smoking, eating disorder, alcohol, stress, family life, professional realization, social status,) and medical and biological factors, excess body weight (EBW), obesity, cholesterolemia, hypertriglyceridemia, hyperglycemia and others) are taken in consideration [8].