REGRESSION MODELS OF RHEOENCEPHALOGRAPHIC INDICES, DEPENDING ON THE ANTHROPO-SOMATOMETRIC PARAMETERS OF THE BODY IN PRACTICALLY HEALTHY WOMEN WITH ENDO-MESOMORPHIC SOMATOTYPE

The article describes and analyzes regression models of individual indicators of cerebral circulation in practically healthy women of the endo-mesomorphic somatotype, depending on the features of anthropo-somatotypological indicators. Constructed all 5 possible time indices of the rheoencephalogram with determination coefficient (R2) from 0.593 to 0.904; of the 5 possible amplitude indices of the rheoencephalogram, 3 of R2 from 0.540 to 720 were constructed; of the 8 possible derivatives of the rheoencephalogram, 7 with R2 from 0.528 to 0.865 were constructed. Constructed models with R2 more than 0.5 most often include: for amplitude rheoencephalogram indicators - body diameters (29.4%), cephalometric indices and thickness of skin and fat folds (by 23.5%); for the time indices of the rheoencephalogram - the thickness of skin and fat folds (35.7%), cephalometric indices (21.4%), longitudinal, circumferential dimensions and diameters of the body (by 10.7%); for derivative indices of the rheoencephalogram - the thickness of skin and fat folds (29.3%), the circumferential size of the body and the width of distal epiphyses of long limb bones (by 17.1%) and body diameters (14.6%).

Key words: practically healthy women, endo-mesomorphic somatotype, cerebral hemodynamics, anthropometric indices, regression models.

Problems of timely diagnosis of cerebrovascular disorder in young people attach great importance to health care institutions concerned about the "rejuvenation" of cerebrovascular pathology and institutions involved in the problem of age and pathological physiology [18, 19]. Rheoencephalography is one of the most commonly used methods for investigating the reactivity of the vessels of the brain, which is, in fact, an integral indicator of the adaptive capacity of the cerebral circulation system (the ability of brain vessels to respond in response to changing conditions and to optimize blood flow in accordance with these conditions) [2, 5, 7].

Changes in cerebral hemodynamics should be considered as regional manifestations of general circulatory disorders and the state of support for the homeostasis of the body as a whole [6, 22]. Therefore, it is definitely important to study the integrative mechanisms of the interaction of elements of the system of regulation of vascular activity and the general human constitution, the definition of which becomes possible in mathematical modeling of rheoencephalographic indices, depending on the anthropo-somatometric parameters of the body in persons of a certain somatotype [4, 9, 10, 13, 20]. It is possible to use the results of mathematical modeling to develop criteria for assessing the functional state of the macrocirculation of the cerebral circulation and in determining the strategy of corrective measures in patients with minimal or asymptomatic brain dysfunctions [13, 15].

Research purpose - to construct and analyze the regression models of individual indicators of cerebral circulation, depending on the anthropo-somatometric parameters of the body of practically healthy women of Podillia endo-mesomorphic somatotype.

Material and methods. The results of anthropometric and rheoencephalographic studies performed in practically healthy urban women of the Podillya region of Ukraine (n = 130) that were taken from the data bank of the Research center of the Vinnitsa National Medical University named after Pirogov. Using a computer diagnostic complex, an automatic processing of the rheoencephalogram was performed with the definition of characteristic points on the curve, the main indicators, the formation and substantiation of the conclusion about the state of the circulatory system of the investigated area [23]. The following parameters of the rheoencephalogram were determined: amplitude - basic impedance (EZ, Ohm); amplitude of systolic wave (EH1, Ohm); incisors amplitude (EH2, Ohm); amplitude of the diastolic wave (EH3, Ohm); amplitude of the phase of rapid blood filling (EH4, Ohm); time - duration of the heart cycle (EC, c); the duration of the ascending part (EA, c); the duration of the downward part (EB, c); duration of fast blood filling phase (EA1, c); duration of the phase of slow blood filling (EA2, s); derivatives - dicrotic index (EH2H1, %); diastolic index (EH3H1, %); average speed of the fast blood filling phase (EH4A1, Ohm/sec); average speed of the phase of slow blood flow (EH4A2, Ohm/sec); index of total arterial tone (EAC, %); index of tone of arteries of large caliber (arteries of distribution) (EA1C, %); mean tone of arteries of medium and small caliber (arteries of resistance) (EA2C, %); the ratio of tone of arteries of different caliber (EA1A2, %). Anthropometric study was carried out in accordance
with the scheme of V. V. Bunak [3]. Craniocephy included a definition: the girth of the head (glabella), sagittal arc, the largest length and width of the head, the smallest head width, face width and mandible [1]. The somatotype is determined by the method of J. Carter and B. Heath [10], and the component composition of the mass of the body - by the method of J. Matiegka [16] and additionally the muscle component - according to the formulas of the American Institute of Nutrition (AIN) [14]. The construction of regression models of individual indicators of cerebral circulation, depending on the anthropo-somatometric parameters of the body of practically healthy women of the endo-mesomorphic somatotype (n = 27), was performed in the “STATISTICA 6.0” licensed statistical package.

**Results and its discussion.** Constructed trustworthy models of individual indicators of cerebral circulation in practically healthy women of the endo-mesomorphic somatotype with a determination coefficient R2 of greater than 0.5 have the following linear equations (in the equations below F is Fisher’s criterion, Std. Error of estimation is the standard error of regression estimation): - EZ (base impedance) = 51,81 - 5,251 × thickness of the skin-fat fold (TSFF) on the forearm - 7,197 × shoulder circumference in a tense state + 97,01 × body surface area + 22,26 × face width - 4,585 × transverse averaged breast size - 10.00 × width of mandible + 2,367 × shoulder width (R2=0.754; F(7,19)=8,31; p<0,001; Std. Error of estimate: 8,347); - EC (duration of the heart cycle) = 2,488 + 0,060 × TSFF on the shoulder front - 0,040 × foot circumference - 0,037 × head girth + 0,047 × width of the lower jaw + 0,020 × sagittal head arch - 0,012 × TSFF on the back of the shoulder (R2=0.780; F(6,20)=11,81; p<0,001; Std. Error of estimate: 0,007); - EA (length of the ascending part) = -0,189 + 0,074 × width of the head + 0,016 × width of distal hip epiphysis - 0,007 × TSFF on the chest - 0,006 × shoulder embankment in non-elastic condition - 0,003 × TSFF under the shoulder blade - 0,005 × anterior-posterior size chest (R2=0.800; F(6,20)=13,35; p<0,001; Std. Error of estimate: 0,014); - EB (time of the downward part) = 2,102 + 0,055 × TSFF on the front of the shoulder - 0,042 × foot circumference + 0,045 × width of the lower jaw + 0,022 × sagittal arch of the head - 0,032 × head circumference - 0,011 × TSFF on the back of the shoulder (R2=0.832; F(6,20)=16,51; p<0,001; Std. Error of estimate: 0,047); - EA1 (fast blood flow time) = 0,034 - 0,001 × TSFF on the thigh + 0,001 × height of the swivel point - 0,001 × height of the pubic point - 0,002 × TSFF on the chest + 0,003 × endomorphic component of the somatotype (R2=0.593; F(5,21)=6,13; p<0,01; Std. Error of estimate: 0,003); - EA2 (time of slow blood filling) = 0,087 + 0,007 × TSFF on the front of the shoulder - 0,009 × TSFF on the chest - 0,003 × height of the pubic point + 0,005 × transverse mid-thoracic size - 0,002 × inter-crest distance of the pelvis + 0,001 × body length (R2=0.904; F(6,20)=31,56; p<0,001; Std. Error of estimate: 0,004); - EH2 (amplitude of incision) = 0,230-0,005 × pelvic intercostal distance - 0,001 × TSFF on the side - 0,009 × TSFF on the chest + 0,004 × TSFF on the shoulder front + 0,013 × face width - 0,007 × maximum head width (R2=0.720; F(6,20)=8,56; p<0,001; Std. Error of estimate: 0,012); - EH3 (amplitude of the diastolic wave) = 0,154 - 0,007 × inter-crest distance of the pelvis + 0,003 × anterior-posterior size of the chest - 0,011 × width of the distal hip epiphysis + 0,002 × height of the swivel point (R2=0.540; F(4,22)=6,46; p<0,01; Std. Error of estimate: 0,013); - EH2H1 (dicrotic index) = 817.3 - 10.59 × head circumference - 2,193 × TSFF on the side + 3,450 × TSFF under the shoulder - 5,157 × foot circumference - 6,764 × mesomorphic component of the somatotype (R2=0.580; F(5,21)=5,80; p<0,01; Std. Error of estimate: 14,51); - EH3H1 (diastolic index) = 211,1 + 7,425 × front-rear size of the chest - 2,442 × TSFF on the thigh - 4,680 × inter-crest distance of the pelvis + 9,596 × transverse lower breast size - 9,589 × least head width - 6,287 × transverse mid-thoracic size (R2=0.734; F(6,20)=9,19; p<0,001; Std. Error of estimate: 9,450); - EH4A1 (average fast blood flow rate) = -1,495 - 0,042 × inter-pelvic distance of the pelvis + 0,059 × head circumference + 0,037 × TSFF on the thigh - 0,036 × TSFF on the tibia (R2=0.528; F(4,22)=6,16; p<0,01; Std. Error of estimate: 0,147);- EAC (tone index of all arteries) = -29,99 + 2,801 × forearm circumference in the lower third - 0,851 × TSFF under the shoulder blade + 0,136 × hip circumference - 1,717 × width of the distal hip epiphysis + 4,959 × width of the distal epiphysis of the shoulder - 7,163 × width of the distal forearm epiphysis + 0,973 × shin circumflex in the lower third (R2=0.865; F(7,19)=17,42; p<0,001; Std. Error of estimate: 1,159);- EA1C (tone of arteries of large caliber) = 5,396 +2,425 × width of shoulder distal epiphysis + 0,175 × muscle component of body weight at Mateyko - 1,944 × width of distal epiphysis of the forearm - 0,113 × height of the finger point - 0,094 × TSFF under the shoulder blade (R2=0.569; F(5,21)=5,54; p<0,01; Std. Error of estimate: 0,739);- EA2C (index tone of the arteries of the medium and shallow caliber) = -7,720 - 0,741 × TSFF on the chest + 4,758 × width of the distal shoulder epiphysis - 1,435 × width of the distal femoral epiphysis - 0,473 × front and rear size of the chest - 0,412 × TSFF under the shoulder blade + 0,924 × hip circumference in the lower third - 0,274 × TSFF on the back of the shoulder (R2=0.800; F(7,19)=10,87; p<0,001; Std. Error of estimate: 1,239); - EA1A2 (ratio of arteries tone) = 221,2 + 1,703 × TSFF under the shoulder - 6,903 × leg circumflex in the lower third + 10,16 × bone component of the body weight at Mateyko + 1,903 × TSFF on the stomach - 1,357 × girth of the chest on the inspiration + 11,18 × largest head length - 1,635 × height of the shoulder point
Thus, with the coefficient of determination more than 0.5, the following models were constructed: from 5 possible amplitude rheoencephalogram parameters - 3 with determination coefficient R2 from 0.540 to 0.720; all 5 possible time rheoencephalograms with determination coefficient R2 from 0.593 to 0.904; from 8 possible derivatives of the rheoencephalogram - 7 with a determination coefficient R2 from 0.528 to 0.865. Constructed models most often included: for amplitude indices of rheoencephalograms - body diameters (29.4%), cephalometric indices and TSFF (by 23.5%); for the time indices of the rheoencephalogram - TSFF (35.7%), cephalometric indices (21.4%), longitudinal, circumflex dimensions and body diameters (by 10.7%); for derivative indices of rheoencephalogram - TSFF (29.3%), the circumferential size of the body and the width of distal epiphyses of long limb bones (17.1%) and body diameters (14.6%). The solution of the tasks of preventive and evidence-based medicine is impossible without scientifically substantiated methods of mathematical modeling of functional indicators taking into account the individual-typological features of the organism. This is understandable because the functional capabilities of human cerebral vessels are the result of the interaction of innate neurophysiological status and external influences, the adaptation of which forms the current morphofunctional state specific for individuals of different typological categories [7, 9, 19]. Traditionally, the morphological criterion - in the form of a somatotype - is taken as the basis for the distinction of types of constitution, since the signs of morphotype are combined with features of a functional organization, parameters of "psychotype", peculiarities of the organization of metabolism, and motor capabilities. As a result, the somatotype is regarded as the main "informer" about the nature of the human constitution [17]. The results of constructing regression models of individual indicators of cerebral circulation according to the anthropo-somatometric parameters of the body in women of the endo-mesomorphic somatotype differ from the results of mesomorphic (in which 3 models of amplitude parameters with determination coefficient R2 from 0.517 to 0.573; only 2 models of time indices with determination coefficient R2 0.613 and 0.582; only one model of derivative with determination coefficient R2 0.509. Constructed models of amplitude and temporal rheoencephalograms parameters most often included circumferential body sizes, cephalometric indexes, TSFF and body diameters) [21] and ectomorphic somatotypes (in which all five models of amplitude indices with a determination coefficient R2 from 0.799 to 0.906 were constructed; all 8 derivative indicators with determination coefficient R2 from 0.733 to 0.909; 4 out of 5 possible time indices with determination coefficient R2 from 0.820 to 0.842. Constructed models most often included: for the time indicators - the circumferential dimensions of the body, TSFF, cephalometric indices and diameters of the body; and for amplitude and derivative indices - the width of the distal epiphyses of the long tubular bones of the extremities in additionally) [11].

Consequently, the typological features of the regression equations confirm the conclusion that representatives of each type of body structure should be regarded as a separate general aggregate. This means that the positive basis for mathematical modeling should be consistent with constitutional features, rather than the results obtained with respect to the entire sample being studied.

Conclusions
1. In the practically healthy women of the endo-mesomorphic somatotype, 15 of the 18 possible models of the studied parameters of cerebral circulation were constructed on the basis of their anthropometric, somatotypological and body composition components with a determination coefficient of R2 greater than 0.5 (3 models of amplitude indices with R2 0.540 to 0.720; all 5 possible time indices with R2 from 0.593 to 0.904; 7 models of rheoencephalograms index derivatives with R2 from 0.528 to 0.865).
2. Among the anthropo-somatotypological indicators, models of amplitude indicators of the rheoencephalogram most often include the diameters of the body (29.4%), cephalometric indices and TSFF (23.5%); to the models of the time indices of the rheoencephalogram - TSFF (35.7%), cephalometric indices (21.4%), longitudinal, circumferential dimensions and diameters of the body (by 10.7%); to models of derivative indices of rheoencephalogram - TSFF (29.3%), the circumferential dimensions of the body and the width of distal epiphyses of long limb bones (17.1%) and body diameters (14.6%).

(R2=0.726; F(7,17)=7.19; p<0.001; Std. Error of estimate: 8.824); where TSFF - in mm; girth dimensions of the body - in cm; body surface area - in m²; cephalometric indices - in cm; transverse body dimensions - in cm; width of distal epiphyses of long tubular limb bones - in cm; longitudinal body dimensions - in cm; components of the somatotype - in marks, indicators of the component weight of the body - in kg. Reliable models with a determination coefficient R2 of less than 0.5 (correspondingly, R2 = 0.330, 0.316, 0.478) for the indicators of the systolic wave amplitude and fast blood flow and the average speed of slow blood flow have been constructed and therefore, these models are not essential for practical medicine.
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Referat

РЕГРЕСІЙНІ МОДЕЛІ РЕОЕНЦЕФАЛОГРАФІЧНИХ ПОКАЗАТЕЛЕВ В ЗАВИСИМОСТІ ВІД АНТРОПО-СОМАТОМЕТРИЧНИХ ПАРАМЕТРОВ ТІЛА ПРАКТИЧНО ЗДОРОВІХ ЖІНОК ЕНДО-МЕЗОМОРОФНОГО СОМАТОТИПУ

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У статті описані і проаналізовані регресійні моделі окремих показників мозкового кровообігу у практично здорових жінок ендомеозоморфного соматотипу в залежності від особливостей антропо-соматотипичних показників. Побудовано всі 5 можливих часових індексів резонансографії з коекфіцієнтом визначення (R2) від 0,593 до 0,904; з 5 можливих індексів амплітуди резонансографії, з 3 R2 від 0,540 до 0,720; з 8 можливих похідних резонансографії, з R2 від 0,528 до 0,865. Побудовані моделі з R2 більше 0,5 найчастіше включають: для показників амплітудної резонансографії - діаметр тіла (29,4%).
цефалометричні показники, товщина шкіри і жирових складок (на 23,5%); для показників часу реоенцефалограми - товщина шкіри і жирових складок (35,7%), цефалометричні показники (21,4%), поздовжні, окружні розміри та діаметри тіла (на 10,7%); для похідних індексів реоенцефалограми - товщина шкіри і жирових складок (29,3%), діаметр тіла і ширина дистальних епіфізів кісток довгих кінцівок (на 17,1%) та діаметри тіла (14,6%).

Ключові слова: практично здорові жінки, ендомезоморфний соматотип, церебральна гемодинаміка, антропометричні показники, регресійні моделі.

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РИВЕНЬ САНІТАРНО-ГІГІЄНІЧНОГО БЛАГОПОЛУЧЧЯ ЯК ІНДИКАТОР ФУНКЦІОНАЛЬНИХ ЗМІН ОРГАНІЗМУ ЮНИХ СПОРТСМЕНІВ

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Виявлено залежність показників функціонального стану організму юних спортсменів від рівня санітарно-гігієнічного благополуччя дитячо-юнацьких спортивних шкіл. Найбільш виражений вплив санітарно-гігієнічних факторів на показники функціонального стану дітей зафіксовано в основній (діти, які займалися у закладах із середнім рівнем санітарно-гігієнічного благополуччя) та першій контрольній групах (діти, які займалися у закладах із низьким рівнем санітарно-гігієнічного благополуччя).

Ключові слова: санітарно-гігієнічні фактори, функціональний стан організму, спортивна патологія.

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Зважаючи на тенденцію до прогресуючого погіршення стану здоров’я дитячого населення, що спостерігається нині в Україні, пріорітетним значення має визначення, оскільки виявлення ранніх відхилень у функціональному стані організму спортсменів є важливою їхніми адаптаційними механізмами різного роду, що їхнє діюче сприяє ефективному профілактичному впливу на формування здоров’я і профілактику змін функціонального стану організму юних спортсменів. Враховуючи на те, що організм спортсмена постійно зосереджений на своєму фізичному здоров'ї, але відбуває процеси, які сприяють його фізичному збереженню та зміцненню здоров'я спортивного резерву [17, 18].