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AGHYPPO O., PUGACH Y., DRUZ V., ZHERNOVNIKOVA Ya.
Kharkiv State Academy of Physical Culture

Determination of biological age in different periods of human ontogenesis.

Abstract. ***The aim****: to determine the parameters of the standardized assessment of biological age and individual characteristics of its occurrence.* ***Material and methods:*** *there is analytical generalization of data of scientific literature, clinical anthropometry of the observed contingent, use of sign semantic spaces.* ***Results:*** *the estimation of biological age, based on the standardized parameters being the basis of morphological and functional organogenesis, is worked out.* ***Conclusions:*** *shows the structure of construction of passport of biological development, that provides the measure similarity of individual development of the relatively set age-related standard.*

Keywords: *biological age, line of the age-related norms, physical development, ontogenesis of organogenesis.*

Introduction. The level of development of organism is determined by the physiological ripening of the morphological and functional systems, reflecting his biological age duration of that in the far of cases does not coincide with chronologic age. For determination of biological age many enough methods are used. It is related to that any morphological and functional systems that came to the maturity undertake in basis of his estimation. Development of the standardized parameters of biological age is extraordinarily important therefore [1, 2, 3].

Reasonable standard determination of biological age will allow in more depth to get to understanding of nature of individual "norm" of physical development and level of physical preparedness in accordance with a project "Innovative approaches to health technology in school physical education."

The aim of the study: is to determine the parameters of the standardized assessment of biological age and individual characteristics of its occurrence.

Material and methods: there is analytical generalization of data of scientific literature, clinical anthropometry of the observed contingent, use of sign semantic spaces.

Results of the study**.** Among the contingent of certain chronologic age biological age corresponds to chronologic only at those persons that make the mode of distribution of the inspected contingent on the controlled morphological and functional criterion of estimation. Each of such sorts of criteria in relation to specifies the mode on late, normal and passing ahead development on this morphological and functional index. By virtue of that the used morphological and functional criteria of estimation of biological age have the chronologic period of maturity, and then they can be built in the successive temporal row of norms of the biological ripening of the systems of organism. At the synchronous ripening the process of development of all morphological and functional formations of organism can be characterized the measure of delay or passing from his norm. However in every controlled population synchronicity as process, reflecting cooperation of the developing systems, being based on statistical principle of achievement of end-point, has a certain range of variation from the modal value. Exactly this disagreement is the basis of propensities organism to certain nosologies. Sizes such the deviation from the norm of synchronous development, number rejectable in the development of morphological and functional educations, order of ranging of them as far as the looked after deviation from the norm of synchronous development present the symptoms of functional violation of interdependent functional relations told on the change of viability of organism. Totality of constantly meeting symptoms taking into account their character relation on the display of the looked after compatibility in their structure determine syndromes characteristic for certain diseases. Establishment of constancy of relations of symptoms in corresponding syndromes and constancy of their met is made by prodrome of display of morphological and functional violations and come forward basis of preclinical diagnosis. The most difficult period establishment of prodrome is early child's age, that determined by insufficiency of selection of necessary amount of symptoms, or to insufficient exactness of their quantitative measuring for systematization corresponding prodrome of ripening or plan nosologies [4, 5].

The first step in this direction is introduction of additional signs of morphological and functional indexes that is present at birth of child. The indexes of clinical anthropometry behave to such signs, entered M. J. Breitman. Their basis is based on measuring of linear sizes of biokinematics structure of body. In all fifteen indexes are used in measuring entered to them. Order such measuring and location of points of output of necessary sizes presented in a table 1 and on a Figure 1.

To data fifteen anthropometric sizes must add the complete height of body, his weight, specific closeness of body and his volume. At a necessity the deeper working out in detail the amount of the controlled signs it maybe to complement by volume of and weighing each of measurable anthropometric descriptions. With the purpose of exception of distinction of size units of measurable indexes of length of body, weight, closeness, a volume must be presented their testimonies in dimensionless units.

This is achieved at introduction of general criterion of comparison in relation to every group of measurable indexes having identical units. For all anthropometric indexes of linear sizes of body attitude of their length is entered toward length of body. It allows to eliminate the absolute sizes of body and express them in the stakes of unit or in a percentage ratio to length of body, that reflects the quality structure of his structure, that remains identical at permanent met in the synchronously developing structures of body with folded for their constitution of somatotype of the looked after criteria of relation of the compared sizes.

It is like possible to execute these operations for gravimetric and by volume indexes. In this case the quality structure of body will be presented by the amount of the used components, in size the looked after deviations from the accepted standard and by the order of the following of them in the ranged presentation. If to take the type of build at that all morphological and

Table 1

Anthropometric proportions of the human body

% ratio		№	Name	Part of body
women	men			Head neck
–	–	I	Upper face	
10	10	II	Lower face	
		III	Neck	
7	6,23	IV	Acromion-teat distance	Body
14	13,3	V	Teat navel distance	
10	10	VI	Umbilical, inguinal distance	
–	–	VII	Hip	Leg
–	–	VIII	Shin	
–	–	IX	Foot	
9	10	X	Half acromioclavicular distance	Horizontal distance
6	6,3	XI	Half the distance between teat	
14	15	XII	The length of the foot from the heel to the end of the thumb	

Fig. 1. Quality structure of structure of body of man depending on different correlation of endocrine activity. (In the construction of linear diagrams of somatotype a complete height is taken for unit by consisting of the parts of body, presented in to the relation of length of body. From fifteen descriptions driven to the table 1 on linear diagrams used only nine. (Table 1 and figure 1 taken from the monograph of M. J. Breitman the “Clinical semiotics and differential diagnostics of endocrine diseases”).

functional systems in the process of the development correspond to the modal values at, that biological and chronologic age coincides, then his structure shown in dimensionless units, it is possible to use as a standard in relation to that it is necessary to execute comparison of individual biological age at certain chronologic age. Increase of quantity of the compared indexes that characterize the structure of display of biological age of interactive morphological and functional educations requires corresponding space of comparison of their measure of likeness.

Basis of construction such of space is based on that the type of build biological and chronologic age of time of development coincides at that comes forward a standard, here all proportions of the compared descriptions come forward unit of comparison. By a zero border of counting out of the looked after rejections aside hypo or hyper displays of the compared descriptions will come true in relation to a line, passing in the distance unit of relatively initial zero. This line executes the role of zero because in relation to her placing of all looked after rejections that can have the differently directed character are conducted. The most comfortable construction of such sign semantic space is the arctic system of coordinates, in that this line will be presented by the circumference of single radius. In this case any radius a vector expresses the certain used index of biological age, which it is presented on a figure 2.

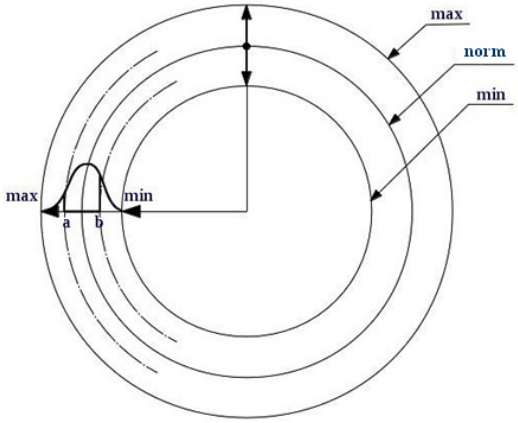
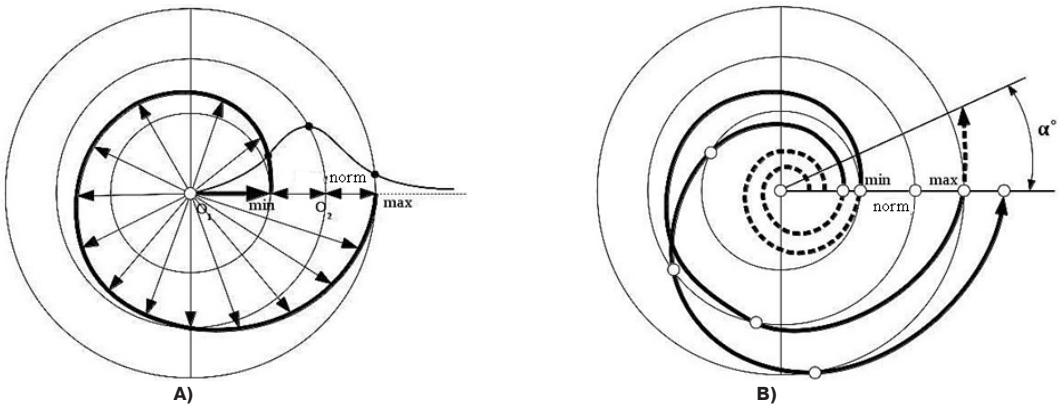


Fig. 2. Circular graph for presentation of passport descriptions of biological age

An external circumference reflects maximally (max) possible deviation from the normal value of the controlled sign; an internal circumference reflects the standard value of the controlled signs and comes forward the index of norm of their display, the radius of this circumference is equal to conditional unit; an internal circumference reflects the border of minimum value of meeting deviation from his standard display in the norm of biological age; the marked zone (a-b) corresponds to the possible vibrations of signs, making functional optimums of the looked after rejections, that reflect operative adaptation providing the no spread function of display of viability arising up in ontogenesis. Talking about the difference of biological age relatively chronologic it is possible only in case that there is synchronous lag or passing ripening of all morphological and functional educations from a norm chronologic and biological age coincides in that. In all other cases it is possible to talk about an allometry and asynchronous of development of different morphological and functional educations with establishment of their ranged row from the latest in development to passing ahead in development, what is the basis of determination of prenosological forecasting of process of developing violations going beyond the zone of operative adaptation functional optimum.

In relation to every measurable sign, the sum of that in dimensionless sizes is equal to unit, it is possible to present the ranged row of elements, in that their order of the following, size of rejection and distance, is set between him. In relation to this order individual logarithmic spirals are built, where the change of the order of structure, related to moving of order or change only of corner between their radiuses, is visible. The structure of such transformations is given in figure 3.



A) B)

Fig. 3. Presentation of the structure of biological age in the form of ranked distribution of controlled amounts recognized in terms of not having a dimension in the case where there is asynchronous in their morphological and functional maturation

There is a radius of vector on a picture (a) [O_1; max] corresponds to the complete height and describes an external circumference. In relation to it radius of the vector taken for unit and making in a sum unit of making him components the stake of every anthropometric description is determined. Every stake depending on her size lines up on this vector in the ranged order. By this value as radius a vector is conduct circumferences. Every next circumference has a radius equal to the sum of preceding members of the ranged row. In an interval from a minimum circumference (R=min) to maximal (R=1) one coil of logarithmic spiral is conducted. The intersections of circumference with a logarithmic spiral specify the order of structure of distribution of shape-generating parts in the norm of construction of body.

In this case established order following of their sizes of query (coefficients of constancy of relations and constancy of met of these relations) and distribution in the ranged row of signs. In relation to this order the individual placing of the controlled signs is built, that allows to see the changes of order of structure of body (violation of normal order or only displacement of corners between radius vectors of, characterizing signs). Number of the entered signs characterizing the biological ripening of shape-generating body weight in his structural educations it is possible to change descriptions of biological age depending on working out in detail. In a variant (a) curvature of logarithmic spiral of standard and individual description remains permanent, length of her coil changes only from the initial turn of radius (R=min) to the turn of radius (R=1).

On a figure (b) the requirement of one coil of spiral, that begins from the minimum value of the controlled sign and ends with a maximal value taking into account their comparing to the standard, is saved in description of individual biological age, but these values lie on one line. Basic descriptions in this case are an order of value of the ranged row and changing curvature of logarithmic spiral.

In the brought presentation over of individual descriptions of biological age the radius of O_1 O_2 reflects distance from the first zero that is beginning of counting out, to the second zero, that comes forward the border of sum of component components, reflecting stakes from unit equal to unit. In this case circumference with a radius equal to unit, salient the measure of comparison of component components, presenting the border of their norms, in relation to that as an equilibrium value or beginning of counting out, i.e. zero, the rejections of the controlled sign are marked.

On every radius vector the values of individual data are put aside. When biological age does not coincide with chronologic, position of radius vector can change. For presentation of individual passport of structure of biological age in relation to the vector of O_1 O_2 signs are put aside with a minimum and maximal value. In a norm, when relation of biological (B) age and chronologic (X) age coincide i.e. (B=X) border of range of min – max is tightened to the zero, that corresponds to the line of norms for every sign. For the location of order of the following of radius vector on a circumference in the ranged value of their stake in the complete sum of unit it is necessary from the end of radius vector with a minimum value that lies on a radius vector of O_1 O_2 to the end of vector with a maximal by share value to conduct one coil (360˚) of logarithmic spiral. Circumferences are then conducted with a radius vector corresponding to the ranged value in their total stake.

Every intersection of corresponding circumference with a logarithmic spiral determines the location of components in relation to each other. The got construction allows defining the order of met of the folded structural relations in normal biological age (X) figure 3a. Analogical procedure is executed for terms, when biological and chronologic age does not coincide ($B \neq X$) for the components of unit. Such the constructions can be executed in two variants. In relation to a preceding construction the second variant is presented on the picture of 3b.

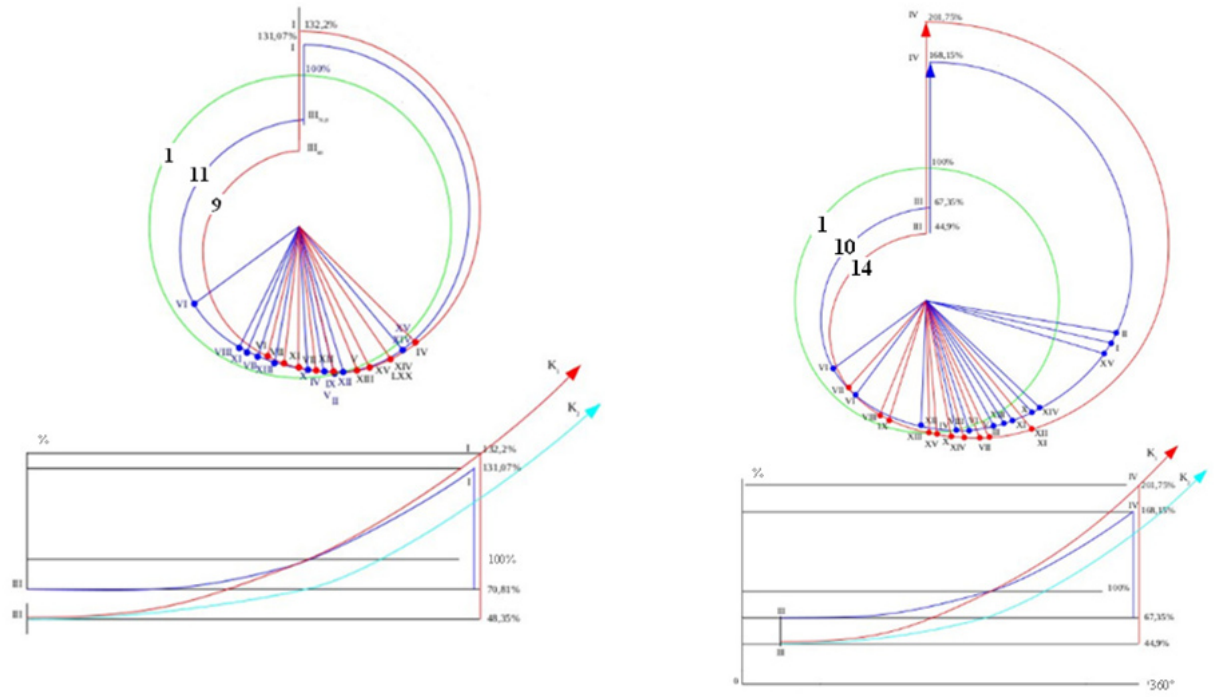
In the first variant it is necessary on every radius vector in the ranged location on a logarithmic spiral to bring in the individual by share values of the used signs. In accordance with the got result, like a preceding construction there is an individual structure of location of elements of row. At the change of size of by share value of min and max elements, or only one of them the change of location in relation to each other of all elements of row will be regulated, what the order of their following and value of min and max can violate can lie on different radius vector. In this case length of logarithmic spiral can be not equal to the complete turn (360˚), which will characterize a certain orientation and character of nosology presentations.

In the second variant it is necessary to save the terms of location of radius vector of min and max of grade value of sign on the line of O_1 O_2. It will cause the change of range of variation due to the change of distances between the component elements of row and curvature of logarithmic spiral, but to maintenance fully of one turn (360˚). Interpretation of the looked after changes in each of variants of well-organized change of structure of variation row will have the advantages. The feature of construction consists in that in first case the point of O_1, comes forward beginning of counting out executing role of zero, and in second case the role of zero and beginning of counting out executes a circumference in relation to that all looked after deviations are put aside from a standard.

In any of the used variants will consist the important index of the looked after rejections in the change of closeness of distribution of variants of structure of the folded locations of elements of the ranged row. In one case it description changes in the estimation of lengths of radiuses of vectors, and in other in the goniometry of their turn in a range from the vector of minimum value to the vector with a maximal value. Analogical constructions can be carried out to the rectangular Cartesian system of coordinates, where an exponential line (fig.4) will come forward instead of logarithmic spiral.

The brought diagrams (a, b) over are chosen as examples in that descriptions of parts of body coincided having minimum values bodies (necks) and maximal values of part of body (overhead person). In the Cartesian system of coordinates after a vertical channel the rejection of the controlled signs is put aside in processes to their standard value taken for 100%. On graphic arts the rejections of min and max descriptions are marked only. Sequence of all elements of the ranged row from an arctic diagram not carried.

Presented system of reflection of structure of biological age of individual attributed to the standard that has a coincidence of biological and chronologic age at all controlled morphological and functional educations can broaden on the number of the included indexes and exactness of their measuring. A basic task consists of choice of those descriptions that is accessible for supervision and measuring and in too time, that their presence was observed on all stages of life



a) b)

Fig. 4. Presentation of violation of quality structure of structure of body in the arctic and Cartesian system of coordinates for four types of build arising up at different endocrine violations. Data are taken from a figure 1; linear diagram (1,9,10,11,14).

cycle.

Being base on position outspoken Geoffroy-Saint-Hilaire (1836г.), about a necessity for the estimation of process of development to distinguish the height of body and its formation, such indexes as body weight and his anthropometric descriptions were chosen [5]. The height of body is directly related to his weight, by volume of and by the closeness of tissue, and formation reflects the process of organogenesis and his ripening. This position and defined the choice of the controlled descriptions for determination of structure of biological age of developing body. The first index in the estimation of biological age is a bodyweight. In accordance with pointing of H. Lotze (1856yr.) a body is direct space the underlying structure of that stipulates an outward form [6]. Consequently she is the external reflection of character of exchange processes originative her. Deep theoretical ground of it position was considerably later given by M. Y. Breitman (1924г.) that was dependence of by share activity of endocrine cooperation's is set on the change of proportions of body [7]. On the basis of this dependence position was formed them that proportions of body are the external reflection of individual features of flowing of exchange processes. Founded on the base of undertaken studies by him the method of clinical anthropometry was worked out.

On the basis of it the method of clinical anthropometry was chosen for the reflection of the biological ripening of process of body formation reflecting his ontogenesis. On the line of norms of development of body of persons at that biological and chronologic age coincides it is possible to define the sequence of time of the biological ripening of different morphological and functional educations or so-called key line of norms of development of body.

Different speed of development of body and morphological and functional educations generates the process of beating in the interdependence providing to the required volume of trade-out of the masses and speed of their forming. It is reflected in the degree of development of pathology, which is mathematically described as violation of amplitude-frequency modulation at forming of end-point of joint cooperation.

In the process of phylogenesis the mechanism of adaptation, sent to maintenance of norm of interrelated relations of the systems of organism in ontogenesis of their development, was produced. This mechanism allows in set borders to restrain the origin of effect of beating. In the process of ontogenesis base bases of such mechanism suffer the corresponding stages his forming repeating his phylogenesis. This orientation (trend) of this process makes stationary basis, operative adaptation flows on the base of that, providing the correction of interrelated relations of the systems of organism in maintenance of the equilibrium state in the environment of his stay. Facilities used for the directed influence the corrections of trend of mechanism of adaptation possibilities, provided by reserve of operative adaptation there are motive activity and feed. Exactly forming of the motive activity sent to providing of search of feed was the determinative of development of corresponding structure of body in the process of his phylogenesis [8, 9].

In ontogenesis of physical development the necessary is required every stage of his flowing on maintenance, accessible for implementation motive activity and corresponding a feed corresponding to the age-related norm. Deviation from this norm draws disagreement of interdependence relations providing their stability Determination of maintenance of norms of necessary and accessible physical activity for every stage of physical development of organism on the maintenance determined on the basis of population average description of quality and quantitative volume of motive activity making the

norm of corresponding arsenal to biological age of physical development of child's organism.

Determination of quality maintenance of motive activity is important for a purposeful management motion of corresponding parts of body and through them on functional processes providing this activity. Efficiency of this influence explained by that endothelial layer of blood vessels, piercing all organism are an active endocrine organ that is diffusely dissipated on all fabrics of organism and makes 18 kg for the grown man of middle-weight. One of basic functions of endothelia consists in maintenance of the equilibrium state of regulative substances providing integral work of the system of blood supply [10].

Muscular exercises leads to increased circulation of relevant bodies and causes the accelerated development of its vessels, which increases the activity of this part and as a consequence decline in activity of other parts of up to stop their development. In early child's age this effect shows up especially brightly, that determines all importance the use of physical activity with the purpose of electoral influence on flowing of physical development of child.

Analogical meaningfulness for normal physical development and his correction, especially in child's age, has a rational feed because through his quality and quantitative composition it is possible to have influence on the second diffusely dissipated in the different organs of the digestive system of gastro esophageal endocrine system, being the greatest and difficult endocrine organ in the organism of man, qualificatory providing of his trophic processes.

Establishment of the age-related norms of motive activity and feed taking into account the features of biological age remains the most poorly studied area in the question of physical development on the whole and especially in early child's age [11, 12, 13].

Conclusions:

1. Biological age is determined by time of the physiological ripening of morphological and functional educations bound by their organogenesis. In relation to this process there is every system, used for the estimation of biological age can fall behind, pass ahead or coincide in the development with her chronologic age. In synchronous development of process of ripening of the controlled systems it is possible to talk about a corresponding difference between biological and chronologic age. The indexes of development of the systems for the coincidence of biological and chronologic age are used by the standard of comparison for the estimation of individual physical development. In case of the asynchronous flowing of process of the biological ripening of the controlled systems description of biological age has more difficult estimation.

2. The qualificatory index of biological age at asynchronous development of organism is body weight, because in the process of physical development presented by two constituents - height of body weight and her formation in the morphological and functional systems. The observed asynchronous maturation process of organogenesis and of deviation from the standard reflects the individual constitutional predisposition to certain diseases, which is the basis of preclinical diagnosis.

3. Streamline presentation of the ranged values of the lobserved after rejections at the asynchronous ripening of the functional systems, presented in sign semantic space with the entered single measure of the distance shown in the stakes of sigma-mesons or unit allow to set the characteristic features of individual biological age and measure of closeness of his descriptions for different individuals. It provides possibility of forming of homogeneous groups on the level of their physical development taking into account deviations from the norm of physical development and systematization of kinesis facilities for their correction.

4. It provides possibility of forming of homogeneous groups on the level of their physical development taking into account deviations from the norm of physical development and systematization of kinesis facilities for their correction.

Further development of researches in the plan of implementation of project "Innovative approaches to health technology in school physical education." will be related to the construction of the system of facilities of physical activity by adequate to every biological age taking into account the individual features of his flowing.

Reference:

1. *Vojtenko V.P. Biologicheskij vozrast, V.P. Vojtenko v kn. Fiziologicheskie mehanizmy starenija – Leningrad: Nauka, 1982. – S. 144-156.*
2. *Fulderb S.S. Spontaneous mutation during the aging of human cells. - in: Vth Eur. Symp. Basic Res. Gerontol., Erlangen, 1977. p 543-545.*
3. *Jalavisto E. Makkonen T. On the assessment of biological age. – Ann. Acad. Sci. fenn., 1963, ser. A, v. 100, p 1-38.*
4. *Obzornyj analiz po probleme «Teoretiko-metodologicheskie osnovy postroenija sistemy massovogo kontrolja fizicheskogo razvitija i sostojanija fizicheskoj podgotovlennosti razlichnyh grupp naselenija»: ucheb. posob. [V.A. Druz', N.V. Buren' S.S. Pjatisockaja i dr.]. – Har'kov: HGAFK, 2014. – 128 s.*
5. *Ontologija teorii postroenija kontrolja i ocenki urovnja fizicheskogo razvitija i fizicheskogo sostojanija : monografija.[A.Ju. Azhippo, Ja.I. Pugach, S.S. Pjatisockaja i dr.]. – Har'kov : HGAFK, 2015. – 192 s.*
6. *Zhofrua-Sent-Iler Obshhaja i chastnaja istorija anatomii teloslozhenija, Zhofrua-Sent-Iler. – Parizh, 1836. – 382s.*
7. *Brejtman. M.Ja. Vvedenie v izuchenie o proporcijah i konstitucijah chelovecheskogo tela. Osnovy koordinirovannogo geneticheskogo sposoba antropometrii (dlja antropologov, vrachej, pedagogov i hudozhnikov). M.Ja. Brejtman. – L.: pedagog. int. Shestjakova, 1924. – 92 s.*
8. *.Sepp E.K. Istorija razvitija nervnoj sistemy pozvonochnyh, E.K. Sepp. – M.: Medgiz, 1959. – 428 s.*
9. *Kaplanskij S.Ja. Izmenenie himicheskogo sostava organizma v processe rosta. Pitanie i rost v kn. Rost zhivotnyh. S.Ja. Kaplanskij. – M.: Biologich. i med. literatura, 1935. –S. 281-325.*
10. *Gonozkov O.A. Jendotelij – «jendokrinnoe derevo», O.A. Gonozkov. – Priroda, 2000. – №5. – S. 38-46.*
11. *Gatev V. Koordinacija dvizhenij. V kN. Fiziologija rebenka rannego vozrasta. Medicina i fizkul'tura. V. Gatev. – Sofija, 1970. – S. 160-185; 403-406.*
12. *Bal'sevich V.K. Ocherki na vozrastnoj kineziologii cheloveka0. V.K. Bal'sevich. – M.: Sovetskij sport, 2009.*
13. *Zhernovnikova Ya. Otsenka biologicheskogo vozrasta i obespecheniye nablyudayemogo v nem individualnogo razvitiya : Materiali IX mezhdunarodna nauchna konferentsiya, «Bdeshcheto vprosi ot sveta na naukata», tom. 39. Fizicheskaya kultura i sport [Evaluation of biological age and ensure it is observed in individual development : Materials IX International Conference, "Future issues of the world of science", Vol. 39. Physical Culture and Sport], Sofiya, 2013, pp. 32–39. (rus)*

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Oleksandr Aghyppo: *Doctor of Science (Pedagogical), Professor; Kharkiv State Academy of Physical Culture: Klochkivska str. 99, Kharkiv, 61058, Ukraine.*
ORCID.org/0000-0001-7489-7605
E-mail: aghyppo@yandex.ua

Yaroslavna Pugach: *PhD (physical education and sport), Associate Professor; Kharkiv State Academy of Physical Culture: Klochkivska str. 99, Kharkiv, 61058, Ukraine.*
ORCID.ORG/0000-0001-5460-772X
E-mail: sanadruz@gmail.com

Valeriy Druz: *Doctor of Science (Biology); Professor; Kharkiv State Academy of Physical Culture: Klochkivska 99, Kharkiv, 61058, Ukraine.*
ORCID.org/0000-0002-4628-6791
E-mail: valeriidruz@gmail.com

Yana Zhernovnikova: *Kharkiv State Academy of Physical Culture: Klochkivska str. 99, Kharkiv, 61058, Ukraine.*
ORCID.ORG/0000-0002-5574-8652
E-mail: zhernovnicova@gmail.com