children from the USA [9], Argentina [19], China [5] and Italy [9]. It should be noted that the average age in this sample was 10.62 years. This fact explains why in our study, scores on the PDSS scale are slightly lower than in studies on the drowsiness of Brazilian [10] or Argentinean children [4].

Conclusion. We have shown that the age of the child affects the level of daytime sleepiness, which, in turn, corresponds to the level of sexual development. Consequently, older children must sleep more than younger children in order to achieve the same level of alertness and cognitive ability. Thus, children compensate for lack of sleep during the next day due to daytime sleep.

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References

1. Полуэктов М.Г., Пчелина П.В. Сон у детей от физиологии к патологии. Медицинский совет. 2017; №9: 97-102. [Poluektov MG, Pchelina PV Sleep in children from physiology to pathology. Medical Council. 2017; V. 9: 97-102. (In Russ.)]

2. Roenneberg T, Kuehnle T, Juda M et al. A marker for the end of adolescence. Epidemiology of Human Circadian ClockSleep Med Rev. 2007; 11 (6): 429-38.

3. Roenneberg T, Kuehnle T, Pramstaller PP et al. A marker for the end of adolescence. Current Biology. 2004; 14:1038-1039.

4. Perez-Lloret S, Videla AJ, Richaudeau A et al. A multi-step pathway connecting short sleep duration to daytime somnolence, reduced attention, and poor academic performance: an exploratory cross-sectional study in teenagers. J Clin Sleep Med. 2012; 9: 469-473.

5. Gau SS-F, Shang C-Y, Merikangas KR et al. Association between morningness-eveningness and behavioral / emotional problems among adolescents. Journal of Biological Rhythms. 2007; 22: 268-274.

6. Carskadon MA, Acebo C, Jenni OG. Regulation of adolescent sleep: implications for behavior. Ann N Y Acad Sci.. 2004; 1021: 276–91.

7. Randazzo AC, Muehlbach MJ, Schweitzer PK, Walsh JK. Cognitive function following acute sleep restriction in children ages 10–14. Sleep. 1998; 6 (21): 861– 865.

8. Maganti R, Hausman N, Koehn M et al. Excessive daytime sleepiness and sleep complaints among children with epilepsy. Epilepsy Behav. 2006; 8 (1): 272-277.

9. Esposito M, Antinolfi L, Gallai B et al. Executive dysfunction in children affected by obstructive sleep apnea syndrome: an observational study. Neuropsychiatr Dis Treat. 2013; 9: 1087-1094. doi: 10.2147 / NDT.S47287.

10. Ferrari Junior GJ, Drake CL, Barbosa DG et al. Factor structure of the Brazilian version of Pediatric Daytime Sleepiness Scale. Chronobiology Int. 2018; 35 (8): 1088-1094.

11. Feinberg I, Campbell IG Sleep EEG changes during adolescence: an index of fundamental brain reorganization. Brain Cogn. 2010; 72 (1): 56-65. doi: 10.1016 / j.bandc.2009.09.09.008.

12. Komada Y, Bregelmans K. Social jetlag affects subjective daytime sleepiness in school-aged children and adolescents: A study using the Japanese version of the Pediatric Daytime Sleepiness Scale (PDSS-J). Chronobiology Int. 2016; 33: 1311-1319.

13. Pereira EF, Teixeira CS, Louzada FM. Sonolência diurna excessiva em adolescentes: Prevalência e fatores associados. Rev. Paul Pediatr. 2010; 28 (1): 98–103.

14. Randler C, Kolomeichuk SN, Morozov AV et al. Psychometric characterization of the Russian version of the Pediatric Daytime Sleepiness Scale (PDSS). Heliyon. 2019; 5 (7): e02134. doi: 10.1016/j.heliyon.2019.e02134

15. Bektas M, Bektas I, Ayar D et al. Psychometric properties of Turkish version of Pediatric Daytime Sleepiness Scale (PDSS-T). Asian Nurs Res. (Korean SocNurs Sci.). 2016; 10 (1): 62-67.

16. Randler C, Frech D. Correlation between morningness–eveningness and final school leaving exams. Biol. Rhythm Res. 2006; 37: 233–239.

17. Rhie S, Lee S, Chae KY. Sleep patterns and school performance of Korean adolescents assessed using a Korean version of the pediatric daytime sleepiness scale. Korean J Pediatr. 2011; 54 (1): 29-35.

18. Roenneberg T, Merrow M. Entrainment of the human circadian clock. Cold Spring Harb. Symp. Quant. Biol. 2007; 72: 293–299.

19. Perez-Chada D, Perez-Lloret S, Videla AJ et al. Sleep disordered breathing and daytime sleepiness are associated with poor academic performance in teenagers. A study using the Pediatric Daytime Sleepiness Scale (PDSS). Sleep. 2007; 30: P. 1698-1703.

20. Gibson ES, Powles AC, Thabane L et al. “Sleepiness” is serious in adolescence: two surveys of 3235 Canadian students. BMC Public Health. 2006; 6: 116.

21. Drake C, Nickel C, Burduvali E et al. The pediatric daytime sleepiness scale (PDSS): sleep habits and school outcomes in middle-school children. Sleep. 2003; 26 (455): 8.

22. Felden EP, Carniel JD, Andrade RD et al. Tradução e validação da Pediatric Daytime Sleepiness Scale (PDSS) para o português do Brasil. J Pediatr (Rio J). 2016; 92: 168–173.

SCIENTIFIC REVIEWS AND LECTURES

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INDICES OF LIPID METABOLISM FOR THE EARLY DIAGNOSIS OF CARDIOVASCULAR DISEASE IN RESIDENTS OF THE NORTH

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Cardiovascular disease is one of the leading causes of morbidity and mortality among the adult population. In Russia, over a million people (around 700 people out of each 100 thousand population) die each year from cardiovascular diseases. The high prevalence of cardiovascular disease is observed in people living in the North, whose severe climatic conditions produce increased demands for a human body. Northern climatic factors lead to significant changes in human’s physiological functions based on modified functional condition of the endocrine system, metabolic processes, and lipid metabolism in particular. According to L.E. Panin’s concept (1978), in high-latitude regions we can observe “the changeover from carbohydrate-type metabolism to the lipid one”. This concept states transformation of the lipid profile in residents of the North caused by a number of external factors frequently leading to changes in metabolic pathways and abnormalities in lipid metabolism. Adequate assessment and correct interpretation of lipid metabolism variables are of major importance for early detection and timely prevention of cardiovascular pathology. The review considers key lipid metabolism indices. We also present our own data about the role of compound indices in lipid metabolism assessment in healthy inhabitants of the North.

Keywords: lipid metabolism, adaptation, North, cardiovascular disease, apolipoproteins.

The issues related to preservation of health in the North are of great medical and social significance. The process of human adaptation to adverse northern factors is aimed at maintenance of stable functioning of various systems separately and of a human body as a whole to ensure normal vital activities under inadequate environmental conditions. Transformation of energy metabolism through changeover of all types of metabolism (of lipids, proteins, carbohydrates, vitamins, macro and microelements) plays an important role in the complex sequence of adaptive changes [6, 28, 32]. According to the member of the Academy of Sciences L.E. Panin [27, 28], the northerners develop a peculiar type of metabolism – the so-called "polar metabolic type" characterized by decreased role of carbohydrates and increased role of the proteins and lipids in energy metabolism. The increased significance of lipids in the energy metabolism of a human body finds its reflection in the changed lipid profile of blood [2, 4, 6, 13, 28]. Within L.E. Panin's concept, we suggest the term "adaptive polar metabolic type" as a special type of metabolism typical for the adapted population of the North, including the indigenous residents of the Far North. Development of this "adaptive polar metabolic type" includes forming of a peculiar hormone profile and metabolism ensuring comfortable living in the Far North conditions in particular. For inhabitants of the North, if compared to residents of middle latitudes, such adaptive changes are related to the transformed metabolism, which is preconditioned by more active basal metabolic rate in particular seasons of year and more short-term reactions connected with some environmental factors of the North [6].

At present time, ideas of the regularities of adaptive processes in residents of the North are based both on the studies of transformation mechanisms of physiological functions and biochemical processes in migrants, and on detection of morphofunctional features in the indigenous populations for which the subextreme and extreme conditions of the northern regions can be considered adequate. The analysis of the literature on metabolism in non-native residents of the North demonstrated that data on their lipid metabolism transformation are quite various and often contradictory, which is probably related to the fact that most studies were carried out on migrants of the North found at different stages of the adaptation [1, 6, 21, 28, 31, 35]. According V.P. Kaznacheyev's classification [13], in the process of a person's adaptation to the Northern environment one can observe a phase of regulatory and homeostatic processes destabilization (from 6 months to over 1 year long), a phase of regulatory and homeostatic processes stabilization and synchronization (10–15 years long) and a phase of lowered resistance of one's body. It is considered that the stage of resistance in residents of the North is explained by efficient changeover from carbohydrate metabolism to the lipid one. Such lipid metabolism transformations occurring throughout the "polar metabolic type" development are to be accompanied by lipoprotein spectrum shifting towards an increase in the number of high density lipoproteins (HDL). However, multiple studies showed that migrants of the North do not develop an optimal metabolic background as a rule. Contrariwise, they develop "northern dyslipidemia" which is reflected as increased atherogenic lipid fractions in blood [8, 12, 30].

Metabolism with predominantly protein-lipid metabolism ("arctic adaptive type") is observed in the indigenous populations of the North. Descendants of several generations of migrants who had been adapting to the northern environment for centuries possess similar ability to switch to the northern type of metabolism. For the indigenous populations of the North, the change of energy metabolism from the carbohydrate type to the lipid one comes on account of exogenous fats, i.e. food lipids [26]. In general, the basal metabolic rate in the northern aborigines is higher than the one in the residents of the middle latitudes [32]. The protein-fatty diet in the northerners implies primarily the use of lipids as the most energy intensive utilizable material and is accompanied by the increased activity of lipolytic enzymes and activated lipid mobilizing processes [26, 35].

The indigenous inhabitants of the North following the traditional lifestyle and diet with their "polar" metabolic type demonstrate more favourable lipid metabolism profiles with regard to the risk of development of a cardiovascular disease than the non-native populations of the North. The indigenous residents of the North (Evenki Autonomous Area, Yakutia, Amur River Region, Khanty-Mansi Autonomous Area, Yamal-Nenets Autonomous Area) have lower total cholesterol (TC) levels and its atherogenic fractions and higher levels of HDL cholesterol (HDL-C) in blood serum than migrants of the North [10, 11, 21-23, 25, 31].

However, social and economic changes of the recent decades, the inflow of migrants and urbanization have affected the traditional lifestyle and diet in the indigenous inhabitants, which has resulted in disturbed adaptive processes followed by increased morbidity. In addition, the indigenous populations of the North suffer adverse metabolic changes with intensified carbohydrate metabolism and increased atherogenic lipid levels in blood more frequently now [3, 9, 18-20, 33].

Atherogenic disorders of lipid metabolism play a major role in the pathogenic mechanism of atherosclerosis [17, 47]. At present time, atherosclerosis is one of the most relevant and important health problems. Atherosclerosis mostly affects aorta, arteries of heart, brain, lower limbs and kidneys. Therefore, coronary disease, myocardial infarction, aortic aneurism rupture, ishemic and haemorrhagic stroke are among top causes of death. In this connection, diagnostics and prevention of lipid metabolism disorders are some of the most significant tasks of today's medicine.

Currently, much attention is paid to studying the role of apolipoproteins in a human's lipid metabolism. It is believed that the analysis of the level of apolipoproteins in health and lipid metabolism disorders doubtlessly bring certain benefits, as it allows to identify accurately features and defects of lipoprotein metabolism. Apolipoproteins were discovered more than 40 years ago. Over 10 apoproteins have been identified and described so far. Apolipoproteins are classified into major and minor proteins. The former ones include apoA, apoB, apoC, apoD, apoE. Minor apolipoproteins include apoF, apoJ, prolin-rich protein, etc. [34, 39]. Depending on the key role performed, apolipoproteins are conditionally divided into two classes. One is apoproteins forming the micellar structure of lipoprotein complexes and serving as lipoprotein "nucleus". This group of apolipoproteins includes apoB (apoB-100 and apoB-48) and apoA (A-I and A-II) which are responsible for afferent and efferent transport of lipids. The other class contains apolipoproteins focusing on lipoprotein and lipid metabolism regulation in the bloodstream and their internalization by cells. These apolipoproteins are present in lipoproteins in low concentrations and transfer between lipoprotein classes as protein-lipid complexes in the process of lipoprotein particles' interconversion in the bloodstream. Key representatives of metabolically active apolipoproteins are apoE with three isoforms (E2, E3, E4) and apoC (C-I, C-II, C-III) [34, 63]. Meanwhile, the functional role of apolipoproteins in lipid metabolism in residents of the North has not been studied thoroughly.

For the first time ever we have ana-

lyzed plasma apoE levels in residents of the European North of Russia. It has been established that apoE levels in residents of the North shifted towards lower values [7, 16, 62]. This observation is consistent with the results of a large international research comparing apoE levels in people residing in six European countries. According to results of this study, there is a north-south increasing gradient of apoE concentrations. The lowest apoE levels were observed in residents of Finland [38, 75]. Low apoE levels in the northerners can be considered as adaptive changes providing metabolic transformation, on the other hand, it can serve as a cause for adverse changes in the lipid profile. One of the key mechanisms for the "northern" dyslipidemia was determined during the research. It has been shown that a low apoE level is risk factor for the development of hypertriglyceridemia [7]. ApoE distribution among the major lipoprotein classes was also studied. It has been found that the preservation of constant concentration of apoE in HDL fraction due to its redistribution among lipoprotein classes is priority at decrease of the total plasma apoE level [15].

The levels of TC, HDL-C, low density lipoprotein cholesterol (LDL-C) and triglycerides (TG) are used as classic indicators of lipid metabolism. However, it has been recently established that these conventional lipid parameters do not always reflect correctly the pro-atherogenic potential of blood [48, 51, 73]. Cases of atherosclerosis occurrence among subjects with normal TC levels have been described [60, 61, 65]. According to the literature, determination of TC and TG levels contributes to detection of 50% of all lipid metabolism disorders only [29]. Several computed indices have been defined in an attempt to raise the clinical benefit of lipid metabolism indicators [56, 80].

There are several types of lipid indices. Some indices reflect the balance between atherogenic and anti-atherogenic lipids, these include atherogenicity coefficient, Castelli 1 (TC/HDL-C) and Castelli 2 (LDL-C/HDL-C) indices, apoB/apoA-I ratio, and atherogenic index (ATH index). Their predictive capacity has been proved by many clinical examinations [36, 37, 47-49, 50, 55, 56]. Meanwhile, of these, the apoB/apoA-I ratio is the best marker of cardiovascular risk. The common method for assessing lipoprotein levels in blood by measuring cholesterol content in them does not always reflect the exact number of lipoproteins adequately. It is related to the fact that the amount of cholesterol within lipoproteins may vary widely due to active exchange of lipid components between lipoprotein particles [71]. Unlike lipoprotein cholesterol, the lipid-transporting apoproteins – apoB and apoA-I do not leave the lipoprotein molecules they build [69]. Therefore, apoB and apoA-I are assumed to be superior markers for lipid abnormalities. ApoB (we mean apoB-100) is an essential structural component of very low-density lipoproteins (VLDL), intermediate-density lipoproteins (IDL) and low-density lipoproteins (LDL). Because each particle of these lipoproteins contains one molecule of apoB, the total atherogenic particles number can be accurately estimated by measuring the plasma level of this apoprotein. By contrast, apoA-I is the structural component of antiatherogenic HDL. So, the apoB/apoA-I ratio displays the balance between atherogenic and antiatherogenic lipoproteins in blood and serves as an early potential marker for the cardiovascular risk [64, 70, 76, 78, 79].

Other indices (LDL-C/apoB, TC/TG and atherogenic index of plasma (AIP)) are surrogate markers of LDL particle size [44, 54, 59, 77, 78]. These indices are thought to indicate the presence of small dense LDL particles which are known to be the most atherogenic lipoproteins. These particles are characterized by prolonged plasma half-life, lower resistance to oxidative stress, affinity to proteoglycans, and higher penetration into the arterial wall [66, 68]. Of note, since the determination of LDL-C levels in subjects with a predominance of small dense LDL leads to significant underestimation of the total amount of these lipoproteins [69-71], it explains the need to take the qualitative composition of this lipoprotein fraction into account as well. There are different views on the rationale for using the LDL-C/apoB ratio as a marker of LDL particle size. Some authors found high correlation between LDL-C/apoB values and the measured LDL particles' size [43, 54, 57, 77], while the others do not recommend using this ratio as marker of small dense LDL particles [40, 53].

Clinical studies globally widely use lipid metabolism indices to characterize lipid profile changes in case of various pathologies or to monitor the results of hypolipidemic or hormone replacement therapy, as well as in prospective epidemiology research aimed at detection of predictive factors of atherosclerosis and related cardiovascular diseases [41, 42, 45-47, 54, 67, 72, 80]. At the same time, usefulness of composite indices in the overall evaluation of lipid metabolism in healthy subjects has hardly been studied. The variation range for lipid metabolism indices and functional relations between them have not been found out yet.

The results of our studies made it possible to enlarge today's view about the lipid metabolism in residents of the North and to define main indices for early detection and monitoring of dyslipidemia risk. The comprehensive study of the lipid profile in apparently healthy residents of the North (157 men aged 20-59) with normolipidemia (TC<5.2 mmol/l, TG<1.7 mmol/l, HDL cholesterol>1.0 mmol/l) showed nonmanifest disturbances of lipid metabolism. Increased atherogenicity of the lipid profile in subjects with normolipidemia occurred as a distorted balance between atherogenic and antiatherogenic lipoproteins and changed qualitative composition of lipoproteins. The analysis of individual data revealed that values above the reference limits for the atherogenicity coefficient, Castelli 2 index, atherogenic index of plasma (AIP) and atherogenic index (ATH index) were observed in 7.0-10.2% of the men with normolipidemia. The study subjects most frequently demonstrated lower values of LDL-C/apoB (26.0%) and higher apoB/apoA-I ratio (19.1%). Deviation of these indices from the reference range was observed on the background of low levels of apoE which is a regulatory protein of lipid transport system [14, 24, 52, 74]. It is known that insufficient amount of apoE leads to slower receptor-mediated elimination and accumulation of TG-rich lipoproteins in blood [5, 39, 58]. In our case, higher levels of TG in the subjects with the unfavorable LDL-C/apoB and apoB/apoA-I ratios indicated the delayed clearance of TG-rich lipoproteins. Thus, the atherogenic changes of lipid profile observed in the healthy subjects with normolipidemia may be due to disturbances in catabolism and metabolic turnover of lipoproteins. Decrease of regulatory effect of apoE on lipoprotein metabolism in healthy subjects at early stages is latent and it does not appear as hyperlipidemia. The LDL-C/apoB and apoB/apoA-I ratios are more sensitive indices compared to conventional indicators and are capable to detect atherogenic changes of the lipid profile even in case of normolipidemia.

In general, it should be noted that the results of our own studies indicate the necessity to conduct determination of the apolipoprotein levels and calculation of compound lipid indices in addition to the conventional indicators of lipid metabolism, which makes it possible to detect metabolic disorders at early stages. Deviation of lipid metabolism indices from the reference range in case of normolipidemia can be considered as early predictor of metabolic transformations

occurring on the background of changes in performance of regulatory systems, but not having shown any clinical implications yet.

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References

1. Аверьянова И.В., Максимов А.Л. Состояние липидного и углеводного обмена у студентов-аборигенов и европеоидов с различными сроками проживания на территории Магаданской области. Экология человека. 2015;9:44-49. [Averyanova IV, Maximov AL. Lipid and carbohydrate metabolism observed in aboriginal and European students having different terms of residing in the territory of Magadan region. Jekologija cheloveka. 2015;9:44-49. (In Russ.).]
2. Бойко Е.Р., Канева А.М. Аполипопротеин Е и его значение в клинической физиологии. Успехи физиологических наук. 2009;40(1):3-15. [Boĭko ER, Kaneva AM. Apoprotein E and its availability in clinical physiology. Uspehi fiziologicheskih nauk. 2009;40(1):3-15. (In Russ.).]
3. Бойко Е.Р. Физиолого-биохимические основы жизнедеятельности человека на Севере. Екатеринбург, 2005 [Bojko ER. Physiological and biochemical basis of human vital activity in the North. Yekaterinburg, 2005. (In Russ.).]
4. Бойко Е.Р., Канева А.М., Потолицына Н.Н. Функциональное значение аполипопротеина-Е в липидном обмене у жителей европейского Севера. Физиология человека. 2010;36(2):138-144. [Boĭko ER, Kaneva AM, Potolitsyna NN. Functional importance of apolipoprotein-E in lipid metabolism in inhabitants of the European North. Fiziologija cheloveka. 2010;36(2):138-144. (In Russ.).]
5. Агбалян Е.В., Клименко О.А., Буяк М.А., Шинкарук Е.В. Ведущие предикторы развития и дальнейшего прогрессирования ишемической болезни сердца среди мигрантов Арктики. Успехи современного естествознания. 2014;9:8-10. [Agbalyan EV, Klimenko OA, Buyak MA, Shynkaruk EV. Leading predictors of the development and further progression of ischemic heart disease among Arctic migrants. Uspehi sovremennogo estestvoznanija. 2014;9:8-10. (In Russ.).]
6. Даренская М.А. Особенности метаболических реакций у коренного и пришлого населения Севера и Сибири. Бюллетень ВСНЦ СО РАМН. 2014;96(2):97-103. [Darenskaya MA. Peculiarities of metabolic reactions in indigenous and migrant populations of the North and Siberia. Bjulleten' VSNC SO RAMN. 2014;96(2):97-103. (In Russ.).]
7. Запесочная И.Л., Автандилов А.Г. Динамика липидного обмена при пятилетнем наблюдении у здоровых лиц, проживающих на Севере. Медицинская наука и образование Урала. 2013;14(3):23-26. [Zapesochnaya IL, Avtandilov AG. Lipid metabolism in the five year observation in healthy persons residing in the North. Medicinskaja nauka i obrazovanie Urala. 2013;14(3):23-26. (In Russ.).]
8. Казначеев В.П. Механизмы адаптации человека в условиях высоких широт. Л., 1980 [Kaznacheev VP. Mechanisms of human adaptation in the high latitudes. Leningrad, 1980. (In Russ.).]
9. Канева А.М., Потолицына Н.Н., Бойко Е.Р. Соотношение холестерина липопротеидов низкой плотности к аполипопротеиду-В как маркер размера частиц липопротеидов низкой плотности. Атеросклероз. 2018;14(2):25-31. [Kaneva AM, Potolitsyna NN, Bojko ER. The ratio of low-density lipoprotein cholesterol to apolipoprotein-B as a marker of low-density lipoprotein particle size. Ateroskleroz. 2018;14(2):25-31. (In Russ.).] DOI: 10.15372/ATER20180204
10. Канева А.М., Потолицына Н.Н., Бойко Е.Р. Количественное распределение аполипопротеина-Е между липопротеинами плазмы крови у здоровых мужчин. Молекулярная медицина. 2018;16(5):51–55. [Kaneva AM, Potolitsyna NN, Bojko ER. Quantitative distribution of apolipoprotein-E among blood plasma lipoproteins in healthy men. Molekuljarnaja medicina. 2018;16(5):51–55. (In Russ.).] DOI: 10.29296/24999490-2018-05-09
11. Климов А.Н., Никульчева Н.Г. Обмен липидов и липопротеидов и его нарушения: руководство для врачей. СПб., 1999 [Klimov AN, Nikul'cheva NG. Lipid and lipoprotein metabolism and its disorder: guide for physicians. Saint Petersburg, 1999. (In Russ.).]
12. Кривощеков С.Г., Пинигина И.А., Махарова Н.В. Структурно-функциональные особенности сердечнососудистой системы и метаболические показатели у молодых жителей Якутии с нормальным и повышенным уровнем артериального давления. Бюллетень СО РАМН. 2009;29(6):100-108. [Krivoschekov SG, Pinigina IA, Maharova NV. Structurally functional features of cardiovascular system and metabolic indicators at young inhabitants of Yakutia with the normal and raised level of arterial pressure. Bjulleten' SO RAMN. 2009;29(6):100-108. (In Russ.).]
13. Уварова Т.Е., Бурцева Т.Е., Софронова С.И., Ефремова С.Д., Гольдерова А.С. Липидный профиль крови и особенности нарушений липидного обмена у коренных малочисленных народов севера Якутии. Дальневосточный медицинский журнал. 2012;3:85-88. [Uvarova TE, Burtseva TE, Safronova SI, Efremova CD, Golderova AS. The blood lipid profile and the lipid metabolism disorders to indigenous people of the Yakutia. Dal'nevostochnyj medicinskij zhurnal. 2012;3:85-88. (In Russ.).]
14. Поляков Л.М., Розуменко А.А., Осипова Л.П., Куницын В.Г., Гольцова Т.В. Липидный спектр сыворотки крови у представителей коренного и пришлого населения Ямало-Ненецкого автономного округа. Сибирский научный медицинский журнал. 2015;35(6):66-69. [Polyakov LM, Rozumenko AA, Osipova LP, Kunitsyn VG, Goltsova TV. Serum lipid spectrum of indigenous and alien population of Yamalo-Nenets autonomous okrug. Sibirskij nauchnyj medicinskij zhurnal. 2015;35(6):66-69. (In Russ.).]
15. Воевода М.И., Романова А.Н., Рагино Ю.И., Семаева Е.В. Некоторые особенности факторов риска коронарного атеросклероза у жителей Якутии. Бюллетень СО РАМН. 2010;30(3):52–57. [Voevoda MI, Romanova AN, Ragino YI, Semaeva EV. Some features of coronary atherosclerosis risk factors in the inhabitants of Yakutia. Bjulleten' SO RAMN. 2010;30(3):52–57. (In Russ.).]
16. Канева А.М., Потолицына Н.Н., Людинина А.Ю., Алисултанова Н.Ж., Бойко Е.Р. Низкое содержание аполипопротеина-Е как фактор риска повышения соотношения аполипопротеин-В/аполипопротеин-АI у здоровых мужчин с нормолипидемией. Клин. лаб. диагн. 2014;59(12):32-36. [Kaneva AM, Potolitsyna NN, Lyudinina AYu, Alisultanova NZh, Bojko ER. Low levels of apolipoprotein-E as risk factor for increase of apolipoprotein-B/apolipoprotein-AI ratio in healthy men with normolipidemia. Klin. lab. diagn. 2014;59(12):32-36. (In Russ.).]
17. Панин Л.Е. Адаптация и питание человека в экстремальных условиях Арктики. Инновации и продовольственная безопасность. 2013;1(1):131-135. [Panin LE. Adaptation and a food of the person in extreme conditions of the Arctic. Innovacii i prodovol'stvennaja bezopasnost'. 2013;1(1):131-135. (In Russ.).]
18. Панин Л.Е. Человек в экстремальных условиях Арктики. Бюллетень СО РАМН. 2010;30(3):92-98. [Panin LE. Man in extreme conditions in the Arctic. Bjulleten' SO RAMN. 2010;30(3):92-98. (In Russ.).]
19. Панин Л.Е. Энергетические аспекты адаптации. Л., 1978 [Panin LE. Energy aspects of adaptation. Leningrad, 1978. (In Russ.).]
20. Плющ М.Г., Самсонова Н.Н. Эффективность лабораторных тестов для диагностики нарушений липидного обмена. Бюллетень НЦССХ им. А.Н. Бакулева РАМН Сердечно-сосудистые заболевания. 2012;13(S6):222. [Plyushch MG, Samsonova NN. The efficiency of laboratory tests for the diagnosis of lipid metabolic disorders. Bjulleten' NCSSH im. A.N. Bakuleva RAMN Serdechno-sosudistye zabolevanija. 2012;13(S6):222. (In Russ.).]
21. Ветошкин А.С., Шуркевич Н.П., Гапон Л.И., Губин Д.Г., Пошинов Ф.А., Велижанин С.Н. Повышенное артериальное давление и атеросклероз в условиях северной вахты. Артериальная гипертензия. 2018;24(5):548-555. [Vetoshkin AS, Shurkevich NP, Gapon LI, Gubin DG, Poshinov FA, Velizhanin SN. High blood pressure and atherosclerosis in the northern watch. Arterial'naja gipertenzija. 2018;24(5):548-555. (In Russ.).] DOI: 10.18705/1607-419X2018-24-5-548-555
22. Рябова Т.И., Попова Т.В. Липидный спектр сыворотки крови у коренного (эвены, нанайцы, ульчи) и пришлого населения Приамурья. Дальневосточный медицинский журнал. 2010;4:106–108. [Ryabova TI, Popova TV. Lipid spectrum's in blood serum in the natives population (nanais, ulchis, evenks) and new comers of the Amur river region. Dal'nevostochnyj medicinskij zhurnal. 2010;4:106–108. (In Russ.).]
23. Севостьянова Е.В. Особенности липидного и углеводного метаболизма человека на Севере (литературный обзор). Бюллетень сибирской медицины. 2013;12(1):93-100. [Sevostyanova YeV. Some features of human lipid and carbohydrate metabolism in the North. Bjulleten' sibirskoj mediciny. 2013;12(1):93-100. (In Russ.).]
24. Климова Т.М., Федорова В.И., Балтахинова М.Е., Кривошапкин В.Г. Содержание холестерина и риск атеросклероза у сельского коренного населения Республики Саха (Якутия). Экология человека. 2014;4:22-27. [Klimova TM, Fedorova VI, Baltakhinova ME, Krivoshapkin VG. Cholesterol and risk of atherosclerosis in rural indigenous population of Republic of Sakha (Yakutia). Jekologija cheloveka. 2014;4:22-27. (In Russ.).]
25. Творогова М.Г. Аполипопротеины – свойства, методы определения, клиническая значимость. Лабораторная медицина. 2005;7:29-37. [Tvorogova MG. Apolipoproteins – properties, determination methods, clinical significance. Laboratornaja medicina. 2005;7:29-37. (In Russ.).]
26. Хаснулин В.И., Геворгян М.М., Бахтина И.А. Особенности липидного обме-на у пришлых жителей Севера, больных артериальной гипертензией. Мир науки, культуры, образования. 2011;29(4):280-283. [Hasnulin VI, Gevorgyan MM, Bakhtina IA. Lipid metabolism characteristics at the alien inhabitants of the North with arterial hypertension. Mir nauki, kul'tury,

obrazovanija. 2011;29(4):280-283. (In Russ.).]
27. Schiele F, De Bacquer D, Vincent-Viry M et al. Apolipoprotein E serum concentration and polymorphism in six European countries: the ApoEurope project. Atherosclerosis. 2000;152(2):475-88.
28. Siest G, Pillot T, Regis-Bailly A et al. Apolipoprotein E: an important gene and protein to follow in laboratory medicine. Clin. Chem. 1995;41(8):1068-86.
29. Décary S, Dumont G, Lamarche B et al. Assessment of the validity of the frequently used lipid indices for predicting LDL peak particle diameter in a large cohort of 1955 normal and dyslipidemic subjects. Clin. Biochem. 2010;43(4-5):401-6. DOI: 10.1016/j.clinbiochem.2009.11.010
30. Onat A, Can G, Kaya H et al. "Atherogenic index of plasma" (log10 triglyceride/high-density lipoprotein-cholesterol) predicts high blood pressure, diabetes and vascular events. J. Clin. Lipidol. 2010;4(2):89-98. DOI: 10.1016/j.jacl.2010.02.005
31. Hattori Y, Suzuki M, Tsushima M et al. Development of approximate formula for LDL-chol, LDL-apo B and LDL-chol/LDL-apo B as indices of hyperapobetalipoproteinemia and small dense LDL. Atherosclerosis. 1998;138(2):289-99.
32. Dobiasova M, Frohlich J. The plasma parameter log (TG/HDL-C) as an atherogenic index: correlation with lipoprotein particle size and esterification rate in apoB-lipoprotein-depleted plasma (FER(HDL)). Clin. Biochem. 2001;34(7):583-8.
33. Yusuf S, Hawken S, Ounpuu S et al. Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case-control study. Lancet. 2004;364(9438):937-52. DOI: 10.1016/S0140-6736(04)17018-9
34. Kaneva AM, Potolitsyna NN, Bojko ER. Usefulness of the LDL-C/apoB ratio in the overall evaluation of atherogenicity of lipid profile. Arch. Physiol. Biochem. 2017;123(1):16-22. DOI: 10.1080/13813455.2016.1195411
35. Furuya D, Yagihashi A, Nasu S et al. LDL particle size by gradient-gel electrophoresis cannot be estimated by LDL-cholesterol/apolipoprotein B ratios. Clin. Chem. 2000;46(8):1202–3.
36. Wägner AM, Jorba O, Rigla M et al. LDL-cholesterol/apolipoprotein B ratio is a good predictor of LDL phenotype B in type 2 diabetes. Acta Diabetol. 2002;39(4):215-20. DOI: 10.1007/s005920200037
37. Millán J, Pintó X, Muñoz A et al. Lipoprotein ratios: Physiological significance and clinical usefulness in cardiovascular prevention. Vasc. Health Risk Manag. 2009;5:757-65.
38. Mahley RW, Weisgraber KH, Huang Y. Apolipoprotein E: structure determines function, from atherosclerosis to Alzheimer's disease to AIDS. J. Lipid Res. 2009;50(Suppl):183-8. DOI: 10.1194/jlr.R800069-JLR200
39. Ma H, Lin H, Hu Y et al. Mean platelet volume in relation to carotid atherosclerosis in normotensive, euglycemic, and normolipidemic Chinese middle-aged and elderly adults. Angiology. 2014;65(6):512-8. DOI: 10.1177/0003319713520462
40. Noël B. Premature atherosclerosis in patients with xanthelasma. J. Eur. Acad. Dermatol. Venereol. 2007;21(9):1244-8. DOI: 10.1111/j.1468-3083.2007.02252.x
41. Kaneva AM, Bojko ER, Potolitsyna NN et al. Plasma levels of apolipoprotein-E in residents of the European North of Russia. Lipids Health Dis. 2013;12:43. DOI: 10.1186/1476-511X-12-43
42. Kondo A, Muranaka Y, Ohta I et al. Relationship between triglyceride concentrations and LDL size evaluated by malondialdehyde-modified LDL. Clin Chem. 2001;47(5):893-900.
43. Galeano NF, Al-Haideri M, Keyserman F et al. Small dense low density lipoprotein has increased affinity for LDL receptor-independent cell surface binding sites: a potential mechanism for increased atherogenicity. J. Lipid Res. 1998;39(6):1263-73.
44. Sniderman AD, Pedersen T, Kjekshus J. Putting low-density lipoproteins at center stage in atherogenesis. Am. J. Cardiol. 1997;79(1):64-7.
45. Sniderman AD, Kiss RS. The strengths and limitations of the apoB/apoA-I ratio to predict the risk of vascular disease: a Hegelian analysis. Curr. Atheroscler. Rep. 2007;9(4):261-5.
46. Srinivasan SR, Berenson GS. Serum apolipoproteins A-I and B as markers of coronary artery disease risk in early life: the Bogalusa Heart Study. Clin. Chem. 1995;41(1):159-64.
47. Kaneva AM, Potolitsyna NN, Bojko ER et al. The apolipoprotein B/apolipoprotein A-I ratio as a potential marker of plasma atherogenicity. Disease Markers. 2015;2015:591454. DOI: 10.1155/2015/591454
48. Haddy N, De Bacquer D, Chemaly MM et al. The importance of plasma apolipoprotein E concentration in addition to its common polymorphism on inter-individual variation in lipid levels: results from Apo Europe. Europ. J. Hum. Genetics. 2002;10(12):841-50. DOI: 10.1038/sj.ejhg.5200864
49. Yoshida A, Kouwaki M, Matsutani Y et al. Usefulness of serum total cholesterol/triglyceride ratio for predicting the presence of small, dense LDL. J. Atheroscler. Thromb. 2004;11(4):215-9. DOI: 10.5551/jat.11.215
50. Walldius G. The apoB/apoA-I ratio is a strong predictor of cardiovascular risk, in Frank S., Kostner G. (Eds.), Lipoproteins in Health and Diseases. Rijeka, 2012, pp. 95-148.

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OBESITY IN VARIOUS ETHNIC POPULATIONS

This article presents a review of the literature. The authors conducted a scientific search on the epidemiology of obesity and overweight in different ethnic groups, using the relevant keywords, on the search engines PubMed and Google Scholar, on the Scopus, Web of Science, MedLine, The Global Health databases, CyberLeninka, eLIBRARY.RU and others. Obesity is widespread among children, adolescents and adults. Most of the epidemiological studies conducted to identify obesity and overweight used the most accessible method - the determination of body mass index (BMI). Data on ethnic origin can provide additional information for a personalized prognosis; to date, there is no single classification for obesity and overweight for Asians.

Keywords: obesity, overweight, body mass index, ethnos, population, prevalence, complications.

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Obesity is an increase in body fat, leading to the appearance of overweight, is a common chronic metabolic disease in Russia and the world that occurs at any age. Currently, there is an increase in overall morbidity and mortality from complications (metabolic syndrome, type 2 diabetes, liver steatosis, arterial hypertension, IHD, etc.) in this condition.

It is well known that the causes of obesity are: hereditary predisposition (increased activity of lipogenesis enzymes and reduced activity of lipolysis enzymes), failure to follow the mode and nature of nutrition (frequent, excessive food), endocrine disorders, stressful situations (psychogenic overeating), hormonal drugs, a sedentary image life (motor mode must be combined with proper nutrition and the rejection of bad habits).

Overweight is not only a socio-economic and cosmetic problem, but primarily a medical one. It is proved that the greater the body weight, the lower the life expectancy due to the development of serious diseases. In this regard, significant efforts of modern endocrinology are aimed at studying the causes and mechanisms of the development of overweight and obesity [3; 12; 13] and their correction.

The epidemiology of obesity depends