DOI:10.23888/PAVLOVJ201927141-48

СРАВНЕНИЕ ДАННЫХ ОЦЕНКИ ВИТАМИННОЙ ОБЕСПЕЧЕННОСТИ НАСЕЛЕНИЯ АРКТИЧЕСКОЙ ЗОНЫ РОССИИ С ПОМОЩЬЮ РАСЧЕТНЫХ И БИОХИМИЧЕСКИХ МЕТОДОВ

© Н.А. Бекетова, О.А. Вржесинская, Э.Э. Кешабянц, И.В. Кобелькова, Н.Н. Денисова, В.М. Коденцова

ФГБУН Федеральный исследовательский центр питания, биотехнологии и безопасности пищи, Москва, Россия

Цель. Сопоставить расчетные показатели потребления с рационами питания витаминов A, B_2, D и бета-каротина и биомаркеры витаминного статуса 178 жителей поселков Тазовский и Гыда Ямало-Ненецкого автономного округа РФ. ***Материалы и методы***. Фактическое питание было исследовано частотным (по частоте потребления пищевых продуктов за предшествующий месяц) и 24-часовым (суточным) методами воспроизведения. Витаминный статус оценивали по содержанию витаминов в сыворотке крови. ***Результаты***. Была установлена статистически значимая взаимосвязь между концентрацией бета-каротина в сыворотке крови и его потреблением с рационом. Не обнаружено выраженной взаимосвязи между уровнем потребления рыбы и обеспеченностью витамином D. ***Заключение.*** Расчетные данные потребления витаминов позволяют выявлять отклонения от оптимального питания и группы риска развития алиментарной недостаточности, но не всегда дают возможность провести объективную оценку индивидуальной витаминной обеспеченности. Так, у лиц с явным недостатком витамина А в рационе в предыдущий перед взятием крови день, в крови он находился в диапазоне, характерном для адекватной обеспеченности.

Ключевые слова*: фактическое питание, обеспеченность витаминами, потребление витаминов, сыворотка крови, коренное и пришлое население.*

EVALUATION OF VITAMIN STATUS OF THE POPULATION OF THE RUSSIAN ARCTIC ACCORDING TO THE DATA ON VITAMIN CONSUMPTION AND SERUM LEVEL

N.A. Beketova, O.A. Vrzhesinskaya, E.E. Keshabyants, I.V. Kobelkova, N.N. Denisova, V.M. Kodentsova

Federal Research Centre of Nutrition, Biotechnology and Food Safety, Moscow, Russia

Aim. To compare the calculated data of A, B2, D vitamins and beta-carotene consumption with diets and biomarkers of vitamin status of 178 residents of Tazovsky and Gyda settlements of Yamal-Nenets Autonomous Area. ***Materials and Methods.*** The actual nutrition was studied by frequency (according to the frequency of food consumption for the previous month) and 24-hour (daily) reproduction methods. Vitamin status was assessed by serum vitamin concentration. ***Results***. A statistically significant relationship between serum beta-carotene level and its consumption with rations was established. There was no significant relationship between the level of fish consumption and vitamin D sufficiency. ***Conclusion.*** Vitamin intake data provide a framework to reveal deviations from optimal nutrition and to identify risk groups with vitamin deficien-

DOI:10.23888/PAVLOVJ201927141-48

cy, but they do not always make it possible to carry out an objective assessment of individual vitamin sufficiency. Thus, in individuals with a clear lack of vitamin A in the diet on the previous day before taking blood, blood retinol level was in the normal range.

Keywords*: actual nutrition, vitamins sufficiency, consumption of vitamins, serum, indigenous and ancestral populations.*

A potential risk factor for the development of vitamin deficiency in the population of the Polar region is the uniformity of the diet, associated both with a limited set of local types of food (mainly fish and fish products, venison) [1], and with the difficulties of importing certain foods (dairy, vegetables and fruits) in conditions of complex transport accessibility of the territory in combination with extreme climatic conditions. The loss of the egalitarian («horizontal») principle of distribution due to the donation-distribution of reindeer-breeding products within the community serves as one of the factors that violate the maintenance of the nutritional status and health of the indigenous northerners [2]. Low sun rise above the horizon and a short day length in winter do not provide adequate levels of vitamin D in the blood due to its endogenous synthesis in the skin [3,4], which may be one of the reasons for the widespread prevalence deficiency of this vitamin in the North [5]. An additional risk factor for the development of vitamin deficiency in the population of the Polar region can be exposure to pollutants and toxic substances as a result of intensive industrial development of hydrocarbon deposits, which is accompanied by activation of free radical oxidation processes [6]. Several vitamins (B group, E, C, carotenoids) involved in metabolic processes, are antioxidants [7,8], this allows us to consider the biochemical markers of vitamin status as one of the criteria for the integral assessment of adaptation reserves of the body in extreme climatic conditions of the Far North [9].

Aim of the study was to compare the calculated data of vitamins consumption with food rations and the results of the assessment of vitamin status based on the concentration of their metabolites in the blood.

Materials and Methods

The actual nutrition and vitamin status of the indigenous and alien populations were examined in 178 people over 18 years old living in the villages of Tazovsky and Gyda, located in the northeast of the Yamal-Nenets Autonomous Area. 78.9% of the surveyed were women, 21.1% were men. The number of the indigenous population leading a settled, nomadic or semi-emacid lifestyle was 79.2% of all those surveyed, while the alien population was 20.8%. The actual nutrition was studied by frequency (according to the frequency of food consumption for the previous month) and 24-hour (daily) reproduction methods [10,11]. Vitamin status was assessed by the content of vitamins in the serum. The concentration of retinol (vitamin A) and beta-carotene was determined using high performance liquid chromatography [12], riboflavin (vitamin B_2) – by fluorimetric method using riboflavin-binding apoprotein [13], 25-hydroxyvitamin D [25(OH)D] (vitamin D) – enzyme immunoassay method using the test system «ELECSYS Vitamin D Total» (F. Hoffmann-La Roche Ltd., Switzerland). Persons with indicators that did not reach the lower limit of the norm [13] were considered to be insufficiently provided with vitamins.

Statistical analysis of the obtained data was performed using the SPSS v.20.0 program (SPSS Inc., USA). Significant differences were considered at $p<0.05$.

Results and Discussion

Analysis of the actual nutritional data revealed vitamin A intake due to retinol 821.0±169.0 μg RE/day; beta-carotene – 2501.0±205.0 μg/day; vitamin B_2 – 1.5±0.1 mg/day [14]. The content of vitamins in the blood serum of the examined was: retinol 41.0±0.9 μg/dL, beta-carotene 14.8±1.1 μg/dL, riboflavin 8.3±0.5 ng/mL, as previously pre-

DOI:10.23888/PAVLOVJ201927141-48

sented [14]. Figures 1-3 show the results of individual assessment of micronutrient status obtained by biochemical methods and actual nutrition indicators for the preceding day for vitamins A, B_2 and beta-carotene. The indicators have the form of «clouds», and for vitamin B_2 there is a tendency of riboflavin level increasing with vitamin B_2 consumption elevation.

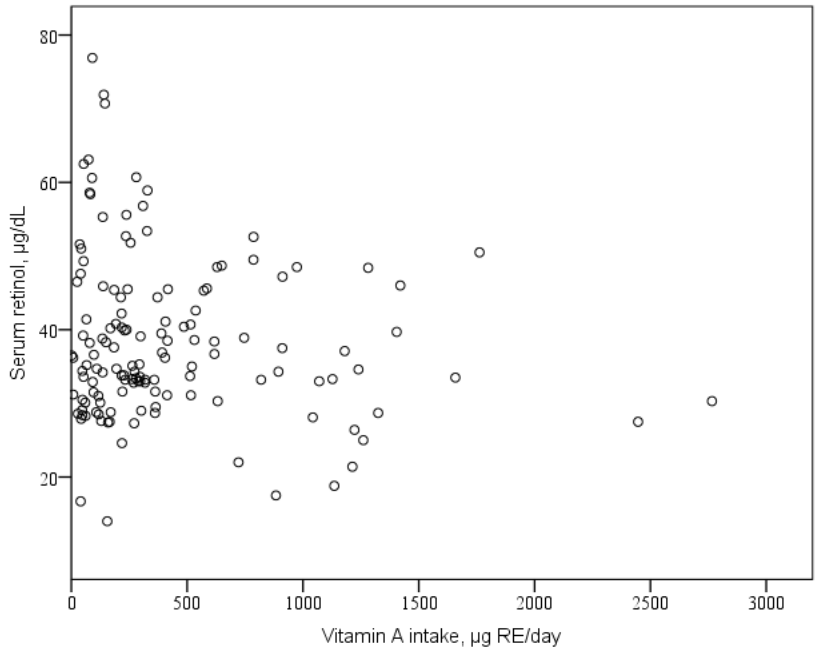

Fig. 1. Individual indicators of the surveyed in the coordinates:
the serum concentration of retinol – vitamin A consumption with diet

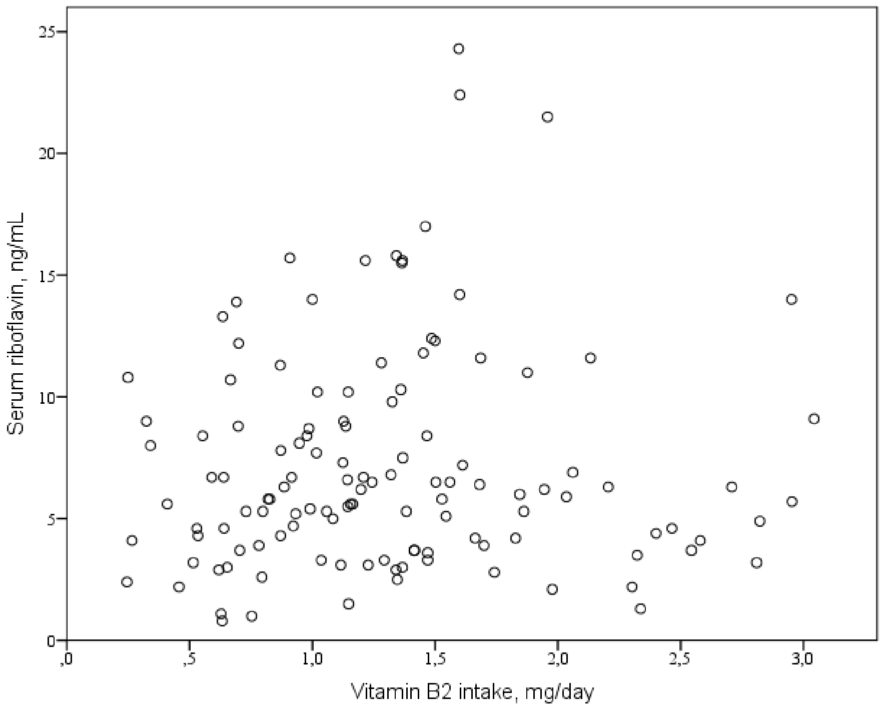

Fig. 2. Individual indicators of the surveyed in the coordinates:
the serum concentration of riboflavin – vitamin B_2 consumption with a diet

DOI:10.23888/PAVLOVJ201927141-48

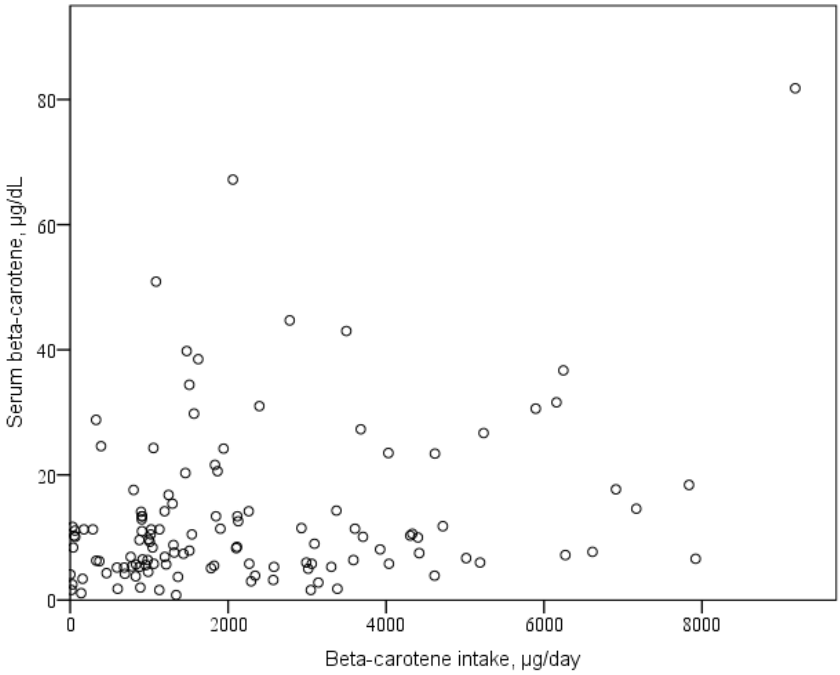

Fig. 3. Individual indicators of the surveyed in the coordinates: the serum concentration of beta-carotene – consumption with diet

An analysis of the relationship between the concentration of metabolites of vitamins in the serum and the consumption of micronutrients shows that a statistically significant relationship is found only for beta-carotene; for the other two vitamins, it does not reach the level of significancy (Table 1).

Table 1

Indicators of the Correlation (ρ of Spearman) between Serum Vitamin Content, Diet Vitamin Intake and the Consumption of Certain Groups of Foods

Biomarker (serum)	Dietary intake	ρ (statistical significance, p)
Retinol, µg/dL	vitamin A (retinol), µg/day	-0.020 (>0.05)
	frequency of consumption of vegetables, portion/day	0.168 (0.042)
Riboflavin, ng/mL	vitamin B2, mg/day	0.051 (>0.05)
25(OH)D, ng/L	fish and fish products, g/day	0.119 (>0.05)
β-carotene, µg/dL	β-carotene, µg/day	0.241 (0.004)
	vegetables, g/day	0.273 (0.001)
	frequency of consumption of vegetables, portion/day	0.365 (<0.001)
	fruit, g/day	0.410 (<0.001)
	frequency of consumption of fruit, portion/day	0.350 (<0.001)

The lack of correlation between the level of vitamin a intake in the form of retinol and its concentration in the blood is obviously explained by the existing mechanism of maintaining the metabolite concentration at the physiological level both due to the transport of retinol with retinol-binding protein from the liver (vitamin a depot) and due to the conversion of beta-carotene from food to retinol. As can be seen from Table 2, the main sources of vitamin A were fish and fish products, as well as dairy products, beta-carotene – vegetables and fruits, vitamin B_2 – meat products, including venison, as well as vegetables.

Table 2

Significant Correlations (ρ of Spearman) between the Vitamins Content in the Diet and the Level of Consumption of the Main Food Groups

Vitamin	Food group	ρ (statistical significance, p)
A (retinol) µg/day	fish and fish products, g/day	0.396 (<0.001)
	milk products in terms of milk, g/day	0.291 (<0.001)
β-carotene, µg/day	vegetables, g/day	0.642 (<0.001)
	fruit, g/day	0.215 (0.005)
B_2, mg/day	meat products in terms of meat, g/day	0.567 (<0.001)
	venison, g/day	0.453 (<0.001)
	vegetables, g/day	0.371 (<0.001)

With regard to B vitamins, it is known that their absorption is affected by the food matrix [15]. Thus, for the final conclusion about the interchangeability of the calculated and biochemical methods for assessing the supply of vitamin B_2, special studies are required, taking into account its bioavailability from different foods.

As can be seen from the data in Table 2, the main sources of vitamin A were fish and fish products, as well as dairy products, beta-carotene – vegetables and fruits, vitamin B_2 – meat products, including venison.

The statistically significant relationship between the biochemical indices of vitamin status and the consumption of the main food groups (Table 1) was found only for beta-carotene that comes with vegetables and fruits, both in terms of quantity (g/day) and frequency of consumption (portions/day, for the last month). Contrary to expectations and literature data, it was not possible to identify a pronounced relationship between the level of fish consumption and vitamin D status (Table 1).

For further analysis, the results were ranked by the amount of consumption of the studied micronutrients (Table 3).

Table 3

Serum Content of Vitamin (M±m), Depending on the Level of its Consumption with a Diet [Me (min-max)]

Index	Tretil consumption		
	1	2	3
Vitamin A			
Vitamin A (due to retinol) intake, µg/day	74 (47.0-159.0)	271 (165.0-413.0)	888 (415.0-1305.0)
Serum retinol, µg/dL	40.2±2.0	38.2±1.3	38.1±1.6
Vitamin B2			
Vitamin B2 intake, mg/day	0.70 (0.5-1.0)	1.29 (1.0-1.5)	2.25 (1.6-9.3)
Serum riboflavin, ng/mL	7.2±0.9	8.3±1.0	8.3±1.0
Beta-carotene			
Beta-carotene intake, mg/day	0.61 (0.13-1.04)	1.57 (1.05-2.40)	4.32 (2.48-6.51)
Serum beta-carotene, µg/dL	9.1±0.8	15.7±2.0[1]	18.0±3.0[1]

Note: [1] – statistically significant difference from the first tretil

DOI:10.23888/PAVLOVJ201927141-48

Thus, it was established that the concentration of beta-carotene in the serum of the subjects examined in the second and third tretil of intake was statistically significantly higher (1.7 and 2.0 times, respectively) compared to the first tretil.

Conclusions

Comparison of two methods for assessing vitamin status showed that the data obtained by frequency and 24-hour recall methods do not always make it possible to conduct an objective assessment of individual vitamin status. Thus, in individuals with a clear lack of vitamin A in the diet on the previous day before taking blood, blood retinol level was in the normal range.

At the same time, the evaluation of the calculated data of vitamin intake for identifying deviations from optimal nutrition and developing measures for correcting them, as well as identifying groups at risk of developing nutritional deficiency is not in doubt. The data obtained demonstrated the importance of simultaneously using several methods for studying actual nutrition and nutritional status.

Литература

1. Мартинчик А.Н., Асауленко В.И., Батурин А.К., и др. Оценка фактического питания коренного и пришлого населения Ямало-Ненецкого автономного округа // Вопросы питания. 2010. Т. 79, №3. С. 55-60.
2. Козлов А.И., Вершубская Г.Г., Козлова М.А., и др. Влияние «традиционного» и «вестернизированного» распределения продуктов «арктической кухни» на статус питания коренных северян // Этнографическое обозрение. 2017. №6. С. 146-154. doi:10.13039/501100002261
3. Brustad M., Edvardsen K., Wilsgaard T., et al. Seasonality of UV-radiation and vitamin D status at 69 degrees north // Photochemical & Photobiological Sciences. 2007. Vol. 6, №8. P. 903-908. doi:10.1039/b702947k
4. Козлов А.И., Вершубская Г.Г., Рыжаенков В.Г. Сывороточный 25-гидроксивитамин D у населения Пермского края // Медицинский альманах. 2015. №4 (39). С. 219-222.
5. Andersen S., Jakobsen A., Rex H.L., et al. Vitamin D status in Greenland – dermal and dietary donations // International Journal of Circumpolar Health. 2013. Vol. 72. e21225. doi:10.3402/ijch.v72i0.21225
6. Snyder R. Xenobiotic Metabolism and the Mechanism(s) of Benzene Toxicity // Drug Metabolism Reviews. 2004. Vol. 36, №3-4. P. 531-547. doi:10.1081/DMR-200033445
7. Жолдакова З.И., Харчевникова И.В. Механизмы процессов биоактивации чужеродных химических веществ под действием ферментных систем организма // Вестник Российской академии медицинских наук. 2002. №8. С. 44-49.
8. Коденцова В.М., Вржесинская О.А., Мазо В.К. Витамины и окислительный стресс // Вопросы питания. 2013. Т. 82, №3. С. 11-18.
9. Рахманов Р.С., Блинова Т.В., Тарасов А.В., и др. Антиоксидантная система как перспективное направление в оценке состояния и прогнозировании здоровья населения // Гигиена и санитария. 2014. Т. 93, №6. С. 91-94.
10. Методические рекомендации по оценке количества потребляемой пищи методом 24-часового (суточного) воспроизведения питания (утв. зам. Главного государственного санитарного врача РФ Г.Г. Онищенко) №С1-19/14-17 от 26 февраля 1996 г.
11. Мартинчик А.Н., Батурин А.К., Баева В.С., и др. Разработка метода исследования фактического питания по анализу частоты потребления пищевых продуктов: создание вопросника и общая оценка достоверности метода // Вопросы питания. 1998. Т. 67, №3. С. 8-13.
12. Якушина Л.М., Бекетова Н.А., Бендер Е.Д., и др. Использование методов ВЭЖХ для определения витаминов в биологических жидкостях и пищевых продуктах // Вопросы питания. 1993. №1. С. 43-48.
13. Kodentsova V.M., Vrzhesinskaya O.A., Spirichev V.B. Fluorometric Riboflavin Titration in Plasma by Riboflavin-Binding Apoprotein as a Method for Vitamin B2 Status Assessment // Annals of Nutrition and Metabolism. 1995. Vol. 39, №6. P. 355-360. doi:10.1159/000177885
14. Никитюк Д.Б., Батурин А.К., Погожева А.В., и др. Проблемы питания населения Ямало-Ненецкого автономного округа // Научный вестник Ямало-Ненецкого автономного округа. 2017. №3 (96). С. 96-100.
15. Бекетова Н.А., Коденцова В.М., Вржесинская О.А., и др. Обеспеченность витаминами жителей сельских поселений российской Арктики // Вопросы питания. 2017. Т. 86, №3. С. 83-91. doi:10.24411/0042-8833-2017-00049

References

1. Martinchik AN, Asaulenko VI, Baturin AK, et al. Evaluation of dietary intake of indigenous and alien

populations in Yamal-Nenets Autonomous District. *Problems of Nutrition*. 2010;79(3):55-60. (In Russ).
2. Kozlov AI, Vershubskaya GG, Kozlova MA, et al. The Influence of the «Traditional» and «Westernized» Distribution of Products in the «Arctic Cuisine» on the Nutrition Status of the Indigenous Northerners. *Etnograficheskoe obozrenie*. 2017;(6):146-54. (In Russ). doi:10.13039/501100002261
3. Brustad M, Edvardsen K, Wilsgaard T, et al. Seasonality of UV-radiation and vitamin D status at 69 degrees north. *Photochemical and Photobiological Sciences*. 2007;6(8):903-8. doi:10.1039/b702947k
4. Kozlov AI, Vershuchbskaya GG, Ryzhayenkov VG. Syvorotochnyy 25-gidroksivitamin D u naseleniya Permskogo kraya. *Meditsinskiy al'manakh*. 2015; 4(39):219-22. (In Russ).
5. Andersen S, Jakobsen A, Rex HL, et al. Vitamin D status in Greenland – dermal and dietary donations. *International Journal of Circumpolar Health*. 2013; 72:e21225. doi:10.3402/ijch.v72i0.21225
6. Snyder R. Xenobiotic Metabolism and the Mechanism(s) of Benzene Toxicity. *Drug Metabolism Reviews.* 2004;36(3-4):531-47. doi:10.1081/DMR-200033445
7. Zholdakova ZI, Kharchevnikova IV. Mekhanizmy protsessov bioaktivatsii chuzherodnykh khimicheskikh veshchestv pod deystviyem fermentnykh sistem organizma. *Vestnik Rossiyskoy akademii meditsinskikh nauk.* 2002;(8):44-9. (In Russ).
8. Kodentsova VM, Vrzhesinskaya OA, Mazo VK. Vitamins and oxidative stress. *Problems of Nutrition*. 2013;82(3):11-8. (In Russ).
9. Rakhmanov RS, Blinova TV, Tarasov AV, et al. Antioxidant system as a perspective direction in the assessment of the state and prognosis of population health. *Hygiene and Sanitation (Russian journal)*. 2014;93(6):91-4. (In Russ).
10. Metodicheskiye rekomendatsii po otsenke kolichestva potreblyayemoy pishchi metodom 24-chasovogo (sutochnogo) vosproizvedeniya pitaniya (utv. zam. Glavnogo gosudarstvennogo sanitarnogo vracha RF G.G. Onishchenko) №S1-19/14-17 26 Feb 1996. (In Russ).
11. Martinchik AN, Baturin AK, Bayeva VS, et al. Razrabotka metoda issledovaniya fakticheskogo pitaniya po analizu chastoty potrebleniya pishchevykh produktov: sozdaniye voprosnika i obshchaya otsenka dostovernosti metoda. *Problems of Nutrition*. 1998;(3):8-13. (In Russ).
12. Yakushina LM, Beketova NA, Bender ED, et al. Ispol'zovaniye metodov v·EZHKH dlya opredeleniya vitaminov v biologicheskikh zhidkostyakh i pishchevykh produktakh. *Problems of Nutrition*. 1993;(1):43-8. (In Russ).
13. Kodentsova VM, Vrzhesinskaya OA, Spirichev VB. Fluorometric Riboflavin Titration in Plasma by Riboflavin-Binding Apoprotein as a Method for Vitamin B2 Status Assessment. *Annals of Nutrition and Metabolism.* 1995;39(6):355-60. doi:10.1159/000177885
14. Nikityuk DB, Baturin AK, Pogozheva AV, et al. Problems of nutrition of the population of the Yamalo-Nenets Autonomous District. *Scientific Bulletin of the Yamalo-Nenets Autonomous District.* 2017; 3(96):96-100. (In Russ).
15. Beketova NA, Kodentsova VM, Vrzhesinskaya OA, et al. Vitamin status of rural residents, living in Russian Arctic. *Problems of Nutrition*. 2017;86(3):83-91. (In Russ). doi:10.24411/0042-8833-2017-00049

Дополнительная информация [Additional Info]

Источник финансирования. Научно-исследовательская работа по подготовке рукописи проведена за счет средств субсидии на выполнение государственного задания в рамках Программы поисковых научных исследований (тема № 0529-2019-0062). [**Financing of study.** Research work on the preparation of the manuscript was carried out at the expense of subsidies for the implementation of the state task in the framework of the program of exploratory research (topic № 0529-2019-0062).]

Конфликт интересов. Авторы декларируют отсутствие явных и потенциальных конфликтов интересов, о которых необходимо сообщить в связи с публикацией данной статьи. [**Conflict of interests.** The authors declare no actual and potential conflict of interests which should be stated in connection with publication of the article.]

Участие авторов. Все авторы участвовали в разработке концепции, анализе и интерпретации данных и окончательно утвердили рукопись для публикации. [**Participation of authors.** All authors participated in the development of the concept, analysis and interpretation of data and finally approved the manuscript for publication.]

Информация об авторах [Authors Info]

***Бекетова Нина Алексеевна** – к.х.н., старший научный сотрудник лаборатории витаминов и минеральных веществ ФГБУН Федеральный исследовательский центр питания и биотехнологии, Москва, Россия. [**Nina A. Beketova** – PhD in Chemical Sciences, Senior Researcher of the Laboratory of Vitamins and Minerals, Federal Research Centre of Nutrition and Biotechnology, Moscow, Russia.]
SPIN: 6604-6431, ORCID ID: 0000-0003-2810-2351, Researcher ID: G-9077-2012. E-mail: beketova@ion.ru

DOI:10.23888/PAVLOVJ201927141-48

Вржесинская Оксана Александровна – к.б.н., ведущий научный сотрудник лаборатории витаминов и минеральных веществ ФГБУН Федеральный исследовательский центр питания и биотехнологии, Москва, Россия. [**Oksana A. Vrzhesinskaya** – PhD in Biological Sciences, Leading Researcher of the Laboratory of Vitamins and Minerals, Federal Research Centre of Nutrition and Biotechnology, Moscow, Russia.]
SPIN: 2745-1454, ORCID ID: 0000-0002-8973-8153, Researcher ID: V-2557-2017.

Кешабянц Эвелина Эдуардовна – к.м.н., старший научный сотрудник лаборатории эпидемиологии питания и генодиагностики алиментарно-зависимых заболеваний ФГБУН Федеральный исследовательский центр питания и биотехнологии, Москва, Россия. [**Evelina E. Keshabyants** – MD, PhD, Senior Researcher of Nutrition Epidemiology and Genodiagnostics of Alimentary-Dependent Diseases Laboratory, Federal Research Centre of Nutrition and Biotechnology, Moscow, Russia.]
SPIN: 1141-9666, ORCID ID: 0000-0001-9762-2647, Researcher ID: L-1533-2018.

Кобелькова Ирина Витальевна – к.м.н., старший научный сотрудник лаборатории спортивной антропологии и нутрициологии ФГБУН Федеральный исследовательский центр питания и биотехнологии, Москва, Россия. [**Irina V. Kobelkova** – MD, PhD, Senior Researcher of Sports Anthropology and Nutrition Laboratory, Federal Research Centre of Nutrition and Biotechnology, Moscow, Russia.]
SPIN: 1190-1096, ORCID ID: 0000-0002-1237-5147, Researcher ID: T-8462-2018.

Денисова Наталья Николаевна – к.м.н., научный сотрудник лаборатории эпидемиологии питания и генодиагностики алиментарно-зависимых заболеваний ФГБУН Федеральный исследовательский центр питания и биотехнологии, Москва, Россия. [**Natalia N. Denisova** – MD, PhD, Researcher of Nutrition Epidemiology and Genodiagnostics of Alimentary-Dependent Diseases Laboratory, Federal Research Centre of Nutrition and Biotechnology, Moscow, Russia.]
SPIN: 2696-2598, ORCID ID: 0000-0002-7664-2523, Researcher ID: L-1600-2018.

Коденцова Вера Митрофановна – д.б.н., профессор, главный научный сотрудник лаборатории витаминов и минеральных веществ ФГБУН Федеральный исследовательский центр питания и биотехнологии, Москва, Россия. [**Vera M. Kodentsova** – PhD in Biological Sciences, Professor, Chief Researcher of Vitamins and Minerals, Federal Research Centre of Nutrition and Biotechnology, Moscow, Russia.]
SPIN: 1190-1096, ORCID ID: 0000-0002-5288-1132, Researcher ID: V-2465-2017.

Цитировать: Бекетова Н.А., Вржесинская О.А., Кешабянц Э.Э., Кобелькова И.В., Денисова Н.Н., Коденцова В.М. Сравнение данных оценки витаминной обеспеченности населения арктической зоны России с помощью расчетных и биохимических методов // Российский медико-биологический вестник имени академика И.П. Павлова. 2019. Т. 27, №1. С. 41-48. doi:10.23888/PAVLOVJ201927141-48

To cite this article: Beketova NA, Vrzhesinskaya OA, Keshabyants EE, Kobelkova IV, Denisova NN, Kodentsova VM. Evaluation of vitamin status of the population of the Russian arctic according to the data on vitamin consumption and serum level. *I.P. Pavlov Russian Medical Biological Herald.* 2019;27(1):41-8. doi:10.23888/PAVLOVJ 201927141-48

Поступила/Received: 17.12.2018
Принята в печать/Accepted: 15.03.2019