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Evaluation of the Intake of Vitamin D in the Daily Food Rations by the Students †

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Abstract: Over the past two years, a significant number of studies and statistical reports have appeared that prove the relationship between the level of vitamin D in the body and the severity of COVID-19. The main sources of vitamin D in the human body are food and sunlight. The purpose of this study was to evaluate the intake of vitamin D in daily food rations by the students. As an applied aspect, consider the effect of the frequency of consumption of vitamin D-containing foods on the occurrence of symptoms of allergic diseases. The study was a cross-sectional descriptive survey of two universities in the city Kharkiv (Ukraine) students. The data collection was carried out by a conducting questionnaire with three sections: frequency of consumption for 22 vitamin D-containing foods, identify allergic symptom, and an estimate of the average duration of exposure time to sunlight by season. The survey suggests that the rations of students are poor to consume products vitamin D-containing foods. The classification of these products was carried out using statistical analysis of data and chemometric techniques. There was a lack of consumption of vitamin D-containing foods and a critical time spent in sunlight, regardless of the season. At the same time, a positive correlation between the presence of vitamin D deficiency in young people and a high percentage of respondents with symptoms of allergic diseases was obtained.

Keywords: vitamin D-containing foods; vitamin D deficiency; vitamin D intake; vitamin D sources; vitamin D; allergic diseases; food preferences

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1. Introduction

Vitamin D is a fat-soluble vitamin, which is necessary for important vital processes. Adequate vitamin D status plays a key role in skeletal health. Vitamin D deficiency has been linked to diseases such as rickets and osteomalacia, and low levels of vitamin D have also been linked to bone loss, muscle weakness, falls, and fractures in the elderly [1]. In addition to its association with bone metabolism, vitamin D is recognized as an immunomodulator with important effects on both adaptive and innate immunity [2]. When considering its role as an immunomodulator, two public health concerns are important in terms of morbidity.

The first of these is recent and related to the COVID-19 pandemic. Numerous publications over the past two years have noted the link the severity of the disease to vitamin D levels in the human body (for example, [3–6]). B meta-analysis with random effect measures [7] concluded that vitamin D deficiency was not associated with a higher chance of contracting COVID-19. But at the same time, vitamin D deficiency accompanies severe

cases of COVID-19 disease compared to mild cases. It also increases the rate of hospitalizations. This allows the authors to conclude that there is a positive relationship between vitamin D deficiency and disease severity.

Another problem is related to the correlation between vitamin D status and asthma, namely, trying to get an estimate of its impact on the prevalence of asthma, allergic rhinitis and other allergic diseases. Thus, according to [8] vitamin D affects the development of the lungs and the immune system, which is important for the development, severity and course of various allergic diseases. The relevance of such research has not decreased even today. The epidemiological data in a review [1] indicate that, on the one hand, in recent years, the incidence of asthma has increased significantly in most countries. On the other hand, there is evidence of a high prevalence of low vitamin D intake and vitamin D deficiency or inadequate vitamin D status. All of the above leads to the conclusion that increasing oral vitamin D intake should be a priority in an optimal public health strategy, including vitamin D-fortified foods [9].

Previously [10] it was shown that foods rich in vitamin D are not among the preferences of young people, with the exception of foods such as eggs and cheese. The various types of fish and seafood that contain the highest concentrations of vitamin D score fairly low on both frequency of consumption and eating habits. In light of this, it is very important to analyze the current intake of vitamin D in young people of reproductive age with an assessment of the relationship between the level of intake of vitamin D and the presence of symptoms of allergic diseases.

2. Methods

2.1. Design of Questionnaire

Data collection was carried out by conducting questionnaire with three sections A, B and C:

1. (A)—the freguency of food consumption were assessed for 22 vitamin D-containing foods on a 5-hoint rating scale as in [10].
2. (B)—the identify allergic diseases according method method [11] than developed by the Ministry of Health of Ukraine were assessed.
3. (C)—средняя длительность пребівания (в часах) под. действием солнечнsх лучей в заисиvости от сезона.

2.2. Questionnaire Distribution and Data Collection

The study was a cross-sectional descriptive survey. The respondents included in the study were 189 students of two universities V.N. Karazin Kharkiv National University and State Biotechnological University in the city Kharkiv (Ukraine) of the aged 17 to 21.

2.3. Data Analysis

Before analysis of data the reliability as the degree of consistency between two independently obtained series of indicators within the framework of a statistical approach using Pearson correlation coefficients was carried out. The obtained coefficients of 0.921 and 0.924 testify to the reliability of the data obtained on consumption frequency of vitamin D-containing foods.

The multivariate analysis (hierarchical cluster and principal component analysis) was performed to classify the vitamin D-containing food based on the similarities of their frequency of consumption as in [10,12].

The data analysis was performed by using and Minitab ver. 18 (Minitab Inc., Pennsylvania, Philadelphia, USA) software.

3. Results and Discussions

3.1. The Consumption of Vitamin D in the Daily Food Rations by the Students

According to the data for all respondents in part A of the questionnaire, the values of the average frequency of consumption of vitamin D-containing products were calculated. The obtained results confirmed the earlier conclusion of the research [13] about the low frequency of consumption of foods rich in vitamin D.

Hierarchical cluster (Figure 1) and principal component (Figure 2) analysis was performed to classify samples based on the similarity of consumption frequency for foods containing vitamin D.

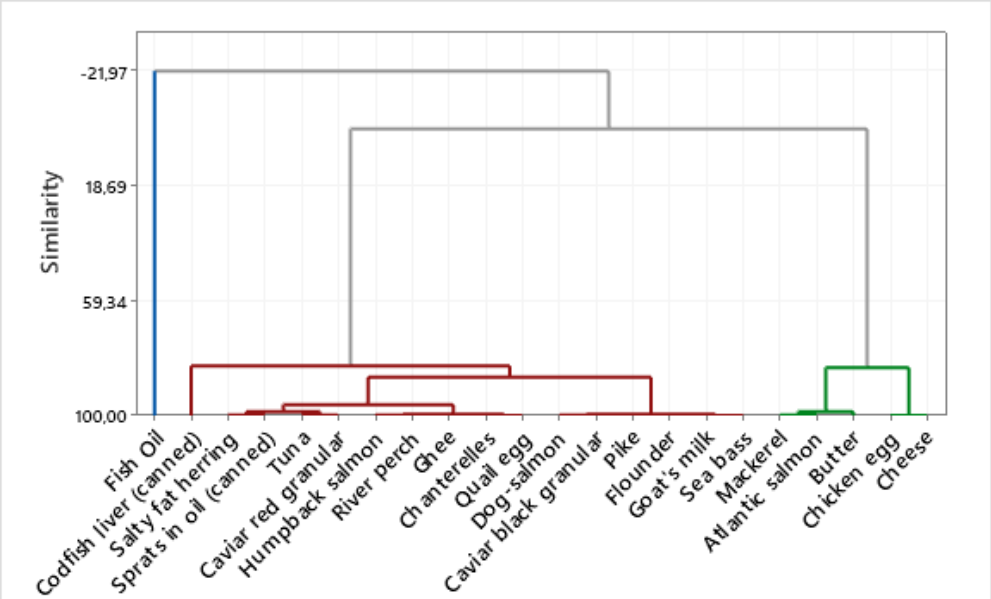

Figure 1. Hierarchical cluster analysis dendrogram with three clusters (with Ward Linkage; Squared Euclidean Distance).

All 22 vitamin D-containing foods considered were assigned to 3 clusters. This distribution is similar to that obtained in [13]. Foods containing the most vitamin D are in cluster 1, with a negative correlation between vitamin D content and intake (Figure 2).

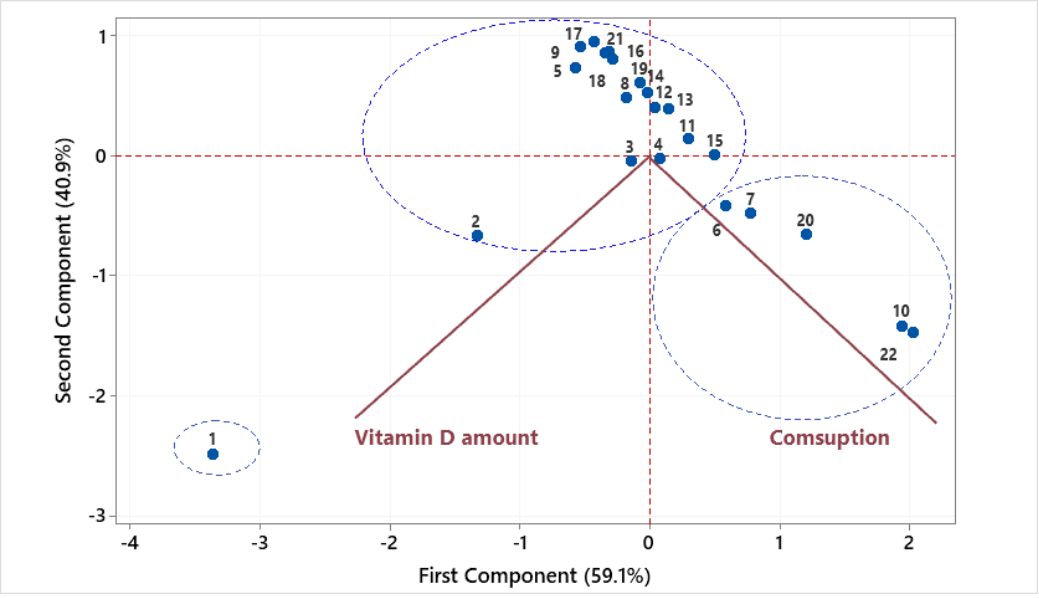

Figure 2. Principal component analysis of the score and loading plot of Comsuption and Vitamin D amount data: 1—Fish Oil; 2—Codfish liver (canned); 3—Salty fat herring; 4—Sprats in oil (canned); 5—Dog-salmon; 6—Mackerel; 7—Atlantic salmon; 8—Humpback salmon; 9—Caviar black granular; 10—Chicken egg; 11—Tuna; 12—Chanterelles; 13—Quail egg; 14—River perch; 15—Caviar red granular; 16—Flounder; 17—Pike; 18—Sea bass; 19—Ghee; 20—Butter; 21—Goat's milk; 22—Cheese.

That is, they are less attractive to students and less consumed. At the same time, cluster 2 with the highest consumption values are traditional products in the diets of the population of Ukraine, but with a low content of vitamin D.

3.2. The Relationship between the Consumption of Vitamin D-Containing Foods and the Development of Allergic Diseases

The results of data analysis are presented in Table 1. The studies presented 149 participants. Data for 37 participants were excluded from consideration. The exclusion criteria from this study were incomplete data from self-completed questionnaires assessing the frequency of consumption of foods rich in vitamin D, and/or incomplete data regarding self-reported signs of allergic diseases in respondents, and/or assessment of the duration of sun exposure depending on the season. The majority of female respondents took part in the study, their number was 74.5% of the total number of respondents. For each of the respondents, according to questionnaire B, the values of the number of allergic manifestations were calculated. These data were reviewed separately for male and female. (Table 1 Allergic manifestations among male and female differ significantly. So in males, the percentage of symptoms of allergic diseases is as follows: asthma attacks—3%, asthma attacks or heavy breathing—11%, attacks of choking cough—0%, periodic wheezing (whistling)—3%, frequent or persistent nasal congestion—22%, discharge from the nose without a cold—22%, itching of the eyes, eyelids, nose—13%, skin rashes—21%, swelling on the skin—5%. For female: attacks of choking—4%, attacks of choking or heavy breathing—11%, bouts of choking cough—4%, periodic wheezing (whistling)—2%, frequent or persistent nasal congestion—13%, discharge from the nose without a cold—13 %, itching of the eyes, eyelids, nose—19%, skin rashes—26%, swelling on the skin—8%.

Table 1. The results of data analysis of questionnaire.

Gender	Number (%)	Respondents with Symptoms or Disease (%)		Average Vitamin D Consumption (in Count of Scale)		Average Time in the Sun (Hour)	
		Group S	Group H	Group S	Group H	Group S	Group H
Female	111 (74.5%)	93 (80.6%)	18 (19.4%)	1.61 ± 0.46 [1]	1.65 ± 0.50	4.71 ± 1.66	5.10 ± 2.53
Male	38 (25.5%)	30 (78.9%)	8 (21.1%)	1.30 ± 0.40	1.78 ± 0.42	4.34 ± 2.27	6.25 ± 1.50

[1] Standard deviation.

Thus, the largest percentage of allergic manifestations among females is skin rashes. And among the males-nasal congestion and discharge from the nose. In addition, males completely lack bouts of suffocating cough. Which suggests that the groups of females and males should still be considered separately.

For further analysis, according to the results of questionnaire B, all females and males were divided into two groups:

- Group H ("healthy"), consisting of respondents who do not have symptoms of manifestations of allergic diseases.
- Group S (with "symptoms"), respondents who had at least one symptom of allergic diseases.

It should be noted that only 26 respondents or 17.4% of the total number of respondents did not indicate signs of manifestation of allergic diseases. When viewed in terms of gender, the number of healthy respondents was approximately 20% for both males and females. Out of a total of 123 people, 38, 64, and 21 respondents had 1, 2, or more than 3 symptoms, respectively.

The uniqueness of this vitamin is associated with the duality of its intake into the human body:

- The first way is associated with the synthesis of vitamin D by the human body under the influence of sunlight [14].
- The second way is associated with eating foods containing this vitamin.

The assessment of the frequency of consumption of products with vitamin D was carried out according to the questionnaire A separately for the indicated groups and genders of respondents. Average vitamin D consumption (frequency) was not associated with a higher demonstration of allergic diseases symptoms. Testing the hypothesis about the equality of means using the t-test showed that the difference between them is not statistically significant. However, the results obtained for the boy group indicate that there is a relationship between the frequency of consumption of foods rich in vitamin D and the presence of symptoms of allergic diseases. For the group of females, the mean scores for the frequency of use in the group with symptoms of allergic diseases and without symptoms of allergic diseases do not differ significantly. This can be explained by the fact that the attitude of girls to their appearance is more critical. The research [15] shows that, что whereas women rely on self-critical social comparison strategies associated with negative body esteem, men's comparison strategies and perfection beliefs are more self-hopeful. Therefore, it can be assumed that a certain percentage of females find non-existent symptoms of skin allergies and therefore the percentage of females with manifestations of symptoms of allergic diseases can be considered overestimated. Based on this, when conducting future studies, questionnaire B should be detailed regarding the symptoms of allergic manifestations associated with the skin. In general, it should be noted that the level of frequency of consumption of foods rich in vitamin D is very low for all groups of respondents.

The duration of sun exposure was also evaluated, since ultraviolet radiation is the most important factor stimulating the synthesis of vitamin D in the human body. Since Kharkiv city is located at 50° north latitude based on the literature data [9] the synthesis of vitamin D in the body ceases between October and April in these latitudes. Average sun exposure data are presented in Table 1. As with the consumption of D-containing foods, the average time in the sun was not associated with a higher demonstration of allergic diseases symptoms based on statistical evaluation. But the results show a correlation between average sun exposure and the presence of allergic diseases symptoms. This is especially true for males.

4. Conclusions

Thus, it can be seen that if we consider groups by gender, then in the group of males, the dependence of the presence of symptoms of allergic diseases on the frequency of consumption of foods rich in vitamin D and the duration of exposure to solar ultraviolet radiation is very clearly traced. In the group of girls, such a clear relationship is not observed. Perhaps this happens, as mentioned above, because a certain percentage of girls perceive their appearance as "imperfect", which introduces a certain percentage of error.

However, analysis of data across the entire sample shows a relationship between the frequency of consumption of foods rich in vitamin D, the duration of sun exposure and the manifestations of allergic diseases. Respondents who do not find manifestations of allergic diseases eat foods rich in vitamin D more often and spend more time in the sun.

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