

Comparative analysis of diet, protein and vitamin-mineral status of Indian vegetarian students with different durations of stay in the Kyrgyz Republic and permanent residents of India

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Abstract. The aim of the study was to examine the characteristics and composition of the diet, including macro- and micronutrients, of Indian students adhering to a vegetarian lifestyle while residing in the Kyrgyz Republic, taking into account the duration of their stay, and to compare these indicators with a control group residing in India. The study included three groups of 50 participants each: newly arrived students in the Kyrgyz Republic (Group 1), students residing in the Kyrgyz Republic for more than four years (Group 2), and a control group living in India. Dietary assessment was performed using a 30-day food diary method. Based on the collected data, average daily energy intake, consumption of proteins, fats and carbohydrates, as well as dietary diversity, were analysed. Using food composition reference tables, the approximate intake of macronutrients and selected micronutrients in the participants' diets was calculated. The results demonstrated that both Group 1 and Group 2 showed reduced intake of proteins and fats, as well as a lower proportion of legumes and dark green vegetables, compared with the control group from India. Adequate overall caloric intake was achieved mainly through increased carbohydrate consumption, including foods with low nutritional value (snacks, sweets), particularly among newly arrived students. In Group 1, reduced dietary intake of iron, vitamin B₁₂ and vitamin A was also observed. Students who had resided in the Kyrgyz Republic for a longer period demonstrated a tendency towards dietary improvement; however, diet quality remained inferior to that of the control group. Conclusions drawn from the obtained data indicated a risk of developing protein-energy and vitamin-mineral deficiencies. This highlighted the need to develop adapted dietary patterns with increased diversity of plant-based foods to prevent deficiencies and improve the health status of foreign students during the adaptation period. The study results could be used in the development of adapted diets for foreign vegetarian students aimed at preventing nutritional deficiencies

Keywords: diet; dietary intake; protein-energy deficiency; vitamin and mineral deficiency; dietary adaptation

Suggested Citation:

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INTRODUCTION

A significant proportion of international students from India, due to cultural and religious traditions, adhered to a vegetarian dietary pattern. Vegetarianism, despite certain positive aspects, was associated with a number of potential risks and specific features that needed to be taken into account when organising adequate nutrition. An unbalanced vegetarian diet was often characterised by a deficiency of several key nutrients, such as proteins, essential amino acids, iron, and vitamins, particularly vitamin B₁₂. A lack of these elements could lead to deficiency states, reduced immunity, deterioration of general well-being, and decreased work capacity [1].

In the study by R.M. Dzhumaev *et al.* [2], the impact of a vegetarian diet on the development of protein-energy and vitamin-mineral deficiencies in Indian students studying abroad was examined. It was demonstrated that an unbalanced plant-based diet was accompanied by reduced intake of protein, iron, and several vitamins, which increased the risk of nutritional deficiencies and deterioration of overall health status. At the same time, in India, the majority of the population obtained approximately 60% of protein from cereal crops. However, even with adequate availability of legume products, the requirement for certain individual amino acids might not have been fully met [3].

A number of studies also emphasised that relocation was accompanied by changes in diet and potential health risks. In the article by R. Ysmailova *et al.* [4], the socio-psychological aspects of adaptation of international students in the Kyrgyz Republic were examined. The influence of nutrition and unfamiliar foods on students' health and academic performance was also noted. In the study by I.A. Lesser *et al.* [5], the relationship between acculturation and dietary habits among immigrants from South Asia (including India) who had relocated to Canada was investigated. It was shown that with increasing length of residence in the host country, the diet of the surveyed participants changed: consumption of local vegetables and fruits increased, food preparation methods improved, but at the same time intake of processed foods, ready-to-eat meals, and sugar-sweetened beverages rose. As a result, both positive and negative dietary changes were demonstrated. However, the conclusions were limited to Western settings and did not identify vegetarians as a separate group. In the study by L.S. Panchenko [6], the nutrition of international students studying in Volgograd was analysed. The study showed that many students retained previous dietary habits typical of a tropical climate; however, these diets were insufficient in terms of protein-fat composition and vitamin content, especially during the cold season in a sharply continental climate, which was also characteristic of the Kyrgyz Republic. As a consequence, students experienced difficulties with physiological adaptation. J.V. Varre *et al.* [7] emphasised that after relocation,

migrants' habitual diets changed: among representatives from South Asia, consumption of traditional whole grains, legumes, vegetables, and fibre-rich foods decreased, while the intake of processed foods increased. Dietary changes were influenced by factors such as length of residence, food availability, and socio-economic status. These changes also led to adverse outcomes, including an increased risk of obesity and metabolic diseases, confirming potential health problems during dietary adaptation. T.P. Yurochko *et al.* [8] reported that the diet of international students in Ukraine changed after relocation; dietary composition, types of foods, and frequency of consumption were assessed. Most students confirmed changes in their diet; however, no comparative "before/after" analysis was conducted. At the local level in the Kyrgyz Republic, A. Murzalieva & M. Manivannan [9] identified that international students faced problems of undernutrition and unbalanced diets. However, the study was predominantly descriptive and did not include dietary intake analysis, highlighting the need for more detailed research. In the study by E. Filipchenko *et al.* [10], the adaptation of Indian students in the Kyrgyz Republic was examined. It was demonstrated that adaptation affected physiological health and body condition, and that nutrition, through dietary characteristics, was considered a possible influencing factor. This reinforced the importance of studying diet and eating habits. However, it should be noted that the article did not provide a detailed dietary analysis and assessed only indirect biomarkers, namely the condition of the buccal epithelium and teeth. The study by A. Moldobaeva *et al.* [11] revealed that after relocation, students of medical universities in the southern part of the Kyrgyz Republic experienced dietary changes. Most students showed reduced consumption of fruits, vegetables, and whole-grain products, indicating a potential deficiency of essential vitamins, minerals, and dietary fibre. In addition, a large proportion of students relied on eating outside the home, which created difficulties in controlling food choices. Problems in finding healthy and preferred foods after relocation were also identified. This study highlighted that the nutrition of international students in the Kyrgyz Republic required special attention. Students faced the need to adapt to a new food environment, organise their own meals, and cope with limited access to familiar foods. Moreover, in the studies mentioned above, vegetarianism was not identified as a separate research group. Given that a vegetarian diet with an established system for compensating potential deficiencies (for example, through legumes and spices) was widespread in India, while the cuisine of the Kyrgyz Republic predominantly emphasised meat-based dishes with limited variety of plant foods, it could be assumed that international students from India who

continued to adhere to vegetarian diets under new conditions encountered difficulties in maintaining their previous nutritional balance.

The aim of the present study was to assess the diet of Indian vegetarian students residing in the Kyrgyz Republic, including the dietary content of macronutrients, iron, and vitamins B₁₂ and A, taking into account the duration of their stay, as well as to compare these indicators with a group continuing to reside in India. The study hypothesis was that the characteristics and quality of the diet of students from India underwent changes during residence in the Kyrgyz Republic, which could lead to reduced intake of key nutrients, primarily protein, iron, and vitamins B₁₂ and A.

The objectives of the study were as follows:

- to conduct a comparative analysis of the actual dietary intake of three groups: students and employees residing in India (control group), students from India in their first-second year of study in the Kyrgyz Republic, and students from India in their fourth-fifth year of study in the Kyrgyz Republic;

- to assess changes in the intake of key nutrients (protein, vitamins B₁₂ and A, and iron) depending on the duration of residence in the Kyrgyz Republic;

- to analyse possible causes and factors hindering adherence to a habitual vegetarian diet abroad (food availability, dietary preferences, and eating conditions).

MATERIALS AND METHODS

Participant recruitment, data collection, and data analysis were conducted from October 2022 to May 2023. Based on data reported in the studies by R.S. Bhatnagar & O.I. Padilla-Zakour [12] and S. Agrawal *et al.* [13] indicating a substantial proportion (>29%) of the vegetarian population in India, fourteen research publications were reviewed using the scientific electronic library eLibrary and the biomedical literature search engine PubMed to examine the impact of an unbalanced vegetarian diet on population health. An analysis of the risks of development and consequences of protein-energy malnutrition, as well as mineral and vitamin deficiencies, was carried out.

Subsequently, an assessment of the diets of three groups of 50 individuals each was conducted using the dietary record method to evaluate actual food intake. Participants who adhered to a vegetarian diet with permitted consumption of eggs and dairy products were selected. The first group consisted of newly arrived students from India in the Kyrgyz Republic, while the second group included students who had been residing in the Kyrgyz Republic for more than 4-5 years. Students of both sexes aged 18-34 years who were studying at Osh State University at the International Medical Faculty were selected. The third group served as a control for the first two groups and consisted of students and employees from various sectors residing in India and consuming a traditional plant-based diet. This group

included individuals living in different states and cities of India corresponding to the regions of origin of students in the first two study groups: the states of Tamil Nadu, Sikkim, Uttar Pradesh, Bihar, West Bengal, Telangana, Puducherry, Karnataka, the city of Delhi, and the Kashmir region. This group comprised students and workers from the educational, banking, and industrial sectors aged 19-42 years. The control group included individuals without severe chronic diseases and not experiencing material deprivation.

All participants provided voluntary informed consent to participate. The collected data were anonymised to ensure confidentiality. Study participants were asked to keep dietary records designed to be completed over a 30-day period. Each day was divided into four sections, in which all foods consumed at breakfast, lunch, dinner, and during snacks were to be recorded. The diaries listed mixed dishes as well as individual foods and beverages consumed during the day. For more accurate data analysis, participants were encouraged to specify the individual ingredients comprising mixed dishes; however, this clarification was not a mandatory requirement. For dishes for which full ingredient composition was not indicated, data from open sources on ingredient content were used. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki [14] and was approved by the Ethics Committee of the International Medical Faculty of Osh State University (Protocol No. 16, 07.10.2022). All participants provided voluntary informed consent, and the collected data were anonymised to ensure confidentiality.

The foods consumed by the study participants were classified into main food groups using the minimum dietary diversity recommendations, which included the following categories: (1) potatoes, (2) beans, peas, and other legumes, (3) nuts and seeds, (4) dairy products, (5) eggs, (6) dark green leafy vegetables, (7) root vegetables, (8) other vegetables, (9) fruits, and (10) cereals and bakery products. Based on the dietary diary data provided, indicators such as average daily energy intake, quantitative protein consumption, and dietary diversity were analysed. Dietary diversity was defined as the sum of food categories consumed from the ten groups proposed in the present study. In addition, a separate supplementary group of foods was identified that was not included in the calculation of minimum dietary diversity. This group comprised sugar-sweetened beverages, sweets, chocolate, cakes, biscuits, chips, snacks, and other products with high sodium and sugar content. In the present study, these products were considered not to meet healthy requirements for macro- and micronutrients. A 10-point scale was used to assess dietary diversity, corresponding to the ten main food group categories, excluding unhealthy products and oils. The collected data on food consumption formed the basis for assessing macronutrients (proteins, fats, and carbohydrates) and three micronutrients (iron, vitamin B₁₂,

and vitamin A), deficiencies of which vegetarians were most susceptible to. Data on the average nutritional value and micronutrient composition of each food item were obtained from the food composition tables edited by I.M. Skurikhin [15] and the U.S. Department of Agriculture, Agricultural Research Service [16].

To assess the statistical significance of differences between the study groups, a one-way analysis of variance (ANOVA) was performed. This method allowed the full set of observations within each group to be taken into account when calculating the F-statistic and determining whether significant differences existed between groups in terms of protein, fat, carbohydrate, vitamin B₁₂, iron, and vitamin A content. The selected significance level was $\alpha = 0.05$. The critical F value was 3.06.

No statistically significant differences were identified for mean daily energy intake (F-statistic = 2.25). In contrast, for the remaining indicators (protein intake, proportion of unhealthy foods, iron content, vitamin B₁₂, and vitamin A), the differences were statistically significant (F-statistic exceeded the critical F value, $p < 0.05$).

RESULTS AND DISCUSSION

Within the framework of the study, the mean daily energy intake of the diets of three groups was assessed: the control group (residing in India), newly arrived students from India studying in the Kyrgyz Republic (Group 1), and students from India who had been residing in the Kyrgyz Republic for more than 4-5 years (Group 2) (Fig. 1).

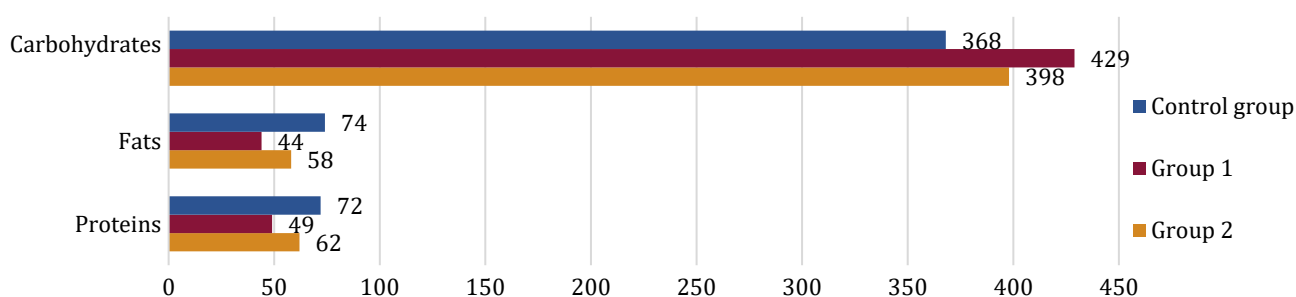


Figure 1. Mean daily nutritional value of the diet, g

Source: developed by the authors

The average daily caloric intake of the control group was 2,426 kcal, in Group 1 – 2,308 kcal, and in Group 2 – 2,362 kcal. Despite a slight decrease in the energy value for students residing in the Kyrgyz Republic, the results of one-way analysis of variance (ANOVA) did not reveal any statistically significant differences in caloric intake between the groups. This indicates that the overall energy provision for the students remained at a comparable level. However, when analyzing average protein consumption, significant differences were observed. In the control group, the average daily protein intake was 72 g, in Group 1 – 49 g (68% of the control group), and in Group 2 – 62 g (86% of the control group). ANOVA showed the statistical significance of these differences: the calculated F-statistic was 103.7. This indicates a significant reduction in protein content in the diet of students who arrived in the Kyrgyz Republic, especially during the early stages of the adaptation period. Thus, despite maintaining overall caloric intake, there was a substantial change in the macronutrient balance, with a decrease in protein and an increase in carbohydrates, which may indicate a risk of protein deficiency among students, particularly during the initial stages of living in a new country. Next, the mass consumption of products from different categories was studied (Fig. 2). The products were divided into 12 categories: potatoes, legumes, nuts and seeds, dairy products, eggs, dark green leafy vegetables, root

vegetables, other vegetables, fruits, grains and bakery products, oils, and unhealthy foods with high added sugars and sodium.

The analysis showed that the main component of the diet in all groups was cereal products. Their consumption among students residing in the Kyrgyz Republic was significantly higher than in the control group, especially during the initial adaptation period (Group 1), where a 25% increase was observed. In Group 2, this indicator decreased but remained 11% higher than in the control group. At the same time, the consumption of most other product categories (legumes, dark green leafy vegetables, fruits, other vegetables, potatoes, root vegetables) among students in the Kyrgyz Republic was lower compared to the control group. A noticeable decrease in the consumption of legumes and dark green leafy vegetables was particularly evident, which may indicate limited diversity and a lack of certain nutrients in the diet of Group 1. Dairy products were consumed at approximately the same level as in the control group, and the consumption of eggs and oils was slightly reduced. An interesting feature was the higher consumption of “unhealthy” products with high added sugar and sodium content among students in the Kyrgyz Republic, especially among newcomers, which was statistically significant. The results of the one-way analysis of variance showed high statistical significance of the differences (F-statistic = 11.7), indicating an in-

crease in the proportion of unhealthy food in the diet of foreign students, particularly during the early stages of

adaptation. Additionally, the average daily diversity of the students' diet was assessed (Fig. 3).

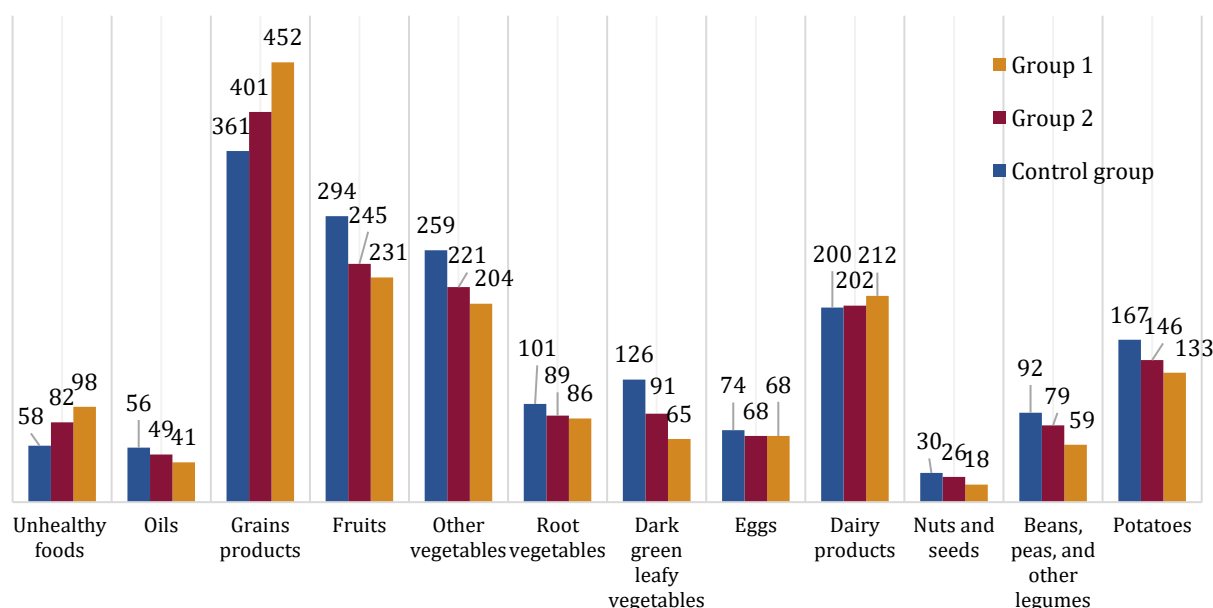


Figure 2. Average daily consumption of products in the specified categories in grams

Source: developed by the authors

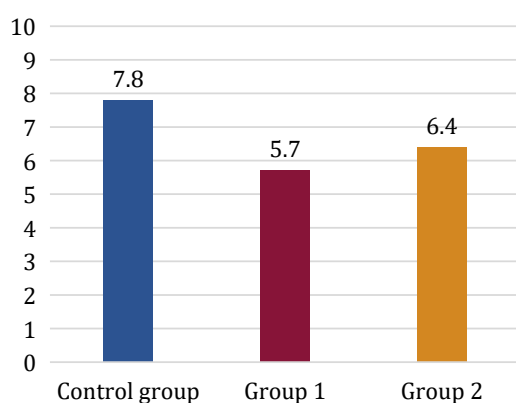


Figure 3. Average daily diet diversity

Source: developed by the authors

The assessment of the students' diet diversity on a 10-point scale revealed differences between the groups. In Group 1, the students who had just arrived in the Kyrgyz Republic, the average diversity score was 5.7, indicating a limited range of consumed product categories. Students in Group 2 demonstrated a higher level of diversity – 6.4, reflecting the gradual adaptation of their diet and an expansion of the range of consumed products with an increasing length of stay. This may be related to foreign students becoming more familiar with the local food assortment over time, as well as a loss of initial caution towards unfamiliar products and cooking methods. The control group, which continued to live in India, maintained the highest level of diversity at 7.8, which corresponds

to a traditional diet with a broad range of food categories. Thus, long-term stay in the Kyrgyz Republic contributes to a more balanced and diverse diet, but the diet still requires adjustments, especially concerning the consumption of legumes and dark green vegetables. Using food composition and micronutrient reference books, the approximate content of the main micronutrients, which are predominantly found in animal products, was calculated. The consumption of these nutrients is limited for lacto-ovo-vegetarians due to the absence of meat in their diet. Figures 4-6 present the average daily consumption values of iron, vitamin B₁₂, and vitamin A.

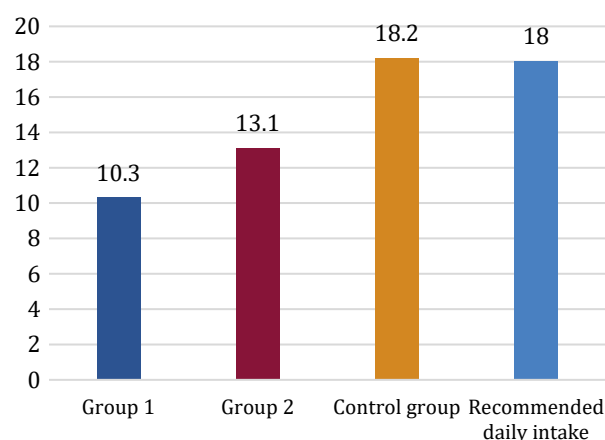


Figure 4. Daily iron consumption, mg

Source: developed by the authors

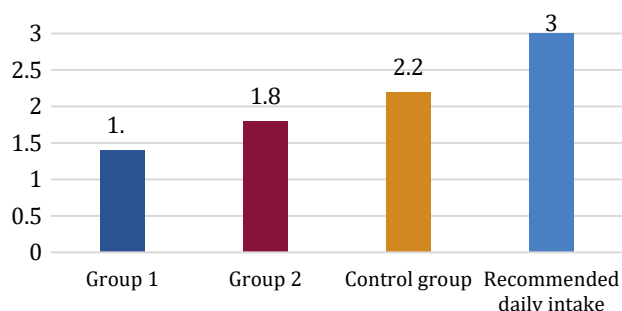


Figure 5. Daily vitamin B₁₂ consumption, µg

Source: developed by the authors

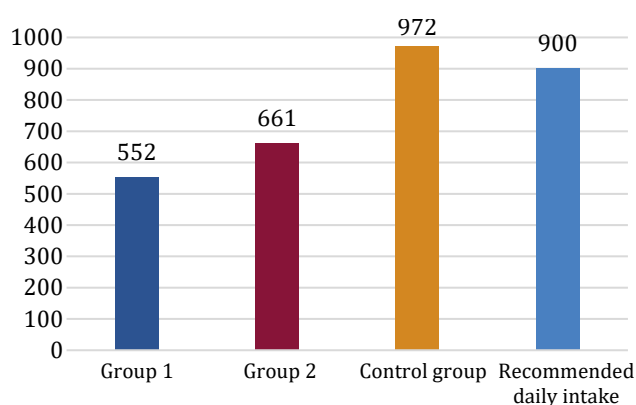


Figure 6. Daily vitamin A consumption, mcg

Source: developed by the authors

The recommended daily intake of iron was taken as the average value between the consumption recommendations for women and men, which is 18 mg. The diet of the control group fully meets the body's iron needs with 18.2 mg. Meanwhile, in Group 1, the average daily iron intake was only 10.3 mg, which is significantly lower than the recommended intake and indicates a risk of iron deficiency. In Group 2, iron consumption was higher (13.1 mg), but still insufficient to fully meet the body's needs. The analysis of vitamin B₁₂ consumption showed that none of the groups reached the recommended daily intake of 3 µg. The highest intake was observed in the control group – 2.2 µg, which is about 73% of the recommended value. Students in Groups 1 and 2 received only 46% (1.4 µg) and 60% (1.8 µg) of the recommended intake, respectively, which indicates a possible risk of vitamin B12 deficiency. The minimum recommended intake of vitamin A is 900 µg. The average vitamin A content in the diet of the control group exceeded this value by 72 µg, which is still below the upper limit for vitamin A consumption. However, in Groups 1 and 2, there is a deficiency of vitamin A: the average consumption is 552 µg and 661 µg, respectively, which is below the recommended value and may indicate a risk of hypovitaminosis. The data obtained demonstrate that students from India living in the Kyrgyz Republic, especially in the early years of their stay, experience significant changes in dietary habits and

food intake compared to the control group remaining in India. Despite comparable total caloric intake, students living in the Kyrgyz Republic show a decrease in protein, vitamin (B₁₂, A), and essential micronutrient intake, such as iron.

The main reason for the change in the quality of the diet is related to the limited availability of legumes, which are typical in Indian cuisine, as well as a limited range of vegetables and fruits, particularly in the autumn and winter periods. In the Kyrgyz Republic, replacing familiar plant-based proteins is difficult due to the smaller selection of legumes, which can be explained by differences in food traditions – eat is the primary source of protein in the local diet, which reduces the demand for and availability of legume products. Furthermore, seasonal fluctuations in the availability of fresh vegetables and fruits exacerbate deficiencies in vitamins and minerals. An additional factor contributing to changes in the diet is adaptation to a new lifestyle. Studying, practical training, stress, and other everyday circumstances influence eating habits and food choices. It is noticeable that students who have been living in the Kyrgyz Republic for more than 4-5 years have a more balanced diet, indicating gradual adaptation to the new conditions. However, despite the improvements, the diet of all students living in the Kyrgyz Republic still requires adjustments and rationalisation.

The study of the eating habits of the investigated groups of vegetarian students from India revealed deficiencies and potential risks associated with the lack of macro- and micronutrients, as well as imbalances in energy provision. To gain a deeper understanding of the dietary characteristics of vegetarians, it is advisable to compare the results of this study with the findings of D.O. Gorbachev *et al.* [17], which examined the actual content of macro- and micronutrients in the diet and biochemical status of vegetarians in Samara. The study focused on vegetarians without specifying their status as immigrants, while the current study focused on the diet of foreign students. Nevertheless, comparing the two studies allowed us to observe which nutrients were actually deficient according to the biochemical markers in the blood of vegetarians. The protein consumption analysis showed that vegetarian students from India had insufficient intake (49 g/day and 62 g/day), which is below the control group value (72 g/day). These results are consistent with the findings of D.O. Gorbachev *et al.*, where vegetarian consumption was 57-58 g/day. As for micronutrients, the deficiency of vitamin B₁₂ and iron was observed in all groups, with the lowest levels in Group 1 (B₁₂ – 1.4 µg/day, iron – 10.3 mg/day). A similar situation was observed in Samara, where most vegetarians had lower levels of vitamin B₁₂ and iron in their blood. The concentration of retinol in plasma was close to the lower limit of the norm, which correlates with the results of the current study, as a clear decrease in retinol in the blood is only observed after its reserves

in the liver are depleted. Thus, the comparison of the data shows that regardless of geographical and social context (Samara vs immigrant students), the diet of vegetarians can lead to deficiencies in protein and key vitamins, particularly B₁₂, iron, and vitamin A. In the study by D.S. Yasakov *et al.* [18], the impact of a vegetarian diet on nutrient status, health, and deficiency risks was analysed. This article identified typical deficiencies common among vegetarians – iron, vitamins A, B₁₂, and others – which confirms the relevance of the micronutrients selected for investigation in the current study. The paper states that lacto- and lacto-ovo-vegetarian diets can fully provide adequate protein intake, which aligns with the fact that the protein consumption in the control group was indeed normal (72 g/day). Additionally, the study by D.S. Yasakov *et al.* highlighted different types of vegetarianism and identified other micronutrients (zinc, vitamins D, B₂), which vegetarians are particularly deficient in but were not addressed in the current study.

In the study by L.D. D'Aloisio *et al.* [19], the adaptation of the diet of migrants and its impact on changes in gut microbiota due to lifestyle changes was examined. The authors showed that among Indians maintaining a traditional diet, the bacteria *Prevotella* spp., which are associated with the breakdown of complex carbohydrates, dominated. In contrast, immigrants demonstrated a transitional flora: a decrease in *Prevotella* spp. and an increase in bacteria typical of Western populations, which correlated with an increase in the consumption of processed foods, unhealthy foods, and a reduction in dietary fibre intake, as observed in the current study when evaluating changes in the consumption of different product categories among the groups. Such data underscore that changes in diet can lead not only to biochemical changes but also shifts in the microbiome, which can alter nutrient absorption, metabolism, and mineral and vitamin status.

The review by G. Holmboe-Ottesen & M. Wandel [20] provided a deeper understanding of the mechanisms underlying the observed changes in the diet of Indian students after migration. The review showed that after the migration of South Asians to Europe, eating habits almost always changed, including a decrease in the consumption of traditional sources of dietary fibre (legumes, vegetables, whole grains) and a reduction in the content of vitamins and minerals in the diet. However, the study did not specifically examine vegetarians. Nevertheless, the results of the current study logically align with the findings of the review: the transition to a new food and social environment leads to a reduction in the consumption of familiar foods that are key sources of micronutrients in India (legumes, various vegetables, spices). At the same time, migrants faced limited access to familiar products, which is reflected in the decrease in the variety of food categories consumed by students arriving in the Kyrgyz Republic. This review

confirms that the observed changes in diet are part of a larger process of dietary restructuring when changing geographical and socio-cultural environments.

In the study by A.S. Vorontsova *et al.* [21], the change in folate levels among Indian students in Arkhangelsk was examined depending on the duration of their studies. Notably, the serum folic acid levels of first-year students were higher than those of sixth-year students (10 ng/ml vs. 4 ng/ml), which was associated with a decrease in vegetable consumption, as well as an increase in smoking and alcohol consumption. In contrast, the current study observed a gradual improvement in the diet as the length of stay increased. This comparison highlights that the consumption of different nutrients may either increase or decrease as the duration of stay in the new country lengthens. It also underscores that deficiencies are formed not only under the influence of diet but also due to other lifestyle factors.

The study found that Indian students living in the Kyrgyz Republic experience significant changes in their diet compared to the control group from India. Despite maintaining overall caloric intake, students in their early years of stay showed a marked decrease in the consumption of protein, iron, vitamins B₁₂ and A, as well as a reduction in dietary diversity and an increase in the proportion of refined foods and those with lower nutritional density. For students who had been living in the Kyrgyz Republic for more than 4-5 years, partial compensation for these changes was observed; however, their diet still lagged behind the control group in terms of quality. These results confirm the hypothesis that adaptation to the new food environment in the Kyrgyz Republic leads to a reduction in the consumption of key nutrients and a shift in the dietary structure of Indian vegetarian students. The data obtained underscore the need for targeted measures to optimise the diet of foreign students during their adaptation period.

CONCLUSIONS

The research hypothesis regarding the reduction in the consumption of protein, iron, vitamins B₁₂ and A among Indian students living in the Kyrgyz Republic was confirmed by quantitative data. It was found that the average daily protein consumption in the control group was 72 g, whereas in Group 1 it decreased to 49 g, and in Group 2 to 62 g. A similar trend was observed for micronutrients: iron consumption decreased from 18.2 mg in the control group to 10.3 mg and 13.1 mg in Groups 1 and 2, respectively; vitamin B₁₂ – from 2.2 µg to 1.4 µg and 1.8 µg; vitamin A – from 972 µg to 552 µg and 661 µg. Dietary diversity was also significantly lower among students who had recently arrived in the Kyrgyz Republic (5.7 points compared to 7.8 in the control group), while students with over 4-5 years of residence showed partial recovery to 6.4 points.

The structure of food groups demonstrated a decrease in the consumption of legumes and dark green

leafy vegetables in both groups of students residing in the Kyrgyz Republic, as well as a statistically significant increase in the proportion of foods with low nutritional density. Despite comparable caloric intake (2,308 and 2,362 kcal compared to 2,426 kcal in the control group), a marked change in the macronutrient balance was observed, with relatively higher carbohydrate consumption and reduced intake of protein and fats. However, students who had been living in the country for more than 4-5 years showed improvement in several indicators, although their diet still did not reach the control group values.

The prospects for further research include several directions. A more detailed analysis is required of the factors determining the reduction in dietary diversity among Indian migrants during the early stages of their stay in the Kyrgyz Republic. Special attention should be given to issues such as the availability of plant-based products specific to tropical regions, local limitations in the food assortment, and the related barriers in forming a balanced diet. It would also be reasonable to delve deeper into studying the dynamics of dietary adaptation among vegetarians in the Kyrgyz Republic in the long term. It is important to assess whether the recovery of dietary habits, followed prior to migration, is taking place or if a stable adaptation to the local food assortment is forming. Such an approach will allow for

a clearer understanding of the dietary mechanisms of vegetarians in the context of long-term residence in a different food environment. Another promising direction is the expansion of the range of evaluated indicators affecting the nutrient status of students. Specifically, it would be prudent to include an analysis of other micronutrients, such as vitamin D, zinc, folates, etc. Furthermore, it is essential to assess the factors influencing their levels, such as behavioural, psychological, and other aspects that potentially affect adherence to and the quality of a vegetarian diet. Additionally, a significant potential lies in including the analysis of biochemical markers for the body's macro- and micro-nutrient status. This would allow for a comparison of the data on the composition of the actual diet with objective physiological indicators, thus providing a more accurate evaluation of the potential changes in diet and their impact on health status.

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CONFLICT OF INTEREST

None.

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Кыргыз Республикасында ар кандай мөөнөттө жашап жаткан индиялык вегетариан студенттердин жана Индияда туруктуу жашаган тургундардын азыктануу статусунун салыштырма анализи

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Аннотация. Изилдөөнүн максаты – Кыргыз Республикасы жашаган жана вегетариандык тамактануу режимин сактаган индиялык студенттердин рационунун мүнөзүн жана курамын, анын ичинде макро- жана микронутриенттерди, алардын өлкөдө жашаган мөөнөтүн эске алуу менен баалоо, ошондой эле бул көрсөткүчтөрдү Индияда жашаган контролдук топ менен салыштыруу болуп саналат. Изилдөөгө 50 адамдан турган үч топ катышты: Кыргызстанга жаңы келген студенттер (1-топ), өлкөдө 4 жылдан ашык жашаган студенттер (2-топ) жана Индияда жашаган контролдук топ. Тамактанууну баалоо үчүн 30 күндүк азык-түлүк күндөлүгүн жүргүзүү ыкмасы колдонулду. Алынган маалыматтардын негизинде суткалык калориялык нарк, белок, май, углеводдордун керектелиши жана рациондун ар түрдүүлүгү анализденди. Тамак-аштын химиялык курамы боюнча маалымдамалардын жардамы менен рациондогу макро- жана айрым микронутриенттердин болжолдуу көлөмү эсептелди. Натыйжалар көрсөткөндөй, 1 жана 2-топтордо Индиядагы контролдук топко салыштырмалуу белок жана май керектөөсүнүн төмөндөшү, буурчак өсүмдүктөрү менен коюу жашыл жалбырактуу жашылчалардын үлүшүнүн азайышы байкалган. Жалпы калориялуулук негизинен углеводдорду, анын ичинде азыктык баалуулугу төмөн продуктуларды (закускалар, таттуулар) көбүрөөк керектөөнүн эсебинен камсыздалган, айрыкча жаңы келген студенттер арасында. Ошондой эле 1-топто темирдин, B_{12} витамининин жана А витамининин керектөөсү төмөндөдү. Кыргызстанда узак жашаган студенттер рационду жакшыртуу тенденциясын көрсөткөнү менен, анын сапаты дагы эле контролдук топко жетпейт. Алынган маалыматтар белок-энергетикалык жана витамин-минералдык жетишсиздик коркунучун көрсөтөт. Бул чет өлкөлүк студенттердин адаптация шарттарында ден соолугун жакшыртуу жана дефициттердин алдын алуу үчүн өсүмдүккө негизделген тамак-аштын ар түрдүүлүгүн көбөйткөн адаптацияланган рациондорду иштеп чыгуунун зарылдыгын айгинелейт. Изилдөөнүн жыйынтыктары чет өлкөлүк вегетариан студенттер үчүн нутритивдик дефициттердин алдын алууга багытталган адаптацияланган тамактануу программаларын түзүүдө практикалык колдонулушу мүмкүн.

Негизги сөздөр: диета; тамактануу рациону; белок-энергетикалык жетишсиздик; витамин жана минералдык дефицит; тамактанууга адаптация

Сравнительный анализ пищевого статуса индийских студентов-вегетарианцев с разным сроком пребывания в Кыргызской Республике и постоянных жителей Индии

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Аннотация. Целью исследования было изучение характера и состава рациона, включая макро- и микронутриенты, индийских студентов, проживающих в Кыргызской Республике и ведущих вегетарианский образ жизни, с учётом длительности их пребывания, а также сравнение этих показателей с контрольной группой, проживающей в Индии. В исследовании приняли участие три группы по 50 человек: новоприбывшие в Кыргызскую Республику студенты (1 группа), студенты, проживающие в Кыргызской Республике более 4 лет (2 группа), и контрольная группа, проживающая в Индии. Для оценки питания использовался метод ведения пищевого дневника в течение 30 дней. На основе полученных данных анализировались среднесуточная калорийность, потребление белков, жиров, углеводов, а также диетическое разнообразие. С использованием справочников по химическому составу продуктов питания было рассчитано примерное содержание макро- и некоторых микронутриентов в рационе исследуемых. Результаты показали, что в 1 и 2 группах наблюдалось снижение потребления белков и жиров, а также уменьшение доли бобовых и темно-зеленых овощей по сравнению с контрольной группой из Индии. Удовлетворительная общая калорийность достигалась в основном за счёт увеличения потребления углеводов, в том числе продуктов с низкой питательной ценностью (снеки, сладости), особенно среди недавно прибывших студентов. Также у 1 группы снижено содержание железа, витамина B₁₂, витамина А в рационе. Студенты, прожившие в Кыргызской Республике длительное время, демонстрировали тенденцию к улучшению рациона, однако его качество всё ещё уступает контрольной группе. Выводы на основе полученных данных указывают на риск развития белково-энергетической и витаминно-минеральной недостаточности. Это свидетельствует о необходимости разработки адаптированных рационов с увеличением разнообразия растительных продуктов для предотвращения дефицитов и улучшения состояния здоровья иностранных студентов в условиях адаптации. Результаты исследования могут быть использованы при разработке адаптированных рационов питания для иностранных студентов-вегетарианцев в целях профилактики нутритивных дефицитов.

Ключевые слова: диета; рацион питания; белково-энергетическая недостаточность; дефицит витаминов и минералов; адаптация питания