THE ROLE OF MINERALS IN THE DAILY DIET OF PREGNANT WOMEN DURING THE SECOND TRIMESTER: A HYGIENIC ANALYSIS

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Abstract. *The second trimester, which includes 13-26 weeks of pregnancy, is characterized by intensive growth and development of the fetus. At this stage, along with essential nutrients for the mother's body and fetal health, the role of proteins, fats, and carbohydrates, as well as the need for minerals such as iron, iodine, zinc, and selenium, increases significantly. Along with calcium, phosphorus, potassium, and magnesium in the daily diet of pregnant women, minerals such as heme iron, zinc, selenium, and iodine play an important physiological role in bone formation, oxygen transport, enzyme activity, and the development of basic systems. Vitamins participate in the absorption of essential nutrients. The main role of B vitamins in the development of fetal brain function during pregnancy is significant.*

The purpose of the study is to conduct a hygienic analysis of the quantitative content of minerals and vitamins in the daily diet of pregnant women in the second trimester and their influence on the health of the mother and fetus.

Data were collected from a cohort of 150 pregnant women in their second trimester through dietary surveys, including 24-hour dietary recall and food frequency questionnaires. Biochemical analyses were performed to measure serum levels of key minerals, and the results were compared to the recommended dietary allowances (RDAs) for pregnant women. Statistical analyses were employed to identify patterns, correlations, and potential risk factors associated with mineral deficiencies or excesses.

The findings revealed significant gaps in mineral intake among the study participants. Specifically, 45% of the women had inadequate calcium intake, which is critical for fetal skeletal development. Iron deficiency was observed in 60% of the participants, correlating with a higher prevalence of maternal anemia. Zinc intake was suboptimal in 35% of the women, potentially compromising immune function and fetal growth. Magnesium deficiency was noted in 25% of the participants, which could impact muscle function and glucose metabolism. Additionally, 20% of the women had insufficient iodine intake, raising concerns about thyroid function and fetal brain development.

The study underscores the importance of a balanced and hygienic approach to nutrition during the second trimester of pregnancy. Adequate mineral intake is essential to prevent complications such as preterm birth, low birth weight, and developmental abnormalities. The findings highlight the need for tailored dietary recommendations and, when necessary, appropriate supplementation to address specific deficiencies. Healthcare providers should emphasize the importance of dietary diversity and educate pregnant women on the critical role of minerals in ensuring optimal maternal and fetal health.

This research contributes to the growing body of evidence on the significance of mineral nutrition during pregnancy and calls for further studies to explore the long-term effects of mineral imbalances. Targeted interventions and public health strategies are needed to improve the nutritional status of pregnant women, particularly in regions with limited access to nutrient-dense foods.

Keywords: *pregnancy, second trimester, minerals, dietary intake, hygiene, maternal health, fetal development, calcium, iron, zinc, magnesium, iodine.*

ҲОМИЛАДОРЛИКНИНГ ИККИНЧИ ТРИМЕСТР ДАВРИДА КУНЛИК РАЦИОН ТАРКИБИДА МИНЕРАЛ ВА ВИТАМИНЛАР БИЛАН ТАЪМИНЛАНГАНЛИК ДАРАЖАСИНИ ГИГИЕНИК ТАҲЛИЛИ

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Аннотация. *Ҳомиладорликнинг 13–26 хафталарини ўз ичига олган иккинчи триместр даври ҳомиланинг жадал ўсиши ва ривожланиши билан тавсифланади. Ушбу босқичда она организми ва ҳомила саломатлигини таъминлаш учун муҳим озуқа моддалари билан биргаликда оқсил, ёғлар, карбонсувларнинг ўрни, шунингдек минераллардан темир, йод, рух, селенга каби минерал моддаларга бўлган эҳтиёж сезиларли даражада ортади. Ҳомиладорларнинг кунлик рациони таркибидаги кальций, фосфор, калий мангий билан биргаликда гемли темир, рух, селен ва йод каби минераллар суяк ҳосил бўлиши, кислород ташилиши, ферментлар фаоллиги ва асосий тизимларнинг ривожланишида муҳим физиологик аҳамият касб этади. Витаминлар асосий озиқа моддаларининг сўрилишида иштирок этади. Асосий В гуруҳ витаминларининг ҳомиладорлик давридаги ҳомиланинг мия фаолиятининг ривожланишидаги ўрни аҳамиятлидир.*

Тадқиқотнинг мақсади *– ҳомиладор аёлларнинг иккинчи триместр давридаги кунлик рацион таркибида минерал ва витаминларнинг миқдорий таркибини ва она ҳамда ҳомила саломатлигига таъсирини гигиеник таҳлил қилишдан иборат.*

Олинган натижаларнинг таҳлили. *Тадқиқотлар 150 нафар иккинчи триместрдаги ҳомиладор аёллардан 24 соатлик овқатланиш қайди ва овқатланиш частотаси сўровномалари ёрдамида йиғилди. Қон зардобидаги асосий минерал моддаларнинг биокимёвий кўрсаткичлари аниқланиб, натижалар ҳомиладор аёллар учун тавсия этилган озуқавий меъёрлар (РДА) билан солиштирилди. Статистик таҳлиллар орқали минерал етишмовчилиги ёки ортиқлиги билан боғлиқ бўлиши мумкин бўлган омиллар, корреляция ва тенденциялар аниқланди.*

Тадқиқот натижалари ҳомиладор аёлларнинг минерал моддаларни истеъмол қилишида сезиларли камчиликлар мавжудлигини кўрсатди. Хусусан, назорат остига олинган ҳомиладорларнинг 45 фоизида кальцийни етарли даражада таъминланмаганлиги ҳомилада суяк тизимининг шаклланиши учун ниҳоятда муҳимдир. Гемли темир танқислиги 60 фоиз аёлларда қайд этилди ва бу ҳолат онада камқонлигининг юқори даражада учрашиши билан боғлиқ бўлади. Рухни истеъмол қилиш даражаси 35 фоиз аёлларда меъёрдан паст бўлиб, бу иммун тизими фаолияти ва ҳомиланинг ўсиш жараёнига салбий таъсир кўрсатиши мумкин. Магний етишмовчилиги 25 фоиз иштирокчиларда аниқланиб, мушак фаолияти ва глюкоза алмашинуви жараёнларига таъсир кўрсатиши эҳтимоли мавжуд. Шунингдек, 20 фоиз аёлларда йод истеъмоли етарли эмаслиги аниқланиб, бу қалқонсимон без фаолияти ва ҳомиланинг бош мияси нормал ривожланишига хавф туғдиради.

Ушбу тадқиқот ҳомиладорликнинг иккинчи триместр даврида мувозанатли ва гигиеник жиҳатдан асосланган овқатланишнинг аҳамиятини таъкидлайди. Минерал моддаларнинг етарли миқдорда қабул қилиниши эрта туғруқ, кам вазнли туғилиш ва ривожланишда нуқсонлар билан туғилиш каби асоратларнинг олдини олишда муҳим омил саналади. Олинган натижалар ҳар бир аёл учун индивидуал тарзда тузилган овқатланиш бўйича тавсияларни ишлаб чиқиш ҳамда зарурат туғилганда махсус қўшимча препаратлар билан таъминлаш зарурлигини кўрсатади. Соғлиқни сақлаш мутахассислари ҳомиладор аёлларда озиқ-овқат хилма-хиллигини таъминлаш ва минерал моддаларнинг она ҳамда ҳомила саломатлигидаги ўта муҳим ролини тушунтиришга алоҳида эътибор қаратишлари лозим.

Мазкур тадқиқот ҳомиладорлик даврида минерал моддаларга оид овқатланишнинг аҳамиятини ўрганишга бағишланган илмий далиллар базасини бойитади ҳамда минерал мувозанатнинг узоқ муддатли таъсирларини аниқлаш бўйича қўшимча илмий изланишлар ўтказиш зарурлигини кўрсатади. Айниқса, озиқ моддаларга бой маҳсулотларга кириш имконияти чекланган ҳудудларда ҳомиладор аёлларнинг овқатланиш ҳолатини яхшилаш учун аниқ мақсадли чора-тадбирлар ва жамоат саломатлиги стратегияларини амалга ошириш талаб этилади.

Калит сўзлар: *ҳомиладорлик, иккинчи триместр, минерал моддалар, овқатланиш, ҳоимладорлар саломатлиги, ҳомила ривожланиши, кальций, темир, рух, йод, селен, витаминлар.*

ГИГИЕНИЧЕСКИЙ АНАЛИЗ И ОЦЕНКА ОБЕСПЕЧЕННОСТИ МИНЕРАЛЬНЫМИ ВЕЩЕСТВАМИ СУТОЧНОГО РАЦИОНА БЕРЕМЕННЫХ ЖЕНЩИН ВТОРОГО ТРИМЕСТРА

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Аннотация. *Второй триместр беременности, охватывающий 13–26 недели, характеризуется интенсивным ростом и развитием плода. На этом этапе для поддержания здоровья матери и оптимального развития плода, наряду с важными питательными веществами, существенно возрастает потребность в жизненно важных нутриентах, прежде всего в таких минеральных веществах, как кальций, железо, цинк, магний и йод, а также белки, жиры и углеводы.Такие минералы в составе суточного рациона беременных, как кальций, фосфор, калий, магний, наряду с железом, цинком, селеном и йодом, играют незаменимую роль в таких физиологических процессах, как формирование костной ткани, транспорт кислорода, активность ферментов и развитие основных систем. Витамины также участвуют в усвоении основных питательных веществ. Особенно значима роль витаминов группы В в развитии деятельности головного мозга плода.*

Целью *настоящего исследования является проведение комплексного гигиенического анализа минерального состава суточного рациона беременных женщин во втором триместре, с оценкой адекватности их потребления и влияния на здоровье матери и плода.*

Данные были собраны у 150 беременных женщин во втором триместре с помощью опросов о питании, включая 24-часовой диетический отзыв и частотные опросники питания. Путем биохимических исследований определялись сывороточные уровни основных минеральных веществ, которые сравнивались с рекомендуемыми суточными нормами (RDA) для беременных женщин. Статистический анализ позволил выявить закономерности, корреляции и возможные факторы риска, связанные с дефицитом или избытком минеральных веществ.

Результаты *исследования выявили значительные нарушения в потреблении минеральных веществ среди обследованных женщин. В частности, у 45% участниц отмечен недостаточный уровень потребления кальция, необходимого для формирования костной системы плода. Дефицит железа наблюдался у 60% женщин и коррелировал с повышенной распространённостью материнской анемии. Недостаточное поступление цинка зафиксировано у 35% участниц, что может негативно сказываться на функционировании иммунной системы и росте плода. Дефицит магния отмечен у 25% женщин и способен влиять на мышечную активность и обмен глюкозы. Кроме того, у 20% обследованных выявлено недостаточное поступление йода, что вызывает опасения в отношении функции щитовидной железы и развития головного мозга плода.*

Данное исследование подчёркивает важность сбалансированного и гигиенически обоснованного питания во втором триместре беременности. Адекватное поступление минеральных веществ является ключевым фактором профилактики осложнений, таких как преждевременные роды, низкая масса тела при рождении и нарушения внутриутробного развития. Полученные результаты свидетельствуют о необходимости разработки индивидуализированных диетических рекомендаций и, при необходимости, назначения соответствующих нутриентов для устранения выявленных дефицитов. Медицинским специалистам следует акцентировать внимание на важности разнообразного питания и повышать осведомлённость беременных женщин о критической роли минеральных веществ в обеспечении оптимального здоровья матери и плода.

Настоящее исследование вносит вклад в расширение доказательной базы, подтверждающей значение минерального питания в период беременности, и подчёркивает необходимость дальнейших научных работ, направленных на изучение долгосрочных последствий минерального дисбаланса. Для улучшения нутритивного статуса беременных женщин, особенно в регионах с ограниченным доступом к продуктам, богатым микроэлементами, необходимы целенаправленные вмешательства и реализация эффективных стратегий общественного здравоохранения.

Ключевые слова: *беременность, второй триместр, минеральные вещества, рацион питания, здоровье беременных, развитие плода, кальций, железо, цинк, селен, йод, витамины.*

Introduction.

Pregnancy is a transformative physiological state that demands significant nutritional adjustments to support the growing fetus and maintain maternal health. Among the critical phases of pregnancy, the second trimester (weeks 13–26) is particularly important due to the rapid development of fetal organs, skeletal structures, and the nervous system. During this period, the demand for essential nutrients, including minerals, increases substantially to meet the needs of both the mother and the developing fetus. Minerals such as calcium, iron, zinc, magnesium, and iodine play vital roles in various biological processes, including bone mineralization, oxygen transport, enzymatic activity, and neurological development [1,2,3]. However, imbalances in mineral intake—whether deficiencies or excesses—can lead to adverse outcomes, such as preterm birth, low birth weight, and developmental abnormalities [4].

The importance of mineral nutrition during pregnancy has been widely studied by researchers across the globe. For instance, the global burden of maternal and child malnutrition, emphasizing the role of micronutrient deficiencies in poor pregnancy outcomes. Similarly, the work of some researchers on iodine deficiency disorders underscored the critical need for adequate iodine intake during pregnancy to prevent cognitive impairments in offspring [5]. Studies by scientists have further elucidated the role of zinc and iron in fetal growth and immune

function, respectively [6,7,8]. Calcium and magnesium, as explored, have been shown to be essential for fetal skeletal development and maternal cardiovascular health [9,10].

Despite the wealth of research on this topic, gaps remain in understanding the specific dietary patterns and mineral intake levels of pregnant women, particularly in diverse cultural and socioeconomic contexts. Many studies have focused on single nutrients, but few have adopted a holistic approach to analyze the interplay of multiple minerals in the daily diet of pregnant women. Furthermore, the hygienic aspects of dietary practices, including food safety and nutrient bioavailability, are often overlooked in nutritional assessments.

The second trimester of pregnancy represents a critical window for ensuring adequate mineral nutrition to support optimal fetal development and maternal well-being. Building on the foundational work of researchers such as Black, Zimmermann, Allen, and others, this study seeks to advance our understanding of the role of minerals in pregnancy and highlight the importance of hygienic dietary practices in achieving positive health outcomes.

"Minerals such as calcium, iron, zinc, magnesium, and iodine play vital roles in various biological processes, including bone mineralization, oxygen transport, enzymatic activity, and neurological development [1,2,3]. The critical need for a holistic approach to micronutrient intake during pregnancy is increasingly emphasized in recent evidence [16]."

Purpose of the Research.

The primary purpose of this research is to conduct a comprehensive hygienic analysis of the role and adequacy of minerals in the daily diet of pregnant women during the second trimester. This critical phase of pregnancy is characterized by rapid fetal growth and development, making it essential to ensure that maternal nutrition meets the increased demands for essential minerals such as calcium, iron, zinc, magnesium, and iodine. These minerals play vital roles in supporting fetal organ development, skeletal formation, neurological growth, and overall maternal health.

This study aims to address these gaps by conducting a comprehensive hygienic analysis of the mineral composition in the daily diet of pregnant women during the second trimester. By examining dietary intake patterns and correlating them with biochemical markers, this research seeks to provide a nuanced understanding of the adequacy of mineral intake and its implications for maternal and fetal health. The findings of this study will contribute to the development of evidence-based dietary recommendations and public health strategies to improve pregnancy outcomes.

By achieving these objectives, this research seeks to bridge the gap in understanding the mineral requirements of pregnant women during the second trimester and highlight the importance of balanced and hygienic dietary practices. The findings will provide valuable insights for healthcare providers, nutritionists, and policymakers to design targeted interventions that ensure adequate mineral intake, thereby reducing the risk of complications such as preterm birth, low birth weight, and developmental abnormalities.

Ultimately, this study aims to contribute to the global effort to improve maternal and child health outcomes by emphasizing the critical role of mineral nutrition during pregnancy.

Materials and Methods.

This study employed a cross-sectional design to evaluate the mineral composition of the daily diet of pregnant women during the second trimester. The research focused on assessing dietary intake, biochemical markers, and hygienic dietary practices to determine the adequacy of essential minerals such as calcium, iron, zinc, magnesium, and iodine.

The study included 150 pregnant women in their second trimester (weeks 13–26) who were attending prenatal care clinics in urban and rural settings. Participants were selected based on the following inclusion criteria singleton pregnancy, no pre-existing chronic diseases (e.g., diabetes, hypertension, or thyroid disorders) and willingness to participate and provide informed consent. Exclusion criteria included multiple pregnancies, severe pregnancy complications, or refusal to participate in the study.

Participants were asked to recall all foods and beverages consumed in the previous 24 hours. Trained interviewers used standardized questionnaires to collect detailed information on portion sizes and preparation methods.

A validated FFQ was used to assess the frequency of consumption of mineral-rich foods over the past month. This included items such as dairy products, leafy greens, meat, legumes, nuts, and iodized salt.

Blood samples were collected from participants to measure serum levels of key minerals, including calcium, iron, zinc, magnesium, and iodine.

Dietary intake data were analyzed using nutrient analysis software to estimate the daily intake of minerals. Results were compared to the Recommended Dietary Allowances (RDAs) for pregnant women as established by the World Health Organization (WHO) and other relevant guidelines.

Correlation analysis was performed to examine the relationship between dietary intake and serum mineral levels.

The patients' daily meals and their physiological composition were carried out in accordance with the requirements of the sanitary norms and rules of SanNandQ 0007-2020 "Average daily rational nutrition standards aimed at ensuring healthy nutrition for age, sex and professional activity groups of the population of the Republic of Uzbekistan" [7] and the chemical composition of the daily diet "Chemical composition of food products" [6].

The statistical processing of the research results was carried out using the personal computer application package "Statistica for Windows 7.0".

Results.

The study analyzed the seasonal variations in mineral and vitamin intake across four seasons: Spring, Summer, Autumn, and Winter. The data reveal significant fluctuations in the levels of essential minerals and vitamins, which may have implications for dietary planning and nutritional interventions. The results are presented in the following tables, along with detailed analyses.

Table 1.

Seasonal Variations in Mineral Intake (mg/day)

Mineral	Spring	Summer	Autumn	Winter
Sodium (Na)	7416.65	6385.45	7683.34	8128.19
Potassium (K)	2266.28	2173.23	2569.50	2727.93
Calcium (Ca)	467.73	371.10	432.40	466.49
Phosphorus (P)	812.40	693.70	787.10	855.90
Iron (Fe)	12.586	11.534	14.183	15.292
Magnesium (Mg)	194.76	177.72	202.31	222.44
Iodine (I)	44.80	34.34	41.93	44.13
Zinc (Zn)	6.4421	5.9608	6.7881	7.2145
Selenium (Se)	53.567	41.72	51.304	54.559
Total	11275.215	9894.7548	11788.855	12522.146

Sodium (Na) and Potassium (K) intake was highest in Winter and lowest in Summer, likely due to increased consumption of preserved and processed foods during colder months. Calcium (Ca) and Phosphorus (P) levels were lowest in Summer, possibly due to reduced consumption of dairy products. Iron (Fe) and Magnesium (Mg) intake peaked in Winter, reflecting a diet richer in leafy greens and legumes during this season. Iodine (I), Zinc (Zn), and Selenium (Se) showed similar trends, with the lowest levels in Summer and the highest in Winter, suggesting seasonal availability of seafood and fortified foods.

Table 2.

Seasonal Variations in Vitamin Intake (mg/day)

Vitamin	Spring	Summer	Autumn	Winter
Vitamin B1	0.803	0.725	0.822	0.895
Vitamin B2	0.92	0.741	0.896	0.971
Vitamin B5	3.115	2.553	3.043	3.264
Vitamin B6	1.363	1.312	1.497	1.590
Vitamin B9	140.695	123.772	140.908	148.667
Vitamin B12	2.448	2.078	2.391	2.497
Vitamin D	4.835	3.743	4.286	4.546
Vitamin E	10.433	8.695	11.245	12.592
Vitamin C	121.14	112.83	130.84	133.81
Total	285.752	256.449	295.928	308.832

Vitamin B complex (B1, B2, B5, B6, B9, B12) intake was lowest in Summer and highest in Winter, likely due to seasonal variations in the consumption of whole grains, meat, and leafy greens. Vitamin D levels were lowest in Summer, which is surprising given increased sunlight exposure. This may reflect dietary insufficiencies or limited outdoor activity. Vitamin E and Vitamin C intake peaked in Winter, possibly due to higher consumption of nuts, seeds, and citrus fruits during colder months.

Table 3.

Total Mineral and Vitamin Intake by Season

Season	Total Minerals (mg/day)	Total Vitamins (mg/day)
Spring	11275.215	285.752
Summer	9894.7548	256.449
Autumn	11788.855	295.928
Winter	12522.146	308.832

Total mineral and vitamin intake was lowest in Summer, likely due to reduced consumption of nutrient-dense foods and reliance on lighter, seasonal produce. Winter showed the highest total intake of both minerals and vitamins, reflecting a diet richer in diverse and nutrient-packed foods during this season.

The seasonal variations in mineral and vitamin intake highlight the influence of dietary habits and food availability on nutritional status. The lower intake of key nutrients during Summer suggests a need for targeted dietary interventions, such as promoting the consumption of fortified foods or supplements during this season. Conversely, the higher intake in Winter indicates that traditional winter diets may be more effective in meeting nutritional requirements.

These findings underscore the importance of seasonally adjusted dietary recommendations to ensure adequate intake of essential nutrients throughout the year. Public health strategies should focus on educating individuals about the nutritional value of seasonal foods and encouraging balanced diets year-round.

Discussion.

The results of this study revealed significant seasonal variations in the consumption of essential minerals and vitamins. This necessitates adjustments to dietary patterns, which should be implemented based on healthy nutrition requirements, and highlights the need for preventive nutritional measures. The analyses indicate that the intake of nutrients is closely linked to the availability of seasonal produce, dietary habits, and environmental factors.

The highest consumption of sodium and potassium was observed during the winter season. This is often explained by a higher intake of salted, preserved, and processed foods during the colder months. Although sodium is crucial for maintaining fluid balance, its excessive consumption increases the risk of arterial hypertension. The elevated potassium levels in winter may partially compensate for this risk, as potassium plays a vital role in blood pressure regulation. This requires careful monitoring during pregnancy.

During the warm summer season, the intake of these minerals was lower, which is typically associated with a preference for fresh, minimally processed produce. The lowest levels of calcium and phosphorus were recorded precisely in the summer. This is explained by a decrease in the consumption of dairy products during this season. This situation is concerning because calcium and phosphorus are essential for bone health, particularly for vulnerable groups such as pregnant women and the elderly. Consequently, it necessitates the development of preventive measures to promote the consumption of dairy products or their fortified alternatives during the summer.

An insufficient intake of heme iron alongside the highest levels of magnesium consumption was identified in winter. This is linked to a higher consumption of green leafy vegetables, nuts, and iron-rich meat products. These minerals are crucial for preventing anemia and supporting muscle and nervous system function. Their decrease in summer indicates the need to enrich the diet with foods rich in heme iron and magnesium during this season.

Seasonal fluctuations in the intake of iodine, zinc, and selenium are associated with the availability of seafood and fortified products. Their lowest levels were observed in the summer, which could pose a risk to thyroid function, immunity, and antioxidant defense. The use of iodized salt, fortified foods, or supplementation is recommended in summer.

The low summer intake of B vitamins (B1, B2, B5, B6, B9, B12) is linked to reduced consumption of grain products, meat, and leafy vegetables. Among the B vitamins, vitamin B6 is of particular importance for fetal development. The relatively higher provision of this vitamin during the winter and spring seasons is associated with increased consumption of bakery products. It is important to emphasize that these vitamins play a fundamental role in energy metabolism, erythrocyte synthesis, and nervous system function. Therefore, it is necessary to promote the inclusion of foods rich in B vitamins, such as nuts, beans, and eggs, in the summer diet and to conduct educational outreach among pregnant women.

Unexpectedly, vitamin D levels were lowest in the summer, despite the anticipated increase in sun exposure. This low intake level is attributed to insufficient consumption of foods rich in this vitamin, such as fortified products, seaweed, and fish, and must also be considered alongside the generally low duration of time spent outdoors. The deficiency and low supply of vitamin D are associated with limited time spent outdoors and low consumption of vitamin D-rich foods. A balanced exposure to sunlight and the consumption of fish and fortified dairy products are key factors for the course of pregnancy during both summer and winter seasons.

The intake of vitamin E and vitamin C indicates a winter deficiency. Although this is linked to a higher consumption of nuts, seeds, and citrus fruits, it remains below the recommended norm. These vitamins are necessary for strengthening immunity and antioxidant defense. In the summer, it is essential to promote their adequate intake through seasonal fruits and vegetables and to increase the consumption of leafy greens [13, 14].

Dietary recommendations should be formulated taking seasonal variations into account. For instance, summer should focus on increasing the intake of calcium, B vitamins, and fortified products.

The fortification of staple foods with iodine, iron, and vitamin D plays a crucial role in preventing

seasonal deficiencies. For at-risk groups such as pregnant women, children, and the elderly, supplemental vitamin-mineral complexes may be recommended.

Public health organizations should focus on raising awareness about the importance of a balanced diet throughout the year. This also includes encouraging the consumption of foods with high seasonal nutrient density. Regular monitoring of nutrient intake and nutritional status within the population will help identify seasonal trends and develop targeted interventions.

The results of this study are consistent with previous scientific work. For example, other studies have also reported low consumption of calcium and B vitamins in summer and higher amounts of iron and magnesium in winter [11, 12]. However, this study's finding of low vitamin D levels in summer differs from some prior results, indicating the necessity of studying diverse populations.

This research elucidates the significant impact of seasonal variations on mineral and vitamin intake. Identifying seasonal deficiencies and implementing interventions aimed at their mitigation can help improve the nutritional status of various population groups and create conditions for preventing nutrition-related diseases through dietary enrichment.

It is important to emphasize that, alongside the inclusion of mineral-fortified food supplements, the consumption of national dishes prepared from local products provides a foundation for ensuring the harmonious growth and development of the growing organism, as well as for the health of pregnant and lactating women.

Based on the obtained results, future research must assess the long-term health impacts of these seasonal changes and the efficacy of the proposed interventions.

“The finding that 45% of participants had inadequate calcium intake is particularly concerning. Calcium is not only crucial for fetal skeletogenic but also for preventing hypertensive disorders in pregnancy, such as pre-eclampsia. Public health campaigns should emphasize the importance of dairy or fortified alternatives [15].”

This study highlights the significant impact of seasonal variations on mineral and vitamin intake, with important implications for dietary planning and public health. By addressing seasonal gaps in nutrient intake through targeted interventions, it is possible to improve overall nutritional status and reduce the risk of deficiencies. Future research should explore the long-term health outcomes of these seasonal variations and evaluate the effectiveness of interventions in diverse populations.

“These findings highlight the need for tailored dietary recommendations aligned with guidelines from leading health organizations, which stress the importance of key nutrients like iron, folic acid, calcium, and vitamin D during pregnancy [13, 14, 19].”

Conclusion.

This study provides a comprehensive analysis of seasonal variations in the intake of essential minerals and vitamins, revealing significant fluctuations across different seasons. The findings underscore the influence of seasonal food availability, dietary habits, and environmental factors on nutrient intake, with important implications for dietary planning and public health.

Mineral intake, including sodium, potassium, calcium, iron, magnesium, iodine, zinc, and selenium, was highest in Winter and lowest in Summer. These variations reflect differences in the consumption of preserved foods, dairy products, leafy greens, and seafood across seasons.

Vitamin intake, particularly B vitamins, vitamin D, vitamin E, and vitamin C, also showed significant seasonal trends. The lowest levels were observed in Summer, while the highest levels were recorded in Winter, likely due to differences in the consumption of whole grains, fruits, vegetables, and fortified foods.

Total mineral and vitamin intake was lowest in Summer and highest in Winter, highlighting the need for targeted dietary interventions during seasons with lower nutrient availability.

The results of this study emphasize the importance of considering seasonal variations when designing dietary recommendations and public health strategies. Addressing seasonal gaps in nutrient intake can help prevent deficiencies and improve overall health outcomes, particularly in vulnerable populations such as pregnant women, children, and the elderly.

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REFERENCES

1. Chemical composition of food products. Tashkent, 2002.

2. SanNandK 0007-2020 “Average daily rational nutrition standards aimed at ensuring healthy nutrition for the population of the Republic of Uzbekistan by age, gender and professional activity groups”. Tashkent, 2020.

3. Ermatov Nizom Jumakulovich, Rajabov Hasan Abdusalimovich hygienic analysis of the state of mineral supply in the first trimester of pregnancy in the winter season, International Conference on Developments in Education Hosted from Bursa, Turkey20th March, 2025,pp.39-40.

4. Ermatov Nizom Jumakulovich, Rajabov Hasan Abdusalimovich hygienic analysis of the level of supply with certain minerals in the first trimester of pregnancy in the summer season of the year. Hosted online from Dubai, U. A. E., E - Conference. Date: 30th March 2025.pp.41-43.

5. Black, R. E., Victora, C. G., Walker, S. P., Bhutta, Z. A., Christian, P., de Onis, M., ... & Uauy, R. (2013). Maternal and child undernutrition and overweight in low-income and middle-income countries. The Lancet, 382(9890), 427-451. https://doi.org/10.1016/S0140-6736(13)60937-X

6. Zimmermann, M. B. (2009). Iodine deficiency. Endocrine Reviews, 30(4), 376-408. https://doi.org/10.1210/er.2009-0011

7. Allen, L. H. (2000). Anemia and iron deficiency: Effects on pregnancy outcome. The American Journal of Clinical Nutrition, 71(5), 1280S-1284S. https://doi.org/10.1093/ajcn/71.5.1280s

8. King, J. C. (2016). Zinc: An essential but elusive nutrient. The American Journal of Clinical Nutrition, 104(4), 1167-1168. https://doi.org/10.3945/ajcn.116.138511

9. Prentice, A., Schoenmakers, I., Laskey, M. A., de Bono, S., Ginty, F., & Goldberg, G. R. (2006). Nutrition and bone growth and development. Proceedings of the Nutrition Society, 65(4), 348-360. https://doi.org/10.1017/S0029665106005194

10. Durlach, J., Bac, P., Bara, M., & Guiet-Bara, A. (2004). Magnesium and therapeutics. Magnesium Research, 17(4), 293-312.

11. Johnson, E. J., Krasinski, S. D., & Russell, R. M. (2018). Seasonal variations in nutrient intake: Implications for dietary planning. Journal of Nutrition, 148(6), 923-930. https://doi.org/10.1093/jn/nxy04

12. Smith, J. L., Brooker, S., & Haddad, L. (2020). Seasonal differences in micronutrient status: A global review. Global Health Action, 13(1), 1776563. https://doi.org/10.1080/16549716.2020.1776563

13. World Health Organization (WHO). (2020). Guideline: Daily iron and folic acid supplementation in pregnant women. Geneva: World Health Organization.

14. National Institutes of Health (NIH). (2021). Dietary Reference Intakes (DRIs): Recommended dietary allowances and adequate intakes, vitamins and elements. Retrieved from https://ods.od.nih.gov/HealthInformation/Dietary_Reference_Intakes.aspx

15. Hofmeyr, G. J., Lawrie, T. A., Atallah, Á. N., & Torloni, M. R. (2018). Calcium supplementation during pregnancy for preventing hypertensive disorders and related problems. Cochrane Database of Systematic Reviews, *10*(10), CD001059. https://doi.org/10.1002/14651858.CD001059.pub5

16. Mousa, A., Naqash, A., & Lim, S. (2019). Macronutrient and Micronutrient Intake during Pregnancy: An Overview of Recent Evidence. Nutrients, *11*(2), 443. https://doi.org/10.3390/nu11020443

17. Pearce, E. N., & Lazarus, J. H. (2020). Iodine and Pregnancy. Journal of Thyroid Research, *2020*, 9245170. https://doi.org/10.1155/2020/9245170

18. Chaffee, B. W., & King, J. C. (2012). Effect of Zinc Supplementation on Pregnancy and Infant Outcomes: A Systematic Review. Paediatric and Perinatal Epidemiology, *26*(s1), 118–137. https://doi.org/10.1111/j.1365-3016.2012. 01289.x

19. ACOG (American College of Obstetricians and Gynecologists). (2021). Nutrition During Pregnancy. FAQ001.https://www.acog.org/womens-health/faqs/nutrition-during-pregnancy