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NUTRITION AFFECTING REPRODUCTIVE HEALTH IN WOMEN

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Abstract
This cross-sectional study examined associations between nutritional status and reproductive outcomes in 240 women of reproductive age at an urban clinical center in Uzbekistan. Deficiencies in iron, vitamin D, and elevated glycemic load demonstrated statistically significant correlations with menstrual irregularity, anovulation, and hormonal imbalance. Findings underscore the necessity of integrating nutritional assessment into standard reproductive health protocols.

Keywords: Micronutrient deficiency, iron deficiency, vitamin D insufficiency, glycemic load, anovulation, follicle-stimulating hormone, luteinizing hormone, insulin resistance, body mass index, ferritin, hemoglobin, menstrual irregularity, oxidative stress, dietary assessment, reproductive endocrinology.

Introduction

Reproductive health, defined as a state of complete physical, mental, and social well-being in all matters relating to the reproductive system, represents a critical dimension of public health that extends beyond the management of pathological conditions. Globally, infertility affects approximately one in six couples of reproductive age, with female-factor infertility accounting for roughly 40-50% of cases. In Central Asia, and Uzbekistan in particular, the intersection of rapidly changing dietary patterns, rising obesity prevalence, and micronutrient deficiencies creates a distinct epidemiological context that remains underexplored in the peer-reviewed literature. Nutritional status constitutes a modifiable determinant of ovarian function, endometrial receptivity, and hormonal regulation. The present study aims to quantify the relationships between specific dietary exposures and biochemical indicators with measurable reproductive outcomes in women attending a reproductive health clinic in Tashkent.

Literature Review

The relationship between nutritional status and reproductive function has been substantiated across multiple research traditions. Chavarro et al. (2007) demonstrated in a prospective cohort of 18,555 women that higher dietary glycemic load was independently associated with a 92% increased risk of anovulatory infertility. Mumford et al. (2016) identified serum vitamin D concentrations below 20 ng/mL as significantly predictive of reduced fecundability, with an adjusted odds ratio of 0.67 (95% confidence interval: 0.48-0.93). Panth et al. (2018) comprehensively reviewed the mechanistic role

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of micronutrients - particularly folate, iron, and zinc - in oocyte quality and implantation. Within the Russian-language literature, Serov and Prilepskaya (2014) documented high rates of iron deficiency anemia among women with chronic anovulation in urban Russian populations. Inomova and Umarova (2019) reported that vitamin D deficiency was present in over 60% of infertile women examined in Tashkent-based reproductive centers, yet dietary counseling remained absent from standard clinical protocols. A notable gap persists in studies that simultaneously assess multiple nutritional variables against hormonal and cycle-based outcomes within Central Asian populations.

Methodology

The study sample comprised 240 women of reproductive age, recruited consecutively from outpatient gynecological consultations. Inclusion criteria specified: female sex, age 18 to 42 years, absence of diagnosed systemic endocrine disease other than polycystic ovary syndrome, no use of hormonal contraceptives within the preceding three months, and willingness to complete dietary recall interviews. Exclusion criteria encompassed pregnancy or lactation at the time of enrollment, confirmed malabsorption syndromes, active pharmacological treatment with iron or vitamin D supplementation, and any oncological history.

The mean age of participants was 28.6 ± 5.3 years. Body mass index was calculated from measured height and weight and classified according to World Health Organization standards: underweight (below 18.5 kg/m²), normal weight (18.5-24.9 kg/m²), overweight (25.0-29.9 kg/m²), and obese (30.0 kg/m² and above). In the study sample, 31.7% of participants were classified as overweight and 18.3% as obese. Dietary intake was assessed using a validated semi-quantitative food frequency questionnaire adapted for the Uzbek dietary context, supplemented by a 24-hour dietary recall conducted on three non-consecutive days, including one weekend day, to capture habitual intake variability. Glycemic load was calculated for each participant using standard reference values, with a high glycemic load defined as exceeding 120 units per day. Fasting venous blood samples were collected on cycle days two through five for hormonal analysis. Biochemical markers included hemoglobin concentration (g/dL), serum ferritin (ng/mL), 25-hydroxyvitamin D (ng/mL), fasting insulin (μIU/mL), follicle-stimulating hormone (IU/L), and luteinizing hormone (IU/L). The follicle-stimulating hormone to luteinizing hormone ratio was computed for each subject, with a ratio below 1.0 considered indicative of gonadotropin imbalance consistent with polycystic ovary syndrome pathophysiology. Insulin resistance was estimated using the Homeostatic Model Assessment of Insulin Resistance index, with values exceeding 2.5 classified as insulin resistant. Statistical analyses were performed using IBM SPSS Statistics, version 26.0. Descriptive statistics were reported as means with standard deviations for continuous variables and as frequencies with percentages for categorical variables. Associations between dietary variables and reproductive outcomes were assessed using Pearson correlation coefficients and binary logistic regression. The chi-square test was applied to categorical comparisons. A significance threshold of $p < 0.05$ was applied throughout; confidence intervals are reported at the 95% level.

Results

Iron deficiency, defined as serum ferritin below 12 ng/mL, was identified in 44.6% of the study sample (n = 107). Among women with confirmed iron deficiency, 61.7% reported menstrual cycle

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irregularity (defined as cycle length outside 21-35 days or intermenstrual variation exceeding seven days), compared with 29.3% among iron-sufficient women ($p < 0.001$). Logistic regression analysis, after adjustment for age and body mass index, yielded an odds ratio of 3.84 (95% confidence interval: 2.21-6.67) for menstrual irregularity in iron-deficient participants. Vitamin D insufficiency (serum 25-hydroxyvitamin D below 20 ng/mL) was present in 63.3% of participants (n = 152). Among women with vitamin D insufficiency, 48.0% met the clinical criteria for infertility - defined as failure to conceive after 12 months of regular unprotected intercourse - compared with 21.6% among those with adequate vitamin D status ($p < 0.001$). The adjusted odds ratio for infertility associated with vitamin D insufficiency was 3.21 (95% confidence interval: 1.89-5.44). Obesity was significantly associated with confirmed anovulation, identified ultrasonographically and hormonally. Among obese participants, anovulation was documented in 68.2% of cases versus 24.5% in normal-weight women ($p < 0.001$), corresponding to an adjusted odds ratio of 6.47 (95% confidence interval: 3.18-13.16). High dietary glycemic load was recorded in 52.9% of participants (n = 127). These women demonstrated significantly elevated fasting insulin levels (mean 18.4 ± 4.7 μIU/mL versus 11.2 ± 3.1 μIU/mL; $p < 0.001$) and a higher prevalence of Homeostatic Model Assessment of Insulin Resistance values exceeding 2.5 (58.2% versus 21.4%; $p < 0.001$). The mean luteinizing hormone to follicle-stimulating hormone ratio was significantly elevated in women with high glycemic load (2.8 ± 0.9 versus 1.6 ± 0.6; $p < 0.001$), indicating a hormonal pattern consistent with gonadotropin dysregulation. Pearson correlation analysis revealed a significant inverse relationship between serum ferritin and cycle irregularity score ($r = −0.41$; $p < 0.001$), and between 25-hydroxyvitamin D and Homeostatic Model Assessment of Insulin Resistance values ($r = −0.38$; $p < 0.001$). Body mass index was positively correlated with fasting insulin ($r = 0.52$; $p < 0.001$) and negatively correlated with follicle-stimulating hormone levels ($r = −0.33$; $p < 0.001$).

Discussion

The findings of this study confirm and extend the existing evidence that nutritional variables exert a quantitatively meaningful influence on reproductive endocrinology. The strong association between iron deficiency and menstrual irregularity is biologically coherent: iron serves as a cofactor in multiple enzymatic pathways involved in thyroid hormone synthesis and mitochondrial respiration within granulosa cells, and its deficiency has been linked to disrupted hypothalamic-pituitary signaling. These results align with the findings of Serov and Prilepskaya (2014) and suggest that iron status screening should be a routine component of reproductive health evaluation in the Uzbek clinical context. The high prevalence of vitamin D insufficiency - affecting nearly two-thirds of the sample - is consistent with regional epidemiological data reported by Inomova and Umarova (2019), and the magnitude of the associated infertility risk reinforces the mechanistic arguments advanced in international literature. Vitamin D receptors are expressed in ovarian granulosa cells, and vitamin D is understood to modulate anti-Müllerian hormone expression, follicular development, and endometrial receptivity through genomic and non-genomic signaling pathways. The observed inverse correlation between 25-hydroxyvitamin D and insulin resistance further suggests that this nutrient operates at the intersection of metabolic and reproductive physiology.

The association between high glycemic load and gonadotropin imbalance is mechanistically mediated by compensatory hyperinsulinemia. Elevated circulating insulin amplifies luteinizing hormone-

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stimulated androgen production in ovarian theca cells, suppresses hepatic sex hormone-binding globulin synthesis, and disrupts the pulsatile release of gonadotropin-releasing hormone - collectively producing the hormonal profile characteristic of anovulatory dysfunction. The magnitude of the luteinizing hormone to follicle-stimulating hormone elevation observed in the high glycemic load group is clinically significant and supports the implementation of low-glycemic dietary interventions as an adjunct to standard fertility treatments. The obesity-anovulation association, while well-established globally, manifests with particular severity in this sample, with an odds ratio exceeding six-fold - higher than many Western cohort estimates. This may reflect the compounding effect of coexisting micronutrient deficiency, physical inactivity, and dietary composition patterns specific to the regional context. Limitations of this study include its cross-sectional design, which precludes causal inference, the reliance on self-reported dietary data subject to recall bias, and the restriction of the sample to a single urban center, limiting generalizability to rural populations. From a public health standpoint, these findings argue for the integration of nutritional screening - encompassing serum ferritin, 25-hydroxyvitamin D, and dietary glycemic assessment - into standard reproductive medicine consultations, and for the development of population-level nutritional education programs targeting women of reproductive age in Uzbekistan.

Deficiencies in iron and vitamin D, elevated dietary glycemic load, and excess adiposity are independently and significantly associated with measurable impairments in reproductive hormonal profiles and fertility outcomes in this urban Uzbek population. Prospective intervention studies are required to establish whether targeted nutritional correction translates into clinically meaningful improvements in conception rates.

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