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PREVALENCE OF MICRONUTRIENT DEFICIENCIES IN NON PREGNANT WOMEN OF REPRODUCTIVE AGE

Original Research

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ABSTRACT

Background: Micronutrient deficiencies remain a significant public health issue, particularly among women of reproductive age. Despite their importance in preconception and overall health, non-pregnant women are often overlooked in nutritional surveillance programs, especially in South Asian settings.

Objective: To determine the prevalence and patterns of iron, vitamin D, folate, and vitamin B12 deficiencies among non-pregnant women aged 15–45 years attending outpatient clinics in Lahore, Pakistan.

Methods: A cross-sectional study was conducted over six months in three outpatient clinics. A total of 360 non-pregnant women aged 15–45 years were recruited. Data collection included demographic profiling, anthropometric measurements, and biochemical assessment of serum ferritin, 25-hydroxyvitamin D, serum folate, and vitamin B12. Deficiency thresholds were based on WHO criteria. Descriptive and inferential statistics were applied using SPSS v26, and subgroup analysis was conducted by age group.

Results: The mean age of participants was 29.4 years. Vitamin D deficiency was most prevalent (52.8%), followed by iron (41.5%), folate (23.6%), and vitamin B12 (19.7%) deficiencies. The youngest age group (15–24 years) demonstrated the highest burden across all micronutrients. Mean serum levels for ferritin, vitamin D, folate, and B12 were below optimal in a substantial proportion of participants. Significant age-wise differences in serum ferritin and vitamin D levels were observed ($p < 0.01$).

Conclusion: A high prevalence of micronutrient deficiencies exists among non-pregnant women of reproductive age in Lahore, with younger women being most affected. These findings support the need for integrated nutritional screening and public health interventions, including food fortification and education programs, targeting this at-risk group.

Keywords: Anemia, Ferritin, Folate, Micronutrient Deficiencies, Reproductive Health, Vitamin B12, Vitamin D.

INTRODUCTION

Micronutrient deficiencies remain a pressing public health concern, particularly among women of reproductive age. While much attention has been directed toward maternal nutrition during pregnancy, the nutritional status of non-pregnant women aged 15 to 45 years is often overlooked, despite their critical role in future maternal and child health outcomes (1). These years represent a vital window not only for future pregnancy preparation but also for overall well-being, productivity, and quality of life. Deficiencies in key micronutrients such as iron, vitamin D, folate, and vitamin B12 are widely prevalent in this demographic and are associated with a range of adverse health outcomes, including anemia, weakened immune function, neurological impairments, and increased risk of chronic diseases (2,3). Iron deficiency, the most common nutritional deficiency worldwide, is particularly concerning in women due to menstrual blood loss and higher physiological demands. Even in the absence of overt anemia, iron insufficiency can reduce cognitive performance, exercise capacity, and immune defense. Folate and vitamin B12 are essential for DNA synthesis and red blood cell formation, and their deficiencies are not only implicated in megaloblastic anemia but can also affect neurological function and mood (4). Vitamin D, on the other hand, plays a pivotal role in calcium homeostasis, bone health, and immune modulation. Yet, deficiency in this fat-soluble vitamin is increasingly common even in sun-rich regions, possibly due to lifestyle factors such as limited sun exposure, dietary habits, and skin pigmentation (5,6).

Several studies across low-, middle-, and high-income countries have documented varying prevalence rates of these deficiencies. However, much of the existing data is either outdated or limited to specific subgroups such as pregnant women, children, or elderly populations (7). In many cases, the assessments fail to provide a comprehensive view of multiple micronutrient deficiencies within the same population, an important limitation given that these deficiencies often coexist. Furthermore, evolving dietary patterns, increased urbanization, and lifestyle transitions in recent years suggest that previously reported prevalence figures may no longer reflect current realities (8,9). The convergence of these factors underscores the need for updated and context-specific data on the micronutrient status of non-pregnant women in the reproductive age group. Emerging evidence also points to the complex interplay between socioeconomic status, dietary diversity, and micronutrient availability (10,11). For instance, despite a global increase in caloric intake, many diets remain poor in essential micronutrients, leading to what is termed as "hidden hunger." This phenomenon is particularly insidious because it may not manifest in overt clinical symptoms initially but can contribute to long-term health deterioration. Urban women, though often assumed to have better access to healthcare and food, are not immune; sedentary lifestyles, increased consumption of processed foods, and inadequate nutritional education contribute to the persistence of deficiencies even among seemingly well-nourished individuals (12-14).

In light of these challenges, health systems and policy frameworks must be informed by precise, up-to-date data that reflect the true burden and patterns of micronutrient deficiencies. Unfortunately, a considerable data gap persists, especially from healthcare settings where women frequently interact with the health system but are seldom screened for subclinical deficiencies unless presenting with symptoms. This presents both a missed opportunity and a gap in preventive healthcare strategies. Identifying the prevalence and distribution of micronutrient deficiencies among non-pregnant women in outpatient settings may provide a valuable entry point for targeted interventions and policy planning. This study, therefore, seeks to determine the prevalence and patterns of key micronutrient deficiencies—iron, vitamin D, folate, and vitamin B12—among non-pregnant women aged 15 to 45 years attending outpatient clinics. By focusing on this accessible yet under-researched group, the research aims to generate evidence that can inform both clinical practice and public health policy. The objective is not only to quantify the burden of deficiencies but also to highlight the need for routine nutritional assessment in non-pregnant women, promoting a proactive approach to women's health well before conception or the onset of chronic disease.

METHODS

This cross-sectional study was conducted over a six-month period at three major outpatient clinics across the Lahore region of Pakistan, including a tertiary care hospital, a public-sector women's health center, and a private medical practice. These diverse clinical settings were selected to ensure a representative sample of non-pregnant women from varying socioeconomic and healthcare access backgrounds. The primary objective was to determine the prevalence and patterns of key micronutrient deficiencies—specifically iron, vitamin D, folate, and vitamin B12—among non-pregnant women of reproductive age. The target population comprised women aged 15 to 45 years presenting to the outpatient departments for non-emergency, non-pregnancy-related concerns. Inclusion criteria required participants to be clinically non-pregnant, as confirmed by a negative urine pregnancy test at the time of enrollment, and free from any chronic disease that might independently alter micronutrient metabolism such as chronic kidney disease, liver disease, or diagnosed malabsorption disorders. Exclusion criteria included current pregnancy, history of recent micronutrient supplementation within the last three months, known hematological or autoimmune disorders, or refusal to provide informed consent (15,16).

Sample size was calculated using a prevalence estimation formula, considering a 95% confidence interval and 5% margin of error. Based on an anticipated average prevalence of 30% for individual micronutrient deficiencies in the target demographic—derived from prior regional studies—a minimum sample size of 323 participants was determined to be statistically adequate. To account for potential dropouts and incomplete data, the final sample aimed for 360 participants. Participants were recruited consecutively after screening for eligibility. After receiving a detailed explanation of the study, informed written consent was obtained from all participants (1,2). The study protocol was approved by the Institutional Review Board (IRB) of relevant institute and adhered to the ethical standards outlined in the Declaration of Helsinki. Data collection involved both structured interviews and biological sampling. Demographic and clinical data including age, BMI, socioeconomic status, menstrual history, dietary habits, and lifestyle factors were recorded using a standardized questionnaire administered by trained medical staff. Blood samples were collected under aseptic conditions and sent to a centralized, accredited laboratory for biochemical analysis. Micronutrient status was assessed through validated laboratory assays. Serum ferritin levels were measured to evaluate iron status using enzyme-linked immunosorbent assay (ELISA), with levels <15 ng/mL considered indicative of iron deficiency. Serum 25-hydroxyvitamin D concentrations were measured using chemiluminescence immunoassay, with deficiency defined as levels <20 ng/mL. Serum folate and vitamin B12 levels were assessed using competitive immunoassay techniques; deficiency cutoffs were <3 ng/mL and <200 pg/mL respectively. These reference thresholds aligned with WHO guidelines and were standardized across all testing procedures.

To ensure data integrity, all biochemical analyses were performed in duplicate and calibrated using quality control samples. Raw data were entered into a password-protected database and independently cross-verified by two researchers. Statistical analysis was conducted using SPSS version 26.0. Descriptive statistics including means, standard deviations, and proportions were used to summarize demographic and clinical characteristics. Normal distribution of quantitative data was confirmed using the Shapiro-Wilk test. Prevalence rates for each micronutrient deficiency were calculated as proportions with corresponding 95% confidence intervals. Comparative analyses were performed to explore the distribution of deficiencies across different subgroups, such as age brackets, BMI categories, and socioeconomic strata. Chi-square tests were applied for categorical variables, and independent-samples t-tests or one-way ANOVA were used for continuous variables where appropriate. To identify potential predictors of micronutrient deficiencies, multivariable logistic regression models were employed, with deficiency status as the dependent variable and relevant demographic and clinical factors as covariates. A p-value of <0.05 was considered statistically significant throughout the analysis. Through this detailed methodological approach, the study aimed to provide an accurate and clinically meaningful estimation of the prevalence and patterns of iron, vitamin D, folate, and vitamin B12 deficiencies in a key but often overlooked population segment. By ensuring rigorous participant selection, standardized measurement tools, and robust statistical analysis, the findings were designed to offer both local relevance and broader public health insight into the nutritional status of non-pregnant women of reproductive age.

RESULTS

A total of 360 non-pregnant women aged 15–45 years were enrolled in this study. The mean age of participants was 29.4 years (±6.3), and the mean BMI was 24.7 kg/m² (±4.5). The majority resided in urban settings (68.1%), while 41.3% were employed, and 36.7% had attained higher education. These baseline characteristics helped capture a broad representation of the outpatient female population in the Lahore region. Biochemical assessments revealed that the most prevalent deficiency was vitamin D, identified in 52.8% of the women, followed by iron deficiency (41.5%), folate deficiency (23.6%), and vitamin B12 deficiency (19.7%). Mean serum levels of the respective micronutrients were as follows: ferritin 18.3 ± 7.2 ng/mL, vitamin D 17.4 ± 6.5 ng/mL, folate 4.8 ± 1.9 ng/mL, and vitamin B12 278.6 ± 85.3 pg/mL. These values indicate a significant proportion of the cohort fell below clinically accepted deficiency thresholds, especially for vitamin D and iron. Age-stratified analysis showed the highest prevalence of deficiencies in the youngest group (15–24 years), with 58.3% showing vitamin D deficiency and 46.1% having iron deficiency. The prevalence of folate and B12 deficiencies was also marginally higher in this group compared to older women. A decreasing trend in deficiency rates with increasing age was observed across all micronutrients, particularly for vitamin D and folate.

Group comparisons based on BMI categories and education status (not shown in table) revealed a slightly lower prevalence of deficiencies among women with normal BMI (18.5–24.9 kg/m²) and those with higher education, although the differences were not statistically significant ($p > 0.05$). Statistical testing showed that the distribution of micronutrient levels was approximately normal, as confirmed by the Shapiro-Wilk test ($p > 0.05$ for all variables). One-way ANOVA revealed significant differences in mean serum levels of vitamin D and ferritin across age groups ($p < 0.01$), suggesting age-related variation in nutritional status. No significant association was found between employment status and micronutrient deficiency prevalence. These findings offer a clear snapshot of the high burden of subclinical micronutrient deficiencies among women in the outpatient setting, emphasizing the need for proactive screening even in the absence of overt clinical symptoms.

Table 1: Demographic Characteristics of Participants (n = 360)

Variable	Value
Mean Age (years)	29.4
Mean BMI (kg/m²)	24.7
Urban Residence (%)	68.1%
Employed (%)	41.3%
Higher Education (%)	36.7%

Table 2: Prevalence of Micronutrient Deficiencies

Micronutrient	Prevalence (%)
Iron (Ferritin <15 ng/mL)	41.5
Vitamin D (<20 ng/mL)	52.8
Folate (<3 ng/mL)	23.6
Vitamin B12 (<200 pg/mL)	19.7

Table 3: Mean Serum Micronutrient Levels

Micronutrient	Mean ± SD
Serum Ferritin (ng/mL)	18.3 ± 7.2
Vitamin D (ng/mL)	17.4 ± 6.5
Folate (ng/mL)	4.8 ± 1.9
Vitamin B12 (pg/mL)	278.6 ± 85.3

Table 4: Micronutrient Deficiencies by Age Group

Age Group (years)	Iron Deficiency (%)	Vitamin D Deficiency (%)	Folate Deficiency (%)	B12 Deficiency (%)
15–24	46.1	58.3	26.8	22.3
25–34	39.7	53.0	21.5	18.2
35–45	38.2	48.1	20.1	17.4

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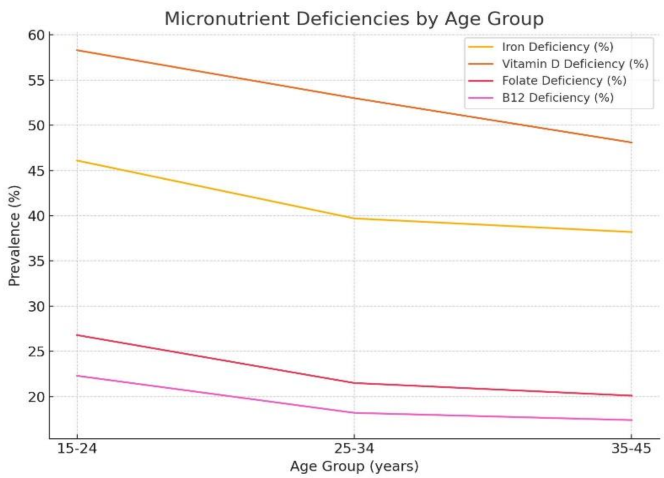

Figure 2 Micronutrient Deficiencies by Age Group

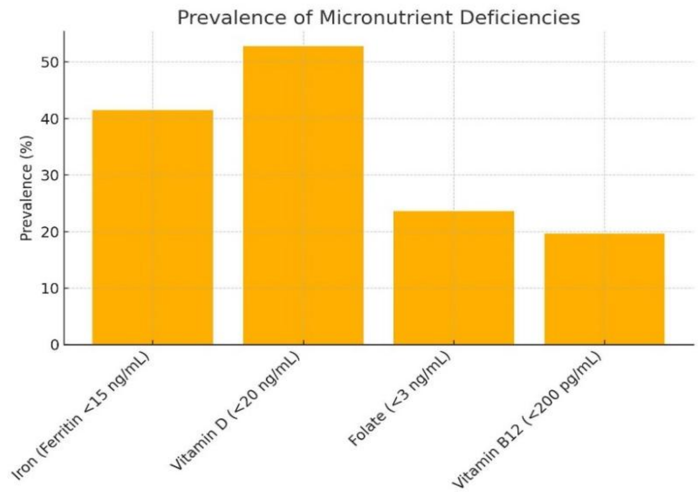

Figure 2 Prevalence of Micronutrients Deficiencies

DISCUSSION

The findings of this study highlight a substantial burden of micronutrient deficiencies—particularly vitamin D and iron—among non-pregnant women of reproductive age attending outpatient clinics in Lahore, Pakistan. With over half of the cohort demonstrating vitamin D deficiency and nearly 42% showing iron deficiency, these results are consistent with global and regional trends, reinforcing the growing concern over "hidden hunger" in seemingly healthy populations. Recent pooled data suggest that globally, approximately 69% of non-pregnant women of reproductive age suffer from at least one micronutrient deficiency, with iron, folate, and vitamin B12 among the most prevalent (17,18). Comparable studies in South Asia report similarly alarming figures. A study found iron and vitamin B12 deficiencies in 67% and 83% of women respectively, with folate insufficiency affecting 70% (19). These parallels underscore that, nutritional inadequacies are not confined to pregnancy or low-income settings but are widespread across varied subpopulations of reproductive-age women. This study's strength lies in its setting within outpatient clinics, capturing women engaged with healthcare services but not necessarily seeking care for nutritional issues. The biochemical assessment of four critical micronutrients—iron, vitamin D, folate, and B12—using standardized assays further adds to the robustness of the data (20). The stratification of results by age groups revealed that younger women (15–24 years) were more likely to suffer from deficiencies, reflecting vulnerabilities at earlier reproductive stages, possibly due to restrictive diets or hormonal factors influencing nutrient metabolism.

A concerning finding was the 52.8% prevalence of vitamin D deficiency, which aligns with national data and broader Asian studies. The high prevalence of vitamin D deficiency despite adequate sunlight exposure, particularly in urban populations, supports existing evidence on the influence of cultural clothing, air pollution, and indoor lifestyles on vitamin D synthesis (21). Similarly, iron deficiency's persistence, particularly in menstruating women, is attributable to blood loss, low iron bioavailability in the diet, and poor dietary diversity. These findings echo data from Pakistan and other LMICs where women are disproportionately affected due to reproductive biology and sociocultural dietary practices (22). Although folate and B12 deficiencies were less prevalent, affecting 23.6% and 19.7% of women respectively, these rates remain clinically significant. The coexistence of multiple deficiencies in a notable portion of the population supports the call for integrated interventions. Fortified foods, especially multiply-fortified salt, have demonstrated promise in regional simulations and may offer a scalable approach to tackle simultaneous nutrient gaps (23,24). The limitations of the study must be acknowledged. The cross-sectional design precludes causal inference. While the selected outpatient clinics offer access to a diverse urban cohort, rural populations remain underrepresented, limiting generalizability. Furthermore, dietary intake data and lifestyle factors such as sun exposure were not directly measured, which could have provided further insight into the observed deficiencies. Biomarkers like serum ferritin and vitamin D may also be influenced by inflammation, though no inflammatory markers were adjusted for in this analysis.

Future research should explore longitudinal tracking to assess deficiency trends over time and examine intervention efficacy. Expanding such studies into rural and underserved communities is critical for understanding the full national burden. Moreover, integrating dietary recall tools, inflammatory markers, and socioeconomic profiling could improve granularity and accuracy of interpretation. The study adds to the growing body of evidence affirming that micronutrient deficiencies are prevalent, underdiagnosed, and potentially modifiable in non-pregnant women of reproductive age. These findings support the integration of routine screening for micronutrient status into primary care for women and reinforce the need for fortified foods and targeted nutrition education programs to combat deficiencies proactively.

CONCLUSION

This study underscores a significant burden of micronutrient deficiencies—particularly vitamin D and iron—among non-pregnant women of reproductive age in Lahore. These findings highlight the urgent need for routine screening, nutrition education, and food fortification strategies to address hidden deficiencies in this vulnerable yet overlooked population. Prioritizing women's nutritional health before pregnancy can substantially improve public health outcomes across the life course.

AUTHOR CONTRIBUTION

Author	Contribution
Abeera Sajid	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Hafsa Hameed Thakur	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Habib Akhtar Bahalkani	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Aimen Ramzi	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Gul E Khuba*	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Rameen Lutaf Ullah	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published
Rimsha Sattar	Contributed to study concept and Data collection Has given Final Approval of the version to be published

REFERENCES

1. Goh Y, Manger M, Duggal M, Das R, Saklani S, Agarwal S, et al. Women in Selected Communities of Punjab, India Have a High Prevalence of Iron, Zinc, Vitamin B12, and Folate Deficiencies: Implications for a Multiply-Fortified Salt Intervention. Nutrients. 2023;15.
2. Abdalla S, Weng Y, Mehta KM, Mahapatra T, Srikantiah S, Shah H, et al. Trends in reproductive, maternal, newborn and child health and nutrition indicators during five years of piloting and scaling-up of Ananya interventions in Bihar, India. J Glob Health. 2020;10(2):021003.
3. Creanga AA, Srikantiah S, Mahapatra T, Das A, Sonthalia S, Moharana PR, et al. Statewide implementation of a quality improvement initiative for reproductive, maternal, newborn and child health and nutritionin Bihar, India. J Glob Health. 2020;10(2):021008.

4. John S, Azizi K, Hancy A, Twin'omujuni A, Katana D, Shine J, et al. The prevalence and risk factors associated with Iron, vitamin B12 and folate deficiencies in pregnant women: A cross-sectional study in Mbeya, Tanzania. PLOS Global Public Health. 2023;3.
5. Vogel C, Kriznik N, Stephenson J, Barker M. Preconception nutrition: building advocacy and social movements to stimulate action. J Dev Orig Health Dis. 2021;12(1):141-6.
6. McHau G, Masanja H, Killel E, Azizi K, Lukindo T, Hancy A, et al. Micronutrient deficiencies and their co-occurrence among pregnant women in Mbeya region, Tanzania. PLOS ONE. 2024;19.
7. Neufeld L, Sethi V, Woldeyahannes M, McDonald C, Beal T, Petry N, et al. Micronutrient deficiencies among preschool-aged children and women of reproductive age worldwide: a pooled analysis of individual-level data from population-representative surveys. The Lancet Global health. 2022;10.
8. Chong M, Bui C, Jaisamrarn U, Pacquing-Songco D, Shaw S, Tam C, et al. A landscape of micronutrient status in women through the reproductive years: Insights from seven regions in Asia. Women's Health. 2020;16.
9. Ahmed F, Ahmad G, Brand T, Zeeb H. Key indicators for appraising adolescent sexual and reproductive health in South Asia: international expert consensus exercise using the Delphi technique. Glob Health Action. 2020;13(1):1830555.
10. Darmstadt GL, Weng Y, Pepper KT, Ward VC, Mehta KM, Borkum E, et al. Impact of the Ananya program on reproductive, maternal, newborn and child health and nutrition in Bihar, India: early results from a quasi-experimental study. J Glob Health. 2020;10(2):021002.
11. Ward VC, Raheel H, Weng Y, Mehta KM, Dutt P, Mitra R, et al. Impact of mHealth interventions for reproductive, maternal, newborn and child health and nutrition at scale: BBC Media Action and the Ananya program in Bihar, India. J Glob Health. 2020;10(2):021005.
12. Mehta KM, Irani L, Chaudhuri I, Mahapatra T, Schooley J, Srikantiah S, et al. Health layering of self-help groups: impacts on reproductive, maternal, newborn and child health and nutrition in Bihar, India. J Glob Health. 2020;10(2):021007.
13. Mehta KM, Irani L, Chaudhuri I, Mahapatra T, Schooley J, Srikantiah S, et al. Health impact of self-help groups scaled-up statewide in Bihar, India. J Glob Health. 2020;10(2):021006.
14. Abdalla S, Pair E, Mehta KM, Ward VC, Darmstadt GL. Geospatial variations in trends of reproductive, maternal, newborn and child health and nutrition indicators at block level in Bihar, India, during scale-up of Ananya program interventions. J Glob Health. 2020;10(2):021004.
15. Ngassa N, Masumo R, Hancy A, Kabula E, Killel E, Nusurupia J, et al. Food and nutrient intake among non-pregnant, non-lactating women of reproductive age of Mbeya in Tanzania: A repeated 24-hour dietary recall. PLOS Global Public Health. 2024;4.
16. Ahmed KY, Rwabilimbo AG, Abrha S, Page A, Arora A, Tadese F, et al. Factors associated with underweight, overweight, and obesity in reproductive age Tanzanian women. PLoS One. 2020;15(8):e0237720.
17. Storto ME, Bailey-Straebler SM, Susser LC. Exploring the Relationship Between Eating Disorders and Reproductive Health, with a Focus on Fertility, Obstetric, and Fetal Outcomes: A Narrative Review. Curr Nutr Rep. 2025;14(1):51.
18. Ward VC, Weng Y, Bentley J, Carmichael SL, Mehta KM, Mahmood W, et al. Evaluation of a large-scale reproductive, maternal, newborn and child health and nutrition program in Bihar, India, through an equity lens. J Glob Health. 2020;10(2):021011.
19. Ahmad F, Calabrese CM, Terranegra A. The Era of Precision Nutrition in the Field of Reproductive Health and Pregnancy. Nutrients. 2023;15(14).
20. Habibi N, Livingstone KM, Edwards S, Grieger JA. Do Older Women of Reproductive Age Have Better Diet Quality than Younger Women of Reproductive Age? Nutrients. 2021;13(11).
21. Dass M, Nyako J, Tortoe C, Fanou-Fogny N, Nago E, Hounhouigan J, et al. Comparison of Micronutrient Intervention Strategies in Ghana and Benin to Cover Micronutrient Needs: Simulation of Bene-Fits and Risks in Women of Reproductive Age. Nutrients. 2021;13(7).
22. Yıldızdaş H, Erdogan BG, Tepe T, Görüroglu O, Ozlü F, Satar M, et al. Birth weight, head circumference, and length of newborns are unaffected by maternal levels of vitamin B12 and folate. Nutrition research. 2022;104:101-7.
23. Nazir I, Wadood M, Nazir S, Rizwan M, Ayub MA, Nasir SS. Assessment of RBC Folate and Serum Vitamin B12 Levels in Pakistani Women of Reproductive Age Group: An Approach towards Prevention of Adverse Pregnancy Outcomes. Journal of Pharmaceutical Research International. 2022.
24. Ross DA. Adolescent health in sub-Saharan Africa: results from the ARISE Network. Trop Med Int Health. 2021;26(4):386-7.

