

## ORIGINAL RESEARCH ARTICLE

# Health implications of folic acid deficiency during pregnancy: women's awareness and attitudes

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## Abstract

Folic acid supplementation is crucial for the health of both mother and newborn. This study investigated Saudi women's awareness, attitudes, and adherence regarding folic acid supplementation. National surveys were conducted across Saudi Arabia from January 1 to February 28, 2025. A validated online questionnaire was presented to female participants to assess socio-demographics, knowledge, and attitudes on folic acid usage. Data analysis was performed using Microsoft Excel, with results displayed as numerical values and percentages. 60% of participants acknowledged the significance of folic acid during gestation. A fair proportion recognized food sources of folic acid, although they misinterpreted the timing of supplementation. A substantial majority (83.5%) favored supplements and natural dietary sources, whilst 10.7% depended only on prescribed supplements. Just under half (45%) reported healthcare personnel to facilitate adherence, whereas 39.1% cited inadequate knowledge as an obstacle to adherence. Despite modest awareness of folic acid importance, there remain deficits in knowledge and obstacles in adherence among Saudi women. Improving educational programs and integrating folic acid counseling into normal healthcare practices are essential for ensuring consistent supplementation and enhancing maternal and fetal health outcomes. (*Afr J Reprod Health* 2025; 29 [6]: 72-81).

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**Keywords:** Female; Knowledge; Attitudes; Folic Acid; Pregnancy

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## Résumé

La supplémentation en acide folique est essentielle à la santé de la mère et du nouveau-né. Cette étude a examiné la sensibilisation, les attitudes et l'observance des femmes saoudiennes concernant la supplémentation en acide folique. Des enquêtes nationales ont été menées en Arabie saoudite du 1er janvier au 28 février 2025. Un questionnaire en ligne validé a été soumis aux participantes afin d'évaluer leurs caractéristiques sociodémographiques, leurs connaissances et leurs attitudes concernant l'utilisation de l'acide folique. L'analyse des données a été réalisée sous Microsoft Excel, les résultats étant présentés sous forme de valeurs numériques et de pourcentages. 60 % des participantes ont reconnu l'importance de l'acide folique pendant la grossesse. Une proportion importante d'entre elles ont reconnu les sources alimentaires d'acide folique, bien qu'elles aient mal interprété le moment de la supplémentation. Une majorité substantielle (83,5 %) a privilégié les suppléments et les sources alimentaires naturelles, tandis que 10,7 % se sont uniquement appuyées sur les suppléments prescrits. Un peu moins de la moitié (45 %) ont indiqué que le personnel soignant facilitait l'observance, tandis que 39,1 % ont cité le manque de connaissances comme un obstacle à l'observance. Malgré une faible sensibilisation à l'importance de l'acide folique, des lacunes persistent dans les connaissances et des obstacles à l'observance chez les femmes saoudiennes. L'amélioration des programmes éducatifs et l'intégration des conseils sur l'acide folique dans les pratiques de santé courantes sont essentielles pour garantir une supplémentation régulière et améliorer la santé maternelle et fœtale. (*Afr J Reprod Health* 2025; 29 [6]: 72-81).

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**Mots-clés:** Femme; Connaissances; Attitudes; Acide folique; Grossesse

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## Introduction

Folic acid, the synthetic form of folic acid (vitamin B9), is essential for fetal development, particularly in preventing neural tube defects such as spina bifida and anencephaly, which are among the most

severe congenital anomalies affecting newborns.<sup>1-3</sup> Since these defects develop within the first few weeks of gestation, often before a woman knows she is pregnant, it is crucial that folic acid intake be adequate before conception and during early pregnancy.<sup>4</sup> Inadequate folic acid intake has been

associated with maternal anemia, pregnancy complications, and poor birth outcomes.<sup>5</sup> Recognizing folic acid significance, the World Health Organization and various health agencies recommend a daily intake of 400 µg of folic acid for all women of reproductive age, particularly those planning to conceive.<sup>6</sup> Despite these recommendations, adherence to folic acid supplementation remains inconsistent worldwide, often influenced by sociocultural factors, healthcare accessibility, and personal beliefs.

Globally, studies indicate that while awareness of folic acid and its benefits is relatively high, adherence remains suboptimal in many regions. A study in Japan found that 70.4% of participants had heard of folic acid, yet a significant proportion lacked adequate knowledge about its correct timing, leading to missed preventive benefits.<sup>7</sup> Similar findings were reported in Eritrea, where many women recognized the importance of folic acid but compliance rates were low due to late antenatal visits and limited healthcare guidance.<sup>5</sup> On the healthcare provider side, a study conducted in Canada revealed that 70% of doctors were either unfamiliar with or unsure about the most recent folic acid guidelines, leading to inconsistent advice being given to pregnant women.<sup>8</sup> The role of healthcare providers in recommending folic acid and ensuring adherence is crucial, yet gaps in their knowledge often contribute to lower compliance among women.<sup>8-10</sup> Collectively, these findings emphasize that knowledge alone is insufficient; effective implementation strategies, including healthcare provider engagement and public health campaigns, are also necessary to improve adherence.

In Saudi Arabia, studies suggest that knowledge of folic acid is relatively high, yet adherence remains inconsistent. Research conducted in Riyadh found that 96% of pregnant women were aware of folic acid supplementation, yet only 55.7% had sufficient information regarding its proper use, with barriers such as lack of counseling, forgetfulness, and nausea contributing to non-adherence<sup>4</sup>. Meanwhile, a large-scale study examining folic acid use among Saudi women found that 88.3% reported taking folic acid supplements during pregnancy, yet confusion remained regarding the correct timing of

supplementation, with only 25.3% of women reporting knowing that folic acid should be taken before pregnancy; 36.9% believed it should be taken only during the first trimester.<sup>11-13</sup> These findings suggest a need for stronger healthcare interventions, particularly in primary care settings, to enhance awareness and adherence among Saudi Arabian women.

This study enhances the existing literature on folic acid supplementation by examining essential knowledge regarding its importance and the factors affecting its utilization and adherence among women in Saudi Arabia who are pregnant or seeking to conceive. This study is unique as its participants solely comprised women. The findings are based on the genuine experiences and viewpoints of persons directly affected by folic acid guidelines. In addition to improving our understanding of the knowledge and attitudes of pregnant women regarding folic acid supplementation, this work also identifies barriers to commitment. Ultimately, the results of this study can help inform public health measures aimed at reducing preventable delivery complications and improving maternal and newborn health in Saudi Arabia.

## Methods

### *Study design*

A national cross-sectional survey was conducted in Saudi Arabia from January 1 to February 28, 2025, utilizing a questionnaire developed and assessed by researchers from the Department of Medical Laboratory Sciences at King Khalid University. The questionnaire was distributed randomly in Arabic to the intended participants, potentially including people who only speak Arabic. The text was translated into English for analysis. The Google Forms platform was utilized to host the survey, with a link generated and distributed to participants through various social channels. Participants included individuals from all regions of Saudi Arabia who consented to participate in this research. Participant confidentiality was assured alongside a clear explanation of the study's purpose. The initial section of the questionnaire included a brief overview outlining the subjects and objectives

of the study. The second section included questions regarding participant age, geographic location, nationality, educational attainment, employment in the medical sector, marital status, and pregnancy-related experience. The remainder of the questionnaire comprised 17 questions divided into two distinct sections: one to evaluate participant knowledge of folic acid use during pregnancy, and the other to elucidate their attitudes towards that topic. All participants were aware of the voluntary nature of their involvement and were afforded the opportunity to withdraw at any moment of their choice. The study was limited to female participants, with male participants excluded.

### **Data analysis**

Data collection was performed using the online Google Forms platform, and analysis was conducted with Microsoft Excel. Participant sociodemographic characteristics, knowledge, and attitudes were quantified and expressed in numerical values and percentages.

### **Ethical consideration**

The research ethics committee of King Khalid University (HAPO-06-B-001) provided approval for this study with reference number ECM#2025-403. At the beginning of the questionnaire, the participants were fully informed about the aims and questions of the study.

## **Results**

### **Socio-demographic characteristics**

The study sample of 1,136 participants exclusively comprised women, reinforcing its reliability in assessing knowledge and attitudes toward folic acid use from the female perspective. The majority of participants were Saudi nationals (91.9%, n=1,044), with 8.1% (n=92) being non-Saudis. The age distribution was varied, with young adults aged 18-24 years comprising the largest group at nearly half of the participants (46.2%, n=525), followed by adults aged 25-34 years at 25.4% (n=288). The participants demonstrated a balanced geographic distribution: Eastern (24.4%), Central (24.5%), Western (23.6%), and Southern (21.2%)

regions were represented. The Northern region exhibited the lowest percentage of respondents, recorded at 6.3%. Regarding marital status, a significant proportion (72.7%) were unmarried. For educational background, nearly half (49.4%) held a bachelor's degree, while the second-largest group (30.7%) had completed high school, underscoring the study population's strong educational foundation. Most participants (86.3%) had no professional background in healthcare, making their responses reflective of the general public's awareness. Furthermore, 77.6% had never been pregnant, ensuring that insights were predominantly derived from women in the preconception phase. Participant socio-demographic characteristics are comprehensively presented in Table 1, which detailed breakdown allows for a clearer visualization of distributions across key variables.

### **Participant knowledge toward folic acid supplementation during pregnancy**

This study assessed participants' understanding of folic acid supplementation, including its sources, benefits, and deficiency risks. The findings, detailed in Table 2, highlight both awareness and misconceptions, underscoring the need for improved education and targeted interventions.

A majority (60%) recognized the significance of folic acid supplementation during pregnancy, while 40% remained unaware. Similarly, over two-thirds (68.9%) correctly identified that folic acid supports fetal growth and maternal immune function, but 29.8% were uncertain.

When asked about their sources of information on folic acid supplementation, 32.8% of participants indicated a complete lack of prior knowledge on the subject. Among the remainder, the most frequently cited source was physicians (24%), whereas only 2.7% had obtained their knowledge through structured training programs.

Participants' responses further revealed gaps in dietary knowledge, with 41.5% correctly recognizing dark leafy greens and certain fruits as natural sources of folic acid, while 55% were unaware or misinformed.

**Table 1:** Sociodemographic characteristics of the study participants (n=1136)

Variable	n	(%)
<b>Age (years)</b>		
< 18	159	14
18-24	525	46.2
25-34	288	25.4
35-45	130	11.4
> 45	34	3
<b>Region</b>		
Northern	72	6.3
Western	268	23.6
Eastern	278	24.5
Southern	241	21.2
Central	277	24.4
<b>Nationality</b>		
Saudi	1044	91.9
Non-Saudi	92	8.1
<b>Education</b>		
Primary	4	0.4
Intermediate	25	2.2
Secondary or equivalent	349	30.7
Pre-university diploma	131	11.5
Bachelor	561	49.4
Postgrad	66	5.8
<b>Medical field</b>		
Yes	156	13.7
No	980	86.3
<b>Marital status</b>		
Married	284	25
Single	826	72.7
Presently unmarried, having been previously married	26	2.3
<b>Reproductive status</b>		
Possesses prior experience of pregnancy	255	22.4
Has never experienced pregnancy	881	77.6

In addition, misconceptions persisted, as 19.4% incorrectly believed that meat contains higher **folic acid** levels than vegetables.

Regarding preventive benefits, a majority (67.1%) correctly identified folic acid as having a

role in reducing neural tube defects, yet nearly a third (31.3%) lacked awareness of this critical function. Likewise, about half (52.5%) recognized **folic acid** significance in anemia prevention, but at the same time nearly half (43%) exhibited a gap in this knowledge.

Knowledge of the optimal timing for supplementation was also limited, as only 45.5% correctly identified that folic acid intake should begin before conception and continue through the twelfth week of pregnancy; fully 49.6% of participants were unsure or misinformed.

Concerning common causes of folic acid deficiency, the most cited reason was inadequate dietary intake (60.7%), followed by poor absorption due to medical conditions (43.9%). Awareness gaps were evident, with 35.7% reporting uncertainty about dietary-related causes, while 52.7% were unaware of absorption-related factors.

All told, despite notable awareness of folic acid among participants, a number of misconceptions persisted, particularly regarding dietary sources, its preventive role in maternal and fetal health, and optimal supplementation timing. These findings highlight the importance of strategic public health interventions to correct misinformation and enhance adherence.

### *Participant attitudes toward folic acid supplementation during pregnancy*

This study examined participants' willingness to use folic acid, key motivators, perceived obstacles, and beliefs about its necessity. The detailed findings are presented in Table 3.

A significant majority expressed willingness to use folic acid when necessary, though source preferences varied. Most participants (949 individuals, 83.5%) preferred a combination of dietary supplements and natural food sources, while 122 (10.7%) relied exclusively on supplements prescribed by medical professionals.

Concerning barriers to folic acid intake, insufficient awareness emerged as the most cited challenge (28.8%), while difficulty accessing supplements was the least reported (2.6%). A notable contributing factor to non-adherence was a lack of pregnancy-related healthcare follow-ups (10.7%).

**Table 2:** Knowledge of study participants regarding the use of folic acid during pregnancy (n=1136).

Variable	n	(%)
<b>Do you possess any information concerning folic acid supplements, and what are your sources of information?</b>		
Yes, my source is a physician	283	24.9
Yes, my source is friends and relatives	146	12.9
Yes, my source is television	0	0
Yes, my source is social media	161	14.2
Yes, my source is the internet	142	12.5
Yes, my source is participating in a training program	28	2.5
I possess no knowledge regarding this matter	373	32.8
<b>Do you have information about the significance of folic acid supplements during pregnancy?</b>		
Yes	682	60
No	454	40
<b>Folic acid is present in dark leafy green vegetables, like spinach, and in certain fruits, such as oranges:</b>		
Yes	472	41.5
No	39	3.4
I do not know	625	55
<b>Folic acid is found in greater quantities in meat than in veggies:</b>		
Yes	220	19.4
No	175	15.4
I do not know	741	65.2
<b>Folic acid supplements are effective in preventing neural tube defects in the brain and spinal cord of the fetus during pregnancy:</b>		
Yes	762	67.1
No	19	1.7
I don't know	355	31.3
<b>Folic acid supplementation decreases the likelihood of anemia development:</b>		
Yes	596	52.5
No	51	4.5
I don't know	489	43
<b>Folic acid supplements support fetal growth and development while improving maternal immune function:</b>		
Yes	783	68.9
No	14	1.2
I don't know	339	29.8
<b>Daily folic acid supplementation is advised, starting at the beginning of conception attempts and continuing through the twelfth week of pregnancy:</b>		
Yes	517	45.5
No	564	49.6
I don't know	55	4.8
<b>A primary cause of folic acid deficiency is inadequate intake of foods that are rich in folic acid:</b>		
Yes	689	60.7
No	41	3.6
I don't know	406	35.7
<b>The deficiency of folic acid can be attributed to reduced absorption in the body due to certain diseases:</b>		
Yes	499	43.9
No	38	3.3
I do not know	599	52.7

**Table 3:** Participant attitudes regarding the use of folic acid during pregnancy (n=1136).

Variable	n	(%)
<b>When necessary, I will use folic acid by:</b>		
Dietary supplements prescribed by medical professionals	122	10.7
Only natural food	65	5.7
Both dietary supplements and natural food sources	949	83.5
<b>If there is an obstacle to my use of folic acid during pregnancy, it is:</b>		
Not attending pregnancy follow-up appointments with a healthcare practitioner	122	10.7
Difficulty getting folic acid supplements	29	2.6
Insufficient awareness	327	28.8
I am assured that my natural diet sufficiently meets my needs	70	6.2
I possess no obstacles	588	51.8
<b>The factors that motivate me to adhere to the intake of folic acid pills when necessary, encompass:</b>		
Guidance from a physician or healthcare professional	511	45
Awareness of its advantages	422	37.1
My prior experience or the experiences of others	108	9.5
I possess no motivation to acquire it	95	8.4
<b>Due to concerns regarding potential adverse effects, I may prefer not to utilize folic acid supplements when they are required:</b>		
Yes	512	45.1
No	624	54.9
<b>Folic acid supplementation throughout gestation should be obligatory:</b>		
Yes	610	53.7
No	85	7.5
I do not know	441	38.8
<b>Obstacles that may undermine my adherence to folic acid supplements during pregnancy include:</b>		
Insufficient knowledge regarding its significance	444	39.1
Social or cultural customs	41	3.6
Difficulty obtaining supplements	41	3.6
I encounter no impediments and am committed to taking it	610	53.7
<b>My opinion on the use of herbal versus medical folic acid supplements during pregnancy:</b>		
Medical folic acid pills are safer and more effective than herbal supplements	547	48.2
Both medical folic acid pills and herbal supplements provide benefits	517	45.5
I will not use supplements and will rely solely on herbal sources	43	3.8
I will not use any supplements and will rely solely on natural sources	12	1.1
Herbal supplements are safer because they are natural	17	1.5

However, more than half of participants (51.8%) reported encountering no barriers.

Regarding motivators for folic acid intake, guidance from healthcare professionals emerged as the primary motivator (45%), followed by awareness of its benefits (37.1%). Nonetheless, 8.4% of participants reported a lack of motivation to acquire folic acid.

Despite the well-documented benefits of folic acid, participant attitudes toward supplementation were also shaped by concerns about potential side effects, with 45.1% expressing

hesitancy. Conversely, 54.9% dismissed such concerns, reflecting confidence in its safety and efficacy.

When comparing folic acid supplements to herbal-based options, nearly half of participants (48.2%) perceived medical folic acid pills as the safer and more effective choice, whereas a comparable share (45.5%) viewed medical and herbal supplements as equally beneficial. Participants held differing views on the necessity of mandatory folic acid supplementation during pregnancy, with 53.7% endorsing obligatory

supplementation, but a substantial 38.8% remaining uncertain.

When asked about obstacles that may hinder regular supplementation, more than half of participants (53.7%) reported no challenges and demonstrated commitment to taking folic acid. However, insufficient knowledge of its significance remained a prominent obstacle (39.1%). Participants also noted difficulty in obtaining supplements and social or cultural customs as equally less common challenges (3.6%).

All told, while most participants acknowledged the importance of folic acid supplementation, knowledge gaps, safety concerns, and accessibility challenges influenced adherence. The misconceptions, cultural beliefs, and perceived necessity among this study population highlight the need for targeted education and strengthened healthcare guidance

## Discussion

Folic acid is a vital compound that prevents serious complications in human development.<sup>4</sup> This research assessed the knowledge and attitudes of women in Saudi Arabia regarding folic acid use, focusing on awareness levels, adherence behaviors, and common misconceptions. The results were analyzed in comparison to previous studies to highlight both similarities and discrepancies with established research. The study population comprised a diverse sample of women varying in age, marital status, education, geographic distribution, pregnancy history, and employment in the medical sector. This enabled a comprehensive evaluation of awareness and attitudes towards folic acid.

The responses revealed participants to have acquired information about folic acid through a range of sources. In total, 67.2% were aware of folic acid, and physicians were the most common source of information (24.9%), particularly among women who had previously been pregnant. This highlights both the role of healthcare professionals in education and the need for better physician-patient communication. Similar trends have previously been observed in Saudi Arabia, where 64.3% of pregnant women reported relying on physicians,<sup>4</sup> and among female university students, 81.1% cited

physicians as their primary.<sup>14</sup> However, knowledge alone does not ensure the utilization of supplements, underscoring the need for improved healthcare educational strategies.

A total of 60% of participants understood folic acid's importance in pregnancy, mirroring the percentage who accessed multiple sources; this suggests receiving information to go nearly hand-in-hand with internalizing it. However, awareness alone does not ensure adherence, as seen in a previous report from Saudi Arabia, where 73.2% recognized folic acid significance, but only 25.3% knew it should be taken before conception,<sup>11</sup> combined with studies that have confirmed knowledge alone is insufficient for behavioral change.<sup>15</sup> Furthermore, despite largely recognizing its importance, participants showed mixed understanding of the roles of folic acid in preventing neural tube defects and anemia, and in supporting maternal and fetal health. This echoes a prior study in which 81.5% of Saudi women recognized its role in preventing birth defects, but only 12.6% associated folic acid with anemia prevention.<sup>4</sup> Similarly, Polish studies found that women primarily linked folic acid to pregnancy but lacked broader awareness of its benefits.<sup>16</sup> These findings underscore the necessity for focused health education initiatives in this area and for structured prenatal counselling and public health efforts to translate awareness into action.

Regarding the etiology of folic acid deficiency, responses were largely positive, with a substantial share of participants (60.7%) correctly identifying insufficient intake as the primary cause. This reflects a fair level of awareness and logical reasoning. However, participant understanding of disease-related causes, such as impaired folic acid absorption due to pathological conditions, clearly remained limited. A study conducted in Ethiopia similarly found that although participants were generally aware of folic acid's roles, they had notably less knowledge of medical conditions that can cause folic acid deficiency.<sup>9</sup> Our results further revealed significant discrepancies in knowledge regarding the timing of folic acid intake. A notably high percentage (49.6%) lacked awareness altogether, while 45.5% correctly identified preconception as the optimal time for supplementation. Among previously pregnant

women (22.4% of the total sample), 54.5% remained misinformed, showing that pregnancy experience does not guarantee awareness. Since most respondents had either a bachelor's degree (49.4%) or secondary education (30.7%), integrating folic acid education into school, university, and community programs could strengthen early awareness.

Despite recognizing the problem of insufficient folic acid intake, 55% of participants lacked accurate knowledge of its dietary sources. Notably, 19.4% mistakenly believed meat contained more folic acid than vegetables, despite 83.5% intending to obtain folic acid from both diet and supplements, risking misinformation-driven choices. In our study, 41.5% of participants accurately recognized green leafy vegetables and fruits as primary sources of folic acid; previous research conducted in Poland and Ghana identified a higher proportion of participants possessing this knowledge, at 60.4% and 75.8%, respectively.<sup>16,17</sup> In addition, 45.5% of present respondents acknowledged that both herbal supplements and medical pills offer benefits; however, concerns persisted, with 3.8% favoring herbs exclusively and 1.5% perceiving them as safer alternatives. The variability in folic acid content and absence of standardized dosing in herbal supplements may present risks, underscoring the necessity for education regarding the bioavailability and appropriate dosage of pharmaceutical folic acid. However, 83.5% of participants were willing to obtain folic acid from both diet and supplements, reflecting a practical albeit incomplete understanding. While 51.8% faced no challenges in taking folic acid and side effects were not a significant concern, with 54.9% reporting no such issues, lack of awareness (28.8%) and insufficient knowledge (39.1%) remain major obstacles to adherence. Limited understanding of folic acid preventive role, fetal impact, and maternal benefits may lead to inconsistent supplementation.

Encouragement also plays a vital role in folic acid intake, with 45% of participants reporting being influenced by healthcare providers and 46.6% by general awareness, past experiences, or recommendations. Similarly, a study in the Philippines identified healthcare providers as the primary source of reliable information.<sup>19</sup> While

healthcare professionals remain a trusted source, expanding health campaigns, school programs, and digital initiatives can strengthen messaging beyond clinical settings.

Finally, participants overall showed strong support for mandatory folic acid supplementation, with 53.7% endorsing such a measure. This reflects a growing recognition of folic acid importance. However, 38.8% remained uncertain, indicating knowledge gaps that may cause hesitancy. A study in Australia found public support for such policies,<sup>20</sup> suggesting that well-structured regulations could promote adherence.

### **Strengths, limitations, and public health implications**

A key strength of this study is its large and diverse sample, which enables a comprehensive evaluation of folic acid awareness and attitudes among women in Saudi Arabia. The inclusion of participants from diverse age groups and educational levels enhances the study's relevance across various population segments. Furthermore, this study offers valuable comparative insights by aligning its findings with previous research conducted both in Saudi Arabia and internationally. However, certain limitations should be acknowledged. As the study relied on self-reported data, responses may have been subject to recall bias or social desirability effects, potentially influencing the accuracy of reported knowledge and attitudes. Future research should incorporate longitudinal studies to monitor changes in awareness and adherence over time, providing deeper insights into the long-term impact of educational efforts.

### **Conclusion**

This study highlights a moderate awareness of folic acid supplementation among Saudi women, with variation in knowledge regarding dietary sources, preventive benefits, and supplementation timing. While attitudes toward folic acid use were generally positive, there were gaps in understanding concerning the optimal intake timing and preventive benefits. Addressing these gaps through targeted educational initiatives, healthcare provider engagement, and public health

campaigns is essential for improving supplementation adherence. Enhancing awareness through structured educational efforts and community outreach will be key in optimizing maternal and fetal health outcomes.

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## Conflicts of interest

The authors declare no conflicts of interest.

## Contribution of authors

Alaa Aba Zayd, Mohammed Makkawi, and Sultan Alasmari planned and designed the study. Alaa Aba Zayd gathered the data. Mohammed Makkawi and Sultan Alasmari conducted a data analysis. Alaa Aba Zayd, Ahmad Shaikh, Mohammed Makkawi, and Sultan Alasmari prepared the manuscript. All writers cited in the publication endorsed the manuscript.

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