



Late Initiation and Overuse of Folic Acid Supplements: A Public Health Challenge in Maternal Nutrition

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Abstract

Folic acid supplementation prevents neural tube defects (NTDs), but late initiation and overuse remain challenges in low-resource settings. This study aimed to understand supplementation patterns to inform public health solutions. A cross-sectional survey was conducted among 381 pregnant women attending antenatal care at Cottage Hospital, Ede, Osun State, Nigeria. Data on socio-demographic characteristics, knowledge, attitude, and intake of folic acid were collected using a structured, interviewer-administered questionnaire. Descriptive statistics and inferential analyses were performed using SPSS version 23. Results showed that while 90.3% had heard of folic acid, only 12.6% knew the correct preconception initiation period. Preconception use was very low (12.9%), while 87.1% commenced supplementation after antenatal booking. Dosage practices revealed that 60.1% consumed 1 mg daily (250% of RDA), while 22.8% consumed 2 mg daily (500% of RDA); only 9.2% reported irregular or no use. Knowledge of specific benefits was limited: 43.3% associated folic acid with fetal growth, 23.6% with blood formation, and only 8.9% with birth defect prevention. Awareness of neural tube defects (NTDs) was low (21.8%). Healthcare providers were the main source of information (55.9%). Despite high awareness, delayed initiation and overdosing undermine the preventive benefits of folic acid and raise safety concerns. Strengthened antenatal counselling, community campaigns, and mandatory fortification of staples such as wheat flour and rice with folic acid are urgently needed to optimise maternal nutrition and reduce preventable birth defects.

Keywords: Folic acid; Maternal nutrition; Applied public health; Neural tube defects; Nigeria

1. Introduction

Folate (vitamin B9) is an essential nutrient required for DNA synthesis, repair, and amino acid metabolism, while its synthetic form, folic acid, is widely used in supplements and food fortification. Adequate folic acid intake before and during early pregnancy can reduce neural tube defects (NTDs) by up to 70% and improve maternal outcomes (Kancherla, 2023). For this reason, the World Health Organization (2012) recommends a daily intake of 400 µg of folic acid for women of reproductive age, beginning before conception and continuing throughout pregnancy (Assefa et al., 2021).

In high-income countries, mandatory food fortification has led to significant declines in NTD prevalence. For example, the United States and Canada recorded a 26–47% reduction following fortification (Martinez et al., 2023). In contrast, Nigeria has no national fortification program, and folic acid use largely depends on antenatal supplementation. Unfortunately, many women initiate antenatal visits late, meaning supplementation often begins after neural tube closure, limiting its protective effects (Amaambo, 2021; Omonuju, 2025).

Evidence from Nigeria and other low-resource settings indicates that, although awareness of folic acid exists, knowledge of the correct timing, dosage, and benefits remains inadequate. Many women commence supplementation only at antenatal booking, and misconceptions about its role are common (Nwankwo et al., 2021). Socio-demographic factors such as maternal education, employment status, and access to healthcare

information further influence folic acid knowledge, attitude, and practice (KAP). These gaps highlight the need for community-specific data to inform public health interventions.

This study addresses these gaps by assessing the knowledge, timing, and intake patterns of folic acid among pregnant women in Osun State, Nigeria, with special attention to both underuse and overuse. Findings from this study provide community-specific evidence to guide maternal health education, strengthen antenatal care, and support nutrition policy, particularly the urgent need for mandatory food fortification.

2. Methodology

2.1 Study Design and Setting

A hospital-based cross-sectional descriptive study was conducted among pregnant women attending the antenatal clinic of Cottage Hospital, Ede, Osun State, Nigeria. Ede is located in Osun West Senatorial District and has a population of approximately 159,866 people according to the 2006 census (Olajumoke et al., 2021). Data were collected over a three-month period, from March to May 2023.

2.2 Study Population and Sampling

The study population comprised pregnant women attending routine antenatal care during the study period. A simple random sampling technique was applied: on each clinic day, a list of attending women was compiled, and every 5th eligible woman was selected after a random starting point determined by ballot. Inclusion criteria were: confirmed pregnancy, registration for antenatal care at the facility, and willingness to provide informed consent. Exclusion criteria included severe illness preventing participation.

2.3 Sample Size Calculation

A total of 381 pregnant women were recruited, exceeding the minimum sample size required for a cross-sectional survey at a 95% confidence level and 5% margin of error. The Cochran formula for sample size calculation was employed as thus:

$$n = \frac{Z^2 \times p(1 - p)}{d^2}$$

where: n = the desired sample size, Z = standard normal deviate usually set at 1.96 (95% CI), P is the prevalence of maximum n at 0.4, and d is the 0.05 margin of error.

$$q = 1 - p = 0.5$$

$$n = \frac{(1.96)^2 \times 0.4 \times 0.6}{(0.05)^2} = 369 \text{ respondents}$$

2.4 Data Collection Instrument

Data were collected using a structured, interviewer-administered questionnaire adapted from previous KAP studies on folic acid supplementation. The questionnaire consisted of four sections:

Section A: Socio-demographic and obstetric characteristics

Section B: Attitudes toward folic acid supplementation and antenatal care

Section C: Knowledge of folic acid benefits, sources, dosage, and timing

Section D: Intake patterns of folic acid and related supplements

To ensure accuracy and comprehension, the questionnaire was translated into Yoruba (the predominant local language) and then back-translated into English to maintain content validity. Interviews were conducted in the preferred language of the participant.

2.5 Data Quality Assurance

Content validity of the questionnaire was reviewed by subject experts. Pre-testing was carried out among 20 pregnant women in a separate facility, and necessary adjustments were made. Research assistants were trained to conduct the interviews consistently and minimize interviewer bias.

2.6 Knowledge and Attitude Scoring

Knowledge was assessed using 10 structured items on timing, benefits, and dosage of folic acid. Scores $\geq 70\%$ (≥ 7 out of 10) were classified as adequate knowledge, while scores $< 70\%$ were inadequate. Attitudes were measured using 8 items on a Likert scale; a mean score ≥ 4 was classified as a positive attitude.

2.7 Data Analysis

Data were entered, coded, and analysed using SPSS version 23. Descriptive statistics (frequencies, percentages, means, and standard deviations) summarised participants' characteristics. Bivariate associations between socio-demographic variables and folic acid knowledge, attitude, and intake were assessed using Chi-square tests, while percentage of RDA (%RDA) calculations were based on the World Health Organization's recommended dietary allowance (RDA) of 400 μg (0.4 mg) folic acid per day for pregnant women (World Health Organization, 2016). Cases with missing responses ($< 5\%$ of total data) were excluded from analysis using listwise deletion. Statistical significance was set at $p < 0.05$.

2.8 Ethical Considerations

Ethical approval was obtained from the Osun State Health Research Ethics Committee (Approval No: OSHREC/PRS/559T/329) on 23rd February 2023. Administrative approval was also secured from the hospital management. Written informed consent was obtained from all participants prior to enrolment. All participants also provided written consent for publication of anonymised data. Confidentiality was strictly maintained, and participation was voluntary.

3. Results

3.1 Socio-Demographic Characteristics

A total of 381 pregnant women participated. The majority (52.2%) were aged 30–34 years, while only 2.1% were above 40 years. Most respondents (63.2%) had completed secondary education, 30.4% had tertiary education, and 6.3% had only primary education. More than four-fifths (82.2%) were employed, and 99% were married. The majority were of Yoruba ethnicity (84.8%), followed by Igbo (12.6%) and Hausa (2.6%).

Table 1. Socio-Demographic Characteristics of Respondents (n = 381)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	< 20	18	4.7
	20–24	45	11.8
	25–29	111	29.1
	30–34	199	52.2
	≥ 40	8	2.1
Education	Primary	24	6.3
	Secondary	241	63.2
	Tertiary	116	30.4
Employment status	Employed	313	82.2
	Unemployed	68	17.8
Marital status	Married	377	99.0
	Single	4	1.0
Ethnicity	Yoruba	323	84.8
	Igbo	48	12.6
	Hausa	10	2.6

3.2 Attitudes Toward Pregnancy and Timing of ANC Registration

Only 35.7% of women enrolled for antenatal care during the first trimester, while 46.5% registered after 25 weeks. Most reported their pregnancies as wanted (92.7%) and planned (88.7%).

Attitudes and Timing Distribution

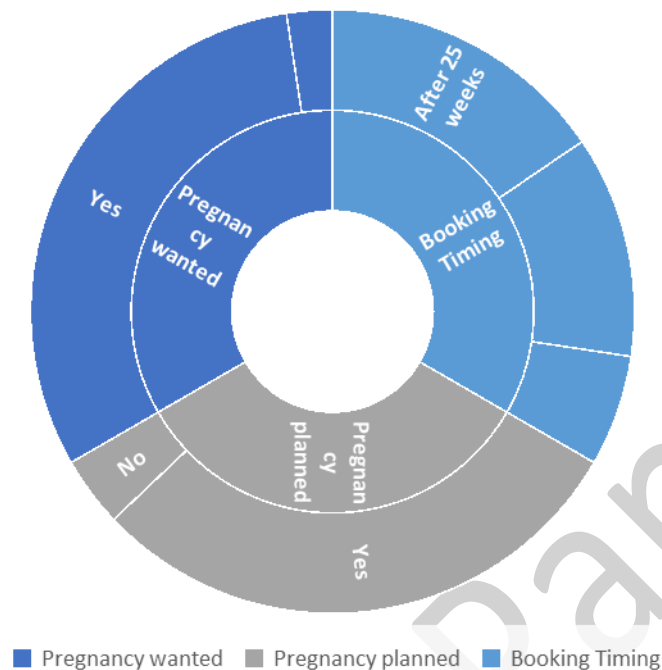


Figure 1. Distribution of Respondent Attitudes Toward Pregnancy and Timing of ANC Registration

3.3 Critical Roles of Builders in Mitigating Building Collapses

Overall, 90.3% of respondents had heard of folic acid, but only 12.6% were aware of the correct preconception initiation period. Knowledge of specific benefits was limited: 43.3% linked folic acid to fetal growth and development, 23.6% to blood formation, and only 8.9% to prevention of birth defects. Awareness of neural tube defects was low (21.8%). Healthcare providers (55.9%) and mass media (23.4%) were the main sources of information.

3.4 Intake Patterns of Folic Acid

The majority (87.1%) commenced supplementation after booking for antenatal care, while only 12.9% reported preconception folic acid use. Supplementation practices varied: 32.0% used folic acid alone, 45.1% combined it with multivitamins, while 12.1% and 10.8% reported iron or calcium, respectively. With respect to dosage, 229 women (60.1%) consumed 1 mg daily (250% of RDA), 87 women (22.8%) consumed 2 mg daily (500% of RDA), 35 women (9.2%) reported irregular or no use, while only 30 women (7.9%) adhered to the recommended dosage of 400 µg (100% of RDA). Dietary intake showed that 57.0% consumed vegetables daily and 44.6% consumed fruits daily.

Table 2. Awareness, Knowledge, and Perceptions of Folic Acid Among Respondents (n = 381)

Variable	Category/Response	Frequency (n)	Percentage (%)
Heard about Folic Acid	Yes	344	90.3
	No	37	9.7
Total		381	100
Correct Timing (Preconception)	Yes	48	12.6
	No	333	87.4
Total		381	100
Perceived Benefits	Fetal growth and development	165	43.3
	Blood formation	90	23.6
	Prevention of birth defects	34	8.9
	Others/Don't know	92	24.2
Total		381	100
Awareness of NTDs	Yes	83	21.8
	No	298	78.2
Total		381	100
Sources of information	Healthcare providers	213	55.9
	Mass media	89	23.4
	Friends/relatives	79	20.7
Total		381	100

Table 3. Folic Acid Supplementation Practices (n = 381)

Variable	Category/Response	Frequency (n)	Percentage (%)
Preconception use	Yes	49	12.9
	No	332	87.1
Total		381	100
Type of supplement	Folic acid only	122	32.0
	Folic acid + multivitamins	172	45.1
	Iron	46	12.1
	Calcium	41	10.8
Total		381	100
Dosage	1 tablet/day (1 mg; 250% RDA)	229	60.1
	2 tablets/day (2 mg; 500% RDA)	87	22.8
	Irregular/none	35	9.2
	RDA/ Normal dosage (400mcg/0.4mg 100% RDA)	30	7.9
Total		381	100
Dietary intake	Daily vegetable consumption	217	57.0
	Daily fruit consumption	170	44.6
Total		381	100

4. Discussion

This study assessed knowledge, timing, and intake patterns of folic acid supplementation among pregnant women in Osun State, Nigeria. Although awareness of folic acid was high (90.3%), correct knowledge of preconception initiation was poor (12.6%). This is consistent with reports from Ibadan, Nigeria, where only 15% of women initiated folic acid before conception (Lawal & Adeleye, 2014). Similar gaps have been documented in other African countries. In Ethiopia, less than 10% of women reported preconception folic acid use (Assefa et al., 2021), while in Ghana, only 6.8% of women initiated supplementation before pregnancy recognition (Akwa Harrison et al., 2024). These findings demonstrate a continent-wide challenge of late initiation, largely linked to unplanned pregnancies, late antenatal registration, and limited preconception counselling. By contrast, studies in Canada and the U.S. report widespread preconception of folic acid use due to effective fortification and health education programs (Chalmers et al., 2008).

Despite high reported usage during pregnancy, most women in this study consumed doses above the recommended dietary allowance. Approximately 60.1% took 1 mg daily (250% of the RDA), 22.8% took 2 mg daily (500% of the RDA), while only 7.9% adhered to the WHO-recommended 400 µg. Overuse of folic acid raises safety concerns. Long-term high intake has been associated with masking vitamin B12 deficiency, which can delay the diagnosis of neurological disorders (11) (Clarke et al., 1998). Other studies suggest potential associations between excessive folic acid intake and adverse health outcomes, including insulin resistance and certain cancers, although evidence remains inconclusive (12) (13) (Mason et al., 2011; Vollset et al., 2013). These findings highlight the need for clearer prescription guidelines and stronger monitoring of supplementation practices in Nigeria and similar settings.

Low awareness of neural tube defects and folic acid's preventive role leads to delayed supplementation. This aligns with evidence that unplanned pregnancies and late antenatal registration are major barriers to optimal folic acid use in low-resource settings (16) (Grattan, 2025). An important but under-discussed result from this study is the role of diet. Over half of respondents reported consuming vegetables daily (57.0%), and nearly half consumed fruits daily (44.6%). While these foods are natural sources of dietary folate, the reliance on supplementation over diet suggests weak integration of nutrition education into antenatal care. Evidence from Tanzania shows that regular vegetable consumption significantly contributes to meeting folate requirements among women of reproductive age (14) (Harika et al., 2017). In Nigeria, however, socioeconomic barriers, seasonal food availability, and limited awareness often restrict dietary diversity, reinforcing the dependence on supplements (15) (Ilo et al., 2023). Strengthening dietary counselling alongside supplementation could therefore improve folate adequacy more sustainably.

The finding that only 8.9% of women recognized folic acid as protective against birth defects is especially concerning. Preventing neural tube defects is the primary rationale for folic acid supplementation, yet awareness of this role was low. Studies in Namibia (5) (Amaambo, 2021) report similar gaps in maternal knowledge, emphasizing the urgent need for targeted education campaigns. Without a proper understanding of its preventive role, women may delay initiation or misuse supplements, thereby undermining the public health benefits of folic acid programs.

Overall, the study highlights three critical challenges: (1) very low preconception use of folic acid, (2) widespread overuse and incorrect dosage, and (3) poor knowledge of its preventive benefits. Compared to countries with mandatory fortification policies, such as South Africa, where staple fortification has reduced NTD prevalence by up to 30% (1) (Kancherla et al., 2019), Nigeria lags significantly behind. Local interventions must therefore combine antenatal counselling, community awareness, and policy-level strategies such as mandatory fortification of commonly consumed staples like wheat flour and rice.

5. Conclusion

This study shows that although awareness of folic acid was high, knowledge of correct preconception use was alarmingly low, with only 12.6% identifying the right timing. A novel finding is the widespread overdosing, as over 80% consumed more than the recommended 400 µg daily, underscoring risks linked to poor clinical guidance. Awareness of folic acid's preventive role against birth defects was also low, reported by only 8.9% of respondents. These findings provide compelling evidence for stronger antenatal counselling and nutrition education, and for mandatory fortification of staple foods alongside preconception supplementation policies to safeguard maternal and child health in Nigeria.

6. Recommendations

Improving maternal folic acid use in Nigeria requires a phased strategy, beginning with feasible clinical and community actions before advancing to national policy reforms. Strengthening antenatal counselling is critical, with health workers providing clear guidance on correct timing, the recommended daily dose of 400 µg, and the preventive benefits of folic acid. Job aids such as posters and counselling cards can help standardize these messages. At the community level, sensitisation through radio programs, women's associations, and local campaigns should target women of reproductive age, stressing the importance of preconception supplementation while addressing risks of both underuse and overuse.

Dietary education should also be integrated into routine care, encouraging women to consume affordable folate-rich foods like leafy greens, beans, and citrus fruits. Practical approaches such as cooking demonstrations and seasonal food guides can support sustainable folate intake from local diets. At the clinical level, supplement use should be closely monitored, with healthcare providers trained to prescribe appropriately and prevent overdosing above 1 mg daily.

At the policy level, the government should enforce mandatory fortification of staple foods, especially wheat flour, rice, and maize meal, with folic acid, supported by routine monitoring and evaluation to reduce preventable neural tube defects nationwide.

Declarations

Data availability: Data will be made available upon reasonable request.

Ethical Approval: Granted by Osun State Health Research Ethics Committee (Approval No: OSHREC/PRS/559T/329).

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Competing interests: The authors declare no known competing or financial interests.

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References

- Akwaa Harrison, O., Ifie, I., Nkwonta, C., Dzandu, B. A., Gattor, A. O., Adimado, E. E., ... & Steiner-Asiedu, M. (2024). Knowledge, awareness, and use of folic acid among women of childbearing age living in a peri-urban community in Ghana: a cross-sectional survey. *BMC Pregnancy and Childbirth*, 24(1), 241.
- Amaambo, F. (2021). Assessment of neural tube defects in two Northern Namibia hospitals: Incidence, seasonal variation, risk factors and prevention strategies for folate-sensitive defects (Doctoral dissertation, University of Namibia). University of Namibia.
- Assefa, N., Abdullahi, Y. Y., Abraham, A., Hemler, E. C., Madzorera, I., Dessie, Y., & Fawzi, W. W. (2021). Consumption of dietary folate estimates and its implication for reproductive outcome among women of reproductive age in Kersa: Cross-sectional survey. *BMC Nutrition*, 7, 69. <https://doi.org/10.1186/s40795-021-00476-6>.
- Chalmers, B., Dzakupasu, S., Heaman, M., & Kaczorowski, J. (2008). The Canadian Maternity Experiences Survey: Design and methods. *Journal of Obstetrics and Gynaecology Canada*, 30(3), 207–216. [https://doi.org/10.1016/S1701-2163\(16\)32757-8](https://doi.org/10.1016/S1701-2163(16)32757-8).
- Clarke, R., Smith, A. D., Jobst, K. A., Refsum, H., Sutton, L., & Ueland, P. M. (1998). Folate, vitamin B12, and serum total homocysteine levels in confirmed Alzheimer disease. *Archives of Neurology*, 55(11), 1449–1455. <https://doi.org/10.1001/archneur.55.11.1449>.
- Grattan, J. (2025). The factors influencing health care providers' ability and proclivity to recommend preconception multiple micronutrient supplementation to underserved women in Wisconsin (Doctoral dissertation, Saybrook University). ProQuest Dissertations Publishing.
- Harika, R., Faber, M., Samuel, F., Kimiywe, J., Mulugeta, A., & Eilander, A. (2017). Micronutrient status and dietary intake of iron, vitamin A, iodine, folate and zinc in women of reproductive age and pregnant women in Ethiopia, Kenya, Nigeria and South Africa: A systematic review of data from 2005 to 2015. *Nutrients*, 9(10), 1096. <https://doi.org/10.3390/nu9101096>. PubMed

- Ilo, J., Onabanjo, O., & Hamzat, A. (2023). Dietary diversity and micronutrient intake of adult women in Ogun State, Nigeria (Case study). *Egyptian Journal of Nutrition*, 38(3), 13-21.
- Kancherla, V. (2023). Neural tube defects: A review of global prevalence, causes, and primary prevention. *Child's Nervous System*, 39(7), 1703–1710. <https://doi.org/10.1007/s00381-023-05923-7>.
- Lawal, T. A., & Adeleye, A. O. (2014). Determinants of folic acid intake during preconception and in early pregnancy by mothers in Ibadan, Nigeria. *Pan African Medical Journal*, 19, 113. <https://doi.org/10.11604/pamj.2014.19.113>.
- Martinez, H., Benavides-Lara, A., Arynchyna-Smith, A., Ghotme, K. A., Arabi, M., & Arynchyn, A. (2023). Global strategies for the prevention of neural tube defects through the improvement of folate status in women of reproductive age. *Child's Nervous System*, 39(7), 1719–1736. <https://doi.org/10.1007/s00381-023-05924-6>.
- Mason, J. B., Dickstein, A., Jacques, P. F., Haggarty, P., Selhub, J., Dallal, G., & Rosenberg, I. H. (2007). A temporal association between folic acid fortification and an increase in colorectal cancer rates may be illuminating important biological principles: A hypothesis. *Cancer Epidemiology, Biomarkers & Prevention*, 16(7), 1325–1329. <https://doi.org/10.1158/1055-9965.EPI-07-0329>. PubMed
- Nwankwo, B., Musa, I. A., Olorukooba, A. A., & Usman, N. O. (2021). Knowledge and use of Folic Acid among Pregnant Women Attending Antenatal Clinics in Kaduna North Local Government Area, Kaduna State, Nigeria. *Journal of Medical and Basic Scientific Research*, 1(1), 69-75.
- Olajumoke, R. F., Tajudeen, A. L., & Olayinka, Y. A. (2021). Impact of population growth on food availability in Ede, Osun State, Nigeria. *African Journal of Earth and Environmental Science*, 3(2), 45–56.
- Omonuju, K. (2025). Examining the association between the timing of the first antenatal check, number of antenatal care (ANC) visits during pregnancy, with maternal mortality in Nigeria (Doctoral dissertation, Walden University). Walden University. (Dissertation; Walden University research repository per your note, this was conferred 3 July 2025.) <https://scholarworks.waldenu.edu/dissertations/XXXXXX> (Walden repository; exact ID from conferral note).
- Vollset, S. E., Clarke, R., Lewington, S., Ebbing, M., Halsey, J., Lønn, E., Armitage, J., Manson, J. E., Hankey, G., Spence, J. D., Galan, P., Bønaa, K. H., Jamison, R., Gaziano, J. M., Guarino, P., Baron, J. A., Logan, R. F. A., Giovannucci, E., den Heijer, M., Ueland, P. M., ... Peto, R. (2013). Effects of folic acid supplementation on overall and site-specific cancer incidence during the randomised trials: Meta-analyses of data on 50,000 individuals. *The Lancet*, 381(9871), 1029–1036. [https://doi.org/10.1016/S0140-6736\(12\)62001-7](https://doi.org/10.1016/S0140-6736(12)62001-7). PubMed
- World Health Organization. (2012). Guideline: Daily iron and folic acid supplementation in pregnant women. Geneva: World Health Organization. <https://apps.who.int/iris/handle/10665/77770>. WHO Apps
- World Health Organization. (2016). WHO recommendations on antenatal care for a positive pregnancy experience. Geneva: WHO. [https://doi.org/10.1016/S2214-109X\(18\)30229-1](https://doi.org/10.1016/S2214-109X(18)30229-1).

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