Prevalence of folic acid supplement consumption: pre-conceptionally and during first trimester of pregnancy

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ABSTRACT

Introduction: Folic acid deficiency causes congenital abnormalities and neural tube defects (NTDs) in fetus, newborn, as well as, anemia and peripheral neuropathy in mothers. Its supplementation is crucial both before and during pregnancy, therefore, ideally started before conception. This study aims to assess the prevalence of folic acid supplementation and its association along with other factors with congenital anomalies among pregnant woman visiting a tertiary care centre.

Methods: This was a cross-sectional study conducted in 215 pregnant women presenting to department of obstetrics inpatient department, within 6 months duration of Devdaha Medical College and Research Institute, Rupandehi, Nepal. Data regarding demographics, socioeconomic status, obstetrics, folic acid supplementation status were recorded. The data was analyzed in SPSS v16.

Results: A majority of the mothers were of age 15-25 years (52.6%), rural areas (58.1%), had one child (43.3%) and secondary education (46%). Pregnancy was intentional in 80% and 74.9% did not have pre-conceptional health visit. Folic acid supplementation prevalence in pregnant women was 50.7%, among which its pre-conceptional and first trimester intake was 7 and 43.7%, respectively. Similarly, the prevalence of congenital anomalies and preterm delivery was 7% and 16.7% respectively. There was association of maternal residence, alcohol consumption, period of gestation and fetal factors such as weight, twin birth with congenital anomalies.

Conclusion: The prevalence of folic acid supplementation, preterm delivery and congenital anomaly was 50.7%, 7% and 16.7% respectively. Congenital anomaly was not neither significantly associated with folic acid supplementation nor socio demographic factors of mother. It was associated with alcohol consumption and comorbidities of mother.

Keywords: Congenital anomalies, Folic acid, Pre-term delivery.

INTRODUCTION

A healthy pregnancy and a successful birth outcome are fundamental rights of every expecting mother. Pregnancy brings profound physiological and psychological changes and therefore requires enhanced nutrition to support both maternal health and fetal growth. A woman's diet must include all essential vitamins and minerals to meet these increased needs.[1]

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Organogenesis is a highly sensitive phase of fetal development that begins around 21–28 days post-fertilization; adequate maternal nutrition during this period is critical for proper organ formation. Periconceptional folic acid supplementation substantially reduces the risk of neural tube defects (NTDs).[2] Observational evidence also suggests that folic acid may lower the risk of other adverse outcomes, including preterm birth, preeclampsia, and small for gestational age, and may contribute to prolongation of pregnancy.[3]

Folic acid (the synthetic, more stable form of folate) has been widely used in supplementation

and food-fortification programs to prevent folate deficiency and its consequences.[4] Congenital anomalies remain a major cause of early mortality and long-term disability worldwide: an estimated 7.9 million newborns are born with a birth defect annually and about 3.3 million of these children die before age five.[5] NTDs such as anencephaly and spina bifida are among the most serious congenital anomalies and are the second most common group of congenital defects after congenital cardiac abnormalities.[6]

To reduce the risk of NTDs, public health guidelines recommend that women of reproductive age take 0.4–1.0 mg of folic acid daily, starting before conception and continuing through the first trimester.[7] However, gaps in awareness and uptake of periconceptional folic acid supplementation persist in many settings.

This study aims to assess the prevalence of folic acid supplementation and its association along with other factors with congenital anomalies among pregnant woman visiting a tertiary care centre. By documenting local prevalence and identifying barriers and facilitators to timely supplementation, this study seeks to inform targeted education, antenatal counseling, and policy decisions (including supplementation programs and fortification efforts) to reduce NTDs and adverse outcomes.

METHOD

A cross-sectional study was conducted in 215 pregnant women presenting to in patient department (IPD) of Obstetrics of Devdaha Medical College, teaching hospital from march to august 2023, Rupandehi, Nepal. Informed consent was obtained from all mothers. Ethical approval was received from Institutional Review Committee of Devdaha Medical College (reference number 726/079/080). The sample size was determined by using formula $n = Z^2p(1-p)/d^2$ where n = sample size, Z = standard normal coefficient = 1.96, P= 0.05. The prevalence was 14%.[8] Therefore, the sample size is calculated as 186. However, as 215 eligible participants were available during the study period, all were included to ensure better representation of the study population. Inclusion of the additional participants, with properly collected data, is expected to enhance the quality and reliability of the study findings. The folic acid tablet provided by Nepal government and most commercially available is available in a dose of 5mg. However, few commercially available multivitamin supplement tablets along with folic acid was available in dose of 0.4mg, that's why folic acid intake in any dose ranging from 0.4-5mg cases were included in this study.

The information was obtained verbally from patient into a proforma which included folic acid tablet (source of supplement/ time/ dose/duration/ compliance/preconceptionally/first trimester), socio-demographic data, maternal risk factors, fetal risk factors and outcomes during delivery such as preterm (37 completed weeks) and congenital anomalies. Congenital anomalies was calculated based on the total number of congenital cases diagnosed after delivery and total number of live births in the same period. The forms were assessed for completeness and indexed. The data was entered in Microsoft excel. The entered data are cleaned and exported to Statistical Package for the Social Sciences (SPSS) for further data analysis. For descriptive data; percentage (%), mean and standard deviation was calculated. While for inferential statistics Chi-square test was applied to find the significant association between categorical variables. Cross tabulation was done for socio-demographic, obstetric and neonatal characteristics. Binary logistic regression was performed to analyse the level of association between the characteristics and birth defects. The significance was determined at $p< 0.05$. All variables with $p<0.2$ in the univariate analysis were considered for multi-variable logistic regression analysis.

RESULTS

The study involved 215 participants, with a majority of them being in the age group (Table 1) of 15-25 years (52.6%), followed by 26-35 years (43.3%), and only a small proportion (4.2%) being older than 35 years. Most participants resided in rural areas (58.1%), while 41.9% were from urban areas. The majority of participants identified as Hindu (87%), followed by Muslim (7%), Buddhist (4.2%), and Christian (1.9%). Almost all participants were Nepali citizens

(98.1%), with only 1.9% being non-Nepali.

Table 1. Sociodemographic Profile of Participants (N=215)

Variables	Grading	Frequency (%)
Age	15-25yrs	113 (52.6)
	26-35	93 (43.3)
	>35	9 (4.2)
	Total	215
Address	Urban	90 (41.9)
	Rural	125 (58.1)
	Total	215
Religion	Hindu	187 (87)
	Muslim	15 (7)
	Christian	4 (1.9)
	Buddhist	9 (4.2)
	Total	215
Citizenship	Nepali	211 (98.1)
	Non- Nepali	4 (1.9)
	Total	215

Regarding maternal parity, the highest proportion of women (43.3%) had one child, followed by 29.8% with two children, and 18.1% were primiparous. Only 8.8% had three or more children. Most participants had secondary education (46%), followed by those with primary education (26%), higher secondary education (20.9%), and university education (5.1%). A small percentage were uneducated (1.9%).The pregnancy intentions of most women were intended (80%), while 6.5% reported mistimed pregnancies, and 13.5% had unintended pregnancies. A quarter of participants (25.1%) had a preconceptionally health visit, while 74.9% did not. None of the participants had undergone infertility treatment, although 1.9% reported receiving ovulation induction or assisted reproductive technology (ART). Folic acid supplementation before pregnancy was reported by 7% of participants, 43.7% took it during the first trimester, and 49.3% did not take it at all.

Smoking was reported by only 2.3% of participants, while the vast majority (97.7%) were non-smokers. Alcohol consumption was rare, with only 4.2% of participants reporting alcohol use. Pre-pregnancy body mass index (BMI) was predominantly normal (67.4%), followed by pre-obese (17.7%), underweight (10.7%), and obese (4.2%). Comorbidities were present in only 6% of participants. Regarding fetal factors, 16.7% of the pregnancies were preterm (<37 weeks), while 83.3% were term (>37 weeks). Birth weight distribution showed that 18.1% of infants had a birth weight of less than 2000gm, 40% had a birth weight between 2000-2500gm, and 41.9% had a birth weight greater than 2500gm. The gender of the infants was predominantly male (51.6%), with 47% female, and a small number of twins (0.9% male-female and 0.5% both female).

Table 2. Maternal factors (N=215)

Variables	Grading	Frequency(%)
Parity	0	39 (18.1)
	1	93 (43.3)
	2	64 (29.8)
	3 or more	19 (8.8)
	Total	215
Maternal Education	Uneducated	4 (1.9)
	Primary	56 (26)
	Secondary	99 (46)
	Higher secondary	45 (20.9)
	University	11 (5.1)
	Total	215
Pregnancy Intention	Intended	172 (80)
	Mistimed	14 (6.5)
	Unintended	29 (13.5)
	Total	215
Preconceptionally Health Visit	Yes	54 (25.1)
	No	161 (74.9)
	Total	215
Infertility Treatment	No	211 (98.1)
	Ovulation Induction	3 (1.4)
	ART	1 (0.5)
	Total	215
Folic Acid Supplementation	Not taken	106 (49.3)
	Before pregnancy	15 (7)
	1st trimester	94 (43.7)
	Total	215

The Table 4 shows that the folic acid intake is majorly provided by government centers like Primary Health Center (PHC)

Age: There was no significant association between age and congenital anomalies. Women aged 15-25 years had the highest frequency of congenital anomalies (4 out of 113), and the odds ratio (OR) for those aged 26-35 years was 1.10 (95% CI: 0.24–5.04), with a p-value of 0.902.

Address: Living in a rural area was associated with a higher likelihood of congenital anomalies, though the OR of 1.83 (95% CI: 0.34–9.66) did not reach statistical significance (p = 0.475). Religion: No significant association was found between religion and congenital anomalies. All groups (Hindu, Muslim, Christian, and Buddhist) had negligible frequencies of anomalies.

Table 3. Risk Factors related to mother

Variables	Grading	Frequency (%)
Smoking	Smoker	5 (2.3)
	Non smoker	210 (97.7)
	Total	215
Alcohol Consumption	Yes	9 (4.2)
	No	206 (95.8)
	Total	215
Pre pregnant BMI	Underweight	23 (10.7)
	Normal	145 (67.4)
	Pre-obese	38 (17.7)
	Obese	9 (4.2)
	Total	215
Comorbidities	Yes	13 (6)
	No	202 (94)
	Total	215
Period of gestation (POG)	<37wks	36 (16.7)
	>37wks	179 (83.3)
	Total	215
Birth Weight	<2000gms	39 (18.1)
	2000-2500gms	86 (40)
	>2500gms	90 (41.9)
	Total	215
Outcome (Sex)	Male	111 (51.6)
	Female	101 (47)
	Twin (1male&1 female)	2 (0.9)
	Twin (Both female)	1 (0.5)
	Total	215

Table 4. Folic Acid Provider (N=215)

Variables	Frequency (%)
None	15 (7)
PHC / Health Post	151 (70.2)
Obstetrician Clinic	26 (12.1)
Higher Centre	23 (10.7)
Total	215

Parity: Parity did not show a strong association with congenital anomalies. Women with 1 child had an OR of 1.26 (95% CI: 0.12–12.56), and those with 2 children had an OR of 1.22 (95% CI: 0.10–13.98). The p-values for these associations were 0.840 and 0.870, respectively. Maternal Education: No significant association between maternal education level and congenital anomalies was found. Participants with primary, secondary, higher secondary, and university education had a low frequency of anomalies, with p-values ranging from 0.532 to 0.929. Pregnancy Intention: Pregnancy intention was not significantly associated with congenital anomalies (p = 0.342). The OR for unintended pregnancies was 1.03 (95% CI: 0.19–5.55), which also lacked statistical significance.Preconceptionally Health Visit: No significant association was observed between periconceptional health visits and congenital anomalies (p = 0.119). However, those who did not visit a health provider before conception had a higher occurrence of anomalies.

Infertility Treatment: None of the women who underwent infertility treatments (ovulation induction or ART) experienced congenital anomalies.

Folic Acid Supplementation: No significant association was found between folic acid supplementation and congenital anomalies. The OR for women who took folic acid before pregnancy was 0.999 (p = 0.823)

Smoking: Smoking was not significantly associated with congenital anomalies, with an OR of 0.18 for smokers (p = 1.192). Alcohol Consumption: Alcohol consumption showed a highly significant negative association with congenital anomalies (OR = 0.03, p < 0.001). Pre-pregnancy BMI: No significant association was found between pre-pregnancy BMI and congenital anomalies. The OR for underweight women was 0.22 (p = 0.110), and for pre-obese women, it was 0.58 (p = 0.603). Comorbidities: The presence of comorbidities was significantly associated with congenital anomalies (OR = 0.99, p = 0.036), with women without comorbidities having a higher frequency of anomalies.

Period of Gestation (POG): No significant association was observed between preterm and term births and congenital anomalies (p = 0.403 for <37 weeks vs. >37 weeks). Birth Weight: Birth weight showed a marginal association with congenital anomalies. Infants weighing more

Table 5. Association of Socio Demo geographic factors with Congenital anomalies

Age	**Grading**	**Presence**	**Absence**	**Odds Ratio**	**X^2 (P-Value)**
	15-25yrs	4	109	RC	
	26-35	3	90	1.10(0.24-5.04)	
	>35	0	9	-	0.902
Address	Rural	5	120	1.83(0.34-9.66)	-
	Urban	2	88	R	0.475
Religion	Hindu	7	180	-	-
	Muslim	0	15	-	0.781
	Christin	0	4	-	-
	Buddhist	0	9	-	-

Table 6. Association of maternal factors with congenital anomalies

Variables	**Grading**	**Presence**	**Absence**	**Odds Ratio**	**X^2 (P-Value)**
Parity	1	-	-	1.26(0.12-12.56)	0.840
	2	-	-	1.22(0.10-13.98)	0.870
	3	-	-	2.11(0.12-35.70)	0.605
	0	-	-	R	-
Maternal education Religion	Primary	2	54	-	0.877
	Secondary	4	95	-	0.549
	High school	1	44	-	0.660
	University	0	11	-	0.532
	Uneducated	0	4	R	0.929
Pregnancy Intention	Intended	4	168	R	0.342
	Mistimed	1	13	0.32	0.202
	Unintended	2	27	1.03	0.976
Periconceptional Health Visit	Yes	0	54	R	0.119
	No	7	154	-	-
Infertility Treatment	No	7	204	R	-
	Ovulation Induction	0	3	-	0.934
	ART	0	1		
Folic Acid Supplementation	Not taken	4	102	R	0.975
	Before pregnancy	0	15	-	0.999
	1st trimester	3	91	-	0.823

than 2500g had a lower likelihood of anomalies (OR = 0.09, p = 0.041). Gender: No significant association between the gender of the infant and congenital anomalies was observed. Twin Births: The presence of twin births was associated with a significantly higher occurrence of congenital anomalies ($p < 0.001$ for twins with one male and one female).

DISCUSSION

Living in a rural area was associated with a higher likelihood of congenital anomalies and the presence of comorbidities was not significantly associated with the lower supplementation of folic acid, periconceptionally. In a study conducted by Prajwal Paudel et al. maternal age younger than 20

Table 7. Association of risk factors with Congenital anomalies

Variables	Grading	Presence	Absence	Odds Ratio	X^2 (P-Value)
Smoking	Smoker	1	4	0.18	1.192
	Non smoker	6	204	2.12	2.274
Alcohol Consumption	Yes	0	9	-	0.999
	No	7	199	0.03	<0.001
Pre pregnant BMI	Underweight	2	21	R	0.430
	Normal	3	142	0.22	0.110
	Pre-obese	2	36	0.58	0.603
	Obese	0	9	-	0.999
Comorbidities	Yes	0	13	R	-
	No	7	195	0.99	0.036

Table 8. Association of fetal factors and congenital anomalies

Variables	Grading	Presence	Absence	Odds Ratio	X^2 (P-Value)
POG	<37wks	2	34	0.48	0.403
	>37wks	5	174	0.05	-
Birth Weight	<2000gms	4	35	R	0.057
	2000-2500gms	2	84	0.20	0.078
	>2500gms	1	89	0.09	0.041
Outcome (gender)	Male	3	108	--	--
	Female	3	98	--	--
	Twin (1male&1 female)	0	2	--	<0.001
	Twin (Both female)	1	0	R	--

years and advantaged ethnicity were risk factors of birth defects. Babies with birth defect have high risk for birth asphyxia, neonatal infection and predischarge mortality at birth. Further evaluation on the care provided to babies who have birth defect is warranted.[9]

In a study by Nosrat et al. 20.12% of women in Golestan province consumed folic acid supplements during the preconception period.[10] Mashayekhi et al. also reported that about 25.07% of women in Tabriz consumed folic acid supplements for at least one month before pregnancy, and 34.82% supplemented with folic acid during the first trimester.[11] In a survey of Italian women, De Santis et al. found that 43.4% of participants took folic acid before becoming pregnant.[12]

Although the women's awareness about the importance of consuming folic acid supplements was not directly assessed in the current study, such large differences may indicate an increasing trend in female awareness and knowledge about the importance of folic acid supplementation and its impact on infant health. The difference in geographic areas may be another reason for the large inconsistencies observed. Socioeconomic status, including women's education level and employment status, were significant determinants of folic acid supplementation. This means that the prevalence of folic acid supplementation was statistically higher in women with higher education levels and who were employed. These findings are consistent with studies by De Santis et al., Riazi et al. and Roth et al.[12-14] It has been shown that higher education levels in women can increase their awareness about the necessity of folic acid supplementation, and their understanding of the important period of folic acid supplementation.[10]

In the current study, economic satisfaction status was assessed subjectively in order to

evaluate household economic status, because the participants may have wished to avoid declaring their actual incomes. The results showed higher scores for economic satisfaction in women who consumed folic acid supplements, but this was not statistically significant. In Iran, community health centres are well distributed across the urban and rural areas of the country in order to provide primary health services for the population. Supplements including iron and folic acid are freely distributed to pregnant women, so this may be one reason for the lack of a significant difference in supplementation between women of different economic status.[10]

Limitations: A community-based study rather than a hospital-based study can better indicate actual prevalence.

CONCLUSION

The prevalence of folic acid supplementation by pregnant women was seen to be 50.7%, of which intake pre-conceptional and during the 1st trimester was 7% and 43.7% respectively. The prevalence of congenital anomalies and preterm delivery among the study group was seen to be 7% and 16.7% respectively. Folic acid supplementation was not associated with congenital anomaly. The intake of folic acid was in majority seen to be given by PHC 70.2%, followed by Obstericians 12.1% and then by higher centres 10.7%. There was increased incidence of congenital anomalies in those mothers who lived in rural areas, also those with comorbidities and twin pregnancy.

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