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Original Research Article

Dietary knowledge, dietary practices, and utilization of antenatal care services among undernourished pregnant women: a cross-sectional study

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ABSTRACT

Background: Maternal undernutrition remains a major public health concern in low- and middle-income countries and is associated with adverse maternal and neonatal outcomes. Adequate dietary knowledge and practices during pregnancy are essential for optimal maternal and fetal health. Antenatal care (ANC) services provide an important platform for nutrition counseling and micronutrient supplementation; however, gaps in knowledge, practices, and adherence persist among undernourished pregnant women.
Methods: A cross-sectional study was conducted among 70 undernourished pregnant women (BMI<18.5 kg/m²) attending antenatal clinics in selected health facilities, Bangalore. Data were collected using a structured questionnaire covering socio-demographic characteristics, dietary knowledge, dietary practices, and ANC utilization. Statistical analysis was performed using Jamovi (version 2.5.3) and RStudio. Descriptive statistics, Mann-Whitney U test, Chi-square test, and Fisher's exact test were applied, with significance set at $p<0.05$.
Results: The median age was 24 years; most participants had secondary education and were homemakers. Inadequate dietary knowledge (87.1%) and poor practices (71.4%) were prevalent, with no significant association (p=0.265). ANC utilization was high (≥6 visits). Adherence was moderate for folic acid (67%) and calcium (63%), but low for iron (39%). Barriers included nausea, vomiting, and forgetfulness. Income was significantly associated with knowledge and practice levels (p=0.046).
Conclusions: Despite adequate ANC utilization, substantial gaps exist in dietary knowledge and practices among undernourished pregnant women. Strengthening nutrition counseling and addressing adherence barriers and socioeconomic constraints are essential to improve maternal nutrition and pregnancy outcomes.

Keywords: Maternal nutrition, Antenatal care utilisation, Dietary knowledge, Dietary practices, Undernourished pregnant women

INTRODUCTION

Nutrition is a crucial factor influencing health at all stages of life, particularly during pregnancy. Maternal nutrition plays a vital role in early pregnancy, as the developing embryo is highly sensitive to inadequate dietary intake during the initial weeks.[1] Therefore, maintaining appropriate dietary practices even before conception is essential to ensure optimal nutritional status during pregnancy.[2] Pregnancy increases the body's physiological demands, raising nutritional requirements; if unmet, this can negatively affect maternal health, pregnancy and lactation outcomes.[3]

The world health organisation (WHO) recommends increased nutritional intake during pregnancy, including an additional 350 kcal/day during the second and third trimesters, along with adequate protein and essential micronutrients.[4] It also advises daily supplementation of iron (30-60 mg) and folic acid (400 µg) to prevent maternal anaemia and support fetal development.[4] Additionally, in populations with low calcium intake, supplementation of 1.5-2 g/day is recommended to reduce the risk of hypertensive disorders such as preeclampsia.[4]

Despite these established recommendations, adherence to micronutrient supplementation remains suboptimal in many settings due to limited awareness, perceived side effects, inadequate counselling, and irregular utilisation of antenatal services.[5]

Several studies from Ethiopia report a high burden of maternal undernutrition, with prevalence estimates of 39.2% in western Ethiopia, 43.1% in Konso, and 21.8% in southern Ethiopia.[3,6,7] Similarly, data from NFHS-5 indicate that 18.7% of women aged 15-49 years are underweight and 57% are anaemic, highlighting a substantial prevalence of nutritional deficiencies among women of reproductive age.[8]

Nutrition during pregnancy is strongly influenced by socio-cultural beliefs and values, which often give rise to food taboos and myths that shape dietary practices. Therefore, adequate knowledge regarding maternal nutrition is essential.[9] Study from Ethiopia indicate that only 33.3% of pregnant women have good knowledge of optimal nutrition and health.[10] Furthermore, a meta-analysis reported that 48.0% of pregnant women possess adequate dietary knowledge.[11] Good dietary knowledge has also been identified as a significant determinant of dietary practices (AOR=2.79).[12]

Most pregnant women had inadequate nutrient adequacy ratios (NAR<0.66), especially for protein and for essential micronutrients such as iron, calcium, and vitamins.[13] Similarly, in an Ethiopian study, less than one-third of pregnant women (32.2%) practised good dietary practices.[14] Evidences have suggested that ANC visits and maternal knowledge influence these dietary practices.[14,15] However, despite this association, only 53% received comprehensive ANC, and 70 (20.6%) did not utilise any form of ANC services in India, indicating suboptimal practices.[13,16]

Although a large majority of women (95.7%) agreed that consuming extra food during pregnancy is beneficial, only 67% actually practised increasing their food intake, highlighting a significant gap between knowledge and practice.[17] Undernutrition among pregnant women is closely linked with inadequate ANC utilisation, poor nutrition knowledge, and suboptimal dietary practices, emphasising the interconnected nature of these factors and the need for a comprehensive approach to improve maternal nutrition.[18]

Regular ANC plays a crucial role in this, as women who attend ANC clinics are more likely to receive nutrition counselling, adhere to supplementation programmes, and adopt healthier dietary practices.[19]

Despite existing evidence, there remains a limited understanding of dietary knowledge, dietary practices, and ANC utilisation collectively contributing to undernutrition among pregnant women. Therefore, the present study aimed to assess dietary knowledge, dietary practices, and utilisation of ANC services among undernourished pregnant women attending antenatal clinics.

Objectives

Objectives were to assess the knowledge on food sources and energy recommendations and food safety practices among undernourished pregnant women and to assess the dietary practices and utilisation of ANC services among undernourished pregnant women.

METHODS

Study design and setting

A cross-sectional study was conducted from March 2024 to July 2025 among undernourished pregnant women attending antenatal clinics at Srirampuram and Ganganagar Maternity Hospitals in Bangalore, Karnataka, India.

Study population

The study included pregnant women identified as undernourished based on body mass index (BMI less than 18.5) and attending ANC services during the study period.

Sample size

A total of 70 undernourished pregnant women were included in the study.

Data collection

Data were collected using a structured questionnaire consisting of the following sections: socio-demographic characteristics, dietary knowledge during pregnancy, dietary practices during pregnancy and utilization of ANC services including micronutrient supplementation and antenatal visits.

Statistical analysis

Statistical analysis was performed using Jamovi version 2.5.3, and RStudio was used for data visualization. Continuous variables were summarized using mean±standard deviation when normally distributed and median with interquartile range when non-normally distributed. Categorical variables were summarized using frequencies and percentages.

The Mann-Whitney U test was used to compare continuous variables between groups. Associations between categorical variables were assessed using the Chi-square test or Fisher's exact test when expected cell counts were less than five. A p value less than 0.05 was considered statistically significant.

RESULTS

Socio-demographic characteristics

The study included 70 undernourished pregnant women (Table 1), predominantly in the 20-25 years age group (66%), followed by 26-30 years (23%), while very few were aged below 20 years (1%) or above 30 years (10%), indicating a relatively young reproductive population (Figure 1).

Regarding educational status, nearly half of the participants had secondary education (44%), followed by higher secondary (23%) and graduate level education (19%). Only a small proportion had primary education (10%), while no formal education and postgraduate qualification were minimal (1% each), suggesting moderate educational attainment overall.

In terms of occupation, the vast majority were homemakers (90%), with very limited participation in self-employment (1%), daily wage work (5%), and private employment (4%), reflecting low workforce engagement among participants.

The monthly family income distribution showed that most participants belonged to the ₹15,000-30,000 category (72%), followed by <₹15,000 (17%), indicating a predominantly lower–middle socioeconomic status. Only a small proportion reported higher income levels (Figure 2).

With respect to religion, Hindus constituted the majority (51%), followed by Muslims (41%) and Christians (8%). Slightly more than half of the participants belonged to joint families (51%), while 49% were from nuclear families.

A substantial majority of participants resided in rural areas (91%), with only a small proportion from urban settings (9%), highlighting the rural predominance of the study population.

Distribution of knowledge and practice levels

Assessment of dietary knowledge revealed that the majority of participants had inadequate knowledge (87.1%), while only 12.9% demonstrated moderate knowledge (Table 2).

Similarly, evaluation of dietary practices indicated that most participants had poor practices (71.4%), whereas 28.6% demonstrated moderate practices (Figure 3).

Association between knowledge and practice

No statistically significant association was observed between dietary knowledge and dietary practices among the participants (Fisher's exact test, p=0.265). Among participants with inadequate knowledge, 64.3% demonstrated poor practices and 22.9% showed moderate practices. Similarly, among those with moderate knowledge, 7.1% had poor practices and 5.7% had moderate practices (Table 3).

Utilization of ANC services and supplementation

The majority of participants reported adequate ANC utilization, with 51% attending 6-10 visits and 47% attending more than 10 visits, while only a negligible proportion had fewer than four visits (Table 4).

Folic acid supplementation was initiated immediately after pregnancy confirmation in 54%, whereas 44% started after 8 weeks, indicating some delay in initiation. Although 67% reported regular consumption, adherence gaps were evident, with 33% not taking it regularly, primarily due to nausea/vomiting (74%) and forgetfulness (26%). Most participants consumed 31-40 tablets (36%), followed by 21-30 tablets (34%).

Calcium supplementation was initiated timely (13-16 weeks) in 94% of participants, and 63% reported regular intake. A substantial proportion (69%) consumed more than 150 tablets, suggesting relatively better adherence compared to folic acid. However, among those with irregular intake, nausea/vomiting (65%) and forgetfulness (23%) were the predominant barriers.

Iron supplementation was also initiated appropriately in most participants (97% at 13-16 weeks), but regular consumption was lower (39%), with 61% reporting irregular intake. The most common reasons for non-adherence were combined gastrointestinal side effects (nausea, vomiting, and heartburn) (44%), followed by nausea/vomiting alone (33%), forgetfulness (18%), and fear of having a large baby (5%). Overall, while initiation of supplementation was largely timely, adherence-particularly to iron and folic acid-remains suboptimal, mainly due to side effects and behavioral factors.

Association of age and income with knowledge and practice

Mann-Whitney U test showed no statistically significant difference in age between participants with moderate and poor practices (p=0.333) or between those with inadequate and moderate knowledge (p=0.333) (Table 5).

However, household income showed a statistically significant association with both knowledge and practice levels (p=0.046), suggesting that socioeconomic status may influence dietary awareness and behavior among pregnant women.

Association of socio-demographic factors with knowledge and practice

Association between socio-demographic characteristics and knowledge and practice categories was examined using Mann-Whitney U and Fisher's exact test (Table 6). Age was not significantly associated with either knowledge level or practice level among the participants (p=0.333). However, monthly household income showed a statistically significant association with both knowledge and practice categories (p=0.046), indicating that participants with higher income levels tended to demonstrate better knowledge and dietary practices.

Further analysis using Fisher's exact test revealed no statistically significant association between socio-demographic variables-as participant education, husband's education, occupation, religion, type of family, and place of residence with either knowledge level/practice level (p>0.05). Although majority of participants with inadequate knowledge and poor practice-homemakers, had secondary education and resided in the rural areas, these differences were not statistically significant. Overall, findings suggest that household income may influence knowledge, and practices related to maternal nutrition, whereas other socio-demographic factors did not show a significant association in this study population.

Table 1: Socio-demographic characteristics of participants, (n=70).

Variables	Category	F	Percentage (%)
Age (in years)	<20	1	1
	20-25	46	66
	26-30	16	23
	>30	7	10
Education status	No formal education	1	1
	Primary education	7	10
	Secondary education	31	44
	Higher secondary	16	23
	Graduate	13	19
	Postgraduate	1	1
Occupation	Self employed	1	1
	Daily wage	3	5
	Private employee	3	4
	Homemaker	63	90
Monthly family Income (₹)	<15,000	12	17
	15,000-30,000	50	72
	31,000-45,000	6	9
	46,000-60,000	1	1
	>60,000	1	1
Religion	Hindu	36	51
	Muslim	29	41
	Christian	5	8
Type of family	Nuclear	34	49
	Joint	36	51
Residence	Rural	63	91
	Urban	6	9

Table 2: Distribution of knowledge and practice categories, (n=70).

Variables	Category	N	Percentage (%)
Knowledge level	Inadequate	61	87.1
	Moderate	9	12.9
Practice level	Poor	50	71.4
	Moderate	20	28.6

Table 3: Association between knowledge and practice categories, (n=70).

Knowledge category	Moderate practice, N (%)	Poor practice, N (%)	P value
Inadequate	16 (22.9)	45 (64.3)	0.265
Moderate	4 (5.7)	5 (7.1)	

Table 4: Utilization of ANC services and micronutrient supplementation among participants, (n=70).

Variables	Category	N	Percentage (%)
Number of ANC visits	<4 visits	1	2
	6-10 visits	36	51
	>10 visits	33	47
Initiation of folic acid supplementation	Prior to conception	1	2
	Immediately after confirmation of pregnancy	38	54
	After 8 weeks of pregnancy	31	44
Total folic acid tablets consumed	≤ 20	18	26
	21-30	24	34
	31-40	25	36
	>40	3	4
Regular consumption of folic acid	Not taken regularly	23	33
	Taken regularly	47	67
Reasons for missing folic acid (n=23)	Nausea/vomiting	17	74
	Forgetfulness	6	26
Initiation of calcium supplementation	13-16 weeks	66	94
	17-20 weeks	4	6
Total calcium tablets consumed	<50	1	1
	50-<100	1	1
	100-150	20	29
	>150	48	69
Regular consumption of calcium tablets	Not taken regularly	26	37
	Taken regularly	44	63
Reasons for missing calcium tablets, (n=26)	Nausea and vomiting	17	65
	Forgetfulness	6	23
	Fear of having big baby	3	12
Initiation of iron supplementation (weeks)	13-16 weeks	68	97
	17-20 weeks	2	3
Regular consumption of iron supplementation	Not taken regularly	43	61
	Taken regularly	27	39
Reasons for missing iron tablets, (n=43)	Nausea/vomiting	14	33
	Nausea vomiting and heartburn	19	44
	Fear of having a big baby	2	5
	Forgetfulness	8	18

Table 5: Association of age and monthly income with knowledge and practice, (n=70).

Variables	Practice			Knowledge		
	Moderate practice, (n=20) median (Q1-Q3)	Poor practice, (n=50) median (Q1-Q3)	P value	Inadequate knowledge, (n=61) median (Q1-Q3)	Moderate knowledge, (n=9) median (Q1-Q3)	P value
Age (in years)	23.5 (21.8-25.0)	24.0 (22.0-27.8)	0.333	24.0 (22.0-27.0)	24.0 (24.0-25.0)	0.333
Monthly income (INR)	15000 (11500-20500)	20000 (15000-30000)	0.046**	20000 (15000-30000)	20000 (12000-25000)	0.046**

**Significant at p<0.05

Table 6: Association of socio-demographic characteristics with knowledge and practice categories, (n=70).

Variables	Category	Knowledge, N (%)		P value	Practice, N (%)		P value
		Inadequate knowledge	Moderate knowledge		Moderate practice	Poor practice	
Education status	No formal education	1 (1.4)	0 (0.0)	0.121*	0 (0.0)	1 (1.4)	0.550*
	Primary	6 (8.6)	1 (1.4)		3 (4.3)	4 (5.7)	
	Secondary	28 (40.0)	3 (4.3)		10 (14.3)	21 (30.0)	
	Higher secondary	12 (17.1)	4 (5.7)		4 (5.7)	12 (17.1)	
	Graduate	13 (18.6)	0 (0.0)		2 (2.9)	11 (15.7)	
	Postgraduate	0 (0.0)	1 (1.4)		1 (1.4)	0 (0.0)	
	Others	1 (1.4)	0 (0.0)		0 (0.0)	1 (1.4)	

Continued.

Variables	Category	Knowledge, N (%)		P value	Practice, N (%)		P value
		Inadequate knowledge	Moderate knowledge		Moderate practice	Poor practice	
Husband's education	No formal education	1 (1.4)	0 (0.0)	0.141*	0 (0.0)	1 (1.4)	0.461*
	Primary	14 (20.0)	4 (5.7)		3 (4.3)	15 (21.4)	
	Secondary	22 (31.4)	2 (2.9)		10 (14.3)	14 (20.0)	
	Higher secondary	16 (22.9)	0 (0.0)		4 (5.7)	12 (17.1)	
	Graduate	8 (11.4)	3 (4.3)		3 (4.3)	8 (11.4)	
Occupation	Self-employed	1 (1.4)	0 (0.0)	0.636*	0 (0.0)	1 (1.4)	0.377*
	Daily wage	2 (2.9)	1 (1.4)		2 (2.9)	1 (1.4)	
	Private employee	3 (4.3)	0 (0.0)		0 (0.0)	3 (4.3)	
	Homemaker	55 (78.6)	8 (11.4)		18 (25.7)	45 (64.3)	
Religion	Hindu	32 (45.7)	4 (5.7)	0.753*	8 (11.4)	28 (40.0)	0.361*
	Muslim	24 (34.3)	5 (7.1)		11 (15.7)	18 (25.7)	
	Others	5 (7.1)	0 (0.0)		1 (1.4)	4 (5.7)	
Type of family	Nuclear	29 (41.4)	5 (7.1)	0.731*	11 (15.7)	23 (32.9)	0.496*
	Joint	32 (45.7)	4 (5.7)		9 (12.9)	27 (38.6)	
Residence	Rural	56 (81.2)	7 (10.1)	0.172*	18 (26.1)	45 (65.2)	1.000*
	Urban	4 (5.8)	2 (2.9)		1 (1.4)	5 (7.2)	

*Non-significant at p<0.05.

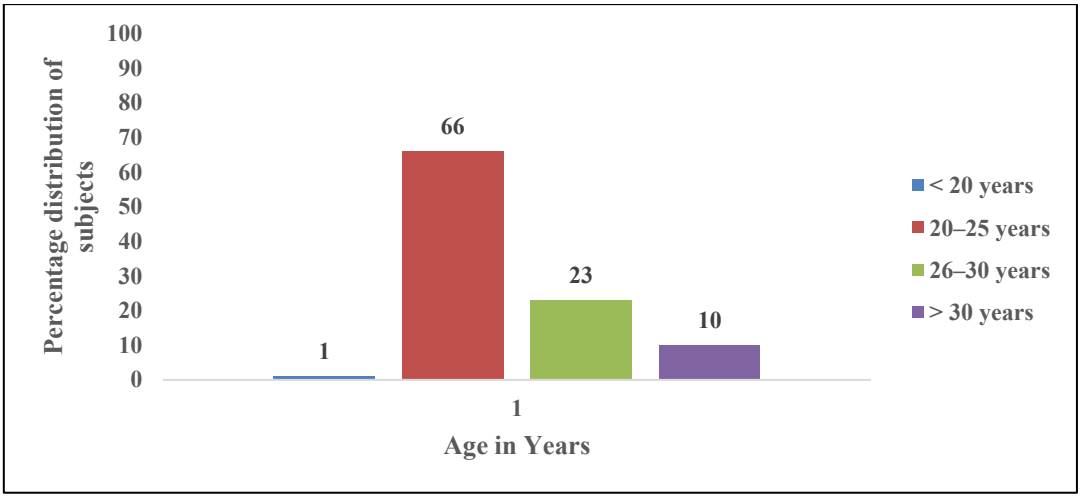

Figure 1: Age of the antenatal women.

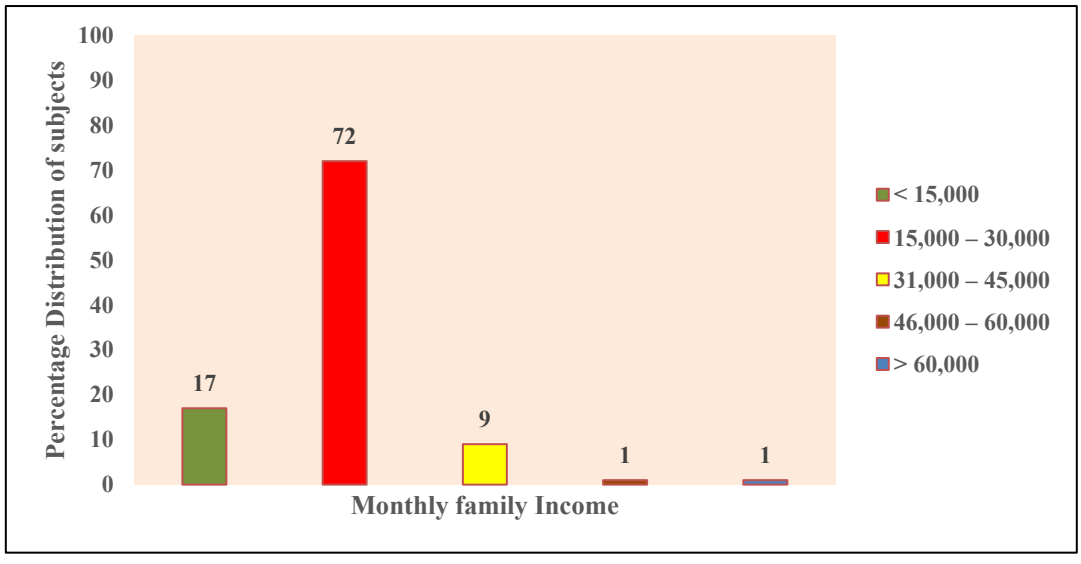

Figure 2: Monthly family income of the antenatal women.

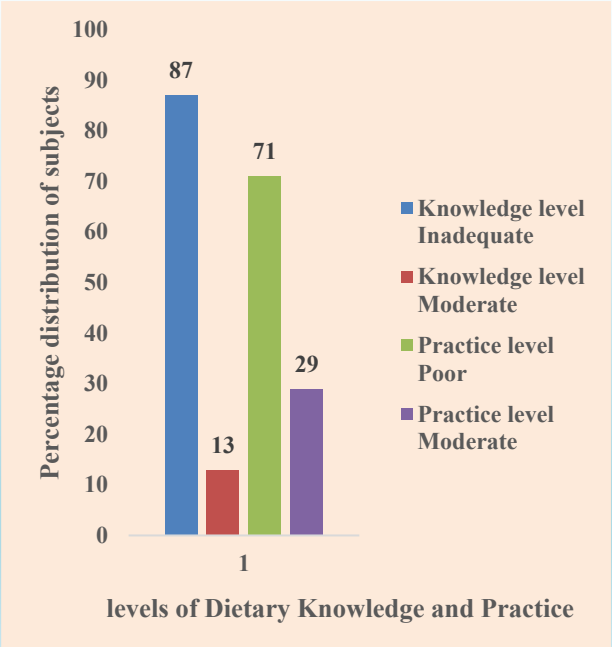

Figure 3: Levels of dietary knowledge and practices.

DISCUSSION

The present study assessed dietary knowledge, dietary practices, and utilisation of ANC services among undernourished pregnant women, aiming to generate evidence on maternal nutritional awareness and behaviours in this population.

In the current study, the median age of participants was 24 years, consistent with findings from several studies conducted in developing countries where the majority of pregnant women fall within the early reproductive age group.[20,21] Most participants had secondary education, and the majority were homemakers, reflecting the typical socio-demographic profile observed among pregnant women attending antenatal clinics in rural settings.[22] Similar patterns have been reported in India,[23] with many ANC attendees having secondary education and limited employment.

Regarding dietary knowledge, the study found that 87.1% of participants had inadequate knowledge, indicating substantial gaps in nutritional awareness among undernourished pregnant women. The findings are consistent with several studies, including one from Ethiopia reporting that only 33.3% of pregnant women had good knowledge of optimal nutrition and health.[10] This also aligns with the findings of a meta-analysis.[24] This may be due to limited nutrition education, low prioritisation of maternal nutrition, and inadequate counselling during ANC. In contrast, another study reported comparatively higher level of knowledge among pregnant women in urban population, which could be attributed to better access to healthcare services, higher educational status and greater exposure to health information.[25]

The present study indicated that 71.4% of participants demonstrated poor dietary practices, suggesting that inadequate knowledge may translate into suboptimal nutritional behaviours. The present study found that 71.4% of participants had poor dietary practices, consistent with studies from Ethiopia (32.2% good practice) and Ghana reporting poor dietary diversity among pregnant women.[14,26] This may be due to limited nutrition knowledge, poor dietary diversity, economic constraints, and inadequate counselling during ANC.

A notable finding of this study was the high utilization of ANC services, with nearly 51% attending 6-10 visits with median of 10 visits. Similar findings have been reported in recent study conducted in India, with 107 (53%) participants receiving comprehensive ANC.[16] These findings are also consistent with global recommendations for regular ANC and reflects improved maternal health service utilization.[4] The high utilisation of ANC observed in this study may reflect improved access to maternal health services, increased awareness of the importance of regular check-ups, and the effectiveness of government initiatives promoting ANC attendance.

Household income was found to be significantly related to both dietary knowledge and practices in this study, indicating that socioeconomic status plays a key role in shaping maternal nutrition-related behaviours. Findings align with several studies, indicating.[14,16] This may be attributed to greater financial capacity to access diverse and nutrient-rich foods, improved access to healthcare services and nutrition information among women with higher socioeconomic status.

Maternal education was not significantly associated with knowledge or practice levels in the present study. In contrast, other studies have reported significant associations between maternal education and nutritional knowledge.[14,18] The lack of association may be due to limited variation in education levels within the study population or the possibility that formal education did not translate into practical nutrition knowledge. Additionally, inadequate nutrition counselling and limited access to reliable health information may have reduced the influence of education on dietary knowledge and practices.

Overall, the findings of this study highlight the need for strengthened nutrition education and counselling interventions during ANC, particularly for undernourished pregnant women. Improving maternal knowledge, addressing misconceptions related to supplementation, and enhancing access to nutritious foods may help improve dietary practices and maternal nutritional status.

CONCLUSION

This study highlights important gaps in dietary knowledge and dietary practices among undernourished pregnant women, despite high utilization of ANC services. A large proportion of participants demonstrated inadequate

knowledge and suboptimal dietary practices, suggesting that routine antenatal visits alone may not be sufficient to ensure appropriate maternal nutrition behaviors. Household income showed a significant association with both knowledge and practice levels, indicating that socio-economic conditions play a crucial role in shaping dietary awareness and behaviors during pregnancy. Although adherence to micronutrient supplementation was relatively good, barriers such as forgetfulness and nausea were frequently reported. These findings emphasize the need to strengthen nutrition-focused counseling during ANC and to implement targeted interventions addressing socio-economic constraints. Enhancing maternal nutrition education and support mechanisms may help improve dietary practices and ultimately contribute to better maternal and fetal health outcomes.

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