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A Prospective Study on Utilization of Comprehensive Antenatal Care Services and Pregnancy Outcomes in the Field Practice Areas of Apollo Institute of Medical Sciences and Research, Hyderabad

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Abstract: Background: Comprehensive antenatal care (ANC) is essential for improving maternal and neonatal health. This study assessed ANC utilization, associated sociodemographic factors, and pregnancy outcomes.**Methods:** A prospective observational study was conducted among 323 pregnant women attending urban and rural field practice areas of Apollo Institute of Medical Sciences and Research, Hyderabad, from January 2023 to June 2024. Data on ANC utilization, sociodemographic characteristics, and pregnancy outcomes were collected prospectively. Associations were assessed using the chi-square test.**Results:** Among 323 participants, 86.4% completed at least four ANC visits, 64.4% registered during the first trimester, and 63.8% consumed at least 100 iron–folic acid tablets. Only 42.7% received adequate comprehensive ANC. Utilization was significantly associated with maternal and paternal education, occupation, socioeconomic status, and parity. Adequate ANC was associated with gestational outcome ($p=0.008$), mode of delivery ($p=0.031$), and neonatal birth weight ($p<0.001$). Low or very low birth weight occurred in 15.6% of adequately attended pregnancies compared with 37.0% of inadequately attended pregnancies.**Conclusion:** Comprehensive ANC utilization remained suboptimal despite high visit attendance and was significantly associated with favourable pregnancy and neonatal outcomes.

Keywords: Antenatal care; Healthcare utilization; Maternal health; Pregnancy outcomes; Low birth weight.

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INTRODUCTION

Antenatal care (ANC) is a basic pillar of maternal health care that enables early detection of pregnancy-related complications, prevention, nutritional supplementation and health education. Comprehensive ANC involves timely registration, clinical assessment, laboratory investigations, immunization, counselling and more than routine visits. The World Health Organization (WHO) puts great emphasis on quality, accessible, and continuous antenatal services for good maternal and neonatal outcomes [1]. There is also some evidence that poor antenatal contact is associated with poorer perinatal outcomes, especially in low-resource areas [2].

Though maternal health care coverage has improved, the coverage of comprehensive ANC is still low in India. A study by Kumar et al. using the National Family Health Survey (NFHS-4) data revealed that only 21% of women received full antenatal care, and there were significant

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socioeconomic and regional differences [3]. Likewise, Girotra et al., based on NFHS-5 data, reported that there were still significant gaps between attendance at antenatal visits and provision of quality services [4]. These results highlight that the number of visits is not sufficient to capture the comprehensiveness of ANC.

Some sociodemographic and obstetric variables are associated with ANC use such as maternal education, occupation, household income, parity and geographical accessibility. Chi et al. found that there were significant inequities in the use of essential antenatal and postnatal services in India by socioeconomic and geographical status of women [5]. These differences can impact access to health care services in a timely manner and the continuity of maternal care, especially for socioeconomically disadvantaged populations.

Comprehensive ANC also is linked to better pregnancy and neonatal outcomes. Haider et al. showed that prenatal iron supplementation could help to prevent maternal anaemia and low birth weight [6]. Kuhnt and Vollmer used data from 69 LMICs to find associations between ANC use and better neonatal and child health outcomes [7]. Likewise, Wondemagegn et al. found a strong relationship between ANC attendance and reduced neonatal mortality [8]. However, the relationships may be affected by differences in service quality and maternal factors.

While national surveys offer information on ANC coverage, prospective studies on full service utilization and pregnancy outcomes in well-defined urban and rural populations are important. Hence, the present study was carried out in the field practice areas of Apollo Institute of Medical Sciences and Research, Hyderabad to determine comprehensive ANC utilization, sociodemographic and obstetric factors associated with it and its relationship with the outcome of pregnancy, mode of delivery and birth weight of the newborn.

MATERIALS AND METHODS

Study design and setting

A prospective observational study with a follow-up was carried out in the field practice areas of Apollo Institute of Medical Sciences and Research, Hyderabad, Telangana, India, from January 2023 to June 2024 in both urban and rural areas. The study sites were the Urban Health Training Centre at Shaikpet and the Rural Health Training Centre at Moinabad. The centres offer antenatal registration, regular clinical examination, laboratory investigations, tetanus vaccination, iron and folic acid supplementation, counselling, obstetric consultation, follow-up and referral services to pregnant women in their respective field practice areas.

Study population and sample size

Pregnant women attending antenatal care services in the study areas during the study period constituted the study population.

The required sample size was calculated using the formula:

Sample size formula:

$$n = (Z^2 \times p \times q) / d^2$$

Where:

$Z = 1.96$

$p = 0.70$

$q = 0.30$

$d = 0.05$

Substituting the values:

$$n = [(1.96)^2 \times 0.70 \times 0.30] / (0.05)^2$$

$$n = (3.8416 \times 0.21) / 0.0025$$

$$n = 322.69$$

Therefore, the required sample size was rounded to 323 pregnant women.

Based on the National Family Health Survey-5 estimate that approximately 70% of mothers in Telangana had received at least four antenatal visits, a prevalence (p) of 0.70, q of 0.30, 95% confidence level (Z=1.96), and absolute precision of 5% were used. The calculated sample size was 323 pregnant women.

Participants were recruited using a convenience sampling technique from the antenatal clinics of the urban and rural field practice areas.

Eligibility criteria

Participants included pregnant women attending antenatal services in the selected field practice areas and available for follow-up of antenatal and pregnancy outcomes. Women who refused informed consent and those with psychiatric illness were excluded.

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Data collection
The data was gathered by a predesigned and pretested structured questionnaire and information from antenatal clinic registers and individual antenatal records. Information was gathered prospectively in the antenatal follow-up and after completion of pregnancy.

Participants were evaluated four times, if possible, once during each trimester and after delivery or within 42 days after termination of pregnancy. Those women who did not attend a scheduled clinic visit were followed up by telephone or home visit.

Data gathered comprised maternal age, residence, religion, maternal and husband's educational level, maternal and husband's occupation, family type, socioeconomic status, age at marriage, parity, timing of antenatal registration, number of antenatal visits, tetanus immunization, iron and folic acid supplementation, clinical and laboratory assessment, and health education received during pregnancy.

Pregnancy-outcome data consisted of gestational age at delivery, mode of delivery, birth status, and neonatal birth weight.

Assessment of comprehensive antenatal care utilization
Comprehensive antenatal care utilization was assessed using the antenatal-care components specified in the study protocol. A woman was classified as having received adequate comprehensive ANC when all of the following criteria were fulfilled:

1. at least four antenatal visits;
2. early registration with the first antenatal visit during the first trimester;
3. clinical and abdominal examination;
4. recommended laboratory investigations;
5. two doses of tetanus-containing vaccine or an appropriate booster dose;
6. consumption of at least 100 iron and folic acid tablets during pregnancy; and
7. receipt of antenatal health education.

Women who did not fulfil one or more of these components were classified as having inadequate comprehensive ANC utilization.

The principal study outcome was the proportion of women receiving adequate comprehensive ANC. Sociodemographic and obstetric factors were compared according to comprehensive ANC utilization status.

Pregnancy and neonatal outcomes
Pregnancy outcomes were assessed prospectively after completion of pregnancy.
Gestational outcome was categorized as:

- **preterm delivery:** delivery before 37 completed weeks of gestation;
- **term delivery:** delivery from 37 to 42 weeks of gestation; and
- **post-term delivery:** delivery beyond 42 weeks of gestation.

Mode of delivery was categorized as normal vaginal delivery, assisted vaginal delivery, or lower-segment caesarean section.

Birth status was recorded as live birth, stillbirth, or abortion.

Neonatal birth weight was assessed among live births. A birth weight of <2.5 kg was classified as low birth weight, while a birth weight of ≥2.5 kg was considered normal birth weight. Very-low-birth-weight neonates were retained as a separate category in the analysis where recorded.

The association of comprehensive ANC utilization with gestational outcome, mode of delivery, and neonatal birth weight was assessed.

Statistical analysis
The data was entered into a spreadsheet and analyzed using Epi Info and IBM SPSS Statistics version 24.

For continuous variables, means and standard deviations (SDs) were reported, and medians and ranges were also reported where appropriate. The categorical variables were presented as frequency and percentage, n (%).

Associations between comprehensive ANC use and maternal education, maternal occupation, husband's education, husband's occupation, family type, socioeconomic class, age at marriage and parity were assessed using the Pearson chi-square test. The same test was applied to the comparison of gestational outcome, mode of delivery, and neonatal birth-weight categories based on comprehensive ANC utilization.

The test statistic (χ^2), degrees of freedom (df), and p-value were reported for all chi-square analyses. All statistical tests were performed in a two-tailed manner and $p<0.05$ was regarded as statistically significant.

Ethical considerations
The study participants were asked to participate voluntarily and informed consent was obtained in

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writing. Participants were told that they could leave the study at any time without it impacting their normal care. Coded study records and the limitation of personally identifiable information were used to maintain confidentiality. The study protocol was reviewed by the research committee of the Apollo Institute of Medical Sciences and Research.

RESULTS

Participant characteristics

A total of 323 pregnant women were included during the study period from January 2023 to June 2024. The mean maternal age was 23.69±3.47 years, with a median age of 23 years and a range of 18–36 years. More than half of the participants, 176 (54.5%), were aged 20–24 years. Urban residents constituted 168 (52.0%) of the cohort, while 155 (48.0%) were from rural areas. Most women were homemakers, 238 (73.7%), and 172 (53.4%) were multigravida. The principal sociodemographic characteristics are summarized in Table 1.

Table 1. Sociodemographic and obstetric characteristics of the study participants

Characteristic	n (%)
Age, years	
<20	30 (9.3)
20–24	176 (54.5)
25–29	97 (30.0)
30–34	18 (5.6)
≥35	2 (0.6)
Residence	
Urban	168 (52.0)
Rural	155 (48.0)
Maternal education	
Illiterate	39 (12.1)
Primary	12 (3.7)
Secondary	98 (30.3)
Intermediate	78 (24.1)
Graduate	80 (24.8)
Postgraduate	16 (5.0)
Maternal occupation	
Homemaker	238 (73.7)
Working	85 (26.3)
Parity*	
Primigravida	150 (46.6)
Multigravida	172 (53.4)
Timing of ANC registration*	
First trimester	208 (64.6)
Second trimester	114 (35.4)

Values are presented as n (%). Mean maternal age=23.69±3.47 years.
*Available data, n=322. ANC, antenatal care.

Utilization of antenatal care services

At least four ANC visits were completed by 279 (86.4%) women, while 208 (64.4%) registered for ANC during the first trimester. Tetanus immunization was received by 315 (97.5%), and 206 (63.8%) reported consumption of at least 100 iron and folic acid tablets. Overall, 138 (42.7%) women fulfilled the criteria for comprehensive ANC utilization, whereas 185 (57.3%) did not (Table 2 and Figure 1).

Table 2. Utilization of key antenatal care services

ANC component	n (%)
≥4 ANC visits	279 (86.4)
First-trimester registration	208 (64.4)
Tetanus immunization/booster	315 (97.5)
Consumption of ≥100 IFA tablets	206 (63.8)
Adequate comprehensive ANC	138 (42.7)
Inadequate comprehensive ANC	185 (57.3)

Percentages are based on the total study population (N=323). ANC, antenatal care; IFA, iron and folic acid.

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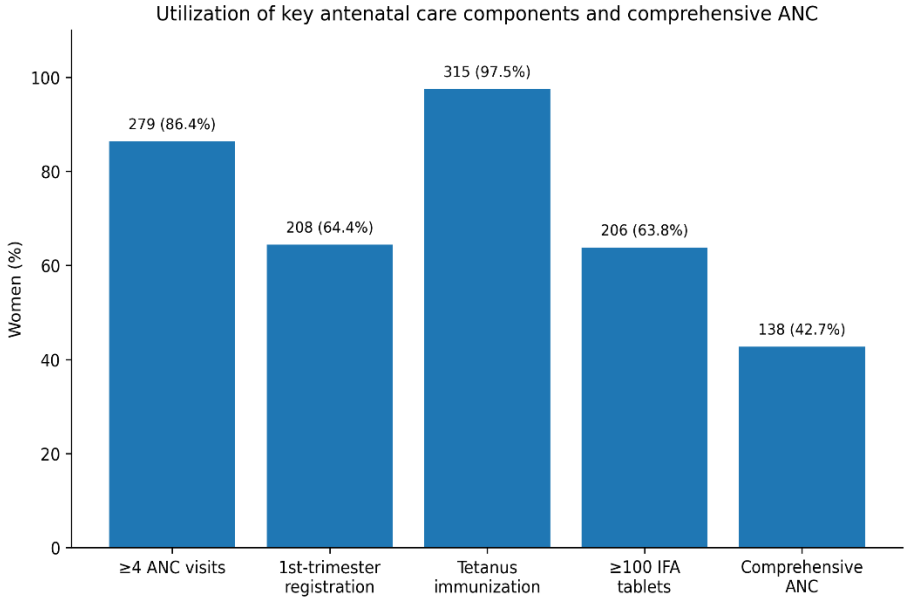


Figure 1. Utilization of key antenatal care components and comprehensive antenatal care among the study participants.

Factors associated with comprehensive ANC utilization

Comprehensive ANC utilization differed significantly according to maternal education, maternal occupation, husband's education, husband's occupation, socioeconomic class, and parity (Table 3). Utilization was highest among women with postgraduate education, 12/16 (75.0%), and among women whose husbands had postgraduate education, 18/20 (90.0%). Working women had higher utilization than homemakers, and primigravida women had higher utilization than multigravida women.

No significant association was observed between comprehensive ANC utilization and family type or age at marriage.

Table 3. Sociodemographic factors associated with comprehensive antenatal care utilization

Characteristic	Adequate ANC n (%)	Inadequate ANC n (%)	χ^2 (df)	p-value
Maternal education			**11.14 (5)**	**0.049**
Illiterate	12 (31.6)	26 (68.4)		
Primary	3 (25.0)	9 (75.0)		
Secondary	41 (41.8)	57 (58.2)		
Intermediate	32 (41.0)	46 (59.0)		
Graduate	38 (47.5)	42 (52.5)		
Postgraduate	12 (75.0)	4 (25.0)		
Maternal occupation			**4.80 (1)**	**0.029**
Working	45 (52.9)	40 (47.1)		
Homemaker	93 (39.2)	144 (60.8)		
Husband's education			**23.49 (5)**	**<0.001**
Illiterate	6 (66.7)	3 (33.3)		
Primary	2 (40.0)	3 (60.0)		
Secondary	33 (34.7)	62 (65.3)		
Intermediate	27 (38.0)	44 (62.0)		
Graduate	52 (42.6)	70 (57.4)		
Postgraduate	18 (90.0)	2 (10.0)		
Husband's occupation			**13.57 (5)**	**0.019**
Daily-wage labourer	2 (25.0)	6 (75.0)		
Farmer	14 (28.0)	36 (72.0)		

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Driver	18 (37.5)	30 (62.5)		
Employee	72 (51.8)	67 (48.2)		
Business	30 (40.0)	45 (60.0)		
Doctor	2 (100)	0 (0)		
Family type			1.43 (2)	0.489
Nuclear	86 (43.4)	112 (56.6)		
Joint	35 (46.1)	41 (53.9)		
Three-generation	17 (35.4)	31 (64.6)		
Socioeconomic class			**14.14 (4)**	**0.007**
Class I	37 (54.4)	31 (45.6)		
Class II	46 (38.3)	74 (61.7)		
Class III	40 (51.3)	38 (48.7)		
Class IV	15 (28.8)	37 (71.2)		
Class V	0 (0)	4 (100)		
Age at marriage			3.13 (1)	0.077
<19 years	43 (36.4)	75 (63.6)		
>19 years	95 (46.6)	109 (53.4)		
Parity			**4.81 (1)**	**0.028**
Primigravida	74 (49.3)	76 (50.7)		
Multigravida	64 (37.2)	108 (62.8)		

Percentages are calculated within each category. Pearson chi-square test was used. Bold p-values indicate statistical significance at $p<0.05$. ANC, antenatal care.

Pregnancy and neonatal outcomes

Pregnancy-outcome information was available for 322 women. Term delivery occurred in 243 (75.5%), while 52 (16.1%) delivered preterm and 27 (8.4%) delivered post-term. Normal vaginal delivery was the predominant mode of delivery, occurring in 222 (68.9%), while 100 (31.1%) underwent caesarean delivery.

There were 319 (99.1%) live births, two (0.6%) abortions, and one (0.3%) stillbirth. Among the 319 live births, 89 (27.9%) had a birth weight below 2.5 kg, including 87 (27.3%) low-birth-weight and two (0.6%) very-low-birth-weight neonates (Table 4).

Table 4. Pregnancy and neonatal outcomes

Outcome	**n (%)**
Gestational outcome (n=322)	
Preterm	52 (16.1)
Term	243 (75.5)
Post-term	27 (8.4)
Mode of delivery (n=322)	
Normal vaginal delivery	222 (68.9)
Caesarean section	100 (31.1)
Birth status (n=322)	
Live birth	319 (99.1)
Abortion	2 (0.6)
Stillbirth	1 (0.3)
Birth weight among live births (n=319)	
Normal birth weight	230 (72.1)
Low birth weight	87 (27.3)
Very low birth weight	2 (0.6)
Birth weight <2.5 kg overall	89 (27.9)

Values are presented as n (%).

Association of comprehensive ANC utilization with pregnancy outcomes

The distribution of gestational outcome differed significantly according to comprehensive ANC utilization ($\chi^2=9.69$, df=2; $p=0.008$). Term delivery was more frequent among women who received adequate comprehensive ANC than among those with inadequate utilization.

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Mode of delivery also differed between the groups (χ^2=4.65, df=1; p=0.031), with normal vaginal delivery accounting for a greater proportion of outcomes among women with adequate comprehensive ANC.

A marked association was observed between ANC utilization and birth weight (χ^2=18.20, df=2; p<0.001). Among live births with available birth-weight data, low or very low birth weight occurred in 21/135 (15.6%) births in the adequate-ANC group compared with 68/184 (37.0%) in the inadequate-ANC group (Table 5 and Figure 2).

Table 5. Association of comprehensive antenatal care utilization with pregnancy and neonatal outcomes

Outcome	Adequate ANC n (%)	Inadequate ANC n (%)	χ^2 (df)	p-value
Gestational outcome			**9.69 (2)**	**0.008**
Post-term	7 (25.9)	20 (74.1)		
Preterm	15 (28.8)	37 (71.2)		
Term	116 (47.7)	127 (52.3)		
Mode of delivery			**4.65 (1)**	**0.031**
Caesarean section	34 (34.0)	66 (66.0)		
Normal vaginal delivery	104 (46.8)	118 (53.2)		
Birth weight			**18.20 (2)**	**<0.001**
Low birth weight	21 (24.1)	66 (75.9)		
Normal birth weight	114 (49.6)	116 (50.4)		
Very low birth weight	0 (0)	2 (100)		

Percentages are calculated within each outcome category. Pearson chi-square test was used. Bold p-values indicate statistical significance at p<0.05. ANC, antenatal care.

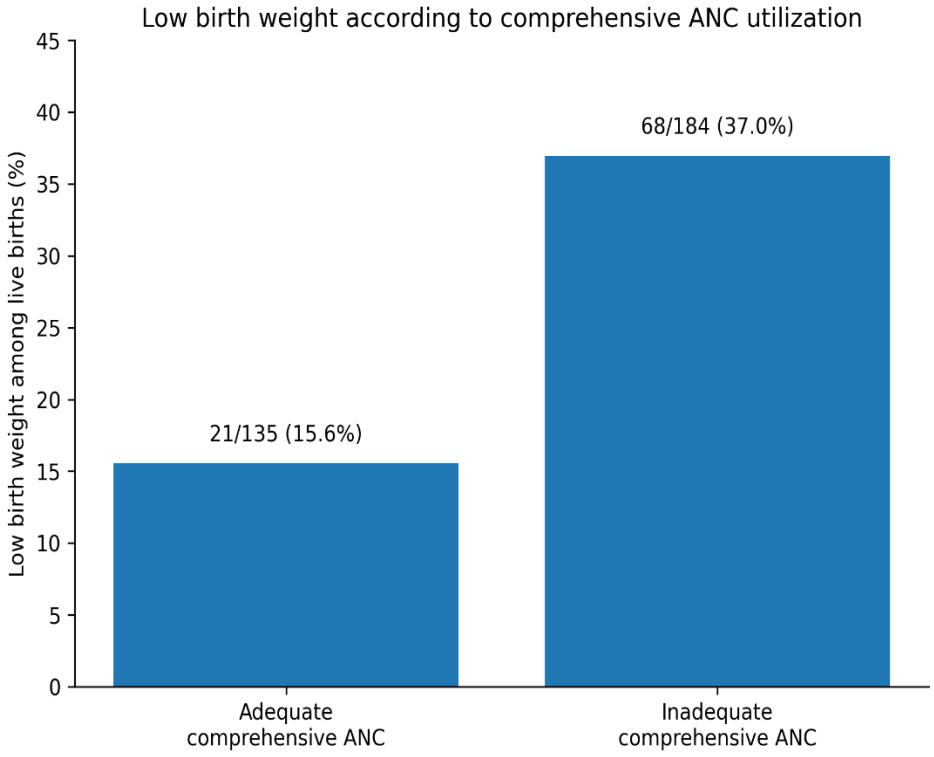


Figure 2. Proportion of low/very-low-birth-weight neonates according to comprehensive antenatal care utilization.

Low or very low birth weight occurred in 21/135 (15.6%) live births among women with adequate comprehensive ANC and 68/184 (37.0%) among women with inadequate comprehensive ANC (χ^2=17.73, df=1; p<0.001).

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DISCUSSION

This present prospective study aimed to assess the utilization of comprehensive antenatal care (ANC) and its relationship with pregnancy outcomes in 323 pregnant women attending field practice areas (FPAs) in urban and rural areas of a tertiary care hospital in Hyderabad. While 86.4% attended at least four ANC visits, only 42.7% fulfilled all the criteria for comprehensive ANC. The percentages of first-trimester registration, tetanus immunization and consumption of 100 or more iron–folic acid (IFA) tablets were 64.4%, 97.5%, and 63.8%, respectively. Maternal and paternal education, occupation, socioeconomic status and parity were significant factors associated with comprehensive ANC utilization. Additionally, good use was linked to an increased percentage of term delivery and normal birth weight, suggesting that the completeness of antenatal services is important in addition to the number of visits.

This difference between the individual service coverage and comprehensive ANC utilization is similar to the national evidence. According to Thakkar et al. [9], who analysed the data of the National Family Health Survey (NFHS-5) of 172,702 women, 40.75% had fewer than four ANC visits. Women living in rural areas were at higher adjusted odds of inadequate attendance (OR 1.12) and women who had no formal education (OR 1.76) and those from the poorest households (OR 1.69) were most at risk. The present study showed higher attendance than the national estimates, but the proportion of women who were not receiving the full package of antenatal services showed that there are still some gaps in the delivery of the package of services. Overall adequacy estimates cannot be directly compared due to differences in sampling and the more complete definition employed in our study.

In the current cohort, maternal education and socioeconomic factors were significant factors influencing utilization. The percentage of women who received comprehensive ANC was higher among the postgraduates (75.0%) than among the illiterate women (31.6%) ($p = 0.049$). The utilization of the services was higher among working women (52.9%) than among homemakers (39.2%) ($p = 0.029$) and higher among primigravida women (49.3%) than among multigravida women (37.2%) ($p = 0.028$). In a community-based study in Rishikesh, Sharma et al. [10] found that 59.66% of women had four or more visits to the ANC, and that only 26.44% had their husbands accompany them. Maternal autonomy and husband involvement were still important factors after adjustment. The results reinforce the significance of household support and maternal decision making for accessing antenatal services.

In our study, the association was more pronounced with paternal education, as women whose husbands achieved postgraduate education had comprehensive ANC utilization rate of 90.0% ($p < 0.001$). Utilization was also significantly related to socioeconomic class ($p = 0.007$). It is suggested from these observations that antenatal care attendance and completion may be affected by family resources, educational awareness, and health seeking behavior. The small numbers in some educational and socioeconomic categories must be interpreted with caution, however.

One important clinical association that was found was the association between comprehensive ANC and neonatal birth weight. The proportion of low or very low birth weight was 15.6% among women receiving adequate comprehensive ANC, compared to 37.0% among women receiving inadequate ANC ($p < 0.001$). In 8,964 children from 42 economically disadvantaged counties in Western China, Zhou et al. [11] found an adjusted prevalence of low birth weight of 9.3%, up from the crude figure of 6.6%. The odds for low birth weight were higher for those who did not complete five ANC visits (adjusted OR 1.32) and for those who attended fewer than eight visits (adjusted OR 1.58). The lack of provision of essential investigations and assessments was also linked to higher risk, which further supports the possible impact of ANC attendance and service content.

However, the data on ANC attendance and birth weight are not always consistent. Girotra et al. [12] found a low birth weight prevalence of 17.29% in their study of NFHS-5 data of 175,240 mothers. The risk was lower with higher maternal education and household wealth, but there was no statistically significant independent association between the number of ANC visits and risk. On the other hand, Singh et al. [13] found that in 149,279 women, low birth weight affected 18.90% of births among women who did not attend ANC. Factors associated with an increased likelihood of LBW were no ANC (adjusted OR 1.19) and no formal maternal education (adjusted OR 1.45). These conflicting results suggest that the quality and completeness of care and maternal nutritional and socioeconomic features may be more informative than attendance.

This study also showed that there was a significant association between comprehensive ANC utilization and gestational outcome ($p = 0.008$). The proportion of women who had adequate ANC who experienced term delivery was 84.1% compared to 69.0% of those women who had

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inadequate ANC. Based on NFHS-5 data for 170,253 births, Jana [14] found an association between incomplete ANC and LBW, with mothers who did not receive full ANC having about 25% higher odds of having LBW. Interestingly, richer household status was associated with higher odds of preterm birth (OR 1.16); lower education and wealth were associated with increased risk of low birth weight. These results indicate that there are different factors associated with preterm delivery and impaired fetal growth, and that gestational duration and birth weight should be studied separately.

The mode of delivery also varied significantly by comprehensive ANC use in our cohort ($p = 0.031$). The percentage of women who delivered vaginally was 75.4% for those who received adequate ANC and 64.1% for those who received inadequate ANC. Pandey et al. [15] found an overall prevalence of caesarean delivery of 21.5% in a nationally representative Indian population, and found that women who had four or more ANC visits had higher adjusted odds of caesarean delivery (OR 2.28). Maternal education was also significantly associated with caesarean delivery (OR 7.30). The divergence of the results might be due to variations in obstetric risk, institutional delivery, referral, and access to health services. Hence, the observed association should not be viewed as proof of a direct effect of comprehensive ANC on the need for caesarean section.

In addition, recent multicountry evidence further emphasizes the importance of antenatal care quality. In a prospective cohort of 3,600 women from Ethiopia, Kenya, South Africa and India, Yang et al. [16] reported that only 5.8% of women received all six essential components of ANC during their first visit, and as low as 1.3% in India. The risk of fetal loss was lower with good quality first-visit care (risk ratio 0.41), but no association with low birth weight was shown.

The strengths of the present study are that it was prospective, included both urban and rural field practice populations, and measured several components of ANC along with pregnancy outcomes. Convenience sampling and single institution setting, however, restrict generalizability. Unadjusted chi-square analyses were used to evaluate associations mainly, and the potential confounding effects of maternal age, socioeconomic status, obstetric risk, parity, and other factors were not addressed. Furthermore, there were small numbers in some outcome categories and reported supplementation might have been subject to recall. The results thus suggest a relationship between comprehensive ANC utilization and good pregnancy outcomes, but are not causal. Enhancing early registration, nutritional support, health education and access to key maternal health interventions could contribute to the completeness of maternal health services.

CONCLUSION

Although the attendance at routine antenatal visits was relatively high, comprehensive antenatal care utilization was low among more than half of the study participants. Maternal and paternal education, occupation, socioeconomic status and parity were significantly associated with service utilization. Higher proportions of term deliveries, normal vaginal deliveries and normal-birth-weight neonates were observed with adequate comprehensive ANC. The results highlight the need to increase early antenatal registration, iron–folic acid supplementation, health education, and access to essential maternal health services to increase the completeness of antenatal care and to support positive pregnancy outcomes.

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