Original Article

Association between Antenatal Care Utilization and Maternal Anemia in Pregnant Women: A Cross-sectional study in RMU & Allied Hospitals

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Abstract

Background: Antenatal care (ANC) is important for preventing maternal complications and improving health outcomes. In Pakistan, although many women utilize ANC, there are still significant issues with timing, quality, and fairness in access.

Objectives: To relationship between ANC use and maternal anemia, at RMU & Allied Hospitals.

Materials and Methods: We carried out a retrospective cross-sectional study using hospital records of 385 women who were admitted for delivery between January 2024 and March 2025. We gathered data on sociodemographic, ANC details, maternal complications, and delivery outcomes. We used R software for statistical analyses, applying chi-square, Fisher's exact, and Wilcoxon rank sum tests to find significant associations.

Results: Anemia was present among 15.3% of the participants. It was notably more common among women from rural areas (22.1%), those with low education (27.9% among those with only primary education), and those from low-income backgrounds (17.1%) (all $p < 0.05$). Even though 98.06% of women had at least one ANC visit, those who started care later (after three weeks) and had more visits (a median of 6 for anemic women compared to 4 for non-anemic women, $p = 0.010$) were paradoxically linked to anemia, suggesting that they sought care after complications developed. Anemic women were more likely to arrive in poor condition, be in advanced labor, and have complications such as bleeding after 28 weeks and threatened miscarriage.

Conclusion: Inadequate and delayed ANC was strongly tied to negative maternal outcomes, particularly anemia. Factors like living in rural areas, low education, and poverty increased the risks. These findings stress the need for early, fair, and effective antenatal care to enhance maternal health in Pakistan.

Keywords:
Antenatal care, anemia, Pregnancy complications, Healthcare Disparities, Pakistan, Rural health

Introduction

Maternal health is a key indicator of a country's healthcare system performance, yet significant challenges persist in low- and middle-income countries (LMICs). In 2017, an estimated 295,000 maternal deaths occurred worldwide, with 94% taking place in LMICs due to largely preventable causes such as postpartum hemorrhage, hypertensive disorders, and infections.[1] Pakistan remains one of the countries with a high maternal mortality ratio (MMR), currently estimated at 186 deaths per 100,000 live births.[2] This underscores persistent systemic inequalities in healthcare access, education, and gender equity.

Antenatal care (ANC) is a cornerstone of maternal healthcare, providing a platform for early detection, prevention, and management of complications during pregnancy. Recognizing its importance, the World Health Organization (WHO) revised its ANC guidelines in 2016, increasing the recommended minimum contacts from four to eight to ensure more comprehensive maternal and fetal monitoring.[3] ANC offers opportunities for early diagnosis of anemia, hypertension, and infections, while also delivering nutritional support, health education, and psychosocial screening.[4] However, ANC effectiveness relies not only on the number of visits, but also on their timing, content, and quality.

Data from the Pakistan Demographic and Health Survey (PDHS) 2017–18 show that while 86% of pregnant women attend at least one ANC visit, only 51% complete the previously recommended minimum of four visits, and an even smaller proportion begin ANC in the first trimester.[5] This gap is driven by multiple social determinants, such as poverty, low female literacy, restrictive gender norms, and urban-rural disparities. In rural Pakistan, women often face logistical and cultural barriers such as long distances to facilities, lack of transport, and dependence on untrained traditional birth attendants. [6]

One of the most prevalent and preventable maternal complications is anemia. In South Asia, approximately 40% of pregnant women suffer from anemia, with national estimates in Pakistan ranging from 18% to over 50% depending on geographic and socioeconomic contexts.[7,8] Anemia during pregnancy increases the risk of preterm birth, low birth weight, poor tolerance to labor, and maternal mortality.[9] Timely ANC enables screening and treatment of anemia through iron supplementation, nutritional counseling, and referral when necessary.

In Pakistani hospitals, while many agree that prenatal care has benefits both locally and worldwide, there is little research on the actual relationship between ANC use and specific maternal complications, especially anemia. Much of the existing research is in communities and will likely not sufficiently capture the variation, or severity, of major complaints that can occur and arise in tertiary care. This study aims to contribute to knowledge gaps relating to the relationships between the amount of used ANC (number of visits and timing of visits) and maternal anemia (and other indirect or direct maternal outcomes) in the context of women admitted to RMU & Allied Hospitals. The study aims

to address the gap in knowledge through context-specific evidence in this hospital-based study, as this evidence can be used to inform more effective, efficient, timely, and equitable maternal health interventions in Pakistan.

The objective of this study is to examine the association between antenatal care utilization (timing and number of visits) and maternal anemia among women admitted to RMU & Allied Hospitals. By generating hospital-based evidence, this study seeks to provide context-specific insights that can guide strategies to improve maternal health outcomes in Pakistan.

Materials and Methods

This retrospective cross-sectional study was conducted in the Department of Obstetrics, Rawalpindi Medical University (RMU) & Allied Hospitals from October 2024 to March 2025. This study was conducted in accordance with the ethical standards of the institutional research committee of Rawalpindi Medical University. Ethical approval was obtained from the RMU Institutional Review Board (IRB) prior to data collection. All participants provided informed consent, and patient confidentiality was strictly maintained throughout the study in compliance with the Declaration of Helsinki. The study population consisted of women who were admitted for delivery and had complete antenatal care (ANC) records.

The criteria for inclusion was (1) admission for delivery by any mode, (2) availability of documented ANC details (i.e. number, timing and place of visits), and documentation of maternal complications during pregnancy/delivery. The exclusion criteria were (1) admission for reasons other than for delivery, (2) women who refused the researchers right of participation in the research, (3) some women did not have an affiliation with RMU or the allied hospitals, and (4) women who had incomplete ANC records. From previous research studies, the expected prevalence of maternal anemia is around 35%. Based on this estimate, with a margin of error (5 percent) and confidence level (95 percent), the sample size was calculated to be 350. A 10 percent oversample (due to missing/incomplete records) was applied to the sample size to have a final sample size of 385. The data was collected using a structured, pretested online questionnaire by trained data collectors (convenience sampling).

The sociodemographic data obtained from the questionnaire included maternal age, the area where the woman lived, occupation of both the woman and head of household, educational level, and monthly household income. Individuals provided monthly household income information for socioeconomic status determinants, which we classified as high monthly household income, if the income exceeded PKR 50,000. ANC variables included gestation age at first ANC visit, total number of ANC visits, which health care provider type or facility this occurred in (basic health unit, rural health center, tehsil headquarter hospital, private general practitioner, gynecologist, or tertiary care facility), and complications that were maternal. Anemia was classified as hemoglobin levels of <11g/dl. Other variables measured were gestational age at delivery, condition of the woman on arrival,

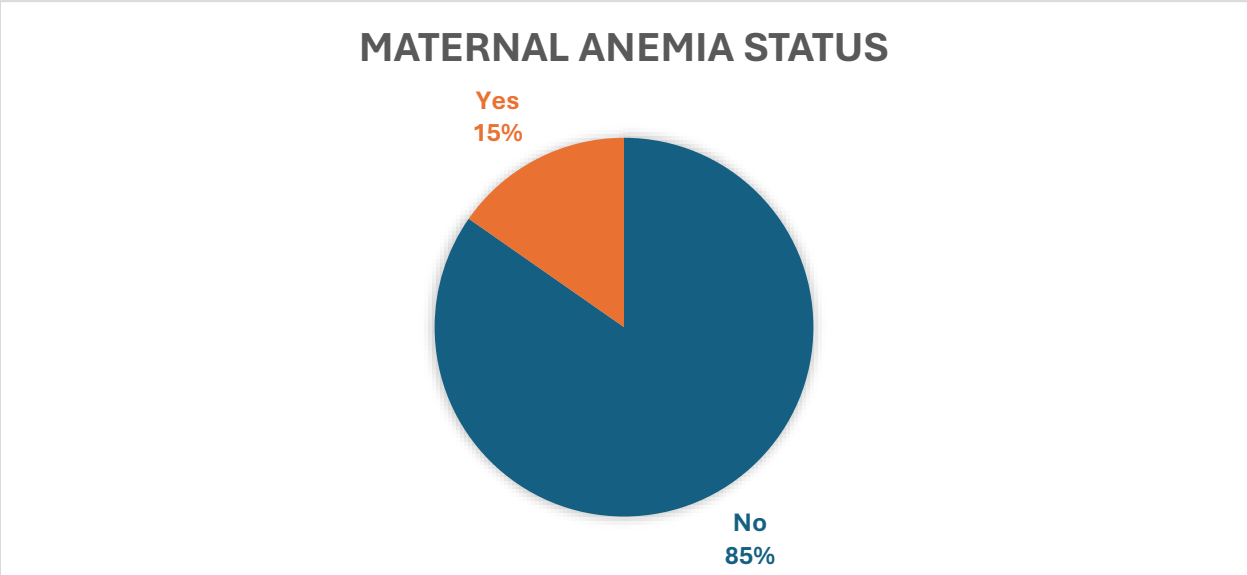
stage of labor, mode of deliveries, fetal status on admission, and duration of labor.

Descriptive statistics were used to summarize the data. Continuous variables were assessed for normality. Categorical variables were analyzed using Chi-square or Fischer's exact test when appropriate. The Wilcoxon rank sum test was used for continuous variables. A p-value of 0.05 or less indicated statistical significance. All analyses were conducted in R (version 4.5.0; R Core Team, 2025).

Results

The study included 385 participants, with 326 (84.7%) non-anemic and 59 (15.3%) anemic mothers. The overall median age was 28 years (IQR: 25–32), consistent across both groups. Most mothers were unemployed (331, 86.0%), and heads of families were primarily skilled workers (176, 45.7%). Rural residence was reported by 149 mothers (38.7%), with higher anemia prevalence in this group (33/149, 22.1%) compared to urban residents (26/236, 11.0%). Educationally, 133 mothers (34.6%) had secondary education; anemia was most frequent among those with primary education (17/61, 27.9%) and heads of family with illiteracy (18/64, 28.1%). Low socioeconomic status predominated (328, 85.2%) and had higher anemia rates (56/328, 17.1%) versus high status (3/57, 5.3%).

Figure 1 *Maternal Anemia Outcome for the Sample of Women.*



The analysis revealed significant associations between maternal anemia and several demographic factors. Rural residence showed a strong positive association with anemia (p = 0.003), with rural mothers having a higher prevalence (22.1%) compared to urban mothers (11.0%). Lower maternal education was also significantly linked to anemia (p = 0.014), particularly among those with only primary education (27.9% anemic vs. 5.5% in graduates). Similarly, illiteracy in the head of

the family was associated with higher anemia rates (28.1% vs. 7.1% in graduates; p = 0.018). Low socioeconomic status was another key predictor (p = 0.022), with 17.1% of low-SES mothers being anemic compared to only 5.3% in the high-SES group. However, age (p = 0.156) and occupational status (mother: p = 0.482; head of family: p = 0.524) did not show significant associations with anemia. These findings suggest that rural location, lower education levels, and poverty are major risk factors for maternal anemia, while employment status and age do not play a significant role.

Table 1 *Association of Demographics with Maternal Outcome of Being Anemic.*

Factors	Overall N = 385	Non-anemic N = 326	Anemic N = 59	p-value
Age of Patient	28.00 (25.00, 32.00)[1]	28.00 (25.00, 32.00)[1]	29.00 (25.00, 33.00)[1]	0.156[2]
Occupational Status of Patient				0.482[3]
Unemployed	331 (85.97%)	282 (73.25%)	49 (12.73%)	
Employed	54 (14.03%)	44 (11.43%)	10 (2.60%)	
Occupational Status of Head of Family				0.524[4]
Unemployed	15 (3.90%)	10 (2.60%)	5 (1.30%)	
Unskilled	47 (12.21%)	41 (10.65%)	6 (1.56%)	
Semi-skilled	52 (13.51%)	45 (11.69%)	7 (1.82%)	
Skilled Worker	176 (45.71%)	151 (39.22%)	25 (6.49%)	
Clerical/Farm Owner/Farmer	68 (17.66%)	55 (14.29%)	13 (3.38%)	
Semi Professional	23 (5.97%)	20 (5.19%)	3 (0.78%)	
Professional (White Collar)	4 (1.04%)	4 (1.04%)	0 (0.00%)	
Location of Residence				**0.003[3]**
Rural	149 (38.70%)	116 (30.13%)	33 (8.57%)	
Urban	236 (61.30%)	210 (54.55%)	26 (6.75%)	
Level of education of patient				**0.014[3]**
Nil	56 (14.55%)	49 (12.73%)	7 (1.82%)	
Primary	61 (15.84%)	44 (11.43%)	17 (4.42%)	
Secondary	133 (34.55%)	111 (28.83%)	22 (5.71%)	
Intermediate	80 (20.78%)	70 (18.18%)	10 (2.60%)	
Graduate	55 (14.29%)	52 (13.51%)	3 (0.78%)	
Level of education of Head of Family				**0.018[4]**
Illiterate	64 (16.62%)	46 (11.95%)	18 (4.68%)	
Middle School	67 (17.40%)	53 (13.77%)	14 (3.64%)	
Primary School	32 (8.31%)	30 (7.79%)	2 (0.52%)	
High School	140 (36.36%)	125 (32.47%)	15 (3.90%)	
Intermediate/Diploma/Post high School	53 (13.77%)	45 (11.69%)	8 (2.08%)	
Graduate/PG	28 (7.27%)	26 (6.75%)	2 (0.52%)	
Professional Degree	1 (0.26%)	1 (0.26%)	0 (0.00%)	

Factors	Overall N = 385	Non-anemic N = 326	Anemic N = 59	p-value
Socioeconomic Status				**0.022**[3]
Low	328 (85.19%)	272 (70.65%)	56 (14.55%)	
High	57 (14.81%)	54 (14.03%)	3 (0.78%)	

Note. Data presented as n(%) unless mentioned otherwise
[1]Median (Q1, Q3)
[2]Wilcoxon rank sum test
[3]Pearson's Chi-squared test
[4]Fisher's exact test

Median gestational age was 37 weeks (IQR: 36–38) overall. Nearly all mothers sought antenatal care (381, 99.0%), primarily at private gynecology clinics (128, 33.3%) or THQ hospitals (105, 27.3%). Anemia was elevated at tertiary care hospitals (12/26, 46.2%) and THQ facilities (21/105, 20.0%). Anemic mothers-initiated care later (first visit median: 3 weeks, IQR: 2–6 vs. 1.5–4 in non-anemic) and had more visits (median: 6 vs. 4). Complications occurred in 293 mothers (76.1%), with anemia being most common (109, 28.3%). Anemic mothers had higher rates of threatened miscarriage (5/12, 41.7%) and bleeding after 28 weeks (8/19, 42.1%). At arrival, 118 mothers (30.7%) were in "poor" condition, including 26/59 (44.1%) anemic cases. Anemia was frequent in second-stage labor (11/23, 47.8%). Cesarean delivery was dominant (325, 84.4%) but unrelated to anemia.

Antenatal care factors demonstrated significant relationships with maternal anemia. Place of antenatal care had a strong association ($p < 0.001$), with higher anemia prevalence in mothers visiting tertiary care hospitals (46.2%) and THQ facilities (20.0%), possibly indicating referral of high-risk cases. Delayed initiation of antenatal care (first visit after 3 weeks) was linked to increased anemia risk ($p = 0.022$). Surprisingly, anemic mothers had more antenatal visits (median: 6 vs. 4; $p = 0.010$), suggesting that care was sought after anemia detection rather than preventively. Pregnancy complications showed a strong correlation ($p < 0.001$), with higher anemia rates in cases of threatened miscarriage (41.7%), bleeding after 28 weeks (42.1%), and UTI (26.7%). Additionally, mothers in "poor" condition at arrival had significantly higher anemia rates (44.1% vs. 17.2% in "good" condition; $p = 0.013$). Second-stage labor was also associated with anemia (47.8% vs. 13.3% in third stage; $p < 0.001$), possibly due to prolonged labor stress. However, gestational age ($p = 0.432$), fetal status ($p = 0.737$), and mode of delivery ($p = 0.718$) were not significant predictors. These findings highlight that late antenatal care initiation, complications, and poor maternal health at arrival contribute to anemia, while delivery-related factors do not.

Table 2 *Association of Antenatal Care and Current other Current Variables with Maternal Outcome of Anemia.*

Factors	Overall N = 385[1]	Non-anemic N = 326[1]	Anemic N = 59[1]	p-value
Gestational age at Current Pregnancy (weeks)	37.00 (36.00, 38.00)	37.00 (36.00, 38.00)	36.00 (36.00, 38.00)	0.432[2]
Antenatal Care seeking in Current pregnancy	381 (98.96%)	322 (83.64%)	59 (15.32%)	>0.999[3]
Place of antenatal care				**<0.001[3]**
No where	4 (1.04%)	4 (1.04%)	0 (0.00%)	
BHU	14 (3.64%)	11 (2.86%)	3 (0.78%)	
RHC	14 (3.64%)	14 (3.64%)	0 (0.00%)	
THQ	105 (27.27%)	84 (21.82%)	21 (5.45%)	
Private Clinics to an MO	21 (5.45%)	21 (5.45%)	0 (0.00%)	
Private Clinics to a Gynae Specialist	128 (33.25%)	118 (30.65%)	10 (2.60%)	
DHQ	73 (18.96%)	60 (15.58%)	13 (3.38%)	
Tertiary care hospital	26 (6.75%)	14 (3.64%)	12 (3.12%)	
Gestational Age at first visit	3.00 (2.00, 4.00)	3.00 (1.50, 4.00)	3.00 (2.00, 6.00)	**0.022[2]**
No. of Antenatal visits	4.00 (2.00, 7.00)	4.00 (2.00, 6.00)	6.00 (2.00, 10.00)	**0.010[2]**
Complication during Current Pregnancy				**<0.001[3]**
None	92 (23.90%)	87 (22.60%)	5 (1.30%)	
Threatened miscarriage	12 (3.12%)	7 (1.82%)	5 (1.30%)	
Bleeding after 28 weeks of pregnancy	19 (4.94%)	11 (2.86%)	8 (2.08%)	
Premature rupture of membranes	24 (6.23%)	22 (5.71%)	2 (0.52%)	
Urinary tract infection	30 (7.79%)	22 (5.71%)	8 (2.08%)	
Cardiac disease	7 (1.82%)	7 (1.82%)	0 (0.00%)	
Diabetes mellitus	35 (9.09%)	35 (9.09%)	0 (0.00%)	
Anemia	109 (28.31%)	87 (22.60%)	22 (5.71%)	
Hypertension	27 (7.01%)	27 (7.01%)	0 (0.00%)	
Placenta previa	3 (0.78%)	0 (0.00%)	3 (0.78%)	
Fetal distress	1 (0.26%)	1 (0.26%)	0 (0.00%)	
Anemia+UTI	4 (1.04%)	4 (1.04%)	0 (0.00%)	
Anemia+UTI+DM	14 (3.64%)	8 (2.08%)	6 (1.56%)	
UTI+Anemia	0 (0.00%)	0 (0.00%)	0 (0.00%)	
DM+HTN	2 (0.52%)	2 (0.52%)	0 (0.00%)	
LFTs Raised	1 (0.26%)	1 (0.26%)	0 (0.00%)	
Benign tumor	5 (1.30%)	5 (1.30%)	0 (0.00%)	
Mother condition at arrival				**0.013[4]**
Poor	118 (30.65%)	92 (23.90%)	26 (6.75%)	
Fair	168 (43.64%)	152 (39.48%)	16 (4.16%)	
Good	99 (25.71%)	82 (21.30%)	17 (4.42%)	
Labor Stage at Arrival				**<0.001[3]**
Not in labor	166 (43.12%)	143 (37.14%)	23 (5.97%)	
First stage	180 (46.75%)	158 (41.04%)	22 (5.71%)	
Second stage	23 (5.97%)	12 (3.12%)	11 (2.86%)	
Third stage	16 (4.16%)	13 (3.38%)	3 (0.78%)	
Fetal status at Arrival				0.737[3]

Factors	Overall N = 385[1]	Non-anemic N = 326[1]	Anemic N = 59[1]	p-value
No fetal heart sounds	7 (1.82%)	7 (1.82%)	0 (0.00%)	
Irregular fetal heart sounds	22 (5.71%)	20 (5.19%)	2 (0.52%)	
Normal fetal heart rate (between 110-160 beats per minute)	307 (79.74%)	256 (66.49%)	51 (13.25%)	
Decreased fetal heart sound (110 beats per minute)	43 (11.17%)	38 (9.87%)	5 (1.30%)	
Increased fetal heart rate (160 beats per minute)	6 (1.56%)	5 (1.30%)	1 (0.26%)	
Mode of delivery (Current Pregnancy)				0.718[3]
Spontaneous vaginal	29 (7.53%)	24 (6.23%)	5 (1.30%)	
Assisted vaginal delivery	29 (7.53%)	23 (5.97%)	6 (1.56%)	
Vaginal breech	2 (0.52%)	2 (0.52%)	0 (0.00%)	
Caesarean section	325 (84.42%)	277 (71.95%)	48 (12.47%)	
Duration of Labor (Hours)	1.00 (0.75, 2.00)	1.00 (0.75, 1.50)	1.00 (0.75, 4.00)	0.123[2]

Note. [1]Median (Q1, Q3); n (%),[2]Wilcoxon rank sum test, [3]Fisher's exact test, [4]Pearson's Chi-squared test, UTI = Urinary Tract Infection, DM = Diabetes Mellitus, HTN = Hypertension, LFTs = Liver function tests

Discussion

The results of this study confirm that ANC utilization patterns, particularly the timing of the first visit and the quality of care received, significantly influence maternal health outcomes. Despite a high reported rate of ANC attendance (99%), a considerable proportion of women-initiated care late and presented with complications such as anemia. This suggests that ANC in this population may not be functioning as a preventive measure but rather as a response mechanism to already-developing health problems, as supported by the higher number of visits among anemic women.[1–2] Rural residence emerged as a major factor in anemia prevalence, aligning with findings from other LMICs where access to quality health services is limited outside urban centers.[3] Women from rural backgrounds often face transportation barriers, lower health literacy, and dependence on male family members to access care, all of which contribute to delayed or inadequate ANC.[4–5] Additionally, low maternal education and illiteracy of the head of household were associated with anemia, reflecting the impact of household-level decision-making and awareness on maternal health outcomes.[6]

Although 71% of anemic women attended multiple ANC visits, these were often initiated too late to prevent complications. This reactive behavior has been documented in similar settings, where women seek healthcare only after experiencing symptoms rather than as a proactive step in pregnancy management. [7–8] The high incidence of anemia-related complications—such as bleeding after 28 weeks, poor general condition at admission, and advanced labor stages—demonstrates the consequences of delayed ANC initiation. These findings

reinforce the idea that the timing of ANC initiation is just as crucial as the number of visits, a fact emphasized by WHO's updated 2016 guidelines. [9]

Our study highlights a concerning trend: while ANC coverage in terms of numbers appears adequate, its quality and timing fall short. This discrepancy suggests that interventions should go beyond increasing the number of visits and instead focus on early engagement, awareness, and service quality. Community-based programs that target rural and low-literacy populations could help improve early ANC uptake.[10–11] Nutritional counseling, free supplementation programs, and awareness campaigns could address the high burden of anemia, particularly when introduced during the first trimester.[12] Previous literature has shown that early ANC booking is associated with better detection of maternal risks and more opportunities for interventions such as tetanus immunization, iron supplementation, and folic acid intake.[13–14] These interventions, when delivered early, significantly reduce the risk of anemia, preterm labor, and low birth weight.[15] Moreover, studies conducted in other South Asian countries have similarly noted that merely increasing the frequency of ANC visits without improving their content and timeliness has minimal impact on maternal mortality or morbidity.[16]

While this study adds valuable hospital-based data to the national discourse, it is not without limitations. As a retrospective design, it depends on the accuracy and completeness of medical records. Also, due to the hospital-based sample, the findings may not be generalizable to community populations or women who deliver at home. However, the clinical focus provides important insights into maternal morbidity patterns observed in real-world tertiary care settings, which are often underrepresented in literature. [17]

In conclusion, timely and adequate ANC is vital in reducing maternal anemia and associated complications. This study emphasizes that while ANC attendance is high on paper, the effectiveness of these visits remains questionable unless they are initiated early and delivered with quality. Addressing barriers such as rural access, illiteracy, and socioeconomic disparity is essential for improving maternal outcomes in Pakistan.[18–19]

This study highlights the need to improve not just the coverage but the quality and timing of antenatal care (ANC) in Pakistan. Efforts should focus on encouraging early ANC initiation, ideally in the first trimester, through community awareness programs that include families and decision-makers, particularly in rural and low-literacy areas. Improving access to care in underserved regions is crucial. Strengthening Basic Health Units and deploying trained Lady Health Workers to provide ANC at the doorstep can reduce delays in seeking care. Simultaneously, nutrition interventions such as routine iron and folic acid supplementation, hemoglobin testing, and dietary counseling should be integrated into every ANC visit to reduce anemia.

Limitations of the study include data from one university and its allied, cross-sectional design, convenient retrospective sampling, limited variables and lack of stratification

into different diet groups and then doing analysis. Results of the study can't be generalized the population and require random sampling and diverse sample.

Conclusion

This study underscores the critical role of timely and adequate antenatal care in preventing maternal anemia and related complications. While ANC coverage appears high, the delayed initiation and poor quality of care suggest significant gaps in effectiveness. Addressing systemic barriers such as rural access, education, and poverty is essential to improving maternal outcomes in Pakistan's healthcare system.

References

1. World Health Organization. Maternal mortality: Levels and trends. Geneva: WHO; 2019.
2. National Institute of Population Studies (NIPS) [Pakistan], ICF. Pakistan Demographic and Health Survey 2017–18. Islamabad, Pakistan and Rockville, MD: NIPS and ICF; 2019.
3. Bbaale E. Factors influencing the utilization of antenatal care content in Uganda. Australas Med J. 2011;4(9):516–26.
4. Ali SA, Lakhani A, Azam SI. Factors affecting antenatal care utilization in rural Sindh, Pakistan. J Ayub Med Coll Abbottabad. 2020;32(1):31–6.
5. Pell C, Meñaca A, Were F, Afrah NA, Chatio S, Manda-Taylor L, et al. Factors affecting antenatal care attendance: A qualitative study in Ghana, Kenya and Malawi. PLoS One. 2013;8(1):e53747.
6. Agha S, Tappis H. The timing of antenatal care initiation in Pakistan. J Health Popul Nutr. 2016;35(1):1–7.
7. Imdad A, Bhutta ZA. Maternal anemia during pregnancy and its outcomes: a review. Nutr Rev. 2012;70(Suppl 1):S20–8.
8. Rahman MM, Abe SK, Kanda M, Narita S, Bilano V, Ota E, et al. Maternal anemia and risk of adverse birth and health outcomes in low- and middle-income countries: systematic review and meta-analysis. Am J Clin Nutr. 2016;103(2):495–504.
9. World Health Organization. WHO recommendations on antenatal care for a positive pregnancy experience. Geneva: WHO; 2016.
10. Bhutta ZA, Ahmed T, Black RE, Cousens S, Dewey K, Giugliani E, et al. What works? Interventions for maternal and child undernutrition and survival. Lancet. 2008;371(9610):417–40.
11. Carroli G, Villar J, Piaggio G, Khan-Neelofur D, Gülmezoglu M, Mugford M, et al. WHO systematic review of routine antenatal care. Lancet. 2001;357(9268):1565–70.
12. Lone FW, Qureshi RN, Emanuel F. Maternal anemia and its impact on perinatal outcome. Trop Med Int Health. 2004;9(4):486–90.
13. Galloway R, Dusch E, Elder L, Achadi E, Grajeda R, Hurtado E, et al. Women's perceptions of iron deficiency and anemia prevention and control in eight developing countries. Soc Sci Med. 2002;55(4):529–44.
14. Abou-Zahr CL, Wardlaw TM. Antenatal care in developing countries: Promises, achievements and missed opportunities. Geneva: WHO; 2003.
15. Peña-Rosas JP, De-Regil LM, Garcia-Casal MN, Dowswell T. Daily oral iron supplementation during pregnancy. Cochrane Database Syst Rev. 2015;2015(7):CD004736.
16. Kuhnt J, Vollmer S. Antenatal care services and its implications for vital and health outcomes of children: Evidence from 193 surveys in 69 low-income and middle-income countries. BMJ Open. 2017;7(11):e017122.
17. Tann CJ, Kizza M, Morison L, Mabey D, Muwanga M, Grosskurth H, et al. Use of antenatal services and delivery care in Entebbe, Uganda: A community survey. BMC Pregnancy Childbirth. 2007;7:23.
18. National Institute of Population Studies (NIPS). Pakistan Maternal Mortality Survey 2019. Islamabad: NIPS; 2020.
19. Bhutta ZA, Soofi S, Zaidi S, Habib A, Hussain M, Jafarey SN, et al. Evidence-based interventions for improvement of maternal and child health outcomes in Pakistan: a call to action. Lancet. 2013;381(9885):2207–1