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Evaluation of antenatal care utilization and its effects on obstetric and newborn outcomes at a public and private hospital of Karnataka: A comparative study

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Abstract:

BACKGROUND: Neonatal outcomes and perinatal mortality are directly and significantly impacted by the use of appropriate antenatal care (ANC) during pregnancy. The objective of this study is to evaluate the association between the use of prenatal services and maternal and newborn outcomes in both public and private healthcare settings.

MATERIALS AND METHODS: This study was carried out in two tertiary healthcare setups in Mangaluru, Karnataka: Government Lady Goschen Hospital (LGH) and Kasturba Medical College Hospital (KMCH) Attavar. Data were collected from 150 women who were a part of the study. Microsoft Excel was used to compile the data, and SPSS version 25 was used to analyze it.

RESULTS: We found that 58 out of 90 women admitted to LGH went for ANC check-ups at least four times during their gestation period and the rest of them went eight times or more, compared to just 3 out of the 60 women admitted at KMCH who went at least four times, whereas the rest went eight or more. The number of checks the mother takes appears to affect the term of the gestation with fewer preterm seen in patients who have come for a minimum of eight ANC visits, a higher risk of abnormal weight gain during pregnancy, and a lower risk of giving birth to preterm babies.

CONCLUSION: The study reveals that private healthcare setups offer more antenatal services, including hospital visits, routine testing, supplements, and doctor advice. The number of antenatal visits is a significant difference between public and private healthcare setups. The public setup requires a minimum of four antenatal care visits, while the updated 2016 version requires eight. The number of antenatal visits affects both mother's and neonatal outcomes. A higher number of visits leads to fewer preterm births and a higher risk of abnormal weight gain. Education also influences the frequency of antenatal visits. The study suggests increasing the frequency of prenatal care visits and improving public education on this matter.

Keywords:

Antenatal care, maternal outcome, neonatal outcome

Introduction

The antenatal period refers to the period from the start of the pregnancy to the onset of labor.[1] Neonatal outcomes and perinatal mortality are directly and significantly impacted by the use of appropriate antenatal care (ANC) during pregnancy.[2] ANC, in addition to the promotion and protection of pregnant women's health, aims to prevent and treat complications arising due to pregnancy and

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to treat pre-existing diseases in the mother. Although quality of care is a complex and multidimensional concept that includes safety, effectiveness, timeliness, efficiency, equity, and patient-centeredness, measuring health indicators may provide some insight into it. The Sustainable Development Goals (SDGs) aim to achieve a maternal mortality ratio of less than 70 per lakh live births (Target 3.1) under "Goal 3: Ensure healthy lives and promote wellbeing for all at all ages."[3] However, the maternal mortality ratio in India is 113 per lakh live births according to the Sample Registration System (SRS) 2014–2016.[4] Pregnancy outcomes, such as maternal and perinatal mortality, are significantly influenced by ANC.[5] By treating medical conditions, identifying and reducing potential risks, and assisting women in addressing behavioral factors that contribute to unfavorable pregnancy outcomes, studies have shown that frequent use of this routine medical service during pregnancy can lower the incidence of perinatal morbidity and mortality.[6] Quality care before, during, and after delivery can prevent maternal deaths.[7] Over time, there have been changes to the recommendations for delivering high-quality ANC. The World Health Organization (WHO) suggested goal-oriented, concentrated prenatal care in 2002: four prenatal visits, the first of which should occur before gestational age (GA) week 12.[8,9] To enhance fetal, neonatal, and maternal health, WHO updated its guidelines in 2016 to eight prenatal care visits, six of which should take place in the third trimester.[10] To be regarded as high quality, ANC must be started before a gestational age of 12 weeks and more ANC check-ups must be made at regular intervals of time so that close monitoring of the pregnant women takes place. Worldwide, 58.6% of expectant women in 2013 attended antenatal checkups before gestational week 12, but there were significant regional differences.[11] Various studies have shown disparities between ANC utilization and newborn outcomes in public and private health settings.[12-14] However, no such studies have been conducted in India, and no studies have compared the two settings regarding maternal and newborn outcomes in ANC. The objective of this study is to evaluate the association between the use of prenatal services and maternal and newborn outcomes in both public and private healthcare settings.

Objectives

- To assess the utilization of ANC and its impact on obstetric and newborn outcomes at a public and private hospital in Karnataka.
- To assess ANC coverage in private and public health facilities.
- To explore any relationship between ANC coverage, and maternal and newborn outcomes in public and private health facilities.

Materials and Methods

Study design and setting

This was a cross-sectional study research done in two tertiary healthcare setups in Mangaluru, Karnataka: Government Lady Goschen Hospital (LGH) and Kasturba Medical College Hospital (KMCH) Attavar.

Study participants

Women were admitted to post-natal wards in designated government and private teaching hospitals attached to the same medical college of Mangaluru.

Sample size

The formula used to determine the sample size, $n = \frac{Z^2_{\alpha/2}pq}{d^2}$., where "n" is the required sample size, "$Z_{\alpha/2}$" is the standard normal deviation, which is equal to 1.96 at a 5% significance level, "p" is the proportion, "q" = 1-p, and "d" is the expected precision.

A previous study from India showed that 28.9% of women were screened for crucial clinical conditions that could lead to eventful pregnancy and birth.[15] Considering this data, with an error of 8%, we had to get a recommended sample size of 124. We had subjects enrolled from each teaching hospital to achieve this sample size.

Sampling method

A process of convenience sampling was applied to select the study participants.

Inclusion criteria

1. Women who had delivered within the past 3 days.
2. Women with Mother and Child Health cards.

Exclusion criteria

1. Women who refused to take part in the study.
2. Women who were critically ill.

Study period

The study was conducted between July 2022 to December 2022.

Data collection tools

A validated, structured proforma.

Data collection procedure

After receiving approval from the Institutional Ethics Committee (IEC), the study was conducted in the designated teaching hospitals of a medical college in Mangaluru. The samples were taken from a government and a private teaching hospital affiliated with the same medical college, after obtaining permission from the

dean and the medical superintendents of the respective hospitals. Women in post-natal wards who delivered within the past 3 days were enrolled in the study. The objective and overview of the research were explained to them. They were informed that their participation would be voluntary, that they could opt out of the study at any point in time, and that the information provided would be used solely for the study. Anonymity and confidentiality of the data were assured to the participants, and their consent was obtained. All data collection methods were performed in accordance with the relevant guidelines and regulations. Subjects' responses to a designated questionnaire and subjects' medical records [viz, Mother and Child Protection (MCP) Card and hospital records] served as the sources of information. The latter served dual purposes. First, we could ascertain the consistency of the data obtained from the questionnaire. Second, it also provided additional information, that the subject may not have been aware of. The latter was considered final in case of discrepancies between the subjects' responses to the questionnaire and data collected from the medical records.

The questionnaire consisted of four parts:
1. Sociodemographic variables
2. ANC indicators
3. Pregnancy outcomes
4. Newborn outcomes.

Maternal demographics: Age, obstetric score, pre-pregnancy BMI, and coexisting health conditions.

Antenatal care indicators: Urine pregnancy test (UPT), registration of pregnancy in the first trimester, at least three antenatal check-ups after registration, blood pressure (BP) and weight measurement at each visit, Tetanus Toxoid vaccination, consumption of at least one Iron and Folic Acid and two calcium tablets daily after the first trimester, taking a single tablet of albendazole 400 mg after the first trimester, hemoglobin estimation, screening for gestational diabetes mellitus, urinary albumin and sugar estimation, screening for HIV and syphilis, and ultrasonography.[16]

Maternal outcomes: Period of gestation at delivery, preterm delivery (delivery before 37 completed weeks of gestation), pre-eclampsia, chorioamnionitis, venous thromboembolism, antepartum hospital admission for at least 2 days, admission to ICU, need for supplemental oxygen, mechanical ventilation, mode of delivery (cesarean or vaginal delivery), and fetal death in utero.[17]

Neonatal outcomes: Birth weight (as recorded in the delivery register), respiratory distress syndrome (RDS; defined as the need for supplemental oxygen in a case with typical radiographic features and no alternate explanations to the distress), Apgar score of <7 at 5 minutes, stillbirth, and admission to NICU (10).

Statistical analysis
Microsoft Excel was used to compile the data, and SPSS version 25 was used to analyze it. The necessary statistical tests (Chi-square test and *t*-test) were used to analyze the data, which were interpreted as proportions and percentages. Analysis of logistic regression has been done to compare the outcome indicators between private and public hospitals.

Ethical considerations
Approval from the IEC of KMCH, Mangaluru, was obtained before conducting the study. Detailed information about the nature, objectives, and procedures followed in the study was provided to the participants, and informed consent was obtained. The anonymity of the study participants was ensured. The participant could resign from the study at any moment and this decision had no detrimental effects on the participant's ability to continue working with the researchers or research bodies in the future. No sort of physical and/or psychological harm was done to the participants in the research. All types of communication for research were done with honesty and transparency. This research only assessed the components relevant to it.

Data availability
Data in a Microsoft Excel spreadsheet sheet is uploaded on Figshare.

Link: 10.6084/m9.figshare.23211458.

Results

Sociodemographics of the study population
Table 1 shows us that out of the 150 women who were a part of the study, 90 were admitted to LGH, and the remaining 60 were admitted to KMCH Attavar. In our study sample, a total of 73 women hailed from rural backgrounds while 77 hailed from urban centers. Eighty-nine women were homemakers (unemployed) and the remaining 61

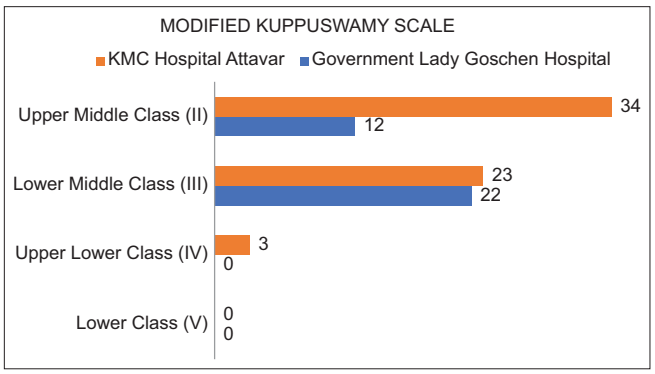

Figure 1: Socioeconomic class of the study population

were employed. Figure 1, which is a column chart on socioeconomic class, depicts that according to the Modified Kuppuswamy Scale 2021, 3 of our participants fall under the Lower Class (V), 56 of our participants fall under the Upper Lower Class (IV), 45 of our participants fall under the Lower Middle Class (III), and 46 of our participants fall under the Upper Middle Class (II).

Antenatal care indicators

To evaluate the efficacy of prenatal care, we looked at a number of criteria. Sixty women admitted to KMCH confirmed their pregnancy using a UPT, whereas 75 women confirmed their pregnancy using a UPT in LGH.

We also found out that 32 out of the 90 women admitted to LGH went for ANC check-ups at least four times during their gestation period and the rest of them went eight times or more, compared to just 3 out of the 60 women admitted to KMCH who went at least four times, and the rest went eight times or more. Figures 2 and 3 are pie charts showing the number of ANC visits done by expectant mothers in each hospital.

Table 2 shows that there is a significant association between the educational qualification of the mother and the number of antenatal check-ups taken by her.

Table 3 gives information about the tablets taken. In LGH, four women had not taken iron and folate supplementation, and 2 women had not taken calcium supplementation all were up to date on their supplementations in KMCH. At KMCH, 42 women had not taken a single dose of albendazole, and at LGH, 58 women had not taken their dose of albendazole. It was also found that nearly 83.3% of the patients who were in LGH, took two doses of TT vaccination whereas all the mothers (100%) from KMCH took both doses of TT Vaccination.

Maternal outcomes

To monitor the maternal outcomes of pregnancy, we considered the following parameters. The period of gestation of the mothers was recorded and a period of gestation less than 37 weeks was considered preterm. In LGH, 30 women had a preterm baby, while 5 women in KMC hospital had a preterm baby [Table 4].

Table 4 shows there is an association between the number of antenatal check-ups done by a mother and the period of gestation.

Table 5 shows that there is an association between abnormal weight gain during pregnancy and the period of gestation.

Figure 4 is a clustered column chart of the mode of delivery of the study population in both hospitals. Out of

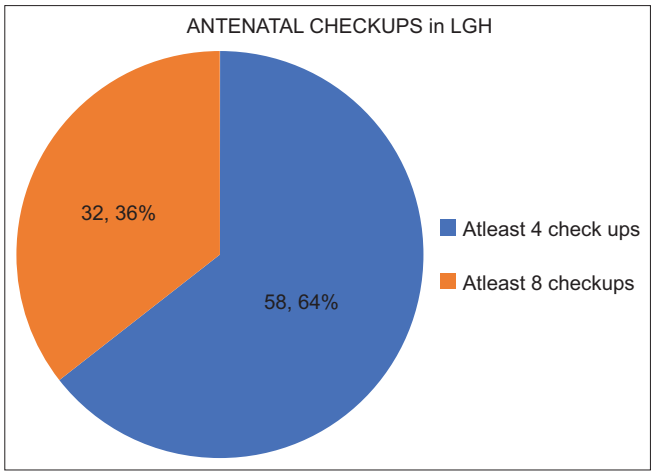

Figure 2: Pie chart of ANC visits in LGH

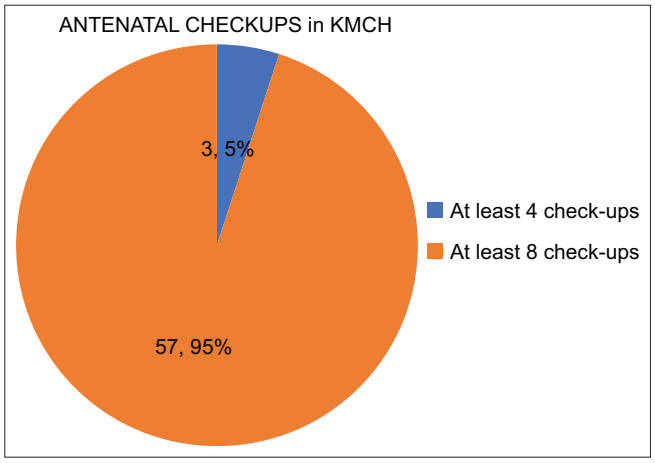

Figure 3: Pie chart of ANC visits in KMCH

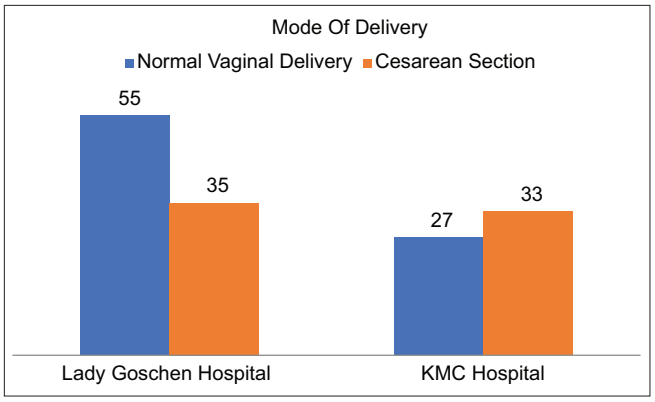

Figure 4: Clustered column chart of mode of delivery of study population in both hospitals

the 90 women admitted to LGH, 35 underwent a cesarean section and the remaining 55 gave birth by normal vaginal delivery. In KMCH, 33 underwent a cesarean section and 27 gave birth by normal vaginal delivery.

Neonatal outcomes

To assess neonatal outcomes, we considered birth

Table 1: Sociodemographics of the study population

	Lady Goshen Hospital		KMC Hospital Attavar		Total	
	Number	Percentage	Number	Percentage	Number	Percentage
Number of Participants	90	60%	60	40%	150	100
Rural	56	62.22%	17	28.33%	73	48.66%
Urban	34	37.78%	43	71.67%	77	51.34%
Employed	23	25.56%	38	63.34%	61	40.67%
Unemployed	67	74.46%	22	36.67%	89	59.33%

*Expressed as a percentage out of the cases in the respective hospitals

Table 2: ANC check-up and educational qualification of mother

	4 Antenatal Checkups	8 Antenatal Checkups	Marginal row totals	*P*
12th and below	48	38	86	<0.000012
Degree	13	51	64	
Total	61	89	150	

Table 3: IFA, calcium and albendazole tablets, TT immunisation taken by study population

	Lady Goschen Hospital		KMC Hospital	
	Number	Percentage	Number	Percentage
IFA				
Yes	86	95.56%	60	100%
No	4	4.44%	0	0%
Calcium				
Yes	88	97.78%	60	100%
No	2	2.22%	0	0%
Albendazole				
Yes	32	35.56%	18	30%
No	58	64.44%	42	70%
TT Immunisation				
2 Doses	75	83.33%	0	0%
1 Dose	13	16.67%	60	100%

Table 4: ANC check-up and term of baby

	Preterm	Term	Marginal Row Totals	*P*
4 antenatal check-ups	20	41	61	0.023433
8 antenatal check-ups	15	74	89	
Marginal columns totals	35	115	150	

Table 5: Weight gain during pregnancy and term of baby

	Preterm	Term	Marginal row totals	*P*
Abnormal weight gain	22	42	64	0.005812
Normal weight gain	13	73	86	
Totals	35	115	150	

weight as a major indicator of adequate fetal growth. In LGH, out of the 90 women, 21 gave birth to low-weight neonates and in KMCH, 7 women out of 60 gave birth to low-weight neonates. We considered neonates weighing less than 2.5 kgs as having low birth weight.[18]

Table 6 shows a Chi-square test of ANC check-ups and low birth weight. There is an association between the number of antenatal check-ups done by a mother and the low birth weight of the neonate.

Regarding NICU admission of neonates of the study population, out of the 60 births in KMCH, 8 neonates were admitted to the NICU for care and 37 out of the 90 neonates born in LGH required NICU care.

Table 7 is a Chi-square test of ANC check-up and NICU admission, as the calculated *P* value is less than 0.05; hence, there is an association between the number of antenatal check-ups taken by a mother and the NICU admission of the neonate.

Table 8 gives details about respiratory distress seen in neonates of the study population in both hospitals. Respiratory distress was seen in seven neonates in LGH and three neonates in KMCH.

Discussion

Studies that have compared ANC coverage between public and private hospitals have shown varied results. Similarly, higher rates of perinatal mortality have been demonstrated in public set-ups than in their private counterparts.

In a study by Li-Chen *et al.*, China, nearly all women (98%) got ANC services at least once, 80% did so at least four times, and 54% did so at least five times. About 46% of the women visited a prenatal care clinic in the first trimester. Some of the 16 services mentioned were provided in both the public and private sectors, but a disproportionately higher number of women underwent ANC procedures in the public sector. Only 8% of women underwent ANC in township hospitals, compared to 75% who did so at county- or higher-level hospitals. Townships saw far fewer women for HIV/AIDS testing than county- or higher-level hospitals did.[19]

Boller *et al.* conducted a study in Tanzania where the findings demonstrated that the structural and interpersonal components of treatment quality were usually good for both public and private providers.

But both lacked the technical aspects of excellence. For instance, prescription guidelines for preventative medications against malaria or anemia were infrequently followed, and diagnostic tests to detect whether a woman was pregnant or had malaria, anemia, or a urine infection were regularly disregarded. In every measure, private healthcare providers fared better than public ones.[11]

A study conducted in Mexico by Barber *et al*. showed that compared to private therapeutic settings, women underwent a considerable increase in procedures in public settings. The number of treatments carried out in private clinical settings is connected with household affluence. Medical physicians' care involves many more procedures than non-medical doctors' care. The individual, home, and societal variables that influence health-seeking behavior are not related to these differences.[20]

A prospective study conducted by N Adams *et al.* in Australia showed that the public cohort had greater perinatal mortality rates than the private cohort. After controlling for severe congenital malformations, delivery mode, and gestational age, these differences decreased by 15.7%, 20.5%, and 19.6%, respectively.[21]

Conclusion

In our study, we have attempted to assess the difference in antenatal service coverage in a public and private healthcare setup. We see that there are many services that people avail more in the private setup compared to the public setup. Some of these services include a number of antenatal visits to the hospital, routine testing, supplements, and advice from the doctors. Out of them, the number of antenatal visits is a major point of difference between these two sectors, the public setup has a minimum of four ANC visit plans that were recommended by WHO in 2002 and not the updated 2016 version, which calls for eight prenatal care visits. The number of ANC visits done appears to affect a lot of quality factors in both the mother's outcome and neonatal outcomes. The number of check-ups the mother takes is seen to affect the term of the gestation with fewer preterm seen in patients who have come for a minimum of eight ANC check-ups, a higher risk of abnormal weight gain during pregnancy is associated with patients who have had less than eight ANC visits. The number of visits a mother has to the ANC clinic is also dependent on her education. It was seen that more mothers who held a degree were more likely to go for a minimum of eight ANC check-ups compared to women who had just completed high school. The newborn is also impacted by the frequency of ANC visits. It has been observed that low birth weight and NICU hospitalization were less common in newborns born to women who had at least eight ANC visits. The mother's weight gain during pregnancy also depended on her family's socioeconomic class, as women who came from Class IV and V of the Modified Kuppuswamy Scale had a higher chance of having abnormal weight gain during pregnancy. It was seen that a maternal outcome such as maternal weight gain could affect the outcome of the neonate, as women with abnormal weight gain during pregnancy were more likely to give birth to preterm babies. Keeping the above outcomes in mind, it is of absolute importance to increase the frequency of prenatal care visits to a minimum of eight visits and improve the overall education of people on this matter.

Table 6: Association of ANC check-up and birth weight of the baby

	Low birth weight	Normal/ large birth weight	Marginal row totals	*P*
4 antenatal check-ups	17	44	61	0.046081
8 antenatal check-ups	13	76	89	
Totals	30	120	150	

Table 7: ANC check-up and NICU admission

	NICU Admission	No NICU Admission	Marginal Row Totals	*P*
4 antenatal check-ups	24	37	61	0.03868
8 antenatal check-ups	21	68	89	
Totals	45	105	150	

Limitations

- Small sample size.
- Unequal sample size collection from two hospitals due to time constraints of the study.
- Findings from the specific public and private hospitals might not apply to other healthcare settings.
- Reliance on self-reported data where records were not maintained of the specific patient.

Recommendation

- Ensure access to quality prenatal care for pregnant women, including regular check-ups and screenings.
- Establish and maintain well-equipped facilities for emergency obstetric and neonatal care, including

Table 8: Respiratory distress seen in neonates of study population in both hospitals

	Lady goschen hospital		KMC hospital	
	Number	Percentage	Number	Percentage
Respiratory distress seen	7	7.78%	3	5%
Respiratory distress absent	83	92.22%	57	95%

cesarean sections, blood transfusions, and neonatal resuscitation.
- Raise awareness about danger signs during pregnancy and in newborns to prompt timely action.
- Encourage proper nutrition for pregnant women and infants, including access to prenatal and post-natal supplements.
- Promote family planning as a means to reduce unintended pregnancies and high-risk pregnancies.

Acknowledgment
We would like to express our gratitude to the dean of KMCH, Mangalore, medical superintendent of Wenlock and Attavar Hospital for providing us with their invaluable time, and permission to conduct the study.

Ethics approval
This study has been approved by the Institution Scientific and Ethics Committee, Kasturba Medical College, Mangaluru (IEC KMC MLR 04-2022/118).

Human and animal rights
The study did not include any animals. The reported study on human subjects was conducted in conformity with the 2013 revision of the 1975 Helsinki Declaration as well as the national and institutional committees responsible for human experimentation.

Consent for publication
Each study participant provided their informed consent.

Author contribution
Rohith Motappa – conceptualization and moderating, Pratham Shetty – paper writing and analysis, and Shrivatsa Acharya – data collection.

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Nil

Conflicts of interest
There are no conflicts of interest.

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