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Research Article
Anthropometric Outcomes

Understanding The Relation Between Antenatal Care, Vaccination, and Anthropometric Outcomes in Early Childhood: A Cross-Sectional Study

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Background: One of the most sensitive measures of a country's public health measures is under-5 mortality. Under-5 mortality is affected by many factors, including socioeconomic status, antenatal care, immunizations, education, etc. Maternal education is another important factor that ensures optimal child health outcomes, which has a sustained impact into adolescence. Despite government programs and initiatives in India, there are continuing gaps in antenatal care utilization and vaccination uptake, especially in rural areas. This research will examine antenatal care factors, immunization status, and anthropometric outcomes in early childhood.

Methods: A cross-sectional study was conducted in rural areas. Data were collected from 100 mothers regarding their demographic details, antenatal care visits, and children's anthropometric measurements. Chi-square tests were used to analyze associations between demographic variables and anthropometric measures, such as weight-for-age classifications based on the Indian Academy of Pediatrics and WHO growth charts, along with mid-upper arm circumference.

Results: Maternal education was significantly associated with weight-for-age classification (p-value= 0.016, p-value= 0.015). Positive associations were also observed between immunization status and anthropometric measures (p-value 0.040). Significance was also found between the mode of delivery and anthropometric measures (p-value 0.042), which was consistent with previous studies that associated delivery type with adolescent lean body mass. The results of this study emphasize how antenatal care is an important factor in determining early childhood growth patterns.

Conclusion: The results of this study indicate a need for better utilisation of antenatal care services to improve outcomes related to growth in children. Recognizing the factors that are causing antenatal care underutilization in rural locations is a critical aspect of developing continuity of care. Improvements in maternal health services can lead to improved anthropometric measures and decreased child mortality.

Keywords: Maternal education, vaccination, under-5 children, growth charts, antenatal care, anthropometry, malnutrition

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Introduction

The under-five mortality rate is an important indicator of a country's public health system. It is a direct reflection of a country's healthcare structure, socioeconomic disparities, and sanitation. [1] It is expressed as number of children under age of 5 (59 months) dying per 1,000 live births. Even though global under-5 mortality rate has significantly decreased (93 per 1,000 live births in 1990 to 37 per 1,000 live births in 2022), it remains a major public health concern, with recent data indicating that infectious diseases like lower respiratory tract infections, diarrhea, pneumonia, malaria, etc. are major contributors to under-5 mortality rate. [2], [3] The majority of such diseases are preventable, and with improvement in public health infrastructure and sanitation, their instances can be reduced. The implementation of routine vaccination has also reduced incidence of such diseases. [4], [5] Therefore, implementation of a national immunization program could result in a significant decrease in mortality. However, despite presence of routine vaccines, presence of concomitant malnourishment can impair a person's immune responses, leading to a decrease in efficiency of vaccinations and increasing susceptibility to such diseases. [6] Therefore, prompt diagnosis and treatment of malnutrition using anthropometric measures, an inexpensive method, is essential.

Under Sustainable Development Goal 3.2, India aims to lower the under-five mortality rate from 32 per 1,000 live births to 25 per 1,000 live births. [7] The nation has started a number of national health initiatives aimed at enhancing medical facilities and offering dietary supplements in order to address these issues. Antenatal care (ANC) is the care provided to a mother during pregnancy, which includes regular checkups, immunization against tetanus, screening for infections, high blood pressure, and nutrient supplementation. To reduce the high number of maternal deaths and their fatal outcomes, the Ministry of Women and Child Development in India launched Pradhan Mantri Surakshit Matritva Abhiyan, which provides free ANC care to expecting mothers on the ninth of each month. Regular antenatal check-ups have been known to decrease low birth weight in infants; however, there is a significant lack of literature that studies the association between ANC care and the health outcomes in children under five. [8], [9]

To understand the long-term benefits of antenatal care on malnutrition in children under five years, we are conducting this research to assess its impact on growth, immunity, and overall health outcomes.

Material And Method

Study Design:

This multicentric, cross-sectional study was started after receiving approval from the institute's ethics committee. Using random selection, five states were selected from 28 states and 8 union territories in India. With the assistance of medical students currently enrolled in a medical college in those states, we collected data from 130 mothers and children under the age of five from rural areas. After applying the inclusion criteria, 100 responses were chosen.

Inclusion and Exclusion Criteria:

This study strictly adhered to the inclusion criteria, enrolling children under the age of five (59 months). Children with medical conditions that could affect their anthropometric measurements, such as ascites, limb deformities, etc., and those who did not consent to have their measurements taken were excluded.

Ethical Considerations:

The study began after obtaining ethical clearance from the hospital's ethics committee.

Research Instruments:

To obtain a thorough assessment of the demographic, ANC, immunization, and anthropometric details, we devised a questionnaire that was administered to the mother.

1. Demography: Details regarding the age and sex of the child, caste, religion, and schooling received were obtained from the mother.

2. ANC care received: Details regarding the type and place of delivery, intrapartum and postpartum complications, immunization against tetanus, and the gap between two pregnancies were recorded.

3. Immunization: The immunization history of the mother and child was taken verbatim from the Mamta card, which is an identity card made for the mother and children used to record their health information.

4. Anthropometry: Measurements, including height, head, and chest circumference, were recorded using an inch tape. A digital scale was used to measure weight. The collected data were then mapped onto the growth chart from the Indian Academy of Pediatrics to calculate the weight-for-age. Children below -3 SD were classified as severely underweight, those between -2 SD and -3 SD as mildly to moderately underweight, those between -2 SD and +2 SD as normal, and those above +2 SD as overweight. To calculate the weight-for-age according to the WHO standards, we used the WHO Anthro Survey Analyser: Software for analyzing survey anthropometric data for children under 5 years of age. Built-in software edition. Version 1.0. Geneva, World Health Organization, 2018.

The mid-upper arm circumference was recorded using Shakir's tape. A circumference above 12.5 cm was classified as normal, between 12.5 cm and 11.5 cm as moderate malnutrition, and below 11.5 cm as severe malnutrition.

Statistical Analysis

After the data was organized in Microsoft Excel 2019, it was then analyzed in IBM SPSS version 26 (trial version). To assess the association between antenatal care received and the anthropometric outcomes, and to evaluate the impact of vaccine coverage on the growth and nutritional status of children under five, the chi-square test was used. To explore the potential interactions between antenatal care and vaccination on childhood anthropometric measures, regression analysis was performed, with significance determined by a p-value of less than 0.05.

Result

Demographic details and procedures

The data were manually collected from rural areas by the researchers. The children's data were obtained from their mothers, who provided demographic details in the case record form, including age, caste, sex, religion, and the mother's level of schooling, as shown in Table 1. To determine the association between these demographic variables and weight-for-age anthropometric measures (according to the Indian Academy of Pediatrics and WHO standards) as well as mid-upper arm circumference, we used the Chi-square test.

Significant associations were found between the mother's level of schooling and the weight-for-age classification using both the Indian Academy of Pediatrics (p-value = 0.016) and the WHO classification (p-value = 0.015).

Table 1: The demographic details of children under the age of five are presented in a tabular format (N=100)

Demographic characteristics	Number	P-value(IAP classification)	P-value(WHO classification)	MUAC
Age	32.62 ± 1.90 months			
Caste				
SC	30			
ST	10			
OBC	35	0.065	0.373	0.218
General	20			
Other	5			
Sex				
Male	62	0.196	0.280	0.578
Female	38			
Religion				
Hindu	73			
Muslim	24	0.941	0.114	0.507
Christian	3			
Schooling of the mother				
Till 5th	13			
Till 10th	36			
Till 12th	18			
Holds a bachelor's degree	8	0.016	0.015	0.908
Holds a master's (or above)	6			
Uneducated	19			

**Significance was found between the schooling of the mother and the Weight for age measure according to both IAP and WHO classification*

Weight-for-age Anthropometric measure and Immunization status

Using the anthropometric data (height, weight, and age), we calculated weight-for-age according to the Growth Chart used by the Indian Academy of Pediatrics and weight-for-age Z-score according to the WHO standards using the WHO Anthro software. We compared these with the vaccination status. A child who received BCG, OPV, DPT, and Measles before age of one was classified as fully immunized.

Any child aged one but who did not receive all four vaccines (BCG, OPV, DPT, and Measles) before the age of one was referred to as partially immunized. Those who did not receive any vaccine were classified as never vaccinated. To find the association between these parameters, we used the Chi-square test. A significant association was found between the WHO weight-for-age Z-score classification and the vaccination status of children under five (p-value = 0.040). The data is presented in Table 2.

Table 2: The Weight-for-age anthropometric measures and immunisation status in tabular format

(Significance <0.05)

Variable		Status		P-value	P-value	MUAC
	Fully vaccinated	Partially vaccinated	Never Vaccinated	(IAP classification)	(WHO classification)	
Severely underweight	7	6	1			
Overweight	2	0	0	0.080	0.040	0.256
Normal weight	36	35	0			
Mild to Moderate underweight	11	3	0			

*Significance was found between immunisation status and WHO classification for WAZ (weight-for-age Z score)

Antenatal care details and Anthropometric measures

To find the association between the antenatal care a mother receives during the nine months of pregnancy and its long-term benefits seen in children under five, we used the ANC details and compared them with the anthropometric variables (weight-for-age and mid-upper arm circumference) using the Chi-square test. We found significant associations between the type of birth and mid-upper arm circumference (p-value = 0.038) and between delivery method and mid-upper arm circumference (p-value = 0.004). The data are presented in Table 3.

*Significance was found between the type of birth and mid-upper arm circumference (p-value = 0.038), as well as between delivery method and mid-upper arm circumference (p-value = 0.004).

Table 3: Associations between Antenatal care and the anthropometric measures using Chi-square test (significance <0.05)

Antenatal Care Details	Number	P-value(IAP classification)	P-value(WHO classification)	MUAC
Place of birth				
Institutional	94	0.807	0.618	0.834
Home	6			
Type of birth				
Vaginal birth	67	0.054	0.042	0.038
Caesarian section	33			
Antenatal care received				
Yes	89	0.289	0.39	0.584
No	11			
Delivery				
At-term	94	0.379	0.749	0.004
Pre-term	6			
Intrauterine complications				
Yes	14	0.863	0.791	0.186
No	86			
Immunization against tetanus				
Yes	90	0.344	0.468	0.617
No	10			
Was the immunization against tetanus complete?				
Yes	23	0.186	0.465	0.186
No	77			

Immunisation details and Anthropometric measures

Table 4: The association between Immunization details and the Anthropometric measures (significance <0.05)

Immunization Details	Number	P-value(IAP classification)	P-value(WHO classification)	MUAC
Distance to the Primary health care facility				
<1 km	45			
1-2 km	30	0.731	0.723	0.472
>2 km	25			
Place of immunization				
Hospital	36			
Anganwadi	60	0.107	0.478	0.955
Home	3			
Not immunized	1			
Does the mother follow the MAMTA card?				
Yes	86	0.618	0.954	0.726
No	14			
Do the parents have to pay a fee for the immunization?				
Yes	93	0.368	0.985	0.459
No	7			

We compared the immunization details of the child while also considering other variables, such as the distance to a primary health care facility, with the anthropometric variables using the Chi-square test. However, no significant association was found. The data are presented in Table 4.

Discussion

This study aimed to find an association between various factors of antenatal care and immunization in both the mother and child, and to study the long-term effects on anthropometric measures for children under five years of age. The goal was to understand the benefits of timely antenatal care and immunization while also considering several other demographic factors, such as the mother's level of schooling, place and type of delivery, distance to the nearest primary health care centre, and fees paid for vaccination. We used these variables to gain a better understanding of all the factors that may affect a child's anthropometric measures, thereby contributing to under-five mortality.

When we compared the demographic characteristics with the anthropometric measures, we found a significant association between the schooling of the mother and both IAP and WHO standard weight-for-age distribution, proving that maternal education can impact the nutritional status of a child. The education of a mother significantly contributes to the nourishment of a child. [10] The justification is that a mother who is educated about the basics of nutrition is more likely to feed her child a balanced meal. In a study conducted in the United States, it was found that, along with maternal education, other factors such as race and socioeconomic conditions also affect the birth weight of an infant. [11] In another study conducted in China, it was found that even in an environment rich in quality food, low maternal education led to poor nutrition in school-going children. [12] Low maternal education has also been linked to lower levels of cognition in adults. [13] The more educated a mother is, the more diverse approaches she will be able to take to protect her child, such as nutrient supplementation and maintenance of proper sanitation. [14] Along with corroborating our findings, these studies highlight the importance of secondary factors, such as maternal education, in preventing malnutrition in children and, in turn, preventing them from preventable diseases, which are the largest contributors to under-5 mortality. 2

In our study, we found a significant association between anthropometric variables and immunization status, highlighting the important role immunization plays in decreasing the risk of malnutrition. [15] Vaccination is one of the most effective tools in reducing under-5 mortality, particularly when administered early in infancy, preferably during the first year, as it can be highly effective [16]. However, if given after malnutrition has set in, their effectiveness diminishes, offering little protection against infections. Therefore, the early mobilization of resources is essential, especially in areas with higher rates of malnutrition. While comparing antenatal care factors and anthropometric measures, we established that the type of delivery was associated with anthropometric outcomes. Previous studies have documented that the mode of delivery significantly impacts the body mass index of adolescents. [17]

Several studies have shown that undernutrition in mothers is associated with low birth weight in infants, which makes them susceptible to several diseases in their adult life. [18], [19] This underlines the importance of antenatal care in enhancing a child's health. Pregnancy-related malnutrition can also impact fetal development by altering the distribution of fat, which can ultimately lead to the emergence of numerous adult-onset diseases. Despite the presence of several government schemes, there are still gaps in implementation. In the NFHS-5 survey, it was found that only 58% of pregnant women in India obtain at least four prenatal care visits. [20] Even though maternal care in India has improved since the last survey (NFHS-4), there is still much work to be done to ensure good-quality maternal care. Our study emphasises the effect of antenatal care on the anthropometric outcomes of children, making it crucial to investigate the reasons behind the underutilization of antenatal care in rural regions. Because of the lasting impact on body composition and susceptibility to chronic diseases, it is crucial to take into account both maternal health and prenatal care aspects when analyzing the long-term health outcomes of children.

Conclusion

This study aimed to highlight the importance of factors such as antenatal care, maternal education, and immunization in the health outcomes of children under 5 years.

According to our study, factors such as maternal education, vaccination, and schooling of the mother influenced long-term anthropometric outcomes in children under 5 years. Additionally, we also noticed a significant association between the type of birth (caesarean section and vaginal delivery) and the anthropometric outcomes. Inadequacy in providing antenatal care and routine vaccination can increase the risk of diseases in a child. Target interventions at these stages can thus reduce under-5 mortality.

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References

1. Pillai KR, Christina I. Causes of under-5 mortality among Brazil, the Russian Federation, India, China, and South Africa nations: a comparative study. Value in Health Regional Issues. 2020 May 1;21:238-44. *[Crossref][PubMed][Google Scholar]*

2. WHO. Child mortality (under 5 years). Fact Sheets. 2022;37:20-3. *[Crossref][PubMed][Google Scholar]*

3. Perin J, Mulick A, Yeung D, Villavicencio F, Lopez G, Strong KL, Prieto-Merino D, Cousens S, Black RE, Liu L. Global, regional, and national causes of under-5 mortality in 2000–19: an updated systematic analysis with implications for the Sustainable Development Goals. The Lancet Child & Adolescent Health. 2022 Feb 1;6(2):106-15. *[Crossref][PubMed][Google Scholar]*

4. Mechita NB, Obtel M, Elmarnissi A, Lahlou L, Lyaghfouri A, Cherkaoui I, Mrabet M, Razine R, Abouqal R. Decline in childhood respiratory-related mortality after the introduction of the pneumococcal conjugate vaccine in Morocco. Journal of Infection and Public Health. 2020 Mar 1;13(3):402-6. *[Crossref][PubMed][Google Scholar]*

5. Deichsel EL, Powell H, Troeger C, Hossain MJ, Sow SO, Omore R, Jasseh M, Onwuchekwa U, Obor D, Sanogo D, Jones JC. Drivers of Decline in Diarrhea Mortality Between GEMS and VIDA Studies. Clinical Infectious Diseases. 2023 Apr 1;76(Supplement_1):S58-65. *[Crossref][PubMed][Google Scholar]*

6. Rytter MJ, Kolte L, Briend A, Friis H, Christensen VB. The immune system in children with malnutrition—a systematic review. PloS one. 2014 Aug 25;9(8):e105017. *[Crossref][PubMed][Google Scholar]*

7. Office of the Registrar General & Census Commissioner, India (ORGI). Sample Registration System (SRS)-Bulletin,2020 VOLUME 55-I India, 2022. Available from: https://censusindia. gov. *in/nada/index.php/catalog/42687 [Last accessed 2025 Feb 7] [Crossref][PubMed][Google Scholar]*

8. 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 Nov 1;7(11):e017122. *[Crossref][PubMed][Google Scholar]*

9. Bountogo M, Sié A, Zakané A, Compaoré G, Ouédraogo T, Lebas E, Brogdon J, Nyatigo F, Arnold BF, Lietman TM, Oldenburg CE. Antenatal care attendance and risk of low birthweight in Burkina Faso: a cross-sectional study. BMC pregnancy and childbirth. 2021 Dec 13;21(1):825. *[Crossref][PubMed][Google Scholar]*

10. Laksono AD, Wulandari RD, Amaliah N, Wisnuwardani RW. Stunting among children under two years in Indonesia: Does maternal education matter?. Plos one. 2022 Jul 25;17(7):e0271509. *[Crossref][PubMed][Google Scholar]*

11. Pollock EA, Gennuso KP, Givens ML, Kindig D. Trends in infants born at low birthweight and disparities by maternal race and education from 2003 to 2018 in the United States. BMC Public Health. 2021 Jun 10;21(1):1117. *[Crossref][PubMed][Google Scholar]*

12. Wang C, Kane RL, Xu D, Li L, Guan W, Li H, Meng Q. Maternal education and micro-geographic disparities in nutritional status among school-aged children in rural northwestern China. PloS one. 2013 Dec 10;8(12):e82500. *[Crossref][PubMed][Google Scholar]*

13. Araújo LF, Giatti L, Chor D, Passos VM, Barreto SM. Maternal education, anthropometric markers of malnutrition and cognitive function (ELSA-Brasil). BMC Public Health. 2014 Jul 2;14(1):673. *[Crossref][PubMed][Google Scholar]*

14. Vikram K, Vanneman R. Maternal education and the multidimensionality of child health outcomes in India. Journal of biosocial science. 2020 Jan;52(1):57-77. *[Crossref][PubMed][Google Scholar]*

15. Nandi A, Deolalikar AB, Bloom DE, Laxminarayan R. Haemophilus influenzae type b vaccination and anthropometric, cognitive, and schooling outcomes among Indian children. Annals of the New York Academy of Sciences. 2019 Aug;1449(1):70-82. *[Crossref][PubMed][Google Scholar]*

16. Nandi A, Shet A, Behrman JR, Black MM, Bloom DE, Laxminarayan R. Anthropometric, cognitive, and schooling benefits of measles vaccination: Longitudinal cohort analysis in Ethiopia, India, and Vietnam. Vaccine. 2019 Jul 18;37(31):4336-43. *[Crossref][PubMed][Google Scholar]*

17. Mínguez-Alarcón L, Rifas-Shiman SL, Sordillo JE, Aris IM, Wu AJ, Hivert MF, Oken E, Chavarro JE. Association of mode of obstetric delivery with child and adolescent body composition. JAMA Network Open. 2021 Oct 1;4(10):e2125161-. *[Crossref] [PubMed][Google Scholar]*

18. Pandit P, Galande S, Iris F. Maternal malnutrition and anaemia in India: dysregulations leading to the 'thin-fat'phenotype in newborns. Journal of Nutritional Science. 2021 Jan;10:e91. *[Crossref] [PubMed][Google Scholar]*

19. Nakano Y. Adult-onset diseases in low birth weight infants: association with adipose tissue maldevelopment. Journal of atherosclerosis and thrombosis. 2020 May 1;27(5):397-405. *[Crossref] [PubMed][Google Scholar]*

20. Ministry of Health and Family Welfare Government of India. Maternal health, National Health Mission. Available from: https://nhm. gov. *in/index1.php? lang=1&level=2&sublinkid=822&lid=218 [Last accessed on 2025 Feb 5] [Crossref][PubMed] [Google Scholar]*