

Study on Weaning Practices and Morbidity Status of Infants

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ABSTRACT

Introduction: Weaning is essential for an infant's growth and development. Faulty weaning practices have harmful effects on health and may lead to infant morbidity.

Objective: The recent study aimed to assess infants' weaning practice and morbidity status.

Methods: The present study was conducted in clinics of Muzaffarpur for infants' morbidity status and weaning practices. Data were collected with the predeveloped questionnaire, and statistical analysis was performed using SPSS version 20.

Result and conclusion: The study's findings reveal that 91% of infant mothers know about the weaning food, while 9% of mothers did not know about the weaning foods. A total of 50% of mothers opted for weaning after 6 months of age, 40% initiated weaning at the recommended age of 6 months, 6.7% started delayed weaning, and 3.3% opted for weaning before 4 months, respectively. Mostly preferred weaning food was dal (49%), followed by Cerelac (26.3%), biscuit with milk (13.6%), and banana shake (11.1%), respectively. The highest morbidity was fever with cold (56.7%), followed by diarrhea (22.8%), vomiting (8.7%), ear infection (6.8%), and other (5%), respectively. A significant correlation was found between infants' morbidity and weaning practices ($p < 0.05$). The highest morbidity was found in those who initiated weaning after 6 months of age. So, it can be concluded that erroneous weaning practices lead to increased morbidity in infants, and weaning should be initiated at 6 months of age to prevent infant morbidity.

Keywords: Morbidity, Weaning food, Weaning practices.

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INTRODUCTION

Weaning practices involve introducing semisolid or solid foods alongside breastfeeding or formula milk to infants, emphasizing the crucial role of proper nutrition during this phase for optimal growth and development.¹ Ensuring an appropriate diet is crucial for fostering the growth and development of infants, particularly during the critical first 2 years of life.² Weaning is a complex process of the gradual introduction of complementary foods to the infant's diet. Solid food is recommended to be introduced between 6 and 12 months of age.³ Weaning is the process of transition from breastfeeding to a semisolid diet for the infant. A reduction in breast milk consumption and the protection it provides during gastrointestinal infection can increase the risk of illness due to diarrhea in children during weaning. Exclusive breastfeeding (EBF) and timely complementary feeds are far from desirable. This takes a heavy toll on their health and increases their susceptibility to develop several morbidities, including diarrhea and respiratory tract infections.⁴ Poor quality of weaning foods and improper weaning practices predispose infants to malnutrition, growth retardation, infection, diseases, and high mortality.⁵ During pregnancy, EBF and appropriate weaning good nutrition can be achieved through proper maternal nutrition.⁶ The correct initiation age of weaning food plays an important role in infant health and early introduction of complementary feeds before the age of 6 months can lead to the displacement of breast milk and increased risk of infections, as the infants are physiologically immature. Moreover, inadequate, inappropriate complementary feeding, or unhygienic practices lead to recurrent and persistent infections and malnutrition that end in growth retardation, immunodeficiency, and eventually fatal outcomes. Keeping the above factors in mind, the present

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study aimed to assess the weaning practice and morbidity status of infants.

METHODS

A present study was conducted on infants (0–3 years) of the Muzaffarpur district of Bihar. The study was conducted in different health clinics and hospitals near Muzaffarpur. A total of 30 infants who visited the clinic for treatment were randomly selected for the study to assess the weaning practice and morbidity in infants. Assessment of the health status of infants was conducted with anthropometric measurement of weight, length, and weight for age as critical indicators of nutritional status and growth. Data were related to morbidity status like the incidences of common illnesses like fever, respiratory infections, and diarrhea, and detailed information on the weaning practices of infants were collected with the predeveloped structured questionnaire. Statistical analysis of data was performed with the help of SPSS version 20.

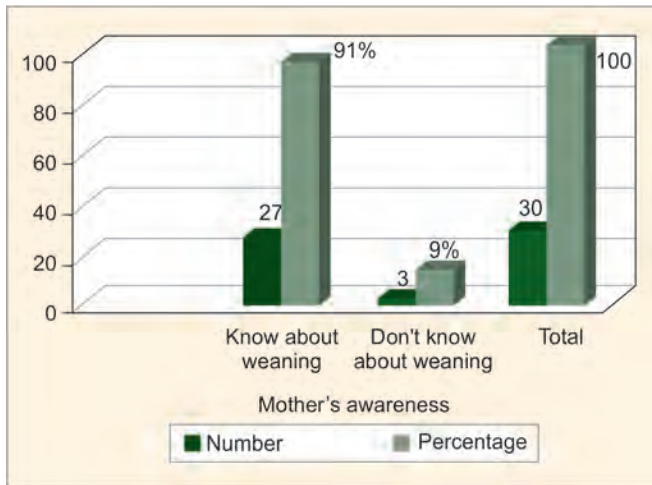


Fig. 1: Distribution of mother's awareness regarding weaning

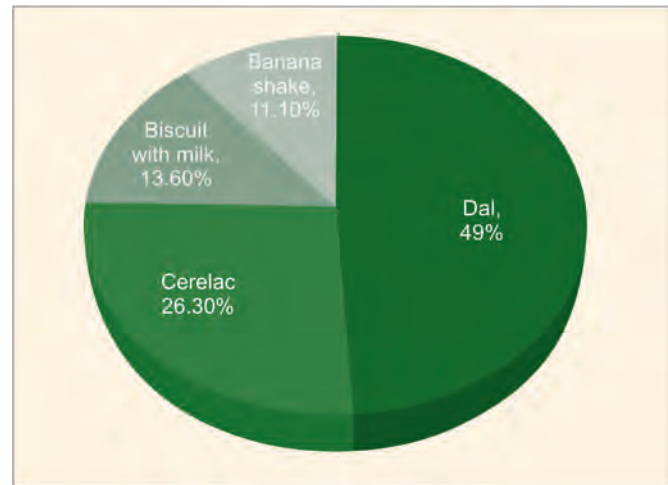


Fig. 2: Preferred weaning foods by mothers

Table 1: Initiation of weaning age

Sl. No.	Age of initiating weaning	Number	Percentage
1	Before 4 months	1	3.3%
2	At 6 months	12	40%
3	After 6 months	15	50%
4	Delayed weaning	2	6.7%
5	Total	30	100

RESULT

Figure 1 shows that 91% of mothers know about weaning. Merely 9% of mothers lack knowledge regarding weaning.

In terms of the timing of weaning, the study reveals diverse practices among mothers demonstrated in Table 1. Findings revealed that half of the mothers (50%) opted for weaning after the recommended age of 6 months, while 40% of mothers were initiated weaning at the recommended age which aligns with global guidelines from WHO and UNICEF.

Figure 2 shows that 49% of mothers preferred dal, while 26.30% of mothers preferred Cerelac, and 13.60% preferred biscuits with milk as weaning food for their infant. Only 11.10% of mothers preferred banana shake as weaning food.

In terms of infant morbidity, fever with cold was the most prevalent issue, affecting 56.7% of infants. Other common health concerns include diarrhea (22.8%), vomiting (8.7%), ear infection (6.8%), and other unspecified conditions (5%) as illustrated in Figure 3.

The correlation analysis conducted in the study reveals a significant association between infant morbidity and weaning practices ($p < 0.05$). The result indicates that poor weaning practices are associated with higher rates of illness among infants (Table 2). Weaning practices have a significant impact on an infant's health and morbidity status.

DISCUSSION

Lack of knowledge might be due to the mother's education, their prior experiences, and the advice of the elders of the family. Weaning is a crucial phase in an infant's life as it marks the transition from EBF to introducing complementary foods for healthy

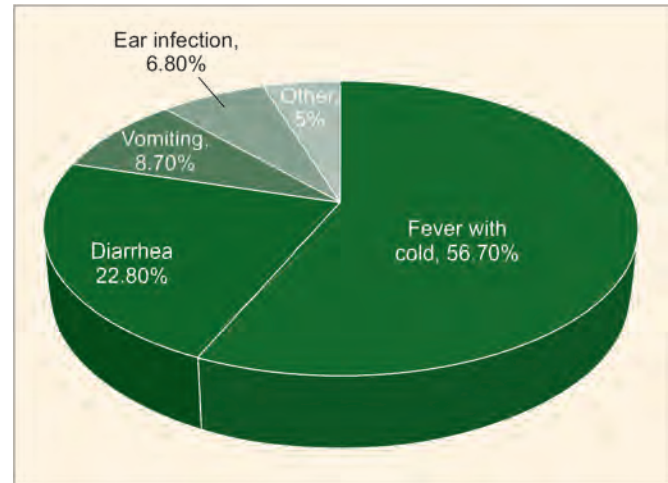


Fig. 3: Percentage of morbidities among infants

Table 2: Correlation between infant morbidity and weaning practices

Variables	Morbidity	Age of initiating weaning
Morbidity		
Pearson correlation	1	0.405*
Sig. (one-tailed)		0.013
N	30	30
Age of initiating weaning		
Pearson correlation	0.405*	1
Sig. (one-tailed)	0.013	
N	30	30

*Correlation is significant at the 0.05 level (2-tailed)

development and growth. Initiating the weaning process at the appropriate time is vital as it allows infants to receive the necessary nutrients from breast milk during the initial 6 months of life.^{7,8} These results are also in accordance with the study.⁹⁻¹¹ Moreover, 6.7% of mothers initiated delayed weaning, while 3.3% opted for weaning before the recommended 4 months of age. Early introduction of complementary foods before four months may not align with the

infant's developmental readiness and nutritional needs, posing potential health risks.^{7,12} Delayed weaning could also affect the infant's nutritional status, making them susceptible to health issues. A study was conducted by Manisha and Khan,¹³ wherein 50% of mothers preferred dal water, followed by khichari (30%). The presence of various infant morbidities provides significant insight into the health challenges faced by infants. Reduced immunity and exposure to various pathogens make them vulnerable to infections and illnesses that may cause an increased incidence of fever and cold among infants. Faulty feeding practices, sensitivity to changes in feeding patterns, an immature digestive system, and gastrointestinal infections contribute to the incidence of vomiting and diarrhea. Additionally, inadequate sanitation and hygiene standards may be linked to increased rates of diarrhea. The present result also on the importance of monitoring and addressing ear health, given the potential for complications such as hearing loss if left untreated.

The highest morbidity rates were found in infants whose weaning was initiated after 6 months of age. The mother's knowledge levels were also related to how they perceived the weaning age and the nutritional content of the weaning food. These results also suggested the potential link between delayed weaning and increased susceptibility to health issues, emphasizing the importance of timely introducing complementary foods, infant's age at weaning, and the kinds of supplementary foods that are given at that time are the main factors that influence the infant's morbidities.^{14,15} The quality of the supplemental food is crucial, as evidenced by the findings of a previous study, food contamination puts infants at risk for gastrointestinal infections.^{16,17} By addressing weaning feed-related factors such as timing, types of foods introduced, and adherence to recommended guidelines, healthcare professionals may potentially mitigate the incidence of common infant morbidities and health concerns. Moreover, these results emphasize the need for continued research and surveillance to elucidate the mechanisms underlying the association between weaning practices and infant morbidity, ultimately contributing to improved infant health outcomes.

CONCLUSION AND RECOMMENDATIONS

The study emphasizes the critical role of weaning practices in shaping infant health outcomes. Variations in weaning practices, such as timing and types of foods introduced, may impact the prevalence or severity of infant morbidity and the vital importance of specific treatments to overcome the mother's ignorance of foods for weaning. Additionally, because delayed weaning is linked to a higher risk of health problems, raising awareness of the importance of starting weaning at the appropriate age is essential to reducing infant morbidity. The results of the present study provide significant perspectives for healthcare practitioners, legislators, and community educators to devise approaches that promote the best weaning habits, thereby improving the health of infants. By recognizing the relationship between weaning practices and infant health, targeted interventions can be developed to promote optimal feeding practices and reduce the risk of common infant health concerns. Overall, it is important to address the relationship between weaning habits and morbidities to protect infants' health and well-being at this crucial developmental stage.

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The Usefulness of Telemedicine for the Elderly in Rural India: A Study from Jharkhand

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ABSTRACT

India's aging population faces numerous healthcare challenges in resource-deficient rural areas. Superimposed with ruralization of the elderly, income instability, social isolation, and logistical difficulties, equitable healthcare is difficult to access. The government's e-Sanjeevani Ayushman Bharat Health and Wellness Centres (AB-HWCs) telemedicine model can address these challenges. This study aimed at understanding the usefulness of e-Sanjeevani telemedicine services for the rural elderly individuals in Jharkhand. In-depth interviews and non-participant observations were conducted with 21 elderly patients, three community health officers (CHO), two medical officers in-charge (MOIC), and one ASHA worker. Thematic analysis was performed to arrive at results. Three broad themes were identified: Participants' experiences with telemedicine, the advantages of telemedicine, and persisting challenges. The benefits included increased access, continuum of care, and optimized patient flows. Barriers such as connectivity issues, reticence from doctors and logistical hurdles hindered implementation. Notwithstanding the challenges, e-Sanjeevani has the potential to ensure equitable healthcare access for elderly individuals in rural India.

Keywords: Aging population, Elderly care, e-Sanjeevani, Telemedicine, Rural healthcare accessibility.

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INTRODUCTION

The challenges of population aging, compounded by factors such as the ruralization of the elderly, income instability, social isolation, out-migration of youngsters, and a preference for aging in place,¹ exacerbate healthcare disparities like the shortage of doctors, logistical challenges, and the burden of travel to seek healthcare.¹⁻³ By 2036, senior citizens will constitute approximately 14.9% of the population, with projections indicating a rise to 20.8% by 2050.^{4,5} Therefore, it becomes essential to address the issue of equitable healthcare access for the elderly, especially those with chronic illnesses or living by themselves.⁶⁻⁸ Telemedicine, defined as the provision of healthcare services remotely through information and communication technologies, has been explored as a healthcare delivery tool for over two decades in India and has resurged as an efficient alternative to physical consultations during the COVID-19 pandemic, especially for those with chronic illnesses.⁹⁻¹⁵ It has encountered numerous challenges, ranging from issues of perception and acceptance to complex implementation obstacles, as evidenced in previous studies.^{16,17} This paper argues that the Indian government's Ayushman Bharat Health and Wellness Centres (AB-HWCs) model of e-Sanjeevani—India's National Telemedicine Service—can be a potent tool to overcome healthcare service challenges for older people—a population that needs constant care but may not require as frequent consultations.^{18,19}

Our study aims to understand the usefulness of e-Sanjeevani Telemedicine services in elderly population of rural Jharkhand, with the specific objectives being (i) to document the experience of (1) the elderly patients availing Telemedicine services, (2) the persons providing the Telemedicine services to the elderly patients, (ii) to understand the benefits of Telemedicine as perceived by the patients and providers, and (iii) to identify the challenges in using Telemedicine services. The findings may promote wider Telemedicine adoption.

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METHODOLOGY

Subjects

The study included two groups: (1) individuals aged over 60 who had availed telemedicine services at least once in the past year, and (2) healthcare providers, such as doctors and health workers, who were involved in providing the telemedicine services. To ensure a diverse and rich dataset, participants were purposively recruited until thematic saturation was achieved through an iterative process. Of the 31 participants initially recruited, 4 were excluded after verifying with community health officers (CHOs) that they had misreported their age. Exclusion based on erroneous self-reported age was necessary for age-related analyses. A comparison of excluded and included participants showed minimal differences,

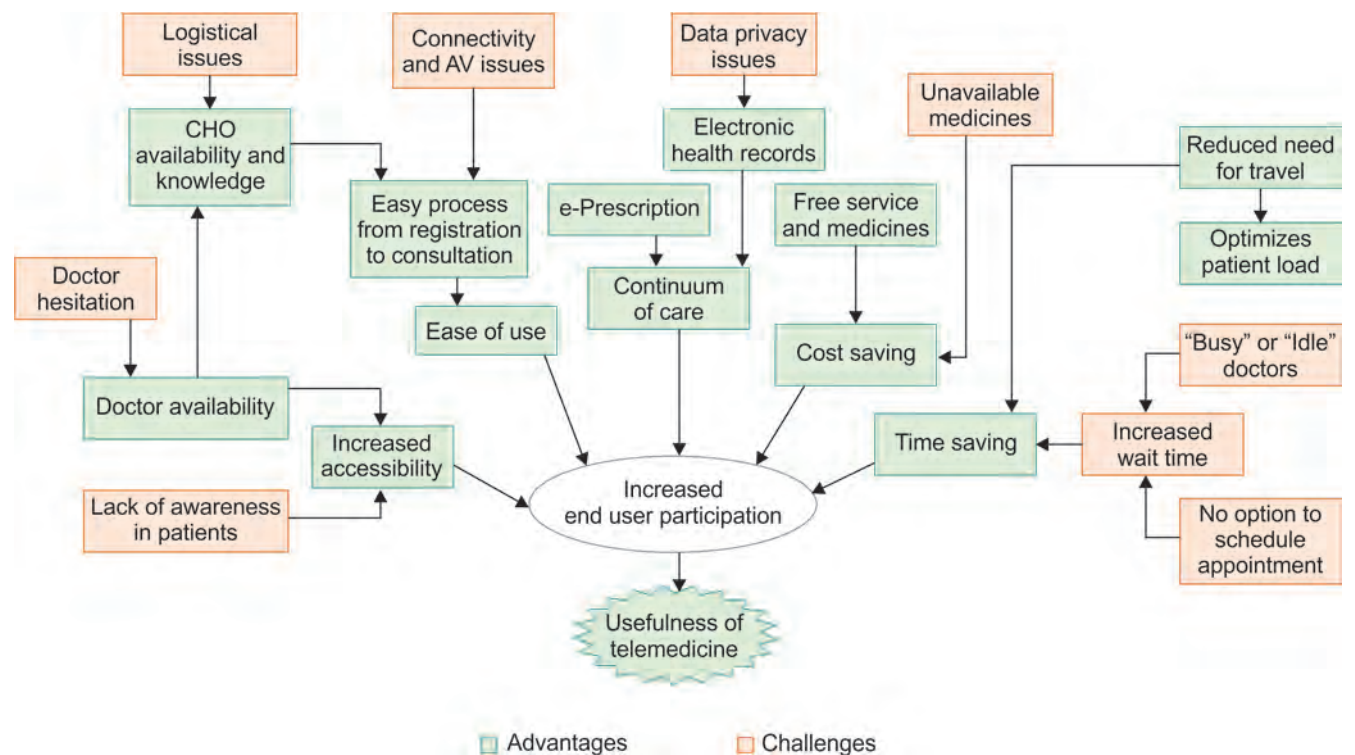


Fig. 1: Thematic framework depicting the factors affecting the usefulness of Telemedicine based on the data analysis

suggesting limited bias. This limitation is noted in the discussion to ensure transparency. The final sample size was 27.

Data Collection

In-depth interviews (IDIs) and non-participant observations were used to collect data from June to November 2023. In-depth interviews were conducted with patients ($n = 21$), CHOs ($n = 3$), medical officers in-charge (MOIC) ($n = 2$), and a *sahiya* ($n = 1$). Interviews took place face-to-face at ABHWCs ($n = 15$), CHCs ($n = 6$), and villages ($n = 6$), lasting 15–45 minutes. The interviews were conducted in English and Hindi, and the health workers' assistance was sought to ensure an accurate understanding while interviewing the Sadri-speaking patients.

The interview guide included questions about experiences with telemedicine, perceived benefits and challenges, and suggestions for improving telemedicine services. Three interviews were audio-recorded with the participant's consent and transcribed verbatim. For those not consenting to recording ($n = 24$), extensive notes were taken and later translated into English. One CHO was re-interviewed for additional insights. The non-participant observations allowed us to understand behaviors, interactions, and environmental factors that might not have been explicitly discussed by participants. They helped pick up non-verbal cues that enriched our interpretation of the interview data.

Ethical Considerations

The study followed the Institutional Review Board guidelines of the Tata Institute of Social Sciences, Mumbai, adhering to the principles outlined in the 1964 Declaration of Helsinki and its subsequent revisions. Ethical approval was not sought specifically for the analysis, as this discussion did not pose a significant risk of harm or disturbance to potential respondents. All participants were

informed about the study's purpose, their voluntary participation, anonymity, the confidentiality of their responses, and their right to withdraw from the study at any time without any consequences. Written informed consent was obtained from all the providers, while verbal consent was sought from the elderly participants. The audio recordings were saved on a password-protected device. All identifiers were removed from the transcripts and notes. To ensure anonymity, the participants had a unique ID number, known only to the primary researcher. The audio tapes were destroyed once the transcripts were translated and cross-referenced.

Data Analysis

Thematic analysis was employed to analyze the interview transcripts using a grounded theory approach. Initially, the transcripts were thoroughly examined to familiarize the researchers with the data and to formulate preliminary themes. Codes were generated manually, and inter-coder reliability was ensured through discussions between the authors to resolve discrepancies. Based on the themes, a thematic framework was developed after the analysis to interpret the data and identify factors affecting the usefulness of Telemedicine for the elderly population in rural areas (Fig. 1).

Findings

The study included 21 elderly participants from rural Jharkhand (ages 60–85; male: 10, female: 11) with varied education levels (no formal education: $n = 10$; primary to matriculation: $n = 11$) and occupations (agriculture: $n = 10$, unemployed: $n = 11$). [Table 1](#) outlines their illnesses. Six healthcare providers, including CHOs, MOICs, and a *sahiya*, were also interviewed for insights on telemedicine implementation.

The thematic analysis identified three broad themes: (1) participants' experience with Telemedicine, (2) advantages of

Table 1: Frequency table of the nature of illnesses of patients

Sl. No.	Nature of illness	Frequency	Percentage (%)
1.	Hypertension	8	23
2.	Diabetes	5	14
3.	Swelling in legs	1	3
4.	Joint pain	3	8
5.	Chronic backache	1	3
6.	Weakness	6	17
7.	Regular vaginal bleeding	1	3
8.	Breathing difficulty	1	3
9.	Chronic cough	1	3
10.	Chest pain	1	3
11.	Fever	2	6
12.	Numbness of hands	1	3
13.	Others	4	11
	Total* ²	35	100

*² The elderly patients often had more than one complaint or were known cases of diabetes, hypertension, and the like. Hence, all the illnesses and complaints that were reported by them were accounted for. This also ensured a wide representation of various disease conditions in the purposively selected participants

Telemedicine, and (3) persisting challenges. Together, these themes shed light on the complexities of implementing Telemedicine in a rural, resource-constrained context.

Participants' Experience with Telemedicine

The study unearthed a dichotomy between the healthcare providers and the patients regarding the understanding of Telemedicine. The CHOs, equipped with prior training, demonstrated a sound comprehension of the entire process, from patient registration to the dispensing of medications. They effectively operated the portal – albeit using their own smartphones – bridging the gap between patients and doctors despite the limited digital penetration among the elderly in rural areas. Community Health Officers reported no notable issues with registration or the consultation flow. All service providers expressed that the e-Sanjeevani enhanced their ability to perform their duties.

One CHO remarked,

“Doctors go online, time by time. We call the available doctor and when the call connects, he or she conducts the consultation with the patient in front. Later, they write everything in the system and even the prescription comes, you can see here (shows the screen). Then we give the medicine to the patients and give instructions. Patients come back when medicines get over or when we call them again for a checkup.”

— (ID 01, CHO)

Conversely, elderly patients were entirely unfamiliar with the term *e-Sanjeevani*, despite a bold insignia on the Health and Wellness Center (HWC) premise wall. While respondents claimed no knowledge of the scheme, further probing revealed that they had indeed received consultations via the platform. However, they regarded the CHOs as their treating doctors (Table 2, quote 1). This may be attributed to the fact that often, due to connectivity issues or doctors being busy or offline, the CHOs note down the

Table 2: Interview quotes about the experience of telemedicine

Sub-themes	Interview quotes (respondent code in parenthesis)
1.1 Understanding of Telemedicine services	“I don't know what it (eSanjeevani) is. I have never heard about it... (after probing and reflection) ... Yes, she made me talk to the doctor on phone... but I follow only what madam (CHO) says.” (ID18, F/60)
1.2 The nature of consultation	“When they (the doctors) are not available, we take a video or a photo, and whatever complaints they have, I write like this (shows some text on the mobile) and send to the doctor. When they reply, I tell the patient what to do and give them medicines.” (ID01, CHO)

chief complaint, take pictures or videos, and consult with the doctor when they become available. In such cases, the elderly patients may not be around when the CHOs talk to the doctors (Table 2, quote 2).

Advantages of Telemedicine

Our study found that the eSanjeevani AB-HWCs model of telemedicine offered numerous advantages in the context of rural healthcare. By leveraging technology, patients in remote villages gain access to a pool of healthcare professionals located at higher-tier healthcare facilities. The expanded reach ensures timely consultations and facilitates the delivery of specialized care and follow-ups, reducing the burden of transportation costs and physical strain. It was particularly impactful for patients with mobility issues.

“In my opinion, its biggest advantage is that we can operate and use the portal anywhere. When we go to the village for vaccination drives or any awareness program, many elderly patients benefit. Because they have difficulty in coming to the health center. Through eSanjeevani, we can make them talk to the doctor right from the comfort of their homes. Having such a facility in a village is a big deal.”

—ID 26 (Village *sahiya*)

The platform also ensured a continuum of care, as the EHRs allowed CHOs to track patient history seamlessly, even when elderly patients struggled to articulate their medical history. It also helps optimize patient load at facilities by streamlining the consultation process and reducing the need for in-person visits. In addition, healthcare providers reported benefiting from the knowledge transfer during teleconsultations, which helps improve their clinical acumen, enhancing the overall quality of primary care. Table 3 presents the dominant quotes for this theme.

The Persisting Challenges

Several obstacles hinder the full realization of Telemedicine's potential benefits. Notably, doctors shared their apprehension about the chance of misdiagnosis in remote consultations, suggesting a lack of confidence in the CHOs' ability to present the cases. They felt some CHOs did not have formal medical or nursing training. An MOIC also highlighted that e-Sanjeevani has increased doctors' workload, as they must manage online consultations alongside regular OPD duties, with calls arriving unpredictably from across Jharkhand.

Operational hurdles further complicate service delivery. Non-participant observations revealed pervasive connectivity issues, such as inability to log in to the portal, audiovisual impairment, and

Table 3: Interview quotes about the advantages of Telemedicine

Sub-themes	Interview quotes (respondent code in parenthesis)
2.1 Doctor availability	"My son works in Ranchi. I don't have any means of transport here... If treatment is available from <i>didi</i> (at the HWC), then my son also worries less. I come here every month to get my blood pressure and sugar checked and also take medicine." (ID09, M/69)
2.2 Increased accessibility	"Its biggest advantage is that we can operate and use the portal anywhere. When we go to the village for vaccination drive or any awareness program, many elderly patients benefit. Because they have difficulty in coming to the health center." (ID26, Village <i>sahiya</i>)
2.3 Time and cost saving	"It is back-breaking to go so far (district hospital). And even when we do, there is no guarantee that we will get to meet the doctor. Coming here saves my time, money and my body too." (ID 24, F/77)
2.4 Continuum of care	"As we were told during training, all the patient records will be stored in it (portal) and whenever a patient comes for treatment, we can see why the patient came first. So, I think this is a benefit of Telemedicine because elderly people often cannot explain their medical history properly. Another benefit is that even if two different doctors carry out the teleconsultation for the patient, the treatment can continue consistently as they can see the whole record." (ID27, CHO)
2.5 Optimizes patient load	"Through telemedicine, we can utilize time more effectively because we can see multiple patients at once, which gives us an opportunity to gain more experience." (ID08, MOIC)
2.6 Knowledge transfer to CHOs	"When we listen to the doctor, we understand what they are asking. For example, if someone has a headache, it could also be a symptom of high blood pressure, so we learn how to deal with the patient." (ID17, CHO)

Table 4: Interview quotes about the persisting challenges

Sub-themes	Interview quotes (respondent code in parenthesis)
3.1 Hesitation among doctors	"See, we might have all the resources, but we are not satisfied with such consultations. As long as the patient is not present, there is always a chance of misdiagnosis. The skillfulness of the CHO matters a lot. Their technical knowledge should be solid. Because we cannot see what the patient is saying. If there is a mistake, it is possible that the diagnosis itself goes wrong. Among CHOs, I believe, some are in B.Sc. Nursing, and some are at a general education level. So, if the latter alter the medical terms, the doctor's thinking will change. The diagnosis will change" (ID16, MOIC).
3.2 Issues of connectivity	"The video was lagging and stuttering in between. Couldn't understand (what the doctor was saying) properly... Didi explained what to do and then gave the medicine." (ID 13, F/60).
3.3 Appointment scheduling issues	"My training happened just recently, but since I haven't received the ID password, I don't remember if there is an option to schedule appointments beforehand or not." ³ (ID27, CHO).
3.4 Audio-visual issues	Doctor: "Do you eat in the morning?" Patient: "Yes, I have a slight cough." ... Doctor: "Make sure to eat properly." Patient: "Okay." (Observed during teleconsultation of ID 11, F/70 in Hindi; chief complaint: weakness). ⁴
3.5 Logistic issues	"Actually, I joined just a couple of months ago. So, we are supposed to receive our individual ID and password, which I haven't received yet. That's why we are unable to conduct consultations right now." (ID 27, CHO). "We have to use our own phones and also pay for the data pack ourselves. We have to spend three hundred rupees every month. We spend because it's our people but it's very troublesome... Can you do something about it so that we don't have to bear this burden?" (ID 17, CHO).

³It was later confirmed that there was no such option available. ⁴The Hindi word "khaati" (to eat) is similar sounding as "khaansi" (cough) owing to which there was a miscommunication. The doctor, assuming that the patient said "haan, "khaati" toh hain thoda-moda" i.e., "Yes, I eat a little bit", goes on to advise how the patient should eat properly. In essence, the two people were not aware that they were not on the same page during the consultation

technical glitches, often resulting in asynchronous consultations, undermining the efficiency of the system. During live consultations, a patchy audiovisual interface and the inability to converse in the local dialect led to patient discomfort and miscommunication. In one instance, the diagnosis took a different direction as the doctor misheard the words (Table 4, quote 3). Doctor unavailability and connectivity issues also meant prolonged waiting times, which were often also aggravated due to the absence of an appointment scheduling feature on the portal.

"One day, I waited over half an hour, but the phone wasn't connecting. Later, the CHO called me, informing me about what the doctor had said. The next day, I went to collect the medicines."

—ID 19 (M, 69)

Furthermore, both parties incurred expenses in the process when, ideally, there should have been none. On one hand, the unavailability of diagnostic facilities and certain medicines at healthcare centers forced patients to seek private care, resulting

in out-of-pocket expenses. On the other hand, the CHOs bore the expense of data connection on their smartphones due to the lack of functional broadband connectivity. They incur a financial burden of around 300 rupees every month, which is neither accounted for nor reimbursed. Moreover, the absence of a dedicated device means a break in consultations when CHOs are transferred. Table 4 depicts the relevant quotes for this theme.

DISCUSSION

Through thematic analysis and non-participant observations, this study presents the experiences of e-Sanjeevani Telemedicine services for elderly persons and service providers in rural Jharkhand, the perceived advantages of Telemedicine over in-person consultations, and the challenges in using Telemedicine services, as voiced by 27 respondents across four groups.

The data show a disparity between what users and service providers understood about the e-Sanjeevani Telemedicine services. The elderly were not familiar with eSanjeevani, which was similar to the findings of a study in another rural setting.¹⁹ This insight highlights the role of the CHOs in the Telemedicine process and the need for improved awareness among the elderly. Despite this finding, our study found that Telemedicine has several positives that help overcome barriers to healthcare delivery in rural and remote areas. By connecting the rural elderly to specialist doctors, the e-Sanjeevani model ensures timely consultations, which was previously unattainable due to geographic and logistic barriers.²⁰ This access is crucial for managing chronic ailments in the elderly, especially those with mobility issues, and posits Telemedicine as a potential tool to deliver specific measures targeted toward the elderly. The necessity of such specific measures has been emphasized by a previous study.²¹ An enhanced continuum of care was another benefit, with Telemedicine facilitating more manageable and convenient follow-ups using electronic health records. Healthcare workers, including doctors, felt that Telemedicine enables patients to adhere to their treatment regimens more consistently, fostering better health outcomes for older people. Moreover, Telemedicine optimizes patient load by streamlining the consultation process and reducing the need for in-person visits, alleviating overcrowding and minimizing waiting times at distant healthcare facilities. This makes it an efficient first point of contact in caregiving and a potent tool for establishing referral linkages to higher facilities.²² Furthermore, significant reductions in travel costs and time were consistently reported, which is congruent with studies about efficient healthcare delivery.²³ Patients with reduced mobility and physical vigor particularly benefited from avoiding visits to the district hospital.

Despite the advantages, several challenges, such as limited acceptability, operational difficulties, and logistic challenges, persist.^{17,24–27} The issue of a robust internet connection continues to impede the effective implementation of telemedicine in rural settings, which has been highlighted as a challenge by a previous study.²⁶ Along with network issues, the lack of a provision to schedule appointments on the portal led to prolonged waiting times or asynchronous consultations.

Although respondents agreed that Telemedicine services have emerged as a potent tool for vulnerable patients in remote locations, most respondents, particularly doctors, view them only as a means to supplement in-person consultations. While the CHOs welcomed the process, as it helped them enhance their caregiving

abilities through observation of the consultations, a chance of misdiagnosis was the most critical concern among doctors. They were wary of how accurately cases were presented and the potential negative implications. This insight highlights the need for inclusion of telemedicine in medical education, refresher training among healthcare workers, and the need to review the Telemedicine Guidelines, consistent with a previous review.^{28,29} The lack of diagnostic test facilities other than screening for hypertension and diabetes and the unavailability of some medicines emerged as prevailing supply side issues that would need attention in order to realize the full potential of Telemedicine.

Moreover, the issue of the CHOs' dependence on personal devices for consultations has two-fold implications. Not only does it create an additional financial burden for them, but it also leads to a break in the continuity of service provision when CHOs are transferred. Instances where the lack of diagnostic facilities and the unavailability of medicines led to out-of-pocket spending point toward the need for the strengthening of supply chain gaps to realize the full potential of Telemedicine as a healthcare service delivery tool.

Recommendations

We suggest recommendations to promote Telemedicine diffusion in resource-constrained settings: Leveraging strong community connections is crucial. Sessions led by CHOs to raise awareness and dispel misconceptions can facilitate receptiveness among older people. Employing residents who understand cultural sensitivities and local dialects as healthcare workers can help improve service delivery. At the policy level, enhanced broadband penetration and investment in telecommunications technologies are needed. Providing CHOs with smartphones with adequate data connectivity or reimbursing their data costs is necessary to prevent demotivation. The e-Sanjeevani platform needs upgrades to incorporate features like appointment scheduling. Indemnity and medico-legal aspects must be addressed in the Telemedicine Practice Guidelines to alleviate doctors' apprehension. Continuous training in Telemedicine, communication skills, and geriatric care, coupled with incentives for CHOs, can enhance service delivery. These measures can improve the adoption of Telemedicine in rural settings. Finally, addressing supply chain management issues and including necessary drugs in the National List of Essential Medicines is crucial to utilizing Telemedicine to achieve the goal of Universal Health Coverage and financial protection.

CONCLUSION

Our study's findings highlight the ability of Telemedicine to overcome geographical barriers, enhance access to care, and reduce healthcare disparities among the old, disadvantaged populations in rural areas. However, it is imperative to address the barriers to diffusion, including policy challenges, infrastructure limitations, and provider concerns, to fully realize this potential. The urgency of investing in awareness, training, and infrastructure cannot be overstated. By doing so, we can harness the true potential of Telemedicine.

Limitations of the Study

Due to its limited sample size and geographic setting, our study may have generalizability limitations. The experiences of elderly people who did not utilize Telemedicine services were not considered, which may have unearthed further challenges

in adoption. While this study followed institutional and local ethical guidelines, the absence of explicit ethical approval for the thematic analysis may be considered a limitation. This was not sought as the analysis involved minimal risk to participants, but future studies should ensure comprehensive ethical review for all aspects of the research process.

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RESEARCH ARTICLE

Factors Affecting Utilization of Antenatal Care Services and Maternal Satisfaction at the Central Government Health Scheme Maternity and Child Centre, New Delhi: A Descriptive Cross-sectional Study

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ABSTRACT

The Central Government Health Scheme (CGHS) Maternity and Child Centre, New Delhi, is the sole maternity facility under CGHS, serving a significant population of CGHS beneficiaries. The center provides antenatal care (ANC), diagnostic services, pediatric care, delivery services, and referrals to higher centers. This study assessed the quality of ANC services, maternal satisfaction, and influencing factors among 120 ANC mothers using a pre-tested semi-structured questionnaire. Results indicated that most ANC services were adequately delivered. However, the absence of a Special Newborn Care Unit (SNCU) and a blood bank, due to proximity to a Government Tertiary Hospital, and staff shortages in radiology and anesthesiology, posed challenges. Investigative services were rated moderately satisfactory. Despite these issues, most users, predominantly lower-salaried government employees, expressed overall satisfaction. Expanding such centers could alleviate pressure on Tertiary Hospitals and support achieving SDG 3.1 by reducing maternal mortality to below 70 per 1,00,000 live births by 2030.

Keywords: Antenatal care, Blood bank, Central government health scheme, Special newborn care unit.

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INTRODUCTION

Established in 1954, the Central Government Health Scheme (CGHS) provides comprehensive healthcare services to central government employees, pensioners, and their dependents.¹ Catering to approximately 4.2 million beneficiaries across 80 cities, CGHS offers outpatient (OPD), inpatient (IPD), and referral services through its network of dispensaries, polyclinics, and Maternity and Child Health Centers.

The CGHS Maternity and Child Health Centre specializes in care for pregnant mothers without risk symptoms, referring high-risk pregnancies to advanced centers. Its services include pregnancy and childbirth care, family planning, pediatric care, radiological services for pregnant mothers, and laboratory services for antenatal, post-natal, and delivered mothers. The center provides 24/7 emergency care for pregnant women and children. The Maternity Center is equipped with 20 beds, one labor-delivery-recovery (LDR) unit with two labor tables, one operating theater (OT) for Cesarean sections and family planning procedures (with two OT tables), and one newborn care corner (NBCC). Registration is done manually, and all necessary antenatal care (ANC) tests, including malaria and dengue, are provided. However, for all higher tests, the ANC mothers were advised externally to any CGHS empaneled hospitals or centers.

Handling a significant caseload, the center manages over 800–1,000 OPD cases monthly and conducts 40–50 deliveries per month. Approximately two-thirds of these deliveries are Cesarean sections, with one-third performed during nighttime hours. Functioning as a First Referral Unit-Community Health Center (FRU-CHC), it operates with 25 beds, offering round-the-clock delivery services for pregnant mothers referred from CGHS dispensaries across Delhi.

Few studies have been done earlier on CGHS services. These studies reported poor patient satisfaction because of

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Dr Sherin Raj is associated as the Editorial board members of this journal and this manuscript was subjected to this journal's standard review procedures, with this peer review handled independently of these Editorial board members and their research group.

long queues, etc. Apart from these issues, they have found that empaneled private healthcare providers are also dissatisfied with exit fees and bank guarantee clauses and rush in the dispensaries during peak hours.^{2,3–6}

Apart from the above, no further studies were conducted in the recent past, and no recent evaluations on CGHS MCHC exist.

Therefore, the present study was planned, which aimed to evaluate service utilization, client satisfaction, the quality of care and medicines provided, as well as the timely diagnosis and referrals of beneficiaries, particularly concerning maternity outcomes. An attempt has been made to evaluate the services offered by the CGHS Maternity and Child Centre based on the guidelines outlined in the Maternal and Newborn Toolkit, 2013, issued by the Ministry of Health and Family Welfare (MoHFW).⁷ These guidelines, developed by the National Health Systems Resource Center (NHSRC) in alignment with MoHFW, establish standardized benchmarks for adherence applicable to all Maternity and Child Health Centres, including those serving as First Referral Unit (FRU) Community Health Centers (CHCs).

METHODOLOGY

The study was conducted among 120 ANC mothers receiving services at the CGHS Maternity and Child Centre in New Delhi. The ANC Clinic operates twice weekly and catering to 70–80 mothers per day. An interview of eight ANC mothers using systematic random sampling was conducted, covering a sample size of 120 mothers over a period of 4 months from January 2023 to April 2023. A pre-tested and validated semi-structured questionnaire was used to gather data on the quality of antenatal services, referral services, service satisfaction, reasons for dissatisfaction, delivery preferences, and factors influencing service utilization and satisfaction among mothers having a CGHS card. The analysis was performed using IBM SPSS v21.0 statistical software, appropriate graphs and charts were generated, and the Chi-square test was employed to assess significant associations, with a $p < 0.05$ considered statistically significant. Ethical approval was obtained from the Institutional Ethics Committee prior to the study.

For analyzing the level of satisfaction of the beneficiaries attending the center, a Likert scale was used. To analyze the satisfaction of mothers, the frequencies of each questionnaire were computed. For calculating the overall satisfaction score, each participants' score was calculated with minimum low score of 18 (18 questions $\times$ lowest score 1, i.e., $1 \times 18 = 18$) and maximum score of 90 (18 questions $\times$ maximum score 5, i.e., $18 \times 5 = 90$), and a new variable was computed with range of scores, viz. up to 18 = very dissatisfied; > 18 to ≤ 36 = dissatisfied; > 36 to ≤ 54 = somewhat satisfied; > 54 to ≤ 72 = satisfied; > 72 to ≤ 90 = very satisfied.

Limitations of the Study

The study was conducted during January to April 2023 so the opinion of ANC mothers coming to the center during the rest of the year could not be included. Since deliveries are having seasonality effect, based on patients' perspectives, availing services during part of the year from only one CGHS Maternity and Child Health Centre may not represent maternity services provided by all other CHGS Hospitals and Dispensaries throughout the year.

FINDINGS

Profile of ANC Mothers

Table 1 shows that the majority of pregnant women attending ANC clinic were in the age group 20–24 years (28%), and 44.17% were in the age group of 25–29 years (44%), the majority (49%) had attained education up to graduation level, and 71.67% were housewives. The majority (83%) of husbands of mothers belonged to the group B category, 44% were second gravida mothers, while 38% were primigravida, and 18% were third gravida and above. In 68%

Table 1: Socio-demographic profile of mothers availing ANC services

Categories	Number (n = 120)	Percent (%)
Age of mothers		
Less than 20 years	5	4.17
20–24 years	34	28.33
25–29 years	53	44.17
30–34 years	21	17.5
35 years and above	7	5.83
Education of mothers		
Illiterate	3	2.5
Up to 8th std	1	0.83
Up to 10th std	5	4.17
Up to 12th std	22	18.33
Graduation	59	49.17
Post-graduation	30	25
Pvt.	12	10
Family income (Rs.)		
30,000–50,000	3	2.50
50,001–70,000	60	50.00
70,001–90,000	56	46.67
>90,001	1	0.83

ANC, antenatal care

cases, husbands decided to come to the CGHS Maternity Center. Primarily, 73% of mothers were referred by the CGHS dispensaries. About one-fourth 24% mothers (29) had a history of abortion. All pregnant mothers got an MCP card at the center.

The majority of mothers (72.5%) chose the center due to referrals from dispensaries, while 12.5% cited trust in doctors or previous positive experiences, and 2.5% mentioned proximity. Decisions to use the center for ANC care were primarily made by husbands (68.33%), followed by women themselves (26.67%), and jointly by both partners in 5% of cases.

UTILIZATION OF ANC SERVICES

Perception of Patients Regarding Basic Amenities Provided at the Center

Table 2 describes that all the mothers who went to the center received an MCP card, and 96.28% reported no difficulties in the registration process. Regarding the waiting time in the registration process, a majority of the pregnant women (48.97%) had waited for less than 10 min time. Waiting time for doctors' consultation was generally perceived as not overly lengthy. A substantial proportion, 40.0% of pregnant women, waiting period was 1–2 hours for consultations, whereas 37.5% reported waiting times of more than 2 hours. Only 22.5% of mothers mentioned that the waiting time was less than half an hour, as illustrated in Table 2.

About 69.13% of mothers felt there were enough chairs in the waiting area, and 55.61% of women reported an adequate number of fans in that area. Only 30.83% of mothers considered the toilet facilities clean, whereas a much higher percentage, 80.33%, acknowledged the provision of clean drinking water at the center.

It was observed in Table 3 that 100% of pregnant women undergo height, weight, blood pressure, and abdomen checks in the course of their ANC visits. Among them, 111 ANC mothers (92.46%) have been prescribed IFA tablets. Additionally, 88.33%

Table 2: Opinion about the registration process, doctor's consultation, and waiting time

<i>Opinion regarding the registration process</i>	<i>Number (n = 120)</i>	<i>Percent (%)</i>
Registration process difficult or not		
Yes	4	3.32
No	116	96.28
Waiting time for registration		
Less than 10 min	59	48.97
10–15 min	51	42.33
15–30 min	10	8.3
Waiting time to consult a doctor		
Less than half an hour	27	22.5
1–2 hour	48	40
More than 2 hour	45	37.5
Time given by doctors in examining ANC mothers (consultation time in minutes)		
Less than 5 min	16	13.28
5–10	59	48.97
10–20	37	30.71
20–30	8	6.64

ANC, antenatal care

Table 3: Opinion regarding ANC services received

<i>ANC services received</i>	<i>Number (n = 120)</i>	<i>Percent (%)</i>
IFA tabs prescribed		
Yes	111	92.46
Height/Weight/BP/abdo check		
Yes	120	100
Dietary advice given		
Yes	106	88.33
Who gave diet advice		
Doctors	100	83.33
Nurses	6	5.00
Not applicable	14	11.67
Given inj. TT		
Yes	79	65.83
No	41	34.17
Place from where got inj. TT		
Here only	32	26.67
At CGHS dispensary next day	47	39.17
Explained about TT		
Yes	24	19.92
No	55	45.83
Not applicable	41	34.17
Number of inj. TT given		
1 dose	40	33.33
2 doses	39	32.47
Not applicable	41	34.17

ANC, antenatal care; BP, blood pressure; CGHS, Central Government Health Scheme

have received dietary advice to enhance their health conditions, and in 83.33% of cases, it is the doctors who provide dietary guidance to pregnant mothers. 65.83% mothers had received inj. TT and among

Table 4: Status of ultrasonography services availed by ANC mothers

<i>Status of ultrasonography services availed by ANC mothers</i>	<i>Number (n = 120)</i>	<i>Percent (%)</i>
USG done at this center or not		
Yes	47	39.2
Place where USG done outside		
Pvt. empaneled hospitals	60	50.0
Pvt. non-empaneled hospitals	9	7.5
Govt. hospitals	4	3.3
Not applicable	47	39.2

ANC, antenatal care; USG, ultrasonography

them only 26.67% had received on the same day at the center itself while 39.17% had to take inj. TT from the CGHS dispensary next day. Among them only 19.92% were explained regarding the importance of inj. TT in pregnancy. While 32.47% had completed their two doses of inj. TT, 33.33% had received their first dose and 34.17% had yet to be prescribed inj. TT.

Opinion Regarding Lab Tests Provided at the Center

While the beneficiaries revealed that the center provided only blood tests for hemoglobin level estimation, blood grouping, blood sugar, GCT, LFT, KFT, urine for pregnancy test, urine albumin, and thyroid tests, for most of the other tests like HPLC, dual /triple/quadruple marker test, ultrasonography (USG) for nuchal transparency, urine culture, etc, they were referred outside the center.

Table 4 describes that 39% of ANC mothers underwent ultrasound scans (USG) at the maternity center, while 60.8% sought services elsewhere. Among those opting for external USG, 50% chose private empaneled hospitals, 7.5% private non-empaneled clinics, and 3.3% government hospitals. Key reasons for external USG included unavailability of higher-level scans at the center (22.4%), shorter waiting times at private facilities (15%), and doctor recommendations (13.28%). Additional factors included unclear fetal pole visibility (8%) and non-functional USG equipment at the center (3.3%).

The referral data for ANC mothers shows (Table 5) that 29.92% were referred to higher centers, while 68.06% were not referred, and 1.67% requested referral due to distance from home. Of those referred, 14.8% experienced timely referrals, while 16.4% reported delays. Key reasons for referral included lack of SNCU and Blood Bank (12.45%), pregnancy-induced hypertension (5.83%), and center renovation (5%). Challenges faced during referrals included private hospitals not accepting late (19%) or complicated cases (10%) and poor treatment of CGHS patients (3%).

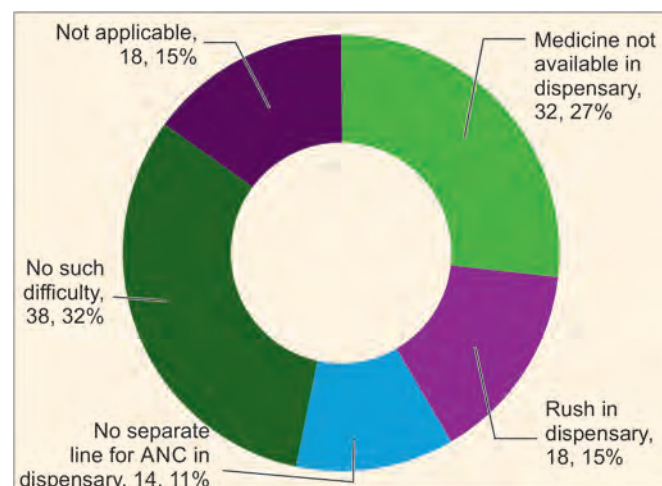
Among those who visited CGHS dispensaries for medicines next day, 31.65% did not encounter any difficulties. However, 27% expressed issues related to the unavailability of medicines, 15% mentioned congestion in dispensaries, and 11.6% reported difficulties due to the absence of a designated line for medicines for pregnant mothers at the dispensaries as shown in Figure 1. This indicates that, while overall, ANC services are “sufficiently” administered at the maternity center, more than half of the mothers expressed difficulties in procuring medicines in the CGHS dispensaries (Figs 2 and 3).

While majority of the participants (87%) had done their lab tests partially inside and partially outside the center, 9% preferred in all tests in private empaneled hospital outside and only 4% had undergone tests in any non-empaneled private hospital/

Table 5: Referral pattern at the maternity and child center

Referral of ANC mothers	Number (n = 120)	Percent (%)
Referred to the higher center		
Yes	36	29.92
No	82	68.06
Timely refer		
Requested as home too far	2	1.67
Not applicable	82	68.06
Yes	18	14.8
No	20	16.4
Reasons for refer to higher center		
Not applicable	82	68.06
No SNCU and BB here	15	12.45
PIH	7	5.83
Center under renovation	6	5.0
Fibroid uterus, anemia	4	3.34
My home is too far	4	3.33
Elderly mother, GDM	2	1.66
Difficulties faced on refer		
Not applicable	82	68
Pvt. do not take late	23	19
Pvt. do not take complicated cases	12	10
Pvt. do not see CGHS patients well	3	3

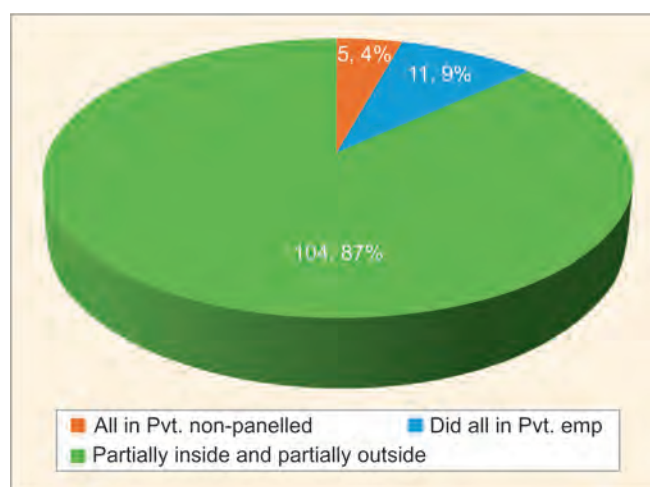
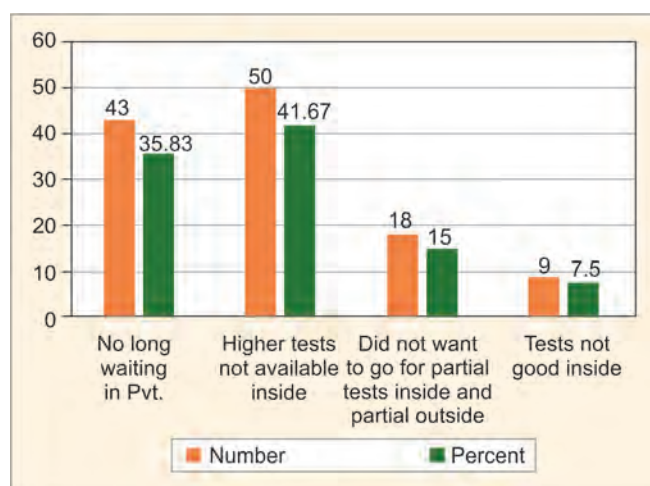
ANC, antenatal care; CGHS, Central Government Health Scheme; SNCU, Special Newborn Care Unit

**Fig. 1:** Reasons for difficulty in getting medicines (n, %)

clinic outside as illustrated in Figure 2. When asked the reasons for going outside, 41.67% highlighted that higher tests were not available at the center, 35.83% told there was no long waiting in private for tests, 15% did not want to go for partial tests inside and partial tests outside and 7.5% complained that the tests were not good inside (Fig. 3).

Choice of Place of Delivery

In the study, 51.67% of mothers preferred delivering at the center, while 44.17% chose private empaneled hospitals, and smaller

**Fig. 2:** Place where lab tests done (n, %)**Fig. 3:** Reason of preference of lab tests outside the center (n, %)

percentages opted for private non-paneled hospitals (3.33%) or government facilities (0.83%). The main reasons for choosing the center included proficient doctors (25.81%) and mistrust of private hospitals due to higher C-section rates (21.58%). Some mothers (4.98%) expressed concerns about CGHS beneficiaries receiving poor treatment in private hospitals. Reasons for preferring private facilities included ease of empanelment (20%), lack of SNCU and clean toilets at the center (19.17%), and previous bad experiences or changing doctors (3.33%). Other factors included returning to hometowns (4%) and dissatisfaction with past care at Safdarjung Hospital (2.5%).

Factors Associated with Number of ANC Services

Table 6 informs that education level was not significantly associated with ANC visits, likely due to the influence of CGHS beneficiary status ($p > 0.05$). Mother's age showed a strong correlation, with younger mothers completing the minimum required visits and older mothers making more visits due to higher complication rates ($p = 0.006$). First-time mothers visited more frequently for ANC than those with higher parity, though the association was not significant ($p > 0.05$). Proximity to the center significantly affected visit frequency, with

Table 6: Factors associated with number of ANC visits

Factors associated with number of ANC visits at the center	No. of ANC visits			p-value
	0–4 visits	5–6 visits	>7 visits	
Education of mothers				
Illiterate	0	0	100	0.105
Up to 8th std	100	0	0	
Up to 10th std	80	0	20	
Up to 12th std	59.09	22.73	18.18	
Graduation	50.85	30.51	18.64	
Post-graduation	60	20	20	
Age of mother				
< 20 years	100	0	0	0.006
20–24 years	79.41	8.82	11.76	
25–29 years	35.85	37.74	26.42	
30–34 years	57.14	19.05	23.81	
35–39 years	42.86	28.57	28.57	
Gravida				
1st gravida	65.22	13.04	21.74	0.206
2nd gravida	49.06	32.08	18.87	
3rd gravida	50.00	25.00	25.00	
5th gravida	0.00	100.00	0.00	
Distance center to home (in km)				
<5	66.67	21.21	12.12	0.03
5–10	64.44	20.00	15.56	
> 10	35.71	30.95	33.33	

ANC, antenatal care

mothers living closer making more visits compared to those living farther away ($p = 0.03$).

Satisfaction of Mothers Regarding ANC Services at the Center

Our findings as shown in Figure 4, suggested that majority of the mothers, 65%, are very satisfied with the behavior of the doctors at the center, 86.67% mothers are satisfied with the behavior of staffs at the center, 87.50% mothers are satisfied with the behavior of nurses at the center, 70% mothers are satisfied with about timely attention given, 64.2% are satisfied with timely information about complications, 62.5% are satisfied with the timely referral services, 55.8% are satisfied with the cleanliness of ward and 50% are satisfied with the cleanliness of labor room.

About 80% of the mothers were neither dissatisfied nor satisfied with the quality of food and water supply, 64.17% were satisfied with the cleanliness of beds and linens provided at the center, 59.17% were satisfied with the waiting room facility, 51.67% were satisfied with the display of IEC material at the center, 54.17% were neither dissatisfied nor satisfied with the ambulance service here, 64.17% were satisfied with the presence of doctors at night, and 52.5% were satisfied with compassion of doctors and staffs here at the center. It is noteworthy that the satisfaction for toilet facility at the center, attendant stay, waiting room, and dispense of medicines ranged from very dissatisfied or dissatisfied to satisfied in varying proportions, highlighting that these factors are more associated with the satisfaction of ANC mothers at the center. Overall, 85.8% mothers were satisfied, and 11.7% were highly satisfied with the services provided at the center.

Factors Affecting Satisfaction for ANC Services

Our analysis in Table 7 shows that a strong positive association exists between job grade and ANC service satisfaction ($p = 0.000$), showing that mothers in higher job grades (groups A and B) are less satisfied than those in group C. Higher-income households report 100% dissatisfaction, while middle-income groups show more satisfaction (80% and 58.9%), with a significant association ($p = 0.02$). Mothers receiving TT injections at CGHS dispensaries reported greater satisfaction than those prescribed elsewhere ($p = 0.05$). Similarly, those receiving IFA tablets from CGHS facilities were more satisfied than those using private hospitals ($p = 0.003$).

Mothers who reported difficulty in getting medicines were less satisfied at the center ($p = 0.00$). Additionally, those who completed USG at the center reported higher satisfaction than those using external facilities at additional cost ($p = 0.004$ and $p = 0.023$). Early communication of complications also improved satisfaction levels significantly ($p = 0.003$). Lastly, the number of ANC visits increases if the mothers are satisfied with the services provided in the ANC clinic at the center, with a significant p -value of 0.08.

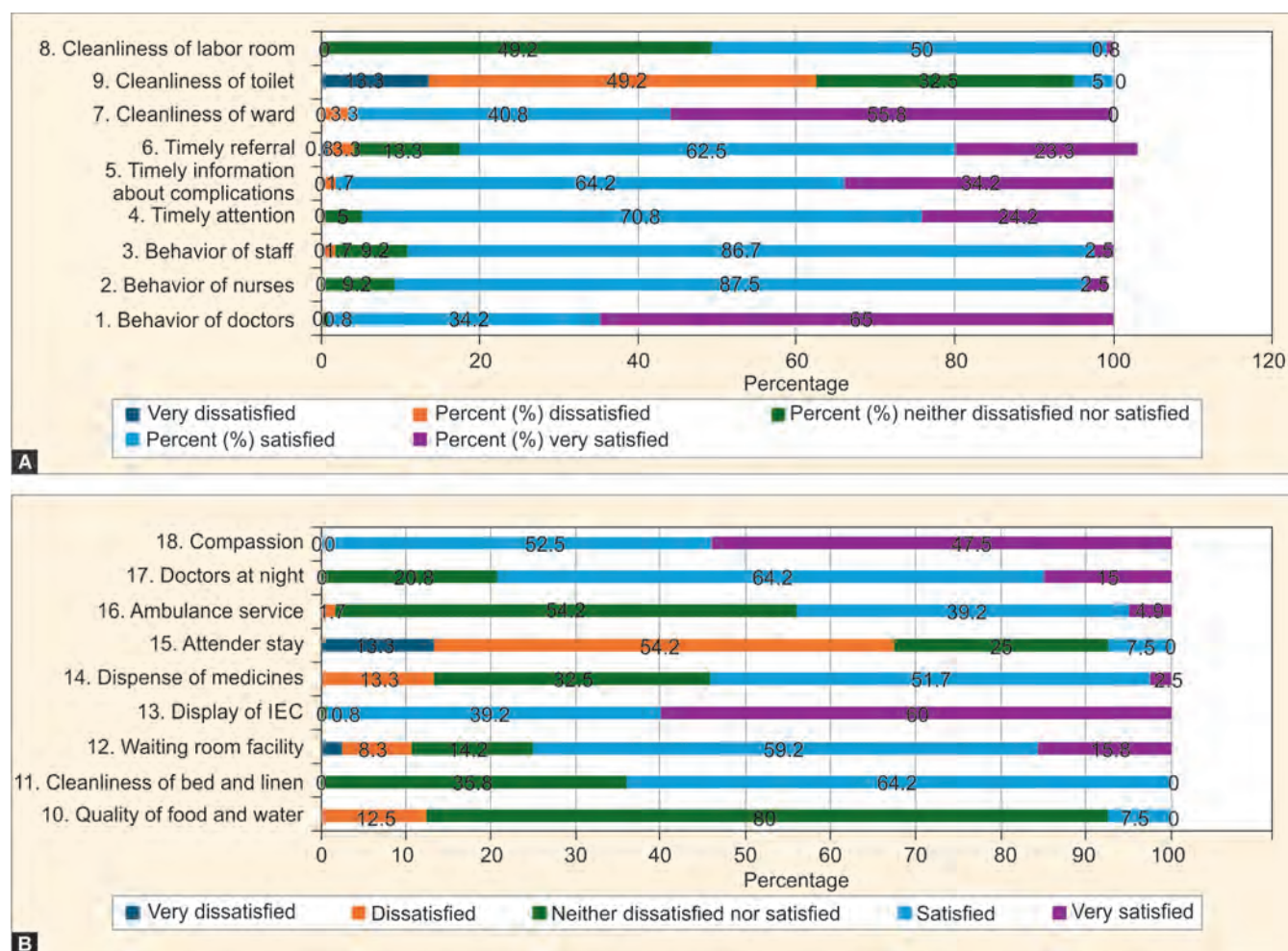
DISCUSSIONS

Regarding the utilization of ANC, the majority of the mothers (68%) reported that the decision to choose this maternity center was primarily made by their husbands. Our findings are consistent with the findings of a study conducted by Vidler et al. that expectant mothers would come to the center if they have trust in the quality and care given by service providers.⁸ The majority of pregnant mothers highlighted that the waiting time for consultations was not very long. A substantial proportion, 40.83% of pregnant women, waiting period was 1–2 hours, whereas 36.6% reported waiting times of more than 2 hours. Evidence shows that patients are less likely to be dissatisfied if their waiting time is within 30 minutes.⁹ The experience while waiting can affect patient satisfaction and is influenced by other factors such as the condition and attractiveness of the waiting area.^{8–11} Moreover, many papers mention the long waiting times at public facilities as reason for seeking care from private.^{6,12–14}

Most mothers were satisfied with basic amenities at the center, including signboards (83.83%), waiting area chairs (69.13%), and fans (55.61%). Clean drinking water was acknowledged by 80.33%, but only 30.83% found toilets clean. Patient satisfaction depends on factors like waiting area conditions, with cleanliness crucial for facility preference during delivery. Bhattacharya S et al. highlighted access, cleanliness, behavior, information, and costs as key satisfaction factors.⁹

Our study found that 84.67% of pregnant women obtained medicines from CGHS dispensaries, while 7.5% relied on private pharmacies. Among those visiting CGHS, 31.65% faced no issues, but 26.65% reported medicine unavailability, 15% noted overcrowding, and 11.66% highlighted the absence of dedicated queues for pregnant women. Studies from Uganda and Cambodia emphasize that private pharmacy use is driven by trust in providers and medicine quality. Additionally, long waiting times at public facilities are a common reason for choosing private pharmacies.^{15–18}

Only 39.17% underwent USG at the maternity center; others preferred private or government facilities due to advanced scans, shorter waits, referrals, or dissatisfaction with onsite services. Similarly, a study in southeast Nigeria reported that private health facilities were the primary choice for healthcare, with public facilities serving as a secondary option.



Figs 4A and B: Satisfaction with services received at center

While 51.67% of mothers expressed their willingness to deliver at this center, 44.17% preferred delivering exclusively in private empaneled hospitals, 3.33% in any private non-paneled hospitals, and 0.83% desired delivery at a government health facility in their village. This is inconsistent with the findings of Velakkal et al. that patients are relatively more satisfied with private healthcare services than with dispensaries-polyclinics.⁴

The center is missing two essential units: An SNCU and a BB facility, both critical components required in an FRU-CHC as outlined in the Maternal and Child Health Toolkit developed by MoHFW.³ However, instead of a BB facility, the center has a blood storage unit to address urgent transfusion needs.

When asked for suggestions for improvement, 39.17% advocated for SNCU and BB facilities, 15% requested cleaner toilets and onsite medicines/TT, 11.67% suggested more radiologists, 4% preferred earlier referrals, and 1% each recommended handicap-accessible toilets and a night helpline for ANC mothers.

There are many studies relating to factors affecting the utilization of services by ANC mothers. In our study, the age of mothers has a significant association with the number of ANC visits done. A study conducted in West and Central Africa has a systematically lower utilization of ANC services than non-adolescent.¹⁹ The study shows that the first gravida mothers are visiting the center more for ANC care than those with increasing number of pregnancies.

Table 7: Factors affecting satisfaction of ANC mothers at the maternity and child center

Factors affecting satisfaction of ANC mothers at the center	Satisfaction of ANC		p-value
	Yes (n = 81)	No (n = 39)	
Job grade of card holder			
Group A	1 (25.0)	3 (75.0)	0.000*
Group B	65 (65.7)	34 (34.3)	
Group C	15 (88.2)	2 (11.8)	
Family income (Rs.)			
30,000–50,000	0 (0)	3 (100)	0.002*
50,001–70,000	48 (80.0)	12 (30.8)	
70,001–90,000	33 (58.9)	23 (41.1)	
90,001	0 (0)	1 (100)	
Clean toilets			
Yes	23 (92.0)	2 (8.0)	0.003*
No	58 (61.1)	37 (38.9)	
Waiting time for consultation			
Less than half an hour	20 (74.1)	7 (25.9)	0.381
1–2 hour	34 (70.8)	14 (29.2)	
More than 2 hour	27 (60.0)	18 (40.0)	

(Contd...)

Table 7: (Contd...)

	Satisfaction of ANC		p-value
	Yes (n = 81)	No (n = 39)	
Sufficient time given by doctors			
Yes	54 (68.4)	25 (31.6)	0.781
No	27 (65.9)	14 (34.1)	
Timely refer			
Yes	9 (50.0)	9 (50.0)	0.138
No	16 (80.0)	4 (20.0)	
NA	56 (68.3)	26 (31.7)	
Timely information of complications			
Difficulty in getting medicines			
Yes	56 (62.2)	34 (37.8)	0.003*
Yes	38 (61.3)	24 (38.7)	0.000*
No	43 (75.4)	14 (24.6)	
NA	0 (0)	1 (100)	
Place from where got IFA tabs			
CGHS dispensary	74 (73.3)	27 (26.7)	0.003*
Private	5 (50.0)	5 (50.00)	
Not advised	2 (100.0)	39 (32.50)	
Place from where got inj. TT			
CGHS Maternity Centre	27 (84.4)	5 (15.6)	0.051*
CGHS dispensary next day	30 (63.80)	17 (36.2)	
Not advised	24 (58.5)	17 (41.5)	
USG done inside			
Yes	39 (83.0)	8 (17.0)	0.004*
No	42 (57.5)	31 (42.5)	
Money spent on lab tests outside (Rs.)			
1,000–2,000	21 (77.8)	6 (22.2)	0.023*
2,001–4,000	55 (64.7)	30 (35.3)	
> 4,001	0 (0)	3 (100)	
No. of visits in ANC			
0–4 visits	37 (56.1)	29 (43.9)	0.008*
5–6 visits	22 (75.9)	7 (24.1)	
7 visits	22 (88.0)	3 (12.0)	

*p-value is statistically significant; ANC, antenatal care; CGHS, Central Government Health Scheme; USG, ultrasonography

This is consistent with the study conducted by Subba D et al. which shows that with the increase in the birth order, there is a decrease in utilization of maternal healthcare services.²⁰ Compared to 1st birth order, women with 2–3 birth orders and above 4 are less likely to have full ANC, safe delivery, institutional delivery, and post-natal care. Also consistent with the findings of Mehari K et al., the study shows the use of maternal health services decreased with increasing birth order.¹⁰

The study further shows that the distance of the center from home of mothers has a positive effect on the number of ANC visits done by mothers, with $p = 0.08$. This shows increased distance between residence and healthcare providers which is

commonly thought to decrease the utilization of health care.^{6,8,12} Among illiterate and less educated mothers, there was a higher percentage willingness to deliver at the CGHS maternity center (100%). Aggarwal R and Thind A in their study found that women with higher education had 4 times higher preference of delivering in a private facility as compared to women with no education.¹¹ Also, a study conducted by Deepak et al. showed that higher educated women seek out better service quality.¹²

The job grade of husbands of ANC mothers is also associated with satisfaction of the center. It shows mothers of higher job grade of husbands, that is, groups A and B are less satisfied for the ANC services provided at the center than those belonging to group C cadre highlighting the impact of socioeconomic factors on satisfaction levels. This is consistent with the findings of Vellakkal et al.⁴

Most mothers reported high satisfaction with provider behavior, including doctors (65%), staff (86.67%), and nurses (87.5%). Satisfaction with timely attention (70%), information on complications (64.2%), referrals (62.5%), ward cleanliness (55.8%), and labor room cleanliness (50%) was noted. Consistent with the study conducted by Jha P et al. the study revealed that women are more satisfied with respectful care providers.¹³ A total of 64.17% of mothers were satisfied with bed and linen cleanliness, 59.17% with the waiting room, 51.67% with IEC materials, and 52.5% with staff compassion. Overall, 85.8% mothers were satisfied, and 11.7% were highly satisfied with the services provided at the center. This finding is consistent with the findings of Kumar et al. whose study found that the beneficiaries were satisfied with both the empaneled private health providers and with CGHS polyclinics or dispensaries.⁷

CONCLUSION

The study concluded that the CGHS Maternity and Child Centre provides comprehensive ANC services to the CGHS beneficiaries. The center needs to streamline the availability of medicines at the dispensaries and ensure separate ANC lines at the pharmacy. Facilities like higher investigation services and higher USG scans are lacking at the center. Additionally, the center lacks major essential services, i.e., Blood bank and SNCU. Creation of such a facility at the CGHS Maternity and Child Centre may make as most sought-after by the beneficiaries.

RECOMMENDATIONS

Ensuring the presence of SNCU and Blood Bank facilities at the center would facilitate expectant mothers to deliver at the maternity center, alleviating any apprehensions about health risks for both themselves and their newborns, and meet the mere purpose of being an FRU-CHC. Given that a significant variety of blood tests, including LFT, thyroid tests, HPLC, dual, triple, and quadruple marker tests, urine culture, etc., were currently not available onsite need to broaden the spectrum of laboratory tests provided at the center. Streamline the medicine availability at the dispensaries and ensure separate ANC lines at the pharmacy. Provision of higher-level USG scans and posting of additional radiologists at the center would also decrease the additional expenditure incurred by the ANC mothers and increase the service utilization of the mothers. Moreover, ensuring clean and hygienic toilet facilities would enhance beneficiary satisfaction, encourage greater utilization of the center, and reduce the preference of CGHS beneficiaries for private facilities.

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Nutritional, Mental, and Social Well-being of Hearing- and Visually Impaired Adolescents: A Comparative Study

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ABSTRACT

Adolescents with sensory impairments often experience nutritional deficiencies, psychological stress, anxiety, depression, low self-esteem, and social anxiety. This study compared the nutritional, mental, and social well-being of 80 hearing-impaired (HI) and 77 visually impaired (VI) adolescents from urban and rural schools for the deaf and blind in Chennai and Kanchipuram, Tamil Nadu. Data were collected using socio-demographic information, anthropometric measures, 24-hour dietary recall, and modified depression anxiety stress scale youth version (DASS-Y) and social phobia inventory (SPIN) scales, respectively, for mental and social well-being. The findings showed that most participants were male, firstborn, and had congenital impairments. The average body mass index was normal (21.04 ± 2.35), with rural adolescents and VI participants showing higher waist-to-hip ratio (WHR) (1.09 ± 0.19) and triceps skinfold thickness measures (18.0 ± 0.37). Visually impaired adolescents consumed more calories (3099 ± 142) and carbohydrates (431 ± 13) but fewer other nutrients. Urban HI and rural VI adolescents had better nutrient intake. Severe depression (17.1%), anxiety (21.6%), and stress (16.0%) were more prevalent among the VI participants, while HI participants reported poorer social well-being (17.20 ± 2.45). Urban adolescents experienced higher stress (22.81 ± 12.05) and lower social well-being (19.33 ± 1.41) than their rural peers. The study highlights the need for tailored nutritional plans, psychological and social support, and an enhanced role for counselors and psychologists to assist sensory-impaired adolescents.

Keywords: Adolescents, Hearing impaired, Mental and social well-being, Nutritional status, Rural area, Urban visually impaired.

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INTRODUCTION

Disability refers to limitations in performing activities within a normal range, caused by physical, cognitive, sensory, or developmental impairments.¹ Movement, hearing, and vision impairments account for 24, 19, and 11% of the total disability burden, respectively. According to the 2011 Census of India, 2.2% of the population is disabled, with Tamil Nadu reporting a 1.6% prevalence. Disability rates are higher in males (1,819 vs 1,451 per 1,00,000) and rural areas (1,670 vs 1,599 per 1,00,000).² Chennai had the highest disability rates in seeing, hearing, and speech of 226, 501, and 86 per 1,00,000 populations, respectively compared to 186, 275, and 93, respectively, in Kanchipuram district.³

Hearing impairment, the most common sensory deficit globally, affects 6.3% of the Indian population and is projected to increase significantly by 2050.⁴ In India, there are approximately 63 million people who are suffering from significant auditory impairment; this places the estimated prevalence at 6.3% in the Indian population. Hearing loss is a major public health problem and has been recently ranked as the fifth leading cause of years lived with disability, even higher than many other chronic diseases.⁵ Hearing impairment leads to communication challenges, delayed language development, and heightened vulnerability to abuse, with deaf adolescents experiencing 2–3 times higher rates of mental health issues compared to their hearing peers.^{6,7}

Visual impairment is defined as “a significant limitation of visual capability coming from either disease or trauma, without the ability to restore it by conventional means”. Vision impairment is also prevalent, with over 4.95 million blind individuals and 70 million vision-impaired persons in India.⁸ Similarly, visual impairment often results in emotional distress, dependence, and social challenges, contributing to anxiety and depression. Persons with impaired

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vision or blindness exhibit different range of emotional and physical complications, feel themselves compromised, victim of some sort of evil, exhibit stereotypical behavior such as anxiety, depression, or excessive thought. They also often face dependence and challenges in social interactions.⁹

Disability and malnutrition are interlinked, as poor diets and physical inactivity are prevalent among people with disabilities. This may partly explain the growth retardation often encountered in such children.¹⁰ Nutrient deficiencies, such as vitamins A, B, D, as well as iodine and iron, are risk factors for disabilities like blindness and hearing loss. Conversely, excessive consumption of fats and carbohydrates can worsen hearing conditions. Malnutrition perpetuates a cycle of disability, poor health, and poverty.¹¹

Due to stigma, discrimination, and a lack of support, people with disabilities are more prone than the general population to experience mental health issues. These issues can have a detrimental effect on their self-esteem and general mental health.

Shame, exclusion, and social devaluation may result from this.^{12,13} Frequent emotional discomfort was reported by 17.4 million (32.9%) people with disabilities in 2018. This is linked to unhealthy habits, higher healthcare use, mental disorders, chronic diseases, and challenges in day-to-day functioning.¹⁴ Helping people with impairments deal with the particular difficulties they face requires promoting social relationships and good mental health. For students with disabilities to succeed and be happy, it is essential to prioritize mental health assistance, make resources easily available, and provide an accepting and understanding environment.¹⁵

Social well-being refers to having healthy relationships, a sense of belonging, meaningful interactions, and feeling valued and authentic. People with disabilities experience mental health disparities, with social exclusion being a key contributing factor.¹⁶ Limited social support or significant social rejection can negatively impact mental well-being, as rejection often increases emotional distress. Integrating individuals with disabilities into social networks is essential, it is equally important to improve the quality of their relationships and tailor support to meet their specific needs.¹⁷ Social participation and interaction among people with disabilities remain low and often unsatisfactory.¹⁸ Similarly, a strong link between social interaction and the well-being of individuals with disabilities was reported in Ho Chi Minh City, Vietnam.¹⁹

Need of the Study

Adolescents with sensory impairments face unique challenges related to nutrition, often relying on caregivers, struggling with meal preparation, and lacking access to healthy eating information. Their impairments may lead to sedentary lifestyles, increasing the risk of obesity, malnutrition, and related diseases. Communication barriers and social exclusion further contribute to mental health concerns such as anxiety, depression, and loneliness, impacting peer relationships and social skills. These challenges can result in long-term disadvantages, including comorbidities, lower education levels, and limited career prospects. Limited data on their well-being hinders targeted interventions. This study aims to address these gaps by proposing inclusive policies, nutritional guidelines, and mental health strategies to improve their quality of life.

Objectives of the Study

- To assess the nutritional status, and mental and social well-being of hearing- and visually impaired (VI) adolescents.
- To compare the nutritional status, and mental and social well-being between hearing- and VI adolescents.
- To compare the nutritional status, and mental and social well-being of hearing- and visually impaired adolescents based on geographic area.
- To study the relationship between the nutritional status, and mental and social well-being of hearing- and VI adolescents.

METHODOLOGY

Selection of Sample

The study involved a total of 157 samples, 80 hearing- impaired (HI) and 77 VI adolescents aged 15–20 years selected through purposive random sampling from schools for the deaf and blind in the Chennai and Kanchipuram districts of Tamil Nadu, India.

Tools Used

A self-structured questionnaire with 4 sections was used:

1. *Demographics*: Collect basic participant information, including age, gender, family history of disability, causes, and other health problems.
2. *Nutritional status*: The nutritional status was assessed through anthropometric measurement, diet survey, and a 24-hours dietary recall method. The nutrient composition of the diet was calculated.
3. *Mental well-being*: Modified questions from the depression anxiety stress scale youth version (DASS-Y), with ratings ranging from normal to very severe. Higher scores indicated poorer mental well-being.²⁰
4. *Social well-being*: Modified social phobia inventory (SPIN), a 10-item scale rated from 0 (not at all) to 4 (extremely).²¹ Scores of 12 and above indicated social phobia. The questionnaire was validated, with a Cronbach's α of 0.82, ensuring reliability.

Anthropometric Measurements

Body Weight

Weight was measured using a digital scale accurate to ± 0.1 kg, with participants wearing light clothing and no shoes.

Body Height

Height was measured with a stature meter. Participants stood upright on a flat surface with their back against the meter, while the headpiece was lowered to lightly compress the hair. The reading was taken with the participant standing straight and looking ahead.

Body Mass Index (BMI)

Body mass index was calculated using the formula: Weight (kg)/height² (m²). Based on World Health Organization (WHO) criteria for Asians, BMI categories are: Underweight (<18.5), normal weight (18.5–22.9), overweight (23–24.9), and obesity (≥ 25).

Mid-upper Arm Circumference (MUAC)

Mid-upper arm circumference was measured at the midpoint between the shoulder and elbow using a nonstretchable tape. Measurements below 12.5 cm indicate malnutrition, while normal values are above 13.5 cm.

Waist and Hip Circumference

Waist circumference was measured at the narrowest point above the navel, while hip circumference was measured at the widest part of the buttocks. The waist-to-hip ratio (WHR) was calculated as waist circumference / hip circumference. A WHR ≤ 0.9 in men and ≤ 0.85 in women is considered normal.

Triceps Skinfold Thickness (TSF)

Triceps skinfold thickness was measured using a Harpenden skinfold calliper. The midpoint of the upper arm (between shoulder and elbow) was marked with the arm bent at 90°. Skinfold thickness was measured by pinching the skin parallel to the epicondyles.

Data Collection and Statistical Analysis

The study was conducted after obtaining prior permissions and securing informed written consent from all participants. For HI students, a sign language interpreter explained the study's purpose and the questionnaire and assisted them in completing it. For VI students, each question was read aloud, and their responses were

Table 1: Sociodemographic details of the respondents

Details	Hearing impaired (80)		Visually impaired (77)		χ^2 p-value
	Urban (43)	Rural (37)	Urban (46)	Rural (31)	
Age (years) (%)					
11–15	60.5	32.4	47.8	61.3	0.84
16–20	39.5	67.6	52.2	38.7	
Gender					
Male (%)	86	86.5	54.3	71	0.051*
Female (%)	14	13.5	45.7	29	
Birth order (%)					
1	48.8	67.6	43.5	51.6	0.05*
2	3.9	21.6	39.1	32.3	
3	16.3	10.8	17.4	16.1	
Family history of disability (%)					
Yes	20.9	35.1	15.2	35.5	0.78
No	79.1	64.9	84.8	64.5	
Cause of disability (%)					
Congenital	83.7	78.4	93.5	90.3	0.09*
Illness	11.6	21.6	6.5	9.7	
Accident	4.7	0	0	0	
Health problems (%)					
Oral	32.6	18.9	13.0	25.8	0.47
Skin	4.7	0	0	0	
ENT infections	14.0	21.6	23.9	48.4	
Nil	48.7	59.5	63.1	25.8	

*Significant at 0.05 level

Table 2: Anthropometric measures of HI and VI adolescents

Anthropometric measures	Hearing impaired			Visually impaired			Hearing impaired	Visually impaired	p-value
	Urban	Rural	p-value	Urban	Rural	p-value			
Weight (kg)	56.1 ± 8.3	53.77 ± 9.6	0.247 NS	58.5 ± 10.2	60.3 ± 7.0	0.395 NS	58.04 ± 8.72	61.1 ± 8.67	0.0001**
Height (cm)	161.6 ± 7.2	163 ± 6.31	0.217 NS	155.5 ± 8.8	154 ± 7.27	0.434 NS	162 ± 6.8	160.1 ± 5.41	0.0001**
BMI	21.41 ± 2.45	20.22 ± 2.7	0.04*	19.93 ± 2.01	22.7 ± 2.99	0.0001**	20.05 ± 1.62	21.96 ± 2.33	0.0001**
MUAC (cm)	23.7 ± 0.57	24.9 ± 0.4	0.0001**	24.28 ± 1.19	23.6 ± 0.67	0.0001**	23.97 ± 2.39	25.25 ± 2.07	0.0001**
WHR	0.84 ± 0.11	0.95 ± 0.50	0.94 NS	0.92 ± 0.32	0.89 ± 0.5	0.745 NS	0.87 ± 1.4	1.09 ± 0.19	0.0001**
TSF (mm)	16.5 ± 0.26	16.8 ± 0.55	0.0001**	17.2 ± 0.9	17.7 ± 0.71	0.001*	17.1 ± 0.8	18.0 ± 0.37	0.0001**

NS, not significant; *Significant at 5% level; **Significant at 1% level

recorded. Data analysis was carried out using SPSS version 21, employing frequency analysis, independent *t*-tests, Chi-square tests (χ^2), and Pearson's multiple correlation coefficient tests, with statistical significance set at $p \leq 0.05$.

FINDINGS

Table 1 summarizes the demographics of adolescents with hearing and visually impairments in urban and rural areas. The mean age was 17 ± 2 years. Most urban HI adolescents were aged 11–15 (60.5%), while most rural HI adolescents were 16–20 (67.6%). The majority of urban and rural VI adolescents were in the 11–15 age-group. A family history of impairment was reported by 35.5% of rural VI individuals, with most participants being firstborn. Males constituted a higher proportion of both HI and VI samples (74.5%, $p = 0.05$), and 52.9% were firstborn. Congenital causes accounted for the majority of disabilities (78.4–93.5%, $p = 0.09$). Oral health issues were common among urban HI adolescents

(32.6%), while ENT infections were prominent among rural VI adolescents (48.4%).

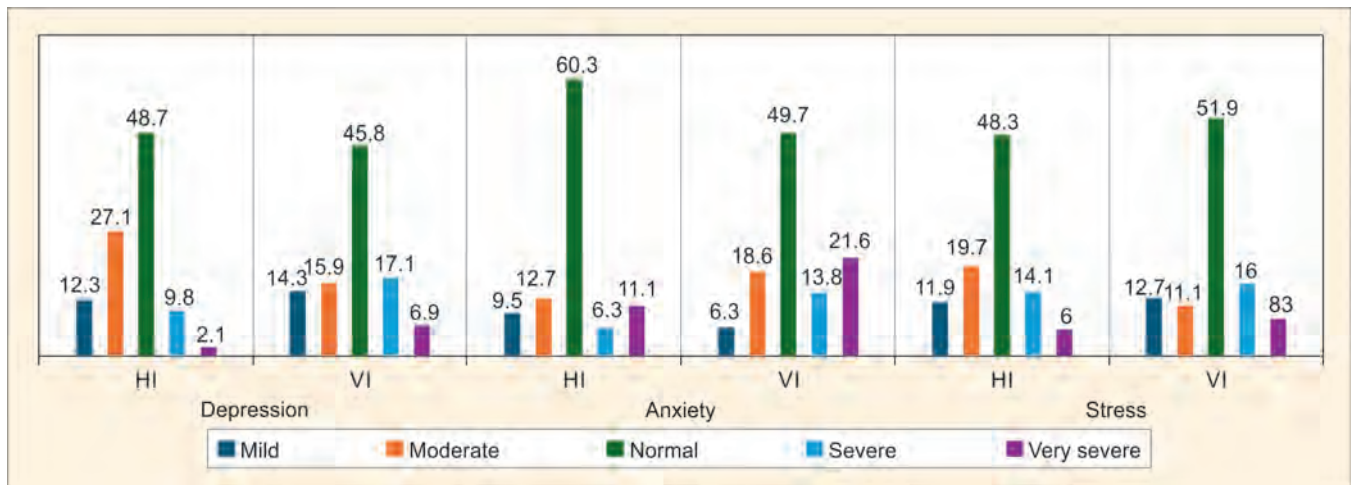
The average body weight and height of the participants were 57 ± 9.6 kg and 159.37 ± 6.97 cm, respectively. Visually impaired adolescents were slightly shorter and more likely to be overweight/obese compared to HI adolescents. Whereas the BMI was within the normal range (21.04 ± 2.35), there were significant differences based on impairment type and area. The MUAC, WHR, and TSF were higher among rural adolescents than urban participants and VI than HI counterparts. Rural adolescents had higher mean scores in all anthropometric measures, with VI individuals significantly outperforming their HI counterparts ($p = 0.0001$) (**Table 2**).

Table 3 presents a comparison of nutrient intake among HI and VI adolescents in rural and urban areas. Nutrient consumption was generally higher among urban adolescents compared to their rural counterparts. Urban HI adolescents had significantly greater intakes of energy (2720 ± 198), protein (40.15 ± 7), calcium (223.63 ± 4.6), and iron (20.92 ± 0.26) compared to those in rural areas ($p = 0.0001$),

Table 3: Comparison of nutrient intake

Nutrients	Hearing impaired			Visually impaired			Hearing impaired	Visually impaired	t-value (p-value)
	Urban	Rural	t-value	Urban	Rural	t-value			
Energy (Kcal)	2720 ± 198	2302 ± 162	10.23**	3002 ± 203	2902 ± 217	1.85 NS	2520 ± 173	3099 ± 142	22.87**
Carbohydrates (gm)	396 ± 27	410.40 ± 63	1.361 NS	431 ± 40	426 ± 69	0.40 NS	409 ± 16	431 ± 13	9.43**
Protein (gm)	40.15 ± 7	40.72 ± 3.6	0.446 NS	35.83 ± 70	32.92 ± 58	0.191 NS	39.7 ± 9.3	34.2 ± 5.7	4.44**
Fat (gm)	27.28 ± 2.6	23.30 ± 3.2	1.511 NS	28.07 ± 5.6	28.03 ± 7.1	0.027NS	25.6 ± 8.1	29.11 ± 2.3	4.68**
Calcium (mg)	223.63 ± 4.6	215 ± 5.9	15.854**	169.85 ± 9.4	162.59 ± 7.0	3.67**	208.75 ± 6.8	167.21 ± 4.9	43.76**
Iron (mg)	20.92 ± 0.26	19.8 ± 0.35	16.38**	20.2 ± 0.19	19.7 ± 0.61	5.211**	21.1 ± 0.8	20.0 ± 0.37	10.98**

*Significant at 5% level; **Significant at 1% level

**Fig. 1:** Comparison of mental well-being of hearing and VI adolescents**Table 4:** Comparison of mental and social well-being

Mental and social well-being	Hearing impaired (80)	Visually impaired (77)	p-value	Rural (68)	Urban (89)	p-value
Depression	11.8 ± 12.62	12.13 ± 11.15	0.748 NS	14.36 ± 12.84	16.98 ± 13.33	0.57 NS
Anxiety	12.63 ± 1.16	13.74 ± 9.57	0.79 NS	14.47 ± 12.92	14.93 ± 11.21	0.57 NS
Stress	19.75 ± 10.85	22.54 ± 9.97	0.202 NS	20.39 ± 11.10	22.81 ± 12.05	0.171 NS
Social well-being	17.20 ± 2.45	14.18 ± 2.69	0.37 NS	16.40 ± 2.18	19.33 ± 1.41	0.371 NS

NS, not significant

with the exception of carbohydrates. A similar trend was observed for VI adolescents, where urban participants consumed more nutrients than their rural peers. When comparing nutrient intake between HI and VI adolescents, the VI group consumed higher amounts of calories (3099 ± 142), carbohydrates (431 ± 13), and fat (29.11 ± 2.3) compared to the HI group (2520 ± 173 , 409 ± 16 , 25.6 ± 8.1 , respectively). However, calcium and iron intake were below the recommended levels across all groups and areas, showing significant differences based on both type of impairment and location. Symptoms of iron deficiency were particularly common among females in both groups.

Figure 1 shows that most participants had normal DASS-Y scores, with similar proportions in the HI (48.7%) and VI (45.8%) groups. Depression, anxiety, and stress were slightly higher in the VI group, particularly among urban participants. A greater percentage of VI individuals fell into severe (17.1%) and very severe (6.9%) categories of depression, anxiety (21.6%), and stress (severe: 16.0%, very severe: 8.3%), compared to HI individuals.

Table 4 indicates no significant differences between the two groups in depression, anxiety, stress, or social well-being. However, VI adolescents reported slightly higher levels of depression

(12.13 ± 11.15), anxiety (13.74 ± 9.57), and stress (22.54 ± 9.97) compared to their HI peers. Urban adolescents demonstrated better mental well-being than rural adolescents, although the differences were not statistically significant. Depression (16.98 ± 13.33) and stress (22.81 ± 12.05) scores were higher among urban adolescents compared to rural adolescents. Social well-being appeared to be lower among HI (17.20 ± 2.45) and urban adolescents (19.33 ± 1.41) compared to VI (14.18 ± 2.69) and rural adolescents (16.40 ± 2.18), though these differences were also not statistically significant ($p = 0.37$).

Table 5 reveals that the relationships between impairments and well-being indicators differ depending on the type of impairment and the rural or urban context. Nutritional status shows weak negative correlations with both types of impairments across all settings ($r = -0.29$; -0.19), indicating a consistent inverse relationship. Mental well-being exhibits strong positive correlations with impairments, especially hearing impairment in rural areas ($r = 0.96^{**}$) and visually impairment in urban areas ($r = 0.95^{**}$). Social well-being is positively correlated with hearing impairment in both contexts but negatively associated with visual impairment, particularly in urban areas ($r = -0.51$).

Table 5: Correlation between nutritional, mental and social well-being of hearing and VI adolescents

<i>Impairedness</i>	<i>Rural</i>			<i>Urban</i>		
	<i>Nutritional status</i>	<i>Mental well-being</i>	<i>Social well-being</i>	<i>Nutritional status</i>	<i>Mental well-being</i>	<i>Social well-being</i>
Hearing impaired	-0.34	0.96**	0.75**	-0.12	0.81**	0.64**
Visually impaired	-0.29	0.82**	-0.36	-0.19	0.95**	-0.51

**Correlation is significant at 0.01 level

DISCUSSION

The present study was conducted to compare the nutritional, mental, and social well-being of HI and VI adolescent students from urban and rural areas. The total sample size was 157, with 80 HI and 77 VI adolescents from the Chennai and Kanchipuram districts of Tamil Nadu state, India. In this study, a self-developed questionnaire with modified DASS-Y scale and SPIN inventory was employed.

Most participants in this study were male, aged 11–15 years, with impairments present since birth.²² Common health issues included dental problems among HI adolescents and ENT infections among VI adolescents.²³ While most had a healthy BMI, VI adolescents were shorter, more likely to be overweight/obese, and had higher WHR and TSF scores. These findings contrast with those commonly reported regarding undernutrition and over nutrition.^{24,25} Hearing-impaired adolescents from urban areas had significantly higher intakes of energy, calcium, and iron compared to those in rural areas. Visually impaired adolescents consumed more calories and carbohydrates than their HI counterparts. The intake of calcium and iron were less than the recommended level in both the groups from both the areas. Iron deficiency symptoms were common among females in both groups. Poor dietary intake was linked with impairments, while inadequate physical activity contributed to higher rates of overweight and obesity among VI adolescents. This may be due to low intake of protein, calcium, and iron. Similarly, malnutrition rates were higher among VI schoolchildren, particularly in rural areas and among those aged 14–18 years. Additionally, the vitamin C and calcium intake of girls, and the calcium intake of boys, were below the recommended values.^{26,27}

Mental health indicators were poorer among VI adolescents than among HI adolescents, consistent with the results of previous studies.²⁸ Mild psychological issues were reported in 40% of adolescents, moderate in 59%, and severe in 1%.^{14,29} Social well-being was low across participants, especially among urban HI adolescents than VI, as HI adolescents often feel social isolation, difficulty to communicate with others through sign language. A strong correlation between mental and social well-being was found in irrespective of disability or area of living.^{16,19}

CONCLUSION

The study found a higher prevalence of sensory impairments among male adolescents and firstborns, mainly due to congenital causes linked to dental and ENT issues. Nutritional deficiencies, particularly in protein, calcium, and iron, were more common among VI adolescents, while HI adolescents had better nutrient intake. Urban adolescents showed significantly better nutrient consumption than their rural counterparts.

Depression, anxiety, and stress were slightly higher in VI adolescents and more pronounced in urban areas. Mental and social well-being scores were higher in the VI group, with no significant rural–urban differences. Nutritional well-being was negatively impacted by both impairment and location, whereas mental and social well-being were positively associated with hearing

impairment and negatively with visual impairment, especially in urban settings.

Recommendations

The study recommends implementing nutritional guidelines and providing psychological, social, vocational, and educational support for sensory-impaired adolescents. It also emphasizes activating the role of counselors and psychologists within and beyond centers for sensory-impaired individuals.

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Ethical Approval

The Ethical Research Committee clearances and an informed consent were obtained from the Institutional Review Board, JBAS College for Women, and from the study participants before the commencement of study.

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RESEARCH ARTICLE

Social and Behavioral Determinants of Hypertension and its Associated Health Risk Indicators among Adults of Bonda Tribe: A Particularly Vulnerable Tribal Group of Odisha, India

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ABSTRACT

Hypertension is a major public health concern and a leading cause of mortality and disability. The present study assessed the prevalence and key determinants of hypertension among adults of the Bonda tribe in Malkangiri district of Odisha. A total of 432 adult individuals (≥ 18 years), including 227 females and 205 males, were included in this study. The overall prevalence of hypertension was 18.5%, 22.4% of which were males and 15.0% of which were females with either stage I or stage II hypertension. Additionally, 3.7% of the studies reported isolated systolic hypertension (ISH), and 6.2% reported isolated diastolic hypertension (IDH). Age and body mass index (BMI) were found to increase with increasing blood pressure. Frequent alcohol consumption [AOR = 2.852, 95% confidence interval (CI) = 1.268–6.413], tobacco use (AOR = 5.08, 95% CI = 2.090–12.345), and extra salt intake (AOR = 6.449, 95% CI = 2.927–14.210) were significantly ($p < 0.05$) associated with hypertension. The study emphasizes the growing public health concern of hypertension among the adult population of the Bonda tribe. High alcohol and tobacco usage, extra table salt intake, and older age and increased BMI were identified as key risk indicators for increasing blood pressure in this particularly vulnerable tribal group.

Keywords: Bonda, Hypertension, Odisha, Particularly vulnerable tribal group, Prevalence, Risk factor.

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INTRODUCTION

The tribal population in India makes up a sizable portion of the country's population, nearly 8.6% of the total population, with over 104.3 million individuals spread throughout more than 700 indigenous groups.¹ Odisha is the home of 64 tribal ethnic groups with the recent inclusion of two more ethnic groups, including 13 particularly vulnerable tribal groups (PVTGs), which constitute 22.8% of the total population of the state.^{1,2} The tribals are the endogamous population with a customary social system, living mainly in isolated hilly and forest areas with limited access to health care facilities;³ furthermore, the PVTGs are the most marginalized among tribals, with distinct features such as extreme physical isolation, stagnant or declining populations, extremely low literacy rates, pre-agricultural levels of technology, and subsistence levels of the economy.² Due to their distinct traditional lives and comparatively remote hills and forested environments, tribes are often thought to be inherently less affected by several cardiovascular diseases (CVDs), including hypertension, diabetes, and stroke. However, a general trend of rising hypertension among the tribal community has been seen in recent years, indicating an epidemiological shift among the adult Indian tribal population.⁴

Hypertension is a major public health concern and a leading cause of mortality and disability and is a serious, chronic medical condition that generally has no symptoms and is known as a silent killer (JNC-VII).^{5,6} Globally, approximately 1.3 billion adults are affected by hypertension, while India accounts for 33% of the global burden (34% male and 32% female).⁶ It is one of the major noncommunicable diseases (NCDs) that accounts for nearly 32% of the burden and approximately 9.1 million deaths in India as of 2019.⁶ According to National Family Health Survey (NFHS) data, the prevalence of hypertension has been increasing since the last two

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decades, both among rural and urban dwellers in Indian.^{7,8} Previous studies revealed an increasing trend of hypertension among the Indian tribal population over the last few decades.^{9,10} The increasing rate of hypertension is due to rapid urbanization, socioeconomic development, and changes in lifestyle pattern.¹¹

Hypertension studies regarding the prevalence and assessment of different cardiovascular health risks on vulnerable tribal populations at the community level are very scarce. Hence, the present study was aimed to assess the prevalence of hypertension and to measure its associations with different socio-behavioral key risk indicators among the adult tribal group of Bonda PVTG.

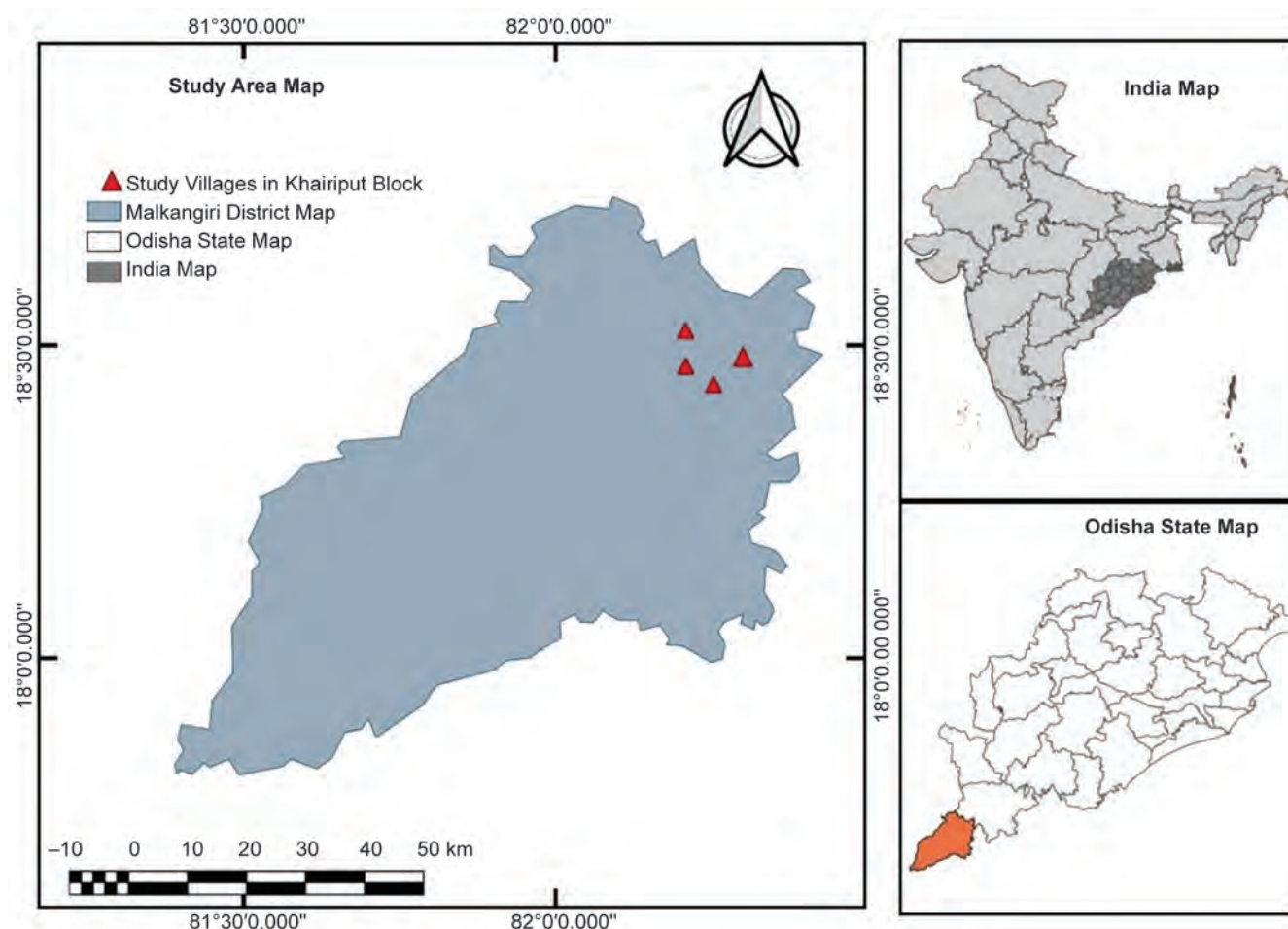


Fig. 1: Study area in Malkangiri district of Odisha, India

MATERIALS AND METHODS

Study Area and People

The present study was conducted among the Bonda tribe in the Malkangiri district of Odisha (Fig. 1). The Bonda are among the 13 PVTGs of Odisha and are found mainly in the Khairiput block of Malkangiri district (Ota A.B. and Mohanty S.C., 2018). According to the 2011 census, the total population of the Bonda community was approximately 12,000 (Census, 2010). The Malkangiri district is located in the southernmost part of Odisha, and the entire district lies between 17° 45' N and 18° 40' N latitudes and 81° 10' E and 82° E longitudes, with a height of 6,411 feet from sea level. Earlier, it was part of the undivided Koraput district and is one of the major districts, as it is home to many indigenous populations, including two important PVTGs (Bonda and Didayi), and its important geographical location is rich in natural resources and minerals (Government of Odisha, 2015).

Field Survey Design and Sample Size

A community-based cross-sectional study was carried out in the selected villages (Bandhaguda, Nuaguda, and Khuriguda) of the Bonda tribe in the Khairiput block of the Malkangiri district. The villages were randomly selected on the basis of the population

concentration of the Bonda tribe. The sample size was determined via the population proportion formula, which is based on the estimated prevalence of hypertension among the adult tribal population. The prevalence of hypertension was estimated at (p) 17% on the basis of a previous meta-analysis.¹⁰ A 95% confidence interval (CI) with a margin of error (d) of $\pm 4\%$ and a nonresponse rate of 5% was used to calculate the sample size. The required sample size was computed at 357, and to further improve validity, the total sample size of the study was increased to 432. The sample

size was calculated via the following formula:
$$n = \frac{Z^2 \cdot P \cdot (1-P)}{d^2}$$

where n = the required sample size

Z = value for 95% CI level (1.96)

P = prevalence rate

d = margin of error

Data Collection

A pretested structured schedule was employed to obtain data on household and sociodemographic characteristics. The schedule contained detailed questions regarding various sociodemographic indicators, including age, sex, educational status, family income pattern, occupation, alcohol consumption, smoking habits, and additional salt intake during meals.

Measurement and Classifications

Blood pressure (BP) was measured via the OMRON HEM 7120 Fully Automatic Digital BP Monitor. Blood pressure was measured, while the participants were in a seated position in the left arm with the apparatus at the level of the heart after they had sat comfortably for 5–10 minutes. A total of three measurements were taken at intervals of five minutes, and the average was recorded for the final measurement. The JNC-VII classification of BP was used to categorize hypertension. Individuals with systolic blood pressure (SBP) < 120 mm Hg and diastolic blood pressure (DBP) < 80 mm Hg are normal, and those with SBP between 120–139 mm Hg or DBP between 90–99 mm Hg are prehypertensive. Systolic blood pressure between 140 and 159 mm Hg or DBP ranging from 90 to 99 mm Hg is considered hypertension stage I, and SBP ≥ 160 mm Hg or DBP ranging from ≥ 100 mm Hg is considered hypertension stage II. Hypertension subtypes were further identified on the basis of SBP and DBP. Isolated systolic hypertension (ISH) was considered based on SBP ≥ 140 mm Hg and DBP < 90 mm Hg; isolated diastolic hypertension (IDH) was identified on the basis of SBP < 140 mm Hg and DBP ≥ 90 mm Hg; and systolic-diastolic hypertension (SDH) was determined by SBP ≥ 140 mm Hg and DBP ≥ 90 mm Hg.¹² Furthermore, anthropometric measurements, i.e., height and weight measurements, were taken to compute body mass index (BMI) by using a standard protocol and precautions. The height was measured with a standardized anthropometric rod to the nearest 0.1 cm, and the weight was measured by using a digital weighing machine (OMRON) to the nearest 0.1 kg. The BMI was calculated via the following formula:

$$\text{BMI} = \frac{\text{weight (kg)}}{\text{height (m}^2\text{)}}.$$

According to the WHO classification (Asian), a BMI > 18.5 is considered underweight, and a BMI between 18.5 and 22.9 is considered normal. A BMI between 23.0 and 24.9 is considered overweight, and a BMI ≥ 25 is considered obese.¹³

Data Analysis

Descriptive statistics, including the mean and standard deviation (SD), were employed to provide an overview of the data. Various statistical tests, such as the Chi-square test, *t*-test, and multivariate and linear logistic regression analyses, were applied to assess the strength and associations among different variables. In the multivariate logistic regression analysis, the hypertension category served as the dependent variable, with various potential risk factors, such as age-group, sex, occupation pattern, economic status, highest education level, alcohol use, tobacco use, extra salt intake, and BMI, as the independent variables. The dependent variable was categorized into two groups: Hypertensive (SBP ≥ 140 and/or DBP ≥ 90) and non-hypertensive (SBP ≤ 140 and/or DBP ≤ 90), with the non-hypertensive category selected as the reference category. The data were analyzed via IBM SPSS version 20.0. Throughout all tests, a significance level of *p* < 0.05 was considered statistically significant.

RESULTS

Table 1 presents the socioeconomic, behavioral, and lifestyle characteristics of the study participants. The study included a total of 432 adult individuals, among whom 42.75% were male and 53.25% were female. However, the age distribution shows that both males and females have equal representation across different age-groups, with the majority being between 18 and 29 years.

Table 1: General characteristics of the study population

Characteristics	Male N (%)	Female N (%)	χ^2 p-value
Age-group			0.944
18–29	76 (37.1)	91 (40.1)	
30–39	49 (23.9)	52 (22.9)	
40–49	35 (17.1)	33 (14.5)	
50–59	25 (12.2)	28 (12.3)	
≥60	23 (10.1)	20 (9.8)	
Marital status			0.036
Married	156 (76.1)	157 (69.2)	
Unmarried	35 (17.1)	37 (16.3)	
Other (widow/widower/ separated)	14 (6.8)	33 (16.3)	
Educational status			0.001
Non-literate	104 (50.7)	153 (67.4)	
Primary to middle	59 (28.8)	35 (15.4)	
High school and above	42 (20.5)	39 (17.2)	
Primary/major occupation			0.003
Agriculture/cultivation	87 (42.4)	68 (30.0)	
Forest-based occupation (hunting and gathering from forest)	40 (19.5)	74 (32.6)	
Labor (daily wage/agricultural)	52 (25.4)	47 (20.7)	
Job/business/other	26 (12.7)	38 (16.7)	
Economic status (updated BG prasad classification)			0.468
Lower	56 (27.3)	52 (22.9)	
Lower middle	46 (22.4)	63 (27.8)	
Middle class	77 (37.6)	79 (34.8)	
Upper middle class	26 (12.7)	33 (14.5)	
Alcohol consumption			0.000
Yes	124 (60.5)	91 (40.1)	
No	81 (39.5)	136 (59.9)	
Tobacco use			0.000
Yes	121 (59.0)	83 (36.6)	
No	84 (41.0)	144 (63.4)	
Extra salt during meal			0.000
Yes	82 (40.0)	129 (56.8)	
No	123 (60.0)	98 (43.2)	
BMI			0.000
Underweight	73 (35.6)	119 (52.4)	
Normal	108 (52.7)	97 (42.7)	
Overweight + Obese	24 (11.7)	11 (4.8)	

The data indicate that more males (76.1%) than females (69.2%) are married, whereas there are higher proportions of unmarried and widowed/separated females (16.3%) than males (6.8%). Education level significantly differed across genders (*p* < 0.05), with more literate males and more non-literate females (*p* < 0.05); however, 67.4% of females and 50.7% of males were non-literate. On the other hand, agriculture/cultivation is performed more often by

Table 2: Blood pressure traits and anthropometric characteristics of the study population

Variables	Total (Mean $\pm$ SD)	Male (N = 205) (Mean $\pm$ SD)	Female (N = 227) (Mean $\pm$ SD)	t	p
SBP	119.97 $\pm$ 16.68	122.23 $\pm$ 15.77	117.93 $\pm$ 17.26	-2.70	0.01
DBP	79.56 $\pm$ 10.42	80.33 $\pm$ 10.17	78.86 $\pm$ 10.62	-1.46	0.15
BMI	19.10 $\pm$ 2.72	19.71 $\pm$ 2.78	18.56 $\pm$ 2.54	4.51	0.000

males (42.4%), whereas females are more engaged in forest-related activities (32.6%). The distribution of economic status was similar for both sexes; thus, no significant difference was detected ($p > 0.05$). The majority of the males (60.5%) reported drinking alcohol compared with the females (40.1%), and similarly, the majority of the males (59%) smoked or chewed tobacco compared with the females (36.6%). However, more women (56.8%) reported adding extra salt to their meals than their male counterparts (40%), which was a significant difference ($p < 0.05$). The distribution of BMI categories showed significant sex-based differences ($p < 0.05$). A substantial proportion of females (52.4%) were underweight, and more males were overweight or obese (11.7%), whereas 35.6% of males were underweight, and 4.8% of females were overweight or obese.

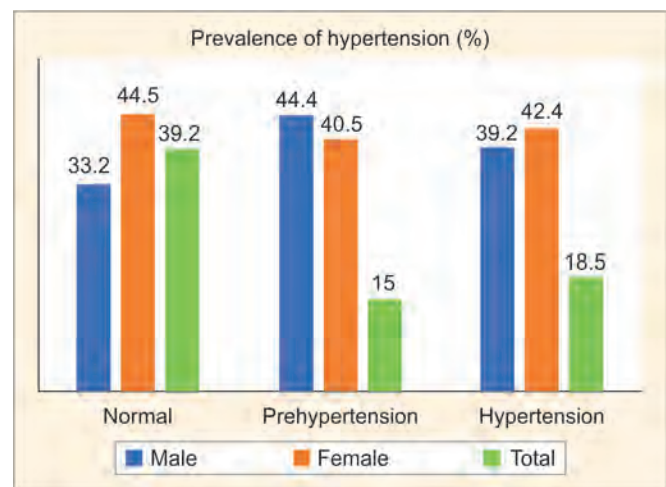
Table 2 shows the descriptive statistics of the BP traits and anthropometric characteristics of the studied community. The study revealed that males presented significantly greater mean SBP than females did. Similarly, a similar pattern was observed for the mean DBP. Males had a greater mean DBP (80.33 $\pm$ 10.17) than females did (78.86 $\pm$ 10.62); however, the difference was not statistically significant ($p > 0.05$). Furthermore, the mean BMI values of the male and female groups were estimated to be 19.10 $\pm$ 2.72 and 19.71 $\pm$ 2.78, respectively, and the difference was significant ($p < 0.05$).

The present study estimated that approximately 12% of individuals had high-SBP, with 15.1% of males and 9.3% of female adults, whereas approximately 15% of individuals had high diastolic blood pressure, with 17.1% of males and 13.2% of female adults. Overall, 18.5% of the adult Bonda were hypertensive, 42.4% were prehypertensive, and 39.2% were normal. Among the total hypertensive patients, 13.7% had stage I hypertension, and 4.9% had stage II hypertension. A significant difference ($p = 0.010$) in the prevalence of high BP was detected between males and females; 22.4% of males and 15% of females had hypertension (Table 3). As Figure 2 illustrates, the prevalence of overall hypertension was higher among males as compared to females. Additionally, the study reported the distribution of hypertension subtypes among the study participants. As shown in Figure 3, 8.6% of the individuals were found to have SDH, with 3.9% being male and 4.7% being female. However, 3.7% of individuals with ISH and 6.2% of individuals with IDH were reported. Table 4 shows that an increasing trend of hypertension (stage I and stage II) was observed with increasing in the age. The results also revealed a statistically significant difference ($p < 0.001$) in the overall incidence of hypertension across age-groups among male and female individuals.

Table 5 presents the influence of several behavioral risk factors and other major risk indicators as determined through the outcomes of a multivariate logistic regression analysis. Adults aged 50–59 and 60 years or above presented 12- and 9-fold increased risks of developing hypertension, respectively (AOR = 12.128, 95% CI = 3.387–43.436; AOR = 9.044, 95% CI = 2.453–33.345). Similarly, a substantial predisposition of nearly 5.3 times greater risk for hypertension was observed among the married individuals (OR = 5.346, 95% CI = 1.238–23.086). Individuals who were frequent

Table 3: Gender-specific distribution of the prevalence of hypertension among the study population

<i>Variables</i>	<i>Male N (%)</i>	<i>Female N (%)</i>	<i>Total N (%)</i>	<i>χ² p-value</i>
Systolic blood pressure				
Normal	92 (44.9)	130 (57.3)	222 (51.4)	0.003
Prehypertension	82 (40.0)	76 (33.5)	158 (36.6)	
Hypertension stage-I	29 (14.1)	14 (6.2)	43 (10.0)	
Hypertension stage-II	2 (1.0)	7 (3.1)	9 (2.0)	
Systolic hypertension (stage I + stage II)	31 (15.1)	21 (9.3)	52 (12.0)	
Diastolic blood pressure				
Normal	92 (44.9)	117 (51.5)	209 (48.4)	0.366
Prehypertension	78 (38.0)	80 (35.2)	158 (36.6)	
Hypertension stage-I	27 (13.2)	20 (8.8)	47 (10.9)	
Hypertension stage-II	8 (3.9)	10 (4.4)	18 (4.2)	
Diastolic hypertension (stage I + stage II)	35 (17.1)	30 (13.2)	65 (15.1)	
SBP-DBP blood pressure				
Normal	68 (33.2)	101 (44.5)	169 (39.2)	0.010
Prehypertension	91 (44.4)	92 (40.5)	183 (42.4)	
Hypertension stage-I	38 (18.5)	21 (9.3)	59 (13.7)	
Hypertension stage-II	8 (3.9)	13 (5.7)	21 (4.9)	
Overall hypertension (stage I + stage II)	46 (22.4)	34 (15.0)	80 (18.5)	

**Fig. 2:** Prevalence and distribution of hypertension

drinkers of alcohol were at 2.9 times greater risk of developing hypertension (AOR = 2.852, 95% CI = 1.268–6.413). The use of

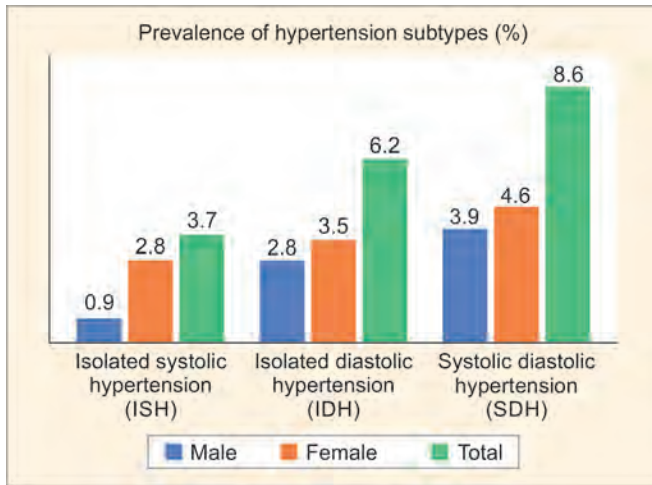


Fig. 3: Prevalence and distribution of hypertension subtypes

tobacco significantly increased the risk of developing hypertension nearly 5-fold (OR = 5.08, 95% CI = 2.090–12.345). Individuals who consumed extra table salt during meals were also significantly more likely to develop hypertension (AOR = 6.449, 95% CI = 2.927–14.210). A higher BMI (overweight and obese) was shown to render 2.7-fold more hypertensive people in this community (AOR = 2.709, 95% CI = 0.838–9.295), but this finding was not statistically relevant, as the number of overweight and obese individuals was too small to compare. However, normal individuals were 2.4 times more likely to develop hypertension than underweight individuals were (AOR = 2.486, 95% CI = 1.188–5.125). Moreover, no significant increase ($p < 0.05$) in hypertension was noted with respect to sex, educational status, or economic condition among the study population.

DISCUSSION

In India, an increase in the prevalence of hypertension in both urban and rural populations was observed. Recently, the nationwide survey NFHS-5 (2019–2021) indicated that the prevalence of hypertension has increased among both rural and urban inhabitants of the Indian population.⁷ The increasing incidence of hypertension, along with the increased prevalence of prehypertension and ISH, has been a major health concern among the Indian tribal population.¹⁴

The findings of the present study revealed a notable prevalence of hypertension in 18.5% of adult individuals in the Bonda community. Compared with national and state averages, the present study revealed a lower rate of prevalence than the 24% reported among males and 21.3% reported among females in the Indian population.⁷ Similarly, Odisha's overall prevalence of 25.6% among males and 22.4% among females with high BP is greater than that reported in the present study. A meta-analysis by Rizwan et al. and Hazarika and Babu reported a pooled prevalence of approximately 16% hypertension among tribals in India, indicating a lower prevalence rate than that reported in the current study.^{9,10}

The findings of the present study reported a higher prevalence than many previous studies among indigenous communities. A study by Satapathy et al. reported a prevalence of 9.26% hypertension among the Juang community of the Keonjhar district of Odisha.¹⁵ Additionally, Satapathy et al. reported a lower rate of hypertension among the Bhumija (12.59%) and Savara (9.76%) tribes of Odisha than did the current study.¹⁶ A recent study

conducted on the Sabara and Munda tribes of Odisha reported a combined prevalence of 16.7%.¹⁷ Consistent with these findings, several previous studies on the tribal population reported a higher prevalence rate of hypertension among Munda (38.33%) and Bhumija (21.01%) tribals of Odisha.^{16,18} Furthermore, Kshatriya and Acharya reported a higher prevalence of hypertension in their study among Santal (19.1%), Bhumija (29.3%), and Bathudi (24%).¹⁹ Similarly, Singh et al. reported a prevalence of hypertension of 11.43% among the tribal population of high-altitude areas in a meta-analysis.²⁰ A similar study involving the adult tribal population of the Baster district of Chhattisgarh reported a prevalence of high BP of 47.3%.²¹ Lugun et al. and Barik et al. reported hypertension incidences of 18 and 18.7%, respectively, among the tribes of Jharkhand (18%) and Santal (18.7%) of Odisha.²² Additionally, Negi et al. reported a prevalence of hypertension of 19.7% among the tribals of the Kinnur district of Himachal Pradesh.²³

Hypertension subtypes are among the most underrated risk factors for CVD morbidity and mortality.²⁴ This differential increase in systolic and DBP results in various hypertension subtypes with different clinical implications.²⁵ The present study revealed that the prevalence of SDH was 8.6%, followed by IDH at 6.2% and ISH at 3.7%. Similarly, Borah et al. reported a prevalence of 6.49% for SDH, followed by IDH at 3.43%.²⁶ Furthermore, a study conducted by Kshatriya and Acharya reported a pooled prevalence of 11.6% of ISH among nine tribal groups in India.¹⁴ In this study, a greater prevalence of hypertension was observed among males than females, although the difference was not statistically significant. This finding aligns with many previous studies.^{16,17,27–29} However, earlier studies among different tribal groups presented a contrasting pattern, with females exhibiting a higher risk of hypertension than their male counterparts.^{30,31} The present study revealed that the odds of developing hypertension increased with increasing age; however, older individuals (≥ 50 years) presented greater odds than their counterparts did. In parallel with the current results, several previous studies reported a consistent increase in odds with increasing age.^{17,21,23,27,29}

Earlier studies have indicated that individuals with lower levels of education have a greater prevalence of high BP, highlighting a strong correlation between education level and hypertension.^{27,30} However, the current study did not find a significant correlation between higher rates of high BP and lower educational attainment. This could be explained by the fact that the majority of the study population consisted of non-literate people, with very few having completed higher education. Interestingly, this observation is consistent with the findings of a study carried out among different tribal groups in India.^{17,31} As hypertension is a multifactorial disease, the occupation category of individuals also has a specific effect on increasing hypertension. Earlier studies reported the significance of the relationship between occupation status and increased BP levels among individuals.^{21,29} However, no such associations were observed in the current study. This may be because the majority of the respondents were engaged in their traditional occupations (cultivation and forest-based livelihoods), but in many cases, it has also been observed that the Bonda seasonally migrate to other places in search of a livelihood. Individuals with a lower socioeconomic background are often burdened by a high prevalence of prehypertension and hypertension. Some studies have linked family economic conditions with the rising BP of individuals and established a significant relationship.^{32–34} However, in this study,

Table 4: Age-group-specific distribution of the prevalence of hypertension in the study population

Variables	Age-group N (%)					χ^2 p-value
	18–29	30–39	40–49	50–59	≥60	
Systolic blood pressure						
Normal	103 (61.7)	54 (53.5)	39 (57.4)	16 (30.2)	10 (23.3)	0.000
Prehypertension	59 (35.3)	40 (39.6)	19 (27.9)	22 (41.5)	18 (41.9)	
Hypertension stage I	4 (2.4)	5 (5.0)	9 (13.2)	15 (28.3)	10 (23.3)	
Hypertension stage II	1 (0.6)	2 (2.0)	1 (1.5)	0 (0.0)	5 (11.6)	
Systolic hypertension (stage I + stage II)	5 (3.0)	7 (7.0)	10 (14.7)	15 (28.3)	15 (34.9)	
Diastolic blood pressure						
Normal	101 (60.5)	45 (44.6)	31 (45.6)	19 (35.8)	13 (30.2)	0.000
Prehypertension	57 (34.1)	43 (42.6)	24 (35.3)	19 (35.8)	15 (34.9)	
Hypertension stage I	6 (3.6)	8 (7.9)	9 (13.2)	12 (22.6)	12 (27.9)	
Hypertension stage II	3 (1.8)	5 (5.0)	4 (5.9)	3 (5.7)	3 (7.0)	
Diastolic hypertension (stage I + stage II)	9 (5.4)	13 (12.9)	13 (19.1)	15 (28.3)	15 (34.9)	
SBP-DBP blood pressure						
Normal	84 (50.3)	39 (38.6)	26 (38.2)	13 (24.5)	7 (16.3)	0.000
Prehypertension	72 (43.1)	48 (47.5)	26 (38.2)	19 (35.8)	18 (41.9)	
Hypertension stage I	8 (4.8)	9 (8.9)	12 (17.6)	18 (34.0)	12 (27.9)	
Hypertension stage II	3 (1.8)	5 (5.0)	4 (5.9)	3 (5.7)	6 (14.0)	
Overall hypertension (stage I + stage II)	11 (6.6)	14 (13.9)	16 (23.5)	21 (39.7)	18 (41.9)	

no such associations were observed among the different income categories and BP traits. This might be because the studied indigenous community has shown an almost unilinear pattern of family income, and no such disparities have been observed among them. The odds of developing hypertension were nearly three times greater among those who consumed alcohol frequently than among their counterparts. Many studies have reported findings that are in line with the current findings.^{23,27,33,35} This situation among the Bonda community may be due to certain changes in their habits toward alcoholic foods and beverages. Although the Bondas are generally frequent consumers of their traditionally made alcohol or liquor (*Handia*, *Salapa*, *Mahuli*, and other locally prepared liquor or *mada*), recent observations reveal a shift in their age-old alcohol due to the introduction of foreign liquor available in nearby towns or in the local weekly market.

In this study, the prevalence and extensive intake of tobacco in the form of either chewing or smoking were observed among the study participants. Specifically, male individuals were observed smoking (bidi, cigarette), whereas both males and females were found to frequently indulge in the consumption of smokeless tobacco or chewing tobacco (Dukuta). The study revealed that the likelihood of developing high BP is almost five times greater among those who use tobacco more frequently than among their counterparts. Similarly, studies conducted by Sajeew et al., Meshram et al., and Giri et al. reported findings parallel to those of the current study.^{17,21,35} However, many other studies reported results contrary to those of the current study.^{29,30} Furthermore, the results of the current study revealed that the likelihood of developing hypertension is six times greater among those who

consume extra salt during meals. Likewise, the studies conducted by Chakma et al. and Meshram et al. were reported to be the same and are in line with the current study.^{21,27} This situation may be because excess salt intake increases the likelihood of fluid retention and hypertension.³⁶

The present study revealed that the odds of developing hypertension among overweight and obese individuals were greater than those among their other counterparts, although no significant difference was observed. Several studies have established a clear relationship between an increase in BMI and an increase in high BP, similar to the present study.^{23,27,28,31,35} However, some studies did not find any significant associations with higher BMI categories.^{17,30}

CONCLUSION

The study emphasizes the growing public health concern of prehypertension and hypertension among the adult population of the Bonda tribe. High alcohol and tobacco usage, extra table salt intake, and older age and increased BMI were identified as key risk indicators for increasing BP in this particularly vulnerable tribal group. These findings underline an alarming rise in cardiometabolic risk and the critical need for community-specific health interventions and policies to address the root causes. Culturally sensitive health awareness initiatives should focus on lowering substance abuse, promoting healthy eating habits, and health education. Furthermore, routine health screenings at the community level should be integrated into the public health system for early detection and monitoring of the increasing risk of hypertension.

Table 5: Multivariate logistic regression analysis of hypertension and associated risk factors

Variables	Total (N)	Hypertension (SBP $\geq$ 140 and DBP $\geq$ 90) N (%)	COR (95% CI)	p-value	AOR (95% CI)	p-value
Age-group						
18–29	167	11 (6.58)	Ref			
30–39	101	14 (13.86)	2.282 (0.993–5.245)	0.052	2.803 (0.914–8.595)	0.071
40–49	68	16 (23.53)	4.364 (1.904–0.001)	0.000	5.299 (1.715–16.375)	0.004
50–59	53	21 (39.62)	9.307 (4.088–1.188)	0.000	12.128 (3.387–43.436)	0.000
$\geq$ 60	43	18 (41.86)	10.211 (4.318–4.149)	0.000	9.044 (2.453–33.345)	0.001
Sex						
Male	205	46 (22.43)	1.642 (1.006–2.686)	0.047	1.733 (0.865–3.472)	0.121
Female	227	34 (15.0)	Ref			
Marital status						
Married	313	62 (19.80)	0.463 (0.168–1.275)	0.136	5.346 (1.238–23.086)	0.025
Unmarried	72	8 (11.11)	0.914 (0.431–1.938)	0.815	2.594 (0.929–7.241)	0.069
Other (Widow/Separated)	47	10 (21.27)	Ref			
Educational status						
Non-literate	257	54 (21.01)	3.725 (1.544–8.988)	0.003	2.277 (0.593–8.751)	0.231
Primary to middle	94	13 (13.83)	2.373 (0.875–6.439)	0.090	2.909 (0.789–10.730)	0.109
High school and above	81	7 (8.64)	Ref			
Economic status (Updated BG Prasad classification)						
Lower	108	23 (21.30)	1.326 (0.583–3.015)	0.501	0.718 (0.221–2.334)	0.582
Lower middle	109	18 (16.51)	0.969 (0.415–0.262)	0.942	0.762 (0.230–2.532)	0.658
Middle class	156	29 (18.58)	1.119 (0.507–2.467)	0.781	0.805 (0.267–2.430)	0.701
Upped middle class	59	10 (16.95)	Ref			
Primary occupation						
Agriculture/Cultivation	155	25 (16.12)	1.289 (0.569–2.921)	0.543	0.529 (0.159–1.761)	0.300
Forest-based occupation (hunting and gathering from forest)	114	16 (14.03)	1.806 (0.788–4.139)	0.163	1.475 (0.471–4.620)	0.505
Labor (Daily Wage/Agricultural)	99	18 (18.18)	1.358 (0.569–3.243)	0.491	0.801 (0.225–2.854)	0.732
Job/Business/Other	64	21 (32.81)	Ref			
Alcohol use						
Yes	215	69 (32.10)	8.851 (4.526–17.308)	0.000	2.852 (1.268–6.413)	0.011
No	217	11 (5.07)	Ref			
Tobacco use						
Yes	204	71 (34.80)	12.990 (6.284–6.853)	0.000	5.080 (2.090–12.345)	0.000
No	228	9 (3.94)	Ref			
Extra intake of table salt during meal						
Yes	211	67 (31.75)	7.444 (3.961–3.990)	0.000	6.449 (2.927–14.210)	0.000
No	221	13 (5.88)	Ref			
BMI						
Overweight + Obese	35	11 (31.42)	2.130 (0.953–4.760)	0.065	2.790 (0.838–9.295)	0.095
Normal	205	35 (17.07)	0.957 (0.569–1.608)	0.867	2.468 (1.188–5.125)	00.015
Underweight	192	34 (17.70)	Ref			

Reference Category: Non-hypertensive; 95% CI, confidence interval; AOR, adjusted odds ratio; COR, crude odds ratio; DBP, diastolic blood pressure; HTN, hypertension; SBP, systolic blood pressure

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DECLARATIONS

Ethics Statement and Informed Consent

The study was approved by the Institutional Ethical Committee (IEC-Human) of Utkal University (IEC reference No. IEC/UU/2022-06). The objectives and purpose of the study were explained to the community members, and informed consent, including consent to participate and consent to publish, was obtained from all the participants involved in the study.

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A Study on Determinants of Child Mortality in Bongaigaon District, Assam, India

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ABSTRACT

The trend of child mortality is one of the important markers of a country's social and economic development. A declining value of child mortality depicts a nation's overall development. Hence, the study on the trend of child mortality is a need of the hour to access the health status of a region. The broad objective of this study is to assess the health status of children by studying the distribution of neonatal and postneonatal mortality in Bongaigaon district of Assam, India. This study reveals that mortality among children is influenced by sex of the child, religion of the household, the mother's education level, and health institution type. It has also been observed that these aforesaid variables impact is different for neonatal and postneonatal mortality. Furthermore, this work successfully identifies the main causes of neonatal and postneonatal mortality as birth asphyxia and birth trauma, which can be easily prevented.

Keywords: Causes of child mortality, Health status, Neonatal and postneonatal mortality.

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INTRODUCTION

The trend of child mortality is one of the important markers of a country's social and economic development. A declining value of child mortality depicts a nation's overall development. Hence, the study on the trend of child mortality is a need of the hour to access the health status of a region.

According to World Health Organization (WHO) "Child Mortality refers to the death of any child under the age of 5 years. It has smaller groups. Perinatal refers to a fetus, a living organism, but not yet born. Neonatal refers to child death within 1 month, or 28 days, of birth. Infant refers to the death of a child before their first birthday or within 12 months of life. Lastly, the under-five mortality rate (UFMR) refers to children who die under the age of 5 or within the first 5 years of life."¹

In global scenario, UFMR rate was reduced from 93 in 1990 to 37 deaths per 1,000 live births in 2022 and infant mortality rate (IMR) declined from 65 deaths per 1,000 live births in 1990 to 28 deaths per 1,000 live births as in 2022.² Regionally, neonatal mortality was highest in Sub-Saharan Africa and South Asia, with the neonatal mortality rate estimated at 27 and 22 deaths per 1,000 live births, respectively, in 2022. However, in India, infant mortality and under-five mortality is relatively high which is 41 and 50 per 1,000 live births, respectively, as per NFHS-4.² According to NFHS-5, in India the IMR and child mortality is reduced to 35 and 42 per 1,000 live births, respectively.³

The IMR of Assam has been improving with time, but the situation is still not up to the mark compared to several other parts of the country. In Assam, during 1998, the IMR was 76 per 1,000 live births, and in 2014, it has reduced to 49 per 1,000 live births. According to NFHS-5, the IMR of Assam has been reduced from 47.6 to 31.9 per 1,000 live births. Similarly, the UFMR has been decreased from 56.5 to 39.1 per 1,000 live births.³

The millennium development goal (MDG) 2015 committed to reduce all preventable neonatal and child deaths by the end of 2030. It aims to decrease neonatal mortality to as low as 12 per 1,000 live births and under-five mortality to at least as low as 25 per 1,000 live

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births.^{4–6} However, according to the report of NFHS-5 (2019–2020), child mortality in India, as well as in Northeastern states, is relatively high. Hence, India is incompetent to attain the MDG of 2015 to reduce child mortality by 2030. Therefore, intervention focusing on reducing infant mortality and under-five mortality should be taken.

This high rate of child mortality is the indication related to public and community problem. Hence, the ongoing study will help to catalyze in assessment of the health status of children which will end up in the overall development of the nation.

Infant and child mortality rates are the third highest in Assam when compared to other Northeastern states, despite the higher level of socioeconomic development.³ The district Bongaigaon of state Assam has been chosen on the basis of purposive sampling for the study because of the familiarity with the language, socioeconomic and sociocultural conditions of the people.

The objectives of this study are:

- To study the distribution of neonatal and postneonatal mortality by background characteristics of the household.
- To identify the principal causes of neonatal and postneonatal death in Bongaigaon district.
- To depict the correlation among variables viz. sex of the infant, religion of the household, caste of the household, education level of the mother, type of death, and place of death.

- To describe the association among type of death with place of death of infants and caste of the household in Bongaigaon district.

METHODOLOGY

This study was conducted in the Bongaigaon district of Assam, located at 26°28'37"N and 90°33'30"E. Both primary and secondary data were collected, and a proper questionnaire was prepared to collect the primary data. Questions were framed according to the objectives of the study. Primary data were collected for the following variables: Religion, caste, and education level of mother. Secondary data were collected by using the Government website: http://nhmssd.assam.gov.in/DashBoard/infpth_index2.php.⁷ The time period of this study spans from March 2018 to March 2023.

The detailed description of the dataset along with the variables used for analysis and interpretation are discussed below:

Type of data	Description of the variable
Health institution	Here 25 different health institutions are considered and mentioned in Appendix of this study
Health institution type	Categorized as government and private
Date and time of birth	Children born between March 2018 and March 2023
Date and time of death	Children died between March 2018 and March 2023
Sex of the infant	Categorized as male and female
Religion of the household	Categorized as Hindu, Muslim, and Christian
Caste of the household	Categorized as General, SC, ST, and OBC
Education level of the mother	Categorized as illiterate, primary, middle, matric, class XII, graduate
Type of death**	Categorized as neonatal and postneonatal death
Cause of death	As mentioned in Table 1
Place of death	Categorized as home, in transit, health facility

**Type of death determined by subtracting date and time of birth and date and time of death; Name of the health institutions: Abhayapuri, Amguri, Argya, Balachar, Barjana, Bidyapur, Bishnupur, Boitamari, Bongaigaon Civil, BPHC, BPHC, Chakla, Chalantapara, Chilarai, DDWH, DEIC, Lower Assam Hospital, Kharija PCH, Lengtisinga, Manikpur Srijangram, Salabara, Santoshpur, Sidalsati, SNCU, Swagat

An appropriate statistical tool was used to study the status of mortality of this region. RStudio, which is a free and open-source software, was used to analyze the data.

FINDINGS AND DISCUSSION

From Table 1, it is observed that females outnumbered male neonatal deaths, which is contrary to postneonatal deaths. There are three categories of religion of the household viz. Hindu, Muslim, and Christian. Among these, both neonatal and postneonatal deaths are higher in households following the Muslim religion. A significantly lower percentage of neonatal and postneonatal deaths is observed whose mothers' education level is class XII and graduate as compared to mother having education level primary

Table 1: Distribution of neonatal and postneonatal mortality by background characteristics of the household

Sociodemographic variables	Type of death		Total
	Neonatal	Postneonatal	
Sex of the infant			
Male	241 (47%)	153 (53%)	394
Female	272 (53%)	136 (47%)	408
Total	513	289	802
Religion of the household			
Hindu	203 (40%)	136 (47%)	339
Muslim	300 (59%)	145 (50%)	445
Christian	9 (1%)	8 (3%)	17
Total	512	289	801
Education level of the mother			
Illiterate	58 (11%)	35 (12%)	93
Primary	124 (24%)	70 (24%)	194
Middle	145 (28%)	83 (29%)	228
Matric	103 (20%)	70 (24%)	173
Class XII	61 (12%)	27 (9%)	88
Graduate	21 (5%)	4 (2%)	25
Total	512	289	801
Health institution type			
Govt.	407 (79%)	241 (83%)	648
Private	106 (21%)	48 (17%)	154
Total	513	289	802

and middle. Health institution type is categorized as government and private. About 79% of neonatal deaths occurred in government institution as compared to 21% in private. Similarly, in the case of postneonatal deaths, 83% deaths occurred in government institution as compared to 17% in private.

Four primary causes, namely birth asphyxia and birth trauma (42%), prematurity and low birth rate (18.80%), others (12.30%) and pneumonia (10.10%) accounted for 83.20% neonatal and postneonatal deaths in Bongaigaon district. The table depicts birth asphyxia and birth trauma as the major cause of death. Birth asphyxia is caused by lack of oxygen and blood flow during birth. This can be prevented by closely monitoring the baby and mother at the time of birth and taking proper medical and prenatal care. The second major cause of infant death is prematurity and low birth rate. Prematurity refers to babies being born alive before 37 weeks of pregnancy are completed. According to WHO (2023), the majority of preterm babies are born in Southern Asia and Sub-Saharan Africa, and most of them die. Deaths and complications from prematurity may be prevented by inducing healthy pregnancy programs, as mentioned in WHO's antenatal care guidelines. Pregnant women may be counseled on maintaining a healthy diet, optimal nutrition, on ill effect of smoking or substance use, and making at least eight contacts with health professionals. The third major cause is others which include some other preventable causes which are not categorized in Table 2. If the symptoms and complications in individual babies are identified and treated early, many of these deaths can be easily prevented. Pneumonia, which constitutes about 10% of infant deaths in Bongaigaon district, is largely due to weak immune system of babies. Because a good immune system baby can easily fight the infection with natural defenses. Some of the factors that may increase an infant's susceptibility to pneumonia

Table 2: Principal causes of neonatal and postneonatal death in Bongaigaon district

<i>Causes of death</i>	<i>Number of death</i>	<i>Number of death (%)</i>
Accident	3	0.40%
Anemia and Hyperbilirubinemia	2	0.20%
Birth asphyxia and birth trauma	337	42.00%
Birth defect	2	0.20%
Diarrheal diseases	14	1.70%
Drowning	4	0.50%
Fever	11	1.40%
Hypothermia	17	2.10%
Meningitis	9	1.10%
Others	99	12.30%
Pneumonia	81	10.10%
Prematurity and low birth rate	151	18.80%
Respiratory problem	9	1.10%
Sepsis	48	6.00%
Unknown	15	1.90%

Table 4: Cross tabulation among type of death and place of death in Bongaigaon district

<i>Type of death</i>	<i>Place of death</i>			<i>Total</i>
	<i>Home</i>	<i>Health facility</i>	<i>In transit</i>	
Neonatal	138 (27%)	301 (59%)	74 (14%)	513
Postneonatal	175 (61%)	78 (27%)	36 (12%)	289
Total	313	379	110	802

p -value = 0.000 (<0.001)

Table 5: Cross tabulation among type of death and caste of the household in Bongaigaon district

<i>Type of death</i>	<i>Caste of the household</i>				<i>Total</i>
	<i>General</i>	<i>OBC</i>	<i>SC</i>	<i>ST</i>	
Neonatal	345 (67%)	105 (21%)	35 (7%)	28 (5%)	513
Postneonatal	166 (58%)	66 (23%)	24 (8%)	32 (11%)	288
Total	511	171	59	60	801

p -value = 0.009 (<0.05)

Table 3: Strength of relation among the variables

<i>Sociodemographic variables</i>	<i>Sex of the infant</i>	<i>Religion of the household</i>	<i>Caste of the household</i>	<i>Education level of the mother</i>	<i>Type of death</i>	<i>Place of death</i>	<i>Health institution type</i>
Sex of the infant		0.022	-0.031	-0.01	-0.057	0.016	0.048
Religion of the household				-0.324**	-0.058	-0.043	-0.170**
Caste of the household				0.207**	0.117**	0.063	0.352**
Education level of the mother					-0.04	0.096**	0.152**
Type of death						-0.251**	-0.049
Place of death							0.181**

**Correlation is significant at the 0.01 level (2-tailed)

are indoor air pollution due to use of biomass fuel, living in crowded houses and parental smoking. Apart from this 4 major causes of death, other causes of infant deaths as mentioned in Table 2 are accident, anemia and hyperbilirubinemia, birth defects, diarrheal diseases, drowning, fever, hypothermia, meningitis, respiratory problem, sepsis, and unknown causes. Almost all of these causes of death can be prevented by taking utmost and prompt interventions.

Table 3 measures the strength of relationships among the variables. A significant relationship is observed between the religion of the household and both the education level of the mother and health institution type. The variable caste of the household is significantly related with education level of the mother, type of death, and health institution type. The aforementioned table also shows a significant association of education level of the mother with place of death and health institution type. The variables type of death and place of death are highly significantly related. A significant relation is observed among place of death and health institution type.

Table 4 clearly portrays that 59% of neonatal deaths occur in health facility as compared to 27 and 14% at home and in transit, respectively. On the other hand, 61% postneonatal deaths occur at home and 27%, and 12% deaths occur at health facility and in transit, respectively. Further, a p -value of 0.000 leads us to agree that both the variables type of death and place of death of the infants are strongly statistically significant. Therefore, it can be concluded

that the place of death and neonatal and postneonatal mortality is significantly associated.

Table 5 represents the caste-wise neonatal and postneonatal deaths. It is observed that more neonatal deaths occurred among families belonging to the general caste, compared to postneonatal deaths. However, postneonatal deaths are more in families belonging to OBC, SC, and ST communities as comparison to neonatal deaths. Since the p -value is 0.009, which is less than 0.05, we may conclude that caste of the household and neonatal and postneonatal mortality is strongly correlated.

CONCLUSION AND RECOMMENDATIONS

This study reveals that mortality among children is influenced by the sex of the child, religion of the household, mother's education level and health institution type. It has also been observed that these aforesaid variables impact is different for neonatal and postneonatal mortality. Furthermore, this work successfully identifies the main cause of neonatal and postneonatal mortality as birth asphyxia and birth trauma, which can be easily prevented. A significant relation is found among type of death (viz. neonatal and postneonatal mortality) with caste of the household and place of death.

The results observed in this study provide a clear picture of the existing scenario of neonatal and postneonatal mortality in the

Bongaigaon district and also in general represents those places which have similar socioeconomic conditions. Existing policies and programs should be revisited, and tailored incentives are to be taken to improve the health conditions of the children in this part of the world.

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Institutional Deliveries in India: A Pathway to Reducing Maternal and Neonatal Mortality

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ABSTRACT

Institutional deliveries are pivotal in reducing maternal and neonatal mortality by ensuring skilled attendance and access to emergency obstetric care. This study investigates trends in institutional deliveries across public and private healthcare sectors in India, utilizing data from the National Family Health Survey rounds 4 (2015–2016) and 5 (2019–2021). The findings reveal a significant increase in institutional delivery rates over two decades, driven by policy interventions such as the Janani Suraksha Yojana and Janani Shishu Suraksha Karyakram. However, disparities persist across regions, socioeconomic groups, and the urban–rural divides, with northern and eastern states lagging behind. The analysis establishes a correlation between higher institutional delivery rates and reduced maternal/neonatal mortality, emphasizing the need for equitable healthcare access. Recommendations include strengthening public health infrastructure, promoting awareness, enhancing financial accessibility, and implementing region-specific strategies. These measures aim to bridge existing gaps and advance progress toward the sustainable development goals related to maternal and child health. The study underscores the critical role of collaborative efforts in achieving universal institutional delivery coverage and improving overall public health outcomes.

Keywords: India, Institutional deliveries, Maternal health, Neonatal health, National Family Health Survey, Public health, Regional disparities.

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INTRODUCTION

Childbirth is a critical event that profoundly impacts the lives of women, families, and societies at large. Ensuring a safe childbirth experience requires robust healthcare systems and equitable access to quality healthcare services. Institutional deliveries, defined as childbirths occurring in healthcare facilities under the supervision of trained healthcare professionals, have been widely recognized as a cornerstone in reducing maternal and neonatal mortality.¹ These deliveries provide a controlled environment with access to emergency obstetric care, skilled birth attendants, and necessary medical interventions, thereby mitigating risks associated with childbirth complications.

Globally, maternal mortality remains a significant public health challenge. According to the World Health Organization (WHO), approximately 2,95,000 maternal deaths were recorded worldwide in 2017, with the majority occurring in low- and middle-income countries.² The sustainable development goals (SDGs), particularly Goal 3.1, aim to reduce the global maternal mortality ratio (MMR) to less than 70 per 1,00,000 live births by 2030.³ Similarly, neonatal mortality, which accounts for nearly 47% of all under-five child deaths, is another pressing issue addressed under SDG 3.2, emphasizing the need to reduce neonatal deaths to at least 12 per 1,000 live births by 2030.⁴

Institutional deliveries play a pivotal role in achieving these targets by providing timely and adequate care. Evidence suggests that access to institutional delivery services can significantly reduce maternal mortality due to preventable causes such as postpartum hemorrhage, hypertensive disorders, and sepsis.⁵ Additionally, neonatal deaths from complications such as birth asphyxia, prematurity, and neonatal infections are substantially lower in institutional settings compared to home deliveries.⁶

In the Indian context, the healthcare landscape is marked by stark disparities. Over the past two decades, the country has

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witnessed substantial improvements in maternal and neonatal health indicators, attributed to policy interventions like the Janani Suraksha Yojana (JSY) and Janani Shishu Suraksha Karyakram (JSSK).⁷ Data from the National Family Health Survey (NFHS) rounds 4 (2015–2016) and 5 (2019–2021) reveal a significant increase in institutional delivery rates, rising from 78.9 to 88.6% nationally.⁸ These gains reflect efforts to promote institutional deliveries through financial incentives, free healthcare services, and awareness campaigns.

However, these improvements are not uniformly distributed. Urban areas and southern states like Kerala and Tamil Nadu have achieved near-universal institutional delivery rates, driven by robust healthcare infrastructure, higher literacy levels, and sociocultural acceptance.⁸ In contrast, rural regions and states such as Bihar, Uttar Pradesh, and Jharkhand continue to lag, with institutional delivery rates below the national average. Socioeconomic barriers, inadequate healthcare facilities, and deeply rooted cultural practices contribute to these disparities.⁹

The importance of addressing these inequities cannot be overstated. Maternal and neonatal mortality rates (NMRs) are

disproportionately high in states with low institutional delivery rates. For instance, Bihar and Uttar Pradesh, with institutional delivery rates of 76.4 and 72.3%, respectively, report MMRs of 167 and 197 per 1,00,000 live births, significantly higher than Kerala's 42.⁸ Such disparities underscore the need for region-specific interventions and sustained policy efforts to bridge these gaps.

This article aims to delve into the impact of institutional deliveries on maternal and neonatal health outcomes in India. By analyzing trends, exploring regional disparities, and correlating institutional delivery rates with health outcomes, this study seeks to provide actionable insights for policymakers, healthcare providers, and public health practitioners. Additionally, it proposes evidence-based strategies to enhance institutional delivery rates in underperforming regions, ensuring equitable healthcare access and improved health outcomes for all.

Objectives

- To analyze trends in institutional deliveries across public and private healthcare facilities in India.
- To examine the correlation between institutional delivery rates and neonatal/maternal mortality.
- To evaluate regional disparities in access to institutional delivery services.

METHODOLOGY

Study Design

This study adopts a mixed-method approach, integrating both quantitative and qualitative analyses to comprehensively understand the trends and disparities in institutional deliveries in India. The quantitative component involves statistical analysis of secondary data from NFHS-4 (2015–2016) and NFHS-5 (2019–2021), while the qualitative component relies on literature reviews and policy analysis to contextualize the findings.

Data Sources

- *NFHS data*: Key indicators, including institutional delivery rates, NMR, MMR, and socioeconomic variables, were extracted from NFHS-4 and NFHS-5. These nationally representative surveys provide district-level estimates and enable trend analysis over time.
- *Global reports*: WHO guidelines and global benchmarks for maternal and neonatal health outcomes were utilized to establish international comparisons and best practices.
- *Peer-reviewed literature*: Studies on the impact of institutional deliveries on health outcomes were reviewed to strengthen the evidence base and provide context.
- *Government programs*: Evaluations of major initiatives such as JSY and JSSK were included to assess their role in improving institutional delivery rates.

Data Analysis Tools

1. *Microsoft Excel*: Used for organizing, cleaning, and preliminary analysis of large datasets.
2. *SPSS*: Employed for advanced statistical analysis, including:
 - Descriptive analysis: To summarize trends in institutional deliveries across time and regions.
 - Correlation analysis: To examine relationships between institutional delivery rates and MMR/NMR.

- Regression analysis: To identify predictors of institutional deliveries, considering socioeconomic and demographic factors.

3. *Tableau*: Utilized for creating interactive visualizations to illustrate trends, disparities, and geographical variations in institutional delivery rates.

Study Population and Sampling

The study population includes all live births recorded in NFHS-4 and NFHS-5. Subgroup analyses were conducted based on the following criteria:

- *Geographical location*: Rural vs urban regions and interstate variations.
- *Socioeconomic status (SES)*: Stratified by wealth index, education level, and caste categories.
- *Healthcare sector*: Comparison between public and private healthcare facilities.

Scope of Analysis

- *Temporal trends*: Examination of changes in institutional delivery rates from NFHS-4 to NFHS-5 at the national, state, and district levels.
- *Public vs private healthcare*: Comparative analysis to evaluate the contribution of different sectors to overall institutional deliveries.
- *Health outcomes*: Correlation between institutional delivery rates and key health indicators, including MMR and NMR.
- *Regional disparities*: Identification of underperforming regions and analysis of socioeconomic and systemic barriers to institutional deliveries.

Limitations

- *Secondary data reliance*: The study is limited by the quality and completeness of NFHS data.
- *Cross-sectional design*: Causal relationships cannot be definitively established due to the cross-sectional nature of the data.
- *Unmeasured confounders*: Factors such as healthcare provider quality and individual health-seeking behavior are not captured in the datasets.

Findings

1. Trends in Institutional Deliveries

Institutional deliveries in India have increased significantly over the past two decades, reflecting concerted efforts by the government and public health stakeholders to promote safe childbirth practices. According to data from NFHS-5 (2019–2021), institutional delivery rates have risen across both public and private sectors (Table 1 and Fig. 1).

This growth can be attributed to impactful government programs such as JSY, which offers financial incentives to promote institutional deliveries among marginalized populations, and

Table 1: Trends in institutional deliveries in India (Public vs Private sector, NFHS-4 & NFHS-5)

Sector	NFHS-4 (2015–2016)	NFHS-5 (2019–2021)	% Increase
Public sector	52.1%	61.9%	18.8%
Private sector	26.8%	30.1%	12.3%
Overall	78.9%	88.6%	12.3%

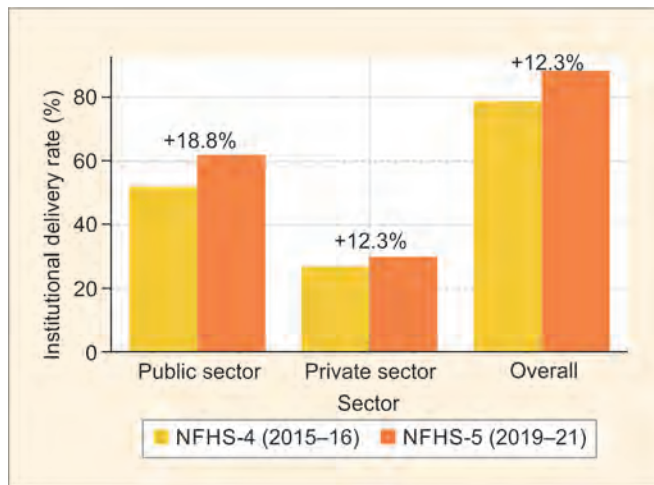


Fig. 1: Trends in institutional deliveries in India (Public vs Private sector, NFHS-4 & NFHS-5)

Table 2: Correlation of institutional deliveries with maternal and neonatal mortality

State	Institutional deliveries (%)	MMR (per 1,00,000 live births)	NMR (per 1,000 live births)
Kerala	99.5%	42	6
Tamil Nadu	97.2%	63	12
Bihar	76.4%	167	28
Uttar Pradesh	72.3%	197	32

JSSK, which provides free delivery services in public facilities.⁷ Furthermore, mass media campaigns emphasizing the benefits of institutional deliveries have played a significant role in increasing awareness and acceptance among communities.

The data also highlight the increasing contribution of private healthcare facilities, particularly in urban areas, where families with higher SES often opt for private care. Despite this, public healthcare facilities remain the primary choice for economically disadvantaged populations.

2. Correlation with Maternal and Neonatal Mortality

States with higher institutional delivery rates consistently report lower MMR and NMR, underscoring the critical role of institutional deliveries in improving health outcomes. For instance, southern states like Kerala and Tamil Nadu, which report institutional delivery rates above 95%, exhibit MMRs of 42 and 63 per 1,00,000 live births, respectively. In contrast, states like Bihar and Uttar Pradesh, with institutional delivery rates of 76.4% and 72.3%, report MMRs of 167 and 197, respectively.⁸ The disparity in neonatal mortality follows a similar trend (Table 2 and Fig. 2).

The data suggest a strong inverse relationship between institutional delivery rates and maternal/neonatal mortality, highlighting the life-saving potential of timely and skilled obstetric care. Emergency obstetric services, accessible primarily through institutional deliveries, address complications like postpartum hemorrhage, obstructed labor, and neonatal asphyxia, which are leading causes of maternal and neonatal deaths.⁶

3. Regional Disparities

While the national average for institutional deliveries has improved, significant regional disparities persist, reflecting systemic inequities

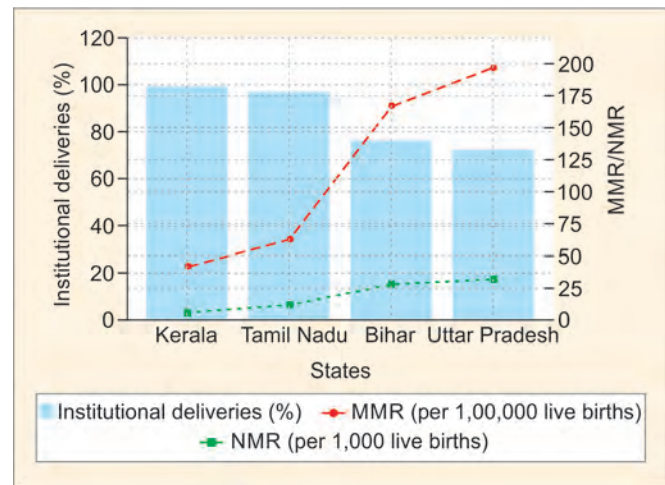


Fig. 2: Correlation of institutional deliveries with maternal and neonatal mortality

Table 3: Regional disparities in institutional deliveries (Urban vs Rural)

Region	Urban (%)	Rural (%)	Total (%)
Southern states	96.5	94.8	95.3
Northern states	83.2	75.6	78.4
Eastern states	81.1	73.9	76.4

in healthcare access. Southern states, including Kerala, Tamil Nadu, and Karnataka, report near-universal institutional delivery rates, largely due to well-established healthcare infrastructure, higher female literacy rates, and proactive policy implementation.⁸ In contrast, northern and eastern states such as Bihar, Uttar Pradesh, and Jharkhand continue to lag behind due to socioeconomic and infrastructural barriers (Table 3).

Key Drivers of Disparities

- **Socioeconomic barriers:** Low income, low literacy levels, and cultural practices favoring home births contribute to disparities in institutional delivery rates.
- **Healthcare infrastructure:** Northern and eastern regions face shortages of skilled personnel, poorly equipped facilities, and limited transportation networks, which deter institutional deliveries.
- **Awareness gaps:** Limited awareness of government schemes and the benefits of institutional deliveries further exacerbates disparities in rural and remote areas.

These disparities have profound implications for maternal and neonatal health outcomes, necessitating targeted interventions to address the underlying factors.

DISCUSSION

Impact of Institutional Deliveries

Institutional deliveries play a transformative role in improving maternal and neonatal health outcomes. They ensure the presence of skilled birth attendants who can manage complications such as postpartum hemorrhage, hypertensive disorders, and obstructed labor. These deliveries also provide timely access to emergency obstetric care, including cesarean sections and advanced neonatal resuscitation, which are critical for reducing maternal and

neonatal mortality.¹⁰ Moreover, institutional settings facilitate the administration of essential interventions such as prophylactic antibiotics, oxytocics to prevent postpartum hemorrhage, and vitamin K for newborns. These measures collectively contribute to better survival rates and improved overall health outcomes.

Challenges in Increasing Institutional Deliveries

Despite substantial progress, achieving universal institutional delivery coverage remains challenging due to various barriers:

- *Overburdened public facilities:* Public healthcare facilities in many states are under-resourced and overburdened, compromising the quality of care. High patient-to-staff ratios and inadequate infrastructure lead to delays and dissatisfaction among patients.¹¹
- *Cost barriers in private sector:* While private facilities offer better infrastructure and shorter waiting times, the high cost of services limits access for economically disadvantaged populations. Out-of-pocket expenditures often discourage institutional deliveries, particularly in rural areas.
- *Cultural and behavioral barriers:* Traditional beliefs and practices favoring home births, coupled with mistrust in formal healthcare systems, hinder institutional delivery uptake. This is especially prevalent in tribal and remote communities.
- *Geographical and infrastructure gaps:* Lack of transportation, poorly equipped facilities, and shortages of skilled healthcare providers in remote areas further exacerbate disparities in institutional delivery rates.⁸
- *Awareness and education deficits:* Limited awareness of the benefits of institutional deliveries and existing government schemes such as JSY and JSSK continues to affect utilization rates, particularly among marginalized populations.

CONCLUSION AND RECOMMENDATIONS

Institutional deliveries are pivotal in reducing maternal and neonatal mortality and in improving overall public health outcomes. This study highlights the significant progress India has made over the past two decades, with institutional delivery rates steadily increasing due to focused policy interventions such as the JSY and JSSK. These programs have successfully incentivized safe childbirth practices and expanded access to skilled care, particularly among economically disadvantaged populations.

However, critical gaps remain. Disparities in institutional delivery rates persist across regions, socioeconomic groups, and urban–rural divides. Southern states and urban areas exhibit near-universal institutional delivery rates, while northern and eastern states, along with rural and tribal communities, face barriers such as inadequate healthcare infrastructure, financial constraints, and cultural resistance to institutional care. Addressing these disparities is essential to achieving universal institutional delivery coverage, which is not just a healthcare goal but a societal imperative.

To bridge these gaps, the following strategies are recommended:

- *Strengthen public health infrastructure:* Invest in expanding healthcare facilities and enhancing their capacity to manage high patient volumes. This includes increasing the availability

of beds, equipment, and trained healthcare professionals in underserved areas.

- *Promote awareness:* Conduct culturally sensitive, community-based awareness campaigns emphasizing the life-saving benefits of institutional deliveries. Leverage local influencers and health workers to disseminate information effectively.
- *Improve financial accessibility:* Broaden the scope of financial assistance programs like JSY and JSSK to include private healthcare facilities. Additionally, ensure the timely disbursement of incentives to beneficiaries.
- *Enhance monitoring and evaluation:* Establish regular audits and feedback mechanisms to monitor service quality and patient satisfaction. Use digital tools to track institutional delivery rates and identify gaps.
- *Develop region-specific interventions:* Design tailored programs to address unique challenges in underperforming states. For instance, focus on improving transport networks and incentivizing healthcare providers to work in remote areas.
- *Integrate postnatal care:* Strengthen the link between institutional deliveries and postnatal care to ensure continuity of care for mothers and newborns, addressing complications that may arise after childbirth.

Ultimately, achieving equitable access to quality maternal and neonatal care requires collaborative efforts between government agencies, non-governmental organizations, and community stakeholders. These interventions are vital not only for improving maternal and neonatal health outcomes but also for advancing India's progress toward the SDGs.

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Nurturing the Future: Complementary Feeding Practices in India

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ABSTRACT

Optimal infant and young child feeding (IYCF) practices are key in helping children reach their potential during infancy and early childhood. Inappropriate complementary feeding may impact on physical, emotional, and mental development of infants' lives. Delayed complementary feeding thereby results in poor health outcomes in children and later life as well. This review article aimed to elucidate the factors, challenges, and practices affecting complementary feeding practices. This article also through the light on strategies that may affect complementary feeding practices at the individual and community level. A literature review of published publications was carried out through various search engine platforms, namely Research Gate, Google Scholar, SCOPUS, and government websites databases, which were searched as part of an evaluation of the literature of published publications. Data were collected in different steps, firstly by the identification of research questions, followed by the selection of articles from the literature using specific keywords and lastly by summarizing information from collected data. Indian Council of Medical Research (ICMR) 2024 guidelines also have focused on complementary feeding. There are many factors that affect children's growth and development, and complementary feeding is one of the important steps of growth in an infant's life. National Family Health Survey (NFHS)-5 data also indicate the complementary feeding practices in India, which have reduced from the past 15 years from NFHS-3 to NFHS-5. Some strategies can be adopted to improve complementary feeding practices and can be implemented at the individual and community levels.

Keywords: Determinants of complementary feeding, Feeding behavior, Food choices, Food selection, Infant and young child feeding and ICMR, Responsive feeding.

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INTRODUCTION

Inadequate complementary feeding of children aged 6–23 months contributes to growth retardation and a high mortality rate in many developing countries. Research-based studies have shown that good strategies and approaches for the promotion of complementary feeding practices have reduced the prevalence of stunting and led to good health and appropriate growth outcomes. A mother's education plays an important role in a child's growth and development. Evidence-based research has shown that mothers who are illiterate and families with large size have been found to have lower minimum dietary diversity in 6–24-month-old children. Therefore, nutritional counseling on child feeding practices becomes mandatory for them. To improve the above condition, the recommendations given by ICMR/NIN 2024 on complementary feeding for 6–12-month-old children should be adopted. It ensures that infants' nutritional needs are met through timely, adequate, safe, and properly fed nutrient-rich complementary foods (CFs).¹ State governments are taking a number of initiatives to improve the nutritional status of children aged 6–36 months. All these initiatives are supported by various evidence-based Indian as well as international studies.

METHODOLOGY

A systematic review of complementary feeding in different states and at individual levels in India was undertaken to systematically search for current practices, trends, and traditional feeding practices was selected for the review article. Inclusion criteria for the review were studies of the Indian context/global scenario, rural and urban, with a quantitative or qualitative outcome about complementary

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feeding practices to young infants. Published articles written in the English language were selected. Similarly, exclusion criteria included studies that reported non-evidence-based studies. ResearchGate, Google Scholar, SCOPUS, and government websites databases were searched as part of an evaluation of the literature of published publications. Selection of articles from the literature using specific keywords like "Feeding behavior," "food selection," "rural and urban," "responsive feeding," "determinants of complementary feeding," "nutritional requirements," "food choices," and "traditional beliefs." The title and abstract, and subsequently the whole article, were screened as per the inclusion criteria as stated.

DISCUSSION

Complementary feeding is very important in the initial phase of life.¹ Complementary feeding is required to meet an infant's nutritional needs. Several factors may lead to complementary feeding practices. Indian Council of Medical Research 2024 guidelines talk

about simple messages like homemade complementary feeding because it is easy, economical, and nutritious for growing infants.¹ Guidelines have focused on the inclusion of whole cereals, grains, pulses, fresh vegetables and fruits, and no added sugar for children <2 years.¹

Global Complementary Feeding Scenario

UNICEF recommends that children at 6 months should eat or get access to the right foods and dietary diversity to reach their full potential. However, the global database reported that over 28% of children aged 6–8 months do not eat solid, semi-solid, or soft foods, and 49% do not have the recommended daily meal frequency or dietary diversity. Additionally, 53% of children do not consume nutrient-rich foods, and 38% do not consume fruits or vegetables. These issues highlight the need for better nutrition for young children.¹ World Health Organization (WHO) recommendations 2023 also talks about the infant and young child feeding (IYCF) practices of children 6–23 months of age.² They have also highlighted the Guideline Development Group (GDG), which has very limited evidence for many of the recommendations. According to UNICEF global databases 2023,³ 72% of children receive solid foods (6–8 months), 62% consume vegetables or fruits (6–23 months), 47% consume egg and/or flesh food (6–23 months); 51% achieve the minimum meal frequency (6–23 months), 34% achieve minimum dietary diversity (6–23 months), and 21% achieve the minimum acceptable diet (6–23 months).³

Indian Complementary Feeding Scenario

Introducing traditionally prepared food items as a food-based approach should be adopted to feed the children, as they are convenient, locally available, affordable, nutritious, and easy to prepare. ICMR 2024³ guidelines also talk about the same. They also emphasize homemade, nutritious foods. In addition, having access to take-home rations of different states of India, checking on microbial contamination at the household level, adopting good hygiene practices, and food handling are the best health-based approaches. But complementary feeding practices have been reduced over the years. Conversely, delaying complementary feeding beyond 6 months can lead to nutrient deficiencies, impacting growth and development, especially in resource-poor settings. Key concerns include iron and zinc deficiencies, which can cause anemia and developmental delays.⁴

Figure 1 clearly explains the trends of the last 15 years of complementary feeding practices in Indian infants. National Family Health Survey-3 says approximately 80% children were having complementary feeding age of 12–17 months, while NFHS-5 says that only 70% complementary feeding at the same age.^{5–7} Hence, from the figure, we can analyze that complementary feeding practices have reduced over a period of time. There are many factors that affect complementary feeding, and there are some gaps and barriers also.

Factors Affecting Complementary Feeding

Timing of Introduction

Early introduction of CFs, particularly before 4 months, poses health risks such as increased infections, gastrointestinal issues, and a higher likelihood of obesity in later childhood.⁸ Dr Francesco Branca from WHO emphasizes that early feeding can displace breastfeeding, reducing the intake of essential nutrients and antibodies.⁹ Dr Kathryn Dewey's research highlights that delayed complementary feeding

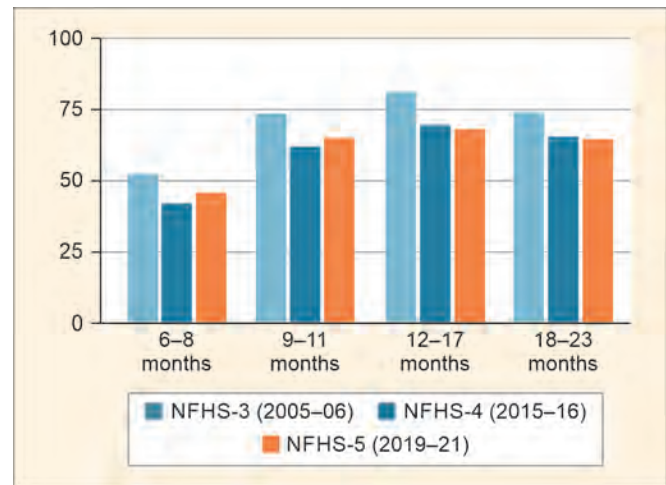


Fig. 1: Comparison of NFHS data of Complementary Feeding in India

is linked to stunted growth and underweight in infants, particularly in undernourished populations.¹⁰ Nutritional inadequacies from delayed feeding may also affect cognitive development, with iron deficiency in infancy associated with long-term cognitive impairment.¹¹ The WHO advocates for introducing complementary feeding at 6 months while continuing breastfeeding for up to 2 years or beyond, as this timing balances the infant's nutritional needs with their physiological readiness to process solid foods.¹² This recommendation is based on extensive research demonstrating optimal growth, health, and cognitive outcomes for infants who begin complementary feeding at 6 months.⁹ The WHO's guiding principles emphasize that at 6 months, an infant's nutrient needs exceed what is provided by breast milk, necessitating the introduction of CFs to meet these needs.¹²

Nutritional Requirements

Energy intake from solid foods should supplement breast milk or formula to prevent growth faltering.¹⁰ Adequate protein intake is crucial for growth and immune function, with CFs like meat, eggs, and legumes providing essential amino acids.¹⁰ Key micronutrients such as iron, zinc, vitamin A, and calcium are vital for growth and cognitive development, as breast milk alone becomes insufficient to meet these needs.¹² Iron deficiency, prevalent in developing countries, can have long-term effects on brain function, making the introduction of iron-rich foods essential.¹¹

Complementary feeding should be balanced with continued breastfeeding or formula feeding, with a gradual transition to solid foods starting around 6 months.⁹ Breast milk continues to provide essential nutrients, while CFs fill gaps in energy and micronutrients.¹⁰ Nutrient-dense foods, providing vitamins and minerals like calcium, zinc, and vitamin A, should be introduced in varying textures and flavors to encourage healthy eating habits.¹⁰ The WHO emphasizes that CFs should be given in sufficient quantities, gradually increasing in frequency and diversity as the child develops.¹²

Cultural and Societal Influences

Complementary feeding practices are significantly influenced by cultural and societal factors, which shape the types of food introduced to infants, their preparation methods, and the timing of their introduction. Traditional beliefs often dictate infant feeding

practices, with some cultures having food taboos that prevent the introduction of nutrient-rich foods, potentially leading to deficiencies.¹³ In India, rice-based foods are commonly introduced first due to cultural and religious beliefs, despite their low iron and zinc content.¹⁴

The influence of family, community, and healthcare workers is also crucial. Family members, especially elders, often advocate for traditional practices that may conflict with modern nutritional guidelines, while healthcare workers can promote evidence-based feeding practices through education and public health campaigns.^{3,15} Overall, while cultural practices reflect identity and tradition, they must be balanced with scientific guidelines to ensure optimal infant nutrition.

Parental Knowledge and Education

Studies indicate that higher parental education levels correlate with the timely introduction of nutrient-rich foods, improving children's nutritional status.¹⁵ Conversely, inadequate knowledge can lead to deficiencies, such as iron deficiency, resulting in anemia and cognitive issues.¹¹

Understanding food safety and hygiene practices is also vital. Proper hygiene, such as washing hands and utensils, prevents contamination and reduces the risk of foodborne illnesses, which are particularly harmful to infants. Safe food preparation and storage techniques are crucial, especially in areas with limited refrigeration.¹² The sources of information parents rely on significantly impact their feeding practices. Healthcare professionals, including pediatricians and nutritionists, are trusted sources who provide evidence-based guidance, helping parents adhere to WHO guidelines.¹⁶

Food Availability and Accessibility

Food availability and accessibility significantly impact complementary feeding practices, influenced by socioeconomic status (SES), seasonal availability of fresh foods, and food insecurity. Higher SES families generally have better access to diverse, nutritious foods, essential for healthy child growth, while lower SES families often rely on low-cost, nutrient-poor foods, leading to deficiencies and developmental delays.^{17,18} The cost of nutritious foods like lean meats and fresh produce can be prohibitive for low-income households, resulting in reliance on cheaper, processed foods high in fat, sugar, and salt, contributing to poor health outcomes.¹⁹

Seasonal availability also affects the quality of complementary feeding, with fresh fruits, vegetables, and proteins being more accessible during certain times of the year. During lean seasons, families may face difficulties accessing fresh produce, leading to nutrient gaps in children's diets.^{20,21} Food insecurity, defined as the lack of consistent access to sufficient, safe, and nutritious food, directly impacts complementary feeding by reducing the quantity and quality of food available for infants. Food-insecure households often rely on cheaper, energy-dense foods, resulting in undernutrition and micronutrient deficiencies.¹⁹ Coping mechanisms, such as skipping meals or reducing portion sizes, further exacerbate nutrient deficiencies.^{13,22} These factors collectively highlight the importance of addressing food availability and accessibility to improve complementary feeding practices and child health outcomes.

Child's Readiness and Development

A child's readiness for complementary feeding is crucial for a smooth transition from breastfeeding or formula feeding to solid

foods. The key indicators of readiness include physical readiness, motor skills, and sensory development. Physical readiness involves the ability to sit up with minimal support and the coordination of chewing and swallowing, typically developing around six months.¹² Introducing solids before these milestones can lead to choking and gastrointestinal distress.²³ Motor skills, such as grasping food and self-feeding, are also essential. By 6–9 months, infants usually develop the palmar and pincer grasps, enabling them to pick up and eat food independently. Self-feeding fosters motor skills development and encourages a willingness to try new foods.^{24,25} Sensory development, including taste and texture sensitivity, plays a significant role in accepting new foods. Infants naturally prefer sweet tastes but can learn to accept a variety of flavors through repeated exposure.²⁶ Introducing a range of textures between 6 and 9 months helps prevent feeding difficulties and picky eating later in life.²⁵

Health Status of the Infant

The health status of infants significantly shapes complementary feeding practices, with growth patterns, chronic conditions, and illnesses influencing nutritional outcomes. Research indicates that introducing CFs at around six months promotes healthy weight gain and supports motor and cognitive development. Early introduction, however, is associated with risks of obesity, undernutrition, and metabolic issues later in life.²⁷ Properly balanced feeding ensures nutritional adequacy, preventing stunting and wasting.²⁸

Allergies, intolerances, or chronic conditions can complicate feeding. Conditions such as cow's milk allergy or lactose intolerance require parents to eliminate certain foods, limiting the diversity of the infant's diet.²⁹ This may lead to micronutrient deficiencies unless appropriately managed with alternative sources of essential nutrients. Infants with chronic health conditions like gastrointestinal disorders or developmental delays may also require specialized feeding approaches to maintain growth and development.

Illnesses and infections disrupt feeding routines, reducing food intake due to poor appetite, vomiting, or diarrhea. Studies show that during episodes of illness, infants may experience slowed growth as parents often rely on breast milk alone or postpone solid food introduction, impacting recovery.²⁸ It is essential to continue nutrient-rich feeding during these periods to prevent growth setbacks and promote faster recovery.

Caregiver Practices and Responsive Feeding

Caregiver practices and the feeding environment play a crucial role in shaping an infant's relationship with food. Responsive feeding, where caregivers recognize and respond to hunger and satiety cues, helps build trust and prevents overeating or undereating.¹⁷ Encouraging self-feeding promotes motor skills development and familiarizes infants with different textures and tastes, fostering food acceptance and reducing picky eating behaviors. Exploration through finger foods also supports autonomy and a positive feeding experience.

Governmental and Institutional Support

Governmental and institutional support plays a crucial role in improving complementary feeding practices and infant nutrition in India. National guidelines, such as the IYCF policy, emphasize exclusive breastfeeding for the first six months, followed by appropriate complementary feeding alongside continued breastfeeding until two years or beyond. Programs like the Mothers' Absolute Affection (MAA) initiative, in collaboration

with the Ministry of Health and Family Welfare, aim to promote breastfeeding practices through public awareness campaigns and community outreach efforts.^{30,31} India's POSHAN Abhiyaan is another significant campaign that addresses malnutrition by driving behavioral change and promoting awareness about holistic nutrition, including optimal infant feeding practices.³² The program supports Anganwadi workers (AWWs) who counsel mothers on infant nutrition, helping them adopt recommended feeding practices. Additionally, Village Health Sanitation and Nutrition Days (VHSNDs) provide health services and nutritional counseling at the community level, further enhancing awareness and accessibility to healthcare.^{30,33}

Challenges remain, particularly in ensuring compliance with the Infant Milk Substitutes (IMS) Act, which regulates the marketing and distribution of infant formula to protect breastfeeding. Gaps in policy implementation, healthcare worker training, and monitoring systems limit the effectiveness of these efforts. Furthermore, comprehensive counseling on infant feeding during healthcare visits remains inconsistent.^{33,34}

Breastfeeding Continuation

Continued breastfeeding alongside complementary feeding offers numerous benefits for the infant's nutrition and development. Breast milk remains a crucial source of nutrients, immune protection, and bonding even after CFs are introduced, typically around six months of age. The WHO² recommends continued breastfeeding up to two years or beyond, as it complements the nutritional gaps that solid foods may not completely fill during early feeding stages.

Approaches and Strategies for Improving Complementary Feeding

Approaches at the individual level include responsive feeding, encouraging caregivers to feed children patiently, engaging them affectionately during meals, and experimenting with different foods if needed. They also suggest incorporating nutrient-rich ingredients like moringa, spinach, and other seasonal leaves into complementary feeding to enhance the nutritional value of meals.³⁵

At the community level, it outlines the role of AWWs and community groups in educating mothers about proper complementary feeding, hygiene, and feeding practices to promote child development. It highlights that the Anganwadi Center is a critical space for awareness, counseling, and joint action in improving children's health and nutrition. Infant and young child feeding practice dissemination through workers at the community level is crucial. Community-level education strategies emphasize providing nutritional counseling to caregivers through various local channels, covering complementary feeding, meal frequency, and encouraging children to eat. A study found that smartphone-based maternal education significantly improved child growth indicators in a food-secure middle-income country.

It underscores the pivotal role of community health workers in promoting appropriate IYCF practices. The consistent communication, advocacy, and use of both traditional methods and mass media are crucial for ensuring the sustained adoption of proper feeding practices. It has been emphasized that repeated reinforcement of nutrition messages and recipe demonstrations about IYCF could improve the knowledge and attitude of mothers of acutely malnourished children.

A few more insights on strategies are given below:

- Need to build mental health inclusive policies/programs for mother and child health, participating in capacity building of grassroots workers to disseminate knowledge about postpartum depression (PPD), and being skilled to recognize and refer to the early indicators of PPD.³⁶
- Introducing a new worker in areas with a high burden of undernutrition in rural eastern India did not significantly increase children's "length for age." However, certain secondary outcomes, such as self-reported dietary diversity, handwashing, and infant survival, improved.³⁷
- The action against malnutrition (AAM) Project involves local food provision to children aged six months to three years in day-care centers and community mobilization targeting women of reproductive age through participatory learning and action. Results show improvements in IYCF practices.³¹
- Inappropriate early childhood feeding practices can have a severe negative impact on children's health and nutritional status. This situation is particularly evident in the urban area of Raipur, Chhattisgarh, India, where children tend to favor breast milk over CFs and lack diverse food options.³⁸
- A nation-specific strategy that considers the diversity of cultural feeding practices is required to improve the feeding of young children.³⁹

Suggestions and Recommendations

Interactive sessions on IYCF should be conducted in Anganwadi centers, with messages to be reinforced. Regular field-based training should improve AWWs' counseling skills. The Nutri-Garden Approach should be promoted at the community and individual levels, with authorities promoting complementary feeding. Parents should be encouraged to start complementary feeding at the right age.

Comprehensive guide to support mothers and fathers during antenatal check-ups and before hospital discharge. It includes counseling sessions, specialized lactation counselors, and the provision of a standard CF recipe booklet. The guide also emphasizes the important role of fathers in cooking and feeding the child, as it helps in sharing the mother's workload and identifying supporting members. It also suggests introducing new foods when the child is hungry and reintroducing the same CF to develop taste.

According to ICMR Guidelines 2024¹

- Complementary feeding starts feeding homemade semi-solid CF to the infant soon after six months of age, till two years of age. About 2–4 times in a day, depending on the child's age.
- Complementary feeding, along with breastfeeding, should be continued even during diarrhea or other common illnesses to prevent malnutrition.
- Observe hygienic practices while preparing and feeding complementary feeding.
- Incorporate green leafy vegetables in complementary feeds to infants.
- Limit the use of salt in complementary feeding.

CONCLUSION

At age 6–24 months, nutritional needs change significantly, necessitating complementary feeding alongside breastfeeding

or formula feeding. Children require increased energy, protein, vitamins, and minerals during this period to support rapid growth and development.¹² Cultural preferences also play a role, with different regions favoring specific foods and preparation methods that may not always meet infants' nutritional needs.^{10,16} Public health initiatives have been effective in some regions, promoting the introduction of iron-rich foods to combat deficiencies.⁴ Parental knowledge and education are crucial in shaping complementary feeding practices, ensuring infants receive proper nutrition during critical growth periods. Awareness of infant nutrition and dietary needs is essential, as informed parents can make better decisions about food types and timing. Overall, enhancing parental knowledge through education and reliable information sources is key to improving complementary feeding practices and infant health outcomes. Creating a safe and hygienic feeding environment is essential for infants' health. Using clean utensils, sterilized bottles, and maintaining hand hygiene helps prevent foodborne illnesses.⁴⁰ In resource-limited settings, caregivers are encouraged to use simple sanitation practices, such as handwashing, to reduce the risk of infections that could disrupt feeding routines.

Overall, while national campaigns and institutional frameworks have advanced awareness about optimal feeding practices, further improvements in policy enforcement, healthcare integration, and targeted interventions are essential to achieve better infant nutrition outcomes across diverse regions of the country.

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Bharatiya Criminal Laws and Medical Practice: Understanding the Interface

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ABSTRACT

Recently, India revamped the criminal justice system with the passing of three new criminal laws: Bharatiya Nyaya Sanhita, Bharatiya Nagarik Suraksha Sanhita, and Bharatiya Sakshya Adhiniyam. These laws contain reformatory provisions that seek to establish a more just and efficient medical profession. This article will provide a more nuanced understanding of the new legal framework influencing medical practice, patient rights, and healthcare accountability in India. Through an analysis of key provisions of the three laws, the present research embarks upon the journey to elucidate the intricate relationship between the new criminal justice system and the medical profession. The reforms in criminal laws are aimed to enhance legal protection of patients and medical professionals at the same time it ensures timely justice in case of medical malpractice. Through the endeavor, the researcher aims to reflect how the democratic process of our country has transformed towards a more transparent, accountable medical field and ensure patient empowerment.

Keywords: Healthcare and crime, Medical liability, Patient rights, Patient safety.

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INTRODUCTION

The law needs to evolve with changing times. The recent trends of industrialization and technological advancement further accelerated the need for a more comprehensive, humane, technosavvy, and ecofriendly justice delivery system. Moreover, the law is required to be able to better protect and serve the interests of socially and economically weaker sections. More often than not, the socially weaker is economically weaker as well. And they suffer the consequences of crime more than others. This created the groundwork for new legislation governing the criminal justice system. Our Parliament, the supreme legislature of the country, has always been keen and proactive in addressing the demands of modern society and the needs of its people. The latest example of foresight and efficient legislation is passing the Bharatiya Nyaya Sanhita, Bharatiya Nagarik Suraksha Sanhita, and Bharatiya Sakshya Adhiniyam.

These legislations have been passed to achieve the Constitutional endeavor that envisions a just and equitable society. The Constitution is the supreme law of the land, and inter alia, it provides fundamental rights to its citizens. Fundamental rights include the right to health.¹ Moreover, the court has laid that in view of people having the right to a healthy life, the state needs to improve health services.² Even the National Health Bill, 2009, states under section 8 that everyone has a right to health that is conducive to life with dignity.³ Though the Act has not yet been passed by the legislature but its specific guarantee in the Bill reflects the importance of health in everyone's well-being. The Parliament has time and again tried to ensure the availability of this fundamental right to health for everyone. The recently revamped criminal justice system also looks to further protect the right to health. In light of recent developments, the present research is focused on how the new criminal laws protect the right to health for everyone. This will also help to have a better understanding of the laws and procedures governing the strict regulation of medical services and efficient administration to those wronged.

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HISTORICAL EVOLUTION OF INTERFACE

The Indus Valley civilization is not only one of the oldest known civilizations but, according to renowned historian Henry Segrist, it is also believed to have most advanced medical facilities amongst ancient civilizations.⁴ For efficient administration and regulation of medical services the Kautilya's Arthashastra lays down rules and principles. Regarding the administration of medical services, a peek into the mind of Kautilya explicitly lays out the importance of medical services. He believed famine to be a bigger danger than the epidemic, as medical services can reduce the adverse effects of epidemics.⁵

Ashoka the Great also established advanced medical services throughout the empire and further provided medical services at state expense. This period is also known for the king taking an enthusiastic interest in the medical care and the law governing it.⁶ So, it will not be wrong to conclude that Indians have had a rich tradition of robust healthcare services since time immemorial. Then India became a British colony. The advent of colonial power brought with it its systems of rules to govern medical practice. But it was only in the nineteenth century that medicine got recognized in Britain. With the formal recognition in Britain, the British policy for healthcare in India also started to take shape. Initially, the health policy was focused on serving the British military and civilian establishment in India. But as healthcare expanded need was felt

to regulate it. An author by the name of Lt. Col. D.G. Crawford, in a book titled "History of British Medical Services, 1600–1913" underlined many instances of medical malpractice that were meted out with severe punishment and deportation at times.

The British passed the Coroner's Act for Bombay and Calcutta jurisdiction to have a law governing procedure dealing with the investigation of criminal acts, such as inquest and autopsy. The Indian Penal Code, passed in 1860, was the primary substantive law for a substantial amount of time. It introduced several offences and penalties for them. But most recently, in 2023, the entire criminal justice system was revamped, including the Penal Code and accompanying procedure.

CODE OF MEDICAL ETHICS

The Indian Medical Council (Professional Conduct, Etiquettes and Ethics) Regulations, 2002 lay down standards for professional conduct and legal responsibility for medical professionals. The aim and objective of these regulations are to ensure patient care and better healthcare services in the country. These regulations confer dual liability on medical professionals. Firstly, on breach of ethical standards towards the Indian Medical Council, and secondly, criminal liability for committing an offence punishable under the law of the land. The mention of these rules is important to mention in an article dealing with the intricate relation of the criminal justice system and the medical profession because these regulations perfectly complement the criminal liability of medical professionals with their ethical and moral liability.

The interface of criminal law and medical practice is highlighted when doctors resort to unethical practices or resort to render service with negligence or any other malpractice by medical professionals. The Indian Medical Council Regulations, 2002, are very crucial to lay down the right set of conduct for doctors to uplift the standards of professional conduct and punish them for acts that do not fall within the strict limits of criminal law.

BHARATIYA NYAYA SANHITA

To protect public health, the Bharatiya Nyaya Sanhita is crucial since it categorizes detrimental actions to health as offences and establishes specific criteria for criminal liability. Besides this, the Bharatiya Nyaya Sanhita plays a significant role in the life of medical practitioners as they have to prepare a medicolegal report commonly known as MLR. This is a fact of law and prudence that no investigation and trial is complete without the expert opinion of doctors. The present analysis will deal with three noteworthy provisions that have arguably the most significant contribution in protecting the health and welfare of the masses, and which the experts in the medical field must be aware of to practice without the law taking away their right to practice their profession. The first one is the offence of causing death by a rash and negligent act. This provision has importance for doctors as they can be put behind bars in the course of practicing their profession if they act in certain way as elucidated hereunder.

Section 106(1) of the Bharatiya Nyaya Sanhita, 2023, is a significant provision. This section stipulates that it is a criminal offense to cause another's death via reckless or negligent conduct that does not fulfill the conditions for culpable homicide. The essence of section 106 is the execution of an act that is both impulsive and negligent, leading to fatality. The existence of either intent or awareness invalidates section 106(1).⁷

An imprudent action differs from a precipitated one. The term "rashness" implies imprudence or indifference to possible repercussions. Despite the actor's awareness that his actions may result in negative or illegal consequences, he neither intends nor anticipates such results occurring.⁸ Conversely, when an individual acts without sufficiently or properly mitigating the possible negative or illegal consequences, it is termed negligent behavior. Moreover, "negligence" as used in this context does not denote mere carelessness. The degree of carelessness must be sufficiently elevated to qualify as a criminal act of recklessness or negligence.

Section 106(1) asserts that the conduct resulting in an individual's death must not have been executed to cause death. Culpable murder is characterized as a deliberate act aimed at causing death or with the awareness that such behavior is likely to result in death. Caution is essential when attributing criminal recklessness or negligence to an individual fulfilling professional duties, as regularly underscored by the courts in situations involving medical practitioners. The threshold for a doctor's criminal culpability over a patient's death is met when his incompetence or negligence transcends mere incompetence and exhibits a degree of indifference to life and safety that amounts to a crime against the state. The Supreme Court further elucidated the three circumstances in which doctors may be held liable in the case of *Jacob Mathew v. Union of India*:

- The physician performs the therapy or addresses the condition despite insufficient knowledge of the procedure.
- Notwithstanding possessing the requisite training and expertise, the physician refuses to provide the treatment.
- The physician, notwithstanding their expertise, prescribes a treatment that no other physician in the same circumstances would have advised.⁹

There exists a peculiarity regarding the penalties for medical misconduct. The maximum sentence for any other kind of criminal negligence charge is 5 years of incarceration. Physicians are accountable for medical negligence for 2 years. This measure is implemented to safeguard the general population, since doctors would hesitate to provide life-saving treatment due to the fear of facing the same repercussions.

The second significant provision is that dealing with offences affecting public health and safety in Bharatiya Nyaya Sanhita. Chapter XV also deals with public nuisance. Acts unnecessarily interfering with the public's welfare, safety, and comfort it is unquestionably a crime. Any factor that substantially impedes individuals' daily physical comfort is deemed a nuisance. Nonetheless, a definitive elucidation of the word is unattainable.

One kind of nuisance can be public, whilst the other can be private. A public nuisance is an annoyance that affects the whole community and irritates all people. Unlike public nuisance, which affects the whole community, private nuisance is directed at certain individuals. This encroaches on the comfort of another individual or their property, real estate, or inheritance. The latter is exempt from public punishment since it constitutes a private infraction impacting certain individuals. Conversely, if it adversely affects both private persons and the public at large, it is classified as a public nuisance, warranting potential penalties from the state. In this context, it is crucial to recognize that the sheer existence of a recurrent nuisance that offers some advantage or convenience does not render it acceptable.

A public nuisance is defined as an action that irritates the whole community or fails to fulfill the demands of the common good.¹⁰ A breach of the rights of community members transpires when an action or inaction affects the broader public or a significant portion thereof.

Now the author will explain particular sections affecting public health and safety by taking one at a time. Section 271 aims to make it unlawful and/or negligent for anyone to engage in actions that may inadvertently facilitate the transmission of another person's illness or disease. Section 272 of the Bhartiya Nyaya Sanhita parallels section 271 in language but pertains to a more severe variant of the crime outlined in section 271. It denotes the criminal offender's "*mens rea*" by using the phrase malignant. The term "malignantly" implies that an individual disseminating an infectious disease or other lethal infection is driven by a malevolent purpose. It implies that the accused had a deliberate objective. The subsequent punishment is more severe than that specified in section 271.

Deliberate adulteration that makes any substance toxic as a food or beverage is subject to penalties under Section 274. The prosecution must demonstrate four elements for a conviction under this section:

- (i) The item in question constituted food or drink intended for consumption by living beings;
- (ii) The accused adulterated it;
- (iii) The adulteration rendered it toxic as food or drink; and
- (iv) The accused either intended to sell the item as food or drink at the time of adulteration or was aware it was likely to be sold in that manner.¹¹

The sale of toxic food or beverages is, however, prohibited under Section 275. This clause does not penalize mere adulteration. The food or beverage should become toxic as a result of adulteration. It must also be shown that the accused or another individual has the intent to sell such toxic food or beverage. This provision prohibits the sale of toxic substances disguised as food or beverages, rather than the sale of any other toxic articles. "Noxious as food" denotes food that is detrimental or otherwise hazardous to one's health. It is not intended to be offensive or injurious. Therefore, while it may disturb the religious sensitivities of certain individuals, marketing a product that consists of a mixture of pig fat and ghee does not render it "noxious as food".¹²

The sale and distribution of counterfeit drugs are governed under Sections 276 and 277. To demonstrate drug adulteration under these laws, it is essential to prove that the medicine is either less efficacious, has a changed effect, or is poisonous. Any dispensary that sells or dispenses tainted medication violates Section 277.

The ancient Roman legal maxim *volenti non fit injuria* has relevance in criminal law, asserting that harm inflicted with consent cannot be classified as an injury. A complicating factor is the victim's permission, constrained by certain societal interests. In general, an individual retains criminal liability under modern criminal law for actions that jeopardize human life. A person is exempt from criminal liability if, in a sincere attempt to assist another, he deliberately inflicts or threatens injury, regardless of consent. The next immediate part will deal with those sections of chapter III (General Exceptions) that absolve criminal liability because of the consent of the sufferer.

According to Sections 26, 27, and 30 of the Bhartiya Nyaya Sanhita, 2023, the one responsible for causing harm must not have

the intention to cause death. Section 26 asserts, "Nothing that is not intended to result in death constitutes a crime." When victims of harm are unable to provide informed consent, the conditions outlined in sections 27 and 30 are applicable. Section 27 pertains to children (individuals under 12 years of age) or those considered mentally incompetent, outlining circumstances in which the legal guardian or caregiver can act or provide consent. The first phrase specifies that "this exception shall not apply to the intentional infliction of death, or the attempt to inflict death." The defense against criminal liability under these statutes does not need intent or *mens rea* to effectuate death, as these terms explicitly indicate. No intention to inflict death should exist in any of these circumstances, even if the offender is aware that their actions will result in such an outcome.

Furthermore, under these three provisions, an accused individual may escape criminal liability if they can demonstrate that their actions were executed not only without the purpose to cause death but also for the benefit of the individual involved. Section 26 stipulates that the aggrieved party must provide their consent.¹³ Section 27 pertains to injuries inflicted on individuals under 12 years of age or those without mental capacity, therefore requiring consent from a guardian or other lawful caretaker. Section 30 handles situations when the wounded individual is a minor, lacks a sound mind, or where getting their consent is impracticable or impossible during an emergency. The examples offered effectively illustrate the circumstances addressed by section 30.

Under all three sections, the individual or organization accountable for the harm must have acted in good faith and without intent to cause death or severe injury. Actions or beliefs executed without due diligence are considered not to be conducted in good faith, as stipulated in Section 2(11) of the Bhartiya Nyaya Sanhita. To claim protection under sections 26 or 27, the accused must demonstrate that he behaved with "due care and attention" throughout the commission of the alleged infraction.

In the context of sections 26, 27, and 30, "good faith" may signify more than just "due care and attention" at times. This is especially pertinent when evaluating the conduct of medical practitioners. Medical practitioners and surgeons who assure treatment must possess, alongside necessary diligence and care, a substantial level of experience in their respective fields.⁹ The patient's consent to assist the offender cannot be realized if it is absent. The interrelationship between patient permission and the good faith of medical practitioners is essential.

Communication sent to the patient in good faith and for their benefit, which results in harm to the recipients, is meant to be safeguarded by Section 33 of BNS, as interpreted with the accompanying example. This section is particularly relevant to medical professionals. Initially, the conversation must be conducted in good faith. Secondly, it must be executed for the advantage of the individual to whom it is directed.¹⁴

BHARTIYA NAGARIK SURAKSHA SANHITA

Similar to Bhartiya Nyaya Sanhita, the Bhartiya Nagarik Suraksha Sanhita contains many provisions that have implications for medical professionals. These provisions also have an effect on the health of the accused, the victim, and other parties involved *per se*. For instance, Section 194 of the Bhartiya Nagarik Suraksha Sanhita requires inquest reports to be prepared to determine the apparent cause of death, and also note that any injuries to the body of the

deceased and specify how or with what tool (if any) they were inflicted. In such cases, the investigating Officer is not required to investigate the identity of the killer or offender in order to conduct the inquest.

The Supreme Court has ruled that the only purpose of preparing an inquest report is to determine whether a person's death was caused by anything unusual or suspicious, and if so, what it was. The subject of the specifics of the assault, including who attacked the victim and when, is beyond the purview of inquest proceedings, according to the Supreme Court.¹⁵

Claims of inconsistencies, omissions, overwriting, or contradiction in the inquest report should not be considered until the author is called upon to explain during his cross-examination as a witness. The inquiry conducted to determine the apparent cause of death is the only objective aspect of the necessary contents of an inquest report issued under section 194 of the BNSS.

The primary goal is to determine whether the death was accidental, suicide, homicidal, or caused by an animal. Additionally, it seeks to determine how the injuries on the corpse were inflicted and by what weapon or tool. It is not necessary to document details of obvious actions in the inquest report. According to section 194 of the BNSS, the scope and breadth of the proceedings do not include questions about the manner, who attacked the dead, the circumstances of the assault, or the identities of any witnesses to the assault. The inquest report does not have to include the specifics of the first information report (FIR), the identities of the accused, or the testimonies of any eyewitnesses, nor is it necessary for any witness to sign the report.¹⁶

Another significant provision having an effect on doctors in the role of public officials is section 197. Public officials are protected from potential criminal proceedings under Section 197 if they are accused of committing or trying to commit an offence while in the performance of their public duties. The legislative strategy is to provide adequate safeguards for public officials, preventing lawsuits against them for actions taken during their official duties without just cause, while granting the government complete authority over the prosecution process if it chooses to use such power. It must be shown that the official in issue was charged with a crime purportedly committed while performing or claiming to perform his official duties before Section 197 may be used. In this context, a reliable approach is to assess whether the public worker might have faced charges for dereliction of duty had he been accountable for the conduct in issue. If affirmative, it may be said that the public servant executed the conduct in issue while doing his official duties, establishing a direct link between the two. This element indicates that the concept of Section 197 is not immediately applicable to the complaint matter upon its initiation. To qualify as an "official duty" of a public employee, an action or inaction must occur when the person is executing their responsibilities for the government.¹⁷ The Criminal Procedure Code, 1973 mandated only a sanction for prosecuting a public servant, but the Bhartiya Nagarik Suraksha Sanhita also requires the sanction to be given within 120 days. This is done with the legislative intent to prevent misuse of the necessity of sanction by delaying the approval for protecting the public servant.

As part of the medical examinations covered in Sections 51–53 of the BNSS, DNA profiling has been specifically included. DNA samples may be extracted from biological sources, but a DNA profile is distinct. For comparison and identification, the use of material samples like fingerprints does not constitute a testimonial act or coercion according to Article 20(3) of the Constitution. Therefore,

there are no constitutional issues in India with the collection and storage of DNA samples, which are considered tangible evidence.¹⁸

Explaining the validity of DNA reports, the Supreme Court in a case involving rape and murder, has ruled that DNA reports must be taken at face value as authoritative scientific evidence. The court cannot substitute its own opinion for that of an expert, especially in cases involving difficult subjects like DNA profiling, according to interpretations of Sections 52 and 53 of the BNSS.¹⁹ Although the administration of certain medical tests on the accused is permitted under Sections 51, 52, and 53 of the BNSS, Narco Analysis, Polygraph, and BEAP tests are excluded from this provision.¹⁹ Although some medical tests are allowed for accused people under Explanation (a) to Sec 51 BNSS, narco analysis, polygraph, and BEAP testing are excluded from this provision.¹⁸

Moreover, when set at liberty individual is responsible for his health and well-being. But when in custody, it is the duty of the person having custody of an accused to take reasonable care of the health and safety of the accused. This is mandated by section 56 of Bhartiya Nagarik Suraksha Sanhita. Furthermore, section 53 prescribes compulsory medical examination of the person arrested. In such a medical examination, the doctor must prepare a record of marks and injuries on the arrestee. This serves a dual purpose, first, it helps corroborate the role of the arrestee in crime through medical evidence, and secondly, it ensures humane treatment of the accused in custody.

Also, the mention of sections 396 and 397 of Bhartiya Nagarik Suraksha Sanhita is important here. Section 396 directs the State Government to make a victim compensation scheme to compensate and rehabilitate the victims. Section 397 requires all government hospitals, whether run by the state or central government, to provide free medical services free of cost to the victim. Thus, it is right to conclude that the Bhartiya Nagarik Suraksha Sanhita is sufficiently able to protect the rights and health of all the persons involved in the process of administration of justice, including doctors, accused, and even victims.

BHARTIYA SAKSHYA ADHINIYAM

According to section 39(1) of the Bhartiya Sakshya Adhiniyam, 2023 (hereinafter referred to as BSA), only a registered medical practitioner enrolled by Section 15(2)(c) of the Indian Medical Council Act, 1956, is permitted to testify as an expert witness in court about medicinal matters.

Although medical witnesses often represent the prosecution, they are permitted to testify only as expert witnesses by section 39(1) of the BSA, 2023, and cannot serve as witnesses for either the prosecution or the defence. Medical witnesses are to be introduced to assist the court in uncovering the truth, perhaps benefiting either the prosecution or the presenting party. The evidence of a medical expert is just advisory. A medical witness evidence is not required to be conclusive. A court will choose whether to affirm such an opinion. Judicial bodies are not compelled to adhere to views that are devoid of logic or impartiality.²⁰

When the views of two doctors conflict, the court may choose to regard the evidence of one doctor over the other. The court may prioritize the doctor whose results align with the prosecution's case.²¹ With regard to the determination of age, a medical opinion from a medical board may be acquired alone in the absence of a birth certificate issued by a corporation, panchayat, or municipality. Although age can be proved through matriculation certificates, school certificates, and any other pertinent documentation.



It is reasonable to take into account the date of birth shown on a juvenile's marksheet and school certificate when assessing their age, rather than just depending on the medical board's assessment.²² To ascertain a juvenile's age, a school certificate is necessary; medical documentation is not needed if it is available.²³

Medical evidence or evidence given by medical professionals is also subject to various explanations by the apex court. These explanations are mandated, given the nature of conflict about medical evidence. There exists a diverse array of potential forms and intensities of discord between medical evidence and oral testimony relating to injury and the weapon used. Occasionally, a weapon often associated with inflicting pain and injury fails to produce any damage at all. In some circumstances, the victim may exhibit injuries that align with the kind of assault weapon used; yet, the weapon's size and proportions may not precisely correspond to the victim's injuries. Injuries received by the victim, which align with those inflicted by the attack weapon but are not located on the body portion indicated by witnesses, fall into the third category. The three categories of apparent conflict in oral and medical data mentioned above preclude the formation of identical conclusions. In the first group, there exists a plausible suspicion that the witness asserting the employment of a particular weapon in the assault is being untruthful. Conversely, the second and third groupings do not permit such an instantaneous inference. When assessing the reliability of eyewitness testimonies, several elements must be evaluated, including the type and severity of the incident, the victim's posture and resistance, the witnesses' observational capacity (influenced by distance and lighting conditions), among others.²⁴

Moreover, the Bhartiya Sakshya Adhiniyam provides three types of presumption wherein the court "may presume," "shall presume," and where one fact will act as "conclusive proof" of another fact. In cases of 'may presume' presumptions, the court, on proof of one fact, may presume the other fact, and even though the court presumes the fact, it is rebuttable, i.e., evidence can be given to disprove the fact. In cases of 'shall presume' presumption, the court is bound to presume a fact on the proof of another fact, but it is also a rebuttable presumption that evidence can be given to disprove the fact. In cases of "conclusive proof," not only is the court bound to presume the fact it cannot allow the evidence to be given to disprove the fact. Section 116 of Bhartiya Sakshya Adhiniyam, though, raises conclusive proof, but the Supreme Court held that perfect scientific proof can rebut even conclusive proof.²⁵ The court has also held that in the event of significant discrepancies in oral testimonies, credible scientific proof can help decide the case.²⁶

The Supreme Court has established the following regulations for the scientific examination of blood or DNA to determine paternity or legitimacy of a child:

- An Indian court cannot regularly order a blood test;
- No application for an unrestricted and broad inquiry may result in the approval of a blood test;
- The spouse has the burden of evidence to demonstrate non-access to refute the presumption established under section 112 of the Evidence Act, necessitating a strong prima facie case.
- Before ordering the blood test, the court must meticulously consider the possible ramifications, including the designation of the mother as unchaste and the child as illegitimate.
- Blood samples cannot be obtained by coercion from any individual.²⁷

CONCLUSION

India's new criminal justice system, including the Bharatiya Nyaya Sanhita, Bharatiya Nagarik Suraksha Sanhita, and Bharatiya Sakshya Adhiniyam, represents a significant advancement in aligning legal principles with contemporary medical requirements. These modifications have established a progressive and protective framework by including protections addressing medical malpractice, patient rights, and public health. This approach aims to enhance patient empowerment while maintaining essential healthcare protocols, balancing stringent safety requirements with allowances for genuine, life-saving interventions.

Furthermore, the legal framework ensures that physicians and medical institutions adhere to ethical standards while safeguarding them from unjust litigation, thereby fostering an environment in which harmed parties can obtain justice more expediently. In line with India's constitutional mandate for a safer and healthier society, the revised criminal laws prioritize the protection of patients and address public health issues, including those arising from the adulteration of food or pharmaceuticals. Through this innovative method, India demonstrates the evolution of its legal system and its dedication to establishing a judicial framework that is equitable and transparent for all stakeholders in healthcare, including physicians and patients.

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