

Mothers' Knowledge and Attitudes Regarding Newborn Heel-prick Screening Tests: A Cross-sectional Study

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ABSTRACT

Introduction: Newborn Screening (NBS) is a crucial preventive health strategy for early detection of metabolic, endocrine and genetic disorders. In India, despite its potential to reduce infant morbidity and mortality, implementation remains limited. Awareness and acceptance among mothers are keys to the success of such programs.

Aim: To assess the knowledge and attitude of postpartum mothers regarding the Heel-Prick Screening Test (HPST) and to determine their association with sociodemographic factors.

Materials and Methods: A cross-sectional study was conducted among 122 postpartum mothers at the Department of Community Medicine, Bharati Vidyapeeth (DU) Medical College, Pune, Maharashtra, India, between July 2023 to September 2023. Mothers who had delivered a live newborn at Bharati Hospital were included in the study. Data were collected using a structured, pretested questionnaire consisting of 13 knowledge items and nine attitude statements. The Chi-square test was applied to examine any association between

mother's knowledge and various sociodemographic variables. The $p < 0.05$ was considered significant.

Results: The mean age of participants was 27.3 ± 3.4 years. The majority were aged 25-30 years 75 (61.47%), Hindu 111 (90.98%), educated up to high school or above 109 (89.34%) and homemakers 120 (98.36%). The mean knowledge score was 2.01 ± 2.56 (18; 15.44% correct responses). Only 61 (50%) mothers knew that HPST is a simple procedure, 3 (2.46%) knew the correct timing (3-7 days after birth). The mean attitude score was 17.86 ± 0.90 (66.15%), reflecting a favourable attitude. A total of 38 (31.15%) agreed that HPST prevents disease and 36 (29.50%) believed it benefits newborns. Maternal age was significantly associated with attitude ($p = 0.010$).

Conclusion: Although 80 (66.15%) mothers exhibited favourable attitudes toward HPST, their awareness remained inadequate. The results highlight the need for structured antenatal and postnatal education, training of healthcare providers and community-level awareness programs to improve knowledge and ensure early participation in NBS initiatives in India.

Keywords: Blood-spot test, Maternal perceptions, Neonatal health, Public health screening

INTRODUCTION

The NBS is a public health program aimed at the early detection and treatment of congenital, metabolic, endocrine and genetic disorders in infants before the onset of symptoms. It prevents irreversible complications and improves the quality of life for affected children [1]. Screening involves analysing dried blood spot samples collected 2-3 days after birth, up to 28 days of life [2].

Phenylketonuria was the first disorder screened through NBS and early dietary intervention with a low-phenylalanine diet successfully prevented intellectual disability [3]. Later, primary hypothyroidism and cystic fibrosis were included due to advances in immunoassays and molecular diagnostics [4]. With technological progress, NBS now detects over 60 disorders, reducing preventable developmental delay, disability and mortality [5,6].

Recognising these benefits, many developed and developing nations have adopted NBS as part of national healthcare policies, tailoring screening panels based on disease prevalence and Wilson-Jungner criteria [7]. However, India, despite contributing to one-fifth of global births, lacks a nationwide NBS programme [8,9]. About 27 million babies are born each year and the incidence of Inborn Errors of Metabolism (IEMs) is estimated at one in 1,000 live births [10]. Consanguinity further increases genetic disorder risk, especially in southern states [11]. IEMs constitute nearly 15% of neonatal intensive care unit admissions in India [12].

Currently, Kerala, Goa and Chandigarh are the only regions with government-led NBS programs [13]. The main barriers to national implementation are limited awareness among parents, healthcare providers and policymakers [14]. Previous Indian studies reveal high awareness among paediatricians, moderate among gynaecologists,

but mixed knowledge and positive attitudes among parents regarding NBS [15-18].

As primary caregivers, mothers significantly shape newborn health outcomes, making their understanding and acceptance of screening tests essential for effective program implementation. [19,20]. Their awareness and acceptance of HPST directly influence participation and follow-up in NBS programs [21,22]. Despite this, very few Indian studies have explored mothers' awareness and attitudes toward HPST [10,11].

Hence, the present study was undertaken to assess the knowledge and attitude of postpartum mothers regarding the HPST and to identify associations between sociodemographic factors and maternal awareness levels.

MATERIALS AND METHODS

A cross-sectional study was conducted at the Department of Community Medicine, Bharati Vidyapeeth (DU) Medical College, Pune, Maharashtra, India, between July 2023 to September 2023. After the approval from Institutional Ethics Committee (BVDUMC IEC approval number REF:BVDUMC/IEC/39 obtained on 12/07/2023), the study participants were briefed about the study protocol, confidentiality and a written informed consent was obtained from them for interview.

Inclusion criteria: Postpartum mothers who had delivered a live newborn at Bharati Hospital were included.

Exclusion criteria: Mothers whose newborns were admitted to Neonatal Intensive Care Unit (NICU) for critical illness and mothers with diagnosed psychiatric illness interfering with interview were excluded from the study.

Sample size calculation: The sample size was calculated using the single proportion formula:

$$n = Z^2 \times p \times (1-p) / d^2$$

where:

$Z=1.96$ (for 95% confidence interval),

$p=0.43$ (based on a previous Jordanian study reporting that 43% of mothers were aware that results of the NBS test may take 1-2 weeks [18]), $d=0.09$ (allowable error of 9%).

Thus, the required sample size was 116. However, in the present study 122 mothers were interviewed. Sampling was done through convenient sampling technique.

Study Procedure

Data were collected using structured pretested questionnaires about their sociodemographic information, knowledge and attitude regarding NBS.

Tools of data collection (Questionnaire/Proforma):

- **Mothers' background information:** The sociodemographic information including mother's age, religion, educational level, number of children, family size, family and per capita income, occupation of mother, socioeconomic status and health of children.
- **Mothers' knowledge about HPST:** This variable was measured using 13 items of knowledge about the HPST. The questionnaire used in the present study was directly adopted from the validated tool developed by Kasem A et al., (2022), which assessed mothers' knowledge and attitudes toward NBS in Jordan. The original instrument demonstrated satisfactory psychometric properties, including content validity and internal consistency reliability. As the questionnaire was previously validated and published, no additional pilot testing or independent validation was performed in the present study. Each correct response in the knowledge section was scored as '1,' while incorrect or 'don't know' responses were scored '0,' yielding a total score range of 0-13. Knowledge was categorised using a 50% cut-off of the total score ($\geq 7/13$ =good knowledge; <7 =poor knowledge) [18].
- **Mothers' attitude about HPST:** This variable was measured using the nine-item attitude scale. In the attitude section, responses were rated on a 3-point Likert scale ('Agree'=3, 'Neutral'=2, 'Disagree'=1), with total scores ranging from 9-27. Attitude was categorised using a 50% cut-off of the total score ($\geq 14/27$ =good Attitude ; <14 =poor Attitude) [18].

Data collection: The mothers were interviewed while they were in the post-partum wards. Considering the mother's frail physical state after delivery, the mothers' responses on the structured questionnaires were gathered using face-to-face interviews with the researcher who documented their responses. At each interview, it took between 10 and 15 minutes to complete a questionnaire.

STATISTICAL ANALYSIS

All statistical analysis was done using Statistical Package for Social Sciences (SPSS) software with version 28.0. Quantitative variable result was shown by descriptive statistics. Categorical variable result was shown by frequency and percentages. Data is presented in tabular and graphical form. Chi-square test was used for categorical variables. One-way ANOVA (F-test) was applied to compare mean knowledge and attitude scores across sociodemographic groups. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 122 postpartum mothers participated. The mean age was 27.3 ± 3.4 years. Most were aged 25-30 years 75 (61.47%), Hindu 111 (90.98%), educated up to high school 56 (45.90%) or graduates

and above 53 (43.44%) and homemakers 120 (98.36%). The majority 81 (66.40%), had a family income between ₹31,000-₹60,000, belonged to socioeconomic Classes I and II 56 (45.90%) and 61; 50.00% respectively) and lived in medium-sized families 64 (52.46%). 69 (56.56%) mothers had <two children and only 3 (2.46%) reported congenital or hereditary problems in their children [Table/Fig-1].

Variables	Range	n (%)
Age (years)	<25	20 (16.39%)
	25-30	75 (61.47%)
	>30	27 (22.13%)
Religion	Hindu	111 (90.98%)
	Muslim	8 (6.56%)
	Others	3 (2.46%)
Level of education	Illiterate	9 (7.38%)
	Primary schooling	4 (3.28%)
	High school	56 (45.90%)
	Graduate and above	53 (43.44%)
Number of children	≤ 2	69 (56.56%)
	> 2	53 (43.44%)
Occupation	Housewife	120 (98.36%)
	Data operator	1 (0.82%)
	Clerk	1 (0.82%)
Family Income (INR)	10,000-30,000	41 (33.60%)
	31,000-60,000	81 (66.40%)
Socioeconomic status (BG Prasad 2024)	I (9098 and above)	56 (45.90%)
	II (4549-9097)	61 (50.00%)
	III (2729-4548)	4 (3.28%)
	IV (1364-2728)	1 (0.819%)
	V (<1364)	0
Family size	1-4	58 (47.54%)
	5-12	64 (52.46%)
Children with health issue	No health issue	119 (97.54%)
	Have congenital/hereditary issue	3 (2.46%)

[Table/Fig-1]: Characteristics of participants sociodemographic variable (N=122). Mothers' knowledge about the heel prick screening test

The mean knowledge score was 2.01 ± 2.56 (out of 13), corresponding to 18 (15.44 %) correct responses. Half 61 (50%) knew that HPST is a simple procedure and 37 (30.32%) recognised its importance for infant health. However, only 3 (2.46%) knew the correct timing (3-7 days after birth) and none (0%) knew that blood is collected by heel-prick. Awareness that the test detects > 25 disorders was limited 3 (2.46%) and only 33 (27.04%) knew that early diagnosis can prevent lifelong impairment. Overall, knowledge about HPST procedure, timing and purpose was poor. Only 14 (11.47%) mothers had good knowledge, while the remaining 108 (88.52%) had poor knowledge [Table/Fig-2].

The mean attitude score was 17.86 ± 0.90 (out of 27), indicating a favourable attitude 80 (66.15 %). 38 (31.15%) mothers agreed that HPST is useful in preventing disease and 36 (29.50%) that it is beneficial to the newborn. Most remained neutral regarding statements of harm 87 (71.31%) or religious conflict 88 (72.13%) [Table/Fig-3].

Maternal age showed a significant association with attitude ($F=4.67$ $p=0.010$). No significant association was observed between knowledge scores and age ($p=0.99$), religion ($p=0.900$), parity ($p=0.990$), education ($p=0.900$), occupation ($p=0.850$), or socioeconomic status ($p=0.880$). Similarly, attitude scores did not show significant associations with religion ($p=0.630$), parity ($p=0.748$), education ($p=0.630$), occupation ($p=0.720$), or socioeconomic status ($p=0.810$) [Table/Fig-4]. Although nine sociodemographic variables were recorded, association analysis

S. No.	Knowledge Statement	Mothers' response n (%)		
		*True	False	Don't Know
1.	The test is a simple procedure for the discovery of genetic and congenital diseases	61 (50%)	0	61 (50%)
2.	The test is important to ensure the infants' good health condition.	37 (30.32%)	0	85 (69.67%)
3.	The test helps in detecting metabolic disorders of an infant to avoid further deterioration of the child's health status	3 (2.46%)	0	119 (97.54%)
4.	When diagnosed early, there is a chance of an excellent prognosis and the newborn may be spared from lifelong impairment and can enjoy a normal life	33 (27.04%)	0	89 (72.95%)
5.	The test aids in the early detection of common genetic and congenital diseases such as PKU, G6PD and CHT	0	0	122 (100%)
6.	The test can identify more than 25 genetic and congenital diseases	0	3 (2.46%)	119 (97.54%)
7.	The blood spot would help future research related to public health problems	3 (2.46%)	28 (22.95%)	91 (74.59%)
8.	The programme is operated by the Ministry of Health.	31 (25.40%)	5 (4.098%)	86 (70.49%)
9.	The test is performed by pricking the newborn's heel.	0	0	122 (100%)
10.	The best time to do the test for a newborn is between three to seven days.	3 (2.46%)	0	119 (97.54%)
11.	The heel-pricking is performed by a nurse, midwife, or doctor.	34 (27.87%)	0	88 (72.13%)
12.	The blood samples will be sent to the Newborn Screening (NBS) Laboratory centre and the result will be released in 7–14 working days.	3 (2.46%)	0	119 (97.54%)
13.	If the results of the heel-prick test are abnormal, it means that the newborn has the risk of developing a genetic or congenital disorder.	37 (30.32%)	0	85 (69.67%)

[Table/Fig-2]: Mothers' knowledge about the heel-prick screening test.
A score of 1 is used to weigh a correct answer, while a score of 0 is assigned for incorrect or "I do not know" responses with the total knowledge score ranging from 0 to 13 and the higher scores indicating a higher knowledge level.
*Correct answer is "true" for all items

S. No.	Attitude statements	n (%)		
		Agree	Neutral	Disagree
1.	Useful if it prevents a disease	38 (31.15%)	84 (68.85%)	0
2.	Useful if it reduces the severity of a disease.	7 (5.73%)	115 (94.26%)	0
3.	Useful even if it cannot improve the disease as it may help me decide about mothering children in the future	3 (2.46%)	119 (97.54%)	0
4.	Is beneficial to the newborn.	36 (29.50%)	83 (68.03%)	3 (2.45%)
5.	Is harmful to the newborn	0	87 (71.31%)	35 (28.69%)
6.	Is essential for the well-being of the newborn	5 (4.10%)	117 (95.90%)	0
7.	Is morally justified	0	119 (97.54%)	3 (2.46%)
8.	Is against my religious belief	0	88 (72.13%)	34 (27.87%)
9.	Would make me feel guilty if the newborn is found to have a genetic disease	0	91 (74.60%)	31 (25.40%)

[Table/Fig-3]: Attitude of mothers toward the heel-prick screening tests.
The responses of the attitude scale range from a score of 1 indicating "disagree" to a score of 3 indicating "agree," ranging the total attitude score from 9 to 27 with the higher scores indicating a more positive attitude toward the HPST

was limited to age, religion, education, number of children, and socioeconomic status, as these are established determinants of maternal knowledge and attitude in newborn-screening literature. The remaining variables were excluded due to minimal variability and highly skewed distribution in the present dataset.

DISCUSSION

The present study assessed the knowledge and attitude of postpartum mothers toward the HPST and identified associated sociodemographic factors. Despite a favourable attitude (mean score 17.86±0.90; 66.15%), mothers' overall knowledge was poor (mean score 2.01±2.56; 15.44%). These findings indicate acceptance of the concept but limited understanding of the procedure and its benefits.

Half of the mothers 61 (50%) knew that HPST is a simple procedure, but awareness of its timing (3-7 days) and method (heel-prick) was almost absent. Only 33 (27.04%) knew that early detection can prevent lifelong impairment. A similar observation was reported by Ali HIM et al., from Egypt, who found that although most mothers had

Variables	Size n=122	Knowledge score [13] Mean±SD	Attitude score [27] Mean±SD
Age (years)			
<25	20	2.2 (2.2934)	18.4 (1.3564)
25-30	75	1.92 (2.5547)	17.76 (0.7088)
>30	27	2.3703 (2.7775)	17.74 (0.7978)
p-value		χ ² =0.047 p=0.995	f=4.67, p=0.010*
Religion			
Hindu	111	1.9729 (2.5520)	17.88 (0.93)
Muslim	8	1.75 (2.2220)	17.75 (0.46)
Others	3	4.0 (2.8284)	17.86 (0.94)
p-value		χ ² =1.196 p=0.90	f=.647, p=0.630
Level of education			
Illiterate	9	1.4444 (2.4545)	17.77 (0.44)
Primary schooling	4	1.75 (2.4874)	17.75 (0.5)
High school	56	1.7142 (2.4764)	17.82 (0.71)
Graduate and above	53	2.3773 (2.5567)	17.92 (1.15)
p-value		χ ² =0.257 p=0.9	f=0.647, p=0.630
Number of children			
<2	69	1.9710(2.5874)	17.91 (1.01)
>2	53	2.0566(2.5209)	17.78 (0.75)
p-value		χ ² =0.0017 p= 0.99	f=0.291, p=0.748
Total (n)	122		
Socioeconomic Status (BG Prasad 2024)			
I (9098 and above)	56	2.0357 (2.5422)	17.875 (0.9647)
II (4549-9097)	61	2.0491(2.5762)	17.8524 (0.865)
III (2729-4548)	4	1.5 (2.5980)	17.75 (0.4330)
IV (1364-2728)	1	-	-
V (<1364)	0	-	-
p-value		χ ² =0.71, p=0.880	F=0.42, p=0.810

[Table/Fig-4]: Variation of knowledge and attitude score across sociodemographic variables. Sociodemographic variables.
χ², Chi-square, f=F-statistic (one-way ANOVA), p level of significance

heard about neonatal screening, detailed knowledge about the test procedure and disorders detected was inadequate [23]. Likewise, Wilaiwongsathien K et al., from Thailand reported modest maternal awareness, particularly regarding the timing and method of blood sample collection [6]. In contrast, a study by Kasem A et al., from

Jordan documented moderate levels of maternal knowledge, which was attributed to structured antenatal counselling and physician-led education, highlighting the role of health-system support in improving awareness [18,24].

Half of the mothers in the present study perceived HPST as a simple procedure; however, awareness regarding the correct timing of screening and heel-prick blood collection was almost absent. Similar gaps were reported by Kadiroğlu T et al., from Turkey, where mothers lacked procedural knowledge despite receiving antenatal care. In contrast, Franková V et al., from the Czech Republic observed significantly higher procedural awareness, as most mothers received information directly from healthcare professionals before delivery, emphasising the importance of provider-driven counselling [25,26].

In the present study, maternal age showed a significant association with attitude ($p=0.010$)-mothers aged 25-30 years displayed more favourable views, aligning with findings from study conducted by Al-Sulaiman A et al., from Saudi Arabia, where younger, educated mothers showed strong support for NBS despite low knowledge [27]. Similar results were observed in previous study by Araia MH et al., from Canada, who reported significantly better maternal comprehension of newborn blood-spot screening outcomes, particularly among educated mothers, reflecting the impact of standardised parental education and informed consent practices in high-income countries [28].

The ethical and social dimensions of NBS have also been noted. Lack of parental information and false-positive anxiety were highlighted in Western literature, emphasising the need for transparent communication and consent practices [29].

Overall, the findings of the present study reinforce that maternal education and counselling are vital for effective NBS implementation. Poor awareness can undermine screening uptake, while a favourable attitude offers a foundation for health education. There is need for outreach programmes, promotional activities, initiatives and implementations of government policies to ensure success of NBS.

Limitation(s)

The present study was conducted at a single tertiary-care hospital in Pune using a convenience sampling technique, which may limit the generalisability of the findings to other regions or community settings. The data were based on self-reported responses, which may be influenced by social desirability or recall bias. Despite these limitations, the study provides important baseline data on maternal awareness and perceptions regarding the HPST in India, offering a foundation for designing targeted educational interventions and larger multicentric studies in the future.

CONCLUSION(S)

The present study highlights that postpartum mothers generally hold favourable attitudes toward the HPST, despite having limited knowledge about its purpose and procedure. Maternal age was associated with attitude, underscoring the influence of sociodemographic factors on perceptions of NBS. These findings emphasise the urgent need to enhance maternal awareness through structured antenatal and postnatal counselling, training of healthcare providers and community-based awareness campaigns. Incorporating HPST education into routine maternal and child health services can significantly improve informed participation, timely screening and newborn health outcomes. In conclusion, favourable attitudes combined with poor knowledge highlight a critical

opportunity for policy-driven educational initiatives and national program integration of NBS in India.

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