



Knowledge of Nursing Students Regarding Human Milk Banking: A Descriptive Cross-Sectional Study from Lucknow, India

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ABSTRACT

Background: Breast milk is a primary source of nutrition for a new born babies. It has the exact amount of nutrients that the infant needs and is very gentle on their tiny stomach, intestine, and other developing body parts. Human milk banking (HMB) represents a critical intervention for vulnerable neonates, particularly those born preterm or with very low birth weight, when mothers' own milk is unavailable. Despite its well-established clinical benefits, knowledge of HMB among nursing students the next generation of clinical practitioners remains insufficiently characterised in the Indian context. **Objectives:** To assess the level of knowledge regarding human milk banking among nursing students enrolled at a nursing college in Lucknow, India, and to determine the association between knowledge levels and selected socio-demographic variables. **Methods:** A non-experimental, descriptive cross-sectional design with quantitative approach was employed. Ninety nursing students (GNM 3rd Year, n=30; B.Sc. Nursing V Semester, n=28; B.Sc. Nursing VI Semester, n=32) were recruited by convenient sampling from Sardar Patel College of Nursing, Lucknow, during 30 November to 6 December 2025. Data were collected using a self-structured, expert-validated 15-item knowledge questionnaire. Scores were categorised as inadequate (0–5), moderate (6–10), or adequate (11–15). Descriptive statistics and chi-square tests were applied for analysis. **Results:** The mean knowledge score was 7.44 (SD=4.007). The majority of students demonstrated moderate knowledge (64.44%), while 22.22% had inadequate and 13.33% had adequate knowledge. Chi-square analysis revealed statistically significant associations between knowledge level and marital status ($\chi^2=15.05$, $df=2$, $p=0.0005$) and academic qualification ($\chi^2=12.31$, $df=4$, $p=0.015$). No significant associations were found for age, gender, type of family, area of living, religion, prior exposure to HMB, or source of information. **Conclusion:** The study conclude that nursing students have moderate knowledge regarding Human Milk Bank. Based on the findings of the present study, there is need for targeted educational interventions to improve nursing student's knowledge regarding the Human Milk Bank. Further experimental and observational studies are recommended to support the development of effective educational strategies for knowledge enhancement.

Keywords: human milk banking; nursing students; knowledge assessment; donor human milk; breastfeeding education; descriptive cross-sectional study; India

INTRODUCTION

Poor nutrition in the early stage of life can cause serious and lasting harm to babies physical growth and brain development. On the other hand if babies receive good nutrition, it supports their healthy development as well as providing protection against disease. Breastfeeding constitutes the cornerstone of early infant nutrition, and both the World Health Organization (WHO) and the Pan American Health Organization (PAHO) unequivocally recommend exclusive breastfeeding for the first six months of life as the optimal strategy to prevent child malnutrition, infection, and mortality [1,2]. For preterm and very low birth weight (VLBW) neonates admitted to neonatal intensive care units (NICUs), however, the immediate availability of adequate volumes of mothers' own milk (MOM) cannot always be guaranteed. In such circumstances, WHO guidelines endorse the use of pasteurised donor human milk (PDHM) from accredited human milk banks as the preferred second-line nutritional intervention, ahead of preterm infant formula [1].

Human milk banking is defined as the systematic process of recruiting, screening, collecting, processing, storing, and distributing human milk donated by lactating women for infants who cannot receive adequate MOM [3]. The clinical rationale

for this practice is compelling: pasteurised donor human milk has been associated with a significant reduction in necrotising enterocolitis (NEC), sepsis, and feeding intolerance compared with preterm infant formula in multiple studies [4,5]. Furthermore, an exclusive human milk-based diet during the NICU stay has been associated with improved neurodevelopmental outcomes including higher cognitive scores at 18–22 months among extremely preterm infants [6]. These cumulative benefits have driven the establishment and expansion of human milk banks across high-income countries and, increasingly, across low- and middle-income countries [1,2].

India bears a disproportionate share of the global preterm birth burden. With a neonatal mortality rate (NMR) that remains elevated relative to high-income counterparts, and preterm birth constituting a major contributor to neonatal deaths, the clinical imperative for effective NICU nutrition strategies, including HMB, is acute [7]. Recognising this, India has witnessed substantial growth in its HMB infrastructure. The Human Milk Bank at Jawaharlal Institute of Postgraduate Medical Education and Research (JIPMER), Puducherry one of India's pioneering facilities celebrated its tenth anniversary in 2025, reflecting a decade of institutional commitment to improving

neonatal outcomes through organised milk banking [8]. Nevertheless, HMB services remain geographically concentrated in tertiary academic institutions and are absent from a large proportion of district-level healthcare facilities, creating significant disparities in access for neonates in secondary and community care settings [8,9].

Uttar Pradesh (UP), India's most populous state, carries an exceptionally high burden of preterm and low birth weight births, contributing substantially to national neonatal morbidity and mortality statistics. Despite the concentration of several tertiary hospitals in Lucknow the state capital access to dedicated human milk banking services in the region remains limited. The nursing workforce trained at institutions in Lucknow will staff NICUs and postnatal wards across UP, making the adequacy of their knowledge regarding HMB a matter of direct clinical and public health consequence.

International studies have documented that nursing students and early-career nurses consistently exhibit significant knowledge gaps regarding both breastfeeding and HMB[10-15]. In the Indian context, prior investigations have begun to characterise these gaps among medical and paramedical students; Taksande et al [10], reported that while 74% of Indian health-professional students had heard of HMB, willingness to donate or use banked milk remained limited. Archana[11] reported that approximately half of nurses in a Bangalore institution had good HMB knowledge, while Divya and Augustin [12] found that the majority of final-year nursing students in Mangalore demonstrated only average or poor HMB knowledge. Despite these early signals, data specifically characterising HMB knowledge among nursing students in North India particularly Lucknow and the broader UP belt remain sparse, precluding region-specific educational planning.

STUDY OBJECTIVES

This study was conducted with the following objectives:

1. To assess the level of knowledge regarding human milk banking among nursing students at Sardar Patel College of Nursing, Lucknow.
2. To determine the association between knowledge levels and selected socio-demographic variables including age, gender, marital status, academic qualification, type of family, area of living, religion, prior exposure to HMB information, and source of information.

MATERIALS AND METHODS

Study Design and Setting: A non-experimental, descriptive cross-sectional design with a quantitative approach was employed. The study was conducted at Sardar Patel College of Nursing, Lucknow, Uttar Pradesh, India - an institution affiliated with Atal Bihari Vajpayee Medical University.

Study Population, Sample Size, and Sampling Technique: The target population comprised nursing students enrolled in GNM (General Nursing and Midwifery) and B.Sc. Nursing programmes at the study institution. The accessible population consisted of students present during the data collection period. A sample of $n=90$ students was recruited using a convenient sampling technique, comprising GNM 3rd Year ($n=30$), B.Sc. Nursing V Semester ($n=28$), and B.Sc. Nursing VI Semester ($n=32$).

Inclusion criteria: Students enrolled in GNM 3rd Year or B.Sc. Nursing V or VI Semester at the study institution; present during the data collection period; willing to provide written informed consent.

Exclusion criteria: Students absent during the data collection period; students who declined to participate; students with prior postgraduate nursing training.

Study Tool: Data were collected using a self-structured knowledge questionnaire developed specifically for this study. The instrument comprised two sections:

Section A: Sociodemographic profile (8 items) covering age, gender, marital status, academic qualification, type of family, area of living, religion, prior exposure to HMB information, and source of information.

Section B: Knowledge assessment (15 items) covering the definition and rationale of HMB, donor eligibility and exclusion criteria, components and processing of human donor milk, clinical indications for PDHM use, contraindications, benefits for preterm and VLBW neonates, infection-control measures including pasteurisation, and nursing responsibilities in the HMB context.

Each item in Section B was scored dichotomously (correct=1, incorrect/unknown=0), yielding a total score ranging from 0 to 15. Knowledge was categorised as inadequate (0–5), moderate (6–10), or adequate (11–15).

Validity and Reliability: The questionnaire was submitted for content validity to six subject experts drawn from the fields of paediatric nursing, obstetric nursing, and neonatology. Expert feedback was incorporated and the content validity index (CVI) was satisfactory. A pilot study was conducted among $n=10$ nursing students from the same institution who were not included in the main sample. The pilot yielded a mean score of 9.5 (SD=1.4; range 7–13), confirming the instrument's discriminatory capacity and feasibility.

Data Collection Procedure: Written informed consent was obtained from each participant prior to data collection. The questionnaire was self-administered; a trained investigator was present to clarify procedural queries without influencing responses. Completed questionnaires were collected immediately upon completion to minimise missing data. Confidentiality and anonymity were maintained throughout.

Statistical Analysis: Data were entered and analysed using standard statistical software SPSS. Descriptive statistics frequency, percentage, mean, and standard deviation were computed for sociodemographic characteristics and knowledge scores. Inferential analysis employed the chi-square (χ^2) test to determine associations between knowledge category and socio-demographic variables. A p -value <0.05 was considered statistically significant.

Ethical Considerations: Institutional ethical approval was obtained from the Research and Ethics Committee of Sardar Patel College of Nursing, Lucknow, prior to study commencement. All participants provided written informed consent. Participation was entirely voluntary, and withdrawal at any point without consequence was assured. Student identifiers were not recorded on questionnaires.

RESULTS

Sociodemographic Profile

Table 1 presents the sociodemographic characteristics of the 90 participants. The majority fell within the 20–22 years age

group (61.11%), with a preponderance of female students (75.55%). Most participants were unmarried (93.33%) and resided in rural areas (51.11%). Hindu students constituted the largest religious group (92.22%). Regarding prior exposure, 67.77% of participants reported having heard of HMB, predominantly via internet or social media (44.44%).

Table 1. Sociodemographic Profile of Nursing Students (n=90)

Variable	Category	n	%
Age (years)	17–19	10	11.11
	20–22	55	61.11
	23–25	24	26.66
	≥25	1	1.11
Gender	Male	22	24.44
	Female	68	75.55
Marital status	Married	6	6.66
	Unmarried	84	93.33
Academic qualification	GNM 3rd Year	30	33.33
	B.Sc. Nursing V Semester	28	31.11
	B.Sc. Nursing VI Semester	32	35.55
Type of family	Nuclear	57	63.33
	Joint	31	34.44
	Extended	1	1.11
	Single parent	1	1.11
Area of living	Rural	46	51.11
	Urban	44	48.88
Religion	Hindu	83	92.22
	Muslim	3	3.33
	Christian	4	4.44
Heard about HMB	Yes	61	67.77
	No	29	32.22
If Yes, Source of information	Internet/Social media	40	44.44
	Friends/Family	8	8.88
	Classroom teaching	10	11.11
	Other	3	3.33

HMB = Human Milk Banking.

Knowledge Levels

Table 2 summarises the distribution of knowledge scores across the three categories. A mean knowledge score of 7.44 (SD=4.007) was observed, placing the overall group within the

moderate knowledge band. The majority of students (64.44%) demonstrated moderate knowledge (scores 6–10), while 22.22% exhibited inadequate knowledge (scores 0–5) and only 13.33% achieved adequate knowledge (scores 11–15).

Table 2. Distribution of Knowledge Scores Among Nursing Students (n=90)

Knowledge Category	Score Range	Frequency (n)	Percentage (%)	Mean knowledge score	SD (Standard deviation)
Inadequate	0–5	20	22.22	7.44	4.007
Moderate	6–10	58	64.44		
Adequate	11–15	12	13.33		
Total	0–15	90	100.00		

Association Between Knowledge Level and Socio-Demographic Variables

Chi-square tests were performed to examine the association between knowledge category and each socio-demographic variable (Table 3). Statistically significant associations were

found for marital status ($\chi^2=15.05$, $df=2$, $p=0.0005$) and academic qualification ($\chi^2=12.31$, $df=4$, $p=0.015$). The remaining socio-demographic variables- age, gender, type of family, area of living, religion, prior exposure to HMB information, and source of information were not significantly associated with knowledge level at the $p<0.05$ threshold.

Table 4: Association between Level of Knowledge Regarding Human Milk Banking and Selected Demographic Variables among Nursing Students (n = 90)

Variables	Category	Inade- quate	Moderate	Adequate	Calcu- lated χ^2	df	Tabu- lated χ^2 (0.05)	p-value	Interpretation
Age (years)	17–19	3	6	1	1.239	6	12.592	0.975	Not Signifi- cant
	20–22	11	36	8					
	23–25	6	15	3					
	≥25	0	1	0					
Gender	Male	4	17	3	0.679	2	5.991	0.712	Not Signifi- cant
	Female	16	41	9					
Marital Sta- tus	Married	5	0	1	15.000	2	5.991	0.001	Significant
	Unmarried	15	58	11					
Academic Qualifica- tion	GNM III Year	13	15	2	12.317	4	9.488	0.015	Significant
	B.Sc. Nursing V Semester	3	21	4					
	B.Sc. Nursing VI Semester	4	22	6					
Type of Family	Nuclear	11	38	8	4.567	6	12.592	0.600	Not Signifi- cant
	Joint	8	19	4					
	Extended	1	0	0					
	Single Parent	0	1	0					
Area of Liv- ing	Rural	13	30	4	3.031	2	5.991	0.220	Not Signifi- cant
	Urban	7	28	8					
Religion	Hindu	17	53	12	2.855	4	9.488	0.582	Not Signifi- cant
	Muslim	1	3	0					
	Christian	2	2	0					
Heard about Human Milk Banking	Yes	14	40	8	0.039	2	5.991	0.981	Not Signifi- cant
	No	6	18	4					
If Yes, Source of Information	Internet/So- cial Media	11	28	7	5.959	6	12.592	0.428	Not Signifi- cant
	Friends/Fam- ily	3	4	0					
	Classroom	0	5	1					
	Teaching								
	Other	0	3	0					

df = degrees of freedom; *p<0.05 considered statistically significant.

DISCUSSION

Overall, Knowledge Level

The present study documented that the majority of nursing students (64.44%) had moderate knowledge of human milk banking, with only 13.33% attaining adequate knowledge and a notable 22.22% exhibiting inadequate knowledge. The mean score of 7.44 out of a maximum of 15 (SD=4.007) indicates that, on average, students correctly answered fewer than half of the knowledge items, signalling a concerning deficit that has direct implications for clinical practice. These findings are consistent with the emerging global and national literature demonstrating that nursing students, despite their professional mandate to promote and support breastfeeding and neonatal nutrition, harbour substantial gaps in their theoretical foundation regarding HMB.

Comparison with Previous Studies

The knowledge profile observed in the present study aligns with findings reported across diverse geographic contexts. In a study conducted among final-year nursing students in Mangalore, India, Divya and Augustin similarly reported that the majority had only average (61.1%) or poor (36.5%) knowledge

of HMB, with very few demonstrating good knowledge a pattern strikingly concordant with the distribution documented here [12]. Among nurses already practising in a Bangalore institution, Archana found that approximately 44.6% reported no prior awareness of HMB, underscoring that the knowledge gap is not simply a feature of student inexperience but may persist into professional life without deliberate remediation [11]. These two Indian studies collectively suggest that inadequate HMB knowledge is systemic within the Indian nursing workforce pipeline rather than isolated to any single institution.

Internationally, analogous gaps have been documented. Yaşar et al. found that only 17.9% of nursing and midwifery students in Turkey had prior awareness of milk banking, and merely 9.3% considered banked milk reliable even lower proportions than observed in the current cohort where 67.77% had at least heard of HMB [26]. Cervera-Gasch et al. reported significant deficits in breastfeeding knowledge among university nursing students across multiple Spanish institutions, reinforcing the universality of this educational challenge [16]. Fernandes and Nayak demonstrated that even among antenatal mothers who have a direct vested interest knowledge of HMB was incomplete in a notable proportion, highlighting systemic gaps that extend beyond the nursing classroom [17].

Association with Socio-Demographic Variables

Marital Status: The statistically significant association between marital status and knowledge level ($\chi^2=15.05$, $p=0.0005$) was an intriguing finding. Although only 6 of the 90 participants (6.66%) were married, this small subgroup tended to score differently from their unmarried peers. This pattern may reflect indirect experiential exposure: married individuals may have encountered HMB discussions through antenatal care visits, peer networks of new parents, or direct neonatal unit experience. Similar indirect acquisition of breastfeeding knowledge through personal or family reproductive experiences has been discussed in broader breastfeeding-knowledge studies comparing undergraduate and graduate nursing students, where graduate students who were, on average, older and more likely to have personal parental experience demonstrated higher breastfeeding knowledge scores than undergraduates [18].

Academic Qualification: The significant association between academic qualification and knowledge level ($\chi^2=12.31$, $p=0.015$) suggests a positive effect of advancing nursing training on HMB knowledge. B.Sc. Nursing VI Semester students ($n=32$, 35.55%) had progressed furthest through the curriculum and were presumably more exposed to relevant paediatric and neonatal nursing content than their GNM 3rd Year counterparts. This gradient aligns with findings reported by Liu et al. in a Chinese cross-sectional study of nursing undergraduates, which identified curriculum exposure and clinical placement experience as the primary determinants of breastfeeding knowledge, with more advanced students demonstrating significantly higher knowledge scores [14]. Yang et al. similarly found that Chinese nursing students showed strongly supportive attitudes but average knowledge, with the desire for additional education being near-universal (92.99%), suggesting appetite for further learning at every stage of training [13].

Non-Significant Variables: The absence of significant associations between knowledge and age, gender, type of family, area of living, religion, prior self-reported exposure to HMB, or source of information is noteworthy. The lack of association with prior self-reported exposure to HMB ($p=0.86$) is particularly instructive: while 67.77% of students reported having heard of HMB (predominantly via internet and social media), this exposure did not translate into a higher knowledge level. This disconnect between informal information exposure and verified knowledge is consistent with the validation of standardised HMB knowledge assessment tools such as the AprendeLact questionnaire developed by Lopez-Peña et al. [19], which similarly found that self-reported familiarity with breastfeeding topics did not reliably predict actual knowledge scores. It underscores that informal digital exposure while potentially raising awareness cannot substitute for structured, evidence-based educational content delivered within the formal curriculum.

Clinical Implications of the Knowledge Deficit: The knowledge gaps identified in this study have direct and serious implications for neonatal clinical outcomes. Nursing students who advance to NICU practice without a grounded understanding of HMB eligibility criteria, processing protocols, donor screening, pasteurisation principles, or the clinical indications for PDHM are ill-equipped to counsel mothers, support donation decisions, or advocate for appropriate neonatal nutrition at the bedside. The clinical significance of this gap is

illustrated by data from Indian NICUs: Ayyagarī [7] reported a dramatic reduction in NEC incidence following the establishment of an in-house milk bank at an Indian extramural unit (9.4% pre-HMB vs 1.76% post-HMB), and Vaghela et al. [25] documented context-specific trade-offs between formula and donor milk in an Indian NICU setting, highlighting the nuanced clinical decision-making that NICU nurses must be prepared to engage with. The clinical benefits of PDHM are well-documented in the international literature, with donor milk associated with earlier achievement of full enteral feeds and a lower incidence of NEC compared with formula; [20,21] however, realising these benefits in practice requires a nursing workforce with the knowledge to advocate for and safely administer banked milk.

STRENGTHS AND LIMITATIONS

STRENGTHS

This study adds to the sparse empirical literature on HMB knowledge specifically among nursing students in North India and contributes regional data from Lucknow, Uttar Pradesh a setting that is substantially underrepresented in existing research. The use of a structured, expert-validated knowledge instrument with defined scoring categories enables standardised assessment and direct comparison with future studies. The inclusion of three distinct programme cohorts (GNM and B.Sc. Nursing at two academic levels) facilitates cross-programme comparison and provides a more representative view of the knowledge landscape within a single institution than single-cohort designs. The close attention to statistical methodology, including use of chi-square tests with explicitly reported degrees of freedom and p -values, enhances the reproducibility and interpretability of the findings.

LIMITATIONS

Several limitations of this study must be acknowledged. First, the convenient sampling technique and restriction to a single institution limit the generalisability of findings to the broader population of nursing students in Lucknow or Uttar Pradesh. Second, the 15-item self-structured questionnaire, while expert-validated, has not been subjected to formal psychometric evaluation including test-retest reliability assessment or confirmatory factor analysis; standardised and validated tools such as the Comprehensive Breastfeeding Knowledge Scale (CBKS)⁽²⁷⁾ or the AprendeLact questionnaire⁽¹⁹⁾ would enable broader cross-study comparisons in future research. Third, the cross-sectional design precludes causal inference; the associations identified between marital status, academic qualification, and knowledge level require prospective or longitudinal confirmation. Fourth, social desirability bias cannot be entirely excluded in self-administered questionnaire studies, though the anonymous format was intended to mitigate this.

NURSING IMPLICATIONS

The findings of this study carry several actionable implications for nursing education and clinical practice. First, human milk banking must be explicitly incorporated into the formal nursing curriculum at both GNM and B.Sc. Nursing levels, with structured didactic sessions covering the scientific rationale for HMB, donor eligibility and exclusion criteria, pasteurisation

and safety protocols, storage and transport requirements, clinical indications for PDHM, and nursing responsibilities in the milk banking chain. Supplementing classroom instruction with structured clinical rotations to functional HMB facilities where available would provide experiential learning that translates theoretical knowledge into practical competence. Second, in-service education programmes for qualified nurses should be developed and implemented in NICUs to address persistent knowledge gaps that survive the pre-registration curriculum. Educational interventions specifically designed to address nursing students' breastfeeding and HMB barriers such as the mixed-methods quasi-experimental programme described by Ramírez-Durán et al.⁽²⁴⁾ have demonstrated efficacy in overcoming attitudinal and knowledge barriers and could be adapted to the Indian context. Third, given the finding that informal social media exposure did not correlate with improved knowledge, nursing educators must proactively supplement and critically engage students' digital health information-seeking behaviours, directing them towards authoritative clinical guidelines and evidence-based resources on HMB.

RECOMMENDATIONS

Based on the results of this study, the following recommendations are proposed:

For nursing educators: Review and update existing nursing curricula to formally integrate dedicated modules on human milk banking within the paediatric and neonatal nursing components of GNM and B.Sc. Nursing programmes.

For nursing institutions: Establish structured clinical exposure to human milk bank facilities as part of neonatal nursing practicums, enabling students to translate knowledge into clinical skill.

For policy makers: Advocate for the expansion of human milk banking infrastructure in Uttar Pradesh, with complementary workforce development programmes to build HMB competencies among nursing graduates.

For future researchers: Conduct larger, multicentre studies using validated psychometric instruments to establish robust baseline data on HMB knowledge across nursing programmes in North India; longitudinal designs should be employed to evaluate the impact of curricular interventions on knowledge outcomes.

CONCLUSION

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This descriptive cross-sectional study demonstrated that the majority of nursing students at a nursing college in Lucknow, India, possessed only moderate knowledge of human milk banking, with a substantial minority exhibiting inadequate knowledge. The mean score of 7.44 out of 15 (SD=4.007) underscores an important educational deficit in a domain with direct clinical consequences for neonatal health. Statistically significant associations between knowledge level and both marital status and academic qualification suggest that personal experiential factors and advancing training are relevant determinants of HMB knowledge. These findings emphasise the urgent need for deliberate, structured curricular integration of HMB content within nursing education programmes, complemented by clinical exposure and evidence-based in-service training, to equip the future nursing workforce in India with the knowledge required to support safe, effective neonatal nutrition and advocate for human milk banking in clinical practice.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

FUNDING

This study received no external funding.

ETHICAL APPROVAL

Ethical approval was obtained from the Research and Ethics Committee of Sardar Patel College of Nursing, Lucknow, Uttar Pradesh, India, prior to study commencement. All participants provided written informed consent. The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki.

DATA AVAILABILITY STATEMENT

The datasets generated and analysed during the current study are available from the corresponding author on reasonable request.

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