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Original Article

Breastfeeding practices for newborns among urban poor in Lucknow, northern India: A prospective follow-up study

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ABSTRACT

Objectives: To describe evidence-based WHO-defined (exclusive, predominant, partial, never breastfed) breastfeeding patterns and the factors associated with them for neonates among urban poor in Lucknow, northern India.

Methods: This prospective follow-up study was conducted at two urban public hospitals at Lucknow. Neonates who did not have any morbidity or congenital malformation and were residents of Lucknow were enrolled within 48 h of birth and followed-up once at six weeks at the outpatients' clinic or home to assess established (voluntary) breastfeeding pattern.

Results: A total of 1020 neonates were enrolled from March 2007 to April 2008. Follow-up information on established breastfeeding pattern was available for 937 (91.8%) of the enrolled neonates. Rate of exclusive breastfeeding during the neonatal period was 26.4%, predominant breastfeeding was 28.7%, partial breastfeeding was 40.1%, and no breastfeeding was 4.7%. Potentially harmful weaning materials (animals' milk (35.8%), formula feeds (17.6%), water (48.1%) and other substances (teas/herbal drinks/juices/soups/rice water/mashed banana/etc (9.9%)) were being fed to 74% (95% CI: 70.7%–76.3%) of the neonates.

Neonates born to mothers with no formal education, fathers with no formal education, whose mothers had fewer (<3) antenatal care visits, were born in Muslim families, were slum residents or were from low socio-economic status were significantly ($p < 0.05$) less likely to be exclusively breastfed than their counterparts.

Conclusion: The proportion of neonates being exclusively breastfed was low at 26.2% (95% CI: 23.7%–29.4%). There is a need for promotion of exclusive breastfeeding for all newborns in urban Lucknow, northern India.

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1. Introduction

In the year 2010, an estimated 7.7 million childhood deaths occurred among which 3.1 million occurred in the neonatal period.¹ India contributes to around one-quarter of all neonatal deaths in the World and more than half (52%) of these are estimated to occur due to infections.² The state of Uttar Pradesh in India, alone, contributes to about 8% of the global neonatal mortality.

Lack of exclusive breastfeeding for first six months is an important public health concern throughout the developing world.³ Amidst the limited coverage of interventions promoting breastfeeding and the community's limited knowledge about the benefits of breastfeeding, early and exclusive breastfeeding remains low, both among the institutional births as well as community settings in India.^{4–8}

Exclusive breastfeeding has been reported to be significantly protective against infant illnesses as well mortality associated with them.^{9–13} Studies have shown that the risk of contracting infections from external sources of feeding gradually diminishes with age^{11,13} and thus, protection provided from breastfeeding (particularly exclusive breastfeeding) has been postulated to provide maximum benefit during the neonatal period.¹⁴ Despite this, majority of studies (excluding those which describe early newborn feeding such as, feeding of colostrums, prelacteals, time to initiation of breastfeeding) only describe breastfeeding patterns during the infancy and at the best during the first half of infancy, possibly due to World Health Organization's (WHO) recommendations for exclusive breastfeeding at least for the first six months of life. This limits the understanding about the infant breastfeeding practices, particularly during the neonatal period, and the understanding about the critical timing when the external sources of feeding are introduced. There is sparse information on evidence-based WHO-defined (exclusive, predominant, partial, never breastfed) breastfeeding patterns¹⁵ for infants in Uttar Pradesh. This study describes the established neonatal breastfeeding practices (exclusive breastfeeding, predominant breastfeeding, partial breastfeeding and no breastfeeding) and the factors associated with them, among the urban poor in Lucknow, Uttar Pradesh, northern India.

2. Methods

2.1. Study design

This was a prospective follow-up study of neonates delivered at two public hospitals in urban Lucknow.

2.2. Setting

Lucknow is the capital city of Uttar Pradesh, a state in northern India and has a native population of 4.5 million.¹⁶ United Nations Centre for Human Settlements (UNCHS) estimates that more than half of Lucknow's urban population lives in slums.¹⁷ The total literacy rate in Lucknow is 79%¹⁶ and sex ratio is 900 females per thousand males.¹⁸ Institutional delivery rate is 47.3% and antenatal care coverage is 42.3%.¹⁸

The study was conducted in two public hospitals, an urban Reproductive and Child Health (RCH) center and a district hospital, after obtaining institutional ethical clearance and permission from relevant district authorities. The RCH center is a 12-bedded hospital, with free outpatients' clinic and free normal vaginal delivery care facilities round the clock which caters to mainly slum and low income group population from the adjoining areas. District hospital is a large 150-bedded hospital, which is well equipped in dealing with complicated obstetric cases referred from Lucknow and adjoining areas. While the district hospital has paid as well as free inpatient facilities, for this study we have recruited mothers from the free facility only, which caters to mainly lower income group so that economic status of subjects were similar to those recruited from the RCH center.

2.3. Participants and definitions

Neonates were screened within 48 h of delivery on all working days excluding Sundays and holidays. Mothers, most (97.3%) of which were willing to come to the outpatients' department (OPD) with the baby for follow-up on pre-specified dates in the next six weeks for routine immunization were enrolled, after obtaining written informed consent. Excluded were the mothers whose neonates required any resuscitation at birth or presented with any clinically detectable serious congenital malformation. Mothers who were not residents of Lucknow or who were likely to move out of the city within next one month were also excluded.

Neonates were followed-up once at six weeks at the OPD of the respective hospitals or if the mother along with the baby did not turn up in the OPD, home follow-up was done by a trained medical social worker to obtain the same information. At the time of follow-up mothers were probed for established breastfeeding (exclusive, predominant, partial, never breastfed) pattern during the newborn period. Exclusive breastfeeding was defined as feeding of only breastmilk and nothing else, not even water, with the exception of prescribed medicines. Predominant breastfeeding was defined as feeding of breastmilk along with any other non-milk fluids (water/sweetened water/juices/teas/herbal drinks, etc). Neonates who were given breastmilk along with top milk (and/or infant formula) and other non-milk fluids or solids were considered to be partially breastfed. Neonates who received any type of milk or non-milk fluids but never received breastmilk were defined as never breastfed. These definitions were consistent with the WHO's definitions for breastfeeding patterns.¹⁵ A structured and pre-tested questionnaire was used to elaborate the details of feeding pattern.

2.4. Data analysis

Per-protocol analysis was performed. We report odds ratios along with 95% confidence intervals as well as corresponding *p* values. *p* Values <0.05 were considered to be statistically significant. All analyses were conducted using Epi Info 7.

Table 1 – Baseline characteristics of the mothers enrolled (N = 1020).

Variables	(N = 1020) n (n/N) %	Site 1 (n = 397) m (m/n) %	Site 2 (n = 623) m (m/n) %
Mother's education			
No schooling	387 (37.9)	211 (53.1)	176 (28.3)
≤ 5 Years education	91 (8.9)	24 (6.0)	67 (10.8)
Secondary/higher	542 (53.2)	162 (40.8)	380 (61.0)
Father's education			
No schooling	398 (39.0)	231 (58.2)	167 (26.8)
≤ 5 Years education	266 (26.1)	122 (30.7)	144 (23.1)
Secondary/higher	356 (34.9)	44 (11.1)	312 (50.1)
Mother's occupation			
Unemployed	976 (95.7)	380 (95.7)	596 (95.7)
Any vocation	44 (4.3)	17 (4.3)	27 (4.3)
Father's occupation			
Daily wages	129 (12.6)	57 (14.4)	72 (11.6)
Salaried/professionals	222 (21.8)	65 (16.4)	157 (25.2)
Self-employed	635 (62.3)	270 (68.0)	365 (58.6)
Others	34 (3.3)	05 (1.3)	29 (4.7)
Religion			
Hindus	467 (45.8)	124 (31.2)	343 (55.1)
Muslims	550 (53.9)	273 (68.8)	277 (44.5)
Others	03 (0.3)	00 (0.0)	03 (0.5)
Residence			
Slum	318 (31.1)	187 (47.1)	131 (21.0)
Non-slum	702 (68.9)	210 (52.9)	492 (79.0)
Socio-economic status			
Low	662 (64.9)	345 (86.9)	317 (50.9)
Medium	358 (35.1)	52 (13.1)	306 (49.1)
Joint family	753 (73.8)	276 (69.5)	477 (76.6)
Mother's age (mean (± SD))	24.9 (± 3.9)	25.1 (±4.0)	24.7 (±3.9)
Father's age (mean (± SD))	29.5 (±5.0)	29.8 (±5.1)	29.4 (±5.0)
Family income^a (mean (± SD))	2777 (±1495)	2373 (±1067)	3035 (±1662)
Other maternal variables			
Any antenatal care (ANC) prior to this delivery	966 (94.7)	366 (92.2)	600 (96.3)
Trimester of first ANC visit			
(1) First trimester	298/966 (30.8)	100/366 (27.3)	198/600 (33.0)
(2) Second trimester	502/966 (51.9)	180/366 (49.2)	322/600 (53.4)
(3) Third trimester	166/966 (17.3)	86/366 (23.5)	80/600 (13.3)
ANC at public hospital	922 (90.4)	351 (88.4)	571 (91.7)
≥3 ANC visits	758 (74.3)	268 (67.5)	490 (78.9)
Tetanus toxoid (≥2 doses)	908 (89.0)	336 (84.6)	572 (91.8)
Newborn variables			
Males	539 (52.8)	214 (53.9)	325 (52.2)
Singletons	998 (97.8)	393 (99.0)	605 (97.1)
Birth weight (<2500 g)	315 (30.9)	99 (24.9)	216 (34.7)
Gestational age			
On the basis of LMP (<37 weeks)	76/664 (11.4)	15/204 (7.4)	61/460 (13.2)
On basis of Ballard (score = 30 or less)	197/969 (20.3)	61/386 (15.8)	136/583 (23.3)
Birth order = 1	350 (34.3)	95 (23.9)	255 (40.9)
Type of delivery			
Normal vaginal	904 (88.6)	395 (99.5)	509 (81.7)
Caesarean	116 (11.4)	02 (0.5)	114 (18.3)

^a Indian rupees (INR) [1 US\$ = 53 INR]. Site 1 = Reproductive and Child Health (RCH) center; Site 2 = District hospital.

3. Results

3.1. Baseline characteristics

From March 2007 to April 2008, a total of 1020 mothers were enrolled in the study, 38.9% (n = 397) from the RCH center and 61.1% (n = 623) from the district hospital (Table 1). Overall, 37.9% of the mothers had never been to school, the proportion from the RCH center (53.1%) being significantly higher than

those enrolled from the district hospital (28.3%). Similarly, 39% of the fathers had never been to school, and the proportion of these from the RCH center (58.2%) also was significantly higher than those enrolled from the district hospital (26.8%). Majority of fathers in our study were self-employed. The proportion of Muslims was significantly higher among the mothers enrolled from the RCH center and although the proportion of slum dwellers among those enrolled from the RCH center was comparable with the proportion of non-slum dwellers, this proportion was significantly less among those enrolled from

the district hospital. The average monthly household income among those enrolled from the RCH center was significantly less than those enrolled from the district hospital.

Although, any antenatal care-seeking was similar among those enrolled from the RCH center and the district hospital, the proportion of late antenatal care seekers (first ANC visit in third trimester) was significantly higher among those enrolled from the RCH center as compared to those enrolled from the district hospital. The proportion of mothers having ≥ 3 ANC visits was significantly lower among those enrolled from the RCH center as compared to those enrolled from the district hospital.

The proportion of low birth weight and neonates with first birth order were significantly higher among those enrolled from the district hospital as compared to those enrolled from the RCH center.

The distribution of other socio-economic and newborn variables was similar across the study sites.

3.2. Follow-up

Overall, 971 (95.2%) neonates were followed-up. Forty nine (4.8%) were lost to follow-up, that is, who neither returned to OPD nor could be located during home visits. Among those followed-up, mothers were respondents in 937 (96.4%) cases while other caregivers (grandmothers, grandfathers, fathers, other relatives in the household) were respondents in 34 (3.6%) cases. In the analysis for established breastfeeding practices (exclusive, predominant, partial, none) we only considered mothers to be a reliable category of respondents, and, hence excluded the cases (3.6%) where mothers were not the key respondents.

4. Breastfeeding pattern

4.1. Exclusive breastfeeding

We found that rate of exclusive breastfeeding in our study population was 26.4% (95% CI: 23.7%–29.4%). We also observed that the neonates of mothers and fathers who had never been to school were significantly less likely to be exclusively breastfed than those whose mothers and fathers had ever been to school, the strength of association being higher for the fathers' category (Table 2).

We also found that mothers who made ≥ 3 ANC visits were significantly more likely to exclusively breastfeed their newborns than those who made fewer or no ANC visits. Similarly, mothers who had two vaccinations of tetanus toxoid (TT) during the antenatal period were more likely to exclusively breastfeed their newborns as compared to those who had fewer or no TT vaccination. We also observed that Muslims and slum dwellers were significantly less likely to exclusively breastfeed as compared to Hindus and non-slum dwellers, respectively.

We further found that mothers from low socio-economic status¹⁹ were significantly less likely to exclusively breastfeed their newborns as compared to those from the medium socio-economic status.

None of the newborn variables (gender, birth weight, gestational age, birth order) were found to be significantly associated with the likelihood of being exclusively breastfed or not.

4.2. Predominant breastfeeding

We found that newborns whose mothers and fathers had never been to school, whose mothers made fewer (< 3) ANC visits, had fewer TT vaccinations (0–1), were Muslims, were slum dwellers, or from the lower socio-economic status were significantly ($p < 0.01$) more likely to be predominantly breastfed, as compared to their counterparts.

4.3. Partial breastfeeding

We found that mothers who had a cesarean delivery or whose neonates were delivered preterm were significantly more likely to partially breastfeed their newborns as compared to those who had normal vaginal deliveries or who had neonates born at full gestational age.

5. Feeding substances and modes of feeding

We observed that 95.3% (893/937) of the newborns in our study population were ever breastfed and the distribution of breastfeeding was uniform across the sub-groups defined by the multiple baseline characteristics and hence this category has not been depicted separately in Table 3. The other feeding substances included top milk (cow, goat, buffalo, milk from dairy supplies) (35.8%), formula feeds (17.6%), water (48.1%) and other substances (such as teas, herbal drinks, sweetened water, juices, soups, rice water, mashed banana, etc) (9.9%).

We found that the distribution of top milk feeding was similar across the various sub-groups. However, the proportion of formula feeding was significantly higher for neonates born to educated mothers and fathers as compared to those who had no education. Similarly, mothers residing in non-slum areas, those who had cesarean delivery, and those enrolled from the district hospital were significantly more likely to formula feed their newborns as compared to their counterparts.

We also found that newborns of mothers and fathers who had never been to school, whose mothers had age less than 20 years, whose mothers made < 3 ANC visits and those from the lower socio-economic status were more likely to be fed water as compared to their counterparts. The distribution of feeding other substances was similar across the sub-groups.

We found no significant associations of bottle-feeding across the sub-groups defined by multiple baseline characteristics of the study population. However, we found that proportions of feeding through cup-spoon were significantly higher among slum dwellers, families with monthly household income ≤ 2500 INR and mothers who had a cesarean delivery as compared to their counterparts.

6. Discussion

We found that exclusive breastfeeding during the neonatal period in our study population was 26.4% (95% CI: 23.7%–29.4%). According to Annual Health Survey²⁰ of India, the rate of exclusive breastfeeding for first six months in urban Lucknow was 25.2%. Our study population was predominantly

Table 2 – Distribution of established newborn feeding practices among urban poor in Lucknow (N = 937).

Variables	N	WHO feeding types				Exclusive vs others ^a OR (95% CI), p value
		Exclusive breastfed (n = 248)	Predominant breastfed (n = 269)	Partial breastfed (m = 376)	Never breastfed (n = 44)	
Mothers' education						
No education	341	78 (22.8)	116 (34.0)	132 (38.7)	15 (4.4)	0.74 (0.54–1.0), p = 0.05
Any education	596	170 (28.5)	153 (25.7)	244 (40.9)	29 (4.9)	
Fathers' education						
No education	364	77 (21.1)	128 (35.2)	140 (38.5)	19 (5.2)	0.63 (0.46–0.87), p = 0.003
Any education	573	171 (29.8)	141 (24.6)	236 (41.2)	25 (4.4)	
Fathers' occupation						
Daily wages/unemployed	143	29 (20.3)	39 (27.3)	68 (47.6)	07 (4.9)	0.67 (0.42–1.05), p = 0.06
Self employed/salaried/professional	794	219 (27.6)	230 (28.9)	308 (38.8)	37 (4.7)	
Number of ANC visits						
≥3	709	208 (29.4)	185 (26.1)	281 (39.6)	35 (4.9)	1.95 (1.32–2.90), p < 0.001
< 3	228	40 (17.5)	84 (36.8)	95 (41.7)	09 (3.9)	
Number of tetanus toxoid						
= 0–1	96	15 (15.6)	34 (35.4)	37 (38.5)	10 (10.4)	0.48 (0.27–0.85), p = 0.01
= 2	841	233 (27.7)	235 (27.9)	339 (40.3)	34 (4.0)	
Religion						
Hindus	422	127 (30.1)	105 (24.9)	173 (41.0)	17 (4.0)	1.41 (1.04–1.90), p = 0.02
Muslims	512	120 (23.4)	164 (32.0)	201 (39.3)	27 (5.3)	
Residence						
Slum	296	64 (21.6)	105 (35.5)	108 (36.5)	19 (6.4)	0.69 (0.49–0.96), p = 0.02
Non-slum	641	184 (28.7)	164 (25.6)	268 (41.8)	25 (3.9)	
Maternal age						
≤ 20 Years	133	32 (24.1)	43 (32.3)	53 (39.8)	05 (3.8)	0.86 (0.55–1.35), p = 0.49
> 20 Years	804	216 (26.8)	226 (28.1)	323 (40.2)	39 (4.9)	
Family type						
Joint	701	179 (25.5)	205 (29.2)	288 (41.1)	29 (4.1)	0.83 (0.59–1.17), p = 0.26
Nuclear	236	69 (29.2)	64 (27.1)	88 (37.3)	15 (6.4)	
Household income						
≤2500 INR	570	146 (25.6)	175 (30.7)	220 (38.6)	29 (5.1)	0.89 (0.66–1.22), p = 0.46
> 2500 INR	367	102 (27.8)	94 (25.6)	156 (42.5)	15 (4.1)	
Socio-economic status (SES)						
Low	598	132 (22.1)	197 (32.9)	237 (39.6)	32 (5.4)	0.54 (0.40–0.74), p < 0.001
Medium	339	116 (34.2)	72 (21.2)	139 (41.0)	12 (3.5)	
Type of delivery						
Normal	832	223 (26.8)	244 (29.3)	326 (39.2)	39 (4.7)	1.17 (0.71–1.94), p = 0.5
Caesarean	105	25 (23.8)	25 (23.8)	50 (47.6)	05 (4.8)	
Birth weight						
< 2500 g	279	73 (26.2)	76 (27.2)	114 (40.9)	16 (5.7)	0.98 (0.70–1.36), p = 0.89
≥2500 g	658	175 (26.6)	193 (29.3)	262 (39.8)	28 (4.3)	
Gestational age						
On the basis of LMP (n=615)						
Preterm	66	15 (22.7)	11 (16.6)	34 (51.5)	06 (9.1)	0.67 (0.36–1.23), p = 0.19
Term	549	167 (30.4)	144 (26.2)	215 (39.2)	23 (4.2)	
On the basis of Ballard (n=891)						
Score ≤ 30	175	45 (25.7)	43 (24.5)	75 (42.9)	12 (6.9)	0.95 (0.65–1.38), p = 0.8
Score >30	716	191 (26.6)	215 (30.2)	279 (39.0)	31 (4.3)	
Birth order						
1	322	94 (29.2)	86 (26.7)	132 (41.0)	10 (3.1)	1.23 (0.90–1.69), p = 0.17
>1	615	154 (25.1)	183 (29.7)	244 (39.7)	34 (5.5)	
Gender						
Males	498	124 (24.9)	153 (30.7)	199 (40.0)	22 (4.4)	0.84 (0.62–1.14), p = 0.24
Females	439	124 (28.2)	116 (26.4)	177 (40.3)	22 (5.0)	
Study site						
RCH center	365	90 (24.6)	130 (35.6)	122 (33.4)	23 (6.3)	0.86 (0.63–1.17), 0.86. p = 0.3
District hospital	572	158 (27.6)	139 (24.3)	254 (44.4)	21 (3.7)	

^a Predominant, partial, never breastfed.

Table 3 – Multiple feeding patterns for neonates among urban poor in Lucknow (N = 937).

Variables	N	Feeding substance ^a				Feeding mode	
		Top milk (n = 336)	Formula (n = 165)	Water (n = 450)	Others (n = 93)	Cup-spoon (n = 466)	Bottle feeds (n = 387)
Mothers' education							
No education	341	124 (36.4)	43 (12.6) ^b	184 (53.9) ^b	35 (10.3)	176 (51.6)	136 (39.9)
Any education	596	212 (35.6)	122 (20.5) ^b	266 (44.6) ^b	58 (9.7)	290 (48.6)	251 (42.1)
Fathers' education							
No education	364	133 (36.5)	46 (12.6) ^b	194 (53.3) ^b	42 (11.5)	195 (53.6)	149 (40.9)
Any education	573	203 (35.4)	119 (20.8) ^b	256 (44.7) ^b	51 (8.9)	271 (47.3)	238 (41.5)
Birth order							
1	322	112 (34.8)	58 (18.0)	145 (45.1)	27 (8.4)	157 (48.7)	129 (40.1)
>1	615	224 (36.4)	107 (17.4)	305 (49.6)	66 (10.7)	309 (50.2)	258 (41.9)
Religion							
Hindu	422	161 (38.2)	72 (17.1)	191 (45.3)	28 (6.6)	198 (46.9)	178 (42.2)
Muslims	512	175 (34.2)	91 (17.8)	257 (50.2)	65 (12.7)	266 (51.9)	207 (40.4)
Residence							
Slum	296	110 (37.2)	32 (10.8) ^b	153 (51.7)	37 (12.5)	167 (56.4) ^b	115 (38.8)
Non-slum	641	226 (35.3)	133 (20.7) ^b	297 (46.3)	56 (8.7)	299 (46.6) ^b	272 (42.4)
Maternal age							
≤ 20 Years	133	45 (33.8)	23 (17.3)	77 (57.9) ^b	13 (9.8)	73 (54.9)	51 (38.4)
> 20 Years	804	291 (36.2)	142 (17.7)	373 (46.4) ^b	80 (9.9)	393 (48.9)	336 (41.8)
Family type							
Joint	701	254 (36.2)	130 (18.5)	341 (48.6)	76 (10.8)	355 (50.6)	294 (41.9)
Nuclear	236	82 (34.7)	35 (14.8)	109 (46.2)	17 (7.2)	111 (47.0)	93 (39.4)
Antenatal care							
<3 Visits	228	86 (37.7)	31 (13.6)	134 (58.8) ^b	26 (11.4)	121 (53.1)	100 (43.8)
≥3 Visits	709	250 (35.3)	134 (18.8)	316 (44.6) ^b	67 (9.4)	345 (48.7)	287 (40.5)
Birth weight							
< 2500 g	279	104 (37.3)	54 (19.4)	131 (46.9)	27 (9.7)	135 (48.4)	125 (44.8)
≥2500 g	658	232 (35.3)	111 (16.9)	319 (48.5)	66 (10.1)	331 (50.3)	262 (39.8)
Gender							
Males	498	181 (36.3)	93 (18.7)	253 (50.8)	41 (8.2)	259 (52.0)	204 (40.9)
Females	439	155 (35.3)	72 (16.4)	197 (44.9)	52 (11.8)	207 (47.2)	183 (41.7)
Household income							
≤2500 INR	570	205 (35.9)	91 (15.9)	282 (49.5)	56 (9.8)	304 (53.3) ^b	224 (39.3)
> 2500 INR	367	131 (35.7)	74 (20.2)	168 (45.7)	37 (10.1)	162 (44.1) ^b	163 (44.4)
Socio-economic status							
Low	598	218 (36.5)	95 (15.9)	309 (51.7) ^b	61 (10.2)	323 (54.0)	246 (41.1)
Medium	339	118 (34.8)	70 (20.6)	141 (41.6) ^b	32 (9.4)	143 (42.2)	141 (41.6)
Fathers' occupation							
Daily wages/unemployed	143	61 (42.6)	26 (18.2)	70 (48.9)	15 (10.5)	78 (54.5)	65 (45.5)
Self-employed/salaried/professional	794	275 (34.6)	139 (17.5)	380 (47.8)	78 (9.8)	388 (48.8)	322 (40.6)
Type of delivery							
Normal	832	292 (35.1)	136 (16.3) ^b	402 (48.3)	89 (10.7)	404 (48.6) ^b	340 (40.8)
Caesarean	105	44 (41.9)	29 (27.6) ^b	48 (45.7)	04 (3.8)	62 (59.1) ^b	47 (44.7)
Study site							
RCH center	365	127 (34.8)	32 (8.8) ^b	178 (48.8)	48 (13.1)	183 (50.1)	136 (37.3)
District hospital	572	209 (36.5)	133 (23.2) ^b	272 (47.6)	45 (7.9)	283 (49.5)	251 (43.9)

^a We have not included breastmilk in this table since nearly all (95.3%) neonates had been breastfed, the distribution of which was similar across sub-groups.

^b Sub-groups with significant differences ($p < 0.05$).

from lower income strata, already at higher risk for neonatal morbidity²¹ and the most alarming finding from our study was that potentially harmful external sources of feeding (top milk, formula, water, teas, etc) were introduced as early as in the neonatal period, when an infant was at the highest risk of contracting infection from external feeding substances than in any other time during infancy or childhood.^{11,13}

We found that mothers having no education were less likely to exclusively breastfeed their newborns than the mothers who had any education, which was similar to other studies done among infants in India and elsewhere.^{22–28} On

the contrary, an analysis of Demographic & Health Survey (DHS) data from Bangladesh²⁹ has reported higher maternal education as a risk factor against exclusive breastfeeding for infants.

We also found that newborns of fathers having no education were significantly less likely to be exclusively breastfed than the newborns of fathers who had any education, the strength of this association being higher than that from the maternal education category. This finding highlights the importance of including fathers in programs aimed at promotion of exclusive breastfeeding. Previous studies have

shown that teaching fathers how to prevent and to manage the most common lactation difficulties was associated with higher rates of exclusive breastfeeding for six months.³⁰

We also found a couple of antenatal care indicators to be associated with exclusive breastfeeding. We observed that the mothers who had received two tetanus toxoid (TT) injections during the antenatal period were significantly more likely to exclusively breastfeed their newborns as compared to mothers who received one or none. This finding could have translated from the fact that the mothers who received TT twice had an exposure to the health personnel at least twice more than those who received only one or none vaccination. We also found that mothers who had three or more antenatal care (ANC) visits were significantly more likely to exclusively breastfeed their newborns than the mothers who made fewer ANC visits ($p < 0.001$). Similar findings (for infants <6 months of age) have been reported from the India's National Family Health Survey (NFHS-3)²² and another study done in Gwalior, India.⁸ Also, in a cross-country comparison of data from four South Asian countries it was found that though there were no factors consistently associated with the rate of exclusive breastfeeding for first six months across countries, more ANC visits was associated with higher rates of exclusive breastfeeding in India.³¹ Thus, there is evidence that antenatal care was significantly associated with exclusive breastfeeding, however, amidst the dearth of adequately powered randomized controlled trials,³² the evidence that antenatal breastfeeding education was effective in increasing breastfeeding duration is mixed.^{32–35} Nevertheless, on the basis of the available evidence,^{35–37} it is likely that improving antenatal care and ensuring breastfeeding education during antenatal care could lead to better breastfeeding outcomes. The WHO and UNICEF endorse breastfeeding education during antenatal period as an important pragmatic intervention for promoting early and exclusive breastfeeding. However, antenatal counseling on breastfeeding remains low^{4,5,38} and needs to be promoted.

We observed that the slum dwelling mothers were significantly less likely to exclusively breastfeed their newborns as compared to mothers from non-slum areas, similar to another study done in Kenya.²⁸ We further observed that Muslim mothers were also significantly less likely to exclusively breastfeed their newborns as compared to Hindus. We found that mothers from low socio-economic status were significantly less likely to exclusively breastfeed their newborns as compared to those from medium socio-economic status ($p < 0.0001$). There was no high socio-economic status category in our study as the mothers were enrolled from free public health facilities primarily catering to low and middle income population.

These findings were noteworthy in the aspect that breastfeeding pattern was not influenced by any of the newborn variables (prematurity, birth weight, gender, birth order) but was affected by socio-economic indicators (such as parental education, socio-economic status, place of residence and ethnicity) and health system utilization (antenatal care, TT vaccination) indicators. Dibley et al (2010) in their cross-country comparison in south Asia³¹ also found that rates of exclusive breastfeeding among infants for first six months were not determined by any of the infant variables (degree of prematurity, size at birth, other neonatal disorders) rather

they were determined by socio-economic status, which was again similar to the findings from Flacking et al (2007).³⁹ This highlights the need for improved breastfeeding support for socio-economically disadvantaged mothers, during and after the hospital stay. On the contrary, a study from Bangladesh has reported high socio-economic status to be a risk factor against exclusive breastfeeding for infants.²⁹

We further found that educated mothers were more likely to formula feed and less likely to feed water to their newborns as compared to uneducated mothers ($p < 0.05$ for both). Father's education also showed a similar association. We also found that formula feeding was significantly higher among non-slum mothers as compared to slum dwelling mothers. Further, neonates born through cesarean delivery and those born at the district hospital were significantly more likely to be formula-fed than neonates born through normal vaginal delivery and born at the RCH center, respectively.

We found that young mothers (≤ 20 years), those from low socio-economic status, those residing in slums, those with household income ≤ 2500 INR and those delivering through cesarean section were significantly more likely to feed water to their newborns as compared to their counterparts. In fact, water was the most predominantly fed substance (48.1% (450/937)) to the newborns in our study population than any other substance which was similar to another study done in Zimbabwe.⁹ Mothers who generally only breastfed their newborns were also wary about the need of water in their neonates, particularly during the hot season. It has been well established that even in the tropical climates, exclusively breastfed infants do not need supplemental water to maintain water homeostasis,^{40,41} and a reduced breastmilk intake is a potential disadvantage of this practice. While promoting exclusive breastfeeding for infants, it is also important to teach mothers that breastmilk had sufficient amount of water required for a developing infant and that external sources of feeding such as water, top milk and formula feeds placed an infant at higher risk of contracting infections.

Although we found that formula feeding was significantly higher among newborns born through caesarean delivery, it was noteworthy that feeding top milk (35.8%) or bottle-feeding (41.3%) was evenly distributed across the study population, with no significant differences among sub-groups. On the contrary, a secondary analysis of the NFHS-3 data has reported that the risk factors for bottle-feeding included cesarean delivery, higher socio-economic status, and higher maternal education level²² which was similar to an analysis of DHS data from Bangladesh.²⁹

A systematic review of infant feeding studies has shown that low maternal education and low socio-economic status were the risk factors for early introduction of cow's milk and that early introduction of complementary foods and cow's milk were associated with increased health risks.⁴² We found that 35.8% of newborns in our study were fed animal milk and that its distribution was similar in our study population which was predominantly from the low socio-economic status.

The NFHS-3 (2005–06) of India, reports a fall of exclusive breastfeeding from 69% at 2 months to 27.6% at six months. A report released in the year 2010, by the World Breastfeeding Trends Initiative (WBTi) on the state of breastfeeding in 33 priority countries (including India) reported that the average

of exclusive breastfeeding for first six months was 46% in these countries.⁴³ Among the 28 states in India, eight (Bihar, Jharkhand, Uttar Pradesh, Uttarakhand, Madhya Pradesh, Chhattisgarh, Orissa and Rajasthan) have been selected as Empowered Action Group (EAG) of the high-focus states. These states account for 48% of the country's population, 59% of births, 70% of infant deaths and 75% of the under-5 deaths. In the Annual Health Survey (AHS) conducted across all 284 districts in these 8 states, it was found that as compared to other EAG states, the rate of exclusive breastfeeding for first six months in Uttar Pradesh was significantly worse at only 17.7%. AHS (2010–11) also found that in Uttar Pradesh, the average age for introduction of water was 1.9 months, while that of introducing animal/formula milk was 2.3 months.²⁰ These figures for urban Lucknow were reported to be 3.3 months and 3.4 months respectively. However, these averages could undermine the inequality of infant feeding practices that exists across different socio-economic groups. We found that potentially harmful weaning materials (top milk (cow, goat, buffalo, milk from dairy supplies) (35.8%), formula feeds (17.6%), water (48.1%) and other substances (such as teas, herbal drinks, sweetened water, juices, soups, rice water, mashed banana, etc) (9.9%)) were introduced to 74% (95% CI: 70.7%–76.3%) of the infants as early as the neonatal period in our study population, enrolled from the free public health facilities in urban Lucknow.

The WBTi report⁴³ also found that among the 33 countries studied, India ranked 25th with a score of two on a ten-point scale, which included indicators on national policy & programs, breastfeeding support to mothers, monitoring & evaluation, among others. This document reported that virtually no steps were taken to promote exclusive breastfeeding in India in the period of evaluation (2005–2008) covered by this report. This report concluded that India failed to capitalize upon the early promise of the Infant & Young Child Feeding (IYCF) guidelines by non-conversion into policy, non-translation into budgets and specific programs and poor implementation as a whole. India cannot undermine the exclusive breastfeeding agenda, since optimum exclusive breastfeeding levels are still far from being achieved, especially among its disadvantaged populations, which are already at higher risk of neonatal/infant morbidity and mortality.^{21,44} Thus, there is a pressing need to aggressively promote exclusive breastfeeding both in the community as well as institutional (such as 'Baby Friendly Hospital Initiative') settings.⁴³

Our study was done in public hospitals among mothers from low socio-economic groups and therefore cannot be generalized for all institutional deliveries. The breastfeeding patterns could differ among home-delivered neonates and those from the general population. Another limitation of this study was its inability to address the issue as to why the rates of exclusive breastfeeding were low in our study population or what were the reasons for non-practicing of exclusive breastfeeding.

7. Conclusion

Although some socio-economic sub-groups (uneducated mothers, uneducated fathers, mothers from low socio-economic status, slum residents and Muslims) and health

system utilization sub-groups (<3 ANC visits, <2 tetanus toxoid vaccination) were significantly less likely to exclusively breastfeed their newborns than their counterparts, the overall proportion of neonates exclusively breastfed was abysmally low at 26.2% (95% CI: 23.7%–29.4%) among the urban poor in Lucknow, northern India. Though, studies report low rates of exclusive breastfeeding for first six months of life, we found that other potentially harmful weaning materials were introduced to 74% (95% CI: 70.7%–76.3%) of the infants as early as the neonatal period. We conclude that there is a need for promotion of exclusive breastfeeding for all newborns in urban Lucknow.

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Conflicts of interest

All authors have none to declare.

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