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Effect of Successful Breastfeeding Practices on Infant Development Outcomes

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Breastfeeding is the most effective approach to nourish and promote the healthy growth of newborns, providing immune support. A differential design was used with the aim of studying the effect of successful breastfeeding practises on infant development outcomes such as physical,

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cognitive, language, psychomotor, and socio-emotional development. The study's population included 180 mother-infant dyads from northern Karnataka, India, with infants ranging in age from 3 to 24 months and mothers. The Socio-economic status (SES) scale developed by Aggarwal et al. (2005) and a self-structured questionnaire were used to document feeding practises, Bayley's Scale of Infant Development -III was used to assess developmental outcomes, and anthropometric tools. The results revealed that more than fifty per cent mothers-initiated breastfeeding within one hour while majority of mothers fed colostrum (77.80 %) and 53.33 per cent of mothers fed prelacteal feeds. When compared to complementarily and never breastfed children, infants exclusively breastfed during the first six months and fed for more than 12 months had better cognitive, linguistic and motor development. The influence of breastfeeding practices on socio-emotional development was not statistically significant. This indicates the need for family-based intervention to promote healthy nursing and proper weaning practices.

Keywords: Breastfeeding; cognitive; psychomotor; language; socio-emotional; morbidity.

1. INTRODUCTION

Breastfeeding is the ideal way to nourish and promote the healthy development of infants. The World Health Organization (WHO) advises exclusive breastfeeding for the first six months and continued breastfeeding with supplementary foods for at least two years. Although breastfeeding is a culturally accepted universal phenomenon in India, it is typically initiated after 3-4 days, and the practice of feeding prelacteal feeds such as honey, sugar water, gutti, water, and so on is common due to ignorance, prevalent misconceptions, and cultural taboos and discarding of colostrum. According to the NFHS-4 data, exclusive breastfeeding rates are 54.90% in India and 54.20% in Karnataka [1]. Breastfeeding rate improvements are crucial to meeting the Sustainable Development Goals of lowering child mortality and increasing mother health [2,3]. Breast milk ingredients and the act of breastfeeding have both been implicated in the process of child developmental milestones/ outcomes.

1.1 Breastfeeding and Cognitive Development

Breastfeeding fosters nurturing interactions between mother and childenhancing infant visual alertness and improved cognitive outcomes in infants [4]. The long chain polyunsaturated fatty acids (DHA and AA), lactose in human milk found primarily in breast milk, are crucial for early language comprehension and expression,neural and visual development of infants [5]. It provides immunoglobulins, hormones, and growth factors like neurotensin, sialylated oligosaccharides, and thyroid stimulating hormone, all vital for brain development during neonatal stages and these are not present in formula milk. Cholesterol, abundant in breast milk but absent in formula, is essential for plasma membrane and myelin, facilitating the formation of new synapses (synaptogenesis) integral to neurodevelopment [6,7].

1.2 Effect of Breastfeeding and Motor Development

Breastfeeding is widely acknowledged as a means of boosting infant growth and health, particularly in underdeveloped countries where it helps avoid malnutrition and lowers the likelihood of morbidity and mortality in the infant's initial year of life. Longer nursing correlates with earlier developmental milestones such as walk by one year,crawling and pincer grasp [8]. A meta-analysis revealed that breastfeeding, when compared to formula feeding, is linked to a lower incidence of overweight [9]. Breastfed individuals exhibit a leptin profile conducive to better appetite control and reduced fat accumulation.Breast milk's changing fat content (higher in hind milk than fore milk) signals the end of feeding episodes for infants, a signal not present in formula feeding [10].

1.3 Breastfeeding and Socio-Emotional Development

Breastfeeding extends beyond nourishment, representing a complex biological and psychological process with strong social implications. It's closely connected to oxytocin, a hormone found in human milk, and associated with pleasant touch and warmth [11,12]. Oxytocin functions as a neuropeptide in the brain and significantly influences various social processes and behaviors, particularly those related to bonding and affiliation [13,14].

Thus, the biochemistry of human milk encompasses a mammoth supply of scientific data and information previously unknown and unrecognized. The current study was conducted in this context with the objective to study the effect of successful breastfeeding practices such as exclusive breast feeding for the first six months, no prelacteal feeds, and continued breast feeding up to two years on infant development outcomes such as cognitive development, language development, psychomotor development, and socio-emotional development [12,13,14].

2. MATERIALS AND METHODS

2.1 Population and Sample

The target population of the study was mother – infant pairs. The infants in the age group of 3 - 24 months and their mothers from Dharwad district of Karnataka were selected using purposive proportionate random sampling method. In phase I, 900 other-infant dyads were studied to assess the breastfeeding practices and factors influencing exclusive breastfeeding practices. In Phase II, among them 180 mother –infant pairs were selected to study further the effect of successful breastfeeding practices on developmental outcomes of infants.

2.2 Tools Used for the Study

A self-structured questionnaire was utilised to obtain personal information about the mother and child, breast feeding practises, and baby illness for the study. The socioeconomic status scale [15] was used to assess the families' socioeconomic status (SES). The third edition of the Bayley scale of infant and toddler development (BSID-III, 2006) was used to assess the cognitive, psychomotor (both gross and fine motor abilities), linguistic (receptive and expressive), and socio-emotional development of infants and toddlers aged one to 42 months [16]. To determine the impact of the home environment on baby development outcomes, the Home Observation Inventory [17] was used [11].

2.3 Study Design

A differential design was used to study the effect of breast feeding practices on infant development out comes and a co-relational design to study the relationship between factors influencing breast feeding and the duration of breast feeding with developmental outcomes.

3. RESULTS

Table 1 depicts the sample's familial characteristics. The majority of the infants (71.70%) were from rural areas, Hindus (96.11%), joint families (60.60 and the majority (78.30%) belonged to the middle SES.

The breastfeeding practices in mothersdepicts that majority (60 %) initiated immediately whereas 6.1 per cent initiated after 24 hrs-3 days and 16.7 per cent initiated after 3 days andmore.The colostrum feeding indicates that majority (77.80 %) fed colostrumand 53.33 per cent gave prelacteal feeds to infants. The breastfeeding practices indicate less than half of children (46.70%) were exclusively breastfed for the first six months, followed by complementarily breastfed (40%) infants, while 13.30% of newborns were never provided with mother's milk. Breastfeeding duration reveals that the majority (71.66%) of mothers breastfed for more than 24 months, 8.30% for 3-6 months, and 3.90% for 6-12 months.

3.1 Breast Feeding and Infant Development Outcomes

The majority of exclusively breastfed (83.30) and complementarily breastfed (61.10%) and never breastfed infants (58.30%) had average cognitive, psychomotor, language and socio-emotional development. When compared to complementarily and never breastfed infants exclusively breastfed infants outperformed in terms ofall the four developmental (ANOVA) outcomes while the never breastfed newborns scored lowest on all the abilities. The mean cognitive scores of exclusively breastfed infants were 17.53 points better than those of never breastfed children, and 13.36 points higher than those of complementarily breastfed children.The average motor ability scores of exclusively breastfed children were 16.96 points better than those of never breastfed children and 12.52 points higher than those of complementarily breastfed children.The average language scores of exclusively breastfed children were 13.54 points higher than those of never breastfed infants and 14.64 points higher than those of complementarily breastfed children. However, there was no significant difference in language development between complementarily and never breastfed infants. However, no significant difference in socio-emotional behavior was identified between exclusively breastfed infants and complementarily breastfed infants (Table 2).

Table 1. Profile of the sample (Mother-Child Dyads)

N=180

Characteristics	Category	N	Percentage
1. Locality	Rural	51	28.30
	Urban	129	71.70
2.Religion	Hindu	173	96.11
	Muslim	07	3.90
3.Family Type	Nuclear	71	39.40
	Joint	109	60.60
4.SES of the family	Low	11	6.10
	Middle	141	78.30
	High	28	15.60
5.Breast feeding initiation	Immediately	108	60.0
	< 1 hr	15	8.30
	1 hr – 6 hrs	08	4.40
	7 hrs – 24 hrs	08	4.40
	> 24 hrs –3 days	11	6.10
	>3 days	30	16.70
6.Colostrum feeding	Fed	140	77.80
	Not Fed	40	22.20
7.Prelacteal feeds	Fed	96	53.33
	Not fed	84	46.70
8.Breast feeding category (WHO classification)	Exclusively breast fed (first six months)	84	46.70
	Complementarily breast fed (Breast milk with other non human milk and prelacteal feeds for first six months)	72	40.00
	Bottle fed/not fed	24	13.30
7. Duration of breast feeding (months)	< 3	15	8.30
	3-6	06	3.30
	6-12	07	3.90
	12-24	23	12.80
	> 24	129	71.66
	Range	0-24	

The correlation (Table 3) between duration of breastfeeding was positive and significant with all developmental outcomes. The influence was 19.80 per cent on cognitive development, 20.30 per cent for both language and socio- emotional and motor development (19.40%).

Fig. 1 depicts direct effects of breast feeding duration and indirect effects of selected factors like mother's age, education, occupation, socioeconomic status, home environment, husband's education and occupation that mediate through breast feeding duration on different infant developmental outcomes. All the above factors were found to significantly influence the breast- feeding duration of infants wherethe effect of mothers' occupation was the highest (21.30%), followed by home environment (14.40%), husbands' occupation (10.80%) and education (9%), mother's education (8.7%), mother's age (7.30%) and SES (4.30%). These factors mediate their effects through breast feeding duration and further breastfeeding duration was found to significantly influence cognitive development by 19.79 %, language development (8.63%), motor development (7.83%). However, there was no significant influence of breastfeeding duration on socio-emotional development.

4. DISCUSSION

WHO highly advises mothers to exclusively breastfeed their infants for the first six months, with continuing breastfeeding and appropriate complementary foods up to two years of age or beyond, to promote optimal growth, development, and health. Better rates of breastfeeding intiation (60 %) and colostrum feeding (77.80 %) was prevailing (Table 2)

among mothers and this indicates the important role of health professional, ASHA workers and government initiatives. It was unfortunate to note that 53.33 per cent fed prelacteal feeds. Regarding duration of breastfeeding majority of mother's breast fed for 1-2 years and the rate of exclusive breastfeeding for first six months was 46.70%. Similar results were observed by Subbiah and Jegannathan [18]. Mc Queen et al. [19] and Arya et al. [20] who reported low rates of breast feeding initiation. Parveen et al. (2012) also found that 70.50 per cent practiced colostrum feeding and 62.30 per cent did not practice exclusive breastfeeding [20,19,3,18].

The findings clearly show that exclusively complementarily and never breastfed infants differed considerably in all developmental abilities. Though the majority of infants in each category had average cognitive, psychomotor, and language abilities, the non-breastfed category had the highest number of infants with low cognitive, psychomotor, and language abilities, followed by complementarily breastfed children. Infants that were exclusively breastfed for the first six months and fed for long period of time (more than a year) were shown to have average to above-average talents. Home environment, SES, father's age, mother's education, mother's age and occupation, father's education and occupation were discovered to regulate baby development outcomes through breast feeding duration. This emphasizes the importance of increasing knowledge among mothers, husbands, and family members about the exponential benefits of good breastfeeding practices during important phases of development.

Gonzalez et al. [21] and Der et al. [22] found that breastfed children had improved cognitive capacities [12,4]. Smith et al. [23] discovered that breastfed children had an advantage in visual-motor integration and that there were variations in test results between breastfed and non-breastfed children [10]. The percentage of exclusively breastfed infants who had high cognitive capacity was higher. The mean

Table 2. Breast feeding practices and Infant development outcomes

Category	Exclusive breast fed for first six months	Complementarily breast fed	Bottle fed/not fed with breast milk	Mean scores ± SD	F
1. Cognitive Development					
Low	03 (3.60)	26 (36.10)	10 (41.7)	106.07a ± 12.37	
Average	70 (83.30)	44 (61.10)	14 (58.30)	92.71^{b} ± 12.45	30.782**
High	11 (13.10)	02 (2.80)	00 (0.00)	88.54^{c} ± 13.06	
2. Psychomotor Development					
Low	03 (2.40)	15 (20.80	08 (33.30)	106.13^{a} ± 2.28	
Average	70 (84.50)	55 (76.40)	16 (66.70)	93.61^{b} ± 11.96	28.973*
High	11 (13.10)	02 (2.80)	00 (0.00)	89.17^{c} ± 12.91	
3. Language Development					
Low	07 (8.30)	28 (38.90)	16 (66.70)	109.00a ± 16.79	
Average	59 (70.20)	40 (55.60)	07 (29.29)	94.36bc ± 15.54	17.921**
High	18 (21.40)	04 (5.60)	01 (4.20)	95.46cb ± 15.08	
4. `Socio-Emotional Development					
Low	04 (4.80)	18 (25.00)	02 (8.30)	102.64^{ac} ± 9.29	
Average	75 (89.30)	53 (73.60)	22 (91.70)	93.32^{b} ± 10.81	17.335**
High	05 (6.00)	01 (1.40)	00 (0.00)	98.75^{ca} ± 8.75	

*- Significant at 5% level, ** - Significant at 1%*

Table 3. Correlation between Breast feeding duration and Developmental outcomes of Infants

Infant Development Outcomes	Duration of breast feeding (r)
Cognitive development	0.198**
Language development	0.203**
Motor development	0.194**
Socio-emotional	0.203**

*** - Significant at 1% level*

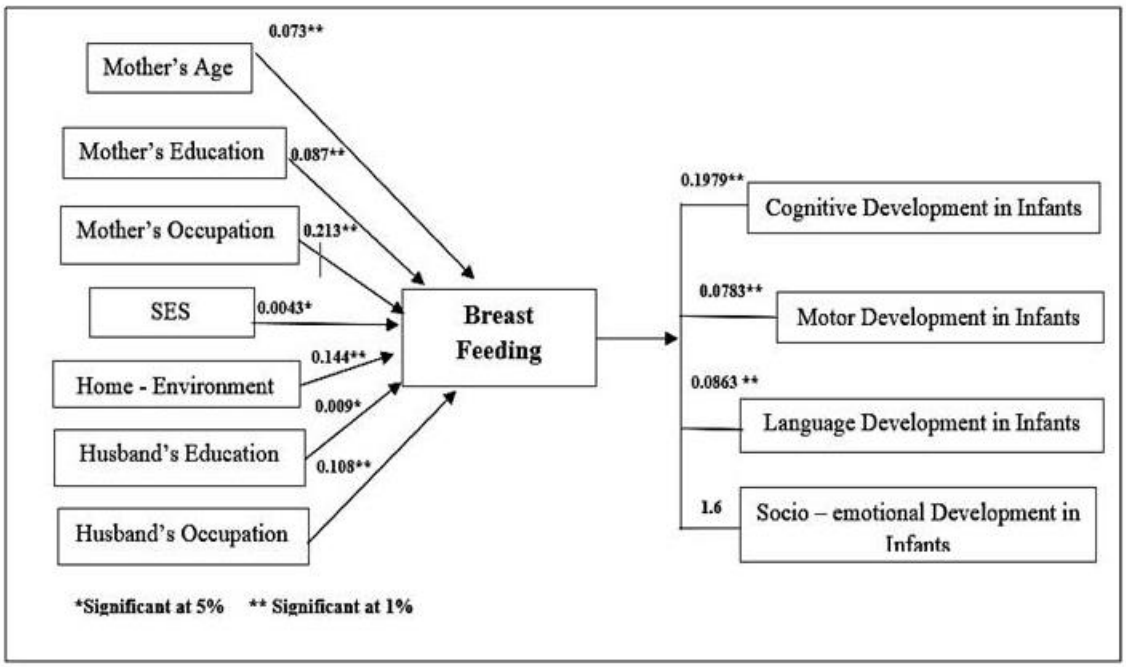

Fig. 1. Path modeling indicating the direct and indirect effects of breast feeding duration on infant development

cognitive scores also show that exclusively breastfed newborns had the highest cognitive ability, followed by complementarily breastfed infants, while never breastfed infants had the lowest. Saliaj et al. [24] discovered that children nursed for only three months have worse psychometric scores than those breastfed for six or more months [25,24,26,27]. Oddy et al. [28,29] found that breastfeeding for fewer than four months increased the risk of developing fine motor skills. The current study's findings agreed with those of Tozzi et al. [30] who discovered a link between language scores and exclusive breastfeeding. Oddy et al. [28] discovered a strong positive relationship between PPVT-R scores and breastfeeding at six and ten years of age. However, the results show that breastfeeding practices has a weak association with socio-emotional development of infants [11,26]. The results were in agreement by the study conducted by Lind et al. [6] who revealed that when children who were never breastfed when compared with those who were breastfed for ≥6 months and exclusively breastfed for ≥ 3 months had decreased odds of difficulties with emotional symptoms, conduct problems, and total difficulties before adjustment. These associations were no longer significant after adjustment for the potential confounding factors (maternal education, pre pregnancy BMI, marital status, possible postpartum depression, maternal age, and child enrichment) that play a role in psychosocial development [6,28,30,31].

5. CONCLUSION

More than half of mothers'-initiated breastfeeding immediately after birth or within one hour and 25.11 per cent of mothers'- initiated breastfeeding after threedays. Majority of mothers fed colostrum (73 %) and also prelacteal feeding was common, where 57.78 per cent of mothers practiced prelacteal feeding.When compared to complementarily breastfed and never breastfed infants, infants exclusively breastfed during the first six months and nursing for a longer time (more than 12 months) had good cognitive, language, motor, and socio-emotional development scores. Breastfeeding, on the other hand, had a moderate impact on infants' socio-emotional development. The most influential component mediating nursing practises for better developmental outcomes was the home environment. SES, father's age, mother's and father's education, and occupation were also predictor variables of baby developmental outcomes.

6. RECOMMENDATION AND IMPLICATIONS

Northern Karnataka in India had a lower rate of exclusive breastfeeding up to six months than

the national number, prelacteal feeding was common, and mothers quit breastfeeding before six months. As a result, there is a need for creating awareness regarding successful breastfeeding practices and proper weaning practices.Exclusive and long duration of breastfeeding on child developmental outcomes such as cognition, language, psychomotor, and socio-emotional development. The mechanism(s) causing these effects are most likely related to the high nutritional content in breast milksensitive to physical, motor and brain development in the critical early period of life.Instead than only presenting messages, health workersshould be trained in counselling and family-based intervention. There is a need to develop policies to regulate commercial brands of prelacteal feeds such as gutti, gripe water, and others that display the advice that they can be given from birth.Establishment of breast milk bank to help feed babies whose mothers are ill or in distress, as well as those who have lost mothers.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

CONSENT AND ETHICS APPROVAL

The study was approved by Ethical committee of University of Agricultural Sciences, Dharwad. Oral consent was obtained from the study participants in this study.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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