

Cognitive Development in Bottle Versus Breastfed Children up to Two Years: A Comparative Study from Islamabad

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ABSTRACT

Objectives: To evaluate the proportion of exclusively breastfeeding and to determine the association of various types of feeding with cognitive development in children up to two years of age.

Study Design: Cross-sectional analytical study.

Place and Duration of Study: Outpatient Department of Pediatrics, Pakistan Air Force Hospital, Islamabad Pakistan, from Jan to Aug 2019.

Methodology: Mothers of children under two years of age visiting the hospital were recruited by systematic sampling. The data was collected through interviews using a semi-structured questionnaire. A score of each child has dichotomized into satisfactory and unsatisfactory cognitive development overall and separately for each domain viz communication, fine motor, gross motor, problem-solving and personal social skills.

Results: Out of 192 children, less than half, 77(40.1), were exclusively breastfed. Feeding practices had a statistically significant effect on overall cognitive development ($p<0.002$) and also individually on communication ($p<0.006$), fine motor ($p<0.022$), gross motor ($p<0.001$) and problem-solving skills ($p<0.011$) of children under two years of age. Exclusive breastfeeding showed better cognitive development ($p<0.003$).

Conclusion: Promoting breastfeeding practices is necessary as it leads to better children's cognitive development. This research revealed that the longer duration of exclusive breastfeeding was a more satisfactory cognitive development.

Keywords: Breastfeeding, Cognitive development, Feeding practices.

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INTRODUCTION

Children's growth and development occur rapidly in the initial two years of their life, mainly in the four domains including motor (physical), language and communication, cognitive and social/emotional.¹ The children of developing countries are exposed to multiple risk factors of poor cognitive development, including factors related to pregnancy and labour, socio-economic status, inadequate health services and feeding practices, posing a major public health problem.²

The WHO recommends absolute breastfeeding for the first six months of the infant's life, including complementary foods afterwards, with continued breastfeeding up to two years of age or beyond.³ Human milk is considered gold standard as its contents are natural and acquiescent with the needs of child growth.^{4,5} Several studies were carried out across the globe to assess the relationship between type and duration of feeding with children's cognitive outcomes showing indeterminate results. Some studies showed positive association,^{1,6} while others showed no such

connotation.^{7,8} In Pakistan, a study from Balochistan specified the effect of only breastfeeding, rather than various feeding practices, on language and cognitive development.⁹ Another study from Sindh on breastfeeding and gross motor milestones showed an insignificant relationship.¹⁰

The scarcity of data and lack of a holistic approach encompassing the multiple feeding types and cognition domains from Pakistan simultaneously focused our attention towards this issue. Therefore, this study was conducted to test the hypothesis that various types of feeding practices in the first two years of children can affect their cognitive development. This research will help motivate policymakers to allocate funds to develop an effective health education program promoting appropriate feeding practices. The one which can improve the health and cognitive development of children and thus ultimately can improve the economy of the country by reducing the health care burden.

METHODOLOGY

The cross-sectional analytical study was conducted at Pakistan Air Force (PAF) Hospital, Islamabad Pakistan, from January to August 2019 after

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approval by the Institutional Review Board of Fazaia Medical College (IBD/FMC/1341/1/IRB). Keeping the prevalence of disability under two years as 5.5/1000,¹¹ the sample size was calculated using the WHO sample size calculator.

Inclusion Criteria: All the children under two years of age, of either gender, visiting the Pediatrics OPD with their mothers were included in the study.

Exclusion Criteria: The children with any birth/congenital disabilities, born with any complications during delivery, had a history of any premorbid disease of the mother during their pregnancy or were severely ill were excluded from the study.

Participants were enrolled through systematic sampling. We decided to collect the data over one month. The estimated number of children under two years of age visiting the Paediatric OPD of PAF hospital a month before data collection was 825. Taking it as total population (N), for a sample size of (n) of 192, the K was calculated as 4.2. Number 3 was selected randomly, and after that, every fourth child

were classified into the same categories based on the pattern of their current feeding practices.

The ASQ assessed five skill domains of a child, viz communication, gross motor, fine motor, problem-solving and personal social skills, through six questions in each domain varying for various age groups (2, 4, 6, 8, 9, 10, 12, 14, 16, 18, 20, 22, 24 months). Pre-trained interviewers interviewed mothers of selected children. Each question using a maternal report method assigned 10 points if the answer was 'yes', 5 points if 'sometimes' or 0 points if 'not yet' were replied, thus making a score of 60 for each domain of child's development and a total cognitive score of 300. All five skill domains' summed-up score was labelled "Overall Cognitive Development". Scores of all five skills and overall cognitive development were dichotomized into those with "Satisfactory/Unsatisfactory" development based on cut-off values given in Table-I. When a child's total score was above the cut-off, the child's development appeared to be satisfactory and vice versa.

Table-I: Cut off values for each Domain and total Score of Cognitive Development with respect to the age of Children

Age	Communication	Gross Motor	Fine Motor	Problem Solving	Personal Social	Total Cut off value
2 Months	22.77	41.84	30.16	24.62	33.71	153.11
4 Months	34.60	38.41	29.62	34.98	33.61	170.77
6 Months	29.65	22.25	25.14	27.72	25.34	130.11
8 Months	33.06	30.61	40.15	36.17	35.84	175.83
9 Months	13.97	17.82	31.32	28.72	18.91	110.74
10 Months	22.87	30.07	37.97	32.51	27.25	150.67
12 Months	15.64	21.49	34.50	27.32	21.73	120.68
14 Months	17.40	25.80	23.06	22.56	23.18	112
16 Months	16.81	37.91	31.98	30.51	26.43	143.64
18 Months	13.06	37.38	34.32	25.74	27.19	137.69
20 Months	20.50	39.89	36.05	28.84	33.36	158.64
22 Months	13.04	27.75	29.61	29.30	30.07	129.77
24 Months	25.17	38.07	35.16	29.78	31.54	159.72

with a mother was recruited into the study. Data was collected using the Ages and Stages Questionnaire (ASQ), 3rd edition, having high sensitivity (82.4%) and reasonable specificity (77%) in detecting developmental concerns overall.¹² The questionnaire was modified by adding some socio-demographic variables.

Mothers of selected children were inquired about the type of feeding given in the first six months of life to the respective child, based on which children were categorized into "exclusive breastfed: who were purely breastfed for initial six months, exclusive bottle-fed: who were purely bottle fed for initial six months or mixed fed: who fed both bottle and breast milk in initial six months". The children under six months

Statistical Package for Social Sciences (SPSS) version 23.0 was used for the data analysis. Quantitative variables were expressed as Mean \pm SD and qualitative variables were expressed as frequency and percentages. Chi-square test was applied to explore the inferential statistics. The *p*-value lower than or up to 0.05 was considered as significant.

RESULT

Out of 192, 59(30.7%) participants were residents of Rawalpindi. The mean age of mothers was 27 \pm 5.0 years, as shown in Table II. We found that most of the children, 77(40.1%), exclusively breastfed in the first six months of their life, as shown in the Figure. Table-III shows children's developmental status, and it was

observed that communication skill was satisfactory among most of the children 177(92.4%). The mean "overall cognitive development" score was 217±58.4. Overall, cognitive development of 161(83.9%) children was satisfactory. Type of feeding had a statistically significant association with maternal age ($p=0.007$) and education ($p<0.001$). Table-IV shows that exclusively bottle-fed children had the least satisfactory result compared to exclusively breastfed children, who had the most satisfactory results in each domain except personal social skills, in which mixed-fed babies showed the highest satisfactory results 35(70%). Moreover, the association of feeding practices with each cognitive skill was found to be statistically significant ($p<0.05$) except for personal social skills ($p=0.212$). The children who exclusively breastfed for longer duration had scored better (72/77; 93.5%) on ASQ than their counterparts (89/115; 77.4%) (p -value=0.003).

Table-II: Socio-demographics of Children and their Mothers (n=192)

Variables	n (%)
Age of Mothers	
Up to 30 years	122(63.5)
31 years and above	70(36.5)
Mean±SD	27.5±5.0 years
Education of Mothers	
Less than matric	55(28.6)
Matric and higher	137(71.4)
Residence	
Rawalpindi	59(30.7)
Islamabad	48(25.0)
Others	85(44.3)
Religion	
Muslims	192(100)
Socioeconomic Status	
Lower	90(46.9)
Middle	72(37.5)
Upper	30(15.6)
Occupation	
Housewife	164(85.4)
Working women	28(14.6)
Characteristics of Children	
Age in months	
1-6	42(21.9)
7-12	71(37.0)
13-18	44(22.9)
19-24	35(18.2)
Mean±SD of age (months)	12±6.6
Birth Order	
1st or 2nd	119(62)
3rd or above	73(38)

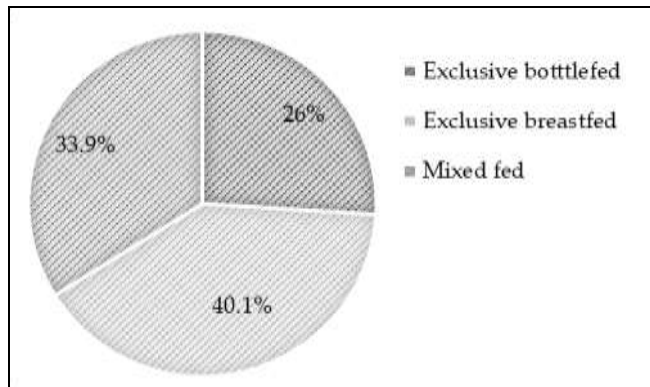


Figure : Proportion of types of Feeding Practices (n=192)

Table-III: Developmental Status of Children in Various Domains of Cognition (n=192)

Cognition Skills	Satisfactory n(%)	Unsatisfactory n(%)
Communication Skills	177(92.2)	15(7.8)
Gross Motor Skills	139(72.4)	53(27.6)
Fine Motor Skills	142(74.0)	50(26.0)
Problem Solving Skills	137(71.4)	55(28.6)
Personal Social Skills	115(59.9)	77(40.1)
Overall Cognitive Development	161(83.9)	31(16.1)
Overall Cognitive Score (Mean±SD)	217.2±58.6	

Table-IV: Association of various Cognitive Skills with Feeding Practices (n=192)

Cognition Skills	Exclusive Breastfed n(%)	Exclusive Bottle-fed n(%)	Mixed-fed n(%)	p-value
Communication Skills				
Satisfactory	75(97.4)	41(82)	61(93.8)	0.006**
Unsatisfactory	2(2.6)	09(18)	04(6.2)	
Gross Motor Skills				
Satisfactory	61(79.2)	26(52)	52(80.0)	0.001**
Unsatisfactory	16(20.8)	24(48)	13(20.0)	
Fine Motor Skills				
Satisfactory	63(81.8)	30(60)	49(75.4)	0.022*
Unsatisfactory	14(18.2)	20(40)	16(24.6)	
Problem Solving Skills				
Satisfactory	62(80.5)	28(56.0)	47(72.3)	0.011*
Unsatisfactory	15(19.5)	22(44.0)	18(27.7)	
Personal Social Skills				
Satisfactory	42(54.5)	35(70.0)	38(58.5)	0.212
Unsatisfactory	35(45.5)	15(30.0)	27(41.5)	
Overall Cognitive Development				
Satisfactory	72(93.5)	35(70.0)	54(83.1)	0.002**
Unsatisfactory	05(6.5)	15(30.0)	11(16.9)	
Total	77	50	65	

*significant p-value <0.05, **highly significant p-value <0.01

DISCUSSION

This study showed an association between the feeding type and children's cognitive development. Children's growth in cognition communication, gross

motor, fine motor and problem-solving domains is significantly better in exclusively breastfed children than in their counterparts.

Children who breastfed exclusively were less in our study (40%) than in Sindh (68.6%), and this variation can be attributed to the differences in the definition of exclusively breastfed babies between the two studies. We classified the children as exclusively breastfed only if it continued for the initial six months of their life, while the study of Sindh considered it till four months of age.¹⁰

The proportion of children who were exclusively breastfed in this study was lower (40.1%) than most of the industrialized countries, including Norway (99%), Denmark (98.7%), Japan (98.3%), United Kingdom (70%), United States (69.5%) and France (62.6%) might be due to their high literacy rate.¹³ It was even lesser than Iran (53.13%), which showed a higher exclusive breastfeeding rate in rural than urban areas reflecting the resilient influence of customary factors than education.¹⁴ At the same time, it was comparable with the studies conducted in Bangladesh (38%) and Pakistan (42%), further influencing the role of cultural similarity.^{15,16}

It was observed that a larger proportion of younger than elderly mother breastfed their babies, similar to the study conducted in Japan.¹⁷ Reverse, and no association found in studies conducted in US and Australia, respectively,^{18,19} might be due to the variation of age categories. Moreover, oversampling of women of more than 36 years of age in Australian studies and the possibility of recall bias can also be the attributable factors for these differences.^{18,19}

The association of better cognition skills with prolonged duration of breastfeeding reinforced the significant role of exclusive breastfeeding in a child's development. The results are consistent with a randomized trial conducted in Ballarus and reassured by another research done in Balochistan which recommended breastfeeding for more than 12 months to bring out the maximum benefit in a child's language and cognitive development.^{9,20} On the contrary, a study conducted in Sindh found no significant association of breastfeeding with the development of gross motor skills, and the differences in findings can be explained by the fact that the study in Sindh investigated only gross motor skills by using a different measuring tool on children with different age group, i.e., more than two years of age with possibility of more recall bias.¹⁰

Longitudinal studies conducted in Korea assessed children up to 3 years, and in Scandinavia, evaluated children at 13 months and five years exhibited a statistically significant positive dose-response effect of duration of breastfeeding on cognitive development similar to our study.^{21,22}

We found that children who breastfed exclusively scored better in all except personal social domains of cognition than mixed-fed and bottle-fed. In addition, the children who were exclusively breastfed showed more satisfactory cognitive development than those who were not.

RECOMMENDATIONS

Based on the result of our study, we highly recommend exclusive breastfeeding for six months and its continuation till two years of age among children for better development of their cognitive skills. Further studies with a more trustworthy analytical approach are required to verify our findings and to see the variations in breastfeeding practices posed by different religions. However, the scarcity of data on the current topic and its significance in developing countries like Pakistan opens the venue for researchers in this domain.

LIMITATIONS OF STUDY

The present study focused on ASQ 3rd edition, while other studies used more than one testing tool. Therefore, various other areas of development had yet to be included.

CONCLUSION

The proportion of exclusively breastfed children was highest than other types of feeding in the present study but could have been better, even though most of the mothers were educated. Children's cognitive development, in terms of their communication, gross motor, fine motor and problem-solving skills, is better in breastfed children than in mixed and bottle-fed children.

Conflict of Interest: None

Author's Contribution:

Following authors have made substantial contributions to the manuscript as under:

AB & AA: Conception, study design, drafting the manuscript, approval of the final version to be published.

IZM & FI & AA: Data acquisition, data analysis, data interpretation, critical review, approval of the final version to be published.

AR & IF & AW: Critical review, drafting the manuscript, data interpretation, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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