

Cognitive and developmental assessment between breast fed and mixed fed children: a cross sectional study

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Abstract

Introduction: The importance of breastfeeding for cognitive development has been researched widely over the past several decades and has been found to be associated with significantly higher scores for cognitive development than the formula feeding. Right from initial research of Hoefler and Hardy, The majority of published studies have concluded that breastfeeding has beneficial effect on cognitive development worldwide. **Objective:** To evaluate cognitive and developmental assessment in breastfed and mixed fed children. **Design:** A cross sectional study. **Setting:** The study was carried out in six blocks of Lalitpur district (U.P.) from June 2009- March 2010. **Material & methods:** Total 705 children including (breast fed and mixed fed) were selected by percentage population allocation technique. Fisher's exact test applied as test of significance. Epi info version-7 was used for statistical calculation. **Result:** After analyzing total 705 children 1mo-2years of age, out of which 458 were breast fed and 247 were mixed fed, all the seventeen items used in TDSC were found to be very significant ($p < 0.0001$) except Raising self to sitting position ($p = 0.3460$) and Walking upstairs with help ($p = 0.2642$). **Conclusion:** As compared to mixed fed group, exclusively breast fed children had better cognitive and developmental skill than mixed fed children. (As matched with TDSC).

Keywords: Developmental delay, Mixed fed, and TDSC scales

Introduction

The importance of breastfeeding for cognitive development has been researched widely over the past several decades and has been found to be associated with significantly higher scores for cognitive development than the formula feeding [1, 2]. Right from initial research of Hoefler and Hardy [3], the majority of published studies have concluded that breastfeeding has beneficial effect on cognitive development worldwide [4-11]. Breast milk contains a complex array of nutrients, trophic factor, and other bioactive ingredients [12, 13]. Docosahexanoic acid is

abundant in human milk and rapidly incorporated into the central nervous system during the first three months of life [14-18, 19].

The act of breast feeding may also favor infant's intellectual development through increased mother-infant positive interaction resulting in better long – term relationship the association between breastfeeding and estimates of cognitive ability is consistently attenuated by adjustment for socioeconomic status and environmental factors [1, 2].

Despite of studies conducted worldwide very little data is available.

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Aims & Objectives

This study was conducted to observe differences in cognitive and development skill between exclusively

breast fed children and mixed fed children (age 1 month- 2 years).

Material & Methods

Sample size (n) = (confidence interval)² p q/ d²

(p = prevalence of disease or morbidity, q = (1- p), d = permissible error (absolute precision) c.i = 1.96).

Sample size was calculated by sample size determination in health studies (practical manual) by S.K. Lwanga and S.Lameshow, WHO, Geneva. Taking the prevalence of developmental delay in children about 16% [20-23] sample size of total 705 children 1 month- 2 years of age with their mothers, were selected by **percentage population allocation technique** in six blocks of Lalitpur. Selection of children was irrespective of sex, birth weight; breast feeding education, mother's age, mother educational status, parity, religion, duration, frequency of breast feeding and religion were matched between populations (**Table – 1**).

Table 1: Population characteristics.

Population characteristics	Breast fed (n1=458)	Mixed fed (n2=247)	Two tailed P - value
Male	340(74.4%)	197(80%)	0.1214
Female	118(25.6%)	50(20%)	
Mean Birth wt.<2.5kg	258(56.3%)	144(58.4)	0.633
Mean Birth wt.>2.5kg	200(43.7%)	103(41.6%)	
Adequate breastfeeding education to mother	214(46.9%)	112(45.5%)	0.7518
Inadequate breastfeeding education to mother	244(53.1%)	135(54.5%)	
Mother age at 1 st delivery			
< 25 yr	268(58.6%)	160(64.9%)	0.106
>25yr	190(41.4%)	87(35.1%)	
Education >8 th standard	270(35.9%)	145(58.7%)	1.0
Education <8 th standard	188(64.1%)	102(45.3%)	
Parity =<2	257(56.2%)	135(54.5%)	0.750
Parity >2	201(43.8%)	112(45.5%)	
General category			
Yes	54(11.7%)	29(11.7%)	1.000
No	404(89.3%)	218(89.3%)	
Breastfeeding initiation			
<1hr of delivery	243(53.0%)	140(56.6%)	0.383
>1hr of delivery	215(47.0%)	107(43.4%)	
Duration of breastfeeding			
<10minutes	250(54.7%)	135(54.5%)	1.000
>10minutes	208(45.3%)	112(45.5%)	
Breastfeeding Frequency			
<6 times/day	236(51.6%)	123(59.8%)	0.693
>6 times/day	222(48.4%)	124(40.2%)	
Hindus	367(80.3%)	183(74.1%)	0.070
Others	91(19.7%)	64(25.9%)	

Case definition: The “Breast fed” child means the one who is/was fed exclusively on breast milk in first six months of his/her life. The “Mixed fed” child refers to one who was either ‘predominantly’ or ‘partially’ breast fed.

Inclusion criteria: all the children who were 1mo-2 years of age, including breast fed & mixed fed.

Exclusion criteria:

1. Children less than 1months of age.
2. children with cerebral palsy, chronic diseases, physically handicapped, malnourished, mentally retarded and other neurological disorder and those who did not participate in this study.

A questionnaire containing (consent form, breastfeeding observation form, breastfeeding education form, director’s guide form, dietary recall form) and TDSC in local language were used to collect the data.

Ethical issues: Ethical issues approval has been obtained by key institution, B. R. D. Medical College, Gorakhpur.

Statistics: Fisher’s exact test applied as test of significance. Epi info version-7 was used for statistical calculation.

Questionnaire forms containing TDSC, the milestones of these children were assessed according to the **TDSC** (Trivandrum Developmental Screening Chart) in children 1mo-2 years of age.

There is an over representation of items near one year of age because one year is an ideal age for formal cognitive and developmental assessment in community setting.

Prior to fill up questionnaire forms all the ANM, ASHA and BFCHI worker were given hands on training in the use of the for questionnaire forms containing TDSC and their ability to use the TDS chart was checked repeatedly.

A vertical line is drawn, or a pencil is kept vertically, at the level of chronological age of child being tested. If child fails to achieve any item that falls short on left side of the vertical line, the child is considered to have a developmental delay. Any obvious abnormality or asymmetry is also considered as abnormal.

The ANM, ASHA and mother support groups persuaded the mother to bring children less than two years of age to the Anganwadi on specific date and time then all details were recorded on the questionnaire forms which were filled after interviewing the mothers and the screening test was administered.

Those who failed to turn up were visited at home and the screening test was administered there, thus covering all the 705 children aged less 1mo-2 years of age from all the 6 blocks of Lalitpur district were enrolled for the study. After interview to the mothers of these babies, the children were divided into two groups the exclusively breast fed group (n=458) and the mixed fed group (n=247).

All those children who failed any one or more test item (developmental delay) and every 10th normal child (without developmental delay) were called to the health centre on specific date and time. Those who failed to turn up were repeatedly contacted.

Finally children found to have developmental delay on TDSC test result, those children were only TDSC test again administered by an experienced observer from the BRD Medical College, Gorakhpur, who blind to the TDSC test result on specific date and time at health center.

Then both of the groups were further divided into two subgroups, viz. normal and delayed, according to attainment or non attainment of the milestones according to age of child on TDSC test.

Result

After analyzing total 705 children less 1mo-2 years of age, out of which 458 were breast fed and 247 were mixed fed, all the seventeen items used in TDSC were found to be very significant ($p < 0.0001$) except Raising self to sitting position ($p = 0.3460$) and Walking upstairs with help ($p = 0.2642$) **Table-2**

Table-2

1mo -6month (N1 =246)	Breastfed (n ₁ =159)		Mixed fed (n ₂ =87)		Two tailed p value
	Normal	Delayed	Normal	Delayed	
Social smile	139(88%)	20(12%)	52(60.0%)	35(40.0%)	0.0001
Eyes follow pen/pencil	138(87.2%)	21(12.8%)	50 (60.0%)	37(40.0%)	0.0001
Holds head steadily	143(90%)	16(10%)	61(70.0%)	26 (30.0%)	0.0001
Rolls from back to stomach	118(74.4%)	41(25.6%)	35(40.0%)	52(60.0%)	0.0001
Transfers objects	142(89.7%)	17(10.3%)	56(65.0%)	31(35.%)	0.0001
Raises self to sitting position	118(74.4%)	41(25.6%)	70(80.0%)	17(20.0%)	0.3460
6mo-1year (N2=352)	Breastfed (n ₃ =225)		Mixed fed (n ₄ =127)		
Standing up by furniture	205(90.9%)	20(9.1%)	93(73.3%)	34(26.7%)	0.0001
Fine prehension of pellet	205(90.9%)	20(9.1%)	76(60.0%)	51(40.0%)	0.0001
Pats a cake	211(93.9%)	14(6.1%)	85(66.7%)	42(33.3%)	0.0001
Walks with help	210(93.3%)	15(6.7%)	68 (53.4%)	59(46.6%)	0.0001
Throws a ball	195 (86.7%)	30(13.3%)	42 (33.3%)	85 (66.7%)	0.0001
Walks alone	204(90.7%)	21 (9.3%)	42(33.3%)	85(66.7%)	0.0001
Says 2 words	208(92.7%)	17(7.3%)	76(60.0%)	51(40.0%)	0.0001
(1year-2year N3=107)	Breastfed (n ₅ =64)		Mixed fed (n ₆ =43)		
Walks backwards	52(81.0%)	12(19.0%)	24(55.0%)	19(45.0%)	0.008
Walks upstairs with help	50(78%)	14(22%)	29(70.0%)	14(30.0%)	0.2642
Points to parts of a doll	48(75.0%)	16(25.0%)	15(35.0%)	28 (65.0%)	0.0001

Discussion

The rationale of this study was to determine the cognitive & developmental assessment in breastfed babies and mixed fed babies and to find if there is any significant correlation between exclusive breast feeding and cognitive development of the baby. The secondary objective was to promote, support & strengthen exclusive breastfeeding, with the help of ICDSs, AWWs & mothers support groups. The reason for selection of this district was based on poor development indicators [24]. During the study, cognitive and developmental assessment was based on the TDSC (Trivandrum Developmental Screening Chart) for 1mo-2 year children. As assessed in this study, there are significant differences in children's physical and mental growth when they are breast fed or mixed fed.

It was found that the children's development was delayed more when they were not exclusively breast fed. Higher IQ connected to breastfeeding; there are two studies summarizing the findings of the Christchurch School of Medicine in New Zealand, which followed 1,000 children for 18 years to establish the relationship between intelligence and breast feeding, it was concluded that breastfeeding is associated with small but detectable increases in child cognitive ability and educational achievement. [33]. other studies that also show a correlation between breastfeeding and cognitive development [11, 25- 26, 31]. Lucas, A. et al. Breast milk and subsequent intelligence quotient in children born preterm; Formula-fed preterm infants had lower IQ scores at age 7-8 years than preemies fed

expressed breast milk; the association held after controlling for mother's education and social class, and regardless of whether the mother attempted to express milk and failed or never attempted to express milk.

Kramer et al. found that prolonged and exclusive breast-feeding improves cognitive development as measured by IQ and teachers' academic ratings in children at age 6.5 years, according to the results of the largest randomized trial ever conducted in the area of human lactation [5,9,11].

"The evidence that breastfeeding improves cognitive development is based almost entirely on observational studies and is thus prone to confounding by subtle behavioral differences in the breastfeeding mother's behavior or her interaction with the infant," write Michael S. Kramer and colleagues from the Promotion of Breastfeeding Intervention Trial (PROBIT) Study Group.

The goal of this cluster-randomized trial was to determine whether prolonged and exclusive breast-feeding was associated with improved cognitive ability in children at age 6.5 years. The breast-feeding promotion intervention was modeled on the Baby-Friendly Hospital Initiative by the World Health Organization and United Nations Children's Fund (UNICEF) [27, 28].

Primary outcomes were subtest and IQ scores on the Wechsler Abbreviated Scales of Intelligence (WASI), and teacher evaluations of academic performance in reading, writing, mathematics, and other subjects.

Compared with the control group, the intervention group had a large increase in exclusive breast-feeding at age 3 months (43.3% vs 6.4%; $P < .001$) and a significantly higher prevalence of any breast-feeding at all ages, up to and including 12 months.

Compared with the control group, the intervention group had higher means on all of the WASI measures. Cluster-adjusted mean differences were +7.5 (95% confidence interval [CI], 0.8 - 14.3) for verbal IQ, +2.9 (95% CI, -3.3 to +9.1) for performance IQ, and +5.9 (95% CI, -1.0 to +12.8) for full-scale IQ.

For both reading and writing, teachers' academic ratings were significantly higher in the experimental group.

"These results, based on the largest randomized trial ever conducted in the area of human lactation, provide strong evidence that prolonged and exclusive breastfeeding improves children's cognitive development," the study authors write. The major study limitation is lack of blinding of the pediatricians who administered the WASI to the experimental vs control intervention status of the children they examined. Several other studies have been also stated that exclusive Breastfeeding Improves Neurological functions and cognitive Development [29-33].

In our study 458 children were/had exclusively breast fed in first six months of their lives while 247 children were not exclusively breast fed, but were given mixed feeding. After interviewing the mothers of children under study, and filling the questionnaire form, we counseled all the mothers about the benefits and techniques of breast feeding and initiation of complementary feeding. For this purpose, we also took the help of ANM, ASHA and other BFCHI workers. In the one year period of study these mothers were regularly followed up on specific date and time and screening test was administered. Those who failed to turn up were visited at home and screening test administered there and were counseled on every visit.

"The evidence that breastfeeding improves cognitive development is based almost entirely on observational studies and is thus prone to confounding by subtle behavioral differences in the breastfeeding mother's behavior or her interaction with the infant," writes Michael S. Kramer, MD, and colleagues from the Promotion of Breastfeeding Intervention Trial (PROBIT) Study Group. Regression adjustment for maternal and other factors associated with breastfeeding reduces the associations between breastfeeding and cognitive or educational outcomes.

Achieving the secondary objective of the study: A project named 'Baby Friendly Community Health Initiative' (BFCHI) is already being implemented by the Department of Paediatrics, BRD Medical College, and Gorakhpur in Lalitpur district (UP). The project started in November, 2006 with an overall objective to

test a district-based model for promoting optimal infant and young child feeding practices.

Limitations of this study are:

1. Smaller sample size
2. Besides feeding, several other factors work for cognitive development of child viz. socio-economic status, parental education, malnutrition, family environment, inadequate stimulation, and emotional factors.

Conclusion

A screening test should ideally be one with a high sensitivity and high specificity. Unfortunately, this is frequently not possible. A screening test with a high sensitivity and a gold standard test with a high specificity is what usually accepted.

In case of developmental delay there is no harm in ignoring out borderline cases particularly because large scale community intervention programs are still not available. Hence we prefer high specificity. In case of developmental delay it is difficult to get an ideal gold standard screening test. Every possible effort was taken to avoid bias in this study. Uniform hands on training were given to all ANM, ASHA and BFCHI workers. The observer who administered and interpreted the TDSC did not know the screening test result. The TDSC test had a sensitivity of 66.7% and specificity of 78.8%

In this study there was significant difference in cognitive & developmental milestones between breastfed & mixed fed babies up to two years of age. The other possible reasons for this may be because of multi-factorial association of child's development (such as poverty, parent's education, malnutrition, medical problems, family environment, etc.).

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