Role of Duration of Breastfeeding on Cognitive Development among Children in Andhra Pradesh: A Longitudinal Study

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Abstract

Child Care is a very important and often overlooked component of child development and can have a huge impact on the future success of children. The aim of this study was to assess the effect of duration of breastfeeding on cognitive development. The analysis is based on longitudinal data from Young Lives Study round 1 (2002) and round 3 (2009). By using OLS regression it show that Math test, EGRA test and PPVT test scores were found significant among children who had breastfed at least 1 to 6 months and who had breastfed along with complementary foods. But after adjusting all the selected socioeconomic and demographic factors only MATH test and PPVT test were found significant among those children who had breastfed along with complementary foods. it cleared that the cognitive development of children were developed within age 5 to 15 years. Therefore, proper duration of breastfeeding was necessary along with appropriate solid food supplements up to two years of age or beyond.

Introduction

India is home to the largest number of children in the world. According to the WHO the exclusive breastfeeding is 1 to 6 months of children. It is necessary to every child for their development. Only 39 per cent of children are exclusively breastfeed across the world(UNICEF, 2013) and in India it is 46 per cent (International Institute for Population Sciences and Macro 2007).According to the NFHS-3 report, in Andhra Pradesh 62.7 percent of children are breastfed. Child development refers to the biological and psychological changes that occur in human beings between conception and the end of adolescence. A healthy early child development, which are include the physical, social/emotional, and language/cognitive domains of development (Irwin et al. 2007). It is very important to children have better cognitive development to make a better future in their life.

Cognitive development is a complex process (Smith et al. 2003).Development of children is affected by various socioeconomic & demographic and environmental factors. Many studies investigated the relationship between breastfeeding and cognitive ability. Some of these found positive relationships and some of these are found little insignificant. In industrialized countries, initiation and duration of breastfeeding both were strongly associated with social factors (Pollack 1994; Pesa & Shelton 1999; Silva et al. 1978; Smith et al. 2003).But after adjustment for socioeconomic status and environmental factors, it associated with cognitive ability (Anderson et al. 1999; Drane & Logemann 2000; Jain 2002).Environmental factors, namely adequate nutrition and the parent's ability have a positive influence on the child's cognitive development (Bacahrach &Baumeister 1998).Several studies have shown a positive correlation between breastfeeding and cognitive development in children.

Increasing duration of breastfeeding was accompanied by a gradual increase in cognitive developmental benefit. Longer duration of breastfeeding was accompanied by greater differences in cognitive development between breast-fed and formula-fed children. While, Shorter duration of breastfeeding was associated with lower scores on mental development and motor development tests both at 13 months and at 5 years of age (Jedrychowski et al. 2012 Angelsen et al. 2001).Many nutrient components present in breast milk, which may have a significant effect on neurologic development in premature and term infants (Goldman 1993; Anderson et al. 1999; Jiang & Gibson-Davis 2011; Uauy et al. 2000).Also observed that the cognitive advantage associated with breastfeeding was no longer statistically significant after maternal verbal ability and home environment was added to the regression model containing social class and maternal education (Jacobson 1992; 1999). In contrary, some studies the association between breastfeeding and cognitive development is not statistically significant after adjustment for such confounders (Jacobson 1992; 1999; Dobbing & Beijers, 1992; Malloy 1998; Richards 1998). The effects of duration of breastfeeding on child outcomes, no significant relationship after adjusting for confounders (Rogan & Gladen 1993).According to Waber

et al. 1981 studies, children performed better on five sub castes and the general quotient of the Griffiths test than those who did not take food supplementation.

Previous research has indicated that in unadjusted compared with children who are formula fed, children who are breastfed score higher on measures of cognitive functioning (Morrow-Tlucak et al. 1998; Quinn et al. 2001; Rao et al. 2002; Rey 2003). Borra 2012, there were statistically significant relationships between breastfeeding and cognitive skills at all ages between school entry and at 14 years of age. Children breastfed for four weeks or more, do better than children breastfed for less than four weeks by about one tenth of a standard deviation across all the cognitive measures we examine.

Although several programs related to child care and their development are going on in the country, still the children had very poor condition in terms of health, education and their well developed. Thus, there is need to know the importance of breastfeeding for cognitive development. Moreover, many studies found the difference in effect of breastfeeding and combined breastfeeding and bottle milk or effect of duration of breastfeeding, which could be showing biased results. The main aim of the present study was to the effect of exclusively breastfeeding on the cognitive development of children aged 8 years old.

Data and Methodology
Data

This study is based on a younger cohort of data Young lives, Andhra Pradesh, India viz. Round 1 (2002) and Round 3 (2009). In India, it has been implemented in Andhra Pradesh by two organizations: Centre for Economic and Social Studies (CESS), Hyderabad and Save the Children UK (India). During the first phase of the study, 2,000 index children aged 6–17 months (one-year-olds) and 1,000 children aged 7–8 years (eight-year-olds) and their households were selected from 20 sentinel sites located across the three regions of Andhra Pradesh. Survey methods included household questionnaires completed by caregivers, child anthropometric measurements, an eight-year-old respondent questionnaire and a community questionnaire. In India's data multistage, stratified clustered sample design was used.

Conceptual Framework

This study investigates the effects of duration of breastfeeding in a diverse sample of children's different socioeconomic backgrounds. It is possible that some characteristics of the children and their families are predictive of the children's cognitive outcomes. These characteristics must be statistically controlled while estimating the effects of duration of breastfeeding. This study adopts methods of analysis that allow such statistical controls. Duration of breastfeeding is expected to affect the cognitive development of the older child through changes in socioeconomic and demographic aspects.

Conceptual Framework
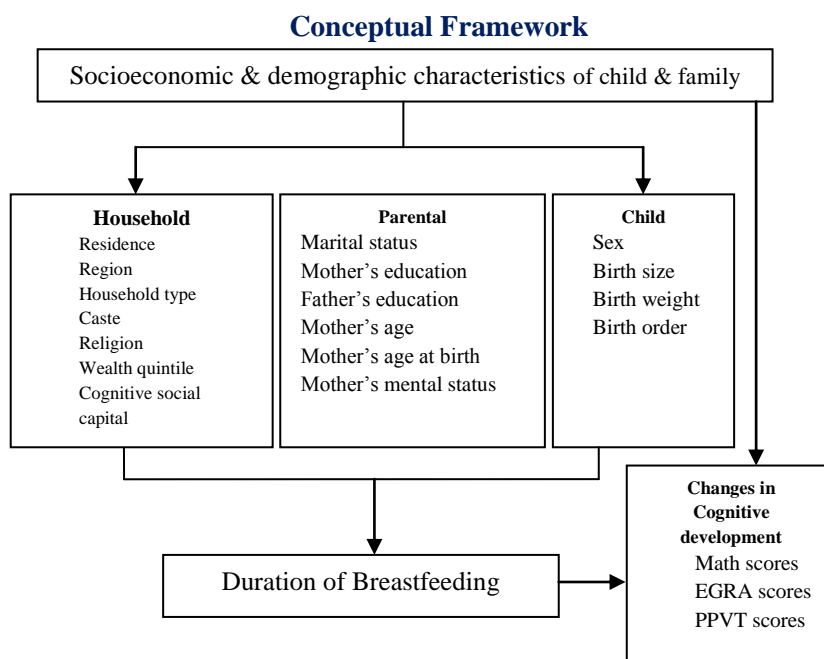
Methodology

In this study only first cohort of children was included whose aged was 1 year. In this study, Cognitive development was measured through Math scores, EGRA scores and PPVT scores of children from round 3.A mother reported, duration of breastfeeding and solids supplements received by her child. It was grouped into three categories: never or less than 1 month received breast milk feedings, exclusive breastfeeding (1 to 6 months), complementary breastfeeding (Breastfeeding + solids supplements).

Analysis

Z-test has been applied to show the differences of proportionate mean of duration of breastfeeding and socioeconomic and demographic factors, while ANOVA test has been applied to determine significant differences in socioeconomic &demographic, paternal and child characteristics. The effect of potential confounding factors was assessed by ordinary least squares, with feeding method as a categorical explanatory variable. Data analysis was performed with the STATA statistical package. All reported p value were considered statistically significant $p < 0.05$.

Results

Table 1 shows the characteristics of children based on socioeconomic and demographic characteristics. Three-fourth of the children belongs to rural areas. The Region wise percentages of children not so much differ, but in Telangana it was lowest. Most of the children belong to joint family. The percentages of male children were about 54 per cent and female was 46 per cent. The majority of children was Hindu (87 percent) and else was others. There were highest percentage of children belongs to OBC (46 per cent) category which was followed by SC/ST (33 per cent) and others (21 per cent). Average birth size of children was 45 per cent and there were approximately 76 per cent of children who had low birth weight. Forty per cent of children's mother were educated above primary. Twenty-four percent of children had never or less than 1 month breastfed and the majority of children had fulfill the duration of breastfeeding 1 to 6 months as recommended by WHO.

Table 2 means for the duration of breastfeeding 14.5 points among male as well as female. Low birth weight children were found high mean for duration of breastfeeding while average birth size of children was higher mean for duration of breastfeeding, which were proportionately significant. Increasing birth order increases the mean for duration of breastfeeding. Children's whose mother and father had below primary education were high mean for duration of breastfeeding. These were proportionately significant at the level of 10 per cent significance. Mean for duration of breastfeeding was highest among children who belong to rural areas. Mean for duration of breastfeeding also vary according to region. Mean for the duration for breastfeeding were high among SC/ST children and lower among the others category of children which were found proportionately significant. Children who belong to poor tertile group, mean for duration of breastfeeding were higher and lower among children who belong to rich tertile group.

The **Table 3** shows that mean for cognitive outcomes in different socioeconomic & demography characteristics. Mean scores of Math scores were 12.7 points (SD 6.5), EGRA scores 5.7 points (SD 3.5) and PPVT scores 61.6 points (SD 31.4) were higher among children who had breastfeed 1 to 6 months. Among male children mean of Math scores (12.1 points) and PPVT scores (61.3 points) were found more than female children. Children whose birth order was 1 were found higher mean scores on Math test 12.7 points (SD 6.3), EGRA test 5.9 points (SD 3.4) and PPVT test 61.9 points (SD 31.0). It was decreases with increases birth order. Children whose mother and father were literate found higher mean scores of cognitive test (Math test, EGRA test and PPVT test) as compared to below primary educated mother-father. Mothers whose aged between 26 to 30 years children were getting 5.6 points mean scores in EGRA test (SD 3.6) and in PPVT test 61.2 points (SD 33.5) higher as compared to other age-group of mothers, while Math test 12.4 points (SD 6.9) in aged between 31-48 years. Children who belong to urban areas were found 13 points and 67.7 points higher in Math test (SD 5.9) and PPVT test (SD 31.3) respectively. Whether EGRA test mean scores were 5.2 points (SD 3.2) which was less among urban children. Considering region, mean scores of cognitive outcome were higher among children who belong to Rayalseema and less who belong to

Telangana. Other caste of children were found highest mean scores of Math scores 14.1 points (SD 6.3), EGRA scores 6.1 points (SD 3.6) and PPVT scores 68.6 points (SD 34.4) followed by OBC and SC/ST category. Children who belong to Hindu family were 12.1 points mean scores in Math test (SD 6.5) and 5.4 points EGRA test (SD 3.4) high and PPVT 57.7 points (SD 30.0) less as compared to children who belong to non-Hindu family. Among richest tertile children, mean scores of cognitive outcomes (Math test, EGRA test and PPVT test) were high followed by middle and poor tertile.

Table 4 shows the results of OLS where it found that the effect of breastfeeding on cognitive outcomes. Considering model 1, study only show the effect of duration of breastfeeding on cognitive outcomes, which was found significant at a level of 10 percent significance. Math scores, EGRA scores and PPVT scores were found a coefficient value of 1.76 points, 0.77 points and 8.60 points difference in the score for children who had breastfeed 1 to 6 months and 1.13 points, 0.46 points and 5.39 points difference in the score for children who had 6 to 15 months respectively. In model 2 and model 3, after controlling child characteristics and mother's characteristic coefficient value were decreased respectively, with significant at a level of 10 percent significance. While model 4, socioeconomic characteristics were controlled. Here cognitive outcomes were found insignificant among children who had breastfeed 1 to 6 months, whether Math test as well as PPVT test scores were found significant among children who had complementary breastfeed.

Conclusion

In India, the population is increasing day by day rapidly and because of it the children not getting better care and their faces the problem of development. It has emerged as an important child care and their development issues in developing countries. After followed previous study it found that there was the issue of whether breastfeeding direct influence the child cognitive outcomes or whether this is merely an association with favourable familial socioeconomic factors. Our longitudinal cohort study was in the results of the 8-year follow-up study done in Andhra Pradesh on the relationship between duration of breastfeeding in infancy and various cognitive outcomes such as Math test, EGRA test (Reading and oral test) and PPVT test (Peabody Picture Vocabulary test) at the age of 8 years (Jedrychowski et al. 2012; Whitehouse et al. 2011). The results suggest that cognitive development is multi-factorial and were affected by various socioeconomic & demographic factors. This study revealed that by using longitudinal data, exclusive breastfeeding 1 to 6 months was associated with an average 12.7 points, 5.7 points and 61.6 points higher gain in Math test, EGRA test and PPVT test respectively in comparison with who never or 1 month breastfeeding and who have mixed feeding practices. The results confirm that exclusive breastfeeding in infancy build up cognitive ability in children who were exclusively breastfed. Biologically exclusive breastfeeding and neonatal brain was strongly associated because in breast milk there are omega-β polyunsaturated fatty acids, which are essential components for development (Jing et al. 2010). In addition, the enhanced cognitive development of exclusively breastfeeding children was observed already in the first year of age, but when maternal education, sex of child and other covariates were controlled it appeared to be insignificant, while complementary breastfeeding was found significant at level of 5 percent significance with Math test scores and PPVT test scores. It suggested that birth weight, mother's education, father's education, mother's age, residence, region, caste, religion and wealth tertile were significant covariates of Math test scores. While birth order, mother's education, mother's age and region were significantly associated with EGRA test scores and PPVT test scores associated with sex of child, birth weight, birth order, mother's education, mother's age and region. Similar results were obtained in Der et al. 2006 study who concluded that breastfeeding has little or insignificant effect on a child's intelligence.

While in another study were obtained that in Poland, it showing with consistent and statistically significant increases in IQ assessed at ages 8 and 9 years and reading comprehension, mathematical ability and scholastic ability assessed during the period from 10 years to 13 years. A strong positive relationship was demonstrated between breastfeeding and the Peabody Picture Vocabulary Test Revised (PPVT-R) scores with increased duration of breastfeeding (Jedrychowski et al. 2012). The PPVT-R is a standardized test of receptive language, which has been extensively validated against other standardized tests of intelligence in children and is indicative of verbal

intelligence (Goldman 1993). In conclusion, the results of our study support the WHO recommendations on exclusive breastfeeding (WHO 2001).For various studies and present study it cleared that the cognitive development of children were developed within age 5 to 15 years. Therefore, proper duration of breastfeeding was necessary along with appropriate solid food supplements up to two years of age or beyond.

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Table 1: Percent distribution of sample children by selected background characteristics, Andhra Pradesh, India, 2002.

Background Characteristics	Percentage (%)	Frequency	Sample Size
Residence			
Rural	74.7	1503	
Urban	25.3	508	2011
Region			
Coastal	34.8	700	
Rayalseema	30.1	606	2011
Telangana	35.1	705	
Household type			
Joint	57.9	1164	
Nuclear	42.1	847	2011
Caste			
SC/ST	33.0	663	
OBC	45.9	924	
Other	21.1	424	2011
Religion			
Non-Hindu	12.5	252	2011

Hindu	87.5	1759		
Sex				
Female	46.3	930	2011	
Male	53.7	1081		
Birth size				
Small	24.8	493		
Average	44.9	890	2011	
Large	30.3	601		
Birth weight				
Low	75.8	1525		
Medium	4.9	98	2011	
Heavy	19.3	388		
Mother's education				
Below Primary	60.4	1214	2011	
Above Primary	39.6	797		
Duration of breastfeeding				
Never or less than 1 month	24.1	484		
Exclusive breastfeeding	41.9	843	2011	
Complementary breastfeeding	34.0	684		
Total	**100**	**2011**		

Table 2: Means for duration of breastfeeding of children by selected background characteristics, Andhra Pradesh, India, 2009.

Background Characteristics	Exclusive breastfeeding			
	N	Mean	SD	P value
Child characteristics				
Sex				
Female	930	14.5	4.1	
Male	1081	14.5	4.3	0.728
Birth weight				
Low	1525	14.6	4.1	
Average	98	14.3	4.4	0.382
Heavy	388	14.0	4.7	0.005
Birth size				
Small	493	14.5	4.2	
Average	890	14.9	3.6	0.000
Large	601	14.5	4.2	0.019
Birth order				
1	757	14.0	4.7	
2	761	14.5	4.2	0.025
2+	493	15.1	3.3	0.000
Family characteristics				
Mother's education				
Below Primary	1214	14.9	3.7	
Above Primary	797	13.8	4.8	0.000
Father's education				
Below Primary	980	14.9	3.8	
Above Primary	1031	14.1	4.6	0.000
Mother's age				
Less than 20	604	14.6	4.2	
21-25	911	14.4	4.4	0.303
26-30	386	14.5	4.1	0.677
31-48	110	14.9	3.4	0.398

Mother's age at birth

Less than 20	810	14.5	4.2	
21-25	800	14.4	4.3	0.805
26-30	308	14.4	4.1	0.830
31-48	93	15.1	3.3	0.163
Depression				
No	1440	14.4	4.3	
Yes	571	14.7	4.0	0.073

Continued...

Table 2: Means for duration of breastfeeding of children by selected background characteristics, Andhra Pradesh, India, 2009.

Background Characteristics	Exclusive breastfeeding			
	N	Mean	SD	P value
Socioeconomic & demographic characteristics				
Residence				
Rural	1503	14.7	4.1	
Urban	508	13.9	4.6	0.000
Region				
Coastal	700	13.9	4.9	
Rayalseema	606	14.7	3.9	0.000
Telangana	705	14.9	3.6	0.000
Household type				
Joint	1164	14.6	4.1	
Nuclear	847	14.4	4.3	0.304
Caste				
SC/ST	663	15.1	3.4	
OBC	924	14.5	4.2	0.006
Others	424	13.4	5.2	0.000
Religion				
Non-Hindu	252	14.3	4.4	
Hindu	1759	14.5	4.2	0.412
Wealth tertile				
Poor	670	14.9	3.8	
Middle	678	14.8	3.8	0.676
Rich	658	13.7	4.9	0.000
Social cognitive				
Low	52	15.2	3.3	
medium	99	13.5	5.5	0.048
High	1860	14.5	4.2	0.243

Table 3: Means for Math scores, EGRA scores and PPVT scores of children by selected background characteristics, Andhra Pradesh, India, 2009.

Background Characteristics	Math score			EGRA score			PPVT score		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
Child characteristics									
Duration of breastfeeding									
No or less than 1 month	448	10.9	6.4	452	4.9	3.2	450	53.0	26.8
1 to 6	804	12.7	6.5	809	5.7	3.5	804	61.6	31.4
6 to 15	652	12.0	6.2	654	5.4	3.4	647	58.4	31.1
Sex									
Female	886	11.9	6.4	891	5.5	3.4	884	55.2	28.1
Male	1018	12.1	6.5	1024	5.4	3.4	1017	61.3	32.1
Birth weight									
Average	1441	11.3	6.3	94	5.7	3.4	92	69.7	34.7
Small	94	14.2	6.4	1452	5.2	3.4	1442	55.4	28.9
Large	369	14.5	6.2	369	6.2	3.4	367	67.7	32.7
Birth order									
1	720	12.7	6.3	721	5.9	3.4	719	61.9	31.0
2	721	12.4	6.5	725	5.6	3.3	715	59.5	30.7
2+	463	10.4	6.2	469	4.5	3.1	467	51.7	28.1
Family characteristics									
Mother's education									
Below Primary	1152	10.5	6.2	1160	4.9	3.2	1151	52.9	27.7
Above Primary	752	14.4	6.1	755	6.1	3.5	750	67.0	32.4
Father's education									
Below Primary	927	10.6	6.3	936	5.0	3.3	930	52.5	27.1
Above Primary	977	13.4	6.2	979	5.8	3.5	971	64.3	32.3
Mother's age									
Less than 20	573	11.5	6.1	579	5.2	3.2	578	54.9	27
21-25	869	12.2	6.4	873	5.5	3.4	867	59.7	31.2
26-30	358	12.2	6.7	359	5.6	3.6	354	61.2	33.5
31-48	104	12.4	6.9	104	5.3	3.3	102	58.7	30.1
Socioeconomic & demographic characteristics									
Residence									
Rural	1444	11.7	6.5	1451	5.5	3.4	1442	55.5	29.6
Urban	460	13.0	5.9	464	5.2	3.2	459	67.7	31.3
Region									

Coastal	666	12.1	6.5	672	5.6	3.1	669	57.8	28.6
Rayalseema	574	14.7	6.3	574	6.9	3.6	565	71.6	35.7
Telangana	664	9.6	5.5	669	3.9	2.8	667	48.1	22.2
Caste									
SC/ST	629	10.5	6.3	633	5.2	3.3	630	54.5	27.9
OBC	887	12.2	6.3	894	5.3	3.3	886	56.9	29.4
Others	388	14.1	6.3	388	6.1	3.6	385	68.6	34.4
Religion									
Non-Hindu	228	11.4	6.1	230	5.2	3.4	229	63.9	33.1
Hindu	1676	12.1	6.5	1685	5.4	3.4	1672	57.7	30.0
Wealth tertile									
Poor	634	9.8	6.0	643	4.9	3.1	640	48.7	23.6
Middle	651	12.5	6.3	652	5.7	3.5	647	58.4	29.8
Rich	614	13.8	6.3	615	5.7	3.5	609	68.8	33.8

Table 4: Results for OLS estimates of the effect of duration of breastfeeding on Math score, EGRA score and PPVT score in Andhra Pradesh, India, 2009.			
Duration of breastfeeding	**Math test**	**EGRA test**	**PPVT test**
	β (95% CI)	β (95% CI)	β (95% CI)
Duration of breastfeeding			
Never of less than 1 month®	1	1	1
Exclusive breastfeeding (1 to 6 months)			
Model 1	1.763***(1.024,2.502)	0.775***(0.387,1.163)	8.602***(5.105,12.098)
Model 2	1.394***(0.672,2.116)	0.698***(0.316,1.081)	7.264***(3.835,10.692)
Model 3	0.920**(0.217,1.624)	0.546***(0.164,0.928)	5.711***(2.332,9.09)
Model 4	0.605 (-0.064,1.273)	0.248 (-0.113,0.61)	3.072 (-0.156,6.3)
Complementary breastfeeding			
Model 1	1.135***(0.366,1.904)	0.462**(0.058,0.865)	5.378***(1.733,9.023)
Model 2	1.040***(0.294,1.786)	0.461**(0.064,0.858)	5.318***(1.768,8.869)
Model 3	1.158***(0.434,1.882)	0.481**(0.087,0.875)	5.859***(2.376,9.343)
Model 4	0.707**(0.023,1.392)	0.186 (-0.185,0.558)	3.836**(0.524,7.148)

Note: *** and ** indicates the values at 10% and 5% level of significance. ® represents the reference category of independent variables.

Regression co-efficient (β) is the effect size (SD) per category increase in breastfeeding and complementary breastfeeding.

Math test: Model 1 only duration of breastfeeding considered; Model 2 adjusted for model 1 parameters + birth size, birthweight, birthorder, birth place, Caesaerean delivery; Model 3 adjusted for model 2 + mother's education, father's education, mother's mental status, mother's age; Model 4 adjusted for model 3 + residence, region, wealth tertile.

EGRA test: Model 1 only duration of breastfeeding considered; Model 2 adjusted for model 1 parameters + birthweight, birthorder, birth place; model 3 adjusted for model 3 parameters + mother's education, father's education, mother's age, mother's age at birth, mother's mental status; model 4 adjusted for model 3 parameters + region, household type, caste, wealth tertile.

PPVT test: Model 1 duration of breastfeeding considered; model 2 adjusted for model 1 parameters + sex of child, birthsize, birthweight, birthorder, birth place, caesarean delivery; model 3 adjusted for model 2 parameters + marital status, mother's education, father's education, mother's age, mother's age at birth, mother's mental status; model 4 adjusted for model 3 parameters + residence, religion, wealth tertile.

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