

Breast Milk and Intellectual Development among Preschool Children attending a Rural Family Healthcare Unit, El Bagour District, Menoufia Governorate, Egypt

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Abstract:

Background: There are several potential mechanisms linking breastfeeding with enhanced neurodevelopment in infancy. Breast milk contains long chain polyunsaturated fatty acids which are structural lipids critical for retina and cortical brain development in early life. **Objectives:** The aim of this study was to assess the relationship between breastfeeding and the intellectual development.

Methods: A retrospective study involving 350 preschool children (aged two years and six months till the age of five years) attending Kafr El-Khadra family health unit, El Bagour district, Menoufia governorate, Egypt during the period of data collection (three months). They were subjected to a semistructured questionnaire from the mothers and their intellectual development were assessed using Wechsler Preschool and Primary Scale questionnaire for children 2013 (WPPSI)

Results: This study revealed that out of 350 studied preschool children, 154 children (44%) had an average intelligence quotient (IQ) while 4 children (1.1%) had an extremely low IQ and one child (0.3%) had very superior IQ. There were high statistically significant difference in IQ of studied children as regard exclusivity of breastfeeding and types of feeding either artificially or breast feeding (P value <0.001). Also, this study shows that there was statistically significant association between duration of exclusive breastfeeding and IQ of the studied children (P value <0.001). **Conclusion:** There is a significant association between breast milk and intellectual development of children. Therefore, the support of breastfeeding should be seriously viewed as a major public health issue.

Keywords: Breast milk, intellectual development, Wechsler.

Introduction: Child development is the biological, psychological and emotional changes that occur in human beings between birth and the end of adolescence. It is a continuous process with a predictable sequence which is not a unique course for every child. Development is a broad term that encompasses language, cognitive, and motor, as well as behavioral, social, emotional, and mental health domains.⁽¹⁾

The preschool years continue the dynamic growth of cerebral development begun in the fetal period and infancy.⁽²⁾ The early years of the life present a unique opportunity to lay the foundation for healthy development. It is a time of great growth and vulnerability. Research on early childhood has underscored the impact of the first five years of a child's life on his/her social-emotional

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en's mental health and affect their cognitive, behavioral, social-emotional development.⁽³⁾ There are

possible mechanisms that may explain the association between breast feeding and child neurodevelopment. The breast milk has long-chain polyunsaturated fatty acids (docosahexaenoic acid and arachidonic acid) which help normal retinal and neural development.⁽⁴⁾

Breastfeeding also provides enhanced psychosocial experience for children, such as mother- child interaction, bonding and greater variety of daily stimulations that may contribute to the development of the infant's limbic system and its cortical connections.⁽⁵⁾ Breast feeding also has been linked with enhancement of cognitive development that increased with the duration of breastfeeding.⁽⁶⁾ The link between breastfeeding duration and subsequent development, cognition, educational, mental, psychomotor and behavioral functioning of the infant has been the subject of much scientific inquiry.⁽⁷⁾ The current study is aiming to assess the intellectual function and the relationship between breast feeding and the intellectual development of preschool children attending Kafr El-khadra Family health Unit, El Bagour District, Menoufia Governorate.

Methods:The present study was approved by the Ethics Committee of the Faculty of Medicine, Menoufia University. It was a cross sectional study carried out in the period from (January2016 to March 2018). It included preschool children attended a rural family health unit, EL Bagour district, Menoufia governorate seeking for any medical service (attending with their mother during antenatal care, contraception counseling or for treatment) during the period of data collection.

According to the prevalence of intellectual disability sample size calculation was done and revealed 350 children.

Breastfeeding history that include duration and exclusivity of breast feeding, and weaning history were obtained. The intellectual function was assessed through using Wechsler preschool and primary scale of intelligence questionnaire for children (WPPI).⁽⁸⁾

The Wechsler Preschool and Primary Scale of Intelligence (WPPSI; Wechsler 2012) is an individually administered intelligence test for children, ages 2 years 6 months (2:6) through 7 years 7 months (7:7). The WPPSI-IV provides two age-band subtest batteries for ages 2:6–3:11 and 4:0–7:7. The 2:6-

3:11 battery includes a set of 5 subtests that yield a Full Scale IQ (FSIQ) score, three primary index scores (i.e., Verbal Comprehension Index [VCI], Visual Spatial Index [VSI], and Working Memory Index [WMI]), and three ancillary index scores (i.e., Vocabulary Acquisition Index [VAI], Nonverbal Index [NVI], General Ability Index [GAI]). The 4:0–7:7 battery includes a total of 14 subtests (the five from the 2:6–3:11 and nine additional subtests) that yield the same composite scores as the 2:6–3:11 battery and adds two additional primary index scores (i.e., Fluid Reasoning Index [FRI] and Processing Speed Index [PSI]) and one additional ancillary index score (Cognitive Proficiency Index [CPI]).

Accordingly the participants were divided into two main groups by age: group 1 aged 2.5-3 years (n=200) and group 2 aged from 4-5 years (n=150), group 1 was asked five questions from the questionnaire and group 2 was asked all the questionnaire. The calculation of an IQ score for a child based on their test performance depends on their age ⁽⁸⁾, The various quotient and Composite scores have a mean of 100 and a standard deviation of 15. Subtest scaled scores have a mean of 10 and a standard deviation of 3. For Quotient and Composite scores: below 70 is Extremely low IQ, 70-79 is Borderline, 80-89 is Low Average IQ, 90-109 is Average IQ, 110-119 is High Average IQ, 120-129 is Superior, 130+ is Very Superior IQ.

When compared with other available instruments for younger children, the WPPSI-IV is primarily designed to measure cognitive development in detail, whereas the Bayley Scales of Infant and Toddler Development, Third Edition, (Bayley-III; Bayley 2005) is designed to assess the development of children without assessing cognitive development in depth. The Kaufman Assessment Battery for Children, Second Edition (KABC-II), does not provide as many separate composite scores at age 3. The processing speed confound in portions of the KABC-II is not present in the WPPSI-IV. The WPPSI-IV also extends to a lower age range than the KABC-II.

A pilot study was performed on ten children who attended the primary health care clinic and they weren't included in the study. Some useful modification was done in the questionnaire format. The language of some questions of the questionnaire was modified to be understandable.

Data Management: The data were tabulated and analyzed by statistical package of social science program (IBM Inc. Chicago, IL), version 23 using a personal computer. Qualitative data were expressed as number and percentage and analyzed by using χ^2 -test. *P* value less than 0.05 was considered significant.

Ethical Considerations: Written consent was obtained from the mother's of the participated child after explaining the aims and benefits of the study through personal interviews; subsequently, they were administered a structured questionnaire. Refused children, children with hearing and vision impairment, congenital anomalies, chromosomal and / or genetic disease chronic illness and with neurological diseases were excluded from the study.

Results: This study revealed that out of 350 studied preschool children, 312 (89%) were breast fed (**figure 1**), 154 child (44%) had an average intelligence quotient (IQ) while 4 children (1.1%) had an extremely low IQ and one child (0.3%) had a very superior IQ (**figure 2**). There was high statistically significant difference in IQ of studied children as regard exclusivity of breastfeeding (*P* value <0.001), as 47.9% of children exclusive breast feeding had an average IQ while 41% of not exclusively breast fed children had low average IQ (**figure 3**).

There was a highly statistically significant association between exclusivity of breastfeeding and IQ of the studied children (*P* value <0.001), as 47.9% of exclusively breastfed children had average IQ, while 31.3% of non-exclusively breastfed children had an average IQ (**table 1**). Duration of exclusive breastfeeding had a statistical significant association with IQ of the studied children (*P* value <0.001), as 61.1% of children exclusively breastfed for six months or more had above average IQ while 7.8% of children exclusively breastfed for three months had above average IQ (**table 2**).

Discussion: This cross-sectional study included 350 preschool children attended a Kafr El-khadra family health unit, El-Bagour district, Menoufia governorate. The number of exclusively breast fed preschool children was 267, about half of them were exclusively breastfed for six months while one third were breastfed for two to three months only. This finding is in agreement with a study conducted in Krakow in Poland by Jedrychowski *et al.*⁽⁹⁾ which revealed that 32.9% of babies in the study received both breast milk and formula since birth (mixed

breastfeeding), 67.1% mothers reported exclusive breastfeeding over different lengths of time.

On the contrary a study conducted in Brazil by Eickmann *et al.*⁽¹⁰⁾ who found that a few infants were never breast fed, at 1 month, 65% were fully breastfed, 26% were partially, and 9% were non-breast fed. At 6 months, 26% were fully breastfed, 25% were partially, and 49% were non-breastfed. This study also showed that most of the studied children (44%) had average IQ, (1.1 %) had an extremely low IQ and one child (0.3%) had very superior IQ.

Regarding exclusivity of breastfeeding, there was a highly statistically significant difference in Intelligent Quotient (IQ) of studied children about (47.9%) of children exclusively breast fed had average IQ compared to (41%) of not exclusively breastfed had low average IQ. This result was in agreement with a study which was conducted in Krakow in Poland by Jedrychowski *et al.*⁽⁹⁾ which revealed that exclusive breastfeeding affect IQ in toddlers positively, even if the time period of exclusive breastfeeding is short.

This may be attributed to the association between breastfeeding and child cognitive function since breastfeeding may be an indicator of a safe and sound maternal attachment status, which has been shown to have a positive influence on the child's psychological development into later age also the differences in brain electrical activity between breastfed and milk-formula-fed infants could have been influenced by omega-3 polyunsaturated fatty acids that are normally present in breast milk or other bioactive components essential for development.

This was against study which was conducted in India by Veena *et al.*⁽¹¹⁾ who found that there were no significant associations between the age at starting complementary foods and any of the cognitive measures. This may be attributed to that they failed to detect an effect because of a lack of heterogeneity in breastfeeding duration in their population. Also if the first 6 months of life is a critical period in which breastfeeding can influence cognition, they may have had inadequate power to detect this because almost all their children were breast-fed during that time.

Regarding type of feeding, there was a highly statistically significant difference between IQ of breastfed and artificially fed children, as about (47.1%)

of breastfed children had average IQ, compared to (18.4%) of artificially fed children had average IQ. This result was in line with study which was conducted in the United States of America by Jiang *et al.*⁽¹²⁾ who found that breast fed children had higher scores on Woodcock Johnson Psycho-Educational Battery-Revised(WJ-R) and Wechsler Intelligence Scale for Children-Revised (WISC-R).

This may attributed to that babies who are not breastfed are more prone to infectious illnesses than breastfed babies, which may have an adverse impact on their social and cognitive development. Furthermore, breastfeeding could lead to more mother–baby interaction, thus improving the readiness and ability to learn and develop in a social setting. This result was in disagreement with study which was conducted in United Kingdom by Holme *et al.*⁽¹³⁾ who found that breast feeding were not affect IQ. This may be attributed to a strong consideration, however, must be the confounding factors of maternal intelligence and education. There is a known association between maternal intelligence and both the initiation and duration of breastfeeding and ‘breast-milk fed are more intelligent than bottle-fed children because their mothers were also more so.

In the present study there was a statistically significant association between duration of exclusive breastfeeding and IQ of the studied children. This was similar to study which was conducted in Denmark by Michaelsen *et al.*⁽¹⁴⁾ who found that the effect of breastfeeding on cognitive development was supported by a significant dose-response effect, with better cognitive development with increased duration of breastfeeding.

A plausible explanation is the differences in composition between human milk and infant formula, e.g. differences in n_3 fatty acids, especially docohexanoic acid (DHA). Long chain poly unsaturated fatty acids (LCPUFAs), especially DHA are major components of cell membranes in the central nervous system and retina. Several lines of evidence suggest that cellular functions are affected by the lipid composition of cell membranes. Another possibility is that mothers who choose to breast-feed on average stimulate and support their infants better than mothers who formula-feed.

On the contrary a study conducted in Brazil by Eickmann *et al.*⁽¹⁰⁾ who found that full breast feeding at one month was associated with a small significant

benefit in mental development compared with partial or no breast feeding, no additional advantage in mental development was found with longer durations of full breastfeeding.

A possible explanation is that why some studies find an effect and others do not is unclear, but differences in methodological robustness and types of tests used are likely to be contributory, at least in part. Differences in vulnerability to poor cognitive development of the populations studied may also be important, and one may speculate that the reason they found a benefit is that their study population had multiple disadvantages.

Study Limitation: Difficulties in data collection because of forgetting the details of breastfeeding history by mothers and uncooperation of some children represented study limitations.

Conclusion: Breast milk had an important role in intellectual development of children, however, there were potential confounders affecting intellectual development of children such as maternal education, maternal working status and socio-economic level. The support of breastfeeding should be seriously viewed as a major public health issue.

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Conflict of interests: We confirm that there are no known conflicts of interest associated with this publication.

References:

1. Toga AW, Thompson PM and Sowell ER "Mapping brain maturation" Trends Neuroscience 29 (3):2015, 148-159.
2. Center for Disease control and prevention Breastfeeding Report Card, United States. Aq2http:// www .cdc .gov / breastfeeding/ pdf / breastfeeding report card. Accessed at 28 October 2018.
3. Shonkoff JP , Phillips DA, and Washington DC National academies National Research Council and Institute of Medicine, Committee on Integrating the Science of Early Childhood Development. From Neurons to Neighborhoods: The Science of Early Childhood Development 2010.

4. Colen, Cynthia G., and Ramey and David M Is breast truly best? Estimating the effects of breastfeeding on long-term child Health and wellbeing in the United States using sibling comparisons." *Social Science and Medicine*.2014, (109) 55-65.
5. Innis SM Human Milk maternal dietary lipids and infant development. *Proc Nutr Soc* 2007, (66) 397-404.
6. Horwood LJ, Darlow BA and Mogridge N Breastfeeding and cognitive abilities at 7-8 years, *Arch Dis Child Fetal Neonatal Educ*2010,(84) 23-27.
7. Wendy H. Oddy, Jiang hong Li, Monique Robinson and Andrew J.O. White house The Long-Term Effect of Breastfeeding on Development, *Contemporary Pediatrics*, Dr. Öner Özdemir (Ed.), 2012, 978-953.
8. Warschausky S., Raiford S.E. Wechsler Preschool and Primary Scale of Intelligence. In: Kreutzer J.S., DeLuca J., Caplan B. (eds) *Encyclopedia of Clinical Neuropsychology*. Springer, Cham (2018) Accessed at 20 September 2018.
9. Jedrychowski W ,Perera F , Jankowski J, Butscher M ,Mroz E , Flak E, et al Effect of exclusive breastfeeding on the development of children's cognitive Function in the Krakow prospective birth cohort study *Eur J Pediatr* 2011.
10. Eickmann SH, de Lira PI, Lima Mde C, Coutinho SB, de Lourdes Perez M and Ann Ashworthc Breast feeding and mental and motor development at 12 months in a low-income population in northeast Brazil. *Paediatr Perinat Epidemiol*; 2007, (21)129–137.
11. Veena SR, Krishnaveni GV, Srinivasan K, Wills AK, Hill JC, Kurpad AV et al: Infant feeding practice and childhood cognitive performance in South India, *Arch Dis Child*. 2010 May; 95(5): 347–354.
12. Jiang M, Foster EM and Gibson-Davis CM Breastfeeding and the child cognitive outcomes: a propensity score matching approach. *Maternal Child Health J* 2011 (15) 1296–307.
13. Holme A, MacArthur Cand Lancashire R The effects of breastfeeding on cognitive and neurological development of children at 9 years. *Child Care Health Dev* 2010,(36)583–90

14. Michaelsen KF, Lauritzen L, Jorgensen MH and Mortensen EL Breastfeeding and brain development, *Scandinavian Journal of Nutrition* 2014; 47 (3): 147 - 151.

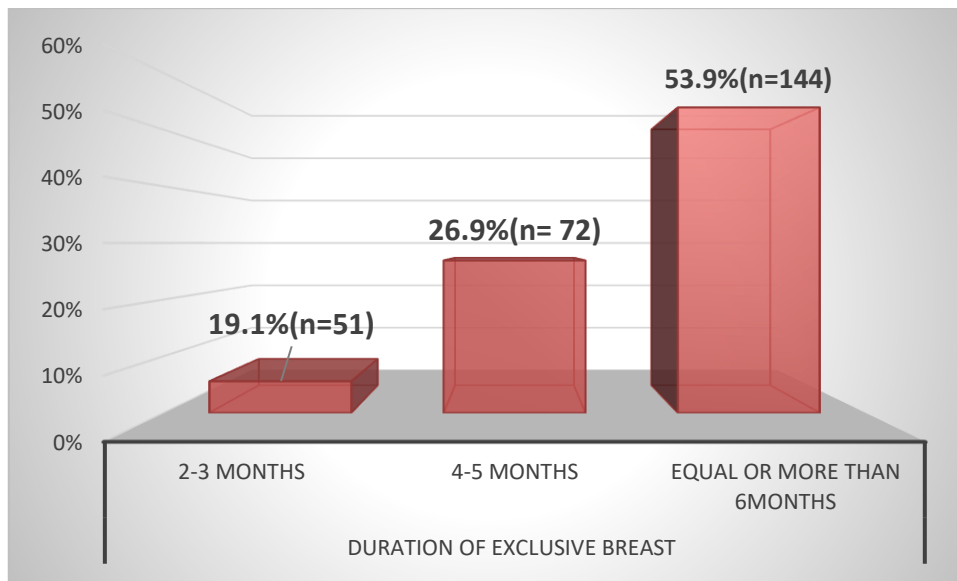


Figure (1): Duration of exclusive breast feeding among the studied participants:

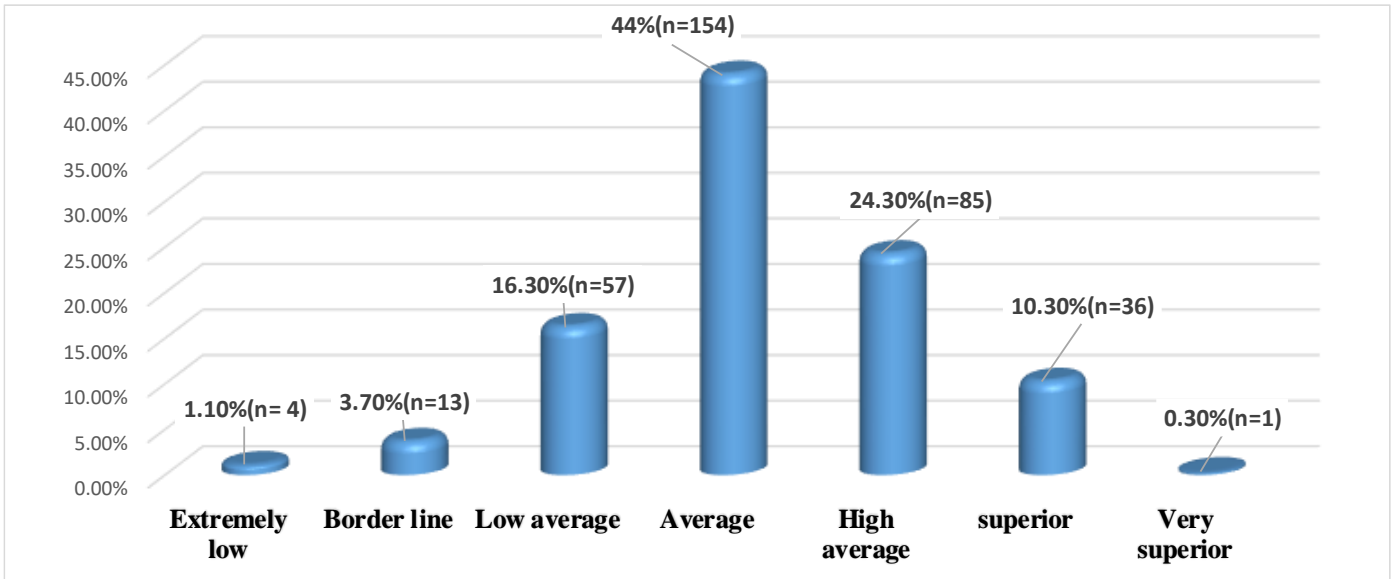


Figure (2): Intelligent Quotient (IQ) of the studied children calculated by Weschler preschool and primary scale of intelligence (WPPSI):

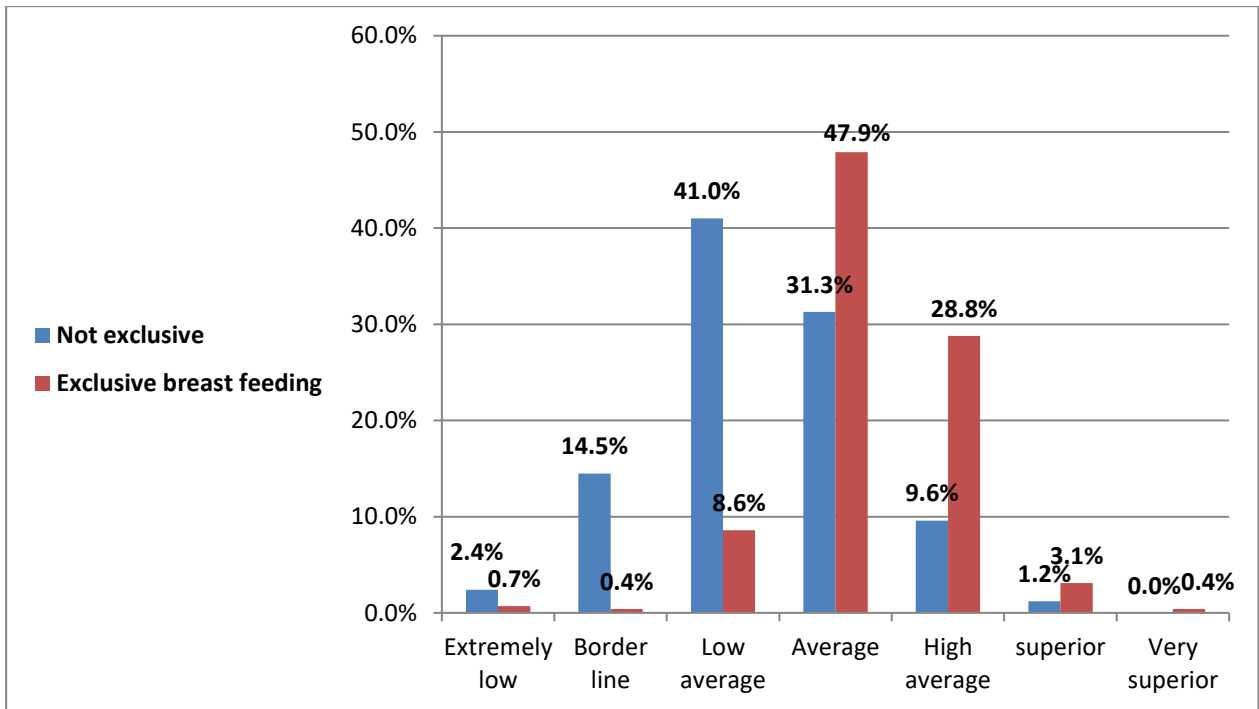


Figure (3): Difference in IQ between studied children with exclusive and nonexclusive breast feeding.

Table (1): Relationship between types of feeding either artificially or breastfeeding and IQ among the studied children:

Items	Not Exclusive breast fed		Exclusive breast fed		χ^2	p-value
	No	%	No	%		
	83	23.7	267	76.3		
Intelligent quotient						
▪ Below average	48	57.8	26	9.7	91.240	<0.001
▪ Average	26	31.3	128	47.9		
▪ Above average	9	10.8	113	42.3		

*Fischer exact test

* P-value < 0.001 is highly significant

Table (2) Duration of exclusive breastfeeding and IQ of the studied children:

Items	2-3 months		4-5 months		≥ 6 months		χ^2	p-value
	No	%	No	%	No	%		
	51	19.1	72	27	144	53.9		
Intelligent quotient								
▪ Below average	9	17.6	7	9.7	10	6.9	51.513	<0.001
▪ Average	38	74.5	44	61.1	46	31.9		
▪ Above average	4	7.8	21	29.2	88	61.1		

* P-value < 0.001 is highly significant

الملخص العربي

لبن الام والتطور الفكري بين الاطفال فى مرحلة ما قبل المدرسة المترددين على وحدة صحة أسرة كفر الخضرة-مركز الباجور-محافظة المنوفية-مصر

صفاء عبد الفتاح بدر- فاطمه احمد السرجاني – رانيا اسماعيل أحمد

الخلفية العلمية: تطور الطفل هو التغيرات البيولوجية التي تطرأ عليه فى الفترة من الولادة وحتى نهاية المراهقة كما ان سنوات ما قبل المدرسة هى الفترة التي يكتمل فيها التطور المخى الذى بدأ فى مرحلة الطفولة المبكرة. هناك عدة آليات تقسر العلاقة بين الرضاعة الطبيعية والتطور الفكري للطفل حيث ان لبن الام يحتوى على سلسلة من الاحماض الدهنية غير المشبعة التي تساعد على التطور الطبيعي للمخ . توفر الرضاعة الطبيعية ترابط نفسى-اجتماعى وتفاعل بين الام والطفل والعديد من التحفيزات اليومية التي تساهم فى تطور الجهاز الحوفي والاتصالات القشرية للطفل. **الاهداف:** هدفت الدراسة الى تقييم التطور الفكري للاطفال ما قبل المدرسة وتقييم العلاقة بين الرضاعة الطبيعية والتطور الفكري فى مجموعة الاطفال الخاضعة تحت الدراسة المترددين على وحدة صحة أسرة كفر الخضرة-مركز الباجور-محافظة المنوفية. **المنهجية وطرق البحث:** اجريت دراسة مرجعية على 350 طفل خلال الفترة من بداية يناير 2016 حتى نهاية مارس 2016 و تم جمع البيانات من خلال استبيان تم تحديده ويتكون من ثلاثة أقسام البيانات الاجتماعية الديموغرافية للمشاركين , تاريخ الرضاعة الطبيعية وتقييم التطور الفكري من خلال استبيان وكسلر لذكاء الأطفال. **النتائج:** كشفت النتائج أن 89% من الاطفال رضعوا رضاعة طبيعية , حاصل الذكاء لدى 44% متوسط و لدى 1,1% منخفض للغاية و طفل واحد حاصل ذكائه متفوق جدا. هناك دلالة احصائية عالية بين حاصل ذكاء الاطفال و الرضاعة الطبيعية الحصرية و نوع الرضاعة سواء كانت طبيعية او صناعية . يوجد دلالة احصائية عالية بين مدة الرضاعة الطبيعية و حاصل ذكاء الاطفال الخاضعين للدراسة. **الخلاصة و الاستنتاجات:** هناك ارتباط كبير بين لبن الأم و التطور الفكري للأطفال لذا يجب النظر بجدية الى دعم الرضاعة الطبيعية كقضية حيوية تستحق الاهتمام بها .