

Long-Term Effect of Breastfeeding in Preschooler's Psychomotor Development

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Abstract—Background: Breast milk may impact early brain development, with potentially important biological, medical and social implications. There is an important discussion on which is the adequate breastfeeding extension to the development consolidation and how the children breastfeeding affects their psychomotor development, in the first year of life, and in following periods as well. Some special fats (LC PUFA) contained in breast milk play a key role in the brain's maturation and cognitive development or social skills. These capacities created during breastfeeding time would be unfolded throughout all lifespan.

Aim of the study: In our research, we have studied the effect of breastfeeding in preschooler's psychomotor assessment.

Method: This study was conducted in a sample of 158 preschool children in Vlorë, Albania. We have measured the psychometric parameters of preschoolers with ASQ-3 (Age&Stage Questionnaires-3). The studied sample was divided in three groups according to their breastfeeding duration (3, 6 and 12 months).

Results: Children breastfed for only 3 months have definitely lower psychometric scores compared to the ones with 6 or more months of breastfeeding (respectively 217 to 239 ASQ-3 scores). Six and twelvemonth breastfed children have progressively more odds to have high levels of psychomotor development comparing to those with only 3 months of breastfeeding. The most affected psychometric domains by shortness of breastfeeding are Communication and Global motor.

Conclusion: This leads to conclusion that to ensure high psychomotor parameters during childhood is necessary breastfeeding for at least 6 months.

Keywords—Breastfeeding, preschoolers, psycho-motor development, psycho-motor domains.

I. INTRODUCTION

RELATIONSHIP between duration of breastfeeding and resultant mental functions, psychomotor and child's behavior has been the subject of many researches. Many studies have found impressive results in the relative advantages that breastfeeding can offer in the child psychomotor development [1], [2]. According to them breastfed children for 6 months or more were less likely to have behavioral problems during childhood and adolescence, 2-14 years. Some studies suggest that breast-feeding for longer than 4 months has a positive effect on the baby's mental development measured at 18 months of age [3], otherwise other researchers found no clear association between duration of breast feeding and motor development at 13 months or 5

years of age [4]. These studies have also found that some psychomotor domains are more sensitive to the duration of breastfeeding, of which the most prominent are Communication and Adaptability. Global motor domain was found to be less sensitive to the duration of breastfeeding. These results also support findings from a New Zealand cohort study that demonstrated benefits for infants breastfed for four months or longer in the domains of intelligence, comprehension and expression [5]. One interesting finding was the gradual improvement of children psychomotor scores with increasing age, which suggested that the risk created by the short duration of breastfeeding is gradually reduced due to the increasing role of other social and familiar factors. Another study [6] suggests that breastfeeding for a long time and exclusively is associated with significant increase of the intellectual coefficient development of children (IQ) at age 6 years and that breastfeeding less than 4 months is associated with the lower scores in psychomotor development in the early years of children's lives. Several studies [7]-[9] have shown that there are some precious fats in breast milk (LC PUFA) which are taken from the children during the first months of life and ensure that they has a higher intelligence coefficient at age 7-8 years, than formula fed children.

Breastfeeding may have a positive effect on mother-child interaction as well, facilitating connection between them, and consequently indirectly impacting the psychomotor development. It is recommended that the impact of breastfeeding on parenting, its effect on to cognitive development, behavior, and social adaptation during infancy and beyond should also be emphasized during the promotion of breastfeeding and early childcare [10].

II. AIM OF THE STUDY

This research has assessed how the preschooler's psychomotor development could be affected by breastfeeding duration.

III. MATERIAL AND METHOD

A. Final Population

A sample of 158 preschool children enrolled in 3 public kindergartens in Vlora, Albania was chosen for conducting this research. The research's population was divided in three groups according to their breastfeeding extension (3, 6 and 12 months).

The psychometric parameters in five domains (Communication, Global motor, Fine motor, Problem solving,

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Personal-social) were assessed for each group of children and a statistical analysis was made to evaluate the differences.

B. Exclusions from the Study

Children with genetic syndromes, sensory handicaps, or diagnosed mental delays were excluded from the study population.

C. Ethical Issues

Ethical consensus was required from the preschool institutions and from the tested children parents. Clarification of the importance of children psycho-motor assessment, potential benefits they could have from it, and provide assurances for anonymity as well, helped not to have obstacles in getting this consensus.

D. Description of Used Instruments

Measurement of psychometric parameters was made by the international standardized test ASQ-3 [11], referred to the chronological age of the children.

The Age & Stage Questionnaires-3 is specified for different age groups, and its scoring is distributed according to the standard deviations in under the cut-off, near to the cut-off and below the cut-off.

- The area above the cut-off is considered normal area (typical development) - child development seems normal and he does not need any sort of supplementary instruction.
- The area near the cut-off is considered a monitoring area - the child must be provided with educational activities and must be monitored.
- The area under cut-off is considered the reference area (atypical development) - development of the child is below the age group and may need professional assistance (development pediatrician, special educator).

ASQ-3 scores taken from children ranged from a minimum of 140 points to a maximum of 300 points, and to better understand the level of psycho-motor development of the studied children the achieved scores are grouped in 3 levels:

- low level = 141-200 ASQ-3 scores
- middle level = 201-250 ASQ-3 scores
- high level = 252-300 ASQ-3 scores

Tests were conducted at the premises of the institutions frequented by children. Most of the tasks of the age group were demonstrated directly by the children, and information about the rest of tasks was taken from the reports of educators or caregivers. To avoid variation of the measuring instrument, all psychometric measurements were conducted during the morning and from 9:00 to 11:00, from the same person.

E. Statistical Analysis

Statistical analyze was conducted with the Statistical Package for Social Sciences (SPSS Statistical Package for Social Sciences, version 17, Inc., Chicago, Illinois). Differences between variables were analyzed through the test of Fisher. Relationships between variables were analyzed by the technique of correlation using the Pearson coefficient (Wessa P. 2012 Pearson Correlation (v1.0.6) in Free Statistics

Software (v1.1.23-r7). The odds rates (OR), confidence intervals (95%) and the p-values across different groups were calculated and are presented in the table. It was considered statistically significant P values <0.05.

IV. RESULTS AND DISCUSSION

In this study were evaluated 74 females and 84 male children from 36 to 66 months.

A. The Average of Children's Psychomotor Development

The average of psychomotor development in these children was found at 227 ASQ-3 scores from 300 scores in maximum. Children breastfed for only 3 months have an average ASQ-3 scoring of 217 scores, whereas the ones breastfed for 6 or 12 months have the average of 236 to 239 in 300 ASQ-3 scores (Table I).

TABLE I
THE AVERAGE OF PRESCHOOLERS' PSYCHOMOTOR DEVELOPMENT

Duration of breastfeeding	Number of children	Average of development in ASQ-3
till 3 months	53	217
till 6 months	44	236
till 12 months	61	239
total	158	227

No significant improvements in ASQ-3 scores are shown from children breastfed for 12 months comparing to those breastfed till 6 months. The minimal necessary duration of breastfeeding is reported differently in various researches [1]-[3], [12]. In these researches the minimal duration of breastfeeding time has been found 3, 4 or 6 months, but no more than 6 months, although it is recommended repeatedly that breastfeeding should continue as long as possible. The present study showed that the average psychomotor development depends on breastfeeding duration up to 6 months. The impact of the breastfeeding extension after this period in psychomotor developmental level is not significant. This minimal 6 months period could be related with impact of long-chain polyunsaturated fatty acids (LC-PUFA) taken by breast milk on infant brain maturation. In a previous study [13] is underlined that if breast-feeding is accompanied by more rapid or better development of neurologic function, it may be because breast milk provides nutrients required for rapid development of the immature brain. Human breast milk may support neurologic development by providing long-chain polyunsaturated fatty acids (LCPUFAs) such as docosahexaenoic acid. Docosahexaenoic acid is a conditionally essential nutrient for adequate neurodevelopment in humans. The effect is mediated not only by the known effects on membrane biophysical properties, neurotransmitter content, and the corresponding electrophysiological correlates but also by a modulating gene expression of the developing brain. Intracellular fatty acids or their metabolites regulate transcriptional activation of gene expression during adipocyte differentiation and nervous system development [14].

B. The Evaluation of Psychometric Domains

Communication is one of the most affected psychometric domain (Table II) with 26% delays in the first group of study (preschoolers which are breastfed for 3 months at maximum), and 16% psychomotor delays in second and third group (preschoolers which are breastfed for 6 and 12 months). Likewise, Global motor domain has shown significant difference between the children of the first group and two other groups. 47% of children in the first group (breastfed until 3 months) were found to be in the reference area (under cut off). In the two other groups, these percentages were found 8-10%. These results are not consistent with previous study which found no clear association between duration of breast feeding and motor development at preschool age [4], [15]-[19]. The other psychometric domains (Fine motor, problem solving, and personal-social) have demonstrated no significant changes (Table II). The percentages of delays in Fine motor domains seem to be increased and other two domains show no differences.

TABLE II
THE PERCENTAGES OF PSYCHOMETRIC DELAYS IN EACH PSYCHOMOTOR DOMAINS

Duration of Breastfeeding	Communication	Global Motor	Fine Motor	Problem Solving	Personal-Social
till 3 months	26	47	15	31	43
till 6 months	16	8	27	24	43
till 12 months	16	10	30	33	44

The data of present study are partially supported from the conclusions of previous studies [1], [2] which has found that some psychomotor domains are more sensitive to the breastfeeding extension, of which the most prominent are communication and adaptability. These studies found that infants breastfed for 4 months or longer had significantly higher mean scores (representing better functioning) for fine motor skills at age 1 and 3, significantly higher adaptability scores up to age two, and higher communication scores at age 1 and 3 years.

C. The Evaluation of Children Psychomotor Level and Typical Development

There is a significant improvement in the psychomotor development scores in children who were breastfed for 6 months (36% of them have high level of psychomotor development) comparing to those who were breastfed for only 3 months (only 17% of them have high level of psychomotor development). This trend doesn't continue in the third group with 12 months breastfeeding duration (where 40% of children have high level of psychomotor development) (Table III). However, the number of children without any delay in psychometric domains (children with typical development) is continued to be raised in the group of children breastfed up to 12 months (from 41% of children without psychomotor delays in 6 months breastfed group to 48% of 12 months breastfed children).

Increasing duration of breastfeeding from 6 to 12 months has not shown any significant improvement in the number of

psychomotor delays. The number of psychometric domains under the cut off is significantly high among children breastfed until 3 months, compare to them breastfed until 6 months (respectively in the first group 70% of children have ≥ 2 psychometric domains under the cut off, to 45% of second group's children who have ≥ 2 psychometric delays). There are no important changes between second group (children breastfed until 6 months) and third group (breastfed until 12 months) which has 41% of children with ≥ 2 psychometric domains under the cut off.

TABLE III
PSYCHOMETRIC DELAYS AND PRESCHOOLER'S PSYCHO-MOTOR DEVELOPMENT LEVELS

Psycho-motor levels according to ASQ-3 scores	Duration of breast-feeding		
	3-months	6-months	12-months
141-200	29	14	10
201-250	15	14	26
251-300	9	16	25
0 delays	17%	36%	40%
	13	18	29
	25%	41%	48%
≥ 2 delays	37	20	25
	70%	45%	41%

TABLE IV
THE STATISTICAL DATA ON DIFFERENT BREASTFEEDING PERIOD

	Odds Ratio	95% CI	P-value
Preschoolers with low/high psychomotor levels, breastfed for 3/6 months	3.6825	1.3065-10.3797	0.0137
Preschoolers with low/high psychomotor levels, breastfed for 3/12 months	8.0556	2.8262-22.9612	0.0001
Preschoolers with 0/ ≥ 2 delays, breastfed for 3/6 months	2.5615	1.0444-6.2823	0.0399
Preschoolers with 0/ ≥ 2 delays, breastfed for 3/12 months	3.3015	1.4426-7.5558	0.0047

Previous researches [1], [2] have found that infants who were breastfed for <4 months were more likely to have at least one atypical score across the five developmental domains than those who were breastfed for 4 months or longer.

As it is shown in Table IV, the odds of having high psychomotor level are 3.6 higher in 6 months breastfeeding children than in 3 months breastfeeding ones, and 8.05 higher in 12 months breastfeeding children. Meanwhile the number of psychomotor delays doesn't seem to have an important improvement after 6 months of breastfeeding. In general, the difference between psychomotor development among children breastfed for only 3 months and at least 12 months has a notable statistical significance (p-value 0.0001 and 0.0047).

In the three parameters taken into account (high psychomotor score level; children with typical development (0 delays); children with ≥ 2 delays) is observed the same phenomenon: the improvement from children breastfed until 3 months to them breastfed until 6 months is significant, and there is little improvement from the 6 months breastfed children to the 12 months breastfed ones. This study has also shown (Table I) that there are no significant improvements in average ASQ-3 scores taken from second group of children (breastfed for 6 months) comparing to average ASQ-3 scores

taken from the third group (those breastfed till 12 months). These results go in support to the conclusion that to have a typical psychomotor development, the minimum time of breastfeeding is 6 months, and there is a slight improvement if the breastfeeding continues for more time.

This is a widely supported these as many previous larger researches [20]-[34] in various communities in developed countries, using a number of developmental tests, which have underlined the relationship between breastfeeding and positive psychosocial outcomes for children.

V. CONCLUSION

Breastfeeding has long-term consequences on child psychomotor development. A period of 3 months in breastfeeding is insufficient to ensure the high quality of child development. The children should be breastfed for at least 6 months to ensure the necessary brain maturation for the development of psychomotor skills in later life.

The most sensitive psychometric domains resulted Communication and Global Motor. Other domains have demonstrated no difference with the duration's change of breastfeeding.

REFERENCES

- [1] The long-term effects of breastfeeding on child and adolescent mental health: a pregnancy cohort study followed for 14 years. Oddy WH, Kendall GE, Li J, Jacoby P, Robinson M, de Klerk NH, et al. 2009, *J Pediatr*, pp. 156: 568–74. doi: 10.1016/j.jpeds.2009.10.020. Epub 2009 Dec 14.
- [2] "Breastfeeding and early child development: a prospective cohort study". Wendy H. Oddy, Monique Robinson, Garth E. Kendall, Jianghong Li, Stephen R. Zubrick, Fiona J. Stanley. 2011, *Acta Paediatrica* ISSN 0803-5253, pp. doi:10.1111/j.1651-2227.2011.02199.x.
- [3] Influence of breast-feeding on mental and psychomotor development. Gómez-Sanchiz M, Cañete R, Rodero I, Baeza JE, Avila O.s.l.: *ClinPediatr (Phila)*, 2003. 42(1):35-42. PMID: 12635980.
- [4] Breast feeding and cognitive development at age 1 and 5 years. Angelsen NK, Vik T, Jacobsen G, Bakkeiteig LS.s.l.: *Arch Dis Child.*, 2001. 85(3):183-8. PMID: 11517096.
- [5] Breast-feeding and alcoholism: the Trotter hypothesis. Goodwin DW, Gabrielli WF Jr, Penick EC, Nickel EJ, Chhibber S, Knop J. 1999, *Am J Psychiatry*, pp. 156 (4):650-2.
- [6] Breastfeeding and child cognitive development: new evidence from a large randomized trial. Kramer MS, Aboud F, Mironova E, Vanilovich I, Platt RW, Matush L, Igunnov S, Fombonne E, Bogdanovich N, Ducruet T, Collet JP, Chalmers B, Hodnett E, Davidovsky S, Skugarevsky O, Trofimovich O, Kozlova L, Shapiro S. 2008, *Arch Gen Psychiatry.*, pp. 65(5):578-84. doi: 10.1001/archpsyc.65.5.578.
- [7] Breastfeeding, Long-Chain Polyunsaturated Fatty Acids in Colostrum, and Infant Mental Development. Mònica Guxens, Michelle A. Mendez, Carolina Moltó-Puigmartí, Jordi Julvez, Raquel García-Esteban, Joan Forns, Muriel Ferrer, Martine Vrijheid, M. Carmen López-Sabater, Jordi Sunyer. 2011, *Pediatrics*, pp. VOLUME 128 / ISSUE 4, retrieved from <http://pediatrics.aappublications.org/content/128/4/e880>.
- [8] Mjeshhtëria e nënës - A dimë ta ushqejmë krijesëntonë? Tushe Edi et al. 2000.
- [9] The role of polyunsaturated fatty acids in term and preterm infants and breastfeeding mothers. WC, Heird. 2001, *PediatrClin North Am.*, pp. 48(1):173-88.
- [10] Effect of breast feeding on child development: Tasnim, Saria. 2014, *South East Asia Journal of Public Health*, p. DOI: <http://dx.doi.org/10.3329/seaiph.v4i1.21831>.
- [11] Ages & Stages Questionnaires – A parent-Completed Child Monitoring System, third edition. Psychometric studies of ASQ. Squires Jane, Ph.D, Twombly Elizabeth, M.S., Bricher Diane, Ph.D, Potter LaWanda, M.S., 2009, p. retrieved from http://agesandstages.com/pdfs/asq3_technical_report.pdf.
- [12] Exclusive Breastfeeding and Developmental and Behavioral. Olof H. Jonsdottir, Inga Thorsdottir. s.l.: *Nutrients*, 2013. 5, 4414-4428; doi:10.3390/nu5114414.
- [13] Breast-feeding and cognitive development: a meta-analysis. James W Anderson, Bryan M Johnstone, and Daniel T Remley. s.l.: *American Society for Clinical Nutrition*, 1999. vol. 70 no. 4 525-535.
- [14] Essential fatty acids in early life: structural and functional role. Uauy R, Hoffman DR, Peirano P, Birch DG, Birch EE. s.l.: *Lipids.*, 2001. Sep; 36(9):885-95. PMID: 11724460.
- [15] Influence of breast-feeding on the infant's intellectual development. Temboury MC, Otero A, Polanco I, Arribas E (1994) *J Pediatr GastroenterolNutr* 18:32–36.
- [16] Infant feeding and mental and motor development at 18 months of age in first-born singletons. Florey C du, Leech AM, Blackhall A (1995) *Int J Epidemiol* 24:S21–S26.
- [17] Duration of breast-feeding and Bayley's mental developmental index at 1 year of age. Paine BJ, Makrides M, Gibson RA (1999) *JPediatr Health* 34:82–85.
- [18] Duration of breastfeeding and developmental milestones during the latter half of infancy. Vestergaard M, Obel C, Henriksen TB, et al. (1999) *Acta Paediatr* 88:1327–1332.
- [19] Lianne J. Woodward, P. K., Breastfeeding, and Child Psychosocial Development. *Encyclopedia on Early Childhood Development*. 2nd edition, 2008. retrieved from: <http://www.child-encyclopedia.com/breastfeeding/according-experts/breastfeeding-and-child-psychosocial-development>.
- [20] Emla Fitzsimons, M. V.-h. Food for the Brain? Breastfeeding and Child Development. CiteSeerX. 2013, retrieved from: <http://cep.lse.ac.uk/seminarpapers/28-06-13-MV.pdf>.
- [21] Breast-feeding and later cognitive and academic outcomes. Horwood J, Fergusson D (1998) *Pediatrics* 101:e9.
- [22] Association between breast feeding, child development and behaviour. Golding J, Rogers IS, Emmett PM (1997) *Early Hum Dev* 49:S175–S184.
- [23] Feeding in infancy and later ability and attainment: a longitudinal study. Rodgers B (1978) *Dev Med Child Neurol* 20:421–426.
- [24] Breast feeding and cognitive development in the first 7 years of life. Fergusson DM, Beautrais AL, Silva P (1982) *SocSci Med* 16:1705–1708.
- [25] Breast-feeding and child development at 5 years. Taylor B, Wadsworth J (1984) *Dev Med Child Neurol* 26:73–80.
- [26] Breast feeding and cognitive development. Rogan WJ, Gladen BC (1993) *Early Hum Dev* 31:181–193.
- [27] Long-term associations with infant feeding in a clinically advantaged population of babies. Pollock JI (1994) *Dev Med Child Neurol* 36:429–440.
- [28] Is breastfeeding beneficial and maternal smoking harmful to the cognitive development of children? Niemelä A, Jarvenpää AL (1996) *Acta Paediatr* 85:1202–1206.
- [29] Mother's choice to provide breast milk and developmental outcome. Morley R, Cole TJ, Powell R, Lucas A (1988) *Arch Dis Child* 63:1382–1385.
- [30] Early diet in preterm babies and developmental status at 18 months. Lucas A, Morley R, Cole TJ, et al. (1990) *Lancet* 335:1477–1481.
- [31] Breast milk and subsequent intelligence quotient in children born preterm. Lucas A, Morley R (1992) *Lancet* 339:261–264.
- [32] A Randomised Multicentre Study of Human Milk versus Formula and Later Development in Preterm Infants. Lucas A, Morley R, Cole TJ, Gore SM (1994) *Arch Dis Child Fetal Neonatal Ed* 70:F141–F146.
- [33] Impact of breast milk on IQ, brain size and white matter development. Isaacs, E. B., Fischl, B. R., Quinn, B. T., Chong, W. K., Gadian, D. G., & Lucas, A. (2010). *Pediatric Research*, 67(4), 357–362. <http://doi.org/10.1203/PDR.0b013e3181d026da>