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Association Between Breastfeeding and Obesity in Preschool Children

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ABSTRACT

Introduction: Childhood obesity is a significant problem nowadays, with breastfeeding being one of many factors responsible for this issue. Breastfeeding as a natural way of feeding infants has many benefits for the child, the mother, and society.

Aim: The present study aimed to investigate the association between overweight children in preschool age and breastfeeding duration. **Methods:** The current study included 674 preschool children aged 2-5 who attended various municipal kindergartens in South Athens. Questionnaires were given to parents where they recorded the child's personal and body data, parenting, and questions about pregnancy and lactation. The effect of BMI on the duration of breastfeeding in children was examined by the chi-square independence test. Fisher's and Monte Carlo simulations were also used. For data processing, Z scores and percentiles BMI for the first, second until fifth year of the child were found and based on these values the following categorization was performed; for values below -2 as low weight, values from -2 to 1 as normal weight, from 2 to 3 as overweight and over 3 as obese children. The Corresponding categorization was based on the 3rd, 85th, 97th, and 99.9th percentage position.

Results: The percentage of children at preschool age who have been breastfed for over six months and had normal weight was higher than those who breastfed below six months. Moreover, the proportion of children who were low weight, overweight and obese was lower in children who had been breastfed more than six months compared to those who breastfed for a shorter period. Additionally, a statistically significant difference was found for the effect of breastfeeding on childhood obesity in children aged 2 to 5 years. **Conclusion:** There is a statistical association between breastfeeding duration and body weight in preschool age. Breastfeeding for more than six months has a positive impact on the child's weight.

Keywords: BMI, breastfeeding, childhood obesity, preschool age.

1. INTRODUCTION

Breastfeeding is the best way to feed the baby and infant and promotes the healthy development and growth of the baby. World Health Organization (WHO) recommends infants to be exclusively breastfed for the first six months, and breastfeeding may go on with appropriate complementary food up to the age of two (1).

Childhood obesity has increased in recent years. Obese children can become obese adults who are at increased risk of chronic illness and premature mortality (2-5). WHO defines childhood obesity as "the XXI century epidemic." Prevention is vital in the treatment of childhood obesity.

WHO recommends the use of developing standard graphs for monitoring the development of children (6, 7). The categorization of children into normal weight, low weight, at risk of overweight, overweight, and obese children is based both on percentiles and Z-score. Based on Z-score, children were categorized as follows: Body mass index (BMI) below -2 the children were classified as low weight, BMI from -2 to 1 as normal weight, BMI between 2 and 3 as overweight, and BMI greater than 3 as obese children. The corresponding categorization was based on percentiles 3rd, 85th, 97th, and 99.9th percentage posts (8). BMI was calculated by dividing the individual's weight (in kilograms) by the square of their height (in meters) and used as an index of obesity (9).

The effect of breastfeeding on childhood obesity has been investigated in many studies. In a recent survey published in 2017, it was found that long-term breastfeeding reduces the BMI of the child for both partial and exclusive

Z-SCORE	1st Year		2nd Year		From 2nd to 5th year	
	Frequency	Rate	Frequency	Rate	Frequency	Rate
Low weight	7	1	6	0.9	7	1
Normal weight	502	74.5	467	69.3	525	77.9
At the limit of becoming overweight	70	10.4	78	11.6	59	8.8
Overweight	12	1.8	17	2.5	20	3
Obese	4	0.6	3	0.4	7	1
Total	595	88.3	571	84.7	618	91.7
Unanswered	79	11.7	103	15.3	56	8.3
Total	674	100	674	100	674	100
PERCENTILE	1st year		2nd year		From 2nd to 5th year	
	Frequency	Rate	Frequency	Rate	Frequency	Rate
Low weight	17	2.5	18	2.7	22	3.3
Normal weight	489	72.6	480	71.2	505	74.9
At the limit of becoming overweight	72	10.7	60	8.9	33	4.9
Overweight	17	2.5	13	1.9	18	2.7
Total	595	88.3	571	84.7	578	85.8
Unanswered	79	11.7	103	15.3	96	14.2
Total	674	100	674	100	674	100

Table 1. Weight distribution of preschool children based on the Z score and percentiles.

breastfeeding. The results were more pronounced when breastfeeding is prolonged and exclusive. Also, the results are more prominent at older ages (10, 11).

Another research performed in children who entered elementary school indicated that the percentage of overweight and obese children who breastfed was lower to those that had not breastfed (12). Besides, several studies have found a protective effect of breastfeeding on childhood obesity (13-19), while other studies have found that breastfeeding did not affect the development of childhood obesity (20-23). However, breastfeeding benefits can be essential both for mother and child, and these benefits have been established in the bibliography.

2. AIM

This study aimed to investigate the effect and the association of breastfeeding duration with childhood obesity in preschool children based on percentiles and Z-scores.

3. MATERIALS AND METHODS

The current study consisted of 674 preschool children aged 2 to 5 years who attended the municipal kindergartens in the area of South Athens and, in particular, the municipalities of Ilioupolis, Vyronas, Daphne-Ymittos, Agios Dimitrios and Glyfada, from October 2018 until June 2019. Questionnaires were given to parents where social, demographic, and somatic data of the child was recorded in addition to questions about pregnancy and lactation. The questionnaire was assessed for reliability by giving the questionnaire to respondents twice, two months apart. For the correlation, the non-parametric Spearman's rho was used. Pregnancy and childbirth questions showed a statistically significant positive correlation between the first and second measurements ($\rho=0.751, p<0.001$). Also, for breastfeeding questions, there was a statistically significant positive correlation between the first and second

measurements ($\rho=0.900, p<0.001$). Based on the results, the questionnaire was considered reliable as a high level of a positive correlation between the two measurements was found.

Descriptive and inductive statistics were used in the present study. The characteristics of the sample and their responses to the questionnaire were shown through the descriptive statistics. Additionally, the effect of breastfeeding duration on the BMI of children was also examined through inductive statistics. The chi-square independence test was used for this purpose. The statistical functions Fisher and Monte Carlo simulations were used to increase the reliability of the control when the assumptions underlying it were not valid (no cells with zero frequency and no more than 20% of cells below 5).

From processing the data, the Z scores and percentages concerning the first, second, until fifth year of the child were estimated and based on these values the following categorization was performed: values below -2 children were categorized as low weight, values between -2 and 1 as normal weight, from 2 to 3 as overweight and over 3 as obese. The corresponding categorization was based on the 3rd, 85th, 97th, and 99.9th percentage posts (8).

4. RESULTS

The total number of the sample (children and their mothers) who participated in the present investigation was 674 individuals. Ninety-four percent (94%) of the mothers were Greeks, 3.4% were Albanians, and the remaining 2.6% other nationalities. The percentages of the mothers' education were 36.3% with higher education, 19.9% with a college education, 20.0% with IVT training, and 16.9% with high school education. 50.6% of the children born were boys, and 49.4% were girls. The 39.5% of mothers gave natural birth to their child, while 60.5% gave birth by cesarean. 93.5% of women reported that they breastfed immediately after their

PERCENTILES		1st Year		2nd Year		From 2nd to 5th year	
		Breastfeeding 1-6 months	Breastfeeding over 6 months	Breastfeeding 1-6 months	Breastfeeding over 6 months	Breastfeeding 1-6 months	Breastfeeding over 6 months
Low weight	N	1	16	10	8	9	13
	%	0.50%	4.20%	4.80%	2.20%	4.20%	3.60%
Normal weight	N	176	313	165	315	180	325
	%	83.00%	81.70%	79.30%	86.80%	84.90%	88.80%
At the limit of becoming overweight	N	28	44	28	32	15	18
	%	13.20%	11.50%	13.50%	8.80%	7.10%	4.90%
Overweight	N	7	10	5	8	8	10
	%	3.30%	2.60%	2.40%	2.20%	3.80%	2.70%
	N	212	383	208	363	212	366
	%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%
Fisher's exact test :		7.149		6,457		1,964	
p:		0.067		0.091		0.58	
CI (99%):		0.590-0.072		0.081-0.096		0,573-0,598	
Z-SCORE		1st Year		2nd Year		From 2nd to 5th year	
		Breastfeeding 1-6 months	Breastfeeding over 6 months	Breastfeeding 1-6 months	Breastfeeding over 6 months	Breastfeeding 1-6 months	Breastfeeding over 6 months
Low weight	N	0	7	4	2	6	1
	%	0.00%	1.80%	1.90%	0.60%	2.60%	0.30%
Normal weight	N	177	325	163	304	186	339
	%	83.50%	84.90%	78.40%	83.70%	81.90%	86.70%
At the limit of becoming overweight	N	28	42	34	44	21	38
	%	13.20%	11.00%	16.30%	12.10%	9.30%	9.70%
Overweight or obese	N	7	9	7	13	14	13
	%	3.30%	2.40%	3.40%	3.60%	6.20%	3.30%
	N	212	383	208	363	227	391
	%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%
Fisher's exact test :		4,948		4,587		10.300	
p:		0.176		0.332		0.016	
CI (99%):		0.163-0.183		0.335-0.349		0.012-0.018	

Table 2. The association between breastfeeding duration and BMI in preschool children based on Z - score and percentiles.

childbirth, while 6.5% of women did not nurse. In terms of breastfeeding, 36.5% of women reported breastfeeding between 1 and 6 months (almost half of them breastfed only the first month, 27 of which reported being their choice, 21 reported that did not satiate the baby and the remaining 72 referred different reasons), 28.5% reported breastfeeding from 6 to 12 months, 12.2% reported 12 to 18 months, 5.5% reported 18 to 24 months, and 7.7% reported more than 24 months. Exclusive breastfeeding was reported by 55.4% of the women, whereas 44.6% of the women had not nursed. Moreover, 53.9% of women have breastfed for over 6 months. 72.8% of women had normal weight, 12.7% of women were overweight, 7.5% were underweight, and 7% were obese.

The child's weight distribution based on Z-score and percentile positions is shown in Table 1. According to Table 1, based on the Z-score, 74.5% of the children in their first

year of life had normal weight, 10.4% were at the limit of becoming overweight, 1.8% were overweight, 1% had low weight, and 0.6% were obese. In the second year of life, 69.3% of children had normal weight, 11.6% of the children were at the limit of becoming overweight, 2.5% were overweight, 0.9% were low weight, and 0.4% were obese children. From the 2nd to 5th year, 77.9% of the children had normal weight, 8.8% were at the limit of becoming overweight, 3% were overweight, 1% had low weight, and 1% of the children were obese.

According to Table 1, as assessed by the number of percentiles, 72.6% of the children in the first year of life had normal weight, 10.7% of children were at the limit of becoming overweight, 2.5% were overweight, and 2.5% of the children were obese. In the second year of life, 71.2% of the children had normal weight, 8.9% were at the limit of becoming overweight, 1.9% were overweight, and 2.7%

had low weight. From the 2nd to 5th year, 74.9% of the children had normal weight, 4.9% of the children were in the threshold of becoming overweight, 2.7% were overweight, and 3.3% had low weight.

The relationship between breastfeeding duration and BMI in children is shown in Table 2. According to this table, no significant statistical relationship was observed between the duration of breastfeeding and BMI, as assessed by percentiles, for the first year (Fisher's exact test = 7.149, $p = 0.067$, CI (99%): 0.059-0.072), for the second year (Fisher's exact test = 6.457, $p = 0.091$, CI (99%): 0.081-0.096) and for the second until the fifth year (Fisher's exact test = 1.964, $p = 0.580$, CI (99%): 0.573-0.598).

Also in Table 2, no significant relationship was observed between the duration of breastfeeding and BMI, as assessed by Z-scores, for the first year of life (Fisher's exact test = 4.948, $p = 0.176$, CI (99%): 0.163-0.183) and the second year (Fisher's exact test = 4.587, $p = 0.332$, CI (99%): 0.325-0.349). Additionally, there was a statistically significant relationship between the duration of breastfeeding and BMI for the second until the fifth year (Fisher's exact test = 10,300, $p = 0.016$, CI (99%): 0.012- 0.018).

5. DISCUSSION

The present research involved 674 children aged 2-5-year-old and their mothers. Children were sorted by calculating their BMI and taking into account both Z-score cutoffs and percentile cutoffs. Children were then classified into normal-weight, under-normal weight, at the limit of becoming overweight, overweight, and obese. There are studies using percentiles cutoff points (24-26), and studies using Z-score cutoffs (14, 27). The proportion of children classified as low weight, overweight, obese, and normal-weight varied according to the cutoff points used. So, when using the Z-score, there was a percentage difference in extreme positions, i.e., children who were low weight and children who were overweight. When percentiles cutoff points are used, the percentage of children who were low weight was increased, and on the contrary, a portion of children who were obese was not detected (8). An essential element of this research was the large proportion of women (53.9%) who exclusively breastfed over six months. An explanation to this is probably the breastfeeding promotion policies that have been applied to healthy environments and the community in recent years.

The present research examined the effect of maternal breastfeeding on the BMI of the child. Although there was no statistically significant relationship for the impact of breastfeeding on BMI, based on percentiles, in the first year of the child's life, the second year and from second to fifth year, the percentage of children who had normal weight was higher while the rate of children who had low weight (3.60%) and overweight (4.90%) was lower in those who breastfed over six months.

Similar results were obtained in a meta-analysis study published in 2014, which included twenty-five studies with 226,508 participants from 12 countries between 1997 and 2014. The results showed that breastfeeding was associated with a significantly reduced obesity risk in children (AOR = 0.78, 95% CI: 0.74, 0.81). Besides, the analysis of 17

studies showed that breastfeeding duration of more than seven months was associated with a reduced risk of childhood obesity (19).

Another study in 2017 demonstrated that long-term breastfeeding reduces BMI for both partial and exclusive breastfeeding, but the results were more pronounced when breastfeeding was prolonged and exclusive. At the age of 7, children who had received exclusive breastfeeding for 16 weeks benefited by having a weight reduction of 0.28 kg/m², as well as a decrease in BMI compared to those who had never breastfed (10).

In another study conducted in the US, which included 1,234 children, found that breastfeeding for one month and over six months reduced the risk of childhood obesity. Logistic regression analysis showed that breastfeeding for a month reduced the risk of childhood obesity by 36% while breastfeeding for more than six months (never before) reduced childhood obesity by 42% (28).

Additionally, the study conducted between 2009 and 2014 and published in 2019 with a sample size of 3,006 women and children, the results showed that the percentage of breastfed children who were overweight /obese (23.5% vs. 37.8%, $p = 0.032$) or obese (9.1% vs. 21.6%, $p = 0.012$) was lower in comparison to those who did not breastfed with an even lower rate at the age of 3 (29).

The study published in 2019 with 774,764 infants who participated in the Korean National Child Health Report from 2007 to 2013, it was found that both exclusive and partial breastfeeding have a preventive effect on childhood overweight. Similar results were obtained for the stratified analysis of boys and girls (30).

McCrorry and Layte (31) used the data from the study Growing-Up in Ireland to assess the association between breastfeeding and obesity of 7,798 nine-year-old children. The results of the multivariate analysis showed that the duration of breastfeeding between 13 and 25 weeks was associated with a reduction by 38% ($p < 0.05$) of the obesity risk, whereas breastfeeding duration for more than 26 weeks the decline amounted to 51% ($p < 0.01$).

On the contrary, a cross-sectional study of 817 preschool children aged 2-4, who attended municipal daycare centers in the town of Taubaté, found no correlation between child's weight and the duration of the exclusive breastfeeding (32).

Arenz et al. (33), in their meta-analysis, examined the association between breastfeeding and childhood obesity. In nine out of the 28 studies they examined ($n = 69,000$), the results showed that breastfeeding remarkably reduced the risk of childhood obesity, while Harder et al. (13) in 17 studies ($n = 120,831$) showed that the long breastfeeding period reduced the percentage of overweight children in comparison to those who had not breastfed. Also, the third round of National Family Health Survey, which was conducted in India between 2005 and 2006, collected data about breastfeeding and obesity on children in the age group from zero to five years old and concluded that exclusive breastfeeding had a protective effect on childhood obesity (34).

In the present research based on Z-score, as measured in the first and second year, the percentage of children who breastfed over six months and had normal weight was higher in comparison to those who breastfed less than six

months. Similarly, the rate of children that were overweight or obese was lower in children who breastfed for a period higher than six months (Table 2). Also, Z-score showed that there is a statistically significant association between the duration of breastfeeding and BMI from the 2nd to the 5th year (Fisher's exact test = 10.300, $p=0.016$, CI (99%): 0.012-0.018). The percentage of overweight and obese infants was lower in those breastfed for periods longer than six months, thus breastfeeding contributes to the prevention of childhood obesity.

Breastfeeding has a protective effect on childhood obesity, but many other factors affect childhood obesity, such as maternal BMI, origin, education of both parents, social and financial status, smoking, exercise, and nutrition. These factors need to be examined with further statistical elaboration.

Limitations of the study: Most important limitation of this study was the sample, which was obtained from four municipalities of South Athens and not from the entire Athens area and/or other regions of Greece, so the sample cannot be considered representative. Also, the response rate obtained was $674/2000 = 0.337=33\%$, and the questionnaires were completed by mothers based on the child's health identity card, their measurements, and the memories of their experiences.

Contribution of the study to the research: The outcomes obtained in the present study contribute to investigating such a vital subject, as the effect of breastfeeding duration in the prevention of childhood obesity. Nevertheless, in light of the above limitations, further investigation is needed for other factors affecting childhood obesity, and the impact of breastfeeding on obesity at older ages should also be investigated.

6. CONCLUSION

In the present study, based on the Z-score, a statistically significant relationship between the BMI and breastfeeding in children aged from 2 to 5 years old was obtained. Additionally, children who breastfed over six months had a higher percentage of normal weight and were, to a lesser extent, low weight and obese. Thus, breastfeeding should be promoted as a natural behavior that contributes to the healthy development of children. Additionally, breastfeeding promotion policies must continue and all women must have the appropriate education, information, and practical training to be able to breastfeed their child. In the present study, it was found that the longer the duration of breastfeeding, the lower the rate of obesity in preschool age. Policies to promote breastfeeding should continue regardless of its effect on childhood obesity, as breastfeeding has proved to be the best way to feed the newborn and infant.

- **Declaration of patient consent:** The authors certify that they have obtained all appropriate patient consent forms.
- **Author's contribution:** Each author gave substantial contributions to the conception or design of the work in acquisition, analysis, or interpretation of data for the work. Each author had a part in article preparing for drafting or revising it critically for important intellectual content, and each author gave final approval of the version to be published and agreed 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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