Longer duration of breastfeeding is associated with lower BMI among individuals aged 8-49 months in Poland.

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Abstract

Objectives: Breastfeeding in the first years of life seems to be an important factor affecting the shaping the body mass, and body mass/height proportion during first months of life, that importantly differentiates body mass and body proportion at the later stages of the human ontogenesis. The aim of this study was to evaluate if duration of breastfeeding affects BMI in later life.

Material: In the analysis 470 children born in time, aged 8-49 months were included. The data came from the nurseries in Lodz (central Poland) where children' parents filed the questionnaires and was collected in years 1993-1997. In the analysis were included information about: duration of breastfeeding, parental educational level, birth body weight, birth body length. The BMI was standardized on sex and age of the children. The stepwise regression models were used to evaluate the hypothesis. The obtained residues for BMI were used to verify only breastfeeding impact using the regression analysis.

Results: The regression model included parental education level and birth parameters were used to adjust BMI on them and revealed that low educated mothers had children with higher BMI (Beta=0.213; $p<0.015$). Additionally heavier newborns had higher BMI at the later stages of ontogenesis (Beta=0.207; $p<0.001$). There were made two regression analyses using BMI residues. The first one treated breastfeeding as categories, and revealed that children breastfed over 6 months vs. not breastfed or breastfed no longer than 1 month had lower BMI (Beta=-0.098; $p<0.030$). The second model treated duration of breastfeeding as a continuous variable, and showed that breastfeeding duration was inversely correlated with BMI residues (Beta=-0.092; $p=0.042$).

Conclusions: Duration of breastfeeding differentiates the BMI among Polish children aged 8-49 months and seems to reduce BMI in further life.

Trial registration: This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving research study participants were approved retrospectively by the Ethical Commission at the University of Lodz (NR21/KBBN- UŁ/I/2018). Written informed consent was obtained from all subjects' parents.

Background

For decades breastfeeding has seemed to be an important factor which protects against later risk of overweight and obesity [1]. The mechanisms which affect later metabolism probably stem from composition of chemical compounds, especially hormones such as: adiponectin, ghrelin, leptin and IGF-1, of maternal milk [2] and regularity of the feeding and self-control by newborns of amounts of the consumed meal [3]. Moreover, the comparison between breastfeeding and formula meals showed that formula food had mainly higher energy density than human milk [4]. There are numerous of researches which indicated valuable impact of breastfeeding on body mass in the latest stages of the human ontogenesis.

Chiasson et al. (2016) [5] presented that breastfeeding was associated with lower probability of obesity in children at age 3. On the other hand, the investigation conducted between 2001 and 2007 among individuals aged 2–6 years in South California (US) showed that those who were breastfed longer than 6 months had slightly lower BMI [6]. Longitudinal studies carried out in Japan in years 2001–2009 showed that breastfeeding was associated with decreased risk of overweight and obesity among children aged 7–8 years [7]. Additionally, Moss et al. (2014) [8] presented that children aged 2–4 years who were breastfed had lower likelihood of obesity than not breastfed individuals. In contrary, Vafa et al (2012) [9] reported that duration of breastfeeding is not associated with BMI among Iranian children aged 7 years.

Taking into account current worldwide problem with obesity, especially during childhood that act long term effect on adulthood obesity [10], it is crucial to determine range of the factors which can be connected with the body mass gaining. Beside importance of breastfeeding, familial factors such as parental education seem to be important covariates for body mass and body proportion. In the study which tackled the problem of familial factors and body composition among Polish children aged 6–13 years it was showed that children whose mothers had basic educational level had excess body fat and BMI [11].

Moreover, birth body parameters have important impact on later BMI and body mass. The newborns characterized by lower birth body weight are significantly lighter during the next years of ontogenesis compared with heavier newborns [12, 13]. There was also observed negative association between birth length and BMI in the future life [14].

The aim of this study was to evaluate if duration of breastfeeding affects BMI in later life taking into account parental education and birth parameters.

Material And Methods

The study material comprised 470 individuals born in time (37th-42nd week), aged 8–49 months. The study material was collected in years 1993–1997 in the nurseries in Lodz (central Poland) and consisted of the questionnaires, which were filed by children's parents and included information about parental educational level and breastfeeding duration. Questions regarding birth parameters and gestational age were obtained from children's medical records kept by parents, which were provided by medical staff immediately after delivery. Current anthropometric measurements: body weight (kg) and body height (cm) were performed by staff of the Department of Anthropology. According to current body weight (kg) and body height (cm), BMI was calculated for each individual. The BMI was standardized on sex and age of the children. Z-score values for current BMI were calculated for each group. All the investigated individuals were divided into separate groups with the same calendar age and sex. Additionally, the z-scores for birth length and weight were calculated. In each case the following equation was used: $z\text{-score} = (x - \mu) / \sigma$, where: x – the individual's value for the analyzed parameter; μ – the mean of the analyzed group; σ – the standard deviation of the created group.

The mothers' and the fathers' level of education was categorized as: (1) basic vocational education (2), secondary education and (3) higher education. Information about breastfeeding duration was reported as full months. In the analysis the breastfeeding duration was treated as a continuous variable (months) and categorized as: (1) not breastfed or no longer than 1 month, (2) longer than 1 month since 6 months and (3) over 6 months.

The study was registered by Ethical Commission of University of Lodz (NR21/KBBN-UŁ/I/2018).

Statistical analysis

To check the differences between categories of breastfeeding duration the χ^2 test (for all included categorical variables) and the ANOVA (for continuous variables) were used.

The forward stepwise multiple regression model was applied to estimate the importance of the breastfeeding as a continuous variable and categorical variable on BMI z-score.

The Statistica ver. 13.0 software was used to perform all calculations.

Results

Among 470 investigated individuals aged 8–49 months the mean duration of the breastfeeding was 5.47 (SD = 5.71) months. In Table 1 there were described basic statistics for breastfeeding duration. The parental education statistically significantly stratified duration of breastfeeding (Table 2a-2b). The longest duration of breastfeeding over 6 months was characteristic for offspring of the medium educated mothers and for fathers with basic education. Shorter duration of breastfeeding was observed the most frequently among offspring of mothers with higher education and fathers with basic education (Table 2a). The birth weight and length and BMI z-score were not statistically significantly associated with breastfeeding duration (Table 2b).

The regression model included parental education level and birth parameters were used to calculate residues for BMI necessary to design model for breastfeeding duration effect. The results were the following: lower educated mothers had children with

higher BMI (Beta = 0.213; $p < 0.015$). Additionally heavier newborns had higher BMI at the later stages of the ontogenesis (Beta = 0.207; $p < 0.001$) (Table 3).

There were made two regression analyses using BMI residues. The first one treated breastfeeding as categories, and revealed that children breastfed over 6 months vs. not breastfed or breastfed no longer than 1 month had lower BMI (Beta=-0.098; $p < 0.030$). The second model treated duration of breastfeeding as a continuous variable, and showed that breastfeeding duration was inversely correlated with BMI residues (Beta=-0,092; $p = 0.042$). However, in both cases the BMI was explained only approximately in 0.5% by breastfeeding duration.

Discussion

Breastfeeding is a factor which undeniably is associated with further metabolism and promotes, lower body fat levels, lower body mass and body proportion in later life. Simultaneously, chemical complexity of the human milk and abundance in hormones such as leptin or ghrelin, but also behavioral process of controlling the amount of food intake resulted in prominent impact on body mass and proportion in later life.

The worldwide discussion considering breastfeeding and later development also involves information about regulation of glucose blood level by skin to skin contact that occurs during breastfeeding [15].

Additionally, it is known that breastfeeding leads to enhancement of the intestinal bacterial flora and may be protective against overweight and obesity [16].

We pointed out that breastfeeding may protect against excess body mass in the later life. However, it has been not investigated yet how long breastfeeding should last for optimal BMI development. In our study, when we presented breastfeeding as categories, the statistically significant effect was for the group breastfed longer than 6 months. Similarly, Wang et al. (2019) [6] showed that individuals aged 2–6 years in South California (US) who were breastfed longer than 6 months had only slightly lower BMI. On the other hand, Yamakawa. et al. (2013) [7] and Moss et al. (2014) [8] presented results which underlined prominent and supportive effect of breastfeeding against obesity and overweight subsequently among children aged 7–8 years and 2–4 years. These results may be interpreted in such a way, that the supportive impact of breastfeeding on BMI is much easier noticeable in the study groups characterized by significant variance of BMI among examined individuals stratified on normal weight versus overweight and obese individuals, than in the homogenous groups that lack presence of overweight or obese children.

Besides explaining the BMI in only 0.5% by breastfeeding among individuals aged 8–49 months we underline the importance of protective influence of human milk. Probably, low R^2 may stem from early step of development of investigated individuals and protective effect of breastfeeding is better visible in phenotype since later stages of the ontogenesis.

We also presented that maternal education and body birth weight may be an important factor for proper shaping BMI in later life. In other investigations which tackle the problem of maternal education impact on the offspring BMI the results were similar - the better educated mothers the lower BMI of their offspring [11, 17, 18]. In the case of birth body parameters we presumed that higher birth body weight is connected with higher BMI values in later stages of life, since 4–56 months of life to adulthood [11, 13, 14, 19].

It is worth to add that also skin to skin contact which is a part of breastfeeding process may lead to a proper brain development including shaping the HPA axis [20]. The important organ in the HPA axis is hypothalamus which regulates hunger and satiety. In the light of these connections we also suspect that breastfeeding may regulate adequate hypothalamus action in the terms of hunger and satiety in later life.

Conclusions

In conclusion we underline that breastfeeding additively slightly differentiates the BMI among Polish children aged 8–49 months and it can reduce BMI in further life

Declarations

List of abbreviations section

None. All abbreviations were explain in the manuscript.

Ethics approval and consent to participate

This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving research study participants were approved by the Ethical Commission at the University of Lodz (NR21/KBBN- UŁ/I/2018).

Consent for publication

Written informed consent was obtained from all subjects' parents.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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None

Authors' contributions

PP-P, designed the study, analyzed the data, prepared the draft and final version of the manuscript. EŻ collected the material, designed the study, prepared the manuscript and provided critical comments on the manuscript.

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Tables

Table 1. Basic statistics for breastfeeding duration.

N	Mean	Median	Minimum	Maksimum	Q1	Q2	SD
470	5.41	4.00	0	30	1.00	7.00	5.71

Table 2a. Differences between each categories of breastfeeding duration (for categorical variables).

Breastfeeding categories	Maternal education Higher	Maternal education Medium	Maternal education Basic	Chi^2	p	Paternal education Higher	Paternal education Medium	Paternal education Basic	Total	Chi^2	p
Not breastfed or breastfed no longer than 1 month	59	53	13	29.974	<0.001	13	34	78	125	18.260	0.001
	40.41%	21.37%	17.11%			14.94%	24.64%	31.84%			
	47.20%	42.40%	10.40%			10.40%	27.20%	62.40%			
	12.55%	11.28%	2.77%			2.77%	7.23%	16.60%	26.60%		
Longer than 1 month since 6 months	62	121	30			39	58	116	213		
	42.47%	48.79%	39.47%			44.83%	42.03%	47.35%			
	29.11%	56.81%	14.08%			18.31%	27.23%	54.46%			
	13.19%	25.74%	6.38%			8.30%	12.34%	24.68%	45.32%		
Longer than 6 months	25	74	33			35	46	51	132		
	17.12%	29.84%	43.42%			40.23%	33.33%	20.82%			
	18.94%	56.06%	25.00%			26.52%	34.85%	38.64%			
	5.32%	15.74%	7.02%			7.45%	9.79%	10.85%	28.09%		
Total	146	248	76			87	138	245	470		

Table 2b.Differences between each categories of breastfeeding duration (for continuous variables).

Breastfeeding categories		Birth length							Birth weight								BMI z-score							
	N	Mean	SD	Q1	Median	Q3	F	p	Mean	SD	Q1	Median	Q3	F	p	Mean	SD	Q1	Median	Q3	F	p		
Not breastfed or breastfed no longer than 1 month	125	3286.560	489.064	3000.000	3250.000	3500.000	0.289	0.749	54.56	2.778	53.0	55.0	56.0	0.801	0.450	0.095	0.915	-0.529	0.076	0.707	1.916	0.148		
Longer than 1 month since 6 months	213	3262.113	426.129	3000.000	3250.000	3550.000			54.31	2.847	53.0	54.0	56.0			0.024	0.934	-0.647	-0.067	0.689				
Longer than 6 months	132	3326.364	478.328	3025.000	3340.000	3650.000			54.44	3.085	52.0	55.0	56.5			-0.121	0.873	-0.816	-0.015	0.505				
Total	470	3286.660	458.197	3000.000	3250.000	3600.000			54.41	2.893	53.0	55.0	56.0			0.002	0.914	-0.675	0.004	0.616				

Table 3. Regression model for BMI z-score (adjusted for age and sex) explaining by parental education and birth parameters.

	b*	Stand. Error.	b	Stand. Error.	t(467)	p	R2	F	p
Paternal education - basic vs. higher	-0.124	0.088	-0.226	0.160	-1.412	0.159	0.040	4.291	<0.001
Paternal education - medium vs. higher	-0.144	0.079	-0.290	0.159	-1.826	0.068			
Maternal education - basic vs.higher	0.146	0.090	0.288	0.178	1.617	0.106			
Maternal education - medium vs. higher	0.213	0.087	0.390	0.159	2.448	0.015			
Birth body weight	0.207	0.062	0.000	0.000	3.352	0.001			
Birth body length	-0.009	0.062	-0.003	0.020	-0.152	0.879			

Table 4 . Regression model for BMires (adjusted for parental education and birth parameters) explaining by breastfeeding

	b*	Stand. Error.	b	Stand. Error.	t(467)	p	R2	F	p
Longer than 1 month since 6 months vs. not breastfed or breastfed no longer than 1 month	-0.043	0.056	-0.077	0.100	-0.767	0.443	0.005	2.243	<0.05
Over 6 months vs not breastfed or breastfed no longer than 1 month	-0.115	0.056	-0.228	0.111	-2.060	0.040			

Table 5. Regression model for BMIres (adjusted for parental education and birth parameters) explaining by breastfeeding

	b*	Stand. Error.	b	Stand. Error.	t(467)	p	R2	F	p
Breastfeeding (months)	-0.092	0.045	-0.014	0.007	-2.042	0.042	0.006	4.168	0.042