

# The effect of maternal obesity on initiation and duration of breast-feeding in Greece: the GENESIS study

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Submitted 12 September 2007: Accepted 25 February 2008: First published online 12 June 2008

## Abstract

**Objective:** The current paper aims to describe the characteristics of mothers failing to initiate breast-feeding, provide information on the factors contributing to longer duration of breast-feeding and identify the association of maternal obesity with both initiation and duration of breast-feeding in the Greek population.

**Design:** Data from the cross-sectional GENESIS (Growth, Exercise and Nutrition Epidemiological Study In preSchoolers) study were used. Mothers were categorized by their pre-pregnancy BMI and their gestational weight gain according to guidelines from the Institute of Medicine.

**Setting:** Preschool children aged 1–5 years in five counties in Greece.

**Subjects:** Preschoolers ( $n$  2374) with full maternal anthropometric data before and during pregnancy and breast-feeding data.

**Results:** A higher percentage of mothers with increased pre-pregnancy BMI or high gestational weight gain failed to initiate breast-feeding compared with their normal-weight counterparts. Obese mothers were 2·86 times more likely to fail in initiating breast-feeding in a multiple logistic regression model. Multiple linear regression analysis showed that among women initiating breast-feeding, those who were either underweight before pregnancy or smoked at the third trimester of pregnancy breast-fed their children for about 1·5 weeks less than their normal-weight or non-smoking counterparts, respectively. Similarly, multiparous women breast-fed their children for about 7 weeks less than uniparous women. In women who initiated breast-feeding, no significant differences in breast-feeding duration were found between women of different gestational weight gains.

**Conclusions:** Mothers with high pre-pregnancy BMI are less likely to initiate breast-feeding while high gestational weight gain has no effect on either the initiation or duration of breast-feeding in Greece.

## Keywords

Breast-feeding  
Obesity  
Greece

Gestational weight gain

The benefits of breast-feeding for the health and well-being of infants have been well recognized<sup>(1–4)</sup>. However in most industrialized countries, including Greece, the percentage of mothers following the recommended breast-feeding practices is far from that desired<sup>(5–9)</sup>. As recent studies in local cohorts in Greece have shown, although more than 90% of women initiate breast-feeding<sup>(5,10)</sup>, only 16·0% of mothers provide any breast-feeding at 6 months postpartum<sup>(5)</sup> and only 7·3% breast-feed for more than 1 year<sup>(11)</sup>. However, these were small-scale studies conducted in urban areas and therefore cannot be representative of the Greek population<sup>(5,10)</sup>. Several characteristics of the child or mother as well as environmental factors have been associated with poor breast-feeding practices in studies conducted in other European countries and the USA. Included among these risk

factors are maternal age, level of education, smoking, parity, infant health, hospital practices and social support<sup>(12,13)</sup>. Some of these factors have been studied locally in large urban areas of Greece but not in a representative sample of the population<sup>(5,10)</sup>.

Another important factor that has been shown to be associated with failure to breast-feed is maternal obesity. Recent studies have shown that initiation and duration of breast-feeding are poor among mothers who are classified as overweight or obese according to their BMI ( $\text{kg}/\text{m}^2$ ) before pregnancy<sup>(7,14,15)</sup>. Similar results are found for the effect of gestational weight gain on breast-feeding initiation and duration<sup>(14,16)</sup>.

The aim of the current paper is to provide information on the characteristics of mothers who fail to initiate

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breast-feeding as well as on the factors that contribute to longer duration of breast-feeding in Greece. Additionally, the paper aims to identify how maternal obesity is associated with both initiation and duration of breast-feeding in the Greek population.

## Methods

### Sampling

The study design has been presented in detail elsewhere<sup>(17)</sup> and only a brief description of the sampling and the methods used are presented here. This cross-sectional study involved Greek preschool children aged 12 to 60 months participating in the GENESIS (Growth, Exercise and Nutrition Epidemiological Study In preSchoolers) study, which was carried out from April 2003 to July 2004. A representative number of randomly selected public and private nurseries, including day-care centres, within municipalities in five counties (Attica, Aitolokarnania, Thessalonica, Halkidiki and Helia) were invited to participate in the study. All nurseries invited to participate responded positively. The sampling of the nurseries was random, multistage and stratified by the total population of children, according to data provided by the National Statistical Service of Greece (Census 1999). Furthermore, an extended letter explaining the aims of the current study and a consent form were provided to each parent or guardian having a child in these nurseries. Those parents agreeing to participate in the study had to sign the consent form and provide their contact details. Approval to conduct the study was granted by the Ethical Committee of Harokopio University of Athens and by all municipalities invited to participate in the study.

Among the total number of nursery schools studied ( $n$  115), sixty-three were in Attica, ten were in Thessalonica, twelve were in Halkidiki, twenty-two were in Aitolokarnania and eight were in Helia. The selected counties are widely scattered over the Greek dominion while their overall local population comprises about 70% of the total Greek population (Census 1999). Signed parental consent forms were collected for 2518 children, aged 1 to 5 years (response rate 75%). From the total number of positive responses complete data became available for 2374 children with participation rate varying from 54% to 95%, reaching the highest rates in rural areas and the lowest ones in urban areas. After adjusting for parental age and educational level of the population agreeing to participate in the study, no significant differences were observed between the overall population characteristics and the study sample within the counties according to data provided by the National Statistical Service of Greece (Census 1999). Thus, the final sample is representative of 70% of the Greek population with the proportion of children aged 12–23, 25–35, 36–47 and 48–60 months being 8.7%, 21.7%, 38.8% and 31.4%, respectively.

### Additional information obtained from parents

During the morning interview at the nursery, additional information was obtained from the guardians with respect to: (i) parental demographic characteristics, such as age and educational level; (ii) parental anthropometric data, such as stature and body weight; (iii) gestational age of the infant in weeks; (iv) multiparity or uniparity; and (v) smoking and alcohol consumption during pregnancy. Furthermore, parents were asked to bring with them the medical record of their child, from which information on the child's weight and length for the first 12 months of life was copied. Data on maternal weight status before conception, before and after childbirth, as well as on the child's feeding patterns from birth to 6 months of age, were collected from the mothers of the children during either a face-to-face or telephone interview.

### Classification of maternal weight before pregnancy and gestational weight gain

Self-reported weight before pregnancy and height were used to calculate BMI before pregnancy; it was then categorized as underweight ( $<19.8 \text{ kg/m}^2$ ), normal weight ( $19.8\text{--}26.0 \text{ kg/m}^2$ ), overweight ( $>26.0\text{--}29.0 \text{ kg/m}^2$ ) or obese ( $>29.0 \text{ kg/m}^2$ ) according to the guidelines from the Institute of Medicine (IOM)<sup>(18)</sup>. Gestational weight gain was self-reported by the mother and categorized according to the IOM recommendations<sup>(18)</sup> as: (i) below IOM ( $<12.5$ ,  $<11.5$ ,  $<7.0$  and  $<6.0 \text{ kg}$  for underweight, normal-weight, overweight and obese women, respectively); (ii) above IOM ( $>18.0$ ,  $>16.0$ ,  $>11.5$  and  $>9.1 \text{ kg}$  for underweight, normal-weight, overweight and obese women, respectively); and (iii) within IOM (weight gain between the cut-off values for below and above IOM recommendation).

### Definition of children's gestational weight

The Nutstat module of the EpiInfo Database and Statistics Software for Public Health Professionals (Centers for Disease Control and Prevention (CDC), Atlanta, GA, USA) was used to determine the age- and sex-specific percentiles for weight according to the CDC 2000 Growth Charts<sup>(19)</sup>. Using the CDC weight-for-age growth charts children were classified according to their birth weight as small for gestational age ( $\leq 10$ th percentile), appropriate for gestational age (10th–90th percentile) and large for gestational age ( $\geq 90$ th percentile).

### Statistical analyses

All variables are reported categorically. To test the effect of the factors under investigation on failure to breast-feed, univariate logistic regression analyses were used and data were modelled using multiple logistic regression analysis. Odds ratios with 95% confidence intervals were computed from the results of the logistic regression analyses. Linear regression analyses were used to estimate the associations of the different factors with duration of

breast-feeding for mothers who initiated, after adjusting for possible cofactors. Gestational weight gain correlated significantly in univariate analyses with maternal weight status before pregnancy and was examined separately both in the logistic and the linear regression models because model diagnostics with these two parameters in the models indicated that the regression estimates were highly collinear. The two models created, in both the logistic and linear regression analyses, were adjusted for birth weight for gestational age, gestational age, parity, maternal age, maternal education and maternal smoking habits during the third trimester of pregnancy. Hypothesized interactions of variables in the models were not significant. All *P* values reported are two-tailed. Statistical significance was set at 0.05 and analyses were conducted using the STATA statistical software package version 8.0 (StataCorp, College Station, TX, USA).

## Results

The characteristics of the study population are shown in Table 1. In the total population almost two-thirds (67.5%)

had a normal BMI before pregnancy, and 68.2% did not meet the recommended weight gain during pregnancy (37.1% gained less and 31.1% gained more than the IOM recommended amount). Similar were the results for women included in the multiple logistic regressions. The multiple linear regression analyses on breast-feeding duration included the women who initiated breast-feeding and had complete data on breast-feeding duration (*n* 853). The distribution of maternal obesity in this subgroup was similar to that of the total population.

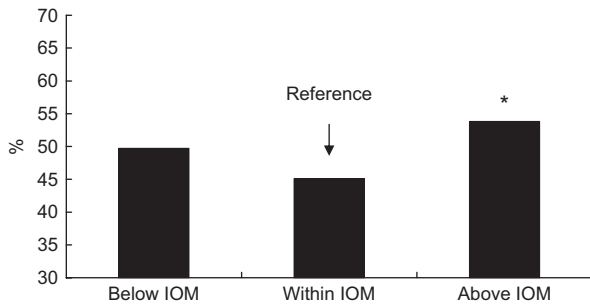
Figure 1 shows the percentage of infants who were never breast-fed by maternal gestational weight gain categorized according to IOM guidelines<sup>(18)</sup>. The percentage of mothers who had gestational weight gain above the IOM recommendation and never breast-fed their children was significantly higher than that of mothers who had gestational weight gain within the recommended range and never breast-fed their children (53.8% *v.* 45.1%, *P* = 0.018).

Figure 2 shows the percentage of infants who were never breast-fed by maternal BMI values before pregnancy categorized according to IOM guidelines<sup>(18)</sup>. The percentage of mothers who were overweight and obese before pregnancy and never breast-fed their children was

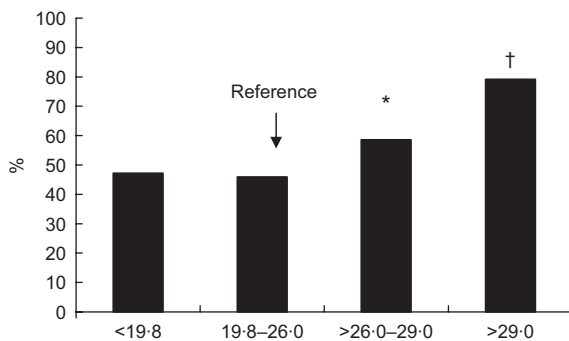
**Table 1** Descriptive characteristics of the study population in multiple logistic regression (*n* 1897) and multiple linear regression (*n* 853) analyses: cross-sectional GENESIS (Growth, Exercise and Nutrition Epidemiological Study In preSchoolers) study involving 2374 Greek preschool children aged 12 to 60 months, April 2003 to July 2004

	Multiple logistic regression		Multiple linear regression	
	<i>n</i>	%	<i>n</i>	%
Maternal BMI before pregnancy				
Normal weight (19.8–26.0 kg/m <sup>2</sup> )	1275	67.2	590	69.2
Underweight (<19.8 kg/m <sup>2</sup> )	368	19.4	180	21.1
Overweight (>26.0–29.0 kg/m <sup>2</sup> )	150	7.9	60	7.0
Obese (>29.0 kg/m <sup>2</sup> )	104	5.5	23	2.7
Gestational weight gain*				
Within IOM	607	32.0	286	33.5
Below IOM	694	36.6	305	35.8
Above IOM	596	31.4	262	30.7
Birth weight for gestational age				
Appropriate (10–89th percentile)	1595	84.1	746	87.5
Small (≤10th percentile)	172	9.1	57	6.7
Large (≥90th percentile)	130	6.9	50	5.9
Gestational age				
<37 weeks	171	9.0	47	5.5
≥37 weeks	1726	91.0	806	94.5
Parity				
Multiparous	98	5.2	10	1.2
Uniparous	1799	94.8	843	98.8
Maternal age at childbirth				
<25 years	231	12.2	105	12.3
25–29 years	669	35.3	310	36.3
30–34 years	712	37.5	317	37.2
≥35 years	285	15.0	121	14.2
Maternal education				
Lower (<9 years)	86	4.5	35	4.1
Medium (9–14 years)	792	41.8	350	41.0
Higher (>14 years)	1019	53.7	468	54.9
Maternal smoking during third trimester of pregnancy				
Not smoking	1596	84.1	756	88.6
Smoking	301	15.9	97	11.4

\*Categorized according to guidelines from the Institute of Medicine (IOM): below IOM, weight gain <12.5, <11.5, <7.0 and <6.0 kg for underweight, normal-weight, overweight and obese women, respectively; above IOM, weight gain >18.0, >16.0, >11.5 and >9.1 kg for underweight, normal-weight, overweight and obese women, respectively; within IOM, weight gain between the cut-off values for below and above IOM.



**Fig. 1** Percentage of infants who were never breast-fed by maternal gestational weight gain categorized according to guidelines from the Institute of Medicine (IOM) (below IOM: weight gain  $<12.5$ ,  $<11.5$ ,  $<7.0$  and  $<6.0$  kg for underweight, normal-weight, overweight and obese women, respectively; above IOM: weight gain  $>18.0$ ,  $>16.0$ ,  $>11.5$  and  $>9.1$  kg for underweight, normal-weight, overweight and obese women, respectively; within IOM: weight gain between the cut-off values for below and above IOM). Data from the cross-sectional GENESIS (Growth, Exercise and Nutrition Epidemiological Study In preSchoolers) study involving 2374 Greek preschool children aged 12 to 60 months, April 2003 to July 2004. Value was significantly different from that of the reference group: \* $P = 0.018$



**Fig. 2** Percentage of infants who were never breast-fed by maternal BMI value before pregnancy categorized according to guidelines from Institute of Medicine ( $<19.8$  kg/m<sup>2</sup>, underweight;  $19.8-26.0$  kg/m<sup>2</sup>, normal weight;  $>26.0-29.0$  kg/m<sup>2</sup>, overweight;  $>29.0$  kg/m<sup>2</sup>, obese). Data from the cross-sectional GENESIS (Growth, Exercise and Nutrition Epidemiological Study In preSchoolers) study involving 2374 Greek preschool children aged 12 to 60 months, April 2003 to July 2004. Value was significantly different from that of the reference group: \* $P = 0.017$ , † $P < 0.001$

higher than that of mothers who were of normal weight before pregnancy and never breast-fed their children (58.6% and 79.2% *v.* 45.9%,  $P = 0.017$  and  $P < 0.001$ , respectively).

The adjusted odds ratios in multiple logistic regression analyses of failure to initiate breast-feeding for different characteristics are shown in Table 2. Obese mothers were shown to be 2.86 times more likely to fail in initiating breast-feeding. As revealed in the analysis, preterm delivery, multiparity, smoking during the third trimester of pregnancy and higher maternal education also decreased the likelihood of breast-feeding initiation.

The coefficients in Table 3 represent how many weeks less a mother with an abnormal BMI before pregnancy or an abnormal gestational weight gain breast-fed than did the reference group after all other factors were controlled for. The results show that among women who initiated breast-feeding, those with a pre-pregnancy BMI below 19.8 kg/m<sup>2</sup> or those who smoked at the third trimester of pregnancy breast-fed their children for about 1.5 weeks less than their normal-weight or non-smoking counterparts, respectively. Similarly, multiparous women who initiated breast-feeding breast-fed their children for about 7 weeks less than women who were uniparous. In women who initiated breast-feeding, no significant differences in duration of breast-feeding were found between women of different gestational weight gains and women with different pre-pregnancy BMI status.

## Discussion

The current study has shown that almost two-thirds of women had a normal BMI before pregnancy while the percentage of women who gained inadequate and excessive weight during gestation reached 37.1% and 31.1%, respectively. The percentage of women with gestational weight gain within the IOM recommendations is comparable to those described in previous reports of gestational weight gain<sup>(20–22)</sup>, but more recent studies depict a trend for even lower percentages of women to have gestational weight gain falling within the IOM recommendations along with higher percentages of women with excessive gestational weight gain<sup>(23)</sup>. Among a longitudinal cohort of pregnant women in San Francisco, gestational weight gain was inadequate for 14% and excessive for 53%<sup>(20)</sup>, while the results of a large retrospective study in the USA showed that 43.3% of women had gestational weight gain above the IOM recommendations<sup>(24)</sup>.

In our study, 68.6% of the mothers who provided data on breast-feeding duration had a recall period of less than 48 months. According to a recent review, maternal recall on initiation and duration of breast-feeding can provide accurate estimates especially when duration is recalled over a relatively short period of time ( $\leq 3$  years)<sup>(25)</sup>. However, it has been shown that retrospective data on breast-feeding duration for children who received exclusive or any breast-feeding are very strongly correlated ( $r = 0.94$  and  $r = 0.95$ , respectively) with the actual data even 8 years after child's birth<sup>(26)</sup>. In this context, the retrospective data obtained in our study can reliably depict duration of breast-feeding in Greece.

Overall, our findings suggest that obese mothers are less likely to initiate breast-feeding than women with normal weight before pregnancy. The percentage of mothers with increased pre-pregnancy BMI who did not breast-feed was significantly higher than that of their

**Table 2** Logistic regression models showing crude and adjusted\* odds (with 95% confidence intervals) of failure to initiate breast-feeding: cross-sectional GENESIS (Growth, Exercise and Nutrition Epidemiological Study In preSchoolers) study involving 2374 Greek preschool children aged 12 to 60 months, April 2003 to July 2004

	Crude OR	95% CI	Adjusted OR	95% CI
<b>Model 1</b>				
Maternal BMI before pregnancy				
Normal weight (19.8–26.0 kg/m <sup>2</sup> )	1.000†	–	1.000	–
Underweight (<19.8 kg/m <sup>2</sup> )	0.793	0.638, 0.986	0.839	0.659, 1.068
Overweight (>26.0–29.0 kg/m <sup>2</sup> )	1.288	0.932, 1.782	1.295	0.911, 1.840
Obese (>29.0 kg/m <sup>2</sup> )	2.931	1.877, 4.577	2.864	1.744, 4.703
Birth weight for gestational age				
Appropriate (10–89th percentile)	1.000	–	1.000	–
Small (≤10th percentile)	0.539	0.391, 0.741	0.754	0.529, 1.074
Large (≥90th percentile)	0.730	0.510, 1.045	0.887	0.596, 1.324
Gestational age				
<37 weeks	1.000	–	1.000	–
≥37 weeks	0.417	0.305, 0.571	0.624	0.420, 0.926
Parity				
Multiparous	1.000	–	1.000	–
Uniparous	0.137	0.075, 0.251	0.147	0.072, 0.303
Maternal age at childbirth				
<25 years	1.000	–	1.000	–
25–29 years	0.968	0.730, 1.283	1.091	0.797, 1.494
30–34 years	0.956	0.723, 1.265	1.077	0.783, 1.482
≥35 years	0.867	0.627, 1.199	1.124	0.770, 1.639
Maternal education				
Lower (<9 years)	1.000	–	1.000	–
Medium (9–14 years)	1.159	0.756, 1.775	1.446	1.025, 2.039
Higher (>14 years)	1.289	0.846, 1.964	1.469	1.054, 2.049
Maternal smoking during third trimester of pregnancy				
Not smoking	1.000	–	1.000	–
Smoking	1.701	1.336, 2.167	1.930	1.478, 2.521
<b>Model 2</b>				
Gestational weight gain‡				
Within IOM	1.000	–	1.000	–
Below IOM	1.098	0.918, 1.314	1.074	0.857, 1.347
Above IOM	1.044	0.866, 1.258	1.051	0.832, 1.328

\*Adjusted for all other variables presented in the table.

†OR of 1.000 indicates the reference category of each variable.

‡Categorized according to guidelines from the Institute of Medicine (IOM): below IOM, weight gain <12.5, <11.5, <7.0 and <6.0 kg for underweight, normal-weight, overweight and obese women, respectively; above IOM, weight gain >18.0, >16.0, >11.5 and >9.1 kg for underweight, normal-weight, overweight and obese women, respectively; within IOM, weight gain between the cut-off values for below and above IOM.

normal-weight counterparts. Findings are similar in other studies, revealing that, of mothers who ever put their infants to the breast, those who were overweight or obese had less success initiating breast-feeding than did their normal-weight counterparts<sup>(14,15,27,28)</sup>.

Our study showed no significant differences in duration of breast-feeding between women with excessive gestational weight gain or high pre-pregnancy BMI status compared with those with a normal weight gain or normal BMI status before pregnancy. In those women who initiated breast-feeding, low body weight before pregnancy, smoking at the third trimester of pregnancy and multiparity were shown to negatively affect the duration of breast-feeding. The results of several large studies have shown a negative effect of obesity on breast-feeding initiation and duration, even after adjusting for possible confounding factors<sup>(16,27,29–31)</sup>. Other cohort studies, some conducted in countries with high initiation rates such as Denmark or Russia, found no difference in breast-feeding initiation or duration according to maternal obesity<sup>(32–35)</sup>. These inconclusive results could

be attributed to the different study designs, definitions of breast-feeding and overweight, but also to other confounding factors for which the analyses were controlled.

The mechanisms lying beneath the association of maternal obesity with poor breast-feeding practice are still unclear. Overweight/obese women have been shown to be more likely to have late arrival of milk than normal-weight women<sup>(36,37)</sup> while the prolactin response to suckling has been shown to be blunted in obese women, providing support for a possible biological association between maternal obesity and the duration of breast-feeding<sup>(38)</sup>. Alternatively, women with large breasts may have practical/mechanical difficulties in breast-feeding their babies<sup>(31,39)</sup>. In addition, several psychosocial factors related to obesity, such as low self-esteem or higher rates of postpartum depression, may play a role in the failure to breast-feed<sup>(31,40–42)</sup>.

Still, we acknowledge that there is a potential limitation of the current study; among our study cohort only 13.4% of women were overweight or obese before their pregnancy, a rather low prevalence in comparison to



**Table 3** Multiple linear regression analyses for breast-feeding duration\*: cross-sectional GENESIS (Growth, Exercise and Nutrition Epidemiological Study In preSchoolers) study involving 2374 Greek preschool children aged 12 to 60 months, April 2003 to July 2004

	Coefficient	P
<b>Model 1</b>		
Maternal BMI before pregnancy		
Normal weight (19.8–26.0 kg/m <sup>2</sup> )	–†	
Underweight (<19.8 kg/m <sup>2</sup> )	–1.37	0.017
Overweight (>26.0–29.0 kg/m <sup>2</sup> )	–0.90	0.320
Obese (>29.0 kg/m <sup>2</sup> )	0.48	0.744
Birth weight for gestational age		
Appropriate (10–89th percentile)	–	
Small (≤10th percentile)	0.64	0.492
Large (≥90th percentile)	–0.31	0.764
Gestational age		
<37 weeks	–	
≥37 weeks	1.59	0.148
Parity		
Multiparous	–	
Uniparous	–7.22	0.004
Maternal age at childbirth		
<25 years	–	
25–29 years	–0.10	0.900
30–34 years	0.53	0.501
≥35 years	–1.38	0.140
Maternal education		
Lower (<9 years)	–	
Medium (9–14 years)	–1.01	0.392
Higher (>14 years)	–1.13	0.339
Maternal smoking during 3rd trimester of pregnancy		
Not smoking	–	
Smoking	–1.56	0.034
<b>Model 2</b>		
Gestational weight gain‡		
Within IOM	–	
Below IOM	–0.57	0.303
Above IOM	–0.57	0.326

\*Adjusted for all other variables presented in the table.

†– indicates the reference category of each variable.

‡Categorized according to guidelines from the Institute of Medicine (IOM): below IOM, weight gain <12.5, <11.5, <7.0 and <6.0 kg for underweight, normal-weight, overweight and obese women, respectively; above IOM, weight gain >18.0, >16.0, >11.5 and >9.1 kg for underweight, normal-weight, overweight and obese women, respectively; within IOM, weight gain between the cut-off values for below and above IOM.

published reports for the corresponding population<sup>(17,43)</sup>. This could be attributed to deliberate under-reporting, over-reporting or recall bias for the self-reported pre-pregnancy body weight and height<sup>(44)</sup>. This is a common limitation in similar studies<sup>(20)</sup>.

However, several studies have shown high correlations between stated and actual pre-pregnancy weights<sup>(45–47)</sup>. Self-reports and measurements of body weight are highly correlated ( $r = 0.86–0.99$ ), varying, on average, by only 1.1 kg to 2.4 kg<sup>(48,49)</sup>. In addition, self-reported weights provide reasonable estimates of BMI category since the reporting error (1–2 kg) is a small percentage of total body weight, and age-related changes in height are not a factor for prenatal populations<sup>(50)</sup>. The good correlation between reported and measured preconception body weights is likely to minimize misclassification bias by BMI category<sup>(51)</sup>.

## Conclusions

In conclusion, the present study shows that mothers with high pre-pregnancy BMI are less likely to initiate breast-feeding while high gestational weight gain has no effect on either initiation or duration of breast-feeding in Greece. Other socio-cultural factors, such as maternal education and smoking, were also shown to be important for the initiation of breast-feeding. Health professionals should take into account that obese women need extra support to initiate and sustain breast-feeding when developing breast-feeding promotion programmes and policies.

## Acknowledgements

The authors would like to thank Evdokia Oikonomou, Vivian Detopoulou, Christine Kortsalioudaki, Margarita Bartsota, Thodoris Liarigkovinos and Christos Vassilopoulos for their contribution to the completion of the study. The study was supported by a research grant from Friesland Foods Hellas.

*Contribution of authors:* Y.M. was responsible for the study design and supervision of the field study. E.G. carried out the data collection and performed the statistical analyses. K.K., E.I., A.A. and M.B. carried out the data collection. All authors contributed to the writing of the manuscript and interpretation of the data, reviewed its content and approved the final version submitted for publication.

*Conflict of interest:* The GENESIS study was supported with a research grant from Friesland Foods Hellas. Y.M. works as a part-time scientific consultant for Friesland Foods Hellas. None of the other authors had any personal or financial conflict of interest. The study sponsor had no interference in the study design, data collection or writing of the manuscript.

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