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## Breastfeeding Offers Protection Against Obesity in Children of Recently Immigrated Latina Women

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### Abstract

Breastfeeding has been found to have a protective effect on subsequent development of obesity in childhood, particularly in white, non-Hispanic populations. The protective effect of nursing for more than 12 months in children of Latina women is less clear, which may be due to differences in levels of acculturation in previously studied populations. We evaluated the association between breastfeeding for 12 months or more and risk for obesity in a cohort of children of recently immigrated relatively unacculturated Latina mothers. Maternal characteristics at birth, including length of stay in the United States, breastfeeding habits at 4–6 weeks of age, 6 months, and 1 year, and anthropometric measurements were obtained for a cohort of 196 children participating in a prospective study. At 1 year of age 39.0 % of infants were being breastfed. Being breastfed at 1 year of age was associated with a decreased risk of obesity in both univariate (odds ratio (OR) 0.49, 95 % confidence interval (CI) 0.21–0.83) and multivariate models (OR 0.39, 95 % CI 0.02–0.93) adjusting for maternal BMI, marital status, education level, country of origin, age, years of living in the United States, and child's birth weight at 3 years of age, regardless of mother's acculturation status using length of stay in the United States as a proxy for acculturation. The association with breastfeeding persisted at 4 years of age as a protective factor for obesity (OR 0.29, 95 % CI 0.11–0.80). Breastfeeding for longer than 12 months provides a significant protective effect on the development of obesity in early childhood in a cohort of children of high-risk recently immigrated Latina women in San Francisco who were relatively unacculturated to the United States.

### Keywords

Obesity; Breastfeeding; Hispanic; Acculturation

### Introduction

Breastfeeding has been found to have a small yet steady protective effect on later development of obesity in childhood. A decreased risk of overweight and obesity in children at 4 years of age of up to 50 % has been described in previous studies [1, 2], and has been found to have a strong dose/response relation in white, non-Hispanic children and adolescents [3]. In Latino children, however, the effects of breastfeeding are less clear.

Some national studies of both early childhood and childhood through adolescence have shown a lack of protection in this population [2, 4, 5], whereas others have linked it to a decreased prevalence of obesity [6].

None of these previous studies took issues of acculturation into consideration. It was not clear how long these Latinos, primarily Mexican in origin, with a smaller number of Central Americans and Caribbeans, had been in the United States and whether acculturation heterogeneity existed in the observed populations. There are inherent differences between breastfeeding initiation and length of breastfeeding among Latina women according to cultural factors such as country of origin, years of stay in the United States, and personal characteristics such as body mass index that may confound the relationship between Latino ethnicity and risk for obesity. A high level of acculturation (as defined by American nativity, parental American nativity, increased years living in the United States, and a low use of Spanish language) in Latina immigrants mainly from Central America, Puerto Rico, and the Dominican Republic has been associated with a lower duration of breastfeeding, whereas a low level of acculturation in this population, as indicated by native language use, is associated with a higher breastfeeding rate but a paradoxically higher BMI Z score at 2 years of age [7].

We examined the effect of breastfeeding on risk for overweight and obesity in a population of Latino children born in the United States from recently immigrated parents, with relatively low levels of acculturation, originating from Mexico and Central America. We hypothesized that breastfeeding for 1 year or longer would be associated with a reduced risk for obesity, irrespective of level of acculturation, as indicated by length of time in the United States.

## Methods

Two hundred and one Latina women were recruited for a prospective cohort evaluating the effect of perinatal depression on obesity during early childhood as previously described [8]. In short, women were recruited during the second and third trimester of pregnancy at prenatal visits at two hospitals in San Francisco. Mothers and babies with anticipated health issues that would prevent them from breastfeeding were not included. Infants were excluded at delivery if they had any special care needs or Apgar scores  $<7$  at 5 minutes.

Baseline and sociodemographic data including age, education, income, marital status, language use, years living in the United States, and body mass index (BMI) in kilograms per meter squared of the participating mothers were collected following informed consent. Medical history was ascertained through chart review and questionnaire. Years of stay in the United States was used as a surrogate indicator of level of acculturation. The variable was analyzed as a continuous and as a categorical variable (to account for a heavily skewed distribution) considering three groups: those recently immigrated (less than 1 year in the United States), women who had lived in the United States for 1 to 5 years, and those who had lived for 5 or more years before enrollment or were born in the United States. Mothers were followed through labor and delivery and gestational age and Apgar scores were recorded. Anthropometric measurements of the infant were obtained at birth, including

weight (using standard digital infant scales) and length (using standard tape measurements). At 4–6 weeks postpartum, as well as at infant's age of 6 and 12 months, the mothers were interviewed to assess infant feeding using a 24-hour dietary recall and food frequency questionnaire. Anthropometric measurements of the children were obtained yearly, as previously described [8, 9].

All procedures were approved by the Committee on Human Research at University of California, San Francisco.

For this analysis, the relationships between any breastfeeding at 1 year and obesity at 3 and 4 years of age were evaluated using Chi squared tests of association and analysis of variance. *Obesity* was defined as BMI percentile per Centers for Disease Control (CDC) growth charts greater or equal to 95 and *overweight* as BMI percentile greater or equal to 85. *Exclusive breastfeeding* during the first 6 months of life was defined as feeding the infant only breast milk without providing any other liquids or foods, although vitamin/mineral drops or medications were permitted according to the WHO's definition of exclusive breastfeeding [10]. Risks for overweight and obesity at 3 and 4 years of age were evaluated in multivariate logistic models to calculate odds ratios. Only those variables with a *P* value < 0.10 in bivariate analyses were included in multivariate models, in addition to previously recognized risk factors such as birth weight, maternal body mass index, and marital status. For all results, we defined statistical significance as *P* < 0.05 and a statistical trend as *P* between 0.05 and < 0.10 to avoid a type II error. Gestational age and birthweight were not included together in the multivariate models owing to collinearity between these variables; however, birthweight was included in multivariate analyses as an independent predictor. Data were entered into Excel and subsequent analyses conducted using Stata 12.0 (Stata Corporation, College Station, TX).

## Results

Two hundred and one mothers were initially enrolled, of which 5 were excluded due to development of insulin-treated gestational diabetes mellitus (*n* = 196). One hundred ninety-two (98.0 %) mother-child dyads were followed at 4–6 weeks postpartum, 166 (85.0 %) were followed at 6 months, and 170 (87.0 %) were followed at 1 year of age for complete assessments (a greater number of follow-up information was available for individual measures). Anthropometric measurements were obtained of 175 (89.0 %) children and 169 (86.0 %) children at 3 and 4 years of age respectively.

As previously reported [8, 9], of the 196 women enrolled, 183(93.0 %) were foreign-born, with 49.5 % of them having lived in the United States for 5 years or less. The majority of the mothers were of Mexican ethnicity (60.7 %), of which only 6.6 % were American born. Only 30 % were married, but a total of 83.5 % reported living with a partner. Mean maternal age was  $26.3 \pm 5.2$ . Most families were enrolled in the WIC program at the time of their child's birth (91.8 %). Mean gestational age was  $39.3 \pm 1.5$  weeks and mean birth weight was  $3.4 \pm 0.5$  kg (mean birthweight z-score of  $-0.15 \pm 0.91$ ). Characteristics by breastfeeding status at 1 year of age are summarized in Tables 1 and 2. At the 3-year visit 14.4 % of children were overweight and 28.2 % were obese; weight parameters at 3 and 4 years of age

are listed in Table 4 in relation to breastfeeding status at 1 year of age. At the 4-year visit 22.5 % of children were overweight, and 24.9 % were obese as previously cited in Zahir et al. [11]. Other demographic characteristics of our cohort have been previously reported elsewhere [8].

### Breastfeeding Characteristics

As previously reported [8], the majority of the enrolled mothers were nursing at 4–6 weeks postpartum (91.2 %), with 71 (37.4 %) infants being exclusively breastfed, 102 (53.7 %) receiving formula in addition to breast milk, and the remaining 17 (8.9 %) being exclusively formula-fed. At the 4–6 week evaluation, 48 (25.4 %) mothers reported feeding foods or liquids other than breast milk or formula.

At 6 months of age 69.3 % of infants were breastfed with 58.6 % receiving supplementation with formula [12]. Mean age at which breastfeeding was stopped for the 33.1 % of infants exclusively receiving formula was  $12.7 \pm 9$  weeks.

At 1 year of age 39.0 % of infants were breastfed (Table 1). There was no increase in the percentage of infants receiving supplementation with formula. The mean age in which previously breastfed infants had been weaned was  $24.1 \pm 17$  weeks [8]. Other demographic characteristics and feeding patterns in relationship to breastfeeding at one year of age can be seen in Table 2.

### Obesity at 3 Years of Age

Twenty-eight percent of children were obese at 3 years of age and 14.4 % were overweight. Although no significant differences exist when comparing all three groups (Table 3), a statistically significant difference was demonstrated between the percentages of obese children breastfed at 1 year of age (22.7 %) compared with non-obese children breastfed at 1 year of age (42.4 %,  $p = 0.02$ ; results not shown). Breastfeeding at 1 year of age was also associated with a decreased weight percentile for age, body mass index percentile and z-score for age, and waist circumference below the 90th percentile. Being breastfed at 1 year of age was associated with a decreased risk of obesity (OR 0.49 [95 % CI 0.21–0.83]) and persisted after controlling for maternal BMI, marriage status, education, country of origin, age, years living in the United States, and child's birth weight (OR 0.39 [95 % CI 0.02–0.93]), (Table 4).

No associations were identified between breastfeeding status at 4–6 weeks of age or 6 months and the subsequent development of obesity at 3 years of age in either univariate or multivariate models. Additionally, exclusive breastfeeding at 4 weeks of age and supplementation with formula at 6 months of age were not found to have a significant association to development of obesity at age 3. However, any supplementation with formula at 1 year of age was associated with increased risk for obesity at age 3 in both univariate (OR 2.77 [95 % CI 1.13–6.79]) and multivariate models (OR 3.02 [95 % CI 1.12–8.17]) (results not shown).

### Obesity at 4 Years of Age

At 4 years of age, 24.9 % of children were identified as obese and 22.5 % were overweight as cited in Zahir et al. [11]. There were a significantly higher percentage of obese children in the group weaned prior to age one in comparison to those still breastfeeding at age 1 (Fig. 1), and independent analysis showed a statistically significant association, where 40.8 % of non-obese children had been breastfed for 12 months and only 21.6 % of obese children had been breastfed for 12 months ( $p = 0.034$ ) (results not shown). A decrease in weight percentile and body mass index percentile and z-score were also associated with breastfeeding for at least 12 months. At 4 years of age, there was no association between nursing for more than 12 months and having a waist circumference below the 90th percentile. We identified a significant association between breastfeeding and obesity at age 4 with both univariate (OR 0.42, 95 % CI 0.22–0.83) and multivariate models (OR 0.29, 95 % CI 0.11–0.8) (Table 4), which accounted for the variables mentioned for age 3. Although no associations were identified in the analysis of secondary outcomes such as breastfeeding at age 4 weeks, exclusive breastfeeding at 4 weeks, and receiving supplemental formula at 6 months or 1 year of age, we found a significant protective effect from breastfeeding at 6 months of age and reduced risk for obesity at 4 years (OR 0.37, 95 % CI 0.14–0.98) (results not shown).

### Level of Acculturation

Ninety-three percent of participants (182/196) were Spanish speakers, and only 18 % (33/182) women whose primary language was Spanish knew any English. No differences were found between immigration or language groups when studying the association between time in the United States and length of breastfeeding or subsequent development of obesity at 3 or 4 years of age (results not shown).

### Discussion

The purpose of this study was to evaluate the effect of breastfeeding on the development of obesity in early childhood in a prospectively followed cohort of Latino mothers and infants, recently immigrated to the United States with relatively low levels of acculturation. Consistent with our hypothesis, we identified a decreased risk of obesity at 3 and 4 years of age in children that were breastfed for 1 year or more, in our population of relatively homogeneous Latinos, with respect to acculturation. The effect of breastfeeding for 1 year persisted after adjusting for maternal age, maternal BMI, marital status, education, years of living in the United States, and country of origin, as well as for child's birth weight. The strong protective effect of breastfeeding on obesity in our population persisted at ages 3 and 4. As in our findings, breastfeeding is generally associated with a decreased risk of obesity in the literature. A systematic review carried out by the World Health Organization [13] determined that breastfeeding decreases the risk of overweight in children and adolescents by 22–24 %.

### Breastfeeding, Obesity, and Acculturation

Several large, population based studies have evaluated the effect of breastfeeding on the subsequent development of obesity in Latinos [2, 14, 15]. Some of these previous studies

have failed to find an association between breastfeeding and obesity [4, 15, 16] dissimilar to our findings.

Although our population was relatively homogeneous, with most participants having immigrated relatively recently to the United States, we were able to appreciate decreased risk of obesity in children of mothers who had lived in the United States for 1–5 years at the time of the child's birth when compared to mothers who immigrated less than one year prior to giving birth in the multivariate model at 4 years of age (Table 4). Although high levels of acculturation have been independently associated to obesity, diabetes, and worsening dietary habits [17, 18] as well as shorter duration of breastfeeding [19–21], the role of acculturation on breastfeeding and the subsequent development of obesity have not been systematically evaluated in Latinos.

It is not clear whether more acculturated Latinos would have a similar magnitude of association between breastfeeding and reduced risk for obesity as seen in our population; it is possible that acculturation is associated with adoption of obesogenic feeding practices. Acculturation has been defined as “the process by which immigrants adopt the attitudes, values, customs, beliefs, and behaviors or a new culture” [22]. A qualitative study evaluating the effect of behavioral and cultural issues on breastfeeding reported that mothers from South and Central American countries find a better promotion of breastfeeding in their native country, and were more likely to breastfeed for a longer period of time prior to emigrating, many times due to lack of a close, supportive network, work constrains and availability of formula, whose cost would have been prohibitive in their country of origin. Foreign-born Latinas with lower levels of acculturation have a longer duration of breastfeeding, and possibly also better overall feeding practices, which could also be associated with the protective effect of breastfeeding and a reduced risk for obesity [19, 20]. However, in one study of 114 Mexican–American women participating in a randomized trial of a specialized breastfeeding peer counseling intervention this effect disappeared after adjusting for age, which suggests that age may modify the effect of acculturation on breastfeeding, with older mothers less likely to modify their practices or become acculturated [19]. Another study did not find a reduced risk with preschool obesity based on maternal acculturation, but actually increased risk although this population had a different demographic with more Caribbeans and fewer Mexicans than ours [7]. It is possible that some of the heterogeneity in findings are related to different dietary practices based on country of origin that are associated with infant feeding practices.

Two larger cohorts from US population based samples (NHANES and PRAMS) found similar results associating a lower level of acculturation to better breastfeeding practices with a persistent effect after adjusting for age, income, and education, which attests to the importance of taking the level of acculturation into consideration when educating new mothers on best practices [20, 21]. These studies, however, did not evaluate the association between breastfeeding and overweight or obesity in children but attest to the importance of evaluating acculturation status in characterizing the relationship between breastfeeding and obesity in Latinos.

## Limitations

Our study was conducted exclusively in Hispanic immigrants to the San Francisco Bay Area, who were mainly lower income families and had recently immigrated to the United States. Although this certainly decreases the generalizability of our study to recent Latino immigrants in other areas of the country, the characteristics of our population are likely a good representation of recent immigrants, particularly to the state of California. Additionally, given the homogeneity of our group in terms of other determinants of acculturation such as language and nativity, acculturation status was assessed using only years since arrival in the United States, which may not accurately reflect the level of immersion of the family in American culture. Other limitations to our study include those inherent to all observational prospective cohorts, where we can identify associations but are unable to document causal relations.

In summary, we found a decreased risk of obesity in 3 and 4 year-old children of Latina women who were breastfed for 12 months or more that persisted after adjusting for confounders, including length of stay in the United States. Given the high risk of obesity and associated co-morbidities in low-income Latino populations as well as the large number of recently immigrated Latinos in the United States, perinatal interventions focusing on improving maternal education regarding breastfeeding and lactation support in these populations may help decrease the future risk of obesity. Future studies must also determine why there was little protective effect of breastfeeding in more acculturated Latinos and whether confounding dietary practices may mitigate the positive impact of breastfeeding in these groups.

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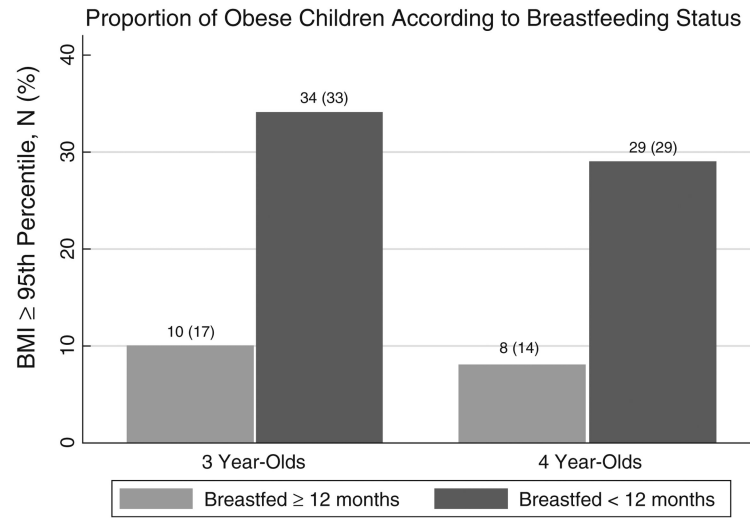
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**Fig. 1. Proportion of obese children at 3 and 4 years according to breastfeeding status at 1-year**

**Table 1**  
**Maternal demographics at baseline by breastfeeding status at 1 year of age (N = 170)**

	Breastfed < 1 year n = 104 n (%)	Breastfed 1 year n = 66 n (%)	P value
Mexican (vs other)	68 (65.4)	36 (54.6)	0.158
Primarily Spanish speaking	99 (95.2)	60 (90.9)	0.269
Any english	26 (25)	15 (22.7)	0.736
Years in the United States			
<1 year	6 (5.8)	5 (7.6)	0.760
1–5 years	42 (40.4)	29 (43.9)	
>5 or since birth	56 (53.9)	32 (48.5)	
Marriage status			
Single	17 (16.5)	6 (9.1)	0.159
Married	30 (29.1)	23 (34.85)	
Cohabiting	56 (54.4)	35 (53.0)	
Divorced/separated/widow	0 (0)	2 (3.0)	
College (vs no college)	18 (18.2)	15 (22.7)	0.475
Maternal postnatal BMI	25.06 ± 3.62*	25.69 ± 5.41*	0.507
Maternal postnatal obesity			
Normal	30 (30.3)	18 (28.6)	0.571
Overweight	30 (30.3)	24 (38.1)	
Obese	39 (39.4)	21 (33.3)	

\* Mean ± SD

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**Table 2**  
**Characteristics of the infant by breastfeeding status at one year of age**

	Breastfed < 1 year n = 104 n (%)	Breastfed 1 year n = 66 n (%)	P value
Birth			
Male gender	53 (51)	32 (48.5)	0.753
Birthweight in kilograms	3.3 ± 0.49*	3.4 ± 0.48*	0.242
Birthweight Z-score	-0.04 ± 0.9*	-0.4 ± 0.9*	0.177
Gestational age	39.2 ± 1.6*	39.3 ± 1.5*	0.584
Enrolled in WIC	95 (95.5)	63 (91.4)	0.308
4–6 weeks of age (n = 168)			
Breastfed at 4–6 weeks	89 (85.6)	65 (100)	0.001
Exclusively breastfed at 4–6 weeks	35 (34.3)	31 (47.7)	0.085
Other foods introduced <4–6 weeks	29 (28.4)	13 (20.3)	0.242
Total Oz. Formula at 4–6 weeks			
<4oz	11 (19.3)	14 (50)	0.014
4–<8oz	14 (24.6)	4 (14.3)	
8–<16oz	10 (17.5)	6 (21.4)	
16–24oz	3 (5.3)	2 (7.1)	
>24oz	19 (33.3)	2 (7.1)	
6 months of age (n = 170)			
Currently breastfed	54 (51.9)	66 (100.0)	0.000
Any supplementation with formula	89 (85.6)	26 (44.1)	0.000
1 year of age (n = 170)			
Any supplementation with formula	89 (85.6)	28 (43.8)	0.000
Age formula started, weeks			
Never	0 (1)	36 (56.3)	0.000
Birth	26 (27.4)	2 (3.1)	
<1 week	13 (13.7)	4 (6.3)	
2–<4 weeks	3 (3.16)	0 (0)	
1–<2 months	11 (11.6)	5 (7.8)	
2–<3 months	8 (8.4)	2 (3.1)	
3–<6 months	26 (27.4)	11 (17.2)	
>6 months	8 (8.42)	4 (6.3)	
Age weaned (months)			
<1	17 (16.8)		NA
1–<3	15 (14.9)		
3–<6	24 (23.8)		
6–<9	20 (19.8)		
9–<12	25 (19.8)		

\* Mean ± SD

**Table 3**  
**Characteristics of the child by breastfeeding status at one year of age**

	Breastfed < 1 year n (%)	Breastfed 1 year n (%)	P value
3 years of age (n = 162)			
Waist >90th percentile	13 (12.5)	2 (3)	0.034
Weight percentile	73.2 ± 23.7*	60.1 ± 28.2*	0.002
BMI percentile	75.5 ± 25.0*	64.2 ± 29.9*	0.010
BMI Z-Score	1.12 ± 1.2*	0.532 ± 1.2*	0.003
Weight			
Normal	55 (53.9)	40 (66.7)	0.070
Overweight	13 (12.8)	10 (16.7)	
Obese	34 (33.3)	10 (16.7)	
4 years of age (n = 157)			
Waist >90th percentile	13 (13.8)	2 (4.1)	0.071
Weight percentile	74.0 ± 24.8*	64.4 ± 24.7*	0.020
BMI percentile	78.6 ± 23.8*	68.0 ± 27.8*	0.012
BMI Z-Score	1.2 ± 1.2*	0.72 ± 1.2*	0.014
Weight			
Normal	48 (48.0)	38 (66.7)	0.050
Overweight	23 (23.0)	11 (19.3)	
Obese	29 (29.0)	8 (14.0)	
Food insecurity	32 (32.0)	21 (35.0)	0.696

\* Mean ± SD

**Table 4**  
**Unadjusted and adjusted odds ratios (OR) and 95 % confidence intervals (95 % CI) of developing obesity (BMI ≥ 95 %) by breastfeeding status at 1 year, maternal factors, and birth weight**

	3 years of age		4 years of age	
	Odds ratio (95 % confidence interval)		Odds ratio (95 % confidence interval)	
	Unadjusted	Adjusted	Unadjusted	Adjusted
Breastfeeding at 1 year of age	0.49 (0.21–0.83) *	0.39 (0.02–0.93) *	0.42 (0.22–0.83) *	0.29 (0.11–0.8) *
Maternal BMI category				
Normal	1	1	1	1
Overweight	1.6 (0.62–1.1)	1.54 (0.54–4.4)	1.58 (0.59–1.3)	1.44 (0.48–14)
Obese	2.1 (0.84–5.3)	1.57 (0.56–4.4)	1.8 (0.69–1.7)	1.65 (0.55–5)
Maternal marriage status at child's birth				
Single	1	1	1	1
Married	0.65 (0.22–2.01) *	0.80 (0.21–3.11)	0.99 (0.29–3.27)	1.5 (0.34–6.54)
Cohabiting	1.3 (0.49–3.39)	1.76 (0.54–5.69)	1.31 (0.44–3.91)	1.8 (0.45–6.76)
Divorced/Separated/Widowed	–	–	–	–
Maternal education				
High school or less	1	1	1	1
Some college or greater	1.03 (0.45–2.36)	0.83 (.31–2.28)	1.5 (0.65–3.6)	0.88 (0.29–2.62)
Maternal country of origin				
All other	1	1	1	1
Mexico	0.68 (0.35–1.33)	0.47 (0.20–1.09)	0.78 (0.38–1.59)	0.63 (0.26–1.54)
Maternal age	0.96 (0.90–1.03)	0.99 (0.92–1.06)	0.94 (0.88–1.02)	0.94 (0.86–1.03)
Years mother has lived in the United States				
<1 year	1	1	1	1
1–5 years	0.73 (0.19–2.71)	0.51 (0.1–2.8)	0.38 (0.11–1.37)	0.17 (0.03–0.97) *
>5 years or since birth	0.80 (0.22–2.89)	0.88 (0.17–4.60)	0.47 (0.14–1.65)	0.26 (0.05–146)
Child's birthweight Z-score	1.42 (0.95–2.09)	1.49 (0.94–24) *	1.35 (0.92–24)	1.35 (0.97–240)

\*  $P < 0.05$