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Exclusive Breastfeeding Is Inversely Associated with Risk of Childhood Overweight in a Large Chinese Cohort[1–3]

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Abstract

The association between breastfeeding status and childhood overweight is inconclusive. The aim of the present study was to investigate the relation between exclusive breastfeeding and childhood overweight risk in children 4–5 y of age in Southeast China. Among 97,424 children enrolled between 1999 and 2009 in the Jiaxing Birth Cohort, 42,550 of them were included in the final analysis with complete records on breastfeeding status and anthropometric measurements at 4–5 y of age (48–60 mo). Overweight and being at risk of overweight were identified as a body mass index (BMI)-for-age Z-score ≥ 2 and between 1 and 2, respectively. After 4–5 y of follow-up, 4845 (11.4%) children were identified as being at risk of overweight, and 1343 (3.16%) children were overweight. Adjusting for important child and maternal characteristics, longer duration of breastfeeding was associated with lower risk of childhood overweight (*P*-trend = 0.009) and being at risk of overweight (*P*-trend < 0.001). Children exclusively breastfed for 3–5 mo and ≥6 mo had 13% (RR = 0.87; 95% CI: 0.77, 0.99) and 27% (RR = 0.73; 95% CI: 0.56, 0.95) lower risk of becoming overweight compared with children exclusively breastfed for <1 mo, respectively. In boys, there were inverse associations of 3–5 mo (RR = 0.83; 95% CI: 0.71, 0.98) or ≥6 mo (RR = 0.65; 95% CI: 0.47, 0.91) of exclusive breastfeeding against becoming overweight, but there were no significant associations in girls (3–5 mo: RR = 0.96, 95% CI: 0.76, 1.22; ≥6 mo: RR = 0.92, 95% CI: 0.60, 1.41). In conclusion, the present findings suggest that longer duration of exclusive breastfeeding is associated with lower risk of becoming overweight in Chinese children. J. Nutr. 144: 1454–1459, 2014.

Introduction

Increasing the rate of breastfeeding was suggested to be 1 important solution to curb the obesity epidemic (1–4). Overweight or obese children are more likely to stay obese into adulthood (5), and overweight and obesity are associated with a higher risk of other chronic diseases such as diabetes and cardiovascular disease at a younger age (6–8). Several systematic reviews reported that breastfeeding was associated with a decreased risk of obesity and overweight in children, and length of breastfeeding was inversely associated with risk of obesity and overweight (9,10). However, the protective association was rather weak, and inconsistent results were reported in a number of studies (4,9,11–17). More prospective studies are needed to further illustrate this important issue, especially for populations from Asian countries, given that most of the previous studies (9,10) were in Western/European countries.

In a Japanese longitudinal survey, breastfeeding was associated with decreased a risk of obesity and overweight among children at 7 and 8 y of age (18). However, no association between breastfeeding and overweight was observed in another Hong Kong Chinese cohort of children ~7 y of age (16). To our knowledge, no published prospective cohort studies were found in mainland China to address this issue. The prevalence of overweight and obesity was suggested to increase from 1.8% and 0.4%, respectively, in 1981–1985 to 13.1% and 7.5%, respectively, in 2006–2010 in Chinese children (19). The prevalence of overweight and obesity was 23.2% and 13.8% for urban boys and urban girls, respectively, in China according to a current national survey (20). Given that the social patterns of breastfeeding behavior are different, to some extent, between Hong Kong and mainland China, it is important to understand the association between breastfeeding and childhood overweight risk in mainland China.

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The aim of the present study was to examine the influence of duration and exclusivity of breastfeeding during the first 6 mo of life on overweight risk in 42,550 children aged 4–5 y from the Jiaxing Birth Cohort.

Materials and Methods

Study design and participants. As part of a large population-based health surveillance system in China initiated in 1993 (21), the Jiaxing Birth Cohort enrolled >0.3 million pregnant mothers who primarily visit local clinics or maternity and child health care hospitals in the Jiaxing area of Zhejiang Province in Southeast China. Mothers were invited to visit the clinics or hospitals 1, 3, 6, 9, and 12 mo after the birth of their children and every year thereafter until their children were 5–6 y of age (before they were enrolled in school). At each visit, anthropometric markers and dietary and lifestyle information were carefully collected and measured through in-person interviews with the parents.

Between 1999 and 2009, the mothers of 97,424 children (singletons) from the Jiaxing Birth Cohort provided detailed breastfeeding information and other anthropometric measurements when the infants were 1, 3, and 6 mo of age. Up until 2013, 44,423 of these children had follow-up information at 4–5 y of age (48–60 mo). Children were excluded if they had missing data on weight or height at 4–5 y (n = 461), had missing data on breastfeeding status at 1, 3, or 6 mo of age (n = 670), or if their sex was not provided (n = 17). Children with extreme values of gestational age (<33 or >44 wk) (n = 165), birth weight (<1500 or >5000 g) (n = 51), or BMI (BMI-for-age Z-scores < −5 or >5) (n = 48) also were excluded. Because our primary aim was to examine the relation between breastfeeding status and overweight risk, children with a BMI-for-age Z-score < −2 were considered as underweight and therefore excluded from the present analysis (n = 575). Ultimately, 42,550 children remained in the dataset for the statistical analysis.

The study protocol was approved by the ethics committee of the College of Biosystem Engineering & Food Science at Zhejiang University in China. All of the parents consented to participate in the study.

Breastfeeding status and key study variables. Breastfeeding status in the previous 24 h was collected during an interview with the parents by asking a single question that explained the definition of exclusive or nonexclusive breastfeeding. Exclusive breastfeeding was defined as breastfeeding while giving no other food or liquid, not even water, with the exception of drops or syrups consisting of vitamins, mineral supplements, or medicine. Breastfeeding status was categorized into 3 groups at each visit in the first 6 mo: exclusive, nonexclusive, and never breastfeeding. Exclusive breastfeeding for ≥3 mo was defined when the mothers reported exclusive breastfeeding during both the 1-mo and 3-mo visits. Similarly, exclusive breastfeeding for ≥6 mo was defined when exclusive breastfeeding was reported at each of the 3 visits (1, 3, and 6 mo). The same strategy applied to the assessment of never breastfeeding at 1, 3, and 6 mo of age.

Recorded exclusive breastfeeding of children at 1 mo but not 3 mo was considered as exclusive breastfeeding for 1–2 mo. Similarly, exclusive breastfeeding reported at 1 mo and 3 mo, but not 6 mo, was considered as 3–5 mo of exclusive breastfeeding. Infants not exclusively breastfed at the 1-mo visit were categorized as <1 mo of exclusive breastfeeding, and parents who reported exclusive breastfeeding at all 3 visits were categorized into a ≥6 mo of exclusive breastfeeding group. The mean ± SD visiting age in months for the 3 visits was 1.4 ± 0.14, 3.1 ± 0.2, and 6.1 ± 0.2, respectively.

Maternal menarcheal age, maternal (paternal) educational level (>high school, high school, <high school), maternal (paternal) occupation (housework, routine job, temporary job, unemployed), maternal caesarean section status (yes vs. no), maternal gestational age, and maternal BMI (<18 gestational wk) was documented throughout the follow-up period. Paternal characteristics were not included in the final models because they did not have any material influence on the results. Maternal alcohol consumption, smoking, or history of diabetes was not included in the final models because of their low prevalence (<0.5%).

Childhood anthropometric assessment. Body weight and height of the children were measured by trained nurses to the nearest 0.1 kg and 0.1 cm, respectively. According to the 2006 WHO Child Growth Standards (22), Z-scores of BMI-for-age and weight-for-age were calculated. Overweight was defined as a BMI Z-score ≥ 2 at 48–60 mo of age. Being at risk of overweight was defined as a BMI-for-age Z-score between 1 and 2. Infancy weight gain during the first 3 mo was calculated as the difference between the weight-for-age Z-score at 3 mo and the weight-for-age Z-score at birth.

Statistical analyses. Statistical analyses were conducted by using STATA version 12 (StataCorp). General maternal characteristics by breastfeeding status were assessed by a chi-square test. Multinomial logistic regression was used to assess the association between breastfeeding status and childhood overweight risk. Linear regression was used to examine the association between breastfeeding status and BMI Z-score. Covariates included in the statistical models were as follows: age of children (mo), sex, birth weight, gestational age, caesarean section (yes vs. no), weight gain during first 3 mo (difference in weight-for-age Z-score), and maternal characteristics (maternal age at birth, maternal menarcheal age, maternal BMI status, maternal parity status, maternal educational level, and maternal occupation). Subgroup analysis based on sex was conducted to examine the influence of sex on the association because a remarkably different prevalence of overweight among boys and girls was observed, and previous studies rarely reported the relation of breastfeeding and overweight by sex because of limited sample size. A two-tailed P value of <0.05 was considered statistically significant.

Results

Population characteristics according to breastfeeding status. Of the 42,550 children (22,007 boys and 20,543 girls), 7399 boys (33.6% of total boys) and 5957 girls (29.0% of total girls) were exclusively breastfed for <1 mo. Girls had a higher proportion of exclusive breastfeeding for 3–5 mo (51.3%) or ≥6 mo (7.8%), compared with boys (46.8% and 7.0%, respectively) (**Table 1**). Children born via caesarean section, compared with those born vaginally, had a higher proportion of shorter-duration exclusive breastfeeding (<1 mo) and a lower proportion of longer-duration exclusive breastfeeding (3–5 mo or ≥6 mo). In addition, maternal parity status, menarcheal age, BMI status, educational level, and occupation were all associated with the exclusive breastfeeding status. The prevalence of children with <1 mo of exclusive breastfeeding was significantly higher in the non-included child sample than the final sample analyzed in the present study (**Supplemental Table 1**).

Childhood overweight status. Among the children 4–5 y of age, 4845 (11.4%) were at risk of overweight and 1343 (3.2%) were overweight. The prevalence of being at risk of overweight and being overweight was higher in boys (13.3% and 4.2%, respectively) than in girls (9.4% and 2.1%, respectively) (P < 0.001). In addition, boys had a higher BMI-for-age Z-score than girls (mean ± SEM: 0.175 ± 0.007 vs. −0.018 ± 0.006, respectively).

Breastfeeding and risk of childhood overweight (BMI Z-score ≥ 2). Children with a longer duration of exclusive breastfeeding had a significantly lower risk of overweight in both the crude model (P-trend < 0.001) and the fully adjusted model (P-trend = 0.009) (**Table 2**). In the fully adjusted model, children exclusively breastfed for 3–5 mo and ≥6 mo had a 13% (RR = 0.87; 95% CI: 0.77, 0.99) and 27% (RR = 0.73; 95% CI: 0.56, 0.95) lower risk of overweight, respectively, compared with children exclusively breastfed for <1 mo. However, when stratified by sex, longer duration of exclusive breastfeeding

TABLE 1 Child and maternal characteristics by exclusive breastfeeding status[1]

		Duration of exclusive breastfeeding				
	n	<1 mo	1–2 mo	3–5 mo	≥6 mo	*P*
Sex						<0.001
Boy	22,007	7399 (33.6)	2772 (12.6)	10,291 (46.8)	1545 (7.02)	
Girl	20,543	5957 (29.0)	2461 (12.0)	10,532 (51.3)	1593 (7.75)	
Birth weight (g)						<0.001
Low (<2500)	752	293 (39.0)	117 (15.6)	295 (39.2)	47 (6.25)	
Normal (2500–3999)	39,074	12,140 (31.1)	4789 (12.3)	19,241 (49.2)	2904 (7.43)	
High (≥4000)	2724	923 (33.9)	327 (12.0)	1287 (47.3)	187 (6.86)	
Gestational age (wk)						<0.001
Preterm delivery (<37)	1116	451 (40.4)	160 (14.3)	439 (39.3)	66 (5.91)	
Term delivery (≥37)	41,434	12,905 (31.2)	5073 (12.2)	20,384 (49.2)	3072 (7.41)	
Mother's age at birth (y)						<0.001
<35	41,440	12,930 (31.2)	5119 (12.4)	20,331 (49.1)	3060 (7.38)	
≥35	1109	425 (38.3)	114 (10.3)	492 (44.4)	78 (7.38)	
Caesarean section						<0.001
Yes	31,230	10,071 (32.3)	3768 (12.1)	15,144 (48.5)	2247 (7.20)	
No	11,229	3263 (29.1)	1455 (13.0)	5633 (50.2)	878 (7.82)	
Parity						<0.001
First pregnancy	35,690	11,470 (32.1)	4375 (12.3)	17,361 (48.6)	2484 (6.96)	
>1 pregnancy	6860	1886 (27.5)	858 (12.5)	3462 (50.5)	654 (9.53)	
Mother's menarcheal age (y)						<0.001
<14	6064	2029 (33.5)	739 (12.2)	2898 (47.8)	398 (6.56)	
14–15	25,105	8006 (31.9)	3064 (12.2)	12,208 (48.6)	1827 (7.28)	
>15	11,239	3277 (29.2)	1413 (12.6)	5653 (50.3)	896 (7.97)	
Maternal BMI status						<0.001
Underweight (BMI < 18.5)	7940	2796 (35.2)	1025 (12.9)	3692 (46.5)	427 (5.38)	
Normal (25 > BMI ≥ 18.5)	29,999	9029 (30.1)	3664 (12.2)	14,989 (50.0)	2317 (7.72)	
Overweight (30 > BMI ≥ 25)	2007	677 (33.7)	206 (10.3)	943 (47.0)	181 (9.02)	
Obese (BMI ≥ 30)	206	84 (40.8)	22 (10.7)	79 (49.1)	21 (10.2)	
Maternal educational level						<0.001
<High school	30,959	8675 (28.0)	3762 (12.2)	15,777 (51.0)	2745 (8.87)	
High school	7507	2814 (37.5)	1006 (13.4)	3381 (45.0)	306 (4.08)	
>High school	4039	1850 (45.8)	458 (11.3)	1645 (40.7)	86 (2.13)	
Maternal occupation						<0.001
Housework	28,153	7932 (28.2)	3386 (12.0)	14,183 (50.4)	2652 (9.42)	
Routine job	7972	2817 (35.3)	1011 (12.7)	3839 (48.2)	305 (3.83)	
Temporary job	2714	993 (36.6)	383 (14.1)	1262 (46.5)	76 (2.80)	
Unemployed	3662	1595 (43.6)	446 (12.2)	1518 (41.5)	103 (2.81)	

[1] Values are *n* (%) unless otherwise indicated and are presented as row percentages.

was not associated with overweight risk in girls, whereas the inverse association was more evident in boys (*P*-trend = 0.006). In boys, exclusive breastfeeding for ≥6 mo demonstrated a 35% (RR = 0.65; 95% CI: 0.47, 0.91) lower risk of overweight compared with those with <1 mo of exclusive breastfeeding. However, no interaction between sex and exclusive breastfeeding was observed (*P* value for sex-exclusive breastfeeding duration interaction = 0.32).

A marginally significant inverse association between exclusive breastfeeding and childhood overweight risk compared with never breastfeeding was observed when breastfeeding status was assessed at 1 (*P* = 0.09), 3 (*P* = 0.08), or 6 mo of age (*P* = 0.06) (**Supplemental Table 2**). However, the inverse association between exclusive breastfeeding and overweight risk was only observed among boys but not girls at any of the 3 time points. Among boys, compared with never breastfeeding, nonexclusive and exclusive breastfeeding up to 6 mo had a 21% (RR = 0.79; 95% CI: 0.60, 1.03) and 40% (RR = 0.60; 95% CI: 0.40, 0.89) decreased risk of overweight, respectively.

Breastfeeding and being at risk of childhood overweight (BMI Z-score between 1 and 2). In the fully adjusted model, a longer duration of breastfeeding was associated with a lower risk of becoming overweight (*P*-trend < 0.001) (Table 2). This protective association was consistent in both boys (*P*-trend = 0.003) and girls (*P*-trend = 0.042). Both 1–2 mo and 3–5 mo of exclusive breastfeeding had a significantly inverse association with risk of being overweight among boys or girls. However, ≥6 mo of exclusive breastfeeding only had a marginally significant inverse association with the risk among girls (RR = 0.82; 95% CI: 0.67, 1.01); no significant association was observed among boys.

Boys and girls had a similar inverse association between nonexclusive and exclusive breastfeeding and the risk of overweight, and no significant difference between boys and girls was observed (Supplemental Table 2). Up to 6 mo of age, exclusive breastfeeding had more evidence for decreasing the risk of being overweight in girls (RR = 0.73; 95% CI: 0.56, 0.95) than in boys (RR = 0.89; 95% CI: 0.72, 1.10).

TABLE 2 Association between duration of exclusive breastfeeding and RR of overweight (BMI Z-score ≥ 2) and being at risk of overweight (BMI Z-score between 1 and 2) in the Jiaxing Birth Cohort[1]

	Being at risk of overweight			Overweight		
	Case/study participants	Adjusted RR (95% CI)	*P*-trend	Case/study participants	Adjusted RR (95% CI)	*P*-trend
	n/*n*			*n*/*n*		
Total population						
Duration of breastfeeding			<0.001			0.009
<1 mo	1695/13,356	1 (ref)		472/13,356	1 (ref)	
1–2 mo	533/5233	0.82 (0.73, 0.91)		161/5233	0.88 (0.72, 1.07)	
3–5 mo	2247/20,823	0.85 (0.79, 0.91)		631/20,823	0.87 (0.77, 0.99)	
≥6 mo	370/3138	0.92 (0.81, 1.04)		79/3138	0.73 (0.56, 0.95)	
Boys						
Duration of breastfeeding			0.003			0.006
<1 mo	1085/7399	1 (ref)		342/7399	1 (ref)	
1–2 mo	334/2772	0.84 (0.73, 0.97)		103/2772	0.75 (0.59, 0.96)	
3–5 mo	1265/10,291	0.82 (0.74, 0.90)		422/10,291	0.83 (0.71, 0.98)	
≥6 mo	233/1545	0.99 (0.84, 1.17)		47/1545	0.65 (0.47, 0.91)	
Girls						
Duration of breastfeeding			0.042			0.542
<1 mo	610/5957	1 (ref)		130/5975	1 (ref)	
1–2 mo	199/2461	0.78 (0.65, 0.93)		58/2461	1.21 (0.87, 1.68)	
3–5 mo	982/10,532	0.89 (0.79, 1.00)		209/10,532	0.96 (0.76, 1.22)	
≥6 mo	137/1593	0.82 (0.67, 1.01)		32/1593	0.92 (0.60, 1.41)	

[1] RR was adjusted for age of children (mo), sex, birth weight, gestational age, caesarean section (yes vs. no), weight gain during first 3 mo (difference in weight-for-age Z-score), and maternal characteristics (maternal age at birth, maternal menarcheal age, maternal BMI status, maternal parity status, maternal educational level, and maternal occupation) ref, reference.

Breastfeeding and childhood BMI Z-score. A longer duration of exclusive breastfeeding was associated with a lower BMI Z-score (*P*-trend < 0.001), which was consistent among boys and girls (**Fig. 1**) (both *P*-trend < 0.001). Children exclusively breastfed for 1–2 mo ($P < 0.001$), 3–5 mo ($P < 0.001$), and ≥6 mo ($P = 0.031$) all had a significantly lower BMI Z-score compared with children exclusively breastfed for <1 mo.

Compared with children who were never breastfed, children exclusively breastfed for longer than 1 ($P < 0.001$), 3 ($P < 0.001$), or 6 mo ($P = 0.022$) had a significantly lower BMI Z-score. However, these significant differences only existed among boys but not among girls (**Supplemental Fig. 1**). Consistently, nonexclusive breastfeeding up to 1 ($P = 0.031$), 3 ($P = 0.024$), or 6 mo ($P = 0.001$) was associated with a lower BMI Z-score only among boys but not among girls.

Discussion

Our present study suggested that a longer duration of exclusive breastfeeding, and any breastfeeding, was associated with a lower risk of childhood overweight in a large, longitudinal cohort study in China. Compared with never breastfeeding, both nonexclusive and exclusive breastfeeding had a protective association against risk of overweight. In addition, a longer duration of exclusive breastfeeding was associated with a lower BMI Z-score in this population. However, the protective association of exclusive breastfeeding against overweight risk was more evident in boys than in girls.

Numerous observational studies have suggested an inverse association between breastfeeding and childhood overweight (9–11,18,23,24). However, the majority of these studies were performed in Western countries, whereas the studies in Asian populations were sparse (16,18). One recent population-based, prospective cohort study (18) found a protective association of breastfeeding on childhood overweight and obesity in Japan, which supported the results from the Western populations. Nevertheless, another study conducted in Hong Kong Chinese did not support this protective association of breastfeeding (16). The present population-based, longitudinal Chinese cohort had a larger sample size than any of the previous studies in Asia (16,18) and supported the results of Yamakawa et al. (18) that breastfeeding did protect against childhood overweight independent of potential confounders, and there was a dose-response

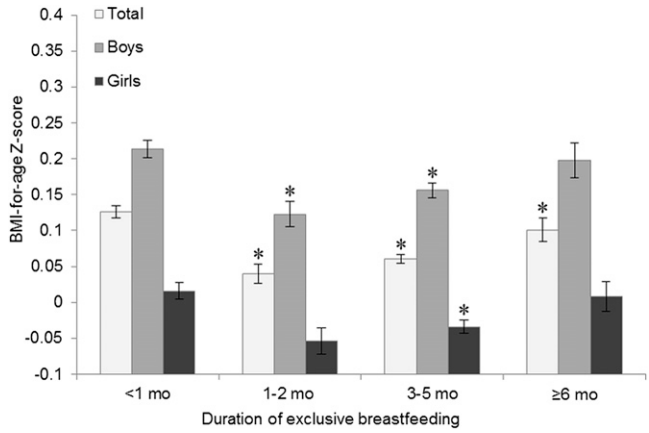

FIGURE 1 Association between duration of exclusive breastfeeding and the children's BMI Z-scores at 4–5 y of age. Linear regression was used to determine the *P* value, adjusting for the age of the children (mo), sex, birth weight, gestational age, caesarean section (yes vs. no), weight gain during first 3 mo (difference in weight-for-age Z-score), and maternal characteristics (maternal age at birth, maternal menarcheal age, maternal BMI status, maternal parity status, maternal educational level, and maternal occupation). Values are means ± SEMs; $n = 13,356$ (7399 boys, 5957 girls), 5233 (2772 boys, 2461 girls), 20,823 (10,291 boys, 10,532 girls), and 3138 (1545 boys, 1593 girls) for <1 mo, 1–2 mo, 3–5 mo, and ≥6 mo of exclusive breastfeeding, respectively. *Different from <1 mo exclusive breastfeeding, $P < 0.05$.

association. One potential explanation for the discrepancy of the present results with that of Hong Kong Chinese (16) is that the proportion of exclusive breastfeeding (>3 mo) was quite low in the Hong Kong study (<7%), whereas it was substantially higher in the present study (>50%). In addition, the Hong Kong study did not investigate the association separately by sex, which may contribute to the null association. The current study suggested that boys were more likely to be protected from being overweight by exclusive breastfeeding than girls. The stronger protective association of breastfeeding on childhood overweight among boys may be partly attributed to some residual confounders or parental behaviors favoring the boys. In addition, the prevalence of overweight was much higher among boys than girls. This may be due to the parental preference for boys in China, leading to a greater likelihood of boys being fed more food during childhood.

The result that exclusive breastfeeding in boys, but not in girls, was protective against overweight should be explained cautiously. First, a relative lower prevalence of overweight in girls than in boys (2.1% vs. 4.2%) was observed. This would limit the statistical power to detect such an association. Second, it may be that girls are less likely to be overweight than boys at this age, as suggested by a population survey in China (20). Third, breastfeeding had a similar protective association with being at risk of overweight (BMI Z-score between 1 and 2) among both boys and girls, who may later develop overweight or obesity. In addition, no breastfeeding-by-sex interaction was observed.

Residual confounders were always an important issue with regard to the assessment of the association between breastfeeding and childhood overweight/obesity (3). Breastfeeding behavior and its relation with childhood obesity may be influenced by parental socioeconomic status and the children's anthropometric factors, such as birth weight or rapid weight change during infancy. Rapid weight gain during infancy was suggested to be associated with childhood overweight and obesity in a number of observational studies (25,26). In addition, mothers who breastfed for a longer duration were more likely to have numerous other characteristics or lifestyles, which appeared to be protective against childhood overweight. However, after adjustment for all these important potential confounders, exclusive breastfeeding still had a protective association in the present study.

There were several potential mechanisms for the anti-adiposity effect of breastfeeding. First, hormones contained in breast milk, such as adiponectin, leptin, ghrelin, insulin-like growth factor-1, resistin, and obestatin, exert a set of complex beneficial effects on children via several biologic pathways, thereby preventing childhood overweight and obesity (27–29). Second, direct breastfeeding infants had a better ability to self-regulate milk intake in later infancy compared with bottle-feeding infants. Bottle-feeding infants were more likely to empty the bottle or cup later in life than breastfeeding infants, which may lead to more energy intake (30). In addition, infant formulas usually have a slightly higher energy density (31), and energy and protein intake of formula-fed infants were reported to be much higher than those of breastfed infants (32,33). This indicates that nonbreastfed or formula-fed children would have a higher energy intake and increased adiposity in later infancy and childhood. Nevertheless, some caution should be taken because a difference in BMI or overweight risk may not only be attributed to a change in body fat, but also to lean tissue and bone mass. More work is warranted to fully investigate the mechanism.

The strengths of the present study include its large sample size and the true population-based nature of the study design. The children's demographic and lifestyle information was well documented at each visit by professional pediatricians, and the assessment of breastfeeding status was unlikely to be affected by recall bias, although occasional feeding with other foods or liquids between clinic visits could not be fully excluded. In addition, data on breastfeeding and childhood overweight in the Chinese population were rather limited. Our study sample size was much larger than another Chinese birth cohort in Hong Kong (16), and therefore may have more statistical power for the detection of the beneficial associations of breastfeeding on childhood adiposity. Furthermore, all children were recruited from a small geographic region in Southeast China where people shared similar social patterns and culture. This minimized the influence of cultural or social factors, which were difficult to be adjusted for in other large cohort studies. According to a Chinese national survey for children aged 7–18 y (20), the prevalence of overweight and obesity was 12.7% for rural boys and 8.6% for rural girls, and it was 23.2% for urban boys and 13.8% for urban girls. The prevalence of childhood overweight among boys or girls and the prevalence of exclusive breastfeeding in the present cohort were consistent with those of other regions of mainland China (20,34), which may increase the generalizability of the results to the populations of other Chinese regions.

However, there are several limitations to our study. First, children were only followed-up for 4–5 y. However, the linkage between breastfeeding status and adiposity status at 4–5 y of age should be sufficient to suggest the impact of breastfeeding during infancy on children and to provide an indication of further development of childhood overweight and obesity in later life. Second, mothers' dietary and lifestyle factors were not sufficiently documented. Nevertheless, the most important factors related to childhood overweight, such as maternal BMI and parity status, were adjusted in the statistical model. Third, to minimize the influence of age on the association, child overweight status between 48–50 mo of age was examined. This strategy ruled out many participants who provided anthropometric information before or after this age, which resulted in a seemingly high loss of the follow-up in the present study. However, this influence should be nondifferential, and selection bias may be limited. Finally, underweight children were excluded from the analysis, which may limit generalizability of the present results. However, underweight children may have some different environmental exposures, genetic backgrounds, or other characteristics compared with normal weight or overweight children, which may bias the present results. In addition, little difference for any result was observed when these children were included in the analysis (data not shown).

To conclude, we found that a longer duration of breastfeeding was associated with a lower risk of overweight in Chinese children aged 4–5 y, and the inverse association was more evident among boys. To confirm the results of the present study, more prospective studies in Asian countries, especially China, are warranted.

Acknowledgments

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