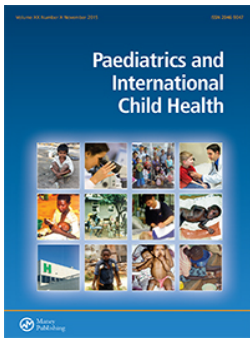


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# Breastfeeding and food pattern in overweight children in the Caribbean

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**Background:** As in most countries around the globe, overweight and obesity are a major threat to public health on the Caribbean island of Aruba. Increasing evidence confirms that breastfeeding protects against overweight and obesity. However, little is known about the mechanism underlying the association between breastfeeding and obesity. One possibility is that breastfed infants are better able to control their meal size and intervals than formula-fed infants. This might lead to a healthier diet in later life and protect against overweight and obesity. **Objective:** To determine the relationship between breastfeeding, food pattern and being overweight in the Caribbean.

**Methods:** In a cross-sectional school-based study in 2004–2005, weight and height were measured by two research assistants in 1776 children aged 6–11 years on Aruba, an island in the Caribbean. BMI was defined according to guidelines by the International Obesity Task Force. Parents completed a questionnaire pertaining to breastfeeding and dietary food pattern.

**Results:** 1451/1776 (81.7%) children were breastfed; 851/1766 (47.9%) children were breastfed for <4 months, 227/1776 (12.8%) for 4–6 months and 373/1776 (21.0%) for ≥6 months. Children who were breastfed for ≥4 months had lower odds (OR 0.32, 95%CI 0.25–0.40) of being overweight including obesity than those who either were not breastfed or who were breastfed for <4 months. Children who were breastfed for ≥4 months were more likely to have a structured food pattern of six eating moments a day (OR 7.43, 95% CI 5.87–9.39, *P*<0.001) and to have breakfast every day (OR 2.86, 95% CI 2.17–3.78, *P*<0.001) than those who were not or who were breastfed for <4 months.

**Conclusions:** Breastfeeding for ≥4 months is associated with a structured food pattern (six eating moments a day including a daily breakfast) and carries a strikingly lower risk of overweight in children. Promoting prolonged breastfeeding together with a focus on a subsequent structured food pattern could be a cheap method of preventing overweight.

**Keywords:** Child, Breastfeeding, Obesity, Food pattern, Caribbean

## Introduction

Obesity is an important public health problem because of serious co-morbidities such as cardiovascular disease and diabetes.<sup>1</sup> Two of every three severely obese children already have at least one cardiovascular risk factor.<sup>2</sup> As in most countries around the globe, overweight and obesity are a major threat to public health on Aruba, an island in the Caribbean, formerly belonging to The Netherlands Antilles. In 2006, 77% of the adult population were overweight (including obesity) and 41% were obese.<sup>3</sup> Furthermore, 36.3% of 6–11-year-old children on Aruba were overweight, including obesity [defined by the Center for Disease Control criteria; this

corresponds to 39.2% by the International Obesity Task Force (IOTF) criteria].<sup>4,5</sup> As overweight and obesity track into adulthood, this underscores the utmost importance of preventing overweight in early life. This will prevent serious obesity-related comorbidities such as cardiovascular disease and type 2 diabetes in young adulthood or even earlier.<sup>6,7</sup>

Increasing evidence confirms that breastfeeding protects against overweight and obesity, even after correction for socio-economic status.<sup>8,9</sup> Most studies reveal a dose-dependent association between duration of breastfeeding and the prevalence of obesity, and report a slightly lower risk of obesity in children who are exclusively breastfed.<sup>10,11</sup> This supports the recommendation of the World Health Organization to (exclusively) breastfeed children for at least 6 months for healthy growth and development.<sup>12</sup>

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However, little is known about the mechanisms of the association between breastfeeding and obesity.<sup>13</sup> One possible explanation is that breastfed infants have a better ability to control their meal size and intervals than formula-fed infants.<sup>14</sup> This might lead to a healthier food pattern in later life and protect against overweight and obesity.<sup>15</sup> Another hypothesis for the protective effect of breastfeeding concerns daily variation in the flavour of breast milk according to a mother's diet.<sup>16,17</sup> Since these flavours can be detected, breastfed infants have early experience of high flavour density which might influence not only their preference and acceptance of food but also their ability to accept new flavours which might last for years.<sup>16,18,19</sup>

In a recent systematic review, Koletzko *et al.* found that the risk of obesity in children decreased significantly with an increasing number of meals.<sup>20</sup> They concluded that it appears prudent to promote a regular meal pattern with five meals per day. According to Dutch recommendations, a healthy diet consists of six eating moments a day: three meals (breakfast, lunch and dinner) and three snacks.<sup>21</sup> On the other hand, United States Dietary Guidelines do not provide recommendations for a specific number of meals and snacks per day.<sup>22</sup> This diversity reflects the scarcity of studies of the association between breastfeeding, optimal food frequency pattern and overweight in children. Dutch as well as US guidelines recommend that 6–11-year-old children should daily consume ample fruit (150–200 or 1.5–2 pieces) and vegetables (100–200 g or 1.5–2.5 cups).<sup>21,22</sup>

The aim of the study was to determine the association between breastfeeding, food pattern and overweight in children in the Caribbean in order to obtain indices for effective prevention of overweight.

## Methods

### General

This was a cross-sectional study between August 2004 and August 2005 of a total population of 9604 children aged between 6 and 11 years attending 35 primary schools on Aruba. Fifteen primary schools with a total of 4330 children were randomly selected to participate in the study. Data on 3952 children (91.3%) were collected. Supplementary data on food pattern and breastfeeding were collected in a subsample of 1776 6–11-year-old school-children. This subsample was obtained by random selection. For every age and for both sexes, one of every two obese and one of every two overweight children were selected. In addition, as control for each overweight or obese child, two normal-weight children matched for sex and age were randomly selected.

Ethical approval was not required because measurement of weight and height are part of regular

child health care on Aruba. The children's parents were contacted by their schools and parental permission for participation in the study was given by means of passive informed consent.

### Measurements

Weight and height were measured by two trained research assistants. Weight was measured in underwear to the nearest 0.1 kg with a calibrated digital scale (Seca® type 80). Height was measured to the nearest 0.1 cm with a microtoise. Body mass index (BMI) is calculated as weight (kg)/height (m<sup>2</sup>). Overweight and obesity were determined according to cut-off values defined by the IOTF.<sup>4</sup> Parents completed a questionnaire pertaining to breastfeeding and food pattern. Questions were asked about the exact meal frequency per day, including breakfast, and the frequency of consumption of fresh fruit and fresh green vegetables (daily, sometimes or never). We categorized the number of eating moments as less or six or more a day according to Dutch recommendations for a healthy diet.<sup>21</sup>

### Statistical analysis

The  $\chi^2$  test was used to determine differences between groups in the frequencies of the measured variables. Multiple logistic regression analysis was used to identify the association between breastfeeding, food frequency patterns and overweight. In total, five different logistic regression analyses were performed with breastfeeding as the central determinant. These included the association between breastfeeding and BMI (categorized as normal weight or overweight including obesity), number of eating moments, having breakfast daily, and fresh fruit and green vegetable consumption. Age and gender were included in the analysis as potential effect modifiers and BMI status, gender and age as potential confounders. All statistical analyses were performed using SPSS for Windows, version 15.0 (SPSS Inc., Chicago).

## Results

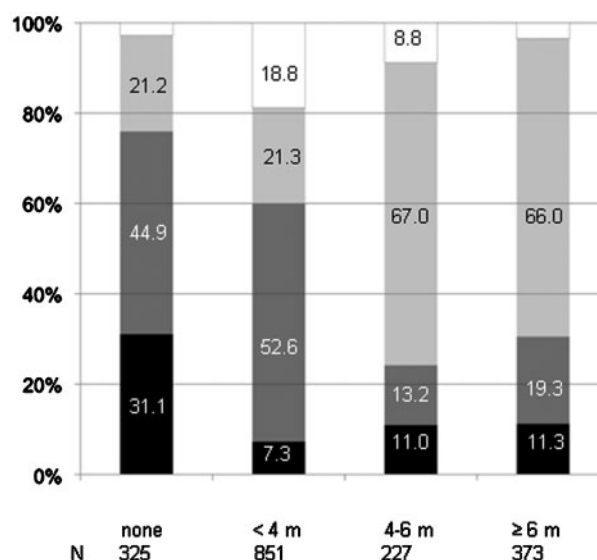
Weight and height were measured in 3952 of 4330 (91.3%) children aged between 6 and 11 years attending 15 primary schools. Data on breastfeeding and food pattern were collected for 1776 children (Table 1). In all, 1451/1776 (81.7%) children were breastfed for various lengths of time (Fig. 1). Significantly fewer children (169/1776, 28.2%) who were breastfed for  $\geq 4$  months were overweight (including obesity) compared with those who were not breastfed or breastfed for  $< 4$  months (588/1776, 50.0%,  $P < 0.001$ ). Children who were breastfed for  $\geq 4$  months had lower odds (0.32, 95% CI 0.25–0.40) of being overweight or obese than those who were not breastfed or were breastfed for  $< 4$  months (Table 2).

Furthermore, children who were breastfed for  $\geq 4$  months were much more likely to have at least six eating moments a day and to eat a daily breakfast than children who were not breastfed or were breastfed for  $< 4$  months (Tables 1 and 2). The odds of daily consumption of fresh fruit and fresh green vegetables were lower in children who were breastfed for  $\geq 4$  months (Tables 1 and 2).

## Discussion

Breastfeeding for  $\geq 4$  months was associated with a lower prevalence of overweight including obesity and a structured food pattern (three meals including breakfast and three snacks daily) in 6–11-year-old children than in those with no or  $< 4$  months breastfeeding. The finding of a protective effect of breastfeeding against overweight and obesity in children on Aruba is in agreement with two meta-analyses which reported pooled odds ratios of 0.78 (95% CI 0.71–0.85) and 0.93 (95% CI 0.88–0.99) for risk of obesity in breastfed children.<sup>8,9</sup> Even after adjustment for three potential confounders (socio-economic status, maternal smoking and parental obesity), this effect remained significant (0.93, 95% CI 0.88–0.99).<sup>9</sup> Observational studies, however, have to deal with confounding issues and, obviously, randomized controlled intervention trials pertaining to breastfeeding are scarce and often lack power.<sup>23</sup>

This study shows that Aruban schoolchildren who were breastfed for  $\geq 4$  months had more structure in their food pattern than their peers who were not breastfed or were breastfed for  $< 4$  months. These findings support the hypothesis that, compared with infants breastfed for a short time and formula-fed infants, infants breastfed for  $\geq 4$  months have a better ability to control meal sizes and intervals, resulting in a more structured food pattern in childhood which can subsequently lead to a lower risk of overweight or obesity. Unfortunately, however, no data were available on portion sizes. The association between duration of breastfeeding,



**Figure 1** Breastfeeding and weight of 6–11-year-old children ( $n=1776$ ) on Aruba ( $P<0.001$ ) (□ underweight, ■ normal weight, ■ overweight, ■ obese)

portions sizes, meal intervals and overweight require further study.

In addition, the study showed that children who were not breastfed or breastfed for  $< 4$  months skipped breakfast more often than children who were breastfed for  $\geq 4$  months. Moreover, skipping breakfast was positively associated with overweight, which agrees with previous studies.<sup>24,25</sup> Therefore, having

**Table 2** Odds for overweight and food pattern in 6–11-year-old children on Aruba if breastfed for at least 4 months compared with less than 4 months or not breastfed at all

	Odds	95% CI
Overweight (including obesity)	0.32*	0.25–0.40 <sup>‡</sup>
Food pattern:		
Six eating moments/day	7.43 <sup>†</sup>	5.87–9.39 <sup>‡</sup>
Daily breakfast	2.86 <sup>†</sup>	2.17–3.78 <sup>‡</sup>
Daily fresh fruit	0.73 <sup>†</sup>	0.59–0.90 <sup>‡</sup>
Daily fresh green vegetables	0.18 <sup>†</sup>	0.13–0.26 <sup>‡</sup>

\* Adjusted for having six eating moments a day; <sup>†</sup> adjusted for age and BMI; <sup>‡</sup>  $P<0.001$ .

**Table 1** Breastfeeding, weight status and food pattern of 6–11-year-old children on Aruba ( $n=1776$ )

	Breastfeeding							
	None		< 4 months		≥ 4 months		All	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
No.	325	18.3	851	47.9	600	33.8	1776	100
Boys	155	47.7	438	51.5	275	45.8	908	51.1
Overweight including obesity*	247	76.9	341	40.1	169	28.2 <sup>†</sup>	757	42.6
Six eating moments per day	145	17.7	232	28.3	443	54.0 <sup>†</sup>	820	46.2
Daily breakfast	204	62.8	619	72.7	524	87.3 <sup>†</sup>	1347	75.8
Daily fresh fruit	65	20.0	451	53.0	237	39.5	753	42.4
Daily fresh green vegetables	91	28.0	219	25.7	40	6.7*	350	19.7

\* Based on International Obesity Task Force criteria;<sup>4</sup> <sup>†</sup> significant difference between none or less than and more than 4 months breastfeeding ( $P<0.001$ ).

breakfast every day is part of a structured, healthy diet.

The main reason for mothers to breastfeed is a belief that it is healthier than formula-feeding.<sup>26</sup> These mothers are probably more conscious of health and nutrition and may be more motivated to establish for their children a healthy, structured diet according to recommendations.

An unexpected finding was the negative association between duration of breastfeeding and daily consumption of fresh fruit and fresh green vegetables. Other studies of fruit and vegetable consumption by breastfed children report higher consumption than by children who were never breastfed.<sup>27–29</sup> The findings might be explained by the fact that overall fruit and vegetable consumption is low on Aruba. Sixty per cent of adults do not eat fresh fruit and vegetables every day.<sup>3</sup> On average, Aruban adults eat fruit on 4 (95% CI 3.8–4.1) days and vegetables on 5.5 (95% CI 5.4–5.6) days a week. Only 2.4% of adults eat the recommended five combined servings of fruits and vegetables per day compared with 25% in the USA and Netherlands.<sup>30</sup> As nearly all fruit and vegetables are imported to Aruba, high cost is implicated which might explain the low fresh fruit and vegetable consumption. Furthermore, as we enquired only about consumption of fresh fruit and fresh green vegetables, it might have been underestimated by not taking account of canned fruit and vegetables and fresh yellow and red vegetables.

A strength of this study is the high number of mothers who breastfed their children for at least 4 months. In most western countries, the period of breastfeeding is shorter. This enabled us to study a large number of children who were breastfed for various lengths of time. Further strengths are the population-based design and high response rate.

A limitation of the study is information bias because data pertaining to breastfeeding and the children's diets were obtained by parental recall. However, this applies both to children with short or no breastfeeding as well as to those who were breastfed for a long time. A further limitation of the study is that data on parental BMI and socio-economic status were not available. Several studies have reported that these factors influence the relationship between breastfeeding and obesity.<sup>8</sup> Unpublished data from a surveillance report by the Aruban Ministry of Health states that, on Aruba, there is a positive association between socio-economic status and duration of breastfeeding.<sup>30</sup>

Children on Aruba who were breastfed for  $\geq 4$  months have a strikingly lower prevalence of overweight (including obesity) at the age of 6–11 years than children who were not breastfed or who were breastfed for  $< 4$  months. Children who are

breastfed for  $\geq 4$  months more often have a structured diet consisting of six eating moments a day including having a daily breakfast. Consumption of fresh fruit and green vegetables is low on Aruba, especially among children breastfed for  $> 6$  months, and further study is required on how to increase that consumption. Promotion of prolonged breastfeeding together with a focus on a subsequent structured, healthy diet might be a cheap means of preventing overweight and obesity.

### Acknowledgments

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