

# Breastfeeding and decreased risk for childhood obesity

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## Abstract

**Background** Breast milk promotes infant growth and appropriate weight gain, minimizing the risk for malnutrition, and possibly for obesity.

**Objective** To determine the influence of infant breastfeeding practices on the risk for obesity in children aged 6 to 8 years.

**Methods** We conducted a case-control study comparing breastfeeding practices between obese and non-obese children. Subjects were selected from two elementary schools in Yogyakarta. Case subjects had body mass index (BMI)-for-age  $\geq +2$  SD (WHO 2007 growth reference curve). Control subjects had BMI-for-age SD between  $-2$  and  $+1$  SD, and were matched for age and gender to the case subjects. Subjects' mothers filled questionnaires on their breastfeeding practices.

**Results** We recruited 68 pairs of obese and non-obese subjects, 47 (69%) pairs of boys and 21 (31%) pairs of girls. The mean duration of breastfeeding in the obese group was shorter than that of the non-obese group, 12.9 months (SD 9.78) vs. 16.1 months (8.39), respectively, a mean difference of 3.24 months (95% CI 0.14 to 6.32). Partially breastfed and formula-fed children had significantly higher odds for obesity compared to that of exclusively breastfed children, OR 4.70 (95% CI 3.96 to 5.43) for partial breastfeeding and 6.20 (95% CI 4.67 to 7.73) for formula feeding. The risk for obesity also declined with longer durations of breastfeeding.

**Conclusion** Exclusive infant breastfeeding and longer duration of breastfeeding lowered the risk for childhood obesity in children aged 6-8 years. [Paediatr Indones. 2012;52:1-5].

**Keywords:** breastfeeding, children, obesity, Indonesia

Obesity has become a global problem. Increasing prevalence of obesity has been observed not only in developed countries, but in developing countries, as well. The Indonesian Health Survey in 2007 reported that, nationally, the prevalence of overweight and obesity in children under the age of 5 years was 12.2%, nearly equal to the prevalence of malnutrition, 13.6%.<sup>1</sup> The prevalence of overweight and obesity in children aged 6 to 8 years in Yogyakarta increased from 8.9% in 1999 to 12.3% in 2004.<sup>2</sup>

Studies have shown that childhood obesity is a risk factor for adult obesity, and a risk factor for metabolic syndrome and cardiovascular diseases.<sup>3,4</sup> Obesity is a condition which is difficult to manage, so identification of risk factors and prevention efforts are important.<sup>4</sup>

Several studies have reported a protective effect of breastfeeding in reducing the risk for obesity in children. However, other studies have reported no effect of breastfeeding on the risk of childhood and adolescent obesity.<sup>3-10</sup>

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Several theories had been proposed regarding a possible mechanism associating breastfeeding to the prevention of obesity. Breastfeeding may preserve the individual's self-regulation of energy intake, thereby influencing early programming of glucose metabolism.<sup>11</sup> In addition, breast milk is considered the best source of infant nutrition for appropriate infant growth and weight gain, while minimizing conditions that may induce obesity.<sup>12</sup>

Although the prevalence of breastfeeding in Indonesia has been reported to be high (97%),<sup>13</sup> the prevalence of exclusive breastfeeding has been reported to be only 14%.<sup>14</sup> Therefore, research on the benefits of breastfeeding, especially that of exclusive breastfeeding, is needed to further evaluate breastfeeding effects in the Indonesian pediatric population. The aim of this study was to determine the influence of breastfeeding practices on the risk for obesity in children aged 6 to 8 years.

## Methods

We conducted a case-control study from September-November 2010. Subjects were students in two elementary schools in Yogyakarta, Budi Mulia Dua and Tarakanita Primary Schools. We chose these private schools because they had students from families of higher socioeconomic level. We expected a higher prevalence of obesity in children from such families.

Subjects were obese and non-obese children aged 6 to 8 years. For the obese group, we included children with BMI  $\geq +2$  SD scored by the WHO 2007 growth reference curve.<sup>15</sup> The non-obese group included children with BMI between  $-2$  and  $+1$  SD. Children with physical abnormalities which might impede the validity of anthropometric measurements such as paralysis, paraplegia, thalassemia and edema, were excluded.

We estimated the required sample size using a formula for case-control studies.<sup>16</sup> We estimated a minimum sample size to be 68 subjects in each group. To obtain the subjects, we screened all students in grades 1-3 in those two schools for obesity by measuring their weights and heights.

Weight was measured using an electronic digital scale and height was measured by microtoise, with a precision to the nearest 0.1 kg and 0.1 cm, respectively.

Equipment was calibrated at the Bureau of Metrology, Yogyakarta.

Body weights and heights were measured once per student by the principle investigator. Students were weighed in their uniforms or in light clothing. Hats, jackets, jumpers and shoes were removed during measurement. Height was measured with the students standing erect, facing forward, back to the wall and head in Frankfurt plane. We calculated body mass indices (BMI), then randomly selected 68 obese children for the case group. Controls were non-obese subjects selected from the same school, and matched for age and gender to the case subjects.

Questionnaires on infant feeding history were filled by subjects' mothers. We defined exclusive breastfeeding as intake of breast milk only, without additional food or drink for the first six months of life. Partial breastfeeding was defined as breastfeeding plus formula feeding before the baby reached the age of six months. Formula feeding was defined as feeding with cow or soy milk infant formula. Length of breastfeeding was determined by the age of the child at the cessation of breastfeeding, assuming they had breastfed since birth.

This study was approved by the Medical and Health Research Ethics Committee, Gadjah Mada University Medical School. All subjects' parents provided written informed consent for their children's participation.

Odds ratio and 95% CI were used to determine the association between breastfeeding and obesity. Statistical significance was analyzed by Chi-square test.

## Results

We screened 798 students from two schools and found 105 (13%) obese children. We randomly selected 68 obese subjects for the case group, and 68 non-obese control subjects, matched for age and gender from the same school. Characteristics of subjects and their mothers are presented in **Table 1**. The mean duration of breastfeeding in obese children was shorter than that in non-obese children, 12.9 months (9.78) vs. 16.1 months (8.39), respectively, with a mean difference of 3.24 months (95% CI 0.14 to 6.32) (not shown in Table).

**Table 2** shows that children who received formula had 6 times increased odds for obesity, compared to those who were exclusively breastfed. Those who were partially breastfed or non-exclusively breastfed (defined as partial breastfeeding and formula feeding groups combined) had almost 5 times increased odds for obesity. Risk of obesity also tended to decline with longer durations of breastfeeding, although the difference was not significant (**Table 3**).

**Table 1.** Characteristics of the study subjects and their mothers

| Characteristic                   | Obese<br>(n = 68) | Non-obese<br>(n = 68) |
|----------------------------------|-------------------|-----------------------|
| Mean age, years (SD)             | 7.2 (0.88)        | 7.2 (0.86)            |
| Sex                              |                   |                       |
| Male, n (%)                      | 47 (69)           | 47 (69)               |
| Female, n (%)                    | 21 (31)           | 21 (31)               |
| Mean weight, kg (SD)             | 40.2 (7.18)       | 23.9 (3.96)           |
| Mean height, cm (SD)             | 128.3 (7.08)      | 120.7 (5.80)          |
| Mean BMI, kg/m <sup>2</sup> (SD) | 24.4 (2.96)       | 16.4 (1.85)           |
| Maternal education               |                   |                       |
| High school or less, n (%)       | 18 (26)           | 25 (37)               |
| College, n (%)                   | 50 (74)           | 43 (63)               |
| Maternal occupation              |                   |                       |
| Works outside home, n (%)        | 41 (60)           | 45 (66)               |
| Housewife, n (%)                 | 27 (40)           | 23 (34)               |
| Maternal nutritional status      |                   |                       |
| Obese, n (%)                     | 7 (10)            | 4 (6)                 |
| Non-obese, n (%)                 | 61 (90)           | 64 (94)               |

## Discussion

Similar to previous studies, we observed that exclusive breastfeeding lowered the risk of obesity in childhood. Taveras *et al.* observed a lower incidence of obesity in 3 year-old children who were exclusively breastfed for 6 months compared to children who received formula or children who received both breast milk and formula.<sup>5</sup> Reviews by Dewey and Arenz *et al.* also concluded that breastfeeding had a small, but significantly protective effect on the incidence of obesity.<sup>11,17</sup>

In contrast, in a retrospective cohort study, Li *et al.* observed no effect of breast milk on BMI and the incidence of obesity in children aged 4 to 18 years.<sup>9</sup> Any effect of breastfeeding may have been limited to a critical period or dependent on other cofactors. After adjusting for sex, parent's BMI, maternal smoking during pregnancy, birth weight, and social class, they found no evidence that breastfeeding influenced BMI or obesity, nor did they find any dose-dependent trend in different age groups. Adjustment for confounding factors did not alter these findings.<sup>9</sup>

A cross-sectional study in children aged 3 to 5 years by Hediger *et al.* also concluded that breast milk did not reduce the risk for overweight in children.<sup>10</sup> In their study, breastfeeding and its duration were not considered to be protective against early childhood

**Table 2.** Comparison of exclusive breastfeeding to formula feeding, partial breastfeeding or non-exclusive breastfeeding until age 6 months for the incidence of obesity in children aged 6 to 8 years

|                                      | Obese<br>(n=68) | Non-obese<br>(n=68) | OR              | 95% CI         |
|--------------------------------------|-----------------|---------------------|-----------------|----------------|
| Exclusive breastfeeding, n (%)       | 10 (15)         | 31 (46)             | 1.0 (reference) | –              |
| Formula feeding, n (%)               | 8 (12)          | 4 (6)               | 6.20            | (4.67 to 7.73) |
| Partial breastfeeding, n(%)*         | 50 (74)         | 33 (49)             | 4.70            | (3.96 to 5.43) |
| Non-exclusive breastfeeding, n (%)** | 58 (85)         | 37 (54)             | 4.86            | (4.13 to 5.59) |

\* Breast milk and formula feeding until the age of 6 months

\*\*Partial breastfeeding group plus formula feeding group

**Table 3.** Various durations of breastfeeding compared to breastfeeding for > 9 months for the risk of obesity in children aged 6 to 8 years.

| Duration of breastfeeding                  | Obese<br>(n=68) | Non-obese<br>(n=68) | OR              | 95% CI       |
|--|-----------------|---------------------|-----------------|--------------|
| Never breastfed or breastfed < 1 mo, n (%) | 8 (12)          | 4 (6)               | 2.47            | 0.69 to 8.84 |
| 1 to 3 mos, n (%)                          | 7 (10)          | 4 (6)               | 2.16            | 0.58 to 7.94 |
| 4 to 6 mos, n (%)                          | 11 (16)         | 8 (12)              | 1.70            | 0.62 to 4.65 |
| 7 to 9 mos, n (%)                          | 4 (6)           | 5 (7)               | 0.99            | 0.24 to 3.94 |
| > 9 mos, n (%)                             | 38 (56)         | 47 (69)             | 1.0 (reference) | –            |

overweight. After adjusting for birth weight status, race, sex, age group, mother's BMI status, and the timing of introduction of solid foods, the study concluded that maternal obesity superseded infant feeding as a risk factor for being overweight in early childhood, suggesting shared familial dietary habits and activity patterns. Furthermore, the dose-dependent effect for duration of breastfeeding and risk for overweight was inconsistent compared with that for maternal obesity. Though breastfeeding continues to be strongly recommended, it was not considered as effective as other factors, such as dietary habits and physical activity, in preventing children from becoming obese.<sup>10</sup>

The mechanism of how breastfeeding reduces the risk of obesity is unclear, but several possible biological mechanisms have been suggested. Children who were breastfed adjusted better to intake of high-calorie foods. Breastfed children learned to self-regulate caloric intake better than non-breastfed infants. Breastfed infants also adapted more readily to new foods, influencing the subsequent caloric density of their diet.<sup>6</sup>

Breastfeeding may lead to lower body weight during the critical neonatal period and may be associated with a lower mean caloric intake in breastfed infants compared to formula-fed neonates. In animal experiments, the type of neonatal feeding was shown to influence the development of neuroendocrine circuits in the mediobasal hypothalamus that regulate appetite control and body weight, with long-term consequences for the risk of obesity. These mechanisms might explain why a longer duration of breastfeeding was associated with a decreased risk of obesity later in life.<sup>18</sup>

Breastfed and formula-fed infants had different hormonal responses to feeding. Formula-feeding provoked a greater insulin response, possibly resulting in earlier fat deposition. Another possibility is that higher protein intake in formula-fed infants had a programming effect on glucose metabolism.<sup>6</sup>

A limitation of this study was that breastfeeding history was obtained by relying only on mothers' memories. However, a previous study showed that mothers were able to remember the history of breastfeeding up to more than 30 years.<sup>19</sup> Another limitation of this study was that we did not assess other factors that might affect the incidence of obesity, such

as physical activity and eating patterns. The effect of these variables may vary in each stage of growth and development.

Our subjects were children from relatively high socioeconomic status families. Therefore, our results reflect the condition of children coming from such families. Studies in poorer families might result in higher levels of malnutrition in non-exclusively breastfed children.<sup>20</sup>

In conclusion, exclusive breastfeeding lowered the odds for obesity in children aged 6 to 8 years. Partially breastfed and formula-fed children had significantly higher odds for obesity than exclusively breastfed children, with OR of 4.70 (95% CI 3.96 to 5.43) for partial breastfeeding and 6.20 (95% CI 4.67 to 7.73) for formula feeding. Risk of obesity also declined with longer duration of breastfeeding.

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