

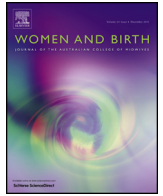


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### Review article

# Obesity and breastfeeding: The strength of association

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#### ABSTRACT

Obesity and attendant co-morbidities are an emergent problem in public health. Much attention has focused on prevention, especially during the perinatal period. Breastfeeding is considered a possible protective factor for obesity in childhood, influencing gene–neuroendocrine–environment–lifestyle interaction. Therefore, breastfeeding and its longer duration are probably associated with lower development of childhood obesity. Through human milk, but not formula, the child assumes greater bioactive factors contributing to immunological, endocrine, development, neural and psychological benefits. Contrarily, other studies did not confirm a critical role of breast milk. Confounding factors, especially maternal pre-pregnancy overweight, may influence breastfeeding effects. This review summarises what is known about the possible relationship between breastfeeding and prevention of obesity development.

*Conclusion:* Breastfeeding appears to represent a protective factor for obesity in childhood, although evidence is still controversial and underlying mechanisms unclear. Further research is needed to improve knowledge on overweight/obesity and breastfeeding.

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## 1. Introduction

Since the mid-1980s, obesity and attendant co-morbidities have been an emergent problem<sup>1</sup> in public health, in both developed as well as developing countries.<sup>2</sup>

A number of perinatal protective factors are associated with the risk of childhood obesity. These include breastfeeding, which represents the optimal nutritional form of feeding for newborns. It confers immunologic, neural, psychological, and developmental

benefits.<sup>3</sup> The absence of breastfeeding has been associated with increased risk of developing several childhood disorders<sup>4</sup> such as: asthma, respiratory infections,<sup>5</sup> atopic eczema,<sup>6</sup> celiac disease,<sup>7</sup> and obesity and/or overweight.<sup>8</sup> Particularly, human milk may be involved in growth and appetite control in the neonatal period and infancy, affecting the programming of energy balance regulation both in childhood and adulthood. Human milk varies from day to day influencing metabolic state and diet of infant, thus, it has been shown that a dose- and time-dependent association could correlate with a lower BMI in older children.<sup>9,10</sup> Prolonged duration and exclusivity of breastfeeding lead to lower growth rates during the first year of life and, subsequently, seem to lower risks of overweight and obesity in preschool children.<sup>10</sup> However, data that breastfeeding in early life might decrease risk of both short- and long-term obesity is controversial, showing both protective and null effects.<sup>11</sup> These results originate from observational studies, which can be altered by confounding factors such as individual (maternal age, level of education, maternal smoking, sedentary or physically activity lifestyle, maternal body mass index – BMI, and race/ethnicity), biomedical (parity, types of delivery, pregnancy complications, during pregnancy) social, and infant health.<sup>12–15</sup> A further confounding factor is that the

*Abbreviations:* BCAAs, branched-chained amino acids; BMI, body mass index; FTO, fat mass- and obesity-associated; GH, growth hormone; IGF-I, insulin-like growth factor-I; IGF-BP, insulin-like growth factor-binding protein; IL, interleukin; Ob-R, obestatin-receptor; PROBIT, Promotion of Breastfeeding Intervention Trial; TNF, tumour necrosis factor; WHO, World Health Organization.

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definition of exclusive and non-exclusive breastfeeding is not always clear even though the World Health Organization (WHO) have published specific definitions.<sup>16</sup> The aim of this review is summarises what is known about the possible relationship between breastfeeding and risk of obesity in childhood. For this purpose a literature search of electronic databases has been undertaken for the major studies published. The databases searched were: PubMed, EMBASE, Midline and Cochrane Library using the keywords “breastfeeding, children, and obesity”. Only published articles in English, assessing the effects of breastfeeding on obesity were considered.

## 2. Breastfeeding and obesity

In recent years several studies have been published focusing on the relationship between breastfeeding and obesity development. Some of them found a protective role of breastfeeding, while some did not.

In 2001, Dietz first reported a positive association between breastfeeding and obesity prevention in later life.<sup>17</sup> In 2005, Owen and collaborators reviewed 28 studies, with over 299,000 participants. They concluded that initial breastfeeding protects against obesity in childhood.<sup>18</sup> In 2007 Horta and colleagues, in a meta-analysis for the WHO, showed that breastfeeding was associated with 22% reduced risk of obesity in later life.<sup>19</sup> More recently, in 2013, a study, with multinomial logistic regression models with adjustment for children and maternal factors, confirmed that exclusive breastfeeding at 6–7 months of age was associated with decreased risk of overweight and obesity compared with formula feeding.<sup>20</sup> These data were also confirmed by Promotion of Breastfeeding Intervention Trial (PROBIT).<sup>21</sup> However, other studies did not find any protective role of breastfeeding on the development of obesity.<sup>22–25</sup> In an Australian birth cohort, using longitudinal analysis, adiposity was examined in relation to breastfeeding. Authors reported that infants breastfed more than 12 months were leaner at 1 year but not at 8 years. Additionally, they also noted that breastfeeding less than 4 months was associated with greatest risk of overweight from 1 to 8 years, and the highest prevalence of adverse maternal lifestyle (obesity, smoking, and lower education).<sup>22</sup> Kwok et al. in a cohort of 8327 Hong Kong Chinese children, did not find any association between breastfeeding and BMI at 7 years of age.<sup>23</sup>

Confirming these findings, a cross-sectional study investigated the weight status and the relationship of infant-feeding variables, birthweight and birth order with BMI in a group of Iranian children.<sup>24</sup> In this study a lower prevalence of overweight in breastfed children than formula- or mixed-fed children was reported, but not statistically significant.<sup>24</sup> In conclusion, not all authors agree on the relationship between breastfeeding and overweight.

## 3. Effects of breastfeeding duration on childhood overweight and/or obesity

The role of breastfeeding in protection against the development of obesity may be attributed to different factors. In particular, the duration of breastfeeding can directly influence the infant's ability to self-regulate milk intake and the infant's growth, promoting the development of differences between breastfed infants for short and long term. However, opinions and recommendations are strongly divided on the optimal duration of exclusive breastfeeding. The WHO and United States Department of Health and Human Services recently concluded that breastfeeding, for at least 6 months, can help reduce the risk of obesity in later life.<sup>16</sup> Harder and co-workers, using exclusively formula-fed subjects as the referent, noted that duration of breastfeeding and risk of

overweight were inversely correlated.<sup>25</sup> Furthermore, duration of breastfeeding reduced likelihood of hypercholesterolemia, hypertension and type 2 diabetes in later life.<sup>26</sup> Caleyachetty and colleagues also suggested that longer breastfeeding duration reduces the risk of obesity.<sup>27</sup> A shorter duration of breastfeeding is probably associated with precocious introduction of solid food, containing more protein than breast milk.<sup>28</sup> Furthermore, shorter duration of breastfeeding was correlated to reduced appetite signalling which in turns induces a greater number of feeding times.<sup>29</sup> Abarin et al. hypothesised that the longer duration of breastfeeding, through its ability to interfere on the fat mass- and obesity-associated (FTO) gene, might reduce the risk of overweight later in life. Recent studies have successfully identified the role of the FTO gene (SNP rs9939609 within the first intron) in increasing BMI and adiposity. It probably interferes with the hypothalamic regulation of appetite or energy expenditure and metabolic rate, and several factors can modify the role of this gene. Duration of breastfeeding is a good candidate as a risk modifier. However, ability of human milk to modify this gene has yet to be determined.<sup>30</sup> Authors concluded that breastfeeding for less than 2 months is insufficient due to poor exposure to protective factors in breast milk. Additionally, in 18 studies, duration of breastfeeding, if greater than 40 weeks, was positively related with a lower weight gain at 1 year.<sup>31</sup> Conversely, it has been suggested that breastfeeding for longer than 8 months may also be deleterious for the inhibition of newborn's hypothalamic–pituitary–thyroid axis, promoting weight gain.<sup>32</sup> Moreover, other studies did not find significant associations between the duration of breastfeeding and risk of obesity.<sup>33–36</sup>

However, there were several variations in methodological study designs that may have impacted the findings of possible relationship between duration of breastfeeding and risk of obesity/overweight in childhood.<sup>37</sup> The duration of breastfeeding was not the same among analysed studies, and the difference between exclusively and partially breastfed newborns was not always clear.<sup>38</sup> Additionally, due to the paucity of studies being conducted in this topic area, the definite minimal duration of breastfeeding required to reduce obesity risk in children remains uncertain.

## 4. Breastfeeding and maternal pre-pregnancy overweight

Rates of overweight/obesity are increasing among women of reproductive age and their children,<sup>28</sup> and thus it has been seen as crucial to find an explanation for this relationship. Hawkins et al. found that the children of overweight mothers are less likely to be breastfed with subsequent risk of development of obesity.<sup>39</sup> Several studies have confirmed that children of overweight mothers had a higher likelihood of becoming overweight or obese at 2 years of age.<sup>28,40,41</sup> The reason may be that overweight/obese mothers had an increased risk of pregnancy complications,<sup>42</sup> such as foetal macrosomia and caesarean-section delivery.<sup>43</sup> Moreover, researchers also suggest that many overweight/obese mothers have large heavy breasts which may adversely affect lactation.<sup>44</sup>

Baker et al. also showed that maternal pre-pregnant BMI was positively correlated with infant weight gain during the perinatal period.<sup>8</sup> This condition is probably caused by several factors. Some authors have also hypothesised that children born from obese mothers received more formula and thus more energy.<sup>45</sup> However, Rasmussen and Kjolhed demonstrated that excess adiposity in obese women contributes to dysregulation of the hypothalamic–pituitary–gonadal axis. They have a lower prolactin response to baby's suckling with delayed onset of milk production even if their newborns have stronger suction,<sup>46</sup> and a significant risk factor for formula supplementation.<sup>42,47</sup>

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