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The Impact of Exclusive Breastfeeding on the Risk of Obesity: A Narrative Review

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ABSTRACT

Background: Childhood obesity is a growing global health concern, affecting nearly 18% of children and adolescents worldwide. Exclusive breastfeeding (EBF) has been proposed as an effective strategy to promote optimal growth and prevent obesity in later life. However, evidence remains inconsistent due to methodological and contextual variations. This narrative review aims to synthesize recent evidence on the relationship between EBF and childhood obesity, including biological mechanisms and maternal factors influencing this association.

Methods: A literature search was conducted in PubMed, ScienceDirect, and Google Scholar for English-language articles published between 2020 and 2025 using the keywords "exclusive breastfeeding," "obesity," "overweight," and "BMI." Original human studies with cross-sectional, cohort, case–control, or interventional designs were included, while non-English, animal, and non-obesity-related studies were excluded. Seven eligible studies were analyzed narratively

Results: Most studies demonstrated that EBF was associated with a 24–44% reduction in obesity risk, with stronger protection observed for breastfeeding durations longer than six months. Biological mechanisms include better appetite regulation, lower protein intake, improved insulin and IGF-1 balance, and healthier gut microbiota. Rapid weight gain during infancy partially mediated this association. Maternal obesity, inflammation, and gestational diabetes were identified as key modifiers of EBF duration and protective effects.

Conclusion: Exclusive breastfeeding provides measurable protection against obesity through nutritional, hormonal, and metabolic pathways. Promoting EBF for the first six months of life should remain a global public health priority, supported by strategies that enhance maternal health, breastfeeding education, and equitable lactation support.

Keywords: Breastfeeding, Childhood Obesity, Exclusive Breastfeeding, Rapid Weight Gain

A. BACKGROUND

Childhood obesity has emerged as a critical global health challenge, affecting approximately 18% of children and adolescents worldwide, with projections suggesting it could reach 25% by 2050 if current trends persist[1]. Obesity in early life is strongly linked to metabolic disorders such as insulin resistance, type 2 diabetes, and cardiovascular disease, making early preventive strategies essential. Among various preventive approaches, exclusive breastfeeding (EBF) has been consistently recognized as a natural and effective nutritional intervention that supports optimal infant growth and reduces later obesity risk.

Breast milk provides a precise balance of macronutrients, micronutrients, and bioactive compounds—such as hormones (leptin, adiponectin, and insulin), oligosaccharides, and growth factors—that regulate appetite and energy metabolism[2]. Compared to formula-fed infants, breastfed infants consume lower protein quantities, resulting in reduced serum insulin and insulin-like growth factor 1 (IGF-1) levels, which contribute to slower and healthier weight gain trajectories. The World Health Organization (WHO) recommends exclusive breastfeeding for the first six months of life and continued breastfeeding with complementary feeding until at least two years of age[2].

Clinical and epidemiological evidence underscores breastfeeding's protective effect against obesity. A multinational cohort from the TEDDY Study demonstrated that exclusive breastfeeding for more than three months was associated with a 32–38% reduction in obesity risk at 5.5 years (adjusted OR 0.62; 95% CI: 0.47–0.81)[3]. Similarly, an analysis of 9,329 children in China found that those breastfed for over six months had a 42% lower risk of overweight or obesity (OR 0.58; 95% CI: 0.44–0.78) compared with those breastfed for less than one month, even among high-risk groups such as infants of mothers with gestational diabetes mellitus (Huang et al., 2024). Evidence from U.S. NHANES data (2009–2020) further revealed that even short-term breastfeeding (three to six months) was associated with a 44% lower obesity risk in children aged 3–4 years compared with those never breastfed[4].

Beyond epidemiological associations, several clinical pathways may explain how EBF influences long-term adiposity regulation. Breastfeeding promotes healthier gut microbiota colonization, improves insulin sensitivity, and enhances leptin signaling, contributing to long-term energy balance. Furthermore, the maternal metabolic state plays a crucial role. Maternal obesity and metabolic inflammation can alter breast milk composition—affecting lipid profiles and hormonal content—which may modulate infants' metabolic programming. In a multicohort study across Spain, Greece, and the United States involving 5,120 mother–child pairs, mothers with obesity had significantly shorter EBF durations ($\beta = -0.73$ months, 95% CI: −0.90 to

−0.55), mediated partly by elevated C-reactive protein (CRP) levels and dietary inflammatory index[5]. This highlights how maternal inflammation and metabolic stress can diminish breastfeeding success and, indirectly, child obesity protection.

Conversely, maternal conditions such as diabetes mellitus and hypertension are linked to lower breastfeeding rates and shorter durations. A study among Saudi mothers showed exclusive breastfeeding prevalence of only 36.9%, with markedly lower rates among obese (28.8%) and diabetic mothers (29.1%), both significantly associated with non-exclusive breastfeeding ($p = 0.04$)[6]. These findings emphasize that maternal metabolic health not only affects breastfeeding behavior but may also influence the biological quality of breast milk.

In summary, exclusive breastfeeding confers both nutritional and clinical advantages that contribute to lowering obesity risk in children through hormonal, metabolic, and epigenetic pathways. Integrating these findings from recent international evidence underscores the importance of maternal health optimization and lactation support as integral components of clinical and public health strategies for preventing childhood obesity.

B. METHODS

This study was conducted as a narrative review with the objective of synthesizing and critically analyzing recent evidence on the relationship between exclusive breastfeeding (EBF) and the risk of childhood obesity. The narrative review design was chosen to enable a comprehensive examination of both epidemiological and clinical findings, including the mechanistic pathways linking EBF to metabolic regulation and adiposity outcomes.

The literature search targeted peer-reviewed articles published in English between 2020 and 2025. The following keywords and Boolean operators were applied: “exclusive breastfeeding” AND “obesity” OR “overweight” OR “BMI”. In addition, manual searches of reference lists from relevant reviews and original studies were performed to identify additional sources not captured through electronic database searches.

The inclusion criteria comprised original research articles assessing the association between exclusive breastfeeding and the occurrence of overweight or obesity in children, conducted on human populations using cross-sectional, cohort, case–control, or interventional designs. Studies were excluded if they were non-English publications, case reports, conference abstracts, animal studies, or focused solely on breastfeeding initiation without reporting obesity-related outcomes.

Article selection was performed by two independent reviewers who screened titles and abstracts, followed by full-text assessments to determine final eligibility.

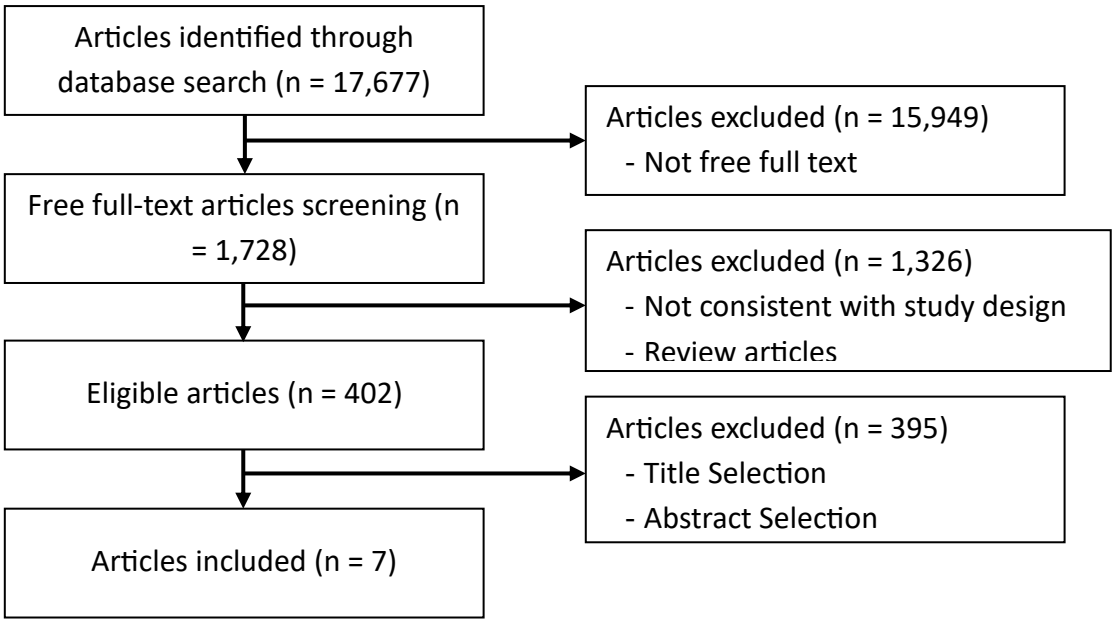

Figure 1 Flowchart of Article Selection Process

Table 1 Selected Studies on Sugar-Sweetened Beverages and Obesity Risk

Title	Author (Year)	Study Design	Country	Result
Mediating Effect of Infant Rapid Weight Gain on the Association Between Exclusive Breastfeeding and the Risk of Obesity Later in Life	González, *et al*. (2024)[7]	*Longitudinal observational*	Spanyol	The proportion of children who were obese at six years of age was 14.5% overall. Within this group, those who were formula-fed and experienced Rapid Weight Gain (RWG) during the first year of life had a higher prevalence of obesity (17%) compared to those who were exclusively breastfed and did not experience RWG (9.3%). Furthermore, the data showed that children who were formula-fed during the first four months had an obesity rate of 22.5%, whereas those who were exclusively breastfed had an obesity rate of only 14.5%.
Exclusivity of breastfeeding and body composition: learnings from	Jayasinghe, *et al*. (2021)[8]	*Prospective cohort*	Australia	There were no significant differences in body weight, fat mass, or body composition between infants who received exclusive

the Baby-bod study				breastfeeding (EBF) and those who received non-exclusive breastfeeding (nEBF) during the first six months of life. At six months, the fat-free mass of nEBF infants was significantly higher (3.01 ± 0.35 kg) compared to EBF infants (2.89 ± 0.34 kg) ($p = 0.03$).
Exclusive breastfeeding can attenuate body-mass-index increase among genetically susceptible children: A longitudinal study from the ALSPAC cohort	Wu, et al. (2020)[9]	*Prospective cohort*	United Kingdom	The findings indicated that exclusive breastfeeding for five months reduced BMI at 18 years of age by 1.14 kg/m² in boys and 1.53 kg/m² in girls with a high genetic risk for obesity, effectively counteracting the increased genetic predisposition.
Breastfeeding and childhood obesity: A 12-country study	Ma, et al. (2020)[10]	*Cross-sectional*	Australia	Furthermore, the study showed that exclusive breastfeeding was associated with a decreased risk of general obesity and high body fat levels among children aged 9 to 11 years across 12 different countries. Children who were exclusively breastfed had approximately 24–40% lower odds of developing obesity or excess body fat compared with those who were exclusively formula-fed, with respective odds ratios of 0.66 and 0.60 after adjustment for confounding variables. Additionally, breastfeeding for more than 12 months showed a trend toward further reduction in obesity risk, although not always statistically significant. These findings support the conclusion that breastfeeding provides a

				protective effect against childhood obesity.
Breastfeeding and overweight/ obesity among children and adolescents: a cross-sectional study	Liu, et al. (2022)[11]	*Cross-sectional*	China	The prevalence of overweight and obesity among children and adolescents aged 6 to 16 years in Shibei District, Qingdao, was 15.45% and 19.76%, respectively. A significant negative correlation was observed between breastfeeding duration and the BMI of children and adolescents. Specifically, those who were breastfed for more than 12 months had a lower BMI compared to those breastfed for less than 12 months, with $\beta = -0.440$ (95% CI: -0.655, -0.224, $P < 0.01$). This finding suggests that longer breastfeeding duration may be associated with a lower risk of overweight and obesity in this population.
Breastfeeding is associated with reduced risks of central obesity and hypertension in young school-aged children: a large, population-based study	Lin, et al. (2023)[12]	*Cross-sectional*	China	Children who were exclusively breastfed for six months had a lower risk of central obesity, defined as a waist-to-height ratio (WHtR) ≥ 0.5 and waist circumference at or above the 90th percentile, with significant risk ratios of 0.73 (95% CI: 0.55–0.96; $P = 0.03$) and 0.78 (95% CI: 0.64–0.95; $P = 0.01$), respectively, compared with children who were not exclusively breastfed. In addition, exclusive breastfeeding for 1–5 months was also associated with a reduced risk of central obesity, with a risk ratio of 0.73 (95% CI: 0.55–0.96; $P = 0.03$).

Relationship Between Exclusive Breastfeeding and Body Mass Index in 3-6 Years Old Children in Bojnourd in 2019	Mafinezhad, et al. (2020)[13]	*Cross-sectional*	Iran	The study results indicated that there was no significant association between the duration of exclusive breastfeeding and the body mass index (BMI) of children aged 3–6 years in Bojnourd, Iran. Although the duration of exclusive breastfeeding was longer among children with excess body weight, this difference did not reach statistical significance ($p = 0.31$). The prevalence of obesity among children in this study was 6.7%, and overweight was 10.6%, indicating that obesity remained relatively low in this population. Therefore, the duration of breastfeeding did not appear to have a direct impact on the body weight of children in the studied sample.

C. RESULT AND DISCUSSION

Childhood obesity has become a major global public health concern, with prevalence rising sharply over the past three decades. According to the World Health Organization (WHO), more than 39 million children under the age of five are currently overweight or obese, and this number continues to grow in both developed and developing countries. Multiple environmental, genetic, and behavioral factors contribute to this complex issue. In early prevention efforts, exclusive breastfeeding (EBF) for the first six months of life has long been identified as a key strategy for promoting optimal growth and preventing long-term obesity. However, scientific evidence regarding the causal link between EBF and obesity risk remains inconsistent, primarily due to methodological variations, population differences, and differences in how confounding variables are controlled.

Recent studies reviewed in this article provide new perspectives that strengthen the notion that EBF has a protective effect against increased body mass index (BMI), adiposity, and obesity risk during childhood and adolescence. Moreover, the biological and environmental mechanisms underlying this association have become clearer, including the

roles of appetite regulation, macronutrient composition of breast milk, and potential interactions with genetic predisposition.

Findings from the multinational ISCOLE (International Study of Childhood Obesity, Lifestyle and the Environment) involving 12 countries demonstrated that children who were exclusively breastfed had 24% lower odds of obesity (OR 0.76) compared with those exclusively formula-fed(10). Longer breastfeeding duration (>12 months) further reduced obesity risk by up to 40%. Although statistical significance diminished after adjustment for maternal BMI, the results indicate that EBF serves as a protective factor across diverse social and geographical settings.

A large Chinese cross-sectional study by Liu et al. (2022) reinforced this conclusion, reporting a negative correlation between breastfeeding duration and BMI among children aged 6–16 years ($\beta = -0.025$, $p < 0.01$), with the strongest protective effect observed among boys aged 9–11 years[(11)]. Similar findings were reported in a Greek cohort of 674 preschool children, where those breastfed for more than six months had a lower prevalence of obesity than those breastfed for shorter durations[(14)].

The consistency of results across populations suggests that EBF confers beneficial effects regardless of ethnicity or socioeconomic background. Nevertheless, the strength of association often varies depending on maternal characteristics such as body mass index, educational level, and gestational diabetes history, which may mediate the relationship.

1. Duration and Exclusivity: Two Critical Dimensions

Both the duration and exclusivity of breastfeeding play complementary roles in obesity prevention. The longitudinal ALSPAC cohort study by Wu et al. (2020) found that EBF for five months reduced BMI by 1.14–1.53 kg/m² at age 18, particularly among children with a high genetic risk of obesity[(9)]. In contrast, EBF for only three months or partial breastfeeding showed much weaker protective effects.

Similarly, Jayasinghe et al. (2021) in the *Baby-Bod Study* showed that breastfeeding exclusivity influenced infant body composition trajectories. Exclusively breastfed infants displayed different fat mass index (FMI) trajectories compared with non-exclusively breastfed infants, indicating that breast milk nutrition helps shape early-life energy balance and metabolism[(8)]. Thus, both longer duration and strict exclusivity—without formula or early complementary feeding—are important to achieve optimal protective outcomes.

2. Biological Mechanisms: From Nutrition to Epigenetics

The protective association between exclusive breastfeeding (EBF) and the risk of obesity can be explained through several plausible biological mechanisms that operate early in life.

First, appetite and metabolic hormone regulation play an essential role. Breast milk naturally contains hormones such as leptin, adiponectin, ghrelin, and insulin at physiological levels, all of which help regulate appetite, energy expenditure, and fat metabolism. Breastfed infants generally develop better satiety cues and appetite control compared to formula-fed infants, thereby reducing the likelihood of overeating in later stages of life. Another important mechanism involves the lower protein content of breast milk relative to formula. Infant formula typically contains about 60–80% more protein than breast milk, and this excessive protein intake stimulates the secretion of *insulin-like growth factor-1* (IGF-1), which promotes adipocyte proliferation and fat deposition. This difference in macronutrient composition contributes to more balanced growth among breastfed infants and may protect against rapid fat accumulation.

Furthermore, as demonstrated in the study by Martin et al. (2014) (Figure 2), there are clear metabolic differences between breastfed infants and those fed with formulas of varying protein content. Breastfed infants exhibited higher levels of milk oligosaccharides and lactic acid in their stool, indicating enhanced carbohydrate fermentation and healthier gut microbiota activity[15]. In contrast, formula-fed infants—both those receiving high-protein (HF) and low-protein (LF) formulas—showed elevated concentrations of short-chain fatty acids (SCFAs) such as propionate, butyrate, and acetate, as well as free amino acids including phenylalanine, tyrosine, leucine, and isoleucine. These findings reflect increased proteolytic activity and more intensive protein metabolism, resulting from the higher protein content of infant formula. Breastfed infants demonstrated a gradual increase in ketone body production (3-hydroxybutyrate and acetoacetate) as a physiological adaptation to the high fat content of human milk, providing a stable energy source for brain development without promoting excessive fat storage. In contrast, formula-fed infants tended to have higher acetoacetate but lower 3-hydroxybutyrate levels, suggesting that protein-derived substrates contributed more prominently to ketogenesis in this group[15].

Additionally, the regulation of gut microbiota serves as a key pathway linking EBF to obesity prevention. Breast milk provides unique prebiotic oligosaccharides that promote the growth of beneficial bacteria such as *Bifidobacterium* and *Lactobacillus*, which are linked to healthier energy homeostasis and reduced inflammation. A balanced early-life microbiome is increasingly recognized as a determinant of long-term metabolic health and obesity risk. Beyond the gut environment, epigenetic and metabolic programming mechanisms have also

been proposed. Evidence from the ALSPAC cohort indicates that EBF can modulate the interactions between obesity-related genes, such as *FTO* variants, and early-life nutrition.

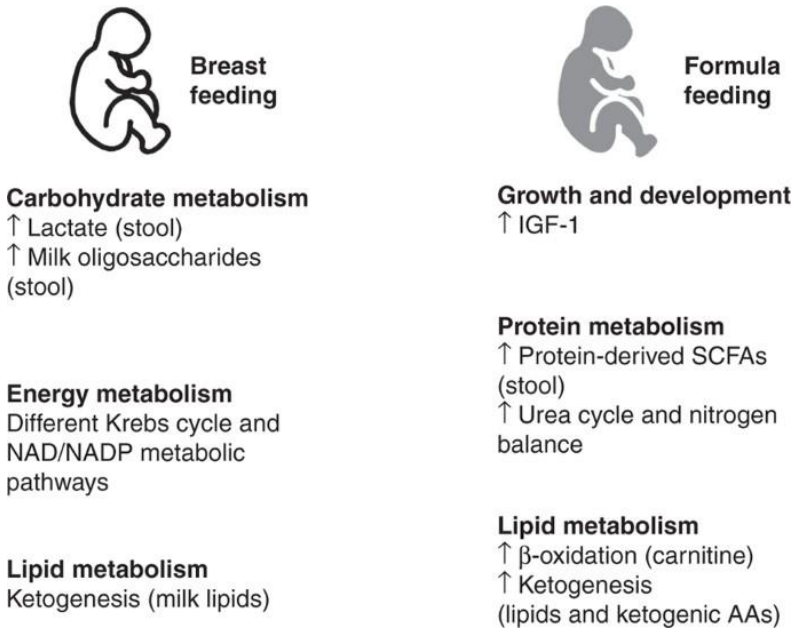

Figure 2 Overview of metabolic differences between breastfed and formula-fed infants (Adapted from Martin et al., 2014)[15]

This suggests that EBF may function as an "epigenetic buffer," influencing gene expression patterns that govern energy storage, appetite regulation, and fat metabolism[9]. Lastly, feeding behavior and self-regulation contribute significantly to this protective effect. Direct breastfeeding allows infants to self-regulate their intake based on hunger and satiety cues, fostering natural control over energy consumption. In contrast, bottle-fed infants are often encouraged to finish their bottles regardless of hunger level, potentially establishing early-life habits of overconsumption. Collectively, these mechanisms underscore how EBF promotes physiological growth regulation and metabolic programming that collectively reduce the long-term risk of obesity.

3. Mediation Effect: The Role of Rapid Weight Gain

The longitudinal study by Nagore González et al. (2025) provided important insight into the mediating effect of rapid weight gain (RWG) in the relationship between EBF and later obesity[7]. Formula-fed infants exhibited higher rates of RWG (39.7%) than exclusively breastfed infants (32.2%), and RWG was significantly associated with increased BMI and obesity prevalence at age six. Mediation analysis indicated that approximately 30–40% of the EBF–BMI relationship was explained by RWG, emphasizing that early weight gain trajectories are a key pathway through which EBF protects against obesity[7].

Therefore, the benefit of EBF extends beyond nutrient composition—it also supports more physiologic, moderate weight gain patterns in infancy. Monitoring infant growth velocity, particularly among non-EBF infants, is crucial for obesity prevention strategies.

4. Maternal and Socioeconomic Factors

While most studies support the protective effect of EBF, some findings highlight that maternal and socioeconomic factors can modify this relationship. In the ISCOLE study, the association between EBF and lower obesity risk became statistically non-significant after adjustment for maternal BMI, suggesting that maternal adiposity is a strong determinant of child weight status[10].

Additionally, maternal education, employment, and socioeconomic status influence both breastfeeding duration and child dietary habits. Mothers with higher education levels tend to breastfeed longer, possess better nutritional awareness, and are less likely to introduce complementary foods prematurely. Therefore, public health strategies to promote breastfeeding should address equity in breastfeeding support and education across different socioeconomic groups[10].

5. Additional Outcomes: Blood Pressure and Metabolic Comorbidities

Beyond reducing obesity risk, EBF also shows protective effects against other cardiometabolic factors. A large population-based study from Shanghai by Lin et al. (2023) found that each additional month of breastfeeding decreased systolic blood pressure by 0.07 mmHg and diastolic pressure by 0.05 mmHg[12]. Children breastfed exclusively for more than one month had 24% lower risk of central obesity and 16% lower risk of hypertension at primary school age[12].

These findings suggest that EBF serves as a multifactorial intervention that not only prevents excess weight gain but also promotes healthier cardiovascular regulation and metabolic profiles in later childhood[12].

6. Inconsistencies and Interpretation Challenges

Although most evidence supports the protective role of EBF, some studies report non-significant associations after multivariate adjustments. This variability can be explained by methodological and contextual factors. Differences in study design—particularly between longitudinal and cross-sectional approaches—affect the strength of causal inference. Cross-sectional studies often capture associations without accounting for temporal relationships. Recall bias is another limitation, as breastfeeding duration is frequently obtained retrospectively from maternal self-report. Inconsistencies in defining EBF further complicate comparisons across studies; some researchers include the provision of water or vitamin

supplements under EBF, whereas the WHO's definition strictly prohibits any additional liquids or solids. Uncontrolled confounding factors, such as children's physical activity, sleep patterns, and parental nutritional status, may also distort associations. Furthermore, most available data derive from high-income populations with better healthcare and nutrition access, limiting the generalizability of findings to low- and middle-income settings. Hence, future research should focus on prospective cohort studies in high-risk regions using standardized, objective measurements and long-term follow-up to establish stronger causal evidence between EBF and obesity risk.

7. Policy and Public Health Implications

The collective findings from global research strongly support the promotion of exclusive breastfeeding for the first six months as a key component of childhood obesity prevention strategies. National programs such as the *Baby-Friendly Hospital Initiative (BFHI)* and adequate maternity leave policies play major roles in improving breastfeeding outcomes.

Beyond hospital-based initiatives, community-level interventions involving families, workplaces, and social media platforms are essential to build supportive environments for breastfeeding mothers. Professional lactation counseling and peer support groups have been shown to significantly enhance EBF rates and duration[1,2,16].

Moreover, obesity prevention should also focus on the post-EBF period, emphasizing appropriate and nutritious complementary feeding practices to avoid excessive caloric intake after six months[17,18].

D. CONCLUSION

Based on this narrative review of seven contemporary studies, several key conclusions can be drawn regarding the role of exclusive breastfeeding (EBF) in obesity prevention. The collective evidence demonstrates that EBF is significantly associated with a lower risk of obesity during childhood and adolescence, with stronger protective effects observed when breastfeeding continues for more than six months. This association appears to be partially mediated by rapid weight gain during infancy, emphasizing the importance of monitoring early growth trajectories as part of obesity prevention strategies. Moreover, genetic susceptibility to obesity can be modulated by early-life nutrition, with EBF serving as a buffering factor that may alter gene–environment interactions involved in adiposity regulation. Beyond its impact on weight outcomes, EBF provides broader cardiometabolic benefits, including improved blood pressure regulation and reduced central adiposity, underscoring its role in supporting overall metabolic health. Although residual confounding cannot be entirely excluded, the

consistency of findings across diverse populations and study designs supports EBF as an effective, low-cost, and universally applicable intervention for the long-term prevention of obesity and related disorders. Consequently, exclusive breastfeeding for the first six months of life should be regarded not only as the gold standard of infant nutrition but also as a strategic public health investment with lifelong benefits. Achieving this goal requires coordinated, cross-sectoral efforts that integrate supportive social policies, professional healthcare training, and community-based education to enhance breastfeeding initiation, exclusivity, and duration, thereby maximizing its protective potential against the growing global obesity epidemic.

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