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Exclusive breastfeeding as a protective factor against overweight and obesity in children: A community-based study

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Abstract

Background: Childhood obesity is a prevalent global health problem. Overweight/obesity is abnormal and excessive accumulation of body fat caused by prolonged positive energy balance. Exclusive breastfeeding has shown its effectivity in reducing mortality in children and preventing diseases, including overweight/obesity.

Purpose: To investigate the role of EBF as a protective factor against childhood overweight/obesity.

Method: This study used retrospective case-control observational analytical approach. The target population included 126 children aged 12-59 months attending "Mother-Toddler Class" in March 2026. Breastfeeding history was evaluated using questionnaire adapted from 2017 IDHS while nutritional status was determined using WHO Child Growth Standards.

Results: Analysis showed association between EBF and overweight/obesity in children was not statistically significant ($p = 0.068$). Nevertheless, EBF showed high clinical impact with 3.167-fold increased risk of overweight/obesity in non-exclusively breastfed infants ($OR = 3.167$).

Conclusion: Despite the marginally significant association in this study, EBF remained beneficial in preventing overweight/obesity in children. Childhood obesity is a serious public health concern that requires national-level policies, with focus on promoting EBF and supporting healthy weight gain.

Suggestion: National policies should focus on integrating supportive environments within workplace to ensure EBF. Standardized program like Mother-Toddler Class should be scaled nationally along with digitalization.

Keywords: Childhood Overweight and Obesity; Exclusive Breastfeeding; Public Health.

INTRODUCTION

Obesity in pediatric population is a global health problem with perennially rising prevalence in low- and middle-income countries (LMICs) complementing the already high prevalence in numerous high-income countries (Jebeile et al., 2022). World Health Organization (WHO) describes overweight and obesity as abnormal and excessive accumulation of body fat in the human body caused by prolonged positive energy balance (Jebeile, Kelly, O'Malley, & Baur, 2022). 24 million children worldwide were diagnosed with overweight/obesity in 2015 including Indonesia with the prevalence as high as 11.5%. Highest prevalence was found in Jakarta, Bali, and Papua (Ayu & Fa'uni, 2021). Additionally, World

Obesity Federation also provided data showing that by 2030, 254 million children and adolescents aged 5-19 years is predicted to suffer from obesity, with the possibility of persistence into adulthood resulting in chronic disorders (Zhang, Liu, Ni, Yi, Fang, Ning, & Li, 2024).

In the society, a considerable amount of mother considered obese toddlers as healthy due to the impression of the toddler receiving sufficient food supply (Ayu & Fa'uni, 2021). However, overweight/obesity remained a disease requiring medical management. Increased adiposity in children is associated with compromised glucose metabolism along with the thickening of carotid intima-media,

making children at risk of developing cardiovascular and metabolic disorder (Tung, Poon, Du, & Wong, 2023). People with complication from early childhood disease, including overweight and obesity, is even predicted to live 3 years and 10 months shorter than they originally could (Kiciak, Słoma-Krześlak, Szczepańska, Białek-Dratwa, Bielaszka, Staśkiewicz-Bartecka, & Kowalski, 2024).

Obesity and overweight in children are linked to the interaction of factors beginning as early as preconception period to adolescence (Nogueira-de-Almeida, Weffort, Ued, Ferraz, Contini, Martinez, & Del Ciampo, 2024). One of the most influential causes is the history of human milk consumption by an infant with no other supplement, except for vitamins, minerals, and medications, also known as exclusive breastfeeding (EBF). EBF is recommended to be initiated within the first hour of birth continued for six months and later accompanied by sufficient complementary feeding until reaching the age of 2 years (Ahmed, Hamid, Shanmugam, Tia, & Alnassry, 2023). For babies, EBF reduces mortality due to infection, helps recovery, and increases immunity. While for mothers, EBF protects them from risk of ovarian and breast cancer along with reducing the risk of maternal obesity (Laksono, Wulandari, Ibad, & Kusri, 2021). Despite its numerous benefits, approximately 63% of babies in LMICs did not receive EBF (Hossain & Mihrshahi, 2022). Especially in Indonesia, EBF rate (52.3%; 95% CI: 0.498-0.548) is lower compared to peer countries, such as Cambodia, Bangladesh, and India (Gayatri, 2021).

RESEARCH METHOD

This study employs retrospective case-control observational analytical approach with the purpose of investigating the effect of EBF as a protective factor against overweight and obesity in children. This study was conducted in Public Health Center of Ardimulyo, Malang, East Java, Indonesia. The center was established in 1985 as a part of government program in providing access to primary health care for the community. This study is carried out by doctors undergoing Indonesia Medical Internship Program as a part of the obligatory mini-project. The target

population for this study included 126 children aged 12-59 months attending the "Mother-Toddler Class" or "Kelas Ibu-Balita" in 8 villages included in the service area of Ardimulyo Public Health Center in March 2026. The inclusion criteria used in this study included: a) children aged 12-59 months during data collection, b) children attending Mother-Toddler Class in the service area of Ardimulyo Public Health Center in March 2026, c) guardian consented to participate in the study by signing the provided informed consent. Exclusion criteria in this study included: a) wasted or severely wasted children according to BMI-for-age ratio provided by WHO Child Growth Standards, b) children with chronic disease, congenital condition, or syndromes medically affecting nutritional status, c) guardian without "Mother-Child Health Handbook", also known as "Buku Kesehatan Ibu dan Anak (KIA)" and/or guardian failed to recall EBF history.

Methods to gather data include: a structured questionnaire sheet, anthropometric measurement tools, and WHO Child Growth Standards for interpretation. The questionnaire used in this research is adapted from the 2017 Indonesia Demographic and Health Survey (IDHS) with added demographic characteristics of the subjects. Anthropometric measurement tools are all calibrated, including: baby scale, floor scale, infantometer, and microtoise. Nutritional status was determined using BMI-for-age based on WHO Child Growth Standards. For statistical power and clinical reference, nutritional status was categorized into 2 groups: normal weight (z-score -2 SD to +2 SD) and overweight/obesity (z-score > +2 SD). BMI-for-age was chosen instead of weight-to-height or weight-to-length ratio for its superior sensitivity in identifying overweight/obesity in children. Maternal education was divided into 2 levels based on the highest educational level completed: low (less than 9 years of schooling) and high (9 years or more). Maternal age was divided into 2 groups: high-risk (<20 years or >35 years) and low-risk (20-35 years), based on standard reproductive age risk categories. Data obtained were later collected and analyzed using Statistical Package for Social Sciences (SPSS v22). Results were presented in tables describing frequency and percentage.

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RESEARCH RESULTS

Table Characteristics of Respondent (N=126)

Variable	Results	P-value	OR (95% CI)
Nutritional Status (n%)			
Overweight/Obesity	20/16.0		
Normal	106/84.0		
Breastfeeding History (n%)		0.068	3.167 (0.872-11.504)
Non-exclusive	85/67.5		
Exclusive	41/32.5		
Gender (n%)		0.040	3.000 (1.017-8.846)
Female	58/46.0		
Male	68/54.0		
Maternal Education (n%)		0.395	1.537 (0.568-4.158)
Low	55/43.7		
High	71/56.3		
Maternal Occupation (n%)		0.001	4.705 (1.711-12.935)
Employed	43/34.0		
Unemployed	83/56.0		
Maternal Age (n%)		0.156	0.480 (0.171-1.344)
High-Risk	56/44.4		
Low-Risk	70/55.6		

The table shows the breastfeeding history, nutritional status, along with demographic distribution of the 126 participants, consisting of predominantly male subjects (54.0%). The majority of the children had normal weight (84.1%) with most children being non-exclusively breastfed (67.5%). Regarding the maternal factors, most mother aged 20-35 years old (55.6%), were unemployed (65.9%), with high educational level (56.3%).

Presents the bivariate analysis using Chi-square test showing the relationship of several factors and the occurrence of overweight or obesity in children. Maternal occupational status was found to be a significant factor ($p = 0.001$) with children of employed mothers had a 4.705 times higher risk of being overweight or obese (95% CI: 1.711-12.935). Another factor with significant impact includes gender of the children ($p = 0.040$) with male subjects having 3.000 times higher risk compared to female subjects. Despite being only marginally significant, a notable clinical trend was observed between EBF and nutritional status ($p = 0.068$) with children not exclusively breastfed had a 3.167 times higher risk of developing overweight/obesity. Other factors in this study such as maternal age and education did not show a statistically significant association with the children's nutritional status.

DISCUSSION

Overweight and obesity in children is a complex health issue caused by interaction of equally important factors including genetic, environmental, and psychological factors (Kiciak et al., 2024). AAP along with UNICEF recommend EBF for as long as 6

months as a key to healthy growth and development. EBF is linked to overall mortality rates reduction along with significant protection against obesity and overweight in children (Ahmed et al., 2023). Nevertheless, despite several studies done in the

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past, inconsistent uptake of EBF definition called for further research regarding its association with childhood overweight and obesity (Del Castillo, Dennis, Wamithi, Briollais, McGowan, Dol, & Lye, 2022). Here, we use the definition set by WHO which is consistent with the 2017 IDHS. Our study revealed that the association between EBF and the occurrence of overweight/obesity in pediatric population was marginally significant ($p = 0.068$), suggesting a notable, clinically relevant trend where children without EBF had a higher tendency toward overweight/obesity. Additionally, children who did not receive EBF had a 3.167 times higher risk of becoming overweight/obese ($OR = 3.167$; 95% CI: 0.872-11.504) compared to those who did. This finding was in line with a cross-sectional study from Banten which showed that non-exclusively breastfed children were 7.8-fold more likely to develop obesity (Sari & Zounia, 2025). Similar results were also observed in a case-control study from Bali mentioning that children without EBF had 4.878-fold higher risk to develop aforementioned disease (Purwaningrum, 2022).

A systematic review revealed a dose-response association between breastfeeding and risk of overweight/obesity in children (Del Castillo et al., 2022). This phenomenon can be explained by series of mechanism, ranging from genetic level alteration to sociocultural aspects. Postnatal nutritional programming related to obesity can be modulated through epigenetic modification through breastfeeding. Breastfeeding facilitates gene expression modification, namely altering the DNA methylation of fat mass and FTO gene which regulates energy metabolism and appetite control. These alterations are associated with the duration of breastfeeding itself. Despite the recommended 6-months period, extending breastfeeding above the period might give additional protection against overweight/obesity with reduction as much as 1% in BMI and 2% in fat mass in each additional month (Muraglia, Faienza, Tardugno, Clodoveo, De la Cruz, Bermúdez, & Orellana-Manzano, 2024); Yang, Li, Cui, Liu, Wang, Zhang, & Wen, 2024).

In regards of hormonal modulation, children with EBF were also observed to develop better satiety control due to appetite-regulating hormones, such as leptin, adiponectin, and ghrelin useful in preventing

excess energy intake. Studies also revealed that babies with EBF show less desire to drink sugary beverages promoting healthier diet (Roldão, Lopes, Silva, Neves, Gomes, Gavina, & Taveira-Gomes, 2024). In addition to that, EBF also delivers nutrients tailored according to infant growth, in contrast to formula which contains higher energy density resulting in considerable caloric intake and adiposity. These unique and dynamic breastmilk contain composition that changes over time while providing bioactive factors linked to the infant's metabolism (Muraglia et al., 2024; Sari & Zounia, 2025).

Breastmilk in babies also affect gut microbiota responsible for rich microorganism compared to obese infants. During breastfeeding, skin-to-skin contact along with colostrum consumption affect colonization process positively affecting metabolic and immune development (Muraglia et al., 2024).

Our research confirmed that overweight and obesity were more common in boys than girls, which is in line with a systematic review by other research similar result was also observed in a study where overweight and obesity being significantly higher in boys than girls. This disparity might be caused by complex interplay of factors (Zhang et al., 2024). Biologically, aside from genetic differences, female children tend to show slower growth from the gestation to infancy, lower lean mass, and higher body fat percentage causing decreased caloric requirements. Culturally, the tendency of girls towards healthier diet regarding their weights also affect parental habit and concerns (Sámano, Lopezmalo-Casares, Martínez-Rojano, Chico-Barba, Gamboa, Plascencia-Nieto, & Téllez-Villagómez, 2025). This sociocultural aspect might differ between one region and the other as seen in a study in Bali where all gender had the same risk of developing overweight/obesity (Purwaningrum, 2022).

Despite the statistically insignificant result ($p = 0.395$), educational level association with childhood nutritional status remained a compelling aspect to observe, especially considering the opposite result found in many literatures. A multivariate study in Mexico revealed that maternal education was one of the significant predictors of childhood nutritional status between two years of age (Sámano et al., 2025). A local study also showed that mother's education significantly affects EBF practice,

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additionally supported with data from Nigeria and China (Laksono et al., 2021).

One of the suspected mechanisms of this disparity is due to the economic heterogeneity in the population (Sámano et al., 2025). Higher parental education supported with financial stability and easier access to healthy food allowed parents to maintain their children nutritional status. However, in resource-constrained regions with limited dietary options, the impact of higher education on nutritional outcomes becomes less pronounced. Another mechanism worth to notice is the fact that the data in this study was obtained from "Mother-Toddler Class", an educational program meant to empower and enhance mothers' understanding of child health, promoting equitable health literacy among caregivers. This suggests a homogenization of nutritional knowledge among participants, most likely due to their active involvement in the class. These sessions might also bridge the gap in health literacy, ensuring similar competencies in managing their child's nutrition despite the respective educational background. In this modern era where processed food or food with high calories yet low nutrients is heavily advertised, it is crucial to strengthen nutritional education for caregivers along with resources to provide access to genuinely nutritious foods (Sámano et al., 2025).

A systematic review mentioned maternal employment status as one of the factors affecting EBF. This is in line with our study where maternal occupation is a statistically significant factor affecting childhood overweight/obesity ($p = 0.001$). Employed mothers tend to have overweight/obese children by 4.705-times (95% CI:1.711-12.935) compared to those who are not (Harahap, Desmawati, & Afriwardi, 2024). Similar finding is also observed in a cross-sectional study which revealed that non-working mothers tend to have more successful EBF due to their ability to stay longer with their infants while employed mothers are affected by work stress, limited support, and lack of breastfeeding facilities, in addition to being separated from their babies resulting in failure during EBF (Gayatri, 2021).

There was no observed statistically significant association between maternal age and the occurrence of overweight/obesity in children within our study ($p = 0.156$). However, previous studies found that maternal age might influence mother's

behavior as a caregiver. Majority of mothers breastfed at the age 20-30 years which is considered healthy reproductive age. This helps mothers in solving issues related to pregnancy, labor, postpartum, and later giving care to babies. Nevertheless, mothers breastfeeding at the age of >35 years have relatively good psychological maturity along with being more experienced in giving breastmilk (Harahap et al., 2024). This suggests age as a secondary factor compared to other variables in the study due to lack of meaningful association.

Pediatric obesity is highly related to national or regional income as well as country development (Zhang et al., 2024). This indicates that overweight/obesity is a public health issue of nation-scale, requiring attention from the policy makers. Two important factors as public health strategies to prevent overweight/obesity in children include promoting sustained EBF and supporting healthy weight gain among parents (Del Castillo et al., 2022). These can be done through a series of prevention. Primary prevention involves comprehensive activity regarding health policy and healthcare. National-level policies are especially important regarding food consumption to guarantee the availability and quality of food for the community (Sámano et al., 2025). In Indonesia, RAN-GENTAS (Rencana Aksi Nasional Gerakan Nusantara Tekan Angka Obesitas/National Action Plan for Nusantara Movement to Reduce Obesity Rates) and KADARZI (Keluarga Sadar Gizi/Nutrition-Conscious Family) was promoted to tackle aforementioned issues. On the other hand, secondary prevention involves screening and active prevention of further weight gain. This includes promoting proper eating habits and participating in physical activity while being accompanied by proper availability of health services for prompt diagnosis along with actively educating the community (Kiciak et al., 2024).

CONCLUSION

This study demonstrates that maternal factors along with child characteristics are pivotal in determining childhood obesity. EBF showed marginally significant protective trend ($p = 0.068$) with notable clinical impact (OR = 3.167 for non-exclusively breastfed children). On the other hand, Maternal occupation ($p = 0.001$) and child gender (p

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= 0.040) emerged as strong predictors. Pediatric obesity is a serious public health issue requiring national-level policies for its management, with focus on promoting EBF and supporting healthy weight gain.

SUGGESTION

Regarding the significant association of maternal occupation and gender on childhood obesity, national health policies should focus on integrating supportive breastfeeding environments within workplace to ensure successful EBF. This integration should include lactation facilities, adjusted workload, and sufficient breaks. Standardized program like Mother-Toddler Class that is proven useful in bridging gaps in nutritional insight in mothers should be scaled nationally along with digitalization, providing easier access to education for mothers.

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