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FACTORS INFLUENCING OBESITY: A SYSTEMATIC LITERATUR REVIEW

Bayu Tri Utami[1], Iis Rahmawati [2*], Tantut Susanto[3]

[1] *Faculty of Nursing, Universitas Jember, Indonesia*
[2] *Department Maternity and Child Nursing, Faculty of Nursing, Universitas Jember, Indonesia*
[3] *Department of Community, Family & Geriatric Nursing, Faculty of Nursing, Universitas Jember, Indonesia*

***Correspondence:** Iis Rahmawati
Email: *iis_r.psik@unej.ac.id*

ABSTRACT
Adolescent obesity represents a significant global health issue escalating in both developed and developing countries, including Indonesia, with impacts on non-communicable disease risks and psychosocial disorders. The complexity of its causes requires a holistic approach via the Socio-Ecological Model (SEM), integrating individual, social, environmental, and policy factors. This study aims to identify and analyze these factors influencing adolescent obesity incidence. A Systematic Literature Review (SLR) method guided by PRISMA 2020 was employed, searching PubMed, Scopus, ScienceDirect, and Google Scholar (2020–2024) using keywords on adolescent obesity, socio-ecological model, and risk factors. From 2,530,000 initial articles, screening of titles, abstracts, and full texts yielded 12 high-quality articles for synthesis. Synthesis revealed individual-level factors such as high-calorie low-fiber diets, low physical activity, sedentary behavior, academic stress, and poor self-regulation contribute to elevated BMI in adolescents. Social factors include family parenting styles, peer influence, and social media; environmental aspects encompass limited healthy food access, fast food dominance, and scarce sports facilities; policy measures like unhealthy food marketing regulations and sugary drink taxes remain suboptimal in developing countries. In conclusion, adolescent obesity arises from multidimensional SEM interactions, necessitating comprehensive multilevel prevention interventions involving families, schools, communities, and government policies for sustained effectiveness.

Keywords: Adolescent Obesity; Dietary Patterns; Physical Activity; Socio-Ecological Model

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INTRODUCTION

Obesity in adolescents is one of the global health problems that has seen a significant increase in recent decades (Jenatabadi et al., 2021). This increase is not only happening in developed countries but also in developing countries, including Indonesia, which is experiencing a transition in dietary patterns and lifestyles along with modernization and urbanization, leading to serious impacts on adolescent health, both in the short and long term, including the risk of non-communicable diseases such as type 2 diabetes and hypertension, as well as psychosocial disorders such as low self-esteem and increased social anxiety (McCormick et al., 2021). The factors causing obesity in adolescents cannot

be understood from just one aspect, but must be viewed holistically thru various interacting factors (Ayala-Marín et al., 2020).

The socio-ecological model provides a comprehensive conceptual framework for explaining how individual, social, environmental, and policy factors influence the occurrence of obesity (Abdelhak et al., 2022). At the individual level, factors such as unhealthy eating patterns, lack of physical activity, and sedentary habits contribute significantly to weight gain, with 70% of adolescents having unhealthy eating habits and over 60% being physically inactive (Jain et al., 2023). However, these factors do not stand alone but are influenced by the social environment, such as family eating patterns, peer influence, and school habits (Nurbaiti et al., 2023). High sedentary activity is even associated with up to a 30% increased risk of obesity (Muhalla et al., 2025) and a decrease in muscle strength and lean body mass in adolescents (O et al., 2025).

The social environment plays a very significant role in shaping adolescents' habits related to eating patterns and physical activity (Holson et al., 2021a). Parenting styles, for example, have a significant influence on determining a child's eating habits from an early age. Parents who provide less education about the importance of healthy eating or have a habit of consuming fast food are more likely to have children at higher risk of obesity (Gunasegaram et al., 2024). Additionally, peer influence can also be a determining factor in whether an adolescent has healthy eating habits or not. If an adolescent is in a peer environment that more frequently consumes high-sugar and high-fat foods and has sedentary habits, they are more likely to follow the same pattern (Noh & Min, 2020). Beside social factors, the physical environment also plays a role in increasing the risk of obesity in adolescents. Access to healthy food and sports facilities is crucial in determining whether a teenager can adopt a healthy lifestyle (Sweetened et al., 2025). Unfortunately, in many urban and rural areas, fast food is more readily available than healthy food (Lang et al., 2021). The lack of green open spaces and adequate sports facilities is also a barrier to promoting sufficient physical activity among adolescents (Mahmudiono et al., 2019). On the other hand, the development of technology and digital media is exacerbating this problem by increasing screen time, which impacts reduced physical activity and increased overeating due to exposure to unhealthy food advertisements (Rodríguez-barniol et al., 2024).

Beside the physical and social environment, government policies also play an important role in addressing the problem of adolescent obesity (Perry et al., 2024). Regulations regarding unhealthy food marketing, school policies on healthy canteens, and public health programs that support active lifestyles are factors that can help reduce obesity rates among adolescents (Agung & Virsa, 2023). ome countries have implemented policies such as taxes on sugary drinks and restrictions on unhealthy food advertising to children, which have proven effective in reducing the consumption of high-sugar and high-fat foods. However, in many developing countries, the implementation of such policies is still not optimal, so efforts to prevent obesity have not been fully effective (Timmermans et al., 2020). Several previous studies have discussed the factors influencing adolescent obesity in various contexts. Research found that a high-calorie, low-fiber diet, influenced by family and social environments, is a major factor in the increased risk of obesity among adolescents (Korom et al., 2023). Other studies show that limited access to sports facilities and green open spaces impacts low physical activity, which in turn contributes to weight gain (Al-Nuaim & Safi, 2023). Meanwhile, research also highlights the role of government policies in reducing obesity rates, such as regulating fast food marketing and implementing healthy canteen policies in schools, which have proven effective in promoting changes in adolescent eating behavior (Greatwood et al., 2023).

However, understanding of the multidimensional interactions between the causes of obesity in adolescents is still limited. This is because most previous research and reviews only highlighted individual factors, such as diet and physical activity, without deeply examining the

role of interacting social, environmental, and policy factors. Additionally, most previous reviews did not explicitly use the Socio-Ecological Model (SEM) framework as the basis for analysis. In fact, this model is capable of illustrating the complex relationship between individuals and their environment in the context of health behavior. With the increasing prevalence of adolescent obesity in various countries, including Indonesia, a systematic review examining the causes of obesity from a socio-ecological perspective is becoming increasingly relevant. Therefore, this study was conducted to synthesize the latest empirical evidence and highlight how individual, social, environmental, and policy factors interact to influence the occurrence of obesity in adolescents. This approach is expected to provide a more comprehensive understanding and serve as the basis for developing more effective and sustainable prevention strategies.

METHODS

Study Design

This study follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) guidelines, using the Systematic Literature Review (SLR) method to analyze and identify various socio-ecological factors contributing to obesity in adolescents. SLR was chosen because this method allows researchers to systematically collect, evaluate, and synthesize the results of previous studies to gain a more comprehensive understanding of the relationship between individual, social, environmental, and policy factors and adolescent obesity.

Search methods

Data sources in this study were obtained from scientific journals indexed in academic databases such as PubMed, Scopus, ScienceDirect, and Google Scholar using a combination of keywords and Boolean operators: ("adolescent obesity" OR "youth overweight") AND ("socio-ecological model" OR "ecological framework") AND ("risk factors" OR "determinants").

Inclusion and Exclusion Criteria

Inclusion Criteria: Articles published between 2020 and 2024, in English or Indonesian, discussing socio-ecological factors in adolescent obesity. Exclusion Criteria: Duplicate articles, non-full access, or out of context.

Data Extraction

The process of identifying and selecting articles was conducted systematically, following the PRISMA 2020 flow. Initial searches across four major academic databases (PubMed, Scopus, ScienceDirect, and Google Scholar) yielded a total of 2,530,000 articles. After initial screening based on publication year (2020–2024), 27,900 temporally relevant articles were obtained. The next step was title screening to remove articles that were not relevant to the research topic, leaving 677 relevant articles. From that number, screening was conducted based on inclusion criteria. The inclusion criteria applied include articles that are written in English or Indonesian and discuss socio-ecological factors related to obesity in adolescents. Meanwhile, the exclusion criteria include articles that are not relevant to the research topic, have unclear methodologies, or are not available in full access. This process yielded 260 articles that met the criteria for further evaluation. The final stage involved an in-depth analysis of articles that met all eligibility criteria, and a total of 12 articles were retained for synthesis in this systematic review

Quality Apprasial

The quality appraisal of the included studies was conducted to ensure the methodological rigor and credibility of the evidence synthesized in this systematic literature review. The assessment focused on several key aspects, including study design, clarity of objectives, appropriateness of data collection methods, sample characteristics, and analytical

procedures. Both qualitative and quantitative studies were evaluated using established critical appraisal principles commonly applied in systematic reviews.

Most of the selected articles demonstrated acceptable methodological quality. Quantitative studies generally used appropriate statistical analyses such as regression analysis, structural equation modeling, and cross-sectional surveys, while qualitative studies applied rigorous thematic analysis or grounded theory approaches through interviews and focus group discussions. However, several studies relied on cross-sectional designs and self-reported measurements, which may introduce bias and limit causal inference. Despite these limitations, the overall quality of the studies was considered adequate to support the synthesis of socio-ecological determinants influencing adolescent obesity.

RESULTS

Search Outcome

The literature search process followed the PRISMA 2020 guidelines and involved four major academic databases: PubMed, Scopus, ScienceDirect, and Google Scholar. The initial search identified approximately 2,530,000 articles related to adolescent obesity and socio-ecological determinants. After applying publication year limits (2020–2024), the number of potentially relevant studies was reduced to 27,900 articles.

Title screening was conducted to remove studies that were not relevant to the research focus, resulting in 677 articles. Subsequently, abstract and eligibility screening based on inclusion and exclusion criteria yielded 260 articles suitable for full-text evaluation. After a comprehensive review of the full texts, 12 articles met all eligibility criteria and were included in the final synthesis of this systematic literature review. The selection process is illustrated in the PRISMA flow diagram presented in Figure 1.

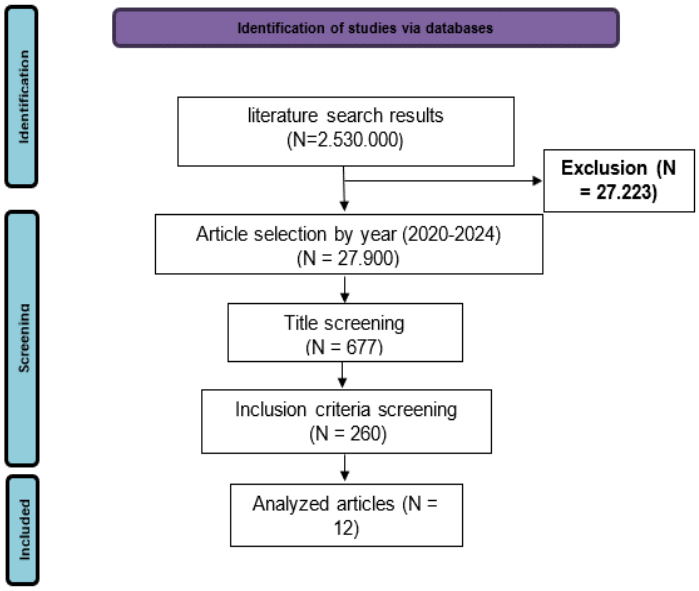

Figure 1. Flow Diagram of Analysis Literature

Quality Assessment Results

The quality assessment results indicate that the majority of included studies demonstrate moderate to high methodological quality. Among the twelve studies reviewed, seven used quantitative approaches such as cross-sectional surveys, regression analysis, latent class analysis, and structural equation modeling, while five studies used qualitative approaches including focus group discussions, interviews, and thematic analysis.

Quantitative studies provided robust statistical evidence regarding the relationships between behavioral, social, and environmental factors and obesity outcomes. Meanwhile, qualitative

studies contributed deeper insights into contextual influences such as family dynamics, community environments, and perceptions of healthy behaviors. Despite these strengths, several studies reported methodological limitations, particularly reliance on self-reported data and limited longitudinal evidence. Overall, the studies provided sufficient empirical evidence to analyze socio-ecological determinants influencing adolescent obesity across multiple contexts.

Table 1. Analysis of Literature Results

No.	Researcher, Year, Country	Title	Method	Result	SEM Level
1	Al-Nuaim, A., & Safi, A. (2023); Saudi Internasional Journal of Environmental Research and Public Health; https://doi.org/10.3390/ijerph20105785	Factors Influencing Saudi Youth Physical Activity Participation: A Qualitative Study Based on the Social Ecological Model	Qualitative (Focus Group Discussion, Thematic Analysis).	Factors hindering participation in physical activity among Saudi youth include lack of time, safety, parental support, policies, access to sports facilities, transportation, and climate. The results of this study provide insights for policymakers in designing community and environment-based interventions	Environmental and Policy
2	Loren, D. M., Rea, E. M., Harber, K. A., & Bohnert, A. M. (2022); Amerika Serikat Health Psychology; https://doi.org/10.1037/hea0001163	An ecological model of weight gain among school-age children	Longitudinal quantitative analysis using national data	This study shows that economic factors, particularly the income-to-needs ratio, have the greatest influence on children's BMI increase, with children living below 200% of the poverty line being more likely to be obese, especially in the Latino group. Additionally, individual factors (physical activity, screen time, sleep duration), social factors (family support and habits), environmental factors (residential safety), and policy/structural factors (economic status and social policies) also interact to influence children's obesity risk based on the socio-ecological model.	Individual, Social, Environmental, Policy
3	Tao Zhang, Joonyoung Lee, Xiaoxia Zhang and Xiangli Gu (2022); Amerika serikat Sustainability; https://doi.org/10.3390/su14191282873	Social-Ecological Factors Predict College Students' Physical Activities and Sedentary Behavior	Quantitative (cross-sectional)	study found that individual factors (self-efficacy) and environmental factors (access to sports facilities) are the strongest predictors of students' physical activity, while social and environmental factors play a role in sedentary behavior.	Individual, social, and physical environment

4	Greatwood, H. C., McGregor, S., Duckworth, L. C., & Griffiths, C. (2023); UK Nutrition & Health; https://doi.org/10.1177/026010602311862	Socio-ecological influences on adolescent dietary typologies	Quantitative (Latent Class Analysis, Multinomial Regression, Path Analysis)	This study identifies three dietary pattern typologies for adolescents: healthy, less healthy, and mixed. Factors influencing eating patterns include physical activity, having siblings, screen time, and social media use. These findings support system-based interventions to improve adolescent eating habits.	Individual, Social, and Policy
5	Gunasegaram, S., Shin Tan, S., & Hussain, S. (2024); Malaysia IMU News; https://doi.org/10.56026/imu.18.2.6	Impact of Academic Stressors on Eating Behaviour Among University Students: Application of Socio-Ecological Model	Quantitative (Survey, Correlation Analysis)	Academic stress increases unhealthy eating patterns in students, including cognitive restraint, uncontrolled eating, and emotional eating. The results of this study support the need for health interventions in the university environment to promote healthier eating patterns.	Individual and environmental
6	Mònica Rodrígue z-Barniol MD, MSc, Georgina P ujol-Busquets PhD, MSc, Anna Bach-Faig PhD, MSc (2024); Spanyol Journal of the Academy if Nutrition and Dietetics; https://doi.org/10.1016/.jand.2024.04.015	Screen Time Use and Ultra-Processed Food Consumption in Adolescents: A Focus Group Qualitative Study	Qualitative study using a focus group discussion approach.	Interactions between individual, social, and environmental factors play a significant role in ultra-processed food consumption among adolescents. Effective interventions should focus on nutritional education, screen time management, family roles, and food advertising regulations.	individual, environmental, social, and policy
7	Holson, D., Stroope, J., & Cater, M. (2021); Amerika Serikat Journal of Extension; https://doi.org/10.54718/EPLE5520	Facilitators and Barriers to Implementation of Community-Based Socio-Ecological Approaches to Obesity Prevention Among Cooperative Extension Agents	Qualitative (FGD, Thematic Analysis).	Identified key factors influencing the ability of CES FCS agents to implement community-based obesity prevention strategies, including knowledge of the socio-ecological model, funding, human resources, as well as community involvement and support.	individual, community, and policy
8	Jenatabadi, H. S., Shamsi, N. A., Ng, B. K., Abdullah, N. A., & Mentri, K. A. C. (2021); Malaysia Healthcare; https://doi.org/10.3390/healthcare9080925	Adolescent obesity modeling: A framework of socio-economic analysis on public health	Quantitative (Bayesian Structural Equation Modeling, SEM-Bayesian).	Developed a complex adolescent obesity model based on household socioeconomic status, healthy/unhealthy food consumption, lifestyle, BMI, and body fat. Results show significant relationships between these variables and adolescent obesity.	individual and interpersonal

9	Korom, B., Malloy, M., Remmers, C., Cevilla, M., Dione, K., Papanek, P., Condit, J., & Nelson, D. (2023); Amerika Serikat BMC Public Health; https://doi.org/10.1186/s12889-023-15005-2	"It's about being healthy"; a novel approach to the socio-ecological model using family perspectives within the Latinx community	Qualitative (Interviews, Grounded Theory).	The social ecology model was used to analyze the FIT 4 YES program to enhance children's self-confidence in healthy behaviors and improve health implementation within families. A new model was developed to explain dynamic interactions between engagement, supportive relationships, and other components in the socio-ecological model.	individual, family, community, environment.
10	Noh, K., & Min, J. J. (2020); Korea Selatan Children; https://doi:10.3390/children7090134	Understanding school-aged childhood obesity of body mass index: Application of the social-ecological framework	Quantitative (OLS Regression Analysis).	Socio-ecological factors significantly influence childhood obesity, including physical activity, maternal age, family structure, and school environment. Recommended solutions include enhancing physical activity in school and home settings.	individual, interpersonal, organizational, and social.
11	Michelle Perry, Kayla Mardin, Grace Chamberlin, Emily A Busey, Lindsey Smith Taillie, Francesca R Dillman Carpentier, Barry M Popkin (2024); 193 negara Advances in Nutrition; https://doi.org/10.1016.advnut.2024.100254	National Policies to Limit Food Marketing and Competitive Food Sales in Schools: A Global Scoping Review	Quantitative (Cross-Sectional Survey).	Provides a global overview that school food regulations represent institutional/policy/community-level interventions within the Social Ecological Model. Implementation of these policies can structurally strengthen childhood obesity prevention efforts, beyond relying solely on individual behavior change.	Policy.
12	Timmermans, Y. E. G., Van De Kant, K. D. G., et al. (2020); Belanda BMC Pregnancy and Childbirth; https://doi.org/10.1186/s12884-020-2786-5	Socio-ecological determinants of lifestyle behavior of women with overweight or obesity before, during and after pregnancy	Qualitative (Interviews).	Socio-ecological factors influence the lifestyle of women with obesity before, during, and after pregnancy. Key factors include knowledge of healthy living patterns, social support, and access to health facilities.	Individual, family, community, environment.

Analytical Findings result

The synthesis of the twelve selected studies reveals that adolescent obesity is influenced by multiple interacting factors across different levels of the Social Ecological Model (SEM), including individual, interpersonal/social, environmental/community, and policy levels. In detail explained as follows:

Individual level

At the individual level, most studies show that personal behavior, self-efficacy, stress, and lifestyle are the main determinants of health behavior. Self-efficacy and individual motivation

are the strongest predictors of college students' physical activity, while poor self-regulation is associated with sedentary behaviour (Zhang et al., 2022). (Gunasegaram et al., 2024) ighlighted the influence of academic stress on unhealthy eating patterns among Malaysian university students, including emotional and uncontrolled eating habits. Other research indicates that children's physical activity and daily eating behaviors significantly contribute to the body mass index (BMI) of school-aged children in South Korea (Noh & Min, 2020). ndividual factors such as self-efficacy, stress, and eating habits are the most consistent predictors of health behavior across contexts. However, most of the research is cross-sectional, so a causal relationship cannot yet be established.

Social/Interpersonal Level

At the social level, family support and social relationships have been shown to have a significant influence on healthy behavior. The research findings indicate that family involvement thru the FIT 4 YES program in the Latinx community increases children's self-confidence to engage in healthy behaviors and strengthens the implementation of healthy behaviors within the family (Korom et al., 2023). It was identified that children from low-income families and those with less healthy family habits are at higher risk of increased BMI. This shows that the eating patterns of adolescents are significantly influenced by family interactions, shared screen time, and social media use (Nagata et al., 2024).

Environmental and community level

The physical and social environment around an individual also plays an important role. In Saudi Arabia, environmental barriers such as lack of access to sports facilities, limited transportation, and hot climate are reported as obstacles to adolescent participation in physical activity (Al-nuaim & Safi, 2023). (Rodríguez-barniol et al., 2024) highlights the influence of digital media exposure and social environment on ultra-processed food consumption among Spanish adolescents, indicating the need for community-based interventions to regulate screen time and provide nutritional education. They identify that the success of community-based interventions using a socio-ecological model is highly influenced by funding and local community involvement (Holson et al., 2021)**.**

Policy Level

At the policy level, regulatory and public policy-based interventions are key to shaping an environment that supports healthy lifestyles. A global review found that only 28% of countries worldwide have national policies restricting the marketing of unhealthy foods in schools, with the best implementation in high-income countries (Perry et al., 2024). highlighting the importance of public policy support and social infrastructure to facilitate physical activity among adolescents. However, policies in developing countries are often not well implemented (Al-nuaim & Safi, 2023). trong evidence suggests that public policies have a broad structural effect on health behaviors, but implementation gaps between countries are significant. Developed countries already have integrated policies (e.g., food labeling and marketing regulations), whereas in developing countries like Malaysia and Indonesia, policies are still fragmented and less monitored.

This policy is highly dependent on implementation and compliance at the community level. Therefore, a socio-ecological model-based approach that considers individual, social, environmental, and policy factors is needed to produce more effective interventions in the prevention and control of adolescent obesity. The research sources used in this study are described in Table 1 below:

DISCUSSION

This systematic literature review aimed to identify and synthesize socio-ecological determinants influencing adolescent obesity. The findings indicate that adolescent obesity is a complex public health issue shaped by interactions among multiple determinants across different levels of the Social Ecological Model (SEM), including individual, interpersonal, environmental, and policy levels. The SEM framework emphasizes that health behaviors are

influenced not only by individual choices but also by social relationships, environmental conditions, and structural policies that shape health opportunities (Kilanowski, 2017; Abdelhak et al., 2022).

Individual-Level Determinants

At the individual level, several behavioral and psychological factors were consistently identified as important determinants of adolescent obesity, including dietary patterns, physical activity, sedentary behavior, self-efficacy, and academic stress. Unhealthy eating patterns, particularly high consumption of ultra-processed foods and sugary beverages, have been strongly associated with increased body mass index (BMI) among adolescents (Rodríguez-Barniol et al., 2024). Similarly, low levels of physical activity and prolonged screen time contribute to sedentary lifestyles that significantly increase obesity risk (Zhang et al., 2022; O et al., 2025).

Psychological factors such as academic stress and poor self-regulation also play an important role in shaping adolescents' eating behaviors. Studies have shown that academic stress may trigger emotional eating and uncontrolled food consumption among university students, which can contribute to unhealthy weight gain (Gunasegaram et al., 2024). Additionally, research conducted in South Korea found that daily physical activity and eating behavior patterns significantly influence BMI among school-aged children (Noh & Min, 2020). These findings highlight the importance of addressing psychological and behavioral determinants in obesity prevention strategies.

However, many of the reviewed studies employed cross-sectional designs, limiting the ability to establish causal relationships between these factors and obesity outcomes (Zhang et al., 2022). Longitudinal research is therefore needed to better understand how behavioral and psychological determinants influence obesity development over time.

Interpersonal and Social Influences

The review findings also highlight the important role of interpersonal relationships and social environments in shaping adolescents' health behaviors. Family support, parenting styles, and peer interactions significantly influence adolescents' dietary habits and physical activity patterns (Korom et al., 2023). Adolescents from families with unhealthy eating habits or limited health awareness are more likely to develop obesity.

Family involvement has been shown to strengthen adolescents' engagement in healthy behaviors. For example, the FIT 4 YES program demonstrated that family-based interventions can improve children's confidence in adopting healthy lifestyles and strengthen healthy behavioral practices within the household (Korom et al., 2023). In addition to family influence, peer relationships also shape adolescents' health behaviors, particularly during adolescence when social identity and group belonging become highly influential.

Social media exposure further contributes to unhealthy eating behaviors among adolescents. Increased exposure to digital food marketing and food-related content can encourage the consumption of ultra-processed foods and sugary beverages (Nagata et al., 2024; Rodríguez-Barniol et al., 2024). These findings indicate that obesity prevention efforts should consider social dynamics and digital environments when designing interventions for adolescents.

Environmental and Community Context

Environmental and community factors were also identified as important determinants of adolescent obesity. Access to healthy food, availability of recreational facilities, transportation systems, and neighborhood safety significantly influence adolescents' ability to maintain healthy lifestyles (Al-Nuaim & Safi, 2023). In many communities, unhealthy food options such

as fast food and sugary beverages are more accessible and affordable than healthier alternatives, creating barriers to healthy dietary behaviors.

Limited access to sports facilities and safe public spaces may also discourage adolescents from engaging in physical activity. Environmental barriers such as transportation difficulties, extreme climate conditions, and limited recreational infrastructure have been reported as major obstacles to youth physical activity participation (Al-Nuaim & Safi, 2023). Community-based interventions that improve access to sports facilities and promote healthy environments can therefore play an important role in obesity prevention.

Furthermore, community engagement and institutional support are essential for the successful implementation of obesity prevention programs. Studies have shown that community-based socio-ecological interventions are more effective when supported by adequate funding, trained personnel, and strong community participation (Holson et al., 2021).

Policy-Level Determinants

Public policies represent another critical level influencing adolescent obesity. Government regulations related to food marketing, school nutrition policies, and national health promotion programs can significantly shape the broader environment affecting adolescents' health behaviors (Perry et al., 2024). For instance, policies restricting the marketing of unhealthy foods to children and regulating school food environments have been shown to reduce the consumption of high-sugar and high-fat foods.

Several high-income countries have implemented policies such as sugar-sweetened beverage taxes, food labeling regulations, and restrictions on unhealthy food advertising targeting children (Perry et al., 2024). These policies aim to create healthier food environments and encourage healthier consumption patterns among adolescents.

However, the implementation of such policies remains limited in many developing countries. Weak regulatory enforcement, limited public health resources, and economic pressures often hinder effective obesity prevention policies (Timmermans et al., 2020). As a result, adolescents in many developing countries continue to be exposed to environments that promote unhealthy dietary behaviors.

Integration of Socio-Ecological Factors

One of the key findings of this review is that adolescent obesity results from complex interactions between determinants at multiple levels of the socio-ecological system. Individual behaviors are shaped by family environments, community conditions, and broader structural policies. For example, adolescents' dietary behaviors may be influenced by family eating patterns, availability of healthy food in the community, and national policies regulating food marketing.

Similarly, physical activity levels depend not only on individual motivation but also on environmental factors such as access to sports facilities and school policies promoting physical education. Therefore, obesity prevention strategies that focus solely on individual behavior change are unlikely to produce sustainable outcomes. Instead, comprehensive multi-level interventions addressing individual, social, environmental, and policy factors are necessary to effectively reduce adolescent obesity (McCormick et al., 2021).

Implications for the Indonesian Context

The findings of this review also reveal an important gap between global research and the Indonesian context. Most of the reviewed studies were conducted in developed countries where obesity prevention policies and health infrastructure are relatively well established. In contrast, Indonesia still faces several structural challenges in addressing adolescent obesity.

For example, regulations related to unhealthy food marketing, school nutrition standards, and urban infrastructure supporting physical activity remain limited. Cultural factors such as permissive family attitudes toward fast food consumption and increasing sedentary lifestyles among adolescents also contribute to the rising prevalence of obesity.

Therefore, adapting the socio-ecological approach to the Indonesian context is crucial. Future interventions should integrate school-based nutrition education, family engagement programs, improved access to sports facilities, and stronger government regulations on unhealthy food marketing. Collaborative efforts involving government agencies, schools, communities, and healthcare institutions are essential to create sustainable obesity prevention strategies in Indonesia (Agung & Virsa, 2023; Nurbaiti et al., 2023).

The gap between the global and Indonesian contexts.
This review reveals a significant gap between the global and Indonesian contexts in the application of the social-ecological model to the issues of obesity and health behavior. Developed countries such as the United States, Spain, and the United Kingdom have integrated strict public policies against unhealthy food marketing and the promotion of physical activity in schools (Perry et al., 2024; Rodríguez-barniol et al., 2024). Conversely, in Indonesia, similar policies are still limited and have not been fully implemented in school environments or communities. Additionally, socio-cultural factors, such as permissive parenting styles toward fast food consumption and a lack of public sports facilities, exacerbate the risk of childhood obesity. Family and community involvement in promoting healthy lifestyles, which has proven effective in the FIT 4 YES program in the Latinx community (Korom et al., 2023), has not been widely adapted in the local Indonesian context.

Strengths and Weaknesses.
Generally, the main strength of the studies in this review is their ability to explain the complexity of cross-level SEM factors, particularly the interconnections between individual factors (knowledge, motivation, self-efficacy), social factors (family support, academic pressure), and environmental factors (access to sports facilities, healthy eating policies) (Nurbaiti et al., 2023). However, its weaknesses lie in the lack of systematic assessment of study quality and minimal cross-cultural analysis. Most studies also do not address how interventions can be adapted in resource-constrained countries like Indonesia.

IMPLICATION AND LIMITATIONS

Implications for future research.
Based on the literature synthesis, future interventions need to be designed in a multi-level and contextual manner. At the individual level, it is important to strengthen nutrition education and physical activity from school age (McCormick et al., 2021). At the interpersonal and community level, family and school-based programs like FIT 4 YES can be adapted to strengthen social engagement and family support (Korom et al., 2023). At the policy level, Indonesia needs to expand regulations on marketing unhealthy foods in schools and promote public-private partnerships to create a physical environment that is more supportive of healthy behaviors, as demonstrated in a global study by(Perry et al., 2024).

Limitations for future research
This systematic review has several limitations. First, most included studies employed cross-sectional designs, limiting causal inference between socio-ecological factors and obesity outcomes. Future research should prioritize longitudinal and experimental designs to better understand temporal and causal relationships within the Social Ecological Model (SEM). Second, many studies relied on self-reported measures of dietary intake, physical activity, and sedentary behavior, which may introduce recall and social desirability bias. The use of objective measurements such as accelerometers and validated nutritional assessment tools is recommended.

Third, the majority of studies were conducted in high- and middle-income countries, limiting generalizability to low-resource settings, including Indonesia. Context-specific and cross-cultural comparative studies are needed to strengthen the applicability of SEM-based interventions. Finally, this review did not conduct a formal meta-analysis due to methodological heterogeneity. Future systematic reviews incorporating quality appraisal tools and quantitative synthesis are warranted to enhance evidence robustness.

CONCLUSION

The review results indicate that health behaviors and obesity are influenced by multi-level factors within the Social Ecological Model (SEM), ranging from individuals to public policy. Individual factors such as self-efficacy, stress, nutritional knowledge, and eating habits directly influence healthy behavior, while family support, social involvement, and a supportive physical environment strengthen an individual's ability to maintain a healthy lifestyle. Practically speaking, health promotion interventions need to be carried out in an integrated manner at all levels: early childhood nutrition education, strengthening the role of families thru community-based programs, increasing access to sports facilities and healthy food in schools, and implementing national regulations to limit the marketing of unhealthy foods, as is done in various developed countries.

Additionally, several important gaps were identified that need to be addressed, such as the scarcity of longitudinal studies in developing countries, the lack of cross-cultural analysis, and the limited empirical evidence at the policy and environmental levels. The socio-ecological model itself makes an important theoretical contribution by emphasizing the dynamic interaction between individual, social, environmental, and policy factors in shaping healthy behavior. Previous studies have shown that the effectiveness of interventions increases when all four levels are applied in an integrated manner. Therefore, the application of SEM in Indonesia needs to be adapted to the local cultural and social context thru cross-sectoral collaboration, strengthening public policy, and sustainable community-based research to create an environment that supports healthy living behaviors.

SUGGESTIONS

Obesity prevention efforts should adopt an integrated Social Ecological Model (SEM) approach tailored to the Indonesian context. At the individual level, strengthening nutrition literacy, stress management, and regular physical activity promotion in schools is essential. Interpersonally, family engagement programs should be expanded to reinforce healthy eating habits and reduce sedentary behaviors at home. At the environmental level, improving access to safe public sports facilities and affordable healthy food options, particularly in urban and semi-urban areas, is necessary. At the policy level, stronger enforcement of regulations on unhealthy food marketing directed at adolescents and the implementation of healthy school canteen policies should be prioritized. Future research in Indonesia should focus on longitudinal and intervention-based designs to evaluate the effectiveness and sustainability of multi-level obesity prevention strategies.

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DECLARATION OF INTEREST

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AUTHOR CONTRIBUTION

BTU contributed to study conceptualization, literature search, data screening, synthesis of findings, and manuscript drafting. IR contributed to study supervision, methodological refinement, critical manuscript revision, and final approval. TS contributed to methodological validation, interpretation of findings, and critical scientific review. All authors have read and approved the final manuscript and agree to be accountable for all aspects of the work.

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BIOGRAPHIES OF AUTHORS

Ns. Bayu Tri Utami, M.Kep is affiliated with the Faculty of Nursing, University of Jember, Indonesia. Her work focuses on nursing science and health research, particularly in community health and evidence-based healthcare development.
242320102003@mail.unej.ac.id

Dr. Iis Rahmawati, S.Kp., M.Kes is a lecturer in the Department of Maternity and Child Nursing, Faculty of Nursing, University of Jember, Indonesia. She holds a doctoral degree in health sciences and has extensive experience in maternal and child health research.
17nDnHAAAAJ
http://orcid.org/0000-0002-6284-7106
57192653086
HPD-7080-2023
iis_r.psik@unej.ac.id

Prof. Ns. Tantut Susanto, M.Kep., Sp.Kep.Kom., Ph.D is a professor in the Department of Community, Family, and Geriatric Nursing, Faculty of Nursing, University of Jember, Indonesia. He specializes in community health nursing, family nursing, and geriatric care, with a strong emphasis on public health interventions and health promotion. He is actively involved in national and international research collaborations.
MwVCSFEAAAAJ
https://orcid.org/0000-0002-9685-9869
57191591437
tantut_s.psik@unej.ac.id