BEHAVIORAL ANALYSIS AND INTERVENTIONS FOR ADOLESCENTS IN OBESITY PREVENTION: A SYSTEMATIC REVIEW

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A B S T R A C T

Background: The high rate of obesity among adolescents has the potential to lead to health issues, both physical and mental, for these young individuals. This can lead to an increase in non-communicable diseases that can cause death in the productive age. The role of parents, teachers, peers, and the surrounding environment is crucial for the prevention of obesity in adolescents. The purpose of this literature review is to analyze adolescent behavior and other supporting factors for the prevention of obesity in adolescents.
Method: This research method is a literature review using two electronic databases, namely PubMed and Google Scholar.
Result: The total number of titles taken from PubMed and Google Scholar is 41,960. From this study, only 10 articles were selected that met the inclusion criteria. This article discusses the multidimensional issues that require a holistic approach to address adolescent problems. In addition, policies and programs are needed that involve families, schools, and communities to address the causes of obesity, support mental health, and create an environment that fosters a healthy lifestyle.
Conclusion: Involving teenagers in planning intervention programs can enhance their effectiveness, supported by the roles of healthcare professionals, parents, and teachers. Therefore, to support obesity prevention efforts, the Integrated School Health Program needs to have clear guidelines regarding the types of food that are served and sold in schools.

INTRODUCTION

The high prevalence of overweight and obesity among children, adolescents, and young adults is a global health issue. Teenagers with overweight and obesity are more likely to experience health issues such as hypertension, dyslipidemia, abnormal glucose metabolism, non-alcoholic fatty liver disease, and orthopedic diseases compared to their peers with normal weight [1-2]. Other studies have shown the relationship and differences

between economic growth and obesity [3-5]. For example, using data from 67 countries, Pampel et al. [5] explored the relationship between economic development, economic growth, and overweight or obesity (i.e., excess weight) and found that higher Socioeconomic Status (SES) is positively associated with overweight in low-income countries, but this relationship becomes negative in high-income countries. In 2016, more than 340 million children and adolescents aged 4 to 19 were overweight or obese (WHO, 2021), a phenomenon that exists in Indonesia. Overweight and obesity in children and adolescents can lead to the onset of degenerative diseases at an early age, such as diabetes and hypertension. Now, obesity has become a global epidemic, troubling many countries, including Indonesia. What was previously considered an adult problem, obesity is now also affecting the population of teenagers and children at an alarming rate. The 2023 Indonesian Health Survey data shows that the prevalence of overweight and obesity is around 19.7% among children aged 5-12 years and 16% among those aged 13-15 years. The prevalence of central obesity among the population aged over 15 years nationally in 2023 is 36.8%. Childhood and adolescent overweight has the potential to lead to overweight in adulthood. The consequences of obesity in children and adolescents not only encompass physical health outcomes but also impact social, behavioral, and emotional well-being. There is compelling evidence that children and adolescents who are overweight or obese have a higher risk of behavioral or emotional disorders such as depression, eating disorders, and lower self-esteem.

METHODS

This research study employs a systematic review technique with a quantitative approach designed to encompass relevant quantitative research and comprehensive analysis. The objective of this systematic review is developed based on the PICO framework. (Pasien, Intervensi, Perbandingan, Hasil). This systematic review establishes inclusion criteria that focus on a quantitative approach to studies used to comprehensively explain research outcomes. The data used in this study was obtained from Google Scholar and PubMed. Articles that met the criteria were then assessed and summarized; research available in free full-text articles; published since 2020; and written in English; the population includes school-age children to young adults. The exclusion criteria are articles that are literature reviews, systematic reviews, or scoping reviews; duplicate publications in two or more journals; not indexed in Scopus; and those that are under preschool age. From the results of the research article search using Boolean Operators, the researcher found a total of 2.530.000

articles that matched this keyword. The researcher then used Scimago to check whether these articles have been indexed in Scopus or not. This study uses the PRISMA diagram, which involves identification, screening, eligibility, and inclusion[16] . Then further examination of the exclusion criteria. After review and reading, 10 articles have been submitted for final review.

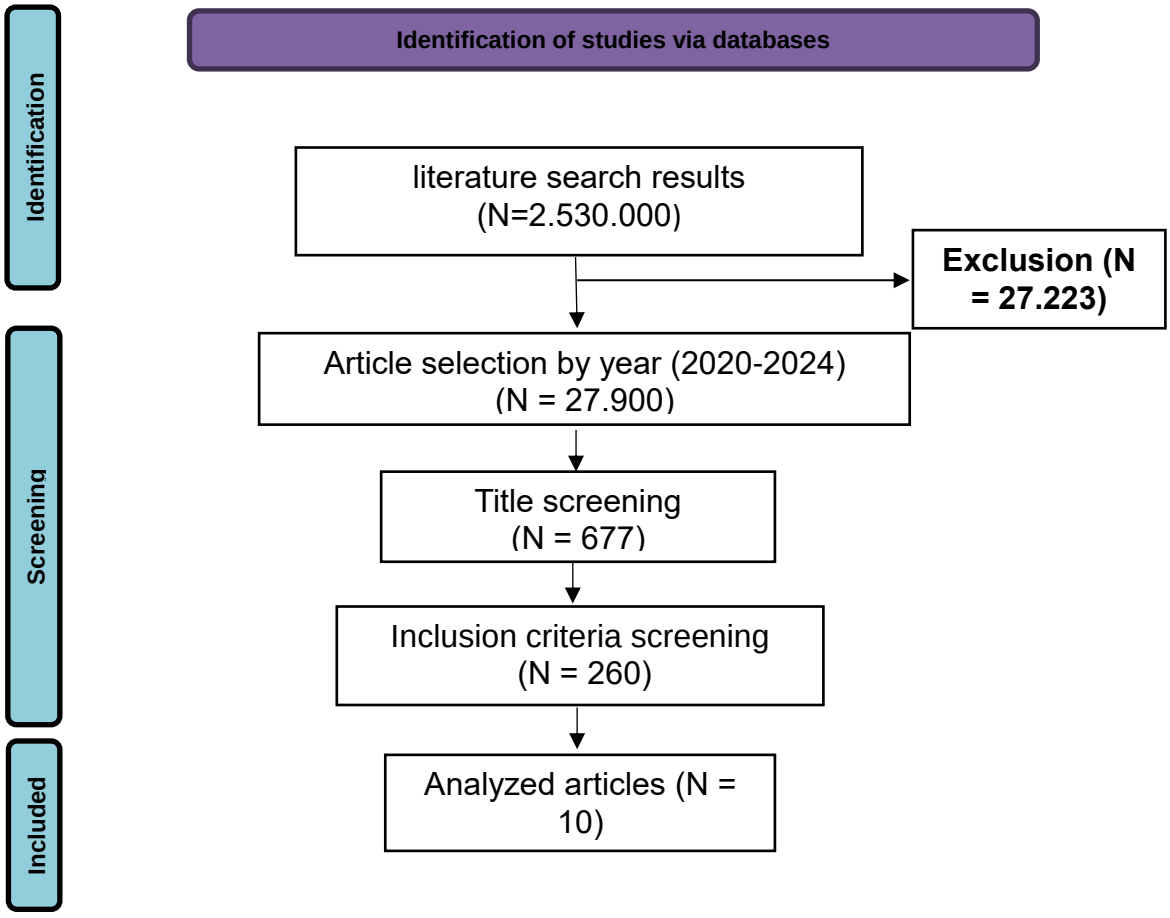

Figure 1. Flow Diagram of Analysis Literature

RESULTS

The findings of the research results are described in Table 1 below:

Table 1. review journal tahun 2020-2024

No.	Research Title	Journal Name, Edition (No), Year	Author	Research Objectives	Methods	Measurement Tools Used	Results and Discussion of the Research	Relation to Your Research
1.	Clinical characteristics and outcomes of children, adolescents and young adults with overweight or obesity and mental health disorders	International Journal of Obesity (2024) 48:423 – 432	Angela Galler, Angelika Thönnes, Jens Joas, Christine Joisten, Antje Körner, Thomas Reinehr, Markus Röbl, Gerd Schauerte, Wolfgang Siegfried Daniel Weghuber, Susann Weihrauch-Blüher, Susanna	to describe the clinical characteristics and outcomes of adolescents with overweight or obesity who have comorbid mental disorders.	data from children, adolescents, and young adults who are overweight or obese from the Adiposity Patient Registry (APV), a standardized and prospective multicenter database used by specialized obesity care centers in Germany and Austria.	Statistical evaluation was conducted using SAS, version 9.4. (build TS1M7, SAS Institute Inc., Cary, NC, AS). Data is presented as the median (first and third quartiles) for continuous variables and as proportions for dichotomous parameters. Descriptive statistics are applied to the entire study population and separately for groups of individuals with	Mental health comorbidities were reported in a total of 3,969 out of 114,248 individuals with overweight or obesity: 42.5% experienced ADHD, 31.3% anxiety disorders, 24.3% depression, and 12.9% eating disorders. Being male (OR 1.39 (95% CI 1.27; 1.52)), older (1.42 (1.25; 1.62)), or experiencing extreme obesity (1.45 (1.30; 1.63)) has the strongest association with mental health comorbidities. Regression analysis shows that the average BMI-SDS is significantly higher in individuals with depression and eating disorders (BMI-SDS 2.13 (lower; upper mean: 2.09;	The data reported from these individuals do not represent all children, adolescents, and young adults with overweight or obesity in Germany and Austria. This research only examines associations, and we cannot draw conclusions about cause or effect between obesity factors and mental disorders. It is very likely that there is underreporting of mental disorders in the adolescent group that does not have reported mental health comorbidities.In this study, only clinically recognized mental disorders that are reported in daily clinical practice are included, and no additional psychological

			Wiegand , Reinhard W. Holl, Nicole Prinz, and APV Initiative.			or without reported mental disorders, as well as for each group of individuals with different categories of mental disorders.	2.16) and 2.22 (2.17; 2.26)) compared to those who do not report mental health comorbidities (BMI-SDS 2.008 (2.005; 2.011); $p < 0.001$). The proportion of severe obesity is higher in individuals with depression (23.7%), anxiety disorders (17.8%), and eating disorders (33.3%), but lower in ADHD (10.3%), compared to those who do not report mental disorders (13.5%, $p < 0.002$). The proportion of dyslipidemia and abnormal carbohydrate metabolism does not differ between adolescents who report having mental health comorbidities and those who do not.	testing was conducted for this analysis.
2.	The role of individual and	J Glob Health 2024;14:04035	Alejandra Gallego1,	to determine the relationship between	Using raw data from the 2021	Statistical evaluation was conducted using	Both individual factors and contextual factors appear to play an	These results highlight the need to address both individual and contextual

	contextual economic factors in obesity among adolescents: A cross-sectional study including 143 160 participants from 41 countries		José Francisco López-Gil.	individual and contextual economic factors and the prevalence of overweight and obesity (i.e., excess weight) or obesity among adolescents from various countries.	online adolescent health behavior survey, this study analyzes sociological and demographic factors, mental health, exercise habits, health behaviors, and other categorical variables, as well as conducting frequency analysis and $\chi 2$ tests for differences in proportions between obesity and non-obesity.	SAS, version 9.4. (build TS1M7, SAS Institute Inc., Cary, NC, AS). Data is presented as the median (first and third quartiles) for continuous variables and as proportions for dichotomous parameters. Descriptive statistics are applied to the entire study population and separately for groups of individuals with or without reported mental disorders, as well as for each group of individuals with different categories of mental disorders.	important role in the prevalence of overweight and obesity among adolescents. An inverse association is shown between socioeconomic status (SES) and overweight or obesity, where adolescents with high and middle SES tend to have lower rates of overweight compared to those with low SES.	factors in the prevention and management of overweight and obesity in adolescents. Policies need to be implemented that address inequalities in food environments and opportunities for physical activity in communities with lower socioeconomic levels, which may include promoting the availability and accessibility of healthy food at affordable prices, as well as creating safe and accessible spaces for physical activity.

						Questionnaire. SES is evaluated using the Family Affluence Scale-III (FAS-III) [14], which consists of six questions with answers ranging from 0 to 13 points.		
3.	Exercise habits and health behaviors on adolescent obesity	Acta Psychologica245(2024)104199	Haoyuan Lia, Weidong Heb, Guifang Liuc,*	to understand the factors associated with the increasing rates of obesity among adolescents, providing a reference basis for the development of projects aimed at promoting adolescent health.	Using raw data from the 2021 online adolescent health behavior survey, this study analyzes sociological and demographic factors, mental health, exercise habits, health behaviors, and other categorical variables, as well as conducting	Questionnaires and surveys using original data from manual surveys and statistics.	The obesity rate among Korean adolescents is 18.25%. The risk of obesity in females is reduced by 0.344 times compared to males (95% CI = 0.327–0.361, $p < 0.001$); high school students have a 1.4 times higher risk of obesity compared to middle school students (95% CI = 1.379–1.511, $p < 0.001$); students with a "subjective household economic status" rated as "Medium" and "Low" experience an increased risk of obesity by 1.07 times (95% CI = 1.020–	This research suggests that teenagers engage in muscle-strengthening exercises to control their weight and develop habits of consuming more fruits. When formulating policies to control adolescent obesity, government agencies must consider gender differences, psychological factors, and health habits. Health education about obesity should be conducted at the right time for various grade levels, forming a collaborative education system among families,

					frequency analysis and $\chi 2$ tests for differences in proportions between obesity and non-obesity.		1.124, $p < 0.01$) and 1.254 times (95% CI = 1.165–1.350, $p < 0.001$), respectively, compared to students with a "subjective household economic status" rated as "High"; students with a "perceived stress" level of "Medium" and "Low" experience a reduction in obesity risk by 0.78 times (95% CI = 0.74–0.823, $P < 0.001$) and 0.75 times (95% CI = 0.70–0.803, $P < 0.001$), respectively, compared to students with a "perceived stress" level that is "High"; students who engage in "muscle strengthening exercises" "1–2 times/week" and "≥3 times/week" experience a reduction in obesity risk by 0.844 times (95% CI = 0.797-0.895, $P < 0.001$) and 0.575 times (95% CI = 0.537-0.616, $P < 0.001$), respectively, compared to students who do not participate in "muscle strengthening exercises."	schools, and communities to effectively promote healthy growth in adolescents.
4.	Relationship	International	Rajaa A.	to investigate the relationship	quantitative descriptive	A self-administered	A total of 385 young girls completed the survey, and	The title of this research is related to the title of the

	between Behavioural Intention for Using Food Mobile Applications and Obesity and Overweight among Adolescent Girls	Journal Of Environmental Research and Public Health 2023, 20, 4432.	Alyami 1 and Manal F. Alharbi 2,*	between food app usage and obesity and overweight among teenage girls	design. female students aged 16–18 years. A sample size of 383.	questionnaire and physiological measurements of students' weight and height to evaluate their BMI. To ensure a representative sample, probability sampling was conducted, which involved clustering techniques and stratified sampling.	five incomplete questionnaires were excluded. As shown in Table 1, the most common age is 17 years (36.1%). The girls registered from the northern education office account for 20.5%, of which 36.6% are currently in their second year. In addition, participants with a normal BMI are the most dominant (71.4%). Our results show that although participants who are overweight/obese have slightly higher attitudes towards using food apps, adolescents with normal/underweight BMI have slightly higher subjective norms, perceived behavioral control, and behavioral intentions; however, this did not yield significance ($p > 0.05$). In general, the behavioral intention to use food applications significantly influences our sample population. There is a high behavioral intention among	research that will be planned. However, there is a lack of information regarding the use of food applications by male students in schools. It is recommended to establish the influence of food delivery app services among individuals with increasing BMI levels. It would be very beneficial if the current findings were replicated in a different context for a better understanding of the factors influencing food app usage behavior across a broader age group. In addition, this study can serve as a reference guide and foundation for future research investigating such topics.

							participants to use food applications, as indicated by the total BI score and its constructs. This is above average points.	
5.	High prevalence of overall overweight/obesity and abdominal obesity amongst adolescents: An emerging nutritional problem in rural high schools in Limpopo Province, South Africa	African Journal of Primary Health Care & Family Medicine	Sego Debeila1 Perpetua Modjadji1 Sphiwe Madiba1 *	The study determined the prevalence of overweight/obesity amongst adolescents in rural high schools and the association with selected factors.	A cross-sectional study was conducted amongst 378 adolescents selected through multistage sampling from high schools.	Data collected were socio-demography, nutritional knowledge, dietary practices and anthropometry. The International Obesity Task Force age and sex-specific body mass index (BMI) cut-off values were used to determine overweight/obesity, whilst adult BMI cut-off values were used for those ≥ 18 years. Waist-to-height ratio	The proportion of overweight/obesity amongst adolescents was 35%, whilst 25% had abdominal obesity by WHR and 21% by WHtR. Multivariate logistic regression showed that being a girl (AOR = 2.9, 95% CI: 1.74–4.85), older adolescent (AOR = 3.1, 95% CI: 1.57–6.29) and living in a household with employed adults (AOR = 2.3, 95% CI: 1.19–4.51) were associated with increased odds of being overweight/obese. Eating breakfast was associated with reduced odds of being overweight/obese (AOR = 0.6, 95% CI: 0.34–0.97).	Overweight/obesity and abdominal obesity amongst adolescents were more prevalent than underweight. The Integrated School Health Programme should have clear guidelines on food items served and sold at schools.

						(WHtR) greater than 0.5 indicated abdominal obesity, as well as waist circumference (WC) and waist-to-hip ratio (WHR) above the cut-off values.		
6.	Influence of Lifestyle Habits in the Development of Obesity during Adolescence	Int. J. Environ. Res. Public Health 2022, 19, 4124.	Pedro Juan Carpena Lucas, Francisco Sánchez-Cubo, Manuel Vargas Vargas and José Mondéjar Jiménez	identifying modifiable risk factors that may contribute to the development of overweight and determining the importance of developing certain habits to prevent overweight and obesity in children.	cross-sectional study. The sample consisted of 416 students aged between 12 and 14 years (12.8 ± 0.62) first-year high school students from Murcia in Spain.	Data was collected regarding their lifestyle habits through the ENHASA questionnaire, and the somatometry of the participants was measured.	The modifiable risk factors that have the greatest potential directly related to the development of overweight in adolescents are 'use of electronic devices' and 'lack of physical activity' ($p < 0.001$). "The social environment and school" and "diet" show a relationship but there is no significant difference with overweight or obesity.	This study explains that sedentary habits, such as watching television, playing video games, or spending more than 2 hours in front of a screen, have the greatest potential for improvement to prevent obesity in children. Public institutions should promote limited and responsible screen time, in addition to enhancing accessibility to engage in appealing extracurricular physical activities such as sports. If it can be used by institutions to design and

								initiate more effective childhood obesity prevention and intervention programs.
7.	Adolescents' Perspectives on the Drivers of Obesity Using a Group Model Building Approach: A South African Perspective	Int. J. Environ. Res. Public Health 2022, 19, 2160.	Gaironeesa Hendrick, Nastalie Savona, Anaely Aguiar, Olufunke Alaba, Sharmilah Booley, Sonia Malczyk, Emmanuel Nwosu, Cecile Knai, Harry Rutter, Knut-Inge Klepp and Janetta Harbron.	to explore the factors causing obesity from the perspective of adolescents using a systems approach through the development of group models in four schools in South Africa.	Qualitative Research	The group development model was used to produce 4 causal loop diagrams with 62 adolescents aged 16–18 years. These maps are combined into a final map, and the main themes are identified: (i) physical activity and social media use; (ii) physical activity, health-related morbidity, and socio-economic status; (iii) accessibility of unhealthy food and energy intake/weight; (iv) psychological	The results of this study illustrate that (i) physical activity and social media usage; (ii) physical activity, health-related morbidity, and socio-economic status; (iii) accessibility of unhealthy food and energy intake/weight; (iv) psychological stress, weight, and weight-related bullying; as well as (v) parental involvement and unhealthy food intake are several significant factors influencing adolescent obesity. From the results of this research, it can be concluded that teenagers tend to be less active outdoors, which is also supported by inadequate safety. In addition, teenagers often consume high-calorie, low-nutrition foods. The lack of	The limitation of this study is the fact that the findings cannot be generalized beyond the time, place, and participants of this study. While this study investigates the perceptions of adolescents, these questions were only given to a portion of the population. (yaitu, remaja berusia 16–18 tahun dalam lingkungan sekolah). Thus, the differences in their understanding of overweight and obesity may have influenced the types of factors they identified.

						pressure, weight, and weight-related bullying; and (v) parental involvement and unhealthy food intake.	intervention from the education sector to control teenagers from making random purchases. Teenagers have started consuming alcohol outside the home. The lack of parental involvement is due to work, which increases the risk of various physical and psychosocial challenges among adolescents, including addiction, suicide, teenage pregnancy, type 2 diabetes, and obesity.	
8.	Overweight, Obesity and Psychological Correlates in a Moroccan Adolescent Sample	Bangladesh Journal of Medical ScienceVolume 23 No. 03 July 2024	Fatima Fathi1, Hafsa Choujaa, Zakaria Abidli, Zineb Serhier, Mohamed Agoub, Rachid Saile.	to assess the prevalence of obesity and its risk factors among children and adolescents in the second and third cycles, as well as secondary education, in a group of schools in rural Portugal.	cross-sectional survey. with a sample of students from 16 secondary schools in Casablanca. The criteria for determining overweight and obesity are based on age- and sex-specific BMI according to WHO reference	The Rosenberg Self-Esteem Scale is used to evaluate self-esteem, and the Beck Inventory is used for depression assessment.	A strong relationship has been found between depression and obesity/overweight, as well as low self-esteem. When assessing the outcomes of obese adolescents, it is important to consider the variables of BMI, the Rosenberg self-esteem scale, and depression. Therefore, it is recommended to implement psychological and psychiatric	In addition, children who are obese tend to view themselves as less competent in areas such as sports, physical appearance, and social interactions with peers. In light of these findings, it is crucial to develop interventions that specifically target overweight or obese early adolescents, with the aim of strengthening and enhancing their self-esteem. Parents should

					standards.		interventions to minimize these consequences.	also play an active role in encouraging and participating in improving eating habits and increasing physical activity, as these factors contribute to enhancing self-esteem during early adolescence. It is important to raise awareness among parents and teachers about the issue of obesity and its consequences, and to work towards reducing the stigma associated with it.
9.	Childhood and Adolescent Obesity in a School in Interior Portugal—A Teen without Risk Study	MDPI Portugal. Obesities 2024, 4, 281–291. https://doi.org/10.3390/obesities4030023 https://www.mdpi.com/journal/obesities.	Patrícia Coelho, Maria Duarte, Ema Torres Cabral, Sónia Mateus and Francisco Rodrigue s.	to assess the prevalence of obesity and its risk factors among children and adolescents in the second and third cycles, as well as secondary education, in a group of schools in rural Portugal.	Quantitative research. Cross-sectional. This research is part of a project titled Teen Without Risk (TWR), a school-based intervention project that focuses on the health and well-being of children and adolescents, as	A questionnaire was administered, and blood pressure measurements as well as lipid profile evaluations were conducted for each individual.	Our findings reveal a high percentage of increased BMI, changes in lipid profiles, and high blood pressure among the adolescent population. Key risk factors such as a family history of cerebrovascular and cardiovascular diseases, a sedentary lifestyle, and poor eating habits play a significant role in the increase of weight, blood pressure, and changes in lipid profiles in young	This research has not yet generalized its findings to a broader population, highlighting the need for more diverse and inclusive studies to ensure that the results can be applied to a wider demographic. With the hope of becoming a foundation for the development of strong and evidence-based policies aimed at addressing this widespread issue. By

					well as promoting health education within school communities in the Beira Baixa and Beira Alta regions.		individuals.	prioritizing the health of young individuals, we can ensure a healthier and more productive future for our society.
10.	Adolescent obesity: Confessions of the young mind	Metabolism Open 7 (2020) 100044	Spyros P. Batzios a, Maria Provatidou b, Athanasios Christoforidis a, *, Haralambos Sidiropoulos b, Dimitrios C. Cassimos c	To investigate adolescents' perceptions regarding various aspects of obesity in a prospective cohort study.	The study population includes elementary school adolescents, aged 11 to 12 years.	The anthropometric measurements of the participants include height and weight. Participants who are overweight and obese are classified using the criteria of the International Obesity Task Force. A structured questionnaire assessing physical activity, dietary habits, parental guidance regarding food intake, and psychological	Our findings support the notion that teenagers are fully capable of expressing their opinions. When planning intervention programs for adolescent obesity management, their perspectives must be given significant attention.	This research measures adolescents' perceptions of obesity and the behavioral factors that influence obesity.

						aspects related to social functioning, weight, and body image has been completed by each teenager.		

DISCUSSION

Article No. 9 and 1 (Research in Portugal, Germany, and Austria) mention that the occurrence of obesity is influenced by genetic, metabolic, environmental, behavioral, social, and cultural factors. In addition, the factors contributing to obesity in adolescents were found in those with a family history of cerebrovascular disease, an inactive lifestyle, and poor eating habits, which ultimately play a significant role in the increase of weight and blood pressure[15]. Obesity will have an impact on mental health issues in children, adolescents, and young adults, especially those who experience anxiety disorders, eating disorders, and depression[7]. Therefore, healthcare professionals must be aware of the harmful effects of obesity on adolescents and young adults so that they can take preventive, curative, and rehabilitative measures to reduce the incidence of obesity.

Articles No. 3, 4, and 6, where the research was conducted in Korea, Riyadh City, and Spain, indicate that the incidence of obesity in men is higher compared to women[8]. Meanwhile, the occurrence of obesity in adolescents is caused by factors such as psychological health, habits related to exercise or involvement in physical activities both at home and at school, and eating habits[11]. The use of high technology, such as food ordering applications, can increase individuals' behavioral intentions to order food, thereby facilitating the consumption of unhealthy food[13]. It is very important to understand the factors that cause obesity in adolescents and young adults. Because by understanding the determinant factors, healthcare workers can take concrete steps to reduce morbidity by eliminating the underlying causes.

Articles No. 7, 8, and 10 (using four schools in South Africa, the city of Casablanca, and Northern Greece), it was found that adolescents suffering from obesity will experience psychological pressure in the form of bullying from their peers[14]. Children with obesity are more likely to see themselves as individuals who are less competent in areas such as sports, physical appearance, and social interactions with peers[17]. Therefore, it is very important to raise awareness among parents and teachers about the issue of obesity and its long-term negative impacts. Teenagers are very capable of expressing their opinions and views, which are sometimes always taken into account when planning the implementation of intervention programs to address childhood obesity.

Article no. 5 (Di Provinsi Limpopo, Afrika Selatan) Observing a phenomenon that as the nutritional gap between urban and rural areas narrows due to nutritional transition, teenagers in rural areas are likely to engage in urban lifestyle behaviors. This research determines the prevalence of overweight/obesity among adolescents in rural high schools and its relationship with certain factors. The highest proportion of overweight/obesity is found among adolescents who experience abdominal obesity. Factors such as being older in adolescence and living in households with working adults are associated with an increased likelihood of being overweight/obese[18]. Breakfast habits indicate a lower likelihood of experiencing overweight/obesity. Daily eating frequency, meal opportunities and timing, as well as eating patterns can affect digestion and calorie absorption, as well as energy balance. The Integrated School Health Program must have clear guidelines regarding the types of food served and sold at school.

CONCLUSION

The results of this systematic literature review conclude that the occurrence of obesity in adolescents is caused by health factors, psychological factors, exercise habits or involvement in physical activities both at home and at school, and eating habits. Therefore, healthcare professionals need to understand the serious impact of obesity on adolescents and young adults in order to take effective preventive, curative, and rehabilitative measures. Identifying the factors that cause obesity is very important so that the interventions carried out can be targeted effectively. In addition, raising awareness among parents and teachers about obesity issues and their long-term impacts. The involvement of adolescents in planning intervention programs can enhance their effectiveness. Therefore, to support efforts in preventing obesity, the Integrated School Health Program needs to have clear guidelines regarding the types of food served and sold in schools.

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