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Systemic Review

Analyzing the complications of children with obesity: a systematic review of its effective management based on the latest guidelines

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ABSTRACT

The epidemic of children with obesity has quickly become a significant issue for public health worldwide. Positive energy balance owing to calorie intake exceeding caloric expenditure and a genetic propensity for weight growth is the most prevalent cause of obesity. The goal of evaluating children with obesity is to identify the factors that led to their weight increase and any associated health problems. Children's weight control rests mainly on family-based lifestyle treatments, such as food changes and increased physical activity. A study was conducted to understand and evaluate the measures for effectively managing the complications in children with obesity. The study was carried out based on PRISMA guidelines. The systematic literature search was conducted between 2018 to 2023 from databases such as Medline/PubMed and psych info. Considering the inclusion criteria, 44 articles were included in the present review. The result showed that most of the studies included in this review were conducted on adolescents with obesity aged 5-19 years. Much of the research was a randomized cohort study that focused on the interventions for effective weight management in adolescents. Many studies also included parents and pregnant women as their study subjects. The findings of the studies involved in this review suggested the prognostic factors and different treatment programs that can reduce the consequences of obesity developing into adulthood. Since this is one of the first reviews of its kind, the results might prove helpful in making predictions about potential solutions to the issue of obesity and opening the door to more research into treatment strategies for reducing the adverse impacts of obesity on children.

Keywords: Pediatric obesity, BMI, Bariatric surgery, Lifestyle factors, Intervention

INTRODUCTION

Over 340 million children and adolescents between the ages of 5 and 19 are suffering from obesity, according to data from the world health organization's global health observatory in 2017.[1] From 1975 to 2016, worldwide obesity increased among teens, with a 4.9% rise for girls and a 6.9% rise for boys.[2] Obesity and overweight have been linked to various health problems later in life.[3] A 40-70 percent of youngsters affected by overweight and obesity will stay obese as adults are just as concerned. Moreover, this continued weight gain from childhood into adulthood might raise the likelihood of acquiring type 2 diabetes, coronary heart disease, certain malignancies, and untimely death.[4]

Excessive body fat is measured by the body mass index (BMI), calculated by dividing a person's weight in kilograms by the square of their height in meters squared. Individuals are classified as overweight when their BMI is less than 25 kg/m^2 and obese when it is more than 30 kg/m^2. Muscle gain or loss in individuals who lead active or sedentary lifestyles, respectively, might lead to an inaccurate assessment of BMI as a measure of body adiposity.[5] Obesity is a complicated etiology due to the combination between heredity and an unhealthy lifestyle.[6] A 97 gene loci are related to a higher BMI in genome-wide association studies (GWAS).[7] Sleep-disordered breathing, sleep apnea, and other obesity-related sleep disorders are only some of the many potential side effects of being overweight. To help doctors learn more about the physiology and therapy of obesity, they are only one in a series of OMA clinical practice guidelines. It may also help doctors treat their patients better, particularly those who are overweight and have sleep problems, including obstructive sleep apnea (OSA) and other metabolic, physiological, and psychological difficulties.[8]

One cause of being overweight is sedentary lifestyle choices. LeBlanc et al recommend reducing screen time, including TV, video games, and internet use.[9] Cognitive and family-based behavioral therapy encourages adherence to healthy eating and regular exercise.[10] Sitting for long periods increases the risk of consuming energy dense. These nutrient-poor foods, in turn, raise the risk of weight gain and obesity, and it also raises the risk of dental decay by allowing more time for fermentable carbohydrates, found in high-sugar snack foods, to encounter dentition.[11] The findings of a comprehensive study also supported a strong correlation between obesity and dental caries in permanent teeth. A common risk factor approach that includes health promotion interventions and health education programs emphasizing healthy eating and focusing on diets high in sugars and cariogenic foods associated with weight gain is also highlighted.[12] Other significant risk factors have been discovered that may contribute to obesity. Risk factors during pregnancy and the postnatal period include maternal obesity, high birth weight for the mother's age, fast weight growth throughout infancy and early childhood, and the absence of breastfeeding (which is protective) in favor of formula feeding. Other possible risk factors include exposure to environmental toxins, gut flora changes, antibiotics use in young children, and traumatic events.[13]

Clinical practice guideline for the assessment and treatment of children and adolescents who are overweight or obese was recently published by the American academy of pediatrics. The clinically-based solutions to children with obesity are detailed in the AAP evaluation. Obesity treatment differs from person to person. The new recommendations emphasize eating healthily, exercising more for pleasure and self-care, and boosting one's confidence and sense of worth.[14] One approach to promoting changes in dietary habits and physical activity is motivational interviewing.[15] Reducing obesity requires a multifaceted strategy, but one of the cornerstones is intensive health behavior and lifestyle treatment.[16] The authors recommend that pediatricians and other PHCPs follow the consensus recommendations to ensure that all children with overweight get the most effective intensive treatment possible and to foster partnerships with other experts and programs in their community. Different treatment strategies include self-management and individualized suggestions for improving healthful behaviors.[14] When all other therapies have failed, and significant problems are evident, bariatric surgery is last resort.[17] Cases at risk of psychosis, severe depression, personality/eating disorders, alcoholism/drug dependency should be referred for neuropsychiatric counseling. Early or late problems are tracked and treated using anthropometric, clinical, and nutritional examination and counseling in surgical follow-up.[18] Given the complexity of causes of obesity, preventative measures should focus on adjusting environmental and social factors. Economic, agricultural, industrial, environmental, social, educational, recreational, and health policies are almost rethought to promote healthy eating and active living.[19] Mild but meaningful changes in dysfunctional behaviors (diet, physical activity, sedentary behaviors) and BMI may be achieved with lifestyle-based therapies. Keeping a child's BMI stable is a worthy health goal.[20]

Objectives

Objectives were to understand the contributory factors for children with obesity, to evaluate the various diagnostic methods for diagnosing children with obesity, to evaluate the various measures that are adopted for the treatment of children with obesity and to understand the effect of various measures in controlling children with obesity.

Research questions

What are the various lifestyle factors that contribute to obesity? What are the genetic factors that predispose in contributing to obesity? How is BMI used for the detection of obesity? What is the clinical utility of BMI in the detection of obesity? What are the various comprehensive obesity treatment methods used for controlling obesity? What is the role of intensive health behavior and lifestyle treatment in controlling obesity? What is the role of weight loss therapy in treating obesity? Is there any significant role of bariatric surgery in controlling obesity?

METHODS

Search strategy

Specific search strings were developed by combining various keywords. The systematic literature search was conducted between 2018 and 2023 using the search strategy primarily in Medline/PubMed and psych Info databases. These two databases gave the required results

for the below-mentioned keywords. In most cases, similar results were obtained irrespective of mixing the terms.

Inclusion criteria

Articles that had open access and articles that were published between 2018-2023 were included in the study.

Exclusion criteria

Articles that were duplicates, book chapters, encyclopedia, abstract, articles that were not published in English. General articles on obesity were excluded.

Search strings used for reference selection

Lifestyle factors and children with obesity, genetic factors and children with obesity, children with obesity and detection methods, clinical utility of BMI and detection of children with obesity, intensive health care behavior and lifestyle treatment, weight loss therapy and control of children with obesity, bariatric surgery and control of children with obesity.

Study selection

Studies showing relevancy were selected by adopting the search strategy, as shown in Table 1. Firstly, articles with appropriate topics were screened using important keywords concerned with the study. The database used here is Medline/PubMed and Psych Info. Secondly, the articles were screened independently by three reviewers. After the study selection, a consensus was made before including the studies in this review. Any conflicts were resolved through discussion and consensus between reviewers. The total number of articles obtained was screened for the English language. Next, the articles were screened according to the year of publication. Finally, only the relevant articles according to the filters applied were selected, a total of 45 articles.

Table 1: Summary of search strategy terms and no. of relevant articles found using different databases.

Database	Keyword/search strategy	Total no. of articles	Relevance
Medline/ PubMed	Lifestyle factors and children with obesity	1211	178
	Genetic factors and children with obesity	1701	387
	Children with obesity and detection methods	895	311
	Clinical utility of BMI and detection of children with obesity	1323	277
	Intensive health care behavior and lifestyle treatment in children with obesity	20	4
	Weight loss therapy and control of obesity in children	593	101
	Bariatric surgery and control of children with obesity	195	45
Psych Info	Lifestyle factors and children with obesity	12057	1151
	Genetic factors and obesity	20000	
	Obesity in children and detection method	10000	
	Clinical utility of BMI and detection of children with obesity	2058	661
	Intensive health care behavior and lifestyle treatment in children with obesity	2	
	Wright loss therapy	20000	
	Bariatric surgery and control of obesity	2	

Data extraction and quality assessment

Separate data retrieval procedures were carried out for each research. Two people reviewed the procedure and came to the same conclusion. Details about the studies themselves, such as the number of patients enrolled and their ages, as well as details about the caretakers involved, the study designs used, and the features and preliminary results of each research, were collected from the available literature. Findings from the selected articles were further evaluated considering the study's selection criteria. Each of the final 45 articles was examined extensively to determine whether it included the contributory factors for children with obesity. The findings were extracted from the selected articles regarding the various diagnostic methods for diagnosing children with obesity. The results from each research were pooled to draw inferences about the various measures adopted for treating and the effect of different measures in controlling children with obesity. The grade of the comprehensive literature evaluation was determined by evaluating each paper based on the study's objectives. Every article's accompanying data was carefully examined before making the final decision. The research-grade was determined by examining how well the included papers reported their results.

Data synthesis and analysis

Once the highest-quality studies were found, the guidelines recommended were thoroughly examined. The inferences drawn from this comprehensive literature review were determined by combining the diagnostic methods and treatments received from the various data. The studies were then summed and assessed for the

uniqueness of the results from all the individual studies pulled from the database comprising comparable information on complications of children with obesity and other information on its management using new guidelines.

RESULTS

PRISMA sheet for finalized references

Medline/PubMed and psych info

Using the keyword 'Lifestyle factors and pediatric obesity'-Medline and PubMed gave 1211 articles, among which 178 were relevant; Psych info gave 12087 articles of which 1151 articles were relevant; From the keyword 'Genetic factors and pediatric obesity' we found 1701 articles from Medline and PubMed of which 387 were relevant; Psych info gave 20000 articles, as the search result was too high these articles were not considered for further screening. The keyword search on Medline and PubMed for 'pediatric obesity and detection methods' gave 898 articles, of which only 311 were relevant; Psych info for the same keyword gave 10000 and above articles; due to the high search results, the articles were not considered for further screening.

From the next keyword, 'clinical utility of BMI and detection of pediatric obesity' 1323 articles were found from Medline and PubMed of which 277 were relevant, whereas Psych info gave 2058 articles, of which 661 were relevant; using the keyword 'Intensive health care behavior and lifestyle treatment in pediatric obesity' medline /PubMed gave 20 articles among which only four were relevant, for the same keyword Psych info gave only two articles however they were not considered for further screening as the articles were too less and not appropriate.

For the keyword 'Weight loss therapy and control of pediatric obesity' Medline /PubMed gave 593 articles among which 101 were relevant; Psych info for the same keyword gave more than 20,000 articles not considered for further screening as the search results were too high. Using the keyword 'Bariatric surgery and control of pediatric obesity,' we found 195 articles, of which only 45 articles were relevant; Psych info for the same keyword gave only two articles, as they were too few and not relevant, they were not further considered for the

screening. Hence, the total number of articles considered for further screening from Medline/PubMed was 1303, and the total number of articles considered from Psych info was 1812. Combining the number of articles from Medline/PubMed and Psych info, the total number of articles found was 3115. However, around 500 duplicate articles were removed based on the exclusion criteria, resulting in 2615 articles for further screening. Similarly, book chapters, encyclopedias, and non-English articles were around 300. Eliminating this resulted in a total of 2315 articles.

Eligibility

The final 2315 articles were further screened for eligibility based on research objectives and questions. Many of the articles were nonspecific on obesity and had little relevance to the study. Hence out of 2315, only 45 articles were selected, thus eliminating the remaining 2270 articles.

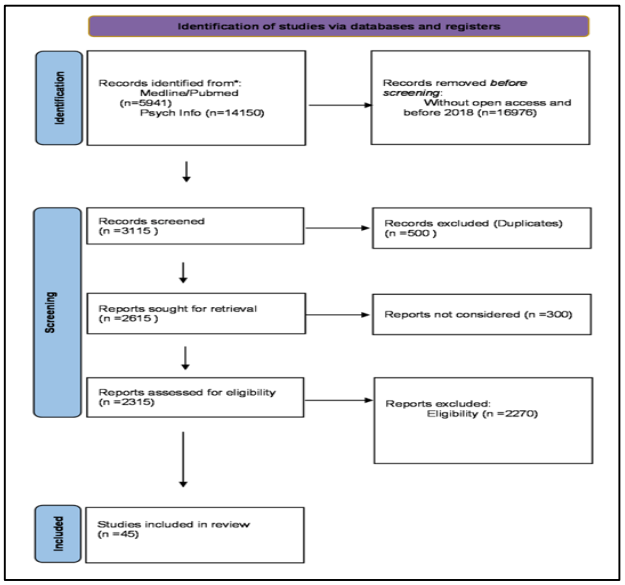

Figure 1: PRISMA sheet summarizing the selection of final articles for review.

Table 3: Results are based on observations from various papers.

Nature of the study	Total no. of subjects	Observation of the Study	Reference
Position paper	Not applicable	Considering the complexity of development of obesity in children and adolescents, an integrated multi-component approach is required for obesity prevention.	Verduci et al, 2021[21]
Systematic literature review	Not applicable	Gender, age, ethnicity, and self-concept were most common influencing factors of children participating in physical activity at the intrapersonal level.	Hu et al, 2021[22]

Continued.

Nature of the study	Total no. of subjects	Observation of the Study	Reference
Interventional genetic association study	1198 children with overweight or obesity	Environmental, social, and behavioral factors seem to play a substantial role in obesity treatment strategies in children.	Heitkamp et al, 2021[23]
Research article	3098 participants aged 2-16 years	A healthy childhood environment might partly offset a genetic predisposition to obesity during childhood and adolescence.	Hüls et al, 2021[24]
Cohort study	600 children aged 5-12 years	No single factor is responsible for children with obesity; its origin is multifaceted. The composite score is a beneficial means of identifying children at risk of overweight/obesity and may be helpful in the development of effective interventions to tackle.	O'Donnell et al, 2022[25]
Mini review	Not applicable	Pediatricians should recognize potential risk factors (sedentary lifestyle, sugar, fats-rich diet, genetic syndromes) and early signs of overweight and obesity to promptly address the child to a pediatric endocrinologist and a specialized reference Center.	Brambilla et al, 2022[26]
Perspective' article	-	Developing effective management strategies necessitate a personalized approach incorporating the subtyping of obese phenotypes by etiologic status (acquired or inherited).	Archer and Lavie, 2022[27]
Cross-sectional study	416 students between the ages of 12 and 14	Responsible and limited use of screens and engaging in extracurricular physical activities may be the most remarkable and cost-effective strategies for obesity prevention programs.	Carpena Lucas et al, 2022[28]
An observational, randomized controlled trial study	250 pregnant women	DiGest follow-up study provides opportunity to assess pregnancy and postnatal risk factors for development of obesity and to describe potential impact of dietary intervention in pregnancy.	Jones et al, 2021[29]
Review article	Not applicable	Biological, cultural, and environmental factors such as readily available high-density food choices impact youth eating behaviors. Media devices and associated screen time make physical activity a less optimal for children and adolescents.	Kansra et al, 2020[30]
Review article	Not applicable	The future of prediction, diagnosis, and treatment relies on a greater understanding of the genetic determinants of children with obesity.	Littleton et al, 2020[31]
Narrative review	Not applicable	Analysis of epigenetic architecture at interface between gene expression and epigenetic environment could be relevant for better understanding of obesity and its associated comorbidities.	Panera et al, 2022[32]
Research article	2,490 adolescents, 11 to 18 years	Percentile curves can be used temporarily for early detection of abdominal obesity among Macedonian adolescents aged 11 to 18; a WHtR of 0.5 may also be used as an obesity threshold in these age groups.	Bojanic et al, 2020[33]
Longitudinal study	353 adolescents	Salivary CRP and insulin were associated with hyperglycemia, obesity, and possibly diabetes in adolescents.	Alqaderi et al, 2022[34]
Retrospective cross-sectional study	318 children with overweight/obese, 2-20 years	Obesity-related morbidity is widely prevalent among children with obesity, and insulin resistance is a critical factor in its prediction.	Abdelhamed et al, 2022[35]
Case-control study	498 Iranian preschool children	Tri-ponderal mass index (TMI) and neck circumference seem to predict general and central obesity in Iranian preschool children.	Mardali et al, 2022[36]

Continued.

Nature of the study	Total no. of subjects	Observation of the Study	Reference
Case-control study	68 adolescents aged 9 to 19 years	Elevated circulating plasma branched-chain amino acids (BCAA) could be an essential link between obesity, NAFLD, and other metabolic pathways involved in lipid and glucose metabolism.	Lischka et al, 2021[37]
Cross-sectional study	98 teenagers	The study demonstrated evidence for a relationship between the eight significant metabolites in adolescents with obesity.	Yin et al, 2021[38]
Cross-sectional study	37,603 children	The study provides insight into the mechanisms that promote overweight and obesity in US children and provide rigorous data for novel programs to lessen the burden on individuals, families, and society.	Tylavsky et al, 2019[39]
Cross-sectional study	8,241 schoolchildren aged 3 to 12 years	The proposed waist circumference (WC) cut-off values, stated for the first time in a young Spanish population, are a simple and valid alternative as diagnostic criteria for abdominal obesity.	Partearroyo et al, 2020[40]
Meta-analysis	177,943 children and 3-19 years of age	The systematic review showed no anthropometric index was superior in identifying hypertension and elevated BP in the pediatric population.	Tao et al, 2022[41]
Cross-sectional study	45 children with obesity and 45 children with normal-weight 10 to 18 years old	Among the five studied miRNAs (miR-193a, miR-122, miR-155a, miR-15a, and miR-146), only the expression level of miR-155 was significantly different in PBMC of children with obesity compared to the standard group (lower in children with obesity)	Behrooz et al, 2023[42]
Population-based study	A total of 656396 children from 31 provinces aged 3 to 19 years old	The prevalence of obesity and overweight in Chinese children and adolescents showed a slight downward trend though it increased in 2020 due to the COVID-19 lockdown.	Yang et al, 2022[43]
Prospective cohort study design	135 mother-child pairs were included in the study.	The presence of several early risk factors related to obesity in infancy was significantly associated with higher BMI z-score and body fat percentage at two years of age	Díaz-Rodríguez et al, 2021[44]
Cross-sectional and cohort study	Database consisted of 2367 measurements in 1953 individuals, of which 92 were selected via obesity clinics.	Raised fat levels are much less common at younger than older ages, and young children with a high BMI centile have lower FMI than older children with the same BMI centile.	Wright et al, 2022[45]
Single-center longitudinal study	55 subjects with obesity (6-16 years)	In children with obesity, cardiovascular impairment could be partially reversed by healthy lifestyle intervention.	Genoni et al., 2021[46]
Pilot study	-	Because interdisciplinary care for children with obesity tends to exist in limited contexts, extending efficacious interventions to community-based providers is important.	Burton and Smith, 2020[47]
Randomized, controlled clinical trial	270 youths aged 5-18 with obesity	The study will also perform sensitivity analyses restricted to children and adolescents with clinical features similar to children with the most significant relative BMI reduction.	Armstrong et al, 2020[48]
Qualitative study	41 Adolescents with overweight/obesity aged 14-19	Behavioral interventions to treat obesity in adolescence should focus messaging/content on healthy lifestyles rather than weight loss and be sex-stratified.	Lee et al, 2021[49]
Retrospective observational study	2825 adolescents with overweight or obese aged 10-17	An entirely remote digital weight loss program effectively facilitates weight loss in adolescents with overweight or obesity in short and mid-term.	Lei et al, 2021[50]

Continued.

Nature of the study	Total no. of subjects	Observation of the Study	Reference
Retrospective cohort study	Children age 3 to 17 years with obesity	Based on current evidence, continued support is necessary to maintain and promote success beyond a brief 6-month intervention. Long-term pediatric weight management programs are needed to promote continuing progress.	Else et al, 2022[51]
Randomized study	One hundred fifty parent/child dyads (age 8-12 years)	On average, children lost weight participating in our obesity treatment, and there was no statistical difference in weight loss between groups.	Eichen et al, 2020[52]
Cohort study	40 subjects with obesity aged 6-17 years	The study showed significantly different metabolomic profiles based on time post-obesity-related intervention.	Sohn et al, 2022[53]
A systematic review	1587 children and adolescents aged 6-18 years	The findings suggest a relationship between a decrease in BMI and/or BMI z-score with diet and physical activity, the involvement of a dietician/nutrition specialist and physician in the treatment team and a longer duration of intervention.	Bondyra-Wiśniewsk et al, 2021[54]
Longitudinal multidisciplinary study	162 children and adolescents aged between 5 and 18 years	The results of real-world experience and frequent medical supervision increase the weight loss associated with a longitudinal multidisciplinary BWRP, with a parallel improvement of a set of auxometric and cardiometabolic parameters.	Rigamonti et al, 2021[55]
Randomized trial	1010 children 2-6 years of age	In children enrolled in PWMIs, achieving CIWL was associated with younger age, not having severe obesity, and consuming fewer sugary beverages.	Fiechtner et al, 2021[56]
Pilot study	30 children with obesity aged 8-18 years	Findings support that yoga classes added to a pediatric weight management program are feasible and acceptable in racially diverse children with severe obesity and their caregivers.	Forseth et al, 2022[57]
Cohort study	1720 patients aged between 5-25 years	The study demonstrates a statistically significant weight loss among adolescents and young adults on select pharmacotherapy.	Czepiel et al, 2020[58]
A qualitative study	18 children (mean age 10 years) and 24 parents interviewed	Participants in a lifestyle behavior intervention program benefit from parental support and help from their (extended) family, peers, and friends.	Schalkwijk et al, 2015[59]
Multidisciplinary intervention study	63 participants with a mean age of 11 years	The study developed a feasible multidisciplinary program based on knowledge education and individualized training.	Chen et al, 2022[60]
Original article (Major updates to 1991 national institutes of health guidelines for bariatric surgery)	-	Joint statement on the currently available scientific information on metabolic and bariatric surgery and its indications.	Eisenberg et al, 2022[61]
Randomized controlled trial	50 adolescents with a mean age of 15.7 years	Aims to inform about whether it is beneficial to undergo bariatric surgery in early adolescence	Janson et al, 2020[62]
No data available			Flores et al, 2022[63]
Retrospective cohort study	One hundred fifty adolescents and adults aged between 15 - 70 years.	Compared to adults, adolescents had greater BMI and weight reductions, even at 4 years, and more excellent resolution of type 2 diabetes and hypertension.	Stanford et al, 2020[64]
A prospective, multicenter cohort study	748 patients, 18 years or older	The study found the prospective relevance of low-frequency loss-of-control eating, binge-eating disorder, and/or limited duration for reduced long-term HRQOL following OS.	Hilbert, et al 2022[65]

Determinants of children with obesity

Efforts to prevent children with obesity must consider the many causes of this epidemic. Their parents' eating habits strongly influence children's weight. Obesity is linked to dietary habits, including drinking sugary beverages and missing breakfast. Eating high-energy-density meals throughout the day leads to obesity by increasing daily caloric intake. A higher daily calorie consumption predicts body weight excess, and more significant portions, particularly energy-dense meals, relate to this.[21] Children from low-education households were shown to be 61% more vulnerable to the polygenic burden of obesity than those from high-education families in separate research.[24] Furthermore, the researchers discovered a greater genetic vulnerability to obesity among children from Southern Europe than those from Central Europe. The only way to effectively intervene to stop the worldwide increase in children with obesity rates is to understand better the factors contributing to the problem. Obesity in children has been discovered to have complex etiological roots, with no one cause being solely accountable for the epidemic. Prevention and treatment measures for this illness must consider several aspects, many of which have origins in childhood and are impacted by parental actions.[25] Cross-sectional research was conducted to identify preventable causes. The research indicated that "use of electronic devices," "not performing physical activity," as well as the "sedentary lifestyle" all had a significant impact on the development of overweight in teenagers. Therefore, the most impressive and cost-effective techniques for obesity prevention programs may be limiting screen time responsibly as well as the encouraging extracurricular physical activity.[28]

Genetic determinants of children with obesity

Significant progress in understanding the genetic contribution to children with obesity has been driven by the introduction of GWAS and next-generation sequencing, according to research. The heritability of obesity has been demonstrated to be influenced by a wide variety of standard and uncommon genetic variations. Clues on which genes and pathways should be targeted with therapeutic drugs may be obtained from studies of syndromic and monogenic variants of children with obesity. Prediction, diagnosis, as well as the treatment may all benefit from a deeper dive into the genetic underpinnings of the condition.[31] Independent of the transfer of a solely genetic predisposition, there is no evidence that maternal obesity/overnutrition during pregnancy and breastfeeding relates to numerous problems in children. The epigenetic architecture of cells may be reprogrammed even before conception if either the father's or mother's gametes are directly exposed to environmental stimuli. Inherited obesity risk may be passed down across families in this way due to epigenetic mechanisms.[32]

Predictors of children with obesity

Using longitudinal analysis, Alqaderi et al found an increase in BMI of 3.5 kg/m^2 and insulin levels of 3.2 kg/m^2 for every unit rises in salivary CRP.[35] Their research showed that elevated levels of CRP and insulin in the saliva of teenagers were linked to hyperglycemia, obesity, as well as probably diabetes. Disease risk assessment and prevention may benefit significantly from using the salivary biomarkers, which are a noninvasive method.

In another study, males were found to have larger waist circumferences, neck circumferences, waist-to-hip ratios, neck-to-height ratios, conicity indices, tri-ponderal mass indices, and body mass indices than females. However, females topped males regarding body adiposity index and hip circumference. Both the BMI and the thigh circumference were shown to be significant predictors. General and abdominal obesity in preschool-aged Iranian children seems to be predictors of TMI and NC.[36] Eighty percent of obese teenagers have non-alcoholic fatty liver disease (NAFLD). Adults are a good test group for non-invasive prediction algorithms since children do poorly in these studies. Therefore, this research aimed to identify new biomarkers for NAFLD and create a score that predicts liver fat in children and adolescents with severe obesity. Potentially, BCAAs bridge the gap between obesity and other metabolic processes. A BCAA-based metabolic score may predict steatosis grade in high-risk children and adolescents. It may one day be a practical alternative to complex procedures like the MRI or biopsy.[37]

Prognostic index of children with abdominal obesity

Detecting obesity early is essential for preventing related problems in later life. The research was conducted to determine the best WC (Waist circumference) cut-off values for the Spanish children's population to compare the various diagnostic criteria used to characterize overweight and obesity. Prevalence rates of overweight and obesity were determined by IOTF (International obesity task force) and WHO (World health organizations) standards. First stated in a young Spanish population, the suggested WC cut-off values were a straightforward and viable replacement for traditional diagnostic standards of abdominal obesity.[40]

In another study, researchers looked at WC percentiles compared to other teenagers to determine whether they were affected by overweight or obesity based on their waist circumference (WC) as well as waist-to-hip ratio (WHtR). The study's results suggested that reference percentile curves developed may be utilized temporarily for early diagnosis of abdominal obesity among the Macedonian teenagers aged 11 to 18; a WHtR of the 0.5 may also be used as the obesity criterion in these age groups.[33]

Management of pediatric obesity

Exercise, healthy eating, and behavioral modifications are the cornerstones of therapy.[66] Evidence shows that helping children with obesity adopt healthier habits may improve their cardiovascular health and GERD.[67] Multiple mechanisms, including changes in body composition, metabolic state, and blood pressure levels, likely contribute to this effect. Effective interventions should be made available to practitioners in the community. Accessibility, sustainability, and equity must all be carefully considered when assessing such initiatives.[47] Adolescents' choices for the instructor, communication, and content of behavioral interventions for treating teenagers with obesity should be considered wherever feasible. Interventionists should consider using motivation, electronic communications, and activities to boost participation and retention. Adolescents suffering from overweight or obesity may lose weight utilizing a remote weight reduction program, according to research. There is additional evidence that after an initial 6-month intervention, ongoing assistance is essential to sustain and enhance success. Programs aimed at reducing childhood obesity should be ongoing if they are to be effective.[70] Another research found that those with a BMI of 35 or above benefit from metabolic and bariatric surgery (MBS), independent of whether they also suffer from co-morbidities or their severity.[67]

DISCUSSION

No previous review has been undertaken that sums together diverse research to understand the contributing factors for children with obesity by analyzing the various diagnostic tools and strategies for the diagnosis and treatment to the best of the author's knowledge. This review sought to determine the impact of different initiatives to curb children with obesity. Since this is the first scoping study of its kind, it should help us better understand how widespread the harms of children with obesity are. This study's results may aid in predicting the causes and pave the way for more studies into methods and new recommendations for dealing with its consequences.

Multiple research projects summarized below have found many factors contributing to obesity. Parents suffering from obesity and the home food environment significantly affect children's weight. The increasing consumption of energy-dense foods that are heavy in fat and carbohydrates but low in proteins contributes considerably to the epidemic of obesity. It is hypothesized that two significant etiological variables contributing to the rising prevalence of children with obesity in developing countries are the prevalence of sedentary lifestyles and high-calorie meals with little nutritional value. Children at risk of becoming overweight include those who are exposed to socioeconomic adversity or who have short infancy development in contemporary surroundings.[68-70]

The obesity epidemic has a vital hereditary component. Another research confirms what this comprehensive literature review has found: that MC4R, which encodes the melanocortin four receptor, is the most often implicated gene. Five percent or less of people with obesity across all ethnicities have mutations in MC4R that impair the protein's ability to regulate appetite. Children with this disorder experience intense hunger and gain weight through chronic overeating (hyperphagia).[61] However, the treatment method depends critically on several key variables. According to one study in the present meta-analysis, BMI and thigh circumference (TMI) are the most significant predictors of children with obesity. Another research found that anthropometric measures of the child and their family were among the most significant indicators. Ancestry and glucose levels during pregnancy were also significant predictors.[72]

Detecting children with obesity early is crucial for preventing adult problems. Therefore, several papers evaluating the various diagnostic criteria for screening for overweight and obesity were found and included in the present review. Comparably, Canfell et al conducted an internal validation of i-PATHWAY, a straightforward, reliable, and clinically helpful prediction model for children who are overweight and obese.[73] Predictive factors for obesity are critical in developing efficient treatment strategies. Recent treatment guidelines published by the American academy of pediatrics can be correlated with the findings compiled in this review. Their recommendations for dealing with obesity include a progressive series of interventions. The recommendations of the guideline included a wide range of obesity care, including both individual and family-centered approaches.

The evidence also suggests that focusing on motivational interviewing as part of an intensive health behavior and lifestyle treatment strategy to reduce BMI or slow the acceleration of excessive weight gain in children may help reduce the risk of developing an eating disorder. The authors of the AAP CPG (Clinical practice guideline) urge many PHCPs, including pediatricians, to encourage patients to engage in certain health-promoting behaviors to achieve a better energy balance. The most effective programs include 26 or more hours of face-to-face, family-based, multicomponent treatment over 2-12 months. The patient and their loved ones are encouraged to manage their disease actively via a self-management strategy.

When alternative therapies have failed, the guidelines urge that pediatricians and other PHCPs use medication to assist children aged 8-11 in reducing weight and those kids with more immediate and life-threatening comorbidities. Metformin is not authorized for weight reduction. However, a few small, randomized trials showed that metformin reduced BMI by about 1 kg/m^2 in adolescents, while the lifestyle-only program increased BMI slightly. Another trial found that 1000 mg twice a

day for six months reduced BMI by 1 kg/m^2, likewise as an addition to lifestyle management. Given its low and unpredictable efficacy, metformin may be used with comprehensive health behavior as well as lifestyle therapy.[72]

Orlistat has been approved for 12-17-year-olds at 120 mg thrice daily. It is FDA-approved for long-term obesity therapy in children over 12.[72] Glucagon-like peptide-1 receptor agonists, including liraglutide, exenatide, dulaglutide, and semaglutide, delay stomach emptying and operate on central nervous system targets to reduce appetite. It's used orally or subcutaneously. Exenatide reduced BMI by 0.9 to 1.18 U in 8-year-olds. Exenatide has been approved for 10-17 years old youngsters with T2DM.[74] Recent randomized controlled research indicated liraglutide (daily injection) to be more successful at weight reduction in children with obesity aged 12-18-year-olds. The beginning dosage is 0.6 mg per day, up to 3.0 mg per day, via subcutaneous injection. Liraglutide is FDA-approved for long-term obesity therapy in children 12 and older with or without T2DM.[76] Diabetes and obesity are very closely related.[77] Melanocortin 4 receptor (MC4R) agonists such as setmelanotide, administered subcutaneously, reduce weight by 12% to 25% over a year. Setmelanotide is FDA-approved for individuals six and older with POMC, proprotein subtilisin or kexin type 1, or leptin receptor dysfunction.[14]

Phentermine is FDA-approved for short-term (3-month) treatment for 16-year-olds at 7.5 mg, 15 mg, 30 mg, or 37.5 mg, which is found to reduce appetite by non-selectively inhibiting serotonin and dopamine reuptake. Topiramate is FDA-approved for epilepsy in children two and older and headache prevention in children 12 and older. Preventing headaches requires 25 mg to 100 mg twice a day. Topiramate for binge eating disorder in adults has also been studied once, and it did not differ from placebo.

Combining phentermine and topiramate effectively treat obesity in children and adolescents aged 12 and above, as per recent data on a history of failure to lose weight by conservative management.[74] Lisdexamfetamine works in a way that's like phentermine, but it's safe to give to kids as young as six who have attention deficit hyperactivity disorder. Although it was developed for adults with binge eating disorder, it is often used off-label to treat children who are overweight. According to the available data, pediatric patients prescribed weight-loss drugs should also be referred for intensive behavioral therapy. If extreme obesity is left untreated, it may lead to the further development of comorbidities and a shorter life expectancy. Hence doctors often recommend metabolic and bariatric surgery. Comprehensive metabolic and bariatric surgery settings are safe as well as the beneficial for pediatric patients undergoing weight reduction surgery.[14]

CONCLUSION

Obesity in children is a complex condition to diagnose. Regarding weight, however, the terms "healthy" and "well-being" may have a wide range of interpretations among children and their families. The results of this study are expected to help make predictions about how best to diagnose and treat children who are overweight or obese, as well as to understand the many sources of ambiguity and difficulty in doing so. This analysis may aid policymakers in developing more effective methods and recommendations for dealing with the present crisis of children with obesity by identifying prognostic indices, complications, and diagnostic criteria. The study also highlights the recent clinical practice guidelines for managing obesity in pediatrics released by the American academy of pediatrics.

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