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# Childhood Obesity Causes Consequences And Management

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**Abstract**

*The rapid rise in the prevalence of childhood obesity has reached epidemic proportions all over the world. Although various types of interventions are being done, they have given only marginal decreases in the prevalence of childhood obesity. Much research has been done on the causes, consequences, and possible interventions to manage the problem. A review of the current status of these aspects can lead to identifying gaps in our knowledge about the problem and scope for future research. Therefore, this paper aimed at a qualitative review of the causes, consequences, and management of interventions to reduce the prevalence of childhood obesity. Google Scholar was searched using the review topic itself as the search term. The search yielded 20 papers for this review. The reviewed papers showed some emerging trends in identifying the causes, assessing the consequences, and implementing possible interventions to manage childhood obesity. Apart from the well-known cause of excess calorie intake and lack of physical activity, more basic information on genetic and pharmacological factors has been obtained. Research on the development of obesity from prenatal to adulthood has given valuable leads for more effective and timely interventions. The consequences researched include comorbidities and psycho-social problems. Obesity stigma needs to be corrected by increasing public awareness about childhood obesity. Interventions at different stages of obesity become increasingly complex, involving more stakeholders at each stage. Bariatric surgery is the last option for highly complicated cases, and the procedure involves side effects and other risks. Hence, some criteria have been developed for this type of intervention. Some limitations of this review have been mentioned at the end of this review.*

***Keywords:*** *Childhood obesity, causes, prevention, management.*

## Introduction

Obesity is a medical condition defined as abnormal or excessive accumulation of body fat that can put a person's health at risk (World Heart Foundation, 2023). According to WHO (2021), over 39 million children [1]below five years of age were obese or overweight in 2020. For the age range of 5-19, the prevalence was 340 million in 2016.

According to the report, WHO provides the following definitions for childhood obesity and overweight:

- For children under five years of age, overweight is when their weight-for-height is more than two standard deviations above the median of the WHO Child Growth Standards, and obesity is when their weight-for-height is more than three standard deviations above that median.

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– For children aged 5 to 19 years, overweight is defined as having a BMI-for-age that is more than one standard deviation above the median of the WHO Growth Reference, while obesity is when their BMI-for-age is more than two standard deviations above that same median.

The trends in the global prevalence of obesity for children and adults are shown in Fig 1 from Bishen (2023). In this data, the prevalence of obesity among boys has been projected to rise from 10% in 2020 to 14%, 17% and 20% by 2025, 2030 and 2035, respectively. In the case of girls, these rates are less than for boys at 8%, 10%, 14% and 18% respectively. These are much lower than for adult men and women. Translating into numbers, 208 million boys and 175 million girls will be obese by 2035. The obesity prevalence rates of selected countries are given in Table 1 (Wisevoter, 2023).

Table 1. The prevalence rate of childhood obesity in selected countries (Wisevoter, 2023).

| **Country** | **Prevalence rate** |
|---|---|
| Nauru | 61% |
| USA | 36.2% |
| Saudi Arabia | 35.4% |
| Australia | 29% |
| UK | 27.8% |
| Russia | 23.1% |
| Brazil | 22.1% |
| China | 6.2% |
| India | 3.9% |

**Children and adolescents (aged 5–19 years)***

| | Boys 2020 | Boys 2025 | Boys 2030 | Boys 2035 |
|---|---|---|---|---|
| Number with obesity (millions) | 103 | 140 | 175 | 208 |
| Proportion of all boys | 10% | 14% | 17% | 20% |
| | **Girls 2020** | **Girls 2025** | **Girls 2030** | **Girls 2035** |
| Number with obesity (millions) | 72 | 101 | 135 | 175 |
| Proportion of all girls | 8% | 10% | 14% | 18% |

** For children and adolescents, obesity is defined using the WHO classification of +2SD above median growth reference.*

**Adults (aged 20 years and over)**

| | Men 2020 | Men 2025 | Men 2030 | Men 2035 |
|---|---|---|---|---|
| Number with obesity (millions) | 347 | 439 | 553 | 690 |
| Proportion of all men | 14% | 16% | 19% | 23% |
| | **Women 2020** | **Women 2025** | **Women 2030** | **Women 2035** |
| Number with obesity (millions) | 466 | 568 | 693 | 842 |
| Proportion of all women | 18% | 21% | 24% | 27% |

Figure 1 Global trends in gender-wise prevalence rates of obesity among children and adults (Bishen, 2023)

The above information shows the seriousness of childhood obesity. Obesity is primarily caused by the imbalance between calories consumed and calories expended. The excess energy is stored as fat, leading to obesity. Genetic factors act as predisposing factors in many cases. However, the basic cause is the lifestyles of consuming excess foods of higher

carbohydrate and fat content without physical activity, resulting from a sedentary life. Ultra-processed foods containing high levels of sugars, sodium, saturated fats and refined carbohydrates are freely available, and these are the key contributors to obesity rising to epidemic proportions.

The consequences of obesity and overweight on children are well-known. World Heart Federation (2023) points out that if not managed or treated adequately, obesity can lead to many health issues like breathing difficulties, increased risk of fractures, hypertension, metabolic disorders, early markers of cardiovascular disease, insulin resistance, low self-esteem, and other psycho-social problems among children.

To prevent children from becoming obese or overweight, a balanced diet low in saturated fats, sugars, and salt and optimum levels of physical activity are required. Process foods need to be avoided. Governments can support healthy eating and exercise through various food policies and attractive schemes to encourage physical activities. Educational institutions should make physical activities a compulsory class activity, just like any other class.

The above facts provide a general overview of the prevalence, causes, consequences, and preventive actions against childhood obesity. Research papers provide more information on these aspects. Therefore, this qualitative review is aimed at critically evaluating the scientific research on these aspects.

## Method and Results

### Method

A Google Scholar search using the topic itself as the search term led to 20 usable papers for this review. The search was stopped when no fresh information was obtained consecutively from three papers. They are discussed in the following sections.

### Results

Childhood obesity (prevalence-33%) among North American children was due to a complex interaction of genetic and hormonal, nutritional, physical activity, and physical and social environmental factors. The consequences were cardiometabolic, pulmonary, and psychosocial complications, sometimes continuing to adulthood. Its management included evidence-based, family-centred multidisciplinary care and surgery in the case of complex instances. Prevention and early intervention strategies are the key to reversing the obesity epidemic (Gurnani, Birken, & Hamilton, 2015).

Sahoo, et al. (2015) noted that overweight and obesity are thought to be due to an increase in caloric and fat intake. However, scientific evidence suggests that soft drinks cause excessive sugar intake to increase. On the other hand, there is supporting evidence that excessive sugar due to increasing consumption of soft drinks and a continuous decline in physical activity have been the reasons for the rapidly rising global prevalence of childhood obesity.

Causes, consequences and solutions to racial disparity in obesity among American children were discussed by Davis (2011). Childhood obesity is more common among minority communities than white communities. The consequences of this disparity are wider due to the discrimination faced by American minorities with respect to healthcare. The school environment, neighbourhood factors, family factors, and individual factors have been attributed to be the causes of racial disparity, leading to the higher incidence of childhood obesity among coloured children in the USA. One legal solution to this problem was a ban on TV marketing of food for children. But neither regulatory authorities nor self-regulation by the food industry was able to do this successfully due to political interference and the selfish interest of the industry itself. Land use planning to increase the space for physical activity and access to fruits and vegetables is another possible solution. But this reform needs strong political initiative. Mandates of various states have met with varied success in

enforcing a minimum level of physical activity to prevent childhood obesity among racial minorities. In many states, political opposition to bills for this purpose has defeated the purpose. The federal law enacted for this purpose is imperfect. The author has suggested the need for federal. State and local governments must work together to find an effective solution.

In an Australian survey of 434 adults (65% parents) by Covic, Roufeil, and Dziurawiec (2007), the participants identified five causal (emotional eating; eating habits and food knowledge; environmental dysfunction; abundance of contemporary lifestyle; cost of contemporary lifestyle), four consequences (behavioural consequences; social consequences; more known and less-known physical consequences) and three potential solutions (parental actions; professional assistance; limiting behaviours). There were no differences between parents and non-parents in identifying these factors and solutions. However, women (70% of the participants) supported two causal factors (emotional eating and abundance of contemporary lifestyle) and two consequence factors (behavioural consequences and social consequences) more strongly than men.

Pharmacological and surgical solutions to childhood obesity were reviewed by Xu and Xue (2016). Body weight is affected by an increase in the number of endogenous molecules like leptin, hypothalamic melanocortin four receptor, and mitochondrial uncoupling proteins. Therefore, these molecules are the potential targets for the pharmacological manipulation of obesity. The effects of drugs being temporary, life-long treatments are necessary for any drug regime for the treatment of obesity. Only 3-8% weight reduction has been achieved by using sibutramine and orlistat used for treating adult obesity. Moderate weight loss has been obtained in small-scale trials with children for metformin, used in obese adolescents with insulin resistance and hyperinsulinemia; octreotide, used for hypothalamic obesity; growth hormone in children with Prader-Willi syndrome; and leptin for congenital leptin deficiency. Bariatric surgery is done on children with severe and complex obesity. Though Roux-en-Y gastric bypass can produce significant weight loss, post-surgery problems limit its applicability.

A signalling model of the leptin pathway controlling energy balance related to the development of obesity (Fig 1) was presented by Han, Lawlor, and Kimm (2010).

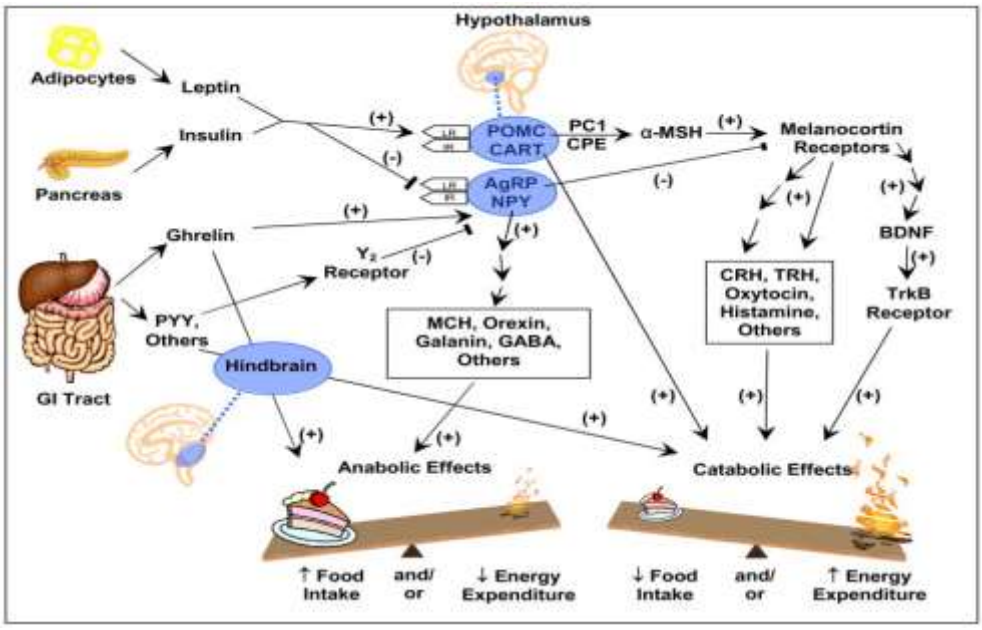


Figure 2 Leptin pathway of obesity (Han, Lawlor, & Kimm, 2010).

Fig 2 of Han, Lawlor, and Kimm (2010) shows the need to consider the possibility of endocrine diseases, congenital and acquired hypothalamic defects, genetic syndromes, and usage of medications affecting appetite in the evaluation of paediatric patients with obesity.

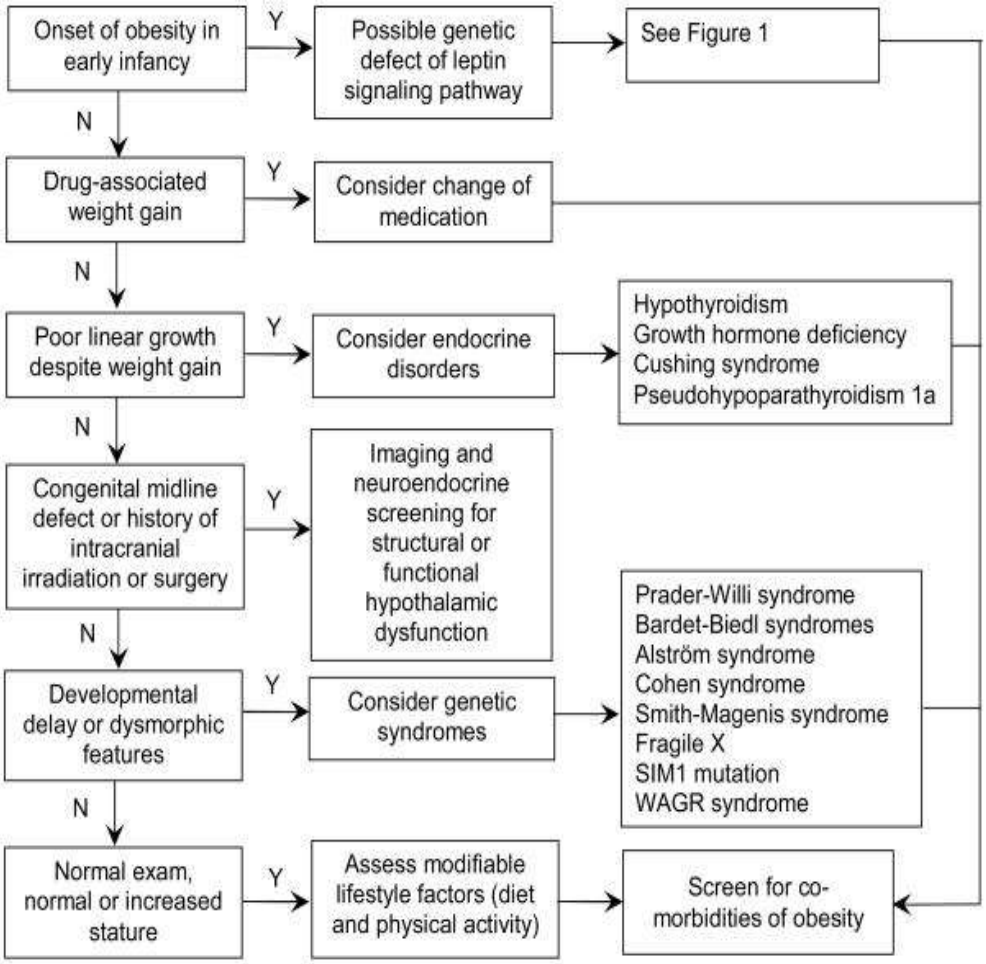


Figure 3 Demonstrating the need to consider endocrinal causes for obesity (Han, Lawlor, & Kimm, 2010)

A system-oriented community-based approach to identify the causes of childhood obesity was tested in an Australian community. In a group model-building session, 12 members of the community built a model to address increasing childhood obesity. The model progressed from connection circles to causal loop diagrams using scripts from the system dynamics concepts. Participants first identified the change in causes and effects of childhood obesity over time in their community. This initial diagram was reviewed and elaborated by 50 community leaders. The diagram provided the basis for community-led planning of a multiple-level prevention strategy in the existing settings and systems (Allender, et al., 2015).

Responses obtained from 137 dietitians, paediatricians, teachers, and parents from a survey conducted by Baker (2006) revealed high levels of concern about childhood obesity among paediatricians and dietitians but not among teachers or parents. All four types of respondents agreed that parents had the primary responsibility to ensure that children followed good eating habits. Children's physical activity levels, parental monitoring of food choices and eating habits of children, and passive entertainment among children dominated the causes identified by the survey participants. Only parents reported a very strong influence on the eating habits of children. Television, followed by friends and peers of children, influenced the eating habits of children most. All four types of participants agreed

that the government's role is mandating school programs on eating habits and physical activity. Strengthening physical education followed by increasing nutrition education by schools found favour with all four types of participants.

Saelens and Daniels (2003) commented on the inconclusive nature of studies on the causes of childhood obesity, the currently practised behavioural interventions due to their long-term efficacy for weight control, recent advances in pharmacological and surgical interventions, and school-based programmes. In another paper, Han, Lawlor, and Kimm (2010) highlighted the need for a re-evaluation and better quantification of calorie intake and activity recommendations on a population level, as children lead a sedentary life now. The commonly recommended calorie prescriptions may be too conservative with an evolving energy gap, and these need to be updated.

The recommendations of a working group on childhood obesity convened in March 2004 in Israel (Speiser, et al., 2005) are given here. The evolution of human beings under stress favoured the storing of fat in the body. This genetic tendency to store fat as an insulin response, combined with a sedentary lifestyle and consumption of processed energy-rich foods, causes obesity and overweight problems. Many genetic markers have been found to be associated with obesity and its metabolic effects. However, identifiable hormonal, syndromic or molecular genetic abnormalities have failed to account for the high incidence of obesity. The need to distinguish between the common primary obesity and the rarer secondary obesity associated with genetic disorders, endocrine disease, central nervous system lesions, or iatrogenic causes has been stressed. Detailed medical history, physical examination, and laboratory tests could provide a reasonable diagnosis of them. BMI may need to be supplemented with precise body fat estimation in some specific cases. Monogenic obesity has been related to many types of genes like leptin, the leptin receptor proopiomelanocortin (POMC), prohormone convertase 1, melanocortin receptors 3 and 4, and the transcription factor single-minded 1 of the leptin-melanocortin regulation pathway (see Fig 2 above). On the other hand, evidence for the association between obesity and human polymorphisms in genes involved in the regulation of peripheral metabolic control is contradictory. One example is mitochondrial uncoupling genes, commonly attributed to ethnic or gender-specific variations. Phenotypes that exclude homozygous mutations of the leptin-melanocortin genes may be a cause of common obesity. Many more genes associated with insulin and chromosomal regions have been found to be the likely causes of obesity. Some syndromes like Prader-Willi syndrome (PWS; OMIM no. 176270), Bardet-Biedl syndrome (BBS; OMIM no. 209900), and Beckwith-Wiedemann syndrome (BWS; OMIM no. 130650) have been associated with different aspects of early childhood obesity. Hormones like GH deficiency, thyroid hormone deficiency, and cortisol excess are associated with reduced energy expenditure, but they are rare cases. More such cases have also been found. Some factors of the nervous system, certain medications, environment, and maternal gestation, psycho-social factors, may variously cause childhood obesity. Diet and physical activity factors play a major role. Some prevention strategies at pregnancy, post-partum, and infancy stages, as well as for families, schools, communities, healthcare providers, industry, government, and regulatory agencies, have been listed. The long-term effectiveness of mass screening of children obesity is suspect, but this needs to be done to get statistical data and prevent further increases in prevalence. Treatment should be standardised around modified diets with increased physical activities for children with BMI between the 85th and 95th percentiles. More aggressive treatment can be prescribed for children and adolescents with BMI at or above the 95th percentile (or z score $\geq 2$) or in the case of less obese children with metabolic, orthopaedic, or cardiopulmonary complications and/or psychological problems. Interventions need to be planned around five priorities: increasing with advancing age, higher obesity levels, and the presence of comorbidities. The priority of goals is decreasing weight by balancing energy intake and expenditure. Prevention of comorbidities should be the next goal. These interventions need to be accompanied by lifestyle adjustments. Suitable pharmacotherapy can be added to it. Bariatric surgery is the final option for highly complex obesity with comorbidities.

However, surgery procedures involve many risks. Various approaches to managing obesity among children need to be coordinated by clinicians or a competent person. Ordinary obesity among children can be managed within families, schools, and communities. When advanced interventions are required, clinical or hospital settings are required.

Many obesity-related health conditions can be considered as an extension of symptoms from childhood to adulthood. Examples include high blood pressure, early symptoms of hardening of the arteries and type 2 diabetes. The increasing prevalence and severity of childhood obesity could reverse the recent steady increase in life expectancy. These problems render childhood obesity a serious public health and economic concern (Daniels, 2006).

Based on a review of papers on high-quality randomised control trials, Epstein, Myers, Raynor, and Saelen (1998) observed high long-term effectiveness of dietary, activity, and behaviour change interventions. The authors also identified characteristics of successful treatment and maintenance interventions. Potential positive side effects of a reduction in blood pressure, serum lipids, and insulin resistance and negative side effects of the development of disordered eating patterns were also observed. Reilly (2005) noted that the current thinner children are fatter than those in the past, with a more central fat distribution. Another review by Lee (2009) indicated a significant association of morbidities with childhood obesity with an immediate impact on the health of obese children and increased risk of morbidities in adulthood.

In another review, Kumar and Kelly (2017) observed that no underlying endocrine or single genetic cause exists for most obese children their weight gain. Evaluation of children with obesity is aimed at determining the cause of weight gain and comorbidities caused by excess weight. Obesity management involves family-based lifestyle interventions, dietary modifications and increased physical activity. A staged approach to paediatric weight management is recommended (Table 1), considering the age of the child, severity of obesity, and presence of obesity-related comorbidities to determine the first stage of treatment. There is a modest effect of lifestyle interventions on weight loss, especially when obesity is severe. Weight loss medications may have lower efficacy and safety. Bariatric surgery may be effective in decreasing excess weight and improving comorbidities in adolescents with severe obesity (Table 2 Criteria for Bariatric Surgery). However, data on the long-term efficacy and safety of bariatric surgery in adolescents are lacking. Kumar and Kelly (2017) suggested the following stage-wise approach:

1. Stage 1 (Prevention Plus) can be implemented in a primary care office setting: five or more servings of fruits and vegetables per day, minimising or eliminating consumption of sugar-containing beverages, <2 hours of screen time and >1 hour of physical activity per day.
2. Stage 2 (Structured Weight Management) can be implemented in a primary care office with a dietitian and includes stage 1 guidelines plus increased structure of meals and snacks with attention to the energy density of foods.
3. Stage 3 (Comprehensive Multidisciplinary Intervention) can be implemented in a primary care office with a multidisciplinary team and outside facilities for structured physical activity, including stage 2 guidelines plus increased structured physical activity and dietary program.
4. Stage 4 (Tertiary Care Intervention) can be ideally implemented in a paediatric weight management centre with a multidisciplinary team with expertise in paediatric obesity, including in addition to stage 3 recommendations, medications, extremely structured dietary regimens, or bariatric surgery.

Table 2. Criteria for bariatric surgery (Kumar & Kelly, 2017)

| Criteria for Bariatric Surgery |
|---|

| |
|---|
| 1. Body mass index ≥35 kg/m2 and severe comorbidity, with significant comorbidity with short-term effects on health (e.g., moderate to severe OSA [apnea-hypopnea index >15], T2DM, pseudotumor cerebri, or severe and progressive steatohepatitis), or BMI 40 kg/m2 or above with more minor comorbidities. |
| 2. Physical maturity, defined as completing 95% of predicted adult stature based on bone age or reaching Tanner stage IV. This criterion is based on theoretical concerns that rapid weight loss might inhibit statural growth if an adolescent has not reached near adult height. |
| 3. History of lifestyle efforts to lose weight through changes in diet and physical activity. |
| 4. Ability and motivation of the patient and family to adhere to recommended treatments pre- and postoperatively, including vitamin and mineral supplementation. |
| 5. Appropriate understanding of the risks and benefits of surgery on behalf of the adolescents |
| 6. Supportive but not coercive family. |

According to Cawley (2015), no single dominant economic cause can be attributed to obesity. Modest risks may exist for many factors. The economic consequences of obesity could be lower wages and higher medical care costs, imposing negative externalities through health insurance. Only modest effects have been observed for menu labelling, taxes on energy-rich foods and financial rewards for losing weight. These trends indicate the need for a range of policies for a significant reduction in the prevalence of obesity.

Causes, consequences, and potential solutions for obesity stigma were reviewed by Westbury, Oyebode, Rens, and Barber (2023). Obesity arises from a complex interaction between genetic and environmental factors. These are not within the control of an individual. Despite this, obesity stigmatisation is a serious problem promoted by the media, entertainment, social media, the internet, advertising, news outlets, and political and public health outlets. The consequences of these are psychological, physical, and socioeconomic harm, which are damaging to the individual. It needs to be recognised that obesity cannot be prevented by stigma. Obesity stigma denotes prejudiced, stereotyped, and discriminatory views and actions by others towards people with obesity, often due to inaccurate knowledge about the causes of obesity. There is a need for a combined, well-coordinated and sustained effort from all stakeholders and decision-makers to remove myths about personal responsibility for the obese body. More empathy needs to be expressed towards fat people. This will lead to effective policies and interventions on the right targets to improve the health of the population.

Based on a review, Abrams and Levitt Katz (2011) cautioned that physicians, besides warning obese children and their families about the long-term consequences of obesity leading to risks in adulthood, should also screen for the many diseases that may already be present.

Findings of systematic research by Rankin et al. (2016) showed a negative relationship between childhood overweight/obesity and psychological comorbidities. These comorbidities included depression, poorer perceived lower scores on health-related quality of life, emotional and behavioural disorders, and self-esteem during childhood. There was insufficient evidence for the relationship between attention-deficit/hyperactivity disorder (ADHD) and obesity. Children who are overweight often suffer from psychological issues due to the stigma, teasing, and bullying they experience. These negative experiences can have serious effects on their emotional and physical well-being. It is not clear if psychiatric disorders and psychological problems cause childhood obesity or if they are a result of it. Additionally, there is uncertainty about the underlying factors that contribute to both obesity and psychiatric disturbances in vulnerable children and teenagers.

Higher birth weights of children, maternal obesity, gestational weight gain, and glycemia during pregnancy were associated with later offspring obesity and were negatively associated with lower risks of comorbidities. Poor foetal nutrition predisposes young children to avoid poor nutrition risks by opting for a high-fat diet. Information already gained on the antenatal mechanism and factors related to the development of obesity as a young baby grows into an adult can be used for effective interventions to reduce childhood obesity instances (Lakshman, Elks, & Ong, 2012).

**Conclusions**

The reviewed papers revealed the existence of multiple causes for the high prevalence rate of childhood obesity. The causes range from dietary imbalances to genetic problems. Some racial disparities are explained by genetic factors.

Many factors are also involved in the development of childhood obesity. The conventional approach had been diet management and physical activity scheduling. Pharmacological interventions are done for more complex cases. Bariatric surgery may be required for extremely complex cases, with adequate handling of the side effects of the procedure. Before all these, it is essential to remove the obesity stigma by suitably educating the public about childhood obesity.

All possible variations in childhood obesity have not been fully understood. Hence, there is a lot of scope for future research, especially related to effective, affordable and manageable interventions.

**Limitations**

Use of only Google Scholar to search papers might have missed some important papers. Very few recent papers only were obtained for review. The criterion to stop searching when no new information is gained, might have been a reason for very few papers selected for this review.

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