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ETIOLOGY AND THE CONSEQUENCES OF CHILDHOOD OBESITY

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Abstract

The development of both nations suffering from childhood obesity was recorded by the World Health Organization (WHO). Worldwide, there has been a rise in childhood obesity. By concentrating on the link between obesity and cancer, this can be minimized. Risk factors are strategies for preventing childhood obesity. Childhood obesity has been linked to both vitamin D and calcium. When it comes to childhood obesity, both micronutrient supplements are necessary. Prebiotics, probiotics, and fatty acids are three natural compounds that can be taken as part of a diet to help reduce childhood obesity. Pharmacological management of childhood obesity should only be used after non-pharmacological interventions have failed in the late stages of obesity. Other prohibitive measures that should be implemented at the family level include a healthy diet, physical activity, enough sleep, and limited screen time. Liraglutide, orlistat, and the phentermine/topiramate combination are approved pharmacological treatments. Setmelanotide, lisdexamfetamine, metformin, zonisamide, and fluoxetine are just a few of the several other treatments that have been approved for different types of obesity. These kids may have medical issues such as asthma, persistent inflammation, anomalies in the orthopedic system, diabetes, or dyslipidemias. Adults frequently experience early mortality and the long-term effects of cardiovascular risk factors. Psychosocial problems are also plaguing them

Keywords: Childhood obesity, Body mass index, Consequences, Overweight

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Introduction

The childhood obesity is a serious concern and one of the key challenges of 21st century. This global problem is increasingly affecting both developed and under developed countries, particularly in urban setup. According to World Health Organization's (WHO) definition, childhood obesity is an abnormal or excessive fat accumulation that may damage health. World Health Organization's Body Mass Index (BMI) Categories Based on Increasing Health Risks. (1)

Body mass index (BMI) = Weight (Kg)/Height²(m)

Percentile range of BMI	Class
<5%	Underweight
5% to <85%	"Normal" weight
85% to <95%	Overweight
95% or over	Obese

Figure 1: World Health Organization's Body Mass Index (BMI) Categories Based on Increasing Risks.

The problem has global pervasiveness and has increased at an alarming rate. It has been reported that globally, in 2015, the total number of less than five years of age overweighted children were predicted to be more than 43 million children are estimated to be obese or overweighted. (2) The results from the National Health and Nutrition Examination Survey (NHANES) in 2011-12 indicate in United States the percentage of children and

Adolescents obesity aged 2-19 was 16.9%, representing a threefold increase since 1970. According to Hales, Carroll, Fryar, Ogden, this percentage is likely to increase up to 18.5%.

The standard calculations to categorise public health depends on Body Mass Index (BMI) system. It is a simple index of weight-for height, is commonly used to classify underweight, overweight and obesity in adults. Obesity is defined as people who are overweight and

having BMI of 30 or above. "Obesity is a medical condition in which excess body fat accumulate to the extent that it may have a negative effect on health. Another survey showed in 2015, 600 million adults (12%) and 100 million children were obese in 195 countries. Moreover, the obesity in the early years of life can cause major health issues including chronic

cardiovascular disease, blood pressure, diabetes, sleep disorders, knee joints problem, asthma and cancer. [5] It is important that childhood obesity is tackled early so that it can be managed before the onset of complications. (3) It is also clear that if the number of children with obesity is reduced, this should positively reduce the prevalence of adult obesity. At present, the management of childhood obesity focuses on lifestyle interventions and the importance of expelling more calories than taking in. Lifestyle interventions have been shown to work in some patients, but the general increasing trend of this problem shows that it is not sufficient (4). Pharmacotherapy is developing rapidly in the adult population and, even though data is limited for these medications in children and young people, there is potential that they could be a valuable adjunct in the management of obesity in children and young people.

1. Definitions of childhood obesity:

Obesity is characterized by excessive fat accumulation in the adipose tissue. Obesity is diagnosed based upon body mass index (BMI), which is calculated by dividing an individual's weight by their height. In people with excess musculature, the degree of adiposity does not correlate with their BMI; however, for most individuals, BMI is felt to be an accurate assessment of adiposity and therefore obesity. In adults, obesity is defined as $BMI \geq 30 \text{ kg/m}^2$ and overweight as $BMI \geq 25 \text{ kg/m}^2$. In paediatric populations, obesity is defined by weight compared to age, reflecting the changing composition of the body during physical development. Many countries utilize country specific reference charts for weight and height. This leads to differing definitions of obesity. The World Health Organisation (WHO) defines overweight as BMI-for-age greater than 1 standard deviation above the WHO Growth Reference median, and obesity as greater than 2 standard deviations above the WHO Growth Reference median. (5)

Overweight is defined as BMI at or above 91st percentile and below 98th percentile for children and adolescents of the same age and sex. Etiology of childhood obesity

Obesity is the result of genetic, behavioural, environmental, physiological, social, and cultural factors that result in energy imbalance and promote excessive fat deposition. The relative contribution of each of these factors has been studied extensively, and although genes play an important role in the regulation of body weight, the World Health Organization Consultation on Obesity (21) concluded that behavioural and environmental factors (i.e., sedentary lifestyles combined with excess energy intake) are primarily responsible for the dramatic increase in obesity during the past 2 decades. The genetic contribution to obesity has been elucidated by

studies of Stunkard et al (81) involving twins, in which concordance rates for varying degrees of overweight were twice as high among monozygotic than dizygotic

male twin pairs at age 20 years. with obesity. The ecological model, as described by Davison et al., suggests that child risk factors for obesity include dietary intake, physical activity, and sedentary behavior. The impact of such risk factors is moderated by factors such as age, gender. Family characteristics

Energy Balance

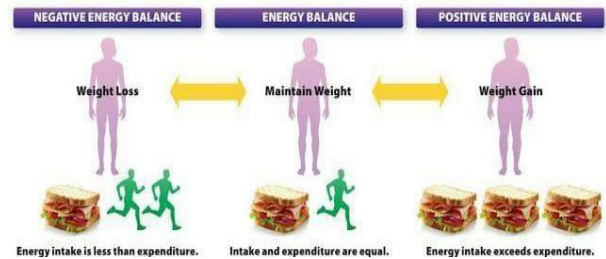


Figure 2

parenting style, parents' lifestyles also play a role. Environmental factors such as school policies, demographics, and parents' work-related demands further influence eating and activity behaviors.

The development of obesity is dependent on an imbalance between energy intake and energy expenditure during an extended period of time. The cause may be viewed as excess energy intake relative to daily energy expenditure, or as low energy expenditure relative to daily energy intake (7). Figure illustrates that energy balance can be achieved only when energy intake and energy expenditure are equal. In accordance with the first law of thermodynamics

(i.e. energy cannot be able to created or destroyed), excess energy is stored as triacyl glycerol's in adipose tissue.

The primary functions of adipocytes are to store energy when calories are in excess and to mobilize energy from this triacylglycerol reservoir when energy needs exceed intake (e.g., during dieting and starvation). An imbalance of as little as 10 surplus calories per day will lead to a 0.45-kg (1-lb) weight gain each year, which can become clinically important if continued for decades (8). Weight gain during adulthood is characterized predominantly by adipocyte hypertrophy, a process by which adipocytes can increase their volume several thousand folds to accommodate large increases in lipid storage. Paradoxically, this viral characteristic is disadvantageous when food is abundant and palatable. Dietary factors have been studied extensively for its possible contributions to the rising rates of obesity. The dietary factors that have been examined include fast food consumption, sugary beverages, snack foods. Fast food Consumption: Increased fast-food consumption has been linked with obesity in the recent years.

1.1 Sugary beverages:

A study conducted in 2006 depicted that children aged 9-14 in the duration of 1996-1998 had history of increasing BMI over the years although changes are

gradual yet impactful. Many studies regarding establishing a connection between sugary drink consumption and weight proves it is one of the fundamental factors of weight gain. It has also been studied and concluded that sugary drinks are less filling than food due to more digestible sugars and lack of fibre(9). They are consumed quickly, resulting in a higher caloric intake and leading to obesity. It has been observed in the surveys that almost 75% of the obese people are having beverages at least once in a day. In an analysis of 30 studies, it was concluded that the consumption of beverages is positively associated with obesity indices in children and adults.

1.2 Snacks and fast food:

There are three major dietary patterns comprising mixed, western and traditional diet. Mixed pattern consisting of all foods excluding rice and beans; traditional diet consists of rice and beans. The traditional diet was found to be lesser responsible for weight gain and developing obesity. In a study conducted by Anderson it was found that prevalence of obesity increased consistently with frequenting fast-food restaurants.(9)

1.3 Environmental factors

Other crucially important causes include perinatal factors, size at birth, catch-up growth, status of breast-feeding, use of antibiotics, environmental chemicals and negative/emotional experiences and occurrences of life. The relationship between obesity and physical activity in children is strongly related. (10) opportunities to be physically active. Furthermore, it has also been seen that a higher degree of obesity in parents is also related significant with an elevated risk of culminating obesity in their respective children.

1.4 Socio-cultural factors:

Socio-cultural factors have also been found to influence the development of overweight and obesity in children. Our society tends to use food as a reward, as a means to control others, and as part of socializing

Family factors:

Family factors have also been associated with the increase of cases of obesity. Many family related factors have also been linked with involvement of obesity since ages. The food preference of family members can influence the foods that their children eat and later on develop a lifelong habit.

The financial condition of parents is playing decisive role in the choices they make in respect of food and activities for their children, and it has been observed that the parents of overweight children are not only facing financial and economic constraints but also having a sub-optimal literacy level.

1.5 Activity level:

One of the key factors that are found to be associated significantly to obesity is a sedentary lifestyle(11). Obesity in children has also enhanced due to massive increase in usage of media related games and hand-held

portable devices, also by the large-scale marketing of junk food products on several electronic and print media, and absence of caring parenting at home

1.6 Short sleep pattern:

Miller, Lumen, Le Bourgeois reported a relation between short sleep patterns through early childhood ages (Three to seven years) leading to same time or later development of obesity. Furthermore, a practice of chronic short sleep originating from very younger age across school age was found to be related with the enhancement of obesity including very short or interrupted sleep duration, poor value sleep, and going late to bed were correlated with developing habit of emotional eating and repetitive restrained eating respectively.(12) Following the habit of regular, consistent sleep schedule in early childhood ages may have an impact in enhancing metabolic regulation and inducing healthy quality sleep with prime healthy eating behaviours in future.

1.7 Genetic factors:

Obesity can also be inherited from overweight parents to children due to sharing family environment. This heritable obesity is may be due to a hormonal disorder that induces change in energy intake and expenditure, leading to increase in obesity. According to a study, 25-40% obesity is heritable. Genetics influence the probability of developing obesity in children amid other factors.

Furthermore, increased incidence of childhood obesity is inherited and has shown to have an association with an existing obesity in family. Among inter alia, parental obesity is one of the prime factors impacting obesity during childhood. Many types of obesity related are known for ample increase in fat-cells numbers.

1.8 Role of vitamin D Deficiency in obesity:

Lower serum levels of vitamin D have been observed in obese children as compared to lean people. Obesity and vitamin D have same risk factors i.e. poor diet and lack of physical activity.

Vitamin D deficiency in childhood obesity causes inflammation, insulin resistance and type 2 diabetes mellitus (in future) and osteoporosis that leads to growth retardation and skeletal deformities (rickets) in children. Major causes of vitamin D deficiency are reduced exposure to sunlight, excessive practice of sun screens/blocks, air pollution and lower consumption of vitamin D fortified foods. (13)

1.9 Role of calcium in obesity:

There is an inverse relationship between calcium intake and obesity. Low level of calcium enhances the level of calcitriol that leads to the accumulation of calcium in adipocytes through vitamin D receptor. Consequences of childhood obesity Childhood obesity can profoundly affect children's physical health, social, and emotional well-being, and self-esteem. It is also associated with poor academic performance and a lower quality of life experienced by the child.

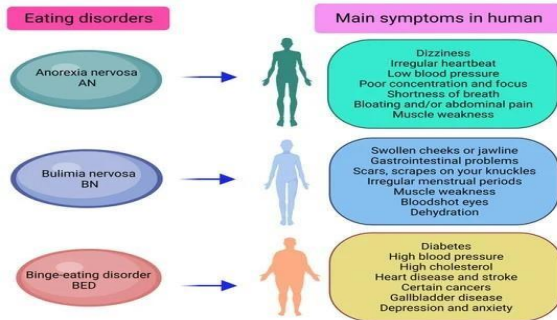


Figure3: Eating Disorders

2. Clinical consequences of childhood obesity:

Many consequences of obesity that were previously thought to be adult-dominated diseases are now affecting children. (7) Childhood obesity can lead to several short and long-term cardiovascular, respiratory, orthopaedic, endocrinology, mental health and gastrointestinal/liver diseases. In this section, the major medical conditions associated with obesity are discussed. Clinical consequences also can mainly focus on some organs. Those are followed below

2.1 Cardiovascular disease:

Childhood obesity has detrimental effects on the cardiovascular system, similar to those seen in adults. The most common cardiovascular risk factors associated with childhood obesity are hyperinsulinemia or insulin resistance, dyslipidaemia, hypertension, ventricular defect, and endothelial function abnormalities. Moreover, children with obesity are approximately three times more susceptible to hypertension than children without obesity. (14)

2.2 Respiratory disease:

Obstructive sleep apnea (OSA) can cause failure to thrive, behavioural issues, decreased intellectual function, and an increased risk of cardiovascular morbidity, insulin resistance and weight gain in children.

2.3 Mental Health and psychosocial:

People with obesity are frequently subjected to public disapproval and stigma because of their weight, with women facing more discrimination. In children with obesity, psychosocial issues can also arise as their weight is perceived as a significant handicap by others.

2.4 Gastrointestinal and Hepatic Diseases:

Childhood obesity significantly increases the risk of NAFLD among the paediatric population. NAFLD manifests differently in children than in adults, with different biopsy findings and higher reported rates of fibrosis and cirrhosis.

3. Treatment

The goals of obesity treatment are to achieve and then to maintain clinically meaningful weight loss, with the ultimate goal of reducing the risk for or severity of obesity-related diseases, impairments, and functional limitations. Weight losses of 5% to 10% of initial body weight produce health benefits and are deemed by many health care practitioners to represent a clinical success. Long-term success, however, is dependent on

maintenance of a 10% weight loss for at least 1 year, 116 a daunting challenge with varying rates of success.117 Wing and Hill116 estimated that approximately 21% of adults who are overweight or obese are successful at 1 year, but longer-term success generally is lower.

Anti-obesity medications are adjunctive treatment to dietary and physical activity changes in childhood obesity and are typically highly sought-after failure of non-pharmacological interventions or in the late stages of obesity. However, recent guidelines advocate the early use of medical and surgical interventions(5). FDA-Approved Medications are many here we are showing about Orlistat Orlistat belongs to the lipase inhibitors pharmacological class approved in 1999 for managing obesity. Its mechanism of action involves acting locally in the stomach and intestine, preventing triglyceride absorption by 30% and inhibiting the action of both gastric and pancreatic lipases. Over a 54-week period, orlistat administration was associated with a significant BMI reduction of 0.55 compared to a BMI increase of 0.31 with placebo (p=0.001).

Conclusion

If society concentrates on the causes, it can reduce the growth of the childhood obesity problem. There are numerous factors that contribute to childhood obesity, some of which are more significant than others. To prevent obesity or overweight, a community-based, school-based combination nutrition and physical activity intervention is more successful. Seven (7) Furthermore, many obesity-related issues may be prevented if parents enforced a better lifestyle at home. Children's home life will eventually influence other areas of their lives with the lessons they learn about healthy food, exercise, and nutritional decision-making. When kids are choosing what to eat at school and fast-food restaurants, this will have the largest impact on their decisions.

Author contributions

All authors are contributed equally.

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Declaration of Competing Interest

The authors have no conflicts of interest to declare.

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