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Obesity: Causes, consequences and management

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Abstract
Obesity is a medical condition in which excess body fat has accumulated to the extent that it may have a negative effect on health. People are generally considered obese when their body mass index (BMI), a measurement obtained by dividing a person's weight by the square of the person's height, is over 30 kg/m^2, with the reference range 25–30 kg/m^2 defined as overweight. Some East Asian countries use lower values as reference. Reference numbers for BMI are 18.5 -24.9 for Normal weight, 25.0 - 29.9 for Overweight, 30.0 - 39.9 for Obese and 40.0 and above as Extreme obesity.

Keywords: obesity, consequences and management

Introduction
Obesity is a chronic disorder that has multiple causes. Overweight and obesity in childhood have significant impact on both physical and psychological health. In addition, psychological disorders such as depression occur with increased frequency in obese children. Obesity is most commonly caused by a combination of excessive food intake, lack of physical activity, and genetic susceptibility. A few cases are caused primarily by genes, endocrine disorders, medications, or mental disorder. The view that obese people eat little yet gain weight due to a slow metabolism is not generally supported. On average, obese people have a greater energy expenditure than their normal counterparts due to the energy required to maintain an increased body mass. The most common symptoms that indicate an adolescent is obese are large body frame, difficulty in doing daily activities, lethargy, breathlessness, disproportionate facial features, breast region adiposity - (sagging fat cells) in boys, big belly (abdomen), sometimes marked with white or purple blemishes, male external genitalia may appear disproportionately small, flabby fat in the upper arms and thighs and knock-knees (Genu valgum) is common.

The symptoms of obesity may resemble other medical problems or conditions. Psychological disturbances are also very common as well as stress, social pressure and doing developmental chores. Obesity is considered to be the root cause of many lifestyle diseases. Obesity puts people at an increased risk of several diseases including diabetes, hypertension, heart and kidney ailments, low back pain, joint problems, and several cancers, including of the uterus, breast, gall bladder, colon, rectum and kidney. Childhood obesity has risen at an alarming pace over the past decade, making obesity the most prevalent health problem among children in the majority of the developed countries. Worldwide, disease profiles are transforming at a rapid pace catching the attention of medical professionals and policy makers alike. This is particularly true in low and middle-income countries that form the major chunk of global population. The emerging epidemics of obesity, cardiovascular disease (CVD) and diabetes form the crux of this phenomenal change. Among these entities, obesity has become a colossal epidemic causing serious public health concern and contributes to 2.6 million deaths worldwide every year. Obesity is an independent risk factor for CVD. Obesity is associated with an increased risk of morbidity and mortality as well as reduced life expectancy. The last two decades of the previous century have witnessed dramatic increase in health care costs due to obesity and related issues among children and adolescents. Mechanical disabilities associated with obesity are: Flat feet, osteoarthritis of knees and hips, lumbar spine, abdominal hernia, varicose veins, difficulty in breathing due to shortness of breath, respiratory infection and accidents.

Overview of Indian scenario
In India, a report submitted by National Family Health Survey, it is revealed that the number of obese people have doubled in the past decade. According to the latest report, a large chunk of the urban population of the country was found to be on the wrong side of Body MASS Index (BMI), with states like Andhra Pradesh, Puducherry and Sikkim registering an alarming percentage of 30% of their population falling in the obese category. The survey is particularly alarming as the country is already dwindling in a crisis of rising heart ailments and diabetes. As per the latest report the number of obese or overweight people has doubled in the last 10 years in India. Ironically, when a large part of the nation that is below the poverty line is battling malnutrition, the urban society is becoming obese. While our country is dealing with the burden of chronic ailments like diabetes and heart disease, this is very disappointing. Most of the Indian states have seen a sharp rise in the number of obese people in the last few years. For instance, in urban Rajasthan one out of five males and one out of four females is overweight or obese. Moreover, Andhra Pradesh, Andaman and Nicobar,

Puducherry and Sikkim have more than 30% of their population falling in the obese category. In Bihar, Madhya Pradesh, Meghalaya, Tripura and West Bengal more than 10% of the people were found to be obese. These numbers have doubled from the last National Family Health Survey that was conducted in 2005-2006. The survey also points out that the urban society is more prone to obesity than the rural population. For example, in Andhra Pradesh, 44.4 per cent urban men suffered from obesity, while the percentage in rural parts was much lower, about 28 per cent. Health experts are predicating that the rapidly growing rates of obesity are responsible for the widespread of diabetes. Today, India is being recognized as the diabetes capital of the world with about 5% of our population suffering from this chronic disease that cannot be cured and needs lifelong management. The single best predictors of types 2 diabetes is obesity or being overweight and about 90% of the people who have diabetes are obese. Therefore, obesity is not a problem in itself but it can put you at a higher risk of other chronic ailments especially diabetes and even heart disease. Thus, Obesity in India has reached epidemic proportions in the 21st century. India is following a trend of other developing countries that are steadily becoming more obese. Unhealthy, processed food has become much more accessible following India's continued integration in global food markets. This, combined with rising middle class incomes, is increasing the average caloric intake per individual among the middle class and above income households. Obesity is a major risk factor for cardiovascular disease. NGO's such as the Indian Heart Association have been raising awareness about this issue Data released in October by the World Obesity Federation, a community of organizations dedicated to solve the problem of obesity, shows that the percentage of Indian adults living with obesity is set to jump to around 5% by 2025, from 3.7% in 2014. According to Global Nutrition report 2017, there are 38% stunted under-5 children, 38% Stunted under-5 children, 21% Wasted' or 'severely wasted' under-5 children who weigh less for their height, 16% Overweight adult men, 22% Overweight adult women and 51% anemia in women of reproductive age. (www. India news.autosales growth in decade)

The growing rate of obesity in India is making it an unhealthy nation, as Indians become increasingly affected by many obesity related problems such as diabetes, hypertension, heart disease etc. According to TOI childhood obesity among adolescents (13-18 years) has grown from 16% to 29% in the past five years in India. Misra *et al.*,(2009) [8]**.** To control this, we need to understand causes of obesity and take charge of the health of the people around us by imparting health education and right nutrition practices. Unlike older days, childhood obesity is very prevalent these days, creating an alarming situation for the future. In a world where childhood obesity is increasing among young children and teenagers, the need to educate everyone about right eating and weight management becomes important. It is widely accepted that increase in obesity results from an imbalance between energy intake and expenditure, with an increase in positive energy balance being closely associated with the lifestyle adopted and the dietary intake preferences. However, there is increasing evidence indicating that an individual's genetic background is important in determining obesity risk. Research has made important contributions to our understanding of the factors associated with obesity. 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 and gender. Family characteristics 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. Genetics is one of the biggest factors examined as a cause of obesity. Some studies have found that BMI is 25–40% heritable. However, genetic susceptibility often needs to be coupled with contributing environmental and behavioral factors in order to affect weight. The genetic factor accounts for less than 5% of cases of childhood obesity**. (**Agrawal 2008**)** [10]. Therefore, while genetics can play a role in the development of obesity, it is not the cause of the dramatic increase in childhood obesity. Basal metabolic rate has also been studied as a possible cause of obesity. Basal metabolic rate, or metabolism, is the body's expenditure of energy for normal resting functions. Basal metabolic rate is accountable for 60% of total energy expenditure in sedentary adults. It has been hypothesized that obese individuals have lower basal metabolic rates. However, differences in basal metabolic rates are not likely to be responsible for the rising rates of obesity. Government and social policies could also potentially promote healthy behavior. Research indicates taste, followed by hunger and price, is the most important factor in adolescents snack choices. Other studies demonstrate that adolescents associate junk food with pleasure, independence, and convenience, whereas liking healthy food is considered odd. As proposed by the National Taskforce on Obesity (2005), fiscal policies such as taxing unhealthy options, providing incentives for the distribution of inexpensive healthy food, and investing in convenient recreational facilities or the esthetic quality of neighborhoods can enhance healthy eating and physical activity. 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, and portion sizes.

Causes of obesity

Fast food consumption

Increased fast food consumption has been linked with obesity in the recent years. Many families, especially those with two parents working outside the home, opt for these places as they are often favored by their children and are both convenient and inexpensive. Foods served at fast food restaurants tend to contain a high number of calories with low nutritional values. Researchers found that both groups consumed more calories eating fast food than they would typically in a home sitting but the lean group compensated for the higher caloric intake by adjusting their caloric intake before or after the fast food meal in anticipation or compensation for the excess calories consumed during the fast food meal. Yajnik, C.S (2007) [11] Though many studies have shown weight gain with regular consumption of fast food, it is difficult to establish a causal relationship between fast food and obesity.

Sugary Beverages
A study examining children aged 9–14 from 1996–1998, found that consumption of sugary beverages increased BMI by small amounts over the years. Sugary drinks are another factor that has been examined as a potential contributing factor to obesity. Sugary drinks are often thought of as being limited to soda, but juice and other sweetened beverages fall into this category. Many studies have examined the link between sugary drink consumption and weight and it has been continually found to be a contributing factor to being overweight. Sugary drinks are less filling than food and can be consumed quicker, which results in a higher caloric intake.

Snack Foods
Another factor that has been studied as a possible contributing factor of childhood obesity is the consumption of snack foods. Snack foods include foods such as chips, baked goods, and candy. Many studies have been conducted to examine whether these foods have contributed to the increase in childhood obesity. While snacking has been shown to increase overall caloric intake, no studies have been able to find a link between snacking and overweight.

Portion Size
Portion sizes have increased drastically in the past decade. Consuming large portions, in addition to frequent snacking on highly caloric foods, contribute to an excessive caloric intake. This energy imbalance can cause weight gain, and consequently obesity.

Activity Level
Most significantly linked to obesity is a sedentary lifestyle. Each additional hour of television per day increased the prevalence of obesity by 2%. Television viewing among young children and adolescents has increased dramatically in recent years. The increased amount of time spent in sedentary behaviors has decreased the amount of time spent in physical activity. Research which indicates the number of hours children spend watching TV correlates with their consumption of the most advertised goods, including sweetened cereals, sweets, sweetened beverages, and salty snacks. Despite difficulties in empirically assessing the media impact, other research discussed emphasizes that advertising effects should not be underestimated. Media effects have been found for adolescent aggression and smoking and formation of unrealistic body ideals. Regulation of marketing for unhealthy foods is recommended, as is media advocacy to promote healthy eating.

Environmental Factors
While extensive television viewing and the use of other electronic media has contributed to the sedentary lifestyles, other environmental factors have reduced the opportunities for physical activity. Opportunities to be physically active and safe environments to be active in have decreased in the recent years. The majority of children in the past walked or rode their bike to school. A study conducted in 2002 found that 53% of parents drove their children to school. Of these parents, 66% said they drove their children to school since their homes were too far away from the school. Other reasons parents gave for driving their children to school included no safe walking route, fear of child predators, and out of convenience for the child. Children who live in unsafe areas or who do not have access to safe, well-lit walking routes have fewer opportunities to be physically active.

Socio-cultural factors
Socio-cultural factors have also been found to influence the development of obesity. Our society tends to use food as a reward, as a means to control others, and as part of socializing. These uses of food can encourage the development of unhealthy relationships with food, thereby increasing the risk of developing obesity.

Family Factors
Family factors have also been associated with the increase in cases of obesity. The types of food available in the house and the food preferences of family members can influence the foods that children eat. In addition, family mealtimes can influence the type of food consumed and the amount thereof. Lastly, family habits, whether they are sedentary or physically active, influence the child. Studies have shown that having an overweight mother and living in a single parent household are associated with overweight and childhood obesity.

Psychological Factors
Depression and Anxiety
Studies find a prospective relationship between eating disturbances and depression. However, this relationship is not unidirectional; depression may be both a cause and a consequence of obesity. Additionally, in a clinical sample of obese adolescents, a higher life-time prevalence of anxiety disorders was reported compared to non-obese controls. Although some studies demonstrate no significant relationship between increased BMI and increased anxiety symptoms. Thus, the relationship between obesity and anxiety may not be unidirectional and is certainly not conclusive.

Self-Esteem
Research findings comparing overweight/obese children with normal-weight children in regards to self-esteem have been mixed. Some studies have found that obese children have lower self-esteem while others do not. There is some consensus in the literature that the global approach to self-esteem measurement with children who are overweight/obese is misleading as the physical and social domains of self-esteem seem to be where these children are most vulnerable.

Body Dissatisfaction
Research has consistently found that body satisfaction is higher in males than females at all ages. Gender differences may reflect the westernized cultural ideals of beauty in that thinness is the only culturally defined ideal for females, while males are encouraged to be both lean and muscular. Thus, there is a linear relationship between body dissatisfaction and increasing BMI for girls; while for boys a U-shaped relationship suggests that boys with BMIs at the low and high extremes experience high levels of body dissatisfaction.
Eating disorder symptoms
Traits associated with eating disorders appear to be common

in adolescent obese populations, particularly for girls. A number of studies have shown higher prevalence of eating-related pathology (i.e. Anorexia, Bulimia Nervosa, and impulse regulation) in obese children/youth.

Emotional Problems

A review of 10 published studies over a period of ten years (1995-2005) investigated the psychological impact of being overweight/obese in children with a sample sizes greater than 50 and revealed that all participants reported some level of psychosocial impact as a result of their weight status. Increased perceived lack of control over eating in adolescent girls seemed to heighten the psychosocial consequences.

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. These potential consequences are further examined in the following sections.

Medical Consequences

Childhood obesity has been linked to numerous medical conditions. These conditions include, but are not limited to, fatty liver disease, sleep apnea, Type 2 diabetes, asthma, hepatic steatosis (fatty liver disease), cardiovascular disease, high cholesterol, cholelithiasis (gallstones), glucose intolerance and insulin resistance, skin conditions, menstrual abnormalities, impaired balance, and orthopedic problems. Until recently, many of the above health conditions had only been found in adults; now they are extremely prevalent in obese children. Although most of the physical health conditions associated with childhood obesity are preventable and can disappear when a child or adolescent reaches a healthy weight, some continue to have negative consequences throughout adulthood. In the worst cases, some of these health conditions can even result in death. Below, three of the more common health problems associated with childhood obesity are discussed, diabetes, sleep apnea, and cardiovascular disease.

Socio-emotional consequences

In addition to being implicated in numerous medical concerns, childhood obesity affects children's and adolescent's social and emotional health. Obesity has been described as being "one of the most stigmatizing and least socially acceptable conditions in childhood." Overweight and obese children are often teased and/or bullied for their weight. They also face numerous other hardships including negative stereotypes, discrimination, and social marginalization. Discrimination against obese individuals has been found in children as young as 2 years old. Obese children are often excluded from activities, particularly competitive activities that require physical activity. It is often difficult for overweight children to participate in physical activities as they tend to be slower than their peers and contend with shortness of breath. These negative social problems contribute to low self esteem, low self confidence, and a negative body image in children and can also affect academic performance. All of the above-mentioned negative effects of overweight and obesity can be devastating to children and adolescents. Yoon *et a*l., (2006)

Academic Consequences

Childhood obesity has also been found to negatively affect school performance. A research study concluded that overweight and obese children were four times more likely to report having problems at school than their normal weight peers. They are also more likely to miss school more frequently, especially those with chronic health conditions such as diabetes and asthma, which can also affect academic performance.

Possible remedial measures

India should also formulate a national policy and partner with the private sector to end the childhood obesity epidemic. Effective policies and tools to guide healthy eating and active living are within our grasp. Some of the specific recommendations are as follows. (National Family Health survey 2005-2006) [9]

Surveillance

- Periodic monitoring of nutritional and obesity status of children including adults:
- To create a database for childhood obesity at various regions to start with and then may be at state level
- Initiate community-based research to document burden of obesity and associated risk factor and monitor these trends over time.
- Maintain a nationwide database on secular trends in obesity and associated comorbidities.

Health Education

- For all children and their families, routine health care should include obesity-focused education
- Nutrition and physical advice through audio-visual media and culturally conducive methods
- Endorsement of healthy lifestyle by prominent people and local champions
- For children who are overweight or obese, a series of clinical counseling interventions in the primary care setting is suggested
- Educational materials are available from a variety of sources to facilitate the counseling. These materials have much in common and have not been directly compared; it is reasonable for providers to select materials with messaging that is best suited to their community.

Community Mobilization

- Organization and participation in health walks and healthy food festivals
- Information about nutrition to parents (particularly mothers)
- Children-specific nutrition information and workshops for newly married women
- Safe walk/bicycle routes to school
- To establish a therapeutic relationship and enhance effectiveness, the communication and interventions should be supportive rather than blaming, and family-centered, rather than focused on the child alone
- Long-term changes in behaviors that are related to obesity

risk should be emphasized, rather than diets and exercise prescriptions, which tend to set short-term goals.

Early infancy and perinatal period
- Balanced nutrition to pregnant mothers
- Encourage exclusive breastfeeding
- Avoidance of catch-up obesity in children
- Maintenance of correct growth velocity under guidance of physicians
- Avoid excess nutrition to stunted children.

School-based interventions
- High importance on physical activity
- Making healthier choice available and banning un-healthy food in cafeteria, (sweetened beverages and energy-dense junk food). Teachers can play a vital role in this initiative
- Training of teachers regarding nutrition education
- Incorporation of more knowledge about nutrition and physical activity and nutrition related diseases in school curriculum.

Home-based interventions
- Key goals to address are the common diet-related problems encountered in children, set firm limits on television and other media early in the child's life, and establish habits of frequent physical activity
- TV/computer time to be restricted to maximum 2 h/day
- Mandatory 60 min of physical activity daily to be supervised by parents
- Restriction on eating out at weekends and restricting availability of junk foods at home.

Policy Formulation
- Creation of national task force for obesity
- Decrease in taxes and prices of fruits and vegetables
- Proper Food labeling practices and quality monitoring
- More playgrounds, parks and walking and bicycle tracks
- Restriction on advertisement of commercial foods on television at prime time and during children's programs and ban on unfair nutrition claims for commercial products
- Encourage trans-national food companies to manufacture healthy snacks
- Prohibition of promotional gifts with junk foods
- Ban on monetary sponsorship of youth festivals by cola companies.

Treatment of Obesity. (Indian Heart Association.org 26 April 2015) [6]

Weight Reduction: A realistic goal for adults is to reduce about 5 - 10 % of body weight over 6 months.

Reduce Intake of Calories: Proposed limits are 1000 - 1200 calories for a woman and 1200 - 1600 calories for a man per day. Eating small frequent meals, and reducing portion sizes are other ways to reduce calories.

Moderate but regular aerobic exercises: Such as walking, swimming, gardening and dancing provided it does not exceed their cardiovascular capacity as well as muscle strengthening, bone strengthening and stretching.

Eating Healthy: A meal that is high in fiber and low in saturated and trans fat, cholesterol, sodium and added sugar especially high fructose corn syrup.

Weight-loss medicines: Are used if it is not possible to lose 1 pound per week after 6 months of lifestyle changes. They have to be taken along with other methods like diet and exercise. Doctors have to monitor the person continuously while taking weight-loss medications.

Orlistat (Xenical and Alli): Are FDA approved drugs that reduce the absorption of fats, and vitamins A, D, E, and K to promote weight loss. With Xenical, the weight loss that usually occurs within the first 6 months of taking the medicine is around 5 -10 pounds.

Two FDA approved medicines for chronic weight management of adults having a BMI of 30 or greater are (Belviq).

Lorcaserin hydrochloride and Qsymia (combination of phentermine and topiramate): They have to be combined with reduced calorie intake and physical activity. Sibutramine, fenfluramine, dexfenfluramine, rimonabant and leptin drugs are also used in the treatment of obesity. (Chambers *et al*. 2008) [7]

Weight-loss surgeries: May be an option, usually as a last resort, and are only recommended in case of morbid or gross obesity for adults with a BMI of 35 or above. or for those who have a life threatening condition.

Vertical Banded Gastroplasty (VBG) or Stomach Stapling: Is a restrictive technique that uses a band to create a small pouch on the top of the stomach that limits the amount of food and liquids the stomach can hold.

Gastric Banding: Is also a type of restrictive surgery which involves the use of laparascopy to place a silicon band in the stomach. This band is adjustable and is capable of squeezing the stomach to hold about one ounce of food.

Sleeve Gastrectomy: Technique is one of the most popular restrictive surgery method which removes more than half of the part of stomach resulting in a vertical sleeve like portion behind.

Malabsorption Technique: Bypasses a portion of the digestive tract to varying degrees thus reducing the absorption of calories and nutrients.

Roux-en-Y Gastric Bypass is a combination of a restrictive technique like stomach stapling and malabsorption technique. A “new” stomach in the form of a small pouch is created using the stapling technique. The food that is eaten is made to directly pass from this to the lower part of the intestine or the jejunum by surgically performing a gastric bypass. The food thus bypasses the upper part of the intestine. There is a feeling of fullness and reduction in the absorption of foods and nutrients. Oral nutrient supplements need to be taken to prevent deficiencies in the body.

Biliopancreatic diversion with dudodenal switch: This surgery is usually done for patients who suffer from serious health problems due to severe obesity. This method may also result in greater malabsorption than Roux-en-Y gastric bypass surgery. Latest research on the "obesity gene" or the fat mass and obesity associated (FTO) gene concludes that people having this gene respond the same way to weight-reducing techniques including diet, exercise and medications as those not having the gene.

Conclusion

Effectively addressing the complex problem of childhood obesity calls for a sustained, multi-sectoral response involving the public, private, and health, professional and non-governmental sectors. This should also include various ministries joining hands together to promote healthy lifestyle and providing an enabling environment. The role of primary or secondary prevention is the mainstay plan for controlling this epidemic. These strategies can be initiated at home and in preschool institutions, schools or after-school care services. However, further research needs to be done to examine the most effective strategies of intervention, prevention, and treatment of obesity. These strategies should be culture specific, ethnical, and should consider the socio-economic aspects of the targeting population. Preventing obesity in a child's earliest years (and even before birth, by healthy habits during pregnancy) confers a lifetime of health benefits and can be the most promising path for turning around the global epidemic

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