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A systematic literature review on obesity: Understanding the classification, causes and management

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Abstract

Overweight and obesity are defined as abnormal or excessive fat accumulation that presents a risk to health. Overweight is defined as a body mass index (BMI) of 25, and obesity as a BMI of greater than 30. The issue has epidemic proportions, according to the global burden of disease, with over 4 million people dying each year as a result of being overweight or obese in 2017. In comparison to individuals who are at a healthy weight, those who are obese are more likely to develop a number of significant illnesses and medical disorders, including Type 2 diabetes, high blood pressure, high cholesterol, and breathing issues including asthma and sleep apnoea. Treatments for overweight and obesity frequently involve losing weight through healthier eating, increasing physical exercise, and making other adjustments to daily habits. Some persons may benefit from weight-management programmes in terms of weight loss or preventing weight gain and some obese people are unable to maintain their weight loss or drop enough weight to enhance their health. In certain circumstances, a physician might think about incorporating other therapies, such as weight-loss drugs, gadgets, or bariatric surgery.

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1. Introduction

Obesity is defined as abnormal or excessive fat accumulation that presents a risk to health. Women with more than 30 percent and men with more than 25 per cent body fat is considered as obese. Overweight is defined as a body mass index (BMI) of 25, and obesity as a BMI of greater than 30. The issue has epidemic proportions, according to the global burden of disease, with over 4 million people dying each year as a result of being overweight or obese in 2017.Obesity can be viewed as the result of a positive energy balance or caloric retention, using the analogy of oedema, which is the result of positive fluid balance or fluid

retention. The prevalence of overweight and obesity in both adults and children is rising. Globally, the prevalence of overweight or obesity among children and adolescents aged 5 to 19 has risen from 4% to 18% between 1975 and 2016. In every continent, with the exception of sub-Saharan Africa and Asia, more people are obese than underweight today, which is one side of the double burden of malnutrition. Overweight and obesity, once thought to be a problem exclusively in high-income nations, are now sharply increasing in low- and middle-income nations, especially in metropolitan areas. Children who are overweight or obese make up the majority of the population in developing nations, where the pace of increase has been more than 30% higher than in industrialised nations (WHO, 2021) [36].

2. Pathophysiology of obesity

Obesity results from a combination of causes and contributing factors including:

Genetics: The quantity and distribution of body fat may be influenced by our genes. The effectiveness with which our bodies turn food into energy and how well they burn calories when exercising may both be influenced by genetics.

Inactivity: People don't burn as many calories if they aren't particularly active. Medical conditions like arthritis can cause people to become less active, which adds to weight gain.

Unhealthy diet: Weight gain is facilitated by diets high in calories, deficient in fruits and vegetables, abundant in fast food, and packed with high-calorie drinks and excessive servings.

Medical problems: Obesity in some individuals can be linked to a medical disease, such as prader-willi syndrome, cushing's syndrome, or another ailment. Reduced exercise might arise from medical issues like arthritis, which can also cause weight gain.

Certain medications: Intake of drugs such as beta blockers, steroids, antipsychotics, anti-seizure meds, diabetic medications, and antidepressants for a long period of time can also lead to obesity.

Social and economic issues: Research has linked social and economic factors to obesity. Avoiding obesity is difficult if you don't have safe areas to exercise or if you don't follow healthy ways of cooking also the people you spend time with may influence your weight.

Age: Any age can develop obesity, especially in young children. However, hormonal adjustments and a less active lifestyle as you age raise your risk of obesity. In addition, as you age, your muscular mass tends to decline. This lower muscle mass has an impact on metabolism. These changes reduce calorie needs and can make it difficult to lose weight. [7].

Role of leptin

Ghrelin is produced in the stomach, is a potent stimulator of appetite in the brain. In addition to increasing the uptake of nutrients by muscle, liver, and fat, insulin acts in the brain to suppress food intake. Gut-derived peptides such as GLP-1 augment insulin release from the pancreas. Leptin levels decline during weight loss, signal to the hypothalamus to stimulate feeding, reduce energy expenditure, and promote weight regain. low leptin levels during weight loss also increase the activity of brain areas involved in the decision-making and reward aspects of eating behaviour. Thus, during dieting, preventing the decline of leptin levels during weight loss by hormone replacement may be a means of overriding the homeostatic and behavioral tendencies toward energy conservation and weight regain (Rosenbaum *et al*., 2008). [20].

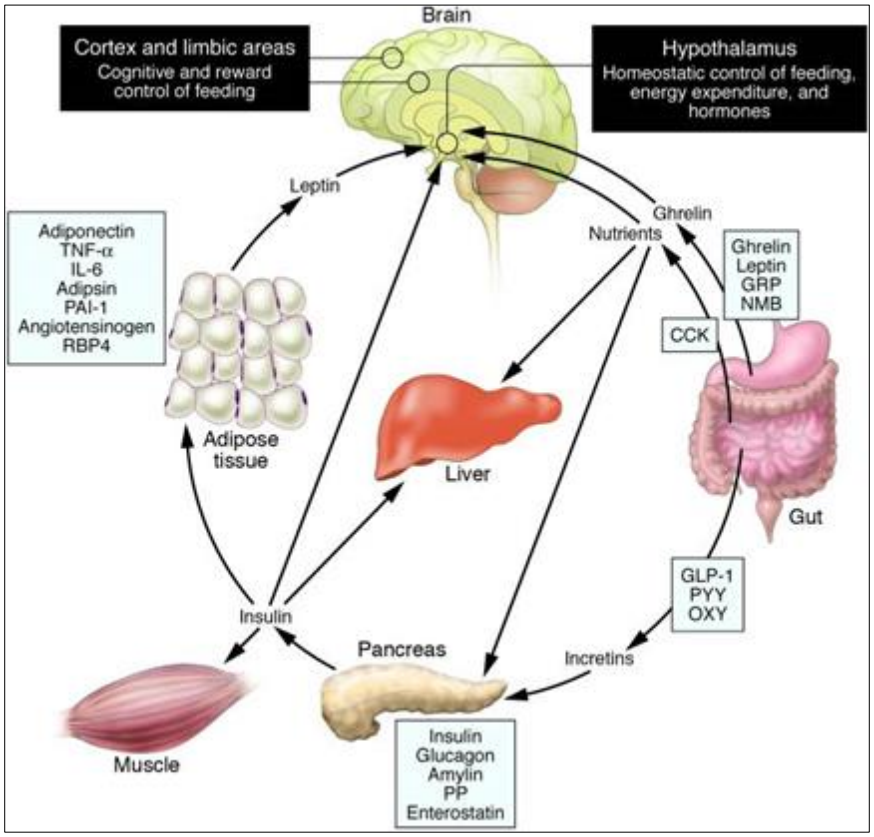

Fig 1: Schematic illustration of peptides secreted by the gut and adipose tissue (fat) that control energy balance

3. Consequences of obesity

People who have obesity, compared to people with a healthy weight, are at increased risk for many serious diseases and health conditions. This includes, high blood pressure and high cholesterol which are risk factors for heart disease, Type 2 diabetes, breathing problems, such as asthma and sleep apnoea, joint problems such as osteoarthritis and musculoskeletal discomfort, gallstones and gallbladder disease.

Patients with abdominal fat that is concentrated, high serum triglycerides, a family history of type 2 diabetes mellitus, early cardiovascular disease, or combinations of these characteristics are more prone to develop metabolic syndrome, diabetes mellitus, and coronary artery disease. Loud snoring, excessive daytime sleepiness, and an elevated risk of metabolic syndrome, hypertension, and cardiac arrhythmias are all symptoms of the frequently misdiagnosed disorder sleep apnoea.

Pickwickian syndrome, also known as the obesity-hypoventilation syndrome, is characterised by poor breathing that leads to hypercapnia, decreased sensitivity to carbon dioxide in stimulating respiration, hypoxia, cor pulmonale, and a higher chance of premature death. This syndrome can develop independently or as a result of sleep apnoea. Obesity and overweight increase the risk of pulmonary embolism, deep vein thrombosis, and gout. [14].

Childhood obesity is associated with psychological problems such as anxiety, depression, low self-esteem and lower self-reported quality of life, social problems such as bullying and stigma, adult [35].

Obesity is diagnosed when body mass index (BMI) is 30 or higher. The other symptoms include:

- Breathing disorders (e.g., sleep apnoea, chronic obstructive pulmonary disease (COPD))
- Certain types of cancers (e.g., prostate and bowel cancer in men, breast and uterine cancer in women)
- Coronary artery (heart) disease
- Depression
- Diabetes
- Gallbladder or liver disease
- Gastro oesophageal reflux disease (GERD)
- High blood pressure
- High cholesterol
- Joint disease (e.g., osteoarthritis)
- Stroke

The more obese a person is, the more likely they are to have medical problems related to obesity [7].

4. Classification of obesity

The initial step in evaluation of obesity is calculation of BMI. Height is measured without shoes. BMI is calculated by dividing weight (in kilograms) by square height (in meters) [9].

Obesity can be classified in to three grades.

Grade I obesity: These individuals have a body mass index of more than 25 but less than 29.9. Their health is normal, obesity has no impact on it, and they have above-average life expectancies. They might go away on their own.

Grade II obesity: The body mass index is between 30-39.9. These patients should be treated by doctors and dietitians. Although they appear to be in good health, they have a lower tolerance to activity, have excessive weariness, and have shortness of breath when exerting themselves. This is because of the additional weight they always bear, as well as the impaired ability of their circulatory and respiratory systems brought on by their excessive internal fat stores and fatty infiltration of their muscles. These people are more likely to develop diabetes, atherosclerosis, hypertension, fatty liver, gall bladder disorders, osteoarthritis, hernias, and varicose veins due to mechanical and metabolic factors. The mortality rate is also rising.

Grade III obesity: These patients are in appalling condition, and their body mass index is above 40. Due to their massive mass and increased susceptibility to the diseases indicated in Grade II, their daily activities are limited. They are prone to accidents, susceptible to atherosclerosis, and have severe psychological disorders [23].

The other types of obesity classification includes

Android Obesity: The extra body fat is spread over the abdomen, giving the person's physique the appearance of being shaped like an apple. In this instance, the majority of the body's fat is concentrated in the neck, shoulders, and chest areas [29].

Gynoid obesity: It is a case that is defined by the analysis of body fat distribution in people. In this situation, the body's excess fat gathers in the lower body portions, such as the thighs and hips. Gynoid obesity is characterised by a pear-shaped look of the fat distribution. These obese persons are believed to be at a decreased risk when compared to other obese people.

Due to the distribution of fat being primarily in the lower areas of the body, they are at a decreased risk of developing heart and thoracic ailments. However gynoid obesity have a lower likelihood of losing body fat because of the distribution of their fat, which is primarily located at their hips and thighs [28].

Childhood obesity: It is one of the serious public health challenges of the 21st century. The problem is global and is steadily affecting many low and middle income countries, particularly in urban settings [27].

Childhood obesity is a multifaceted illness involving intricate interactions between genetic, metabolic, neuroendocrine, environmental, sociocultural, and psychological components (Raj *et al*., 2010) [19].

Children over two, who consume a diet heavy in saturated and trans fats typically have blood cholesterol levels that are higher than those who follow the suggested dietary recommendation. As fatty plaque deposits start to build up in arterial walls, blood flow is reduced, the heart must work harder, and the youngster is more likely to develop atherosclerotic heart disease. In accordance with recommendations made by the American Academy of Paediatrics (AAP), young children with increased cholesterol levels should be identified and treated right once, especially if their families have a history of cardiovascular disease (Eissa *et al*., 2009) [5].

5. Diet and obesity management

According to WHO (2021) [29], Obesity and overweight are primarily caused by an imbalance in energy between calories consumed and calories burned. Around the world, there have been an increase in the consumption of high fat and sugary foods that are high in energy, as well as an increase in physical inactivity because of the changing modes of transportation, growing urbanisation, and the sedentary nature of many occupations.

A lack of supportive policies in areas like health, agriculture, transportation, urban planning, environment, food processing, distribution, marketing, and education often leads to environmental and societal changes that affect dietary and physical activity patterns (WHO, 2021) [30].

Reducing energy density is useful for weight reduction and weight maintenance, according to clinical investigations. By lowering energy density, implementing portion control, and enhancing food quality, a range of useful tactics and methods can support effective weight management.

Macronutrients and obesity

Some studies reported that a higher protein, lower carbohydrate diet may have some advantages in managing obesity. However, the quality and food sources of essential nutrients contribute more for the prevention of chronic diseases than its quantity [31].

Dietary fat

According to Melanson *et al*. (2009) [13], low-fat eating plans have long been recommended as the way to maintain a healthy weight. Clinical studies that were carefully conducted have shown that adopting a low-fat diet does not make losing weight any simpler than adopting a moderate or high fat diet. Low fat diets can be problematic since they contain large amounts of carbohydrates, particularly those from foods that digest quickly, like white rice and bread. Furthermore, eating a lot of these items raises your chance of developing diabetes, heart disease, and weight gain.

Protein and weight

High protein diets appear to offer some advantages for weight loss. There are a few reasons why consuming more calories from protein might aid in weight management. It provides greater satiety and thermic effect: Consuming protein tends to make people feel fuller and more satisfied than consuming carbohydrates or fat (Halton *et al*., 2004) [6]. Protein requires more energy to metabolise and store than other macronutrients, which may enable people to raise their daily caloric expenditure (Halton *et al*., 2004; Westerterp-Plantenga *et al*., 2009) [6, 26].

It appears that protein helps people maintain lean muscle mass while losing weight, which can also increase the energy burned side of the energy balance equation (Westerterp-Plantenga *et al*., 2009) [26]. Diets with a higher protein and lower carbohydrate content enhance blood lipid profiles and other metabolic markers, which may help minimise the risk of diabetes and heart disease (Westerterp-Plantenga *et al*., 2009; Shai *et al*., 2008) [26, 22]. However, consumption of red meat and processed meat is linked to an increased risk of heart disease, diabetes, and colon cancer (Pan *et al*., 2012) [18]. According to a recent study from the Harvard School of Public Health, replacing red and processed meat with nuts, beans, fish, or poultry seems to lower the risk of heart disease and diabetes, and this diet strategy may help with weight control. Researchers tracked the diet and lifestyle habits of 120,000 men and women for up to 20 years, looking at how small changes contributed to weight gain over time (Mozaffarian *et al*., 2011) [15]. They found that people who ate more red and processed meat over the course of the study gained more weight, about a pound extra every four years and people who ate more nuts over the course of the study gained less weight, about a half pound less every four years.

Carbohydrates and weight

In the short term, diets with more protein and less carbs may help people lose weight. However, carbohydrate quality is far more crucial than carbohydrate amount in terms of preventing weight gain and chronic disease.

Carbohydrate rich foods like white rice, white bread, processed cereals, milled and refines grains have high glycemic index and glycemic load. These foods can increase the blood sugar and insulin level, which can result in overeating. In the short term, eating lower carbohydrate and low protein diet may have some weight loss advantage. In the long run, consuming these foods increases the risk of weight gain, diabetes, and heart disease (Mente *et al*., 2009) [12].

Specific foods and weight control

There is evidence that some meal selections may aid with weight management. Many of the foods that are helpful for maintaining a healthy weight also work to prevent diabetes, heart disease, and other chronic illnesses. Contrarily, foods and beverages that cause weight gain in particular, refined carbohydrates and sugary beverages also cause chronic disease.

Role of whole Grains, fruits and vegetables

Whole grains such as whole wheat, brown rice, barley, and others are metabolised more slowly than refined grains, especially in their less-processed forms. They therefore have a milder impact on insulin and blood sugar, which might aid in preventing hunger. There are numerous advantages to eating "slow carb" foods for illness prevention, and there is evidence that they can also aid in weight loss. Compared to fruits and vegetables, whole grains have more weight-controlling benefits (Koh-Banerjee *et al*., 2004) [8].

Nuts

According to research, eating nuts does not result in weight gain and may even aid in weight management. This is likely because nuts are high in protein and fibre, both of which may make people feel satisfied and less hungry (Mattes *et al*., 2008; Bes-Rastrollo *et al*., 2009) [10, 3]. As a result of their high fat content and high calorie density, nuts were historically shunned by dieters. Another reason to incorporate nuts in a healthy diet is that regular nut eaters are less likely than seldom ones to experience heart disease.

Dairy and weight

The numerous trials that have evaluated weight-loss properties of dairy, concluded that an energy-restricted, dairy-based diet resulted in improved weight loss, increased fat loss, and an increase in lean body mass. Dairy does not help people lose or gain weight when they add it to their diets. Adding fat to food increases the energy density and there is no proof that dairy fat helps people lose weight, so butter and other fat spreads should only be used in moderation.

Due to its high nutritional density and high energy density, cheese is more problematic. It is wise to keep the amount of full-fat cheese in processed foods like pizza to not more than 1 ounce (30 gm) per day when following an energy-restricted diet. Milk and yogurt's energy content is significantly impacted by the amount of fat they contain, although other nutritional content is very slightly affected (Sanders *et al*., 2012) [21].

Sugar-sweetened beverages and weight

According to a recent meta-analysis, the body mass index rises by 0.08 units in children and adolescents for every additional

12-ounce serving of sugary beverage taken daily (Malik *et al*., 2009) [11]. It was also found that those who regularly consume sugar-sweetened beverages have a 26% higher chance of getting type 2 diabetes and heart disease than those who do not. According to research, carbohydrate in liquid form given to a person, is less likely to make them feel full, which can result in overeating (Pan *et al*., 2011) [17].

Alcohol and weight

Alcohol calories are empty calories because they don't provide the body with the nutrients it needs. Alcoholic beverages are often consumed as extras, increasing daily caloric requirements. Alcohol loosens people's inhibitions, which increases their likelihood of overeating or choosing unhealthy foods. Alcohol can also interfere with the body's fat-burning mechanisms [32].

Fast food and weight

Fast food is known for its large portions, low prices, high palatability, high sugar and fat content. A study conducted by Mohammad beigi *et al*. (2018) [16] to estimate the prevalence of fast food consumption and its association with obesity, found that majority of the subjects consume at least one type of fast food on monthly basis and fast food consumption was associated with abdominal obesity based waist to hip ratio and is not related to general obesity based on body mass index [33].

6. Treatments

It is better to lose weight slowly and constantly than losing a lot quickly. Exercise and dietary management are the major weight-loss tools. Medication or surgery might be an option for people if this is not effective.

Dietary management

When a person consumes more calories than their requirement, excess weight and fat can build up. This may result in weight increase over time. There are some foods that are more likely to make you gain weight. Some of the chemical additives such as high fructose corn syrup is used in processed foods can cause changes in the body that result in additional weight gain.

Including more proteins, fibre and restriction of high fat, processed and refined foods rich in fat and sugar will help in controlling weight. Dietary fibre both prevents and treats diseases linked to obesity. Reduced macronutrient absorption and increased satiety are two mechanisms for this protection. Short-chain fatty acids and changes in the gut flora are two newly discovered mechanisms that help to explain why high-fibre diets help prevent obesity and play a part in its management (Dayib *et al*., 2020) [4].

Role of exercise

Trying to lose weight quickly by crash dieting can lead to new health problems, vitamin and mineral deficiencies. According to recommendations from the World Health Organisation, the U.S. Department of Health and Human Services, and other organisations, individuals should engage in atleast two and a half hours of moderate-to-vigorous physical exercise per week for good health.

Slow walking seems to be less efficient for weight control than vigorous activities. Physical exercise raises people's overall energy expenditure, which can help to maintain energy balance or even lose weight. Exercise reduces overall body fat and waist fat, which delays the onset of abdominal obesity. Exercises like weightlifting, pushups, and other muscle-strengthening techniques increase muscle mass, which boosts the body's ability to burn more calories throughout the day, even when it is at rest, and makes it simpler to manage weight. Physical activity lowers anxiety and depressive symptoms, and this mood boost may encourage individuals to continue with their exercise routines over time [34].

Weight loss medication

Weight loss medication can be given if dietary changes and exercise have not resulted in weight loss and if the person's weight poses a significant risk to their health. These medications may have side effects including gastrointestinal symptoms, such as fatty stool and increased or decreased defecation. Some people have reported unwanted effects on the respiratory system, muscles and joints, headaches etc.

Doctors prescribed sibutramine from 1997 to 2010, but the United States Food and Drug Administration (FDA) revoked its authorization in 2010 due to concerns about severe adverse effects.

Intragastric baloon

A brand-new, minimally invasive bariatric procedure for treating obesity is the intragastric balloon. The balloon is a medical implant that a doctor implants in your stomach to temporarily reduce its capacity. There is no surgery involved because the balloon is inserted through your throat using an endoscope.

Surgery

Bariatric surgery involves removing or changing a part of a person's stomach or small intestine so that they do not consume as much food or absorb as many calories as before. This can help to lose weight and also reduce the risk of high blood pressure, type 2 diabetes, and other aspects of metabolic syndrome that can occur with obesity. The 1991 National Institutes of Health guidelines recommended consideration of bariatric surgery in patients with a body mass index (calculated as weight in kilograms divided by height in meters squared) of 40 or higher or 35 or with higher serious obesity-related comorbidities. These guidelines are still widely used; however, there is increasing evidence that bariatric procedures can also be considered for patients with type 2 diabetes and a body mass index of 30 to 35 if hyperglycemia is not under control despite optimal medical treatment.

In comparison to nonsurgical therapies, there is strong evidence that surgery improves outcomes for type 2 diabetes and weight loss. The two most popular operations now being utilised are the gastric bypass and sleeve gastrectomy, both of which have similar impacts on outcomes for diabetes and weight loss. (Arterburn *et al*., 2020) [1].

Role of Hormones

Ghrelin: Levels of ghrelin rise in people with dietary weight loss or anorectic disorders, but in contrast are low in obesity, and after gastric bypass surgery (Weigle *et al*., 2003) [25].

If ghrelin levels could be reduced or the receptor inhibited,

this might be used as an obesity treatment. Thus, the development of ghrelin antagonists and receptor blockers as potential anti-obesity strategies has garnered some interest. (Troke *et al*., 2015) [24].

Peptide YY

Substantial evidence indicates basal levels of PYY are lower in obese subjects compared with their lean counterparts, and in obesity, there is also a blunted postprandial PYY rise.

PYY infusion has been shown to reduce ghrelin levels and lack of endogenous PYY secretion may be implicated in the development of obesity. Infusion of PYY, obese and lean subjects alike experience a reduction in hunger and caloric intake making it likely that exogenous PYY could be a successful therapy for obesity. PP is known to reduce food intake in rodents, in normal weight human subjects and in Prader–Willi syndrome, a condition characterized by obesity and hyperphagia (Asakawa *et al*., 2006) [2].

Oxyntomodulin: Due to its simultaneous effects on reducing food intake and increasing energy expenditure, oxyntomodulin, a 37-amino-acid peptide hormone, offers an intriguing possibility for the treatment of obesity. It appears to be able to act at the glucagon receptor to increase energy expenditure. To achieve the greatest possible reduction in food intake, with the best possible effects on energy expenditure and glycemic management, it will be essential to understand the ratio of agonism between the GLP-1 and glucagon receptors.

7. Conclusion

Obesity is the fifth leading cause of mortality worldwide. It is regarded as a major public health concern. Overweight or obesity can lead to multiple chronic diseases, such as malignancies, diabetes, metabolic syndrome, and cardiovascular diseases. According to the World Health Organisation, 30% of deaths worldwide will be brought on by lifestyle diseases by 2030. These deaths can be avoided by appropriately identifying and addressing relevant risk factors as well as by implementing behavioural engagement programmes. Therefore, it is critical to identify and treat obesity as soon as possible.

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