REVIEW ARTICLE

Understanding Obesity: History, Epidemiology, Causes, Consequences and Comprehensive Solutions

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Abstract

The purpose of this study is to provide an overview of obesity disease including its definition, prevalence, causes, complications, and management. Obesity is a global epidemic that contributes significantly to chronic diseases worldwide. Obesity was recognized by Hippocrates as a medical condition capable of causing health problems. Obesity is classified into several types based on factors such as body mass index (BMI), body fat distribution, waist-to-height ratio, causes, and potential health risks. Adipose tissue produces adipokines and activates inflammatory signaling pathways, accelerating the onset and progression of obesity-related illnesses. Obesity is the result of a complex interaction between community and individual factors. These categories include physical activity, food consumption and production, personal psychology, and social psychology, additionally, obesity studies have highlighted the importance of genetic factors. Being overweight and obese can be avoided by increasing the intake of whole grains, polyphenolic-rich legumes, nuts, vegetables, and fruits, selecting probiotic strains completely restriction the intakes of simple sugars and soluble starch and soda beverages; replacing saturated fats with unsaturated fats and increasing physical activity levels. Although lifestyle management is still the primary treatment for this condition, both medication and bariatric surgery result in greater and more sustained weight loss.

Keywords: *Obesity, overweight, history, classification, pathophysiology, consequence, management.*

INTRODUCTION

Obesity has been a problem for centuries, but the prevalence and understanding of the condition have changed over time. Obesity has a long history, beginning in ancient times. Obesity was once regarded as a sign of wealth and prosperity, as excess body fat indicated that one had access to plenty of food. Obesity was recognized by Hippocrates as a medical condition that could cause health problems [1, 2]. Obesity became more common during the nineteenth century, as industrialization led to more sedentary lifestyles and excess calorie intake, particularly among the upper classes. The medical literature began to focus more on the health risks associated with obesity [3, 4]. Obesity rates continued to rise throughout the twentieth century, particularly in industrialized nations. Several investigations have improved our understanding of the physiological, behavioral, and social factors that contribute to obesity [5, 6].

Obesity in ancient Egypt was connected to cultural beliefs, eating habits, and health effects. The view of body weight as a marker of status highlights the intricacies of ancient Egyptian society, where the health impacts of obesity were clear in the mummified bodies of people from different social classes [7].

An Overview of the Epidemiology of Obesity

Over the past few decades, obesity has become more commonplace worldwide. The World Health Organization (WHO) estimates that 650 million adults were obese and more than 1.9 billion were overweight in 2016 [8].

In the United States, the percentage of adults who are obese rose from 30.5% in 1999-2000 to 42.4% in 2017-2018 [9]. The prevalence is higher among middle-aged people, members of racial/ethnic minorities, and those from lower socioeconomic backgrounds [9, 10].

Worldwide, the prevalence of childhood and adolescent obesity is rising. According to a 2017 study in The Lancet, there were 124 million obese children and adolescents (ages 5 to 19) in 2016 compared to 11 million in 1975 [11].

Obesity is regarded as a major public health concern, ranking fifth among the leading causes of death worldwide. Overweight and obesity are two of the most common lifestyle illnesses that cause additional health problems and contribute to a variety of chronic diseases, including cancer, diabetes, metabolic syndrome, and heart disease. The WHO also predicted that by 2030, 30% of deaths worldwide will be caused by lifestyle diseases, which can be avoided by identifying and addressing associated risk factors and implementing behavioral involvement policies [12].

An Overview of the Epidemiology of Obesity in Egypt

Obesity has become a significant public health concern in Egypt in recent decades. According to the 2022 Egypt Demographic and Health Survey, the prevalence of obesity among adults aged 18 and older was 35.5% [13]. This represents a substantial increase from earlier surveys for example; the 2008 Egypt Demographic and Health Survey found the obesity rate was 28.9% [14].

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The rise in obesity has been more pronounced among women than men. In 2022, the obesity rate was 44.5% for women, compared to 26.5% for men. Obesity is also more common in urban areas (40.2%) compared to rural areas (31.8%). Socioeconomic factors have a significant impact, obesity has been linked to increased wealth, education, and media exposure Egypt's economic development has led to an increase in obesity-causing lifestyle factors such as sedentary behavior and unhealthy diets, particularly among higher-income urban populations [15, 16]. Obesity among children is becoming increasingly prevalent in Egypt, 16.1% of children under five were overweight or obese, according to the 2022 survey. This is concerning because childhood obesity is a major risk factor for adult obesity and other non-communicable diseases.

To summarise, obesity has reached epidemic proportions in Egypt, owing to a complex interaction of economic, demographic, and behavioral factors. Addressing this issue will necessitate a multifaceted public health strategy that addresses both individual and environmental obesity risk factors.

Classification of Obesity

Obesity is divided into several types based on a variety of standards:

I. According to BMI

Obesity is generally categorized through BMI, which is determined by dividing an individual's weight in kilograms by the square of their height in meters (kg/m²).

The WHO classification [17]:

1. Underweight (BMI < 18.5 kg/m²)
2. Normal weight: BMI 18.5-24.9 kg/m²
3. Overweight: BMI 25.0-29.9 kg/m²
4. Obese: BMI ≥ 30 kg/m^2

Class I: BMI: ranges from 30.0 to 34.9 kg/m², Class II: 35.0 to 39.9 kg/m². Class III (severe or morbid obesity): BMI ≥ 40.0 kg/m².

The National Institutes of Health (NIH) offers a similar classification system [18]:

1. Overweight (BMI 25.0 - 29.9 kg/m²)
2. Obesity:
   - Class I: BMI 30.0-34.9 kg/m².
   - Class II: BMI 35.0-39.9 kg/m².
   - Class III (extreme or morbid obesity): BMI > 40.0 kg/m².

It is essential to recognize that although BMI is a widely utilized and beneficial tool for categorizing obesity, it possesses certain limitations. BMI fails to differentiate between fat mass and lean body mass, which may lead to an inaccurate representation of body composition, especially in individuals with significant muscle mass, such as athletes. Alongside BMI, alternative metrics such as waist circumference, body fat percentage, and clinical evaluations can offer a more thorough assessment of an individual's health condition [17, 18].

II. According to Abdominal Fat (Visceral Obesity)

The build-up of fat surrounding internal organs, especially in the abdominal cavity, is referred to as visceral obesity, also called central or abdominal obesity [19]. Compared to subcutaneous (under the skin) fat, this kind of obesity is linked to higher health risks [20]. Visceral obesity, defined as the presence of visceral adipose tissue (VAT), is linked to a variety of chronic illnesses and metabolic disorders [21].

Proxy measurements for assessing excess fat accumulation, such as BMI and waist circumference, have proven inadequate for diagnosing visceral obesity; however, the waist-to-height ratio has demonstrated potential [22]. The most reliable methods for evaluating visceral fat are computed tomography (CT) scans and magnetic resonance imaging (MRI). In research studies, visceral fat area (VFA) is typically assessed using single-slice CT or MRI imaging [23].

A waist circumference exceeding 88 cm for women and 102 cm for men indicates a higher level of visceral fat, providing a straightforward method for its assessment [24].

III. According to Waist / Height Ratio

The National Institute for Health and Care Excellence (NICE) has acknowledged the Waist/Height Ratio (WHtR) as a significant indicator of preliminary health risk. Recent data from the UK, aim to assess whether the WHtR-based classification reveals a greater cardiometabolic risk compared to the existing 'matrix' of BMI and waist circumference used for screening purposes. Cardiometabolic risk was determined through the Health Survey for England, which included a sample of 4,112 individuals with obesity, and assessed factors such as elevated glycated hemoglobin, dyslipidemia, and hypertension. The findings indicated that HbA1c, total/HDL cholesterol and systolic blood pressure were more effective predictors of WHtR than the 'matrix' approach. The initial screening threshold of a WHtR of 0.5 conveys a clear message: an individual's waist measurement should be less than half of their height. This guideline encourages individuals to remain aware of their health risks [25].

Other Methods of Classification

I. According to the Distribution of Body Fat, also known as the pattern of fat accumulation, can be used to

categorize obesity. The following are the primary categories of obesity based on the distribution of fat:

1. Android obesity (central or abdominal): Also referred to as "male-type" or "apple-shaped" obesity distinguished by the build-up of extra fat, mostly in the abdominal area, especially around the waist and abdomen. Men are more likely to exhibit this pattern of fat distribution, which is linked to an increased risk of metabolic disorders such as cardiovascular disease, elevated blood pressure type 2 diabetes [26].

2. Gynoid (Gluteo-Femoral or Peripheral Obesity): Also referred to as "female-type" or "pear-shaped" obesity, defined by the build-up of extra body fat, mostly in the lower body, including the thighs, hips, and buttocks. Compared to android obesity, this pattern of fat distribution is more frequently seen in women and is linked to a decreased risk of metabolic complications [27].

   After accounting for total adiposity, more subcutaneous fat mass, particularly in the lower body, is protective compared to greater android or visceral adipose tissue mass [28].

3. Mixed Obesity: This condition is characterized by a mix of gynoid and android fat distribution patterns.

II. According to Causes

1. Exogenous Obesity: Resulting from a sedentary lifestyle and/or excessive calorie intake. The increasing prevalence of obesity worldwide is thought to be largely caused by sedentary lifestyles, poor eating habits, and modifications to the food environment [29, 30].

2. Secondary (endogenous) Obesity: Resulting from underlying illnesses, such as genetic disorders *e.g.* Leptin (LEP), the leptin receptor (LEPR), proopiomelanocortin (POMC), prohormone convertase 1 (PCSK1), the melanocortin 4 receptor (MC4R), single-minded homolog 1 (SIM1), brain-derived neurotrophic factor (BDNF), and the neurotrophic tyrosine kinase receptor type 2 gene (NTRK2) are eight genes that have been implicated in obesity [31] Hormonal imbalances, several endocrine abnormalities that result from modifications to the hypothalamic-pituitary hormone axis are linked to obesity. These include growth hormone deficiency, hypogonadism, Cushing's disease, and hypothyroidism. Adipose tissue has numerous additional vital roles, by producing and releasing hormones by adipocytes, such as adiponectin and leptin. Moreover, polycystic ovarian syndrome frequently manifests as obesity, with hyperinsulinemia serving as the main contributing cause [32]. Certain drug classes, such as β-receptor antagonists, anti-psychotic drugs, corticosteroids, neurotropic drugs, and those used in the therapy of HIV, significant weight gain and metabolic disturbances occur in susceptible patients [33].

III. According to the Potential Health Risks

1. Simple Obesity: Obesity without accompanying health issues. The degree of adiposity alone cannot adequately account for the wide range of individual risk factors for obesity-related comorbid diseases. Metabolically healthy obesity (MHO) was developed as a result of findings that a percentage of obese people have a markedly lower risk of cardiometabolic abnormalities [34].

2. Complex Obesity (Obesity with associated health issues): Lauby-Secretan *et al.* (2016) reported that obesity's rising prevalence poses a significant public health issue, given its established link to, various long-term health issues including certain types of cancer, heart disease, type 2 diabetes, osteoarthritis, sleep apnea and musculoskeletal problems [35].

Blood Pressure

A study conducted over eight years involving men and women aged 20 to 49 revealed that obesity could account for 78% of hypertension cases in men and 65% in women [36].

Cardiovascular Diseases

Obesity has been identified as a factor that elevates the risk of developing cardiovascular disease (CVD), especially heart failure (HF) and coronary heart disease (CHD). The pathways by which obesity heightens the risk of CVD include alterations in body composition that can influence hemodynamics and modify cardiac structure. Additionally, pro-inflammatory cytokines generated by adipose tissue can lead to cardiac dysfunction and facilitate the development of atherosclerotic plaques [37].

Diabetes

The lifetime risk of developing diabetes in men over the age of 18 rises significantly from 7% to 70% as body mass index (BMI) escalates from below 18.5 kg/m² to above 35 kg/m². Similarly, the lifetime risk for women shows an increase from 12% to 74% within the same BMI range. Consequently, it is recommended that all individuals with obesity undergo screening for diabetes [38].

Glomerulomegaly

The prevalence of renal disorders associated with obesity has risen tenfold in recent years. A significant consequence of obesity is the elevation of the glomerular filtration rate (GFR), which results in the

enlargement of the renal glomerulus, a condition known as glomerulomegaly [39].

Sleep Apnea

Sleep apnea is a condition characterized by interruptions in breathing during sleep, often caused by a constricted or obstructed upper airway. Recent research has increasingly indicated a connection between excess body weight and sleep apnea. Increased body weight can intensify the symptoms of sleep apnea and amplify its harmful health consequences [40].

Osteoarthritis

Obesity continues to be the primary risk factor and the foremost contributor to the onset and advancement of osteoarthritis. The excess weight associated with obesity places significant strain on the joints, resulting in the degradation of articular cartilage [41].

Musculoskeletal Problems

The prevalence of osteoarthritis and low back pain (LBP) among individuals classified as obese (BMI > 30 kg/m²) was reported to be 34% and 22%, respectively [42].

Cancer

Research indicates that an excess of body fat elevates the risk of various cancers, including colorectal, post-menopausal breast, uterine, esophageal, and kidney cancers. The presence of large visceral fat cells creates a low-oxygen environment, which subsequently induces inflammation. Prolonged inflammation resulting from excess visceral fat can harm the body and heighten the risk of cancer [43].

It is crucial to understand that the categorization of obesity is not mutually exclusive, and a person may display features of various types of obesity. Knowledge of the different types of obesity can assist healthcare providers in creating personalized treatment and management plans.

Pathophysiology of Obesity

An increase in energy consumption without an increase in energy expenditure leads to the enlargement and multiplication of adipocytes, as well as the accumulation of visceral fat in other tissues, resulting in cardiovascular and liver illness. Adipose tissue can also release adipokines and inflammatory cytokines, influencing the disturbance of the local environment of cells, inducing insulin resistance, and hyperglycemia, and activating inflammatory signaling pathways. This exacerbates the onset and progression of obesity-related illnesses [44].

Main Causes of Obesity

Obesity results from a complicated interplay of individual and community factors. While most of these factors can be modified, managing all of them effectively poses a considerable challenge. A particular study describes these risk factors as ‘interconnected’ and categorizes them into various clusters within an ‘obesity map’ to enhance the comprehension and management of obesity. These clusters include food consumption and production, physical activity, individual psychology, and social psychology. Grasping these risk factors individually, as well as how they influence one another, is essential for understanding the origins of obesity and creating an effective approach to tackle this global crisis [45].

Recent advances in obesity research have highlighted the importance of genetic factors while also acknowledging the significant role of environmental influences. The incorporation of genetic insights into public health strategies may open up new avenues for combating the obesity epidemic [46].

Health Consequences of Obesity

Being overweight or obese has major consequences on health. Excess body fat can lead to serious health issues, especially heart disease and strokes, type 2 diabetes, disorders of the musculoskeletal system like osteoarthritis, and various types of cancer including endometrial, breast, and colon cancer. These health problems contribute to considerable disability and early mortality [47].

Obesity Prevention

The good news is that most of the time, obesity and overweight can be avoided. Finding an energy balance between the number of calories used and the number of calories consumed is crucial for success. To achieve this goal, people can reduce their energy intake from total fats, increase intake of whole grains, legumes, nuts, vegetables, and fruits, reduce sugar consumption, and replace saturated fats with unsaturated fats. To boost calorie burn and increase physical activity levels to at least 30 minutes of consistent, moderate-intensity activity on most days [47].

Obesity Management

Body mass index measurement is indicated to begin the evaluation process for overweight and obesity and to identify disease categorization. Weight-related conditions should be considered when determining disease severity. Although lifestyle management remains the primary treatment for this condition, both medication and metabolic and bariatric surgery result in higher and more sustained weight loss in treatment-approved populations than lifestyle changes alone. To manage this dangerous, progressive, chronic disease, patients and clinicians should work together continuously [48].

I. Dietary Therapy

Eating a balanced, healthful diet that satisfies the Dietary Reference Intake (DRI) and is adequate to meet the nutrient needs of almost all healthy people, but low in total calories is essential to the prevention of obesity.

1. Low-Calorie Diet (LCD) Description: Restricts caloric intake to 800-1,200 calories per day [49].

2. Low-Carbohydrate Diet (LCD) Description: Consumption of carbohydrates as < 45% of daily calories or < 130 mg/day [50].

3. Mediterranean Diet Description: Emphasizes the consumption of plant-based foods, such as fruits, vegetables, whole grains, legumes, and olive oil, with moderate consumption of fish and poultry [51].

4. Functional foods in the management of obesity: Numerous studies have demonstrated the health benefits of using some functional foods with specific herbs in the manufacture of some bakery products for the management of obesity and its complications. Whole grains and seeds, such as whole wheat, barley, oat, and parsley seeds have been used for weight loss and to help alleviate the complications associated with obesity, Certain nuts and legumes, such as tiger nut, soybeans, and chickpeas have also been shown in some nutrition trials to be beneficial for weight loss and reduce the obesity-related comorbidities. These studies consisted of two intervention phases, each lasting eight weeks. Female volunteers, who displayed varying degrees of obesity and met the criteria for metabolic syndrome, were involved in the study, with ages ranging from 25 to 60 years. Throughout the eight-week duration, all participants followed a balanced low-calorie diet. In the first phase, they ingested the supplement in the form of pie or biscuits (two pieces, each weighing approximately 20 grams) during breakfast and dinner while adhering to the prescribed regimen. In the second phase, they transitioned to traditional bread that provided an equivalent caloric intake for comparative purposes. Participants were clinically and anthropometrically monitored, as well as assessed through 24-hour dietary recalls and biochemical evaluations at three points: the beginning, the midpoint, and the end of the study. The results revealed that the dietary intervention yielded positive outcomes, exhibiting anti-inflammatory and antidiabetic effects, alongside promoting weight loss and enhancing kidney function [52-58]. A recent study demonstrated that adding Moringa oleifera leaf, and turmeric to some baked products has a health effect in combating obesity and its complications [59]. Another study demonstrated the value of combining probiotics with a high-fiber diet in the treatment of obesity and its complications [60]. The probiotic component of the product used in the study contained a blend (one fermented milk cup contained 100 g, 10 × 109 CFU) of proprietary strains of *Lactobacillus acidophilus* CUL60, *Lactobacillus acidophilus* CUL21, *Lactobacillus acidophilus* NCFM, *Bifidobacteria lactis* HNO19, *Bifidobacteria animalis supsplactis* CUL34, and *Bifidobacteria bifidum* CUL20 was purchased from GNC Ultra Probiotic Complex (UK).

II. Pharmacotherapy

Use FDA-approved anti-obesity medications in conjunction with lifestyle changes [61]. Over the past 60 years, obesity pharmacotherapy has evolved significantly, with six FDA-approved anti-obesity medications (AOMs) used for long-term obesity treatment. These medications are recommended for individuals with a BMI of 30 kg/m2 or higher and obesity-related comorbidities [62]. They work by either increasing feelings of fullness, decreasing the absorption of fat, or suppressing appetite.

III. Bariatric Surgery

Bariatric surgery may be considered for individuals with severe obesity (BMI ≥ 40 kg/m2) or those with obesity-related comorbidities (BMI ≥ 35 kg/m2) [63]. For obese individuals who are at higher risk, bariatric surgeries continue to be a safe and successful strategy. In the setting of a chronic illness, clinical judgment should be grounded in evidence. A multidisciplinary approach to perioperative care is required, with special emphasis on dietary and metabolic concerns [64].

Types of Bariatric Surgery:

- Roux-en-Y (roo-en-wy) gastric bypass. This procedure is the most common method of gastric bypass.
- Sleeve gastrectomy.
- Biliopancreatic diversion with duodenal switch (BPD/DS).
- Single-anastomosis duodeno-ileal bypass with sleeve gastrectomy (SADI-S).

CONCLUSION

A complex interplay of social, economic, cultural, and genetic factors can be seen in the history of obesity. Over the centuries, people's perceptions of body weight have been significantly influenced by industrialization, consumer culture, and shifting into bad dietary habits. In the past, obesity was typically linked to prosperity and wealth; however, in the modern world, it is more often linked to unhealthy lifestyle choices, especially bad dietary habits. Obesity was now considered a serious public health issue rather than a cosmetic concern. Fast food, processed foods, and sedentary lifestyles are the main causes of the obesity epidemic in many parts of the world. Today, preventing obesity requires a multifaceted approach that includes education, policy changes dietary intake, activity, and other support systems. Knowing the

origins of obesity can help direct current approaches to prevention and treatment.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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