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A SYSTEMATIC LITERATURE REVIEW ON UNDERSTANDING THE CAUSES AND CONSEQUENCES OF OBESITY

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Abstract: Obesity is a complex, multifactorial condition that has reached epidemic proportions worldwide, with significant implications for public health. Globally, obesity an invited disease is becoming a public health problem in the general population. Obesity is escalating at an alarming rate worldwide; affecting children and adults in both developed and developing countries. Obesity means excess deposition of fat in the body. It is caused by ingestion of greater amounts of food than can be used by the body for energy. Excessive fat accumulation in the body may impair health leading to a significant long-term health consequences including the development of diabetes, coronary heart disease, and osteoarthritis as well as increasing the risk of developing certain cancers and influencing their outcomes. Most of the world's population live in countries where overweight and obesity kills more people than underweight. Obesity is becoming a severe public health problem; its epidemiology is increasing rapidly, however it is preventable. The exposure factors vary across different geopolitics. Primarily, living in obesogenic environments such as sedentary life style, urbanization, and rural to urban migration, consuming energy-dense foods, and physical inactivity were determinants.

Keywords: Carbohydrates, Diabetes, Epidemiology, Fats, Geopolitics, Obesity, Osteoarthritis.

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INTRODUCTION

Obesity is a nutritional disorder that spans all ages, ethnicities and affects both the sexes. Obesity is a growing global health crisis that significantly contributes to chronic diseases such as type 2 diabetes, cardiovascular disorders, sleep apnoea, hypertension, and certain type of cancers. It is recognized as a multifactorial condition influenced by genetic, environmental, behavioral, and psychological factors (Balwan and Saba, 2025). WHO has adopted definitions of adult obesity based upon the body mass index (BMI weight in kilograms divided by the square of the height in meters (WHO, 2025). Although generally acceptable for epidemiology, this method of defining obesity cannot account for differences in muscle mass between subjects, and it is well known that heavily muscled individuals may fulfil WHO criteria to be labelled obese even though their total and percentage by fat content is low (e.g. most champion heavy weight boxers). This is a limitation with the WHO definition

because the co-morbidities of obesity are probably more related to the amount of fat tissue that an individual carries than to their total weight. But for India, Dr. Mandal's formula is more acceptable than BMI (Mandal, 1997; Mandal, 2010). According to this formula maximum weight should be height in cm minus 100cm in kg (which means if a person has the height of 165 cm his weight should not exceed 65 kg and the lowest weight should be 15% less ; here it is 55 kg). The overweight should be expressed in percentage of overweight or by kg of overweight instead of overweight, obese and morbid overweight as an index of overweight. This will give to idea about the overweight to the patient (Mandal, 1997; Mandal, 2010). In Asians, a BMI of 27 kg/m^2 is equivalent to a value of 30kg/m^2 in other groups (Table 1).

Table 1: WHO definition of adult obesity by body mass index (BMI) in Caucasians. *Source*: World Health Organisation (2025).

Category	**BMI (Kg/m^2)**
Underweight	< 18.5
Healthy, Normal or Acceptable	18.5 – 24.9
Overweight	25.0 – 29.9
Obese	30.0 – 39.0
Morbid Obesity	40.0 (Jones *et al*., 1997)

EPIDEMIOLOGY OF OBESITY

According to the World Health Organization (WHO, 2021), more than 650 million adults globally are classified as obese, and this number is steadily rising. Obesity is a major risk factor for numerous chronic diseases, contributing to increased morbidity, mortality, and healthcare costs. Obesity is a major health problem and rates have risen dramatically in recent years, in fact, it has been estimated that worldwide there are now more-obese individuals than malnourished, with about 22 million obese children under 5 years old. In Europe, the overall prevalence figures are around 20% in men and 15.25% in woman in 2004. The prevalence has increased by around 40% in most extent, a more sedentary lifestyle.

In some developing countries there may also have been a concomitant increase in the consumption of energy or fat, but in Western societies, total energy intake has been falling. In the UK, the prevalence of obesity has more than doubled in women and tripled in men since 1980. In 2002, 22% of men and 23% of women in England were clinically obese and a further 43% of men and 34% of women were overweight. The 2017 global nutrition report showed that 2 billion adults are overweight / obese and 41 million children are overweight worldwide (Global Nutrition Report, 2017*)*. In the last three decades, obesity increased globally; unexpectedly, it is also gradually rising in low- and middle-income countries frequently due to uncontrolled urbanization and nutrition transition (shifting dietary habit from traditional to westernized diet) (Hoffman, 2001; Ford *et al.,* 2017). The global prevalence of overweight in children aged less than five years was increased modestly. The trend of overweight was heterogeneous in low- and middle-income countries. Meanwhile, the prevalence of obesity in children aged 2-4 years has increased moderately. In 1975, children with obesity aged 5-19 years were relatively rare, but it becomes highly prevalent in 2016 (Assari and Bazargan, 2019). In the majority of European countries, the prevalence was increased from 10% to 40% in the last 10 years, and specifically in England, it increased more than three folds (Agha and Agha, 2017; Balwan and Saba, 2025). The prevalence of obesity among reproductive age women was 5.1% in India (Al-Kibria *et al.,* 2019), 15.7% in Palestinian schoolchildren, and 34.8% among adult populations of Saudi Arabia (Al-Raddadi *et al.,* 2019). The prevalence of overweight and obesity was 40.9% in Kuwait among children aged 6-8 years. Amazingly, their mothers' perceive that they had healthy weight; in contrary, those children

who have normal weight were also criticized by their mothers to be unhealthy (Mandal, 2010; Al-Rodhan *et al.,* 2019).

A systematic review conducted in Africa among primary school educators revealed that the continental figure of obesity increased. In this review, the magnitude of obesity was measured based on three international standards, i.e., World Health Organization (WHO), Center for Disease Control (CDC), and International Obesity Task Force (IOTF) cut-off points. Based on the criteria mentioned above, the prevalence of obesity was 6.1% (WHO 2007), 4.0% (Cole *et al.,* 2000), and 6.9% (Emmerich *et al.,* 2024). Generally, the prevalence of obesity in Africa among schoolchildren lies between 4.4% and 21.2 percent (Baalwa *et al.,* 2010; Adom *et al.,* 2019; Ganle *et al.,* 2019).

Another critical issue is currently the emerging sarcopenic obesity. Sarcopenic obesity is defined as loss of skeletal muscle and excess body fat accumulation. Clinically, it can be diagnosed through muscle biopsy, computed tomography or magnetic resonance spectroscopy, bioelectrical impedance analysis (BIA), and dual energy X-ray. Primarily, the consequence of sarcopenic obesity end is liver cell damage either carcinogen or any abnormality (Baffy, 2019). It is highly prevalent in elder population even though it did not get emphasis in the majority of countries.

Obesity is a major risk factor for a number of pathological disorders, including overweight, Type 2 diabetes, hypertension and atherosclerosis (Guyton and Hall, 2004; Balwan and Kour, 2021). Cardiovascular disease in obese subjects may have a variety of presentations. These include:

a) Atherosclerotic coronary disease
b) Cardiomyopathies and heart failure
c) Arrhythmias and sudden death
d) Venous thromboembolic disease
e) Stroke.

Clearly these presentations are not mutually exclusive; many patients may have more than one of these presentations. Atherosclerosis is common in obese subjects and can be shown frequently at post-mortem. However, perhaps because of coexisting cardiomyopathy, or coexisting type 2 diabetes, or perhaps because of low levels of physical exercise, morbidly obese patients often do not present with a classic history of exertional angina. As for the other clinical presentations of heart disease in obesity, stress, poor sleep, weight imbalance, the frequent presence of underlying co-morbidities, such as type 2 diabetes, hypertension, and nocturnal hypoventilation, may contribute to the clinical picture. In particular, diabetes may lead to 'silent' ischemia as well as predisposing to arrhythmias, heart failure and stroke (Table 2).

Table 2: Obesity associated diseases.

Co-morbidities principally causing morbidity rather than mortality	a) Osteoarthrosis. b) Gall stones. c) Bladder dysfunction d) Superficial infections such as intertrigo. e) Low social status, unemployment and social disadvantage. f) Low level of physical fitness. g) Psychological problems including depression etc. h) Polycystic ovary syndrome and other reproductive disorder. i) Benign intracranial hypertension. j) Asthma, breathlessness and non-specific chest pain. k) Increased risk with surgical operations. l) Lymph edema.

Co-morbidities indirectly causing mortality, mostly via cardiovascular disease	a) Obstructive sleep apnoea and other nocturnal hypoventilation. b) Dyslipidaemia (hypertriglyceridemia, low iidl-cholesterol, small dense LDL). c) Hypertension. d) Thromboemobolic disease. e) Fatty liver. f) Type 2 diabetes.
Co-morbidities directly causing mortality or death	a) Cardiovascular disease including cardiomyopathies. b) Obesity related cancers such as colonic, uterine, ovarian, gall bladder etc.

GUT MICROBIOTA AND NUTRITION AS INDICATOR OF OBESITY

Helicobacter pylori is a good indicator for development of obesity; even though the exact pathophysiology is unknown, most studies correlate with gastrointestinal hormones such as leptin and ghrelin. In normal physiology, ghrelin facilitates food intake and leptin is involved in reduction of food consumption. It is evidenced that there is low serum leptin and ghrelin levels in *H. pylori*-positive patients. As a result of the level of leptin, food intake will be reduced. So its reduction may be involved in excessive dietary intake and obesity. In contrary, reduction of plasma ghrelin concentration ends with a physiological adaptation to the positive energy balance associated with obesity.

High availability of branched-chain amino acids (BCAA), non-esterified fatty acids, organic acids, acylcarnitines, deficient 25(OH) vitamin D serum concentrations, and phospholipids etc are identified as potential biomarkers for obesity.

CHILDHOOD OBESITY

The increasing trend in the global prevalence of childhood overweight and obesity presents a major public health challenge. Currently, obesity is one of the most common and serious health problems among children and adolescents, with documented increases in prevalence in many countries including the UK. There is some uncertainty about how best to measure obesity in children. These problems notwithstanding, it appears that early onset obesity is a risk factor for obesity and its comorbidities and mortality later in life. The cause of obesity in children is more or less similar to that of adults (i.e. an imbalance between energy intake and energy expenditure). Overweight is increasing in cities of India, but it is very few in villages because of physical work/ adequate playing facilities in villages (Arora *et al.,* 2019; Bartelink *et al.,* 2019; Bayoumi *et al.,* 2019). Globally, the prevalence of childhood overweight/obesity is increasing, with public health implications in both developed and developing countries. According to the UNICEF (2016) an estimated 41 million children under five were overweight or obese in 2016 with about 25% of this number living in Africa alone, while among children and adolescents aged 5-19 years, 340 million were overweight or obese.

The prevalence may have stabilized in some industrialized countries; however, the trend seems to be on the increase particularly in some low-to-middle income countries (Wabitsch *et al.,* 2014). Childhood obesity is associated with early onset of cardiovascular risk factors, including elevated blood pressure, and impaired fasting glucose as well as higher odds of remaining overweight or obese in the adulthood. The growing obesity epidemic with its related health risks has the potential to significantly undermine improvements made in the healthcare delivery systems among populations living in low-to-middle income countries. Childhood obesity is rising in developed and developing countries, while childhood underweight is rising mainly in developing countries. Childhood underweight has been shown to increase a child's risk of rapid weight gain. Overweight and obese children are more likely to become obese adults, which increases the risk of type-II diabetes and cardiovascular diseases (Al Lahham *et al.,* 2019).

GENETIC FACTORS OF OBESITY

Evidence revealed that a family history of obesity and different genetically arranged genes may be responsible for obesity risk (Narciso *et al.,* 2019; Gokosmanoglu *et al.,* 2019). Genome-wide association studies (GWAS) identified that more than 250 genes/loci were associated with obesity. Of these genes, the fat mass- and obesity-associated gene (FTO) showed an important role for development of the obesity and type 2 diabetes. A study conducted among adults explicitly recognizes the correlation between these genes and a higher body mass index (BMI), fat mass index (FMI), and leptin concentrations (Andonian *et al.,* 2019). Some studies included in this review use cross-sectional study design, and majority of those studies assess obesity with the WHO standard (Table 3).

Table 3: Descriptive characteristics of studies included in this review.

Authors; Country	Study population (Sample size)	Study Design	Anthropometric used	Criteria	Prevalence of obesity	Risk factor
Hu *et al*. (2017); China	Adult (N = 15364)	Cross-sectional	BMI percentiles	WHO	7.9%	Urban residence.
Al Lahham *et al*. (2019); Palestine	School children (N = 1320)	Cross-sectional	BMI percentiles	CDC	15.7%	Urban residence and high waist circumferences.
Golshevsky *et al*. (2020); Australia	Children (N = 343)	Cross-sectional	BMI percentiles	CDC	No prevalence	Watching television, obstructive sleep and sleep apnea.
Gokosmanoglu *et al*. (2019); Turkey	Adolescent (N = 750)	Cross-sectional	BMI percentiles	WHO	4%	Irregular physical exercise, family history of obesity and consuming pastry foods.
Karki *et al*. (2019); Nepal	School children (N = 575)	Cross-sectional	BMI for age-sex	WHO	7.1%	Children mothers' high education level, having professional mother, consuming energy-dense food, having sedentary behaviour.
Al-Raddadi *et al*. (2019); Saudi Arabia	Adult (N = 1419)	Cross-sectional	BMI percentiles	WHO	34.8%	No factor identified.
Adom *et al*. (2019); Africa	Children (N = 89468)	Systematic review and meta-analysis	-	WHO/ CDC/ IOTF	6.1%, 6.9%, 4%	Urban residence and learning in private school.
Al-Kibria *et al*. (2019); India	Women (N = 647, 168)	Cross-sectional	BMI percentiles	WHO	5.1%	Older age, ever-pregnant, ever married, being muslims, high education level, wealthy and urban residence.

MANAGEMENT AND PREVENTION OF OBESITY

Obesity is a rapidly growing public health problem affecting an increasing number of countries worldwide because of its prevalence, costs, and health effects. Obesity is a luxurious disease (Verma, 2017); leading risk factor for global death and disability, and is associated with various non-communicable diseases including sleep apnoea, hypertension, diabetes, cancer, and cardiovascular disorders. Child overweight measurement is difficult but when the child becomes 120 cm or more in height Dr. Mandal's formula can be applied to titrate the overweight (Mandal, 1997; Mandal, 2010). Each individual and each doctor should not wait for obesity for the guideline of treatment instead they should start to advise whenever there is slightest overweight according to BMI and Dr. Mandal's formula otherwise there will be difficulty in treatment. Besides, everybody should remember that excess diet only is the cause of overweight or obesity if it is not burnt by exercise or work. Every mother will say that the child is taking nothing but is becoming overweight. But if you take the detailed history of food it will be found that they are taking excess (instead of two meals and two tiffins they are also taking health drinks in

between). Besides we want to remind that each bottle of 300ml cold drink contains 50g of sugar which will give equal calories of a tiffin. So, whole awareness of food is essential for diet measurement both in children and adults. The management plan for obesity is shown in Table 4.

Table 4: Management Plan for Obesity

BMI	Assessment	Advice
18.5-24.9	Weight steady in adult the gained – 5 kg in adult life.	Healthy eating plan, Weight maintenance with increase exercise.
25-29.9	1. No other risk factors 2. Risk factors present 3. Waistline problem	1. Healthy eating plan + weight reduction plan 2. Weight reduction plan + treat risk factor 3. Weight reduction plan
30		Weight reduction plan
Prevention is better than treatment		

BENEFITS OF A SUSTAINED 10% REDUCTION IN WEIGHT FOR THE OBESE

Mortality

a) 20-25% fall in total mortality.
b) 30–40% fall in diabetes–related deaths.
c) 40–50% fall in obesity-related cancer deaths.

Angina

a) Reduces symptoms by 90%.
b) 33% increase in exercise tolerance.

Blood Pressure

a) Fall of 10 mm Hg systolic pressure.
b) Fall of 20 mm Hg diastolic pressure lipids.
c) Fall by 10% in total cholesterol.
d) Fall by 15% in low-density lipoprotein (LDL) cholesterol.
e) Fall by 30% in triglycerides.
f) Increase by 8% in high-density lipoprotein (HDL) cholesterol.

Diabetes

a) Reduces risk of developing diabetes by > 50%.
b) Fall of 30-50% in fasting glucose.
c) Fall of 15% in HbA_1C.

Weight Reduction Plan

This aims to provide a three month structured management plan designed to meet the needs of each individual patient (Mandal, 2010; Abiola and Mello, 2019; Armenta-Guirado *et al.,* 2019; Arora *et al.,* 2019; Bartelink *et al.,* 2019; Bayoumi *et al.,* 2019):

1. Support from a trained health-care persons/ professional in a group setting since greater weight loss is achieved using groups than with individual consultations. This may reflect the interplay and mutual support of the individuals in the group.

2. Diet consisting of a moderate reduction in energy intake of about 600 kcal (2.5 MJ) less than expenditure assessed on weight, sex and age (published formulae are used). This produces a greater weight loss than stricter diets (e.g. 1000 kcal) probably as compliance is better. Most diets aim to reduce fat intake. Starvation diets are potentially dangerous due to a risk of sudden death from heart disease exacerbated by profound loss in muscle and the development of arrhythmias secondary to elevated free fatty acids and deranged electrolytes. The dietary change should involve the patient's entire family. During dietary restriction minerals and vitamins should be supplemented.

3. Behavioural modification therapy, which is designed to support a process of change in the individual's attitude, nature, perception and behaviour in relation to food intake, lifestyle and physical activity. The information box

provides some examples of the topics covered in a structured programme.

4. Promotion of increased physical activity, which can be maintained long-term. Walking briskly for 30 minutes each day can contribute 100-200 kcal (0.4-0.8MJ) of energy expenditure daily, resulting in an additional weight loss of 1 kg per month. If a person cannot walk briskly, can walk slowly.

Principles of Behavioural Modification

Issues to be discussed in group behavioural therapy are:

a) Self-monitoring of daily food intake.
b) Need for long-term lifestyle change.
c) Need to modify eating habits.
d) Need to assess present exercise level and ideas to increase this if necessary.
e) Importance of restricting occasions and situations when inappropriate types or amounts of food are eaten.
f) Planning of daily food intake.
g) Understanding of food labels and adapting recipes with regard to fat, salt, sugar and fibre.
h) Possibility of changes to individual cating style.
i) Reduce the rice intake; avoidance of bread, biscuits etc.

Weight Maintenance Plan

The weight reduction module is followed by three month structured programme emphasising weight maintenance although continued weight loss may be an option for some. This again emphasises therapy in groups, with continued behavioural therapy, promotion of exercise and diet modification. Exercise in this module is designed to prevent weight regain once weight has been lost by dietary restriction (Mandal, 2010; Abiola and Mello, 2019; Arora *et al.,* 2019).

Very Low Calorie Diets Plan

Nutritionists always use the following proverb to explain the effect of diet in our health 'what you eat today; they determine your life tomorrow.' Dietary habit is a major determinant factor for our health, not merely to obesity.

Very low calorie diets (VLCDs) produce weight losses of 1.5–2.5 kg/week compared to 0.5 kg on conventional diets. VLCDs are mainly used for short-term rapid weight loss. In the UK, the recommendation is that VLCDs should only be considered by those with a BMI>30 and under the supervision of an experienced physician/ nutritionist. The composition of the diet should ensure a minimum of 50g protein each day for men and 40g of protein for women to minimise muscle degradation. Energy content should be minimum 400 kcal (1.65 MJ) for women of height < 1.73 m and 500 kcal (2.1 MJ) for all men and women taller than 1.73 m. Side-effects tend to be a problem in the early stages of the diet especially orthostatic hypotension, headache, diarrhoea and nausea (Mandal, 2010; Abiola & Mello, 2019; Armenta-Guirado *et al.,* 2019; Arora *et al.,* 2019; Bartelink *et al.,* 2019; Bayoumi *et al.,* 2019; Balwan and Kour, 2021).

Healthy Food Subsidization and Taxation of Junk Food

The good news regarding obesity is that the government can reduce obesity by subsidization of healthy foods or increasing taxation of junk foods. This is strongly implemented in the UK; this scenario shows that an increment of price of high sugar snacks by 20% shows significant reduction in energy intake, BMI, and prevalence of obesity. As a result, increasing taxation or price for unhealthy foods is an effective approach to control obesity and their metabolic disorder (Pauline *et al.,* 2019; Balwan and Kour, 2021).

Bariatric Surgery Plan

Two procedures now dominate surgical practice, namely vertical banded gastroplasty and gastric bypass. Vertical banded gastroplasty involves the construction of a small stomach pouch fashioned by vertical stapling to restrict both gastric outlet and size; however, such treatment is difficult and prolonged observation is necessary (Mandal, 1997; Mandal, 2010; Bolling *et al.,* 2019).

PREVALENCE OF OBESITY IN JAMMU AND KASHMIR

The prevalence of obesity in Jammu and Kashmir varies across studies and populations. Overall, obesity rates are higher in urban areas and among women compared to men. Studies indicate that

obesity is an emerging concern, particularly among children and young adults, and is linked to various health issues. According to Bhat *et al.* (2021), the prevalence of overweight by International Obesity Task Force (IOTF) criteria was 24.7% while as that of Obesity was 11.5%. As per CDC Criteria, the prevalence of underweight, normal weight, overweight and obesity was 7.0%, 70.7%, 11.7% and 10.6% in boys, and 5.9%, 71.8%, 12.5% and 9.7% in girls respectively. By IOTF Criteria, the prevalence of normal weight, overweight and obesity was 65.4%, 23.9%, and 10.5% in boys and 61.6%, 25.6% and 12.7% in girls respectively. Factors significantly associated with Obesity on logistic regression is age more than 10 years (OR 1.44; P<0.001) and female gender (OR 1.29; P<0.001). Urban status had no statistical significance with obesity (OR 1.08; P>0.3).

CONCLUSION

Obesity is a chronic, relapsing, and progressive chronic disease that gently require long-term, multicomponent treatment strategies to improve the health and well-being of individuals. Obesity is an abnormal accumulation of body fat (usually 20% above the normal ideal body weight) to the extent that it may have an adverse effect on health. Obesity is becoming a severe public health problem; its epidemiology is increasing rapidly day by day. The exposure factors vary across different geopolitics. Primarily, living in obesogenic environments such as sedentary life style, urbanization, and rural to urban migration, consuming energy-dense foods, and physical inactivity were determinants. There are a lot of biomarkers, of which microRNAs, adipocytes, oxidative stress, and microbiota were promising for the determination of obesity. Since the consequences of obesity are vast and interrelated, a multilevel prevention strategy is mandatory. The obesity is a bountiful disorder, which occurs due to individual behaviour and the living environment. As a result of this, to prevent obesity, both legal and voluntary counselling services are effective as well as mandatory.

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest.

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