Review Article

Health Consequences of Obesity: A Review

Abstract:

Obesity is a global epidemic that threatens to deplete health-care resources by increasing the prevalence of diabetes, heart disease, hypertension, and cancer. Obesity is the leading preventable cause of death worldwide, affecting both adults and children. Obesity has two effects: an increase in the bulk of adipose tissue and an increase in pathogenetic product release by larger fat cells. This view of obesity as a disease allows for a straightforward distinction between the negative effects of obesity caused by fat bulk and those caused by fat cell metabolic effects. Obesity stigma causes social difficulties, sleep apnea is caused in part by increased parapharyngeal fat deposits, and osteoarthritis is caused by the wear and tear on joints caused by carrying an enlarged quantity of fat fall under the first category. A wide range of policy issues could have an impact on food ecosystems. Fiscal food policies, obligatory nutrition panels on the formulation and reformulation of manufactured foods, food and nutrition labelling implementation, and limiting marketing and advertising prohibitions on unhealthy foods are among these topics. In this review, we overview current evidences on health consequences of obesity.

Keywords: obesity, overweight, BMI, chronic diseases, hypertension, DM

Introduction:

Overweight and obesity are defined by the World Health Organization (WHO) as abnormal or excessive fat accumulation that poses a health risk. Overweight is defined as a body mass index (BMI) of 25 kg/m2, whereas obesity is defined as a BMI of 30 kg/m2. Obesity and overweight are well-known worldwide problems, with high incidence in both developed and developing countries. [1] According to the 2017 global nutrition report, 2 billion adults and 41 million children worldwide are overweight or obese. [2] Obesity has increased globally in the last three decades; unexpectedly, it is also increasing in low- and middle-income nations as a result of uncontrolled urbanization and nutrition transition (moving from a traditional to a westernized diet). [3, 4] Overweight prevalence in children under the age of five years has grown somewhat globally. In low- and middle-income countries, the overweight trend was varied. Obesity prevalence in children aged 2–4 years has enlarged abstemiously in the meantime. Obesity in children aged 5 to 19 years was uncommon in 1975, but it is now very common in 2016.[5] It is in the last ten years, the prevalence has climbed from 10% to 40% in the majority of European countries, and it has increased more than twofold in England [6].

Obesity is a global disease that is straining health-care resources by increasing the prevalence of diabetes, cardiovascular disease, high blood pressure, and cancer. Obesity has two effects: it increases the bulk of adipose tissue and causes larger fat cells to release pathogenetic products. This view of obesity as a disease enables a straightforward distinction between the negative effects of obesity caused by fat mass as well as those caused by fat cell metabolism. The first category includes social difficulties caused by the shame related to obesity, sleep apnea caused in part by increased parapharyngeal excess fat, and osteoarthritis caused by joint wear and tear caused by carrying an excessive amount of fat [1, 3].

The physiologic variables associated with a far effects of molecules produced by larger fat cells fall under the second category. Fatty - acid release from fat cells, which is then deposited in the liver or muscle, is likely to be the cause of the insulin-resistant disorder that is so prevalent in obesity. Diabetes occurs when the pancreas' secretion capacity is exhausted by the fight against insulin resistance. Because of the close relationship between increasing fat, especially abdominal fat, and diabetes, this result is especially concerning in terms of health-care costs. Fat

cell cytokine production, particularly IL-6, may contribute to the proinflammatory state that characterises obesity. Increased prothrombin activator inhibitor-1 release from fat cells may contribute to the procoagulant state of obesity, as well as changes in endothelial function, which may contribute to an increased risk of cardiovascular disease and hypertension. The larger stromal mass's synthesis of estrogens has been linked to a higher risk of cancer. Increased cytokine release may aid in other types of proliferative proliferation. The combined effect of these pathogenetic consequences of increasing fat reserves is a lower likelihood of life expectancy. [7]

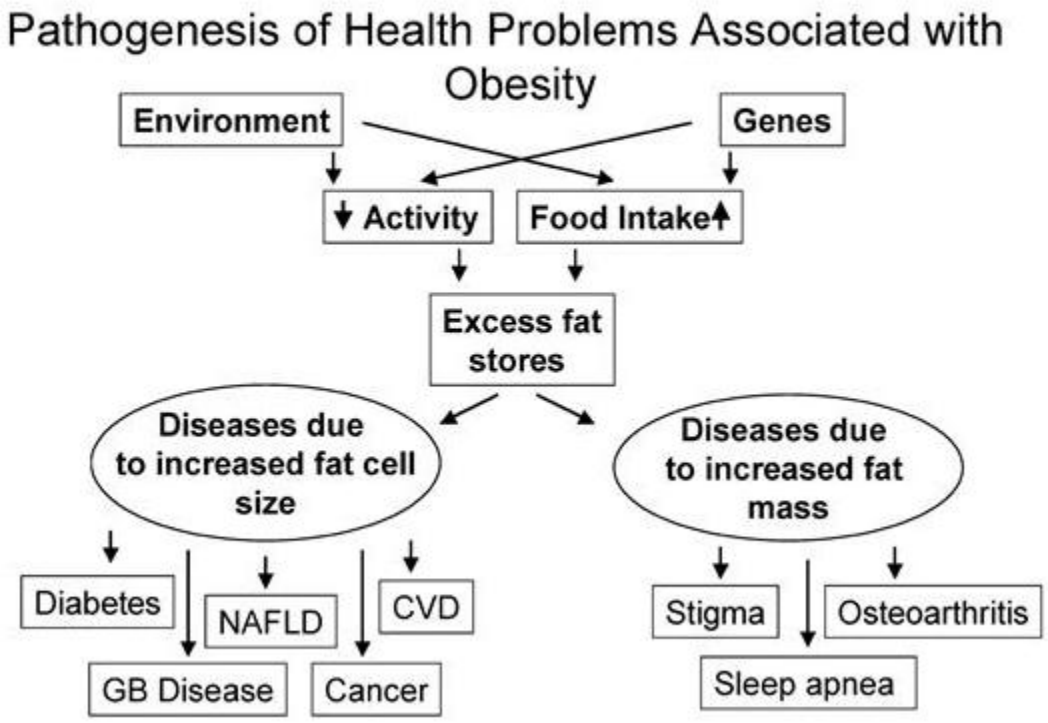
Obesity and metabolic diseases are exacerbated by childhood malnutrition. Although the link between childhood malnutrition and the development of obesity later in life remains unknown, researchers have suggested an alternative hypothesis. The first is when the socioeconomic status improves and living standards rise, as well as exposure to obesogenic conditions outside the uterus, which results in obesity. This could be due to a mismatch between intrauterine and postnatal nutritional needs. Second, obesity may result from a positive response to undernutrition in the womb, as well as exposure to an unhealthy environment. Obesity may also result from the foetal's positive response to undernutrition in order to protect vital organs, as well as exposure to an obesogenic environment. [8] As a result, nutritionists frequently use the phrase "what you eat today determines your life tomorrow" to emphasise the importance of diet on our health. Obesity is not the only factor influencing our health; dietary habits are as well. As a result, studies [10, 14, 15] have linked the consumption of energy-dense foods such as confectionaries, sugars, soft drinks, fats, and alcohol to obesity and chronic diseases. A variety of factors contribute to obesity, including feeding habit culture [16], consumption of pastry foods [16], consumption of ultra-processed food (refined carbohydrate) [13], excessive alcohol consumption [9, 11], and a monotonous diet or lifestyle [10, 14, 17, 18]. Obesity is limited by eating breakfast and fruit [17], so although obesity is compelled by eating an evening snack [19]. Furthermore, school-aged children are exposed to obesity in grocery stores and school food environments [12]. Obesity is also linked to a family history of the condition and a number of genetically arranged genes [12, 16]. According to genome-wide association studies, obesity has been linked to over 250 genes/loci (GWAS). Among these genes, the fat mass and obesity-associated gene (FTO) was

discovered to play an important role in the development of obesity and type 2 diabetes.

Pathogenesis of Obesity:

Obesity is a progressive, chronic, and recurrent medical disorder characterised by a pathological accumulation of adipose tissue in absolute values and percentages in relation to lean mass, to the point that it adversely affects health. It's a true metabolic disorder that wreaks havoc on hunger control and energy metabolism [20]. Therefore, each disease with an increased risk due to obesity can be divided into one of two pathophysiological groups. The first group of disabilities is caused by an increase in fat mass. Obesity stigma and the behavioural responses it causes, osteoarthritis, and sleep apnea are just a few of them. The dangers connected with metabolic alterations caused by excess fat fall under the second category. Diabetes mellitus, gallbladder disease, hypertension, cardiovascular disease, and several cancers linked to obesity are among them (Fig. 1). [21].

FIG. 1.



Obesity's excess adiposity can lead to difficulties due to its anatomical and metabolic impacts.

Subcutaneous adipose tissue acts as a'metabolic sink,' storing extra calories as triglycerides and protecting lean visceral organs including the heart, kidney, liver, and pancreas through adipocyte hyperplasia and hypertrophy. When the capacity of subcutaneous adipose tissue is exceeded, hypertrophied adipocytes rupture, causing inflammation and triglycerides to be deposited in visceral adipose tissue[22]. Obesity is linked to diastolic heart failure, chronic kidney disease (CKD), non-alcoholic fatty liver disease (NAFLD), and type 2 diabetes mellitus (T2DM). [23].

Obesity and atherosclerosis:

Atherosclerosis is a condition in which the arteries' walls harden over time, losing their suppleness, and eventually blocking or narrowing them, obstructing blood flow. Fatty and fiber-like deposits cause the obstruction. The most common cause of cardiovascular disease is atherosclerosis. It can cause coronary artery disease and heart attacks when it affects the heart. Strokes occur when this affects the brain, and peripheral artery disease occurs when it affects the blood vessels. And a high BMI is inextricably linked to the development of atherosclerosis. Atherosclerosis is strongly linked to increased waist circumference, waist hip ratio, and abdominal subcutaneous fat deposition. The link is made with the intimal–medial thickness (IMT) of the carotid artery, which is a marker for atherosclerosis. Furthermore, men may have a stronger link between high body weight and atherosclerosis than women who have not yet reached menopause. [24].

Liver disease:

Obese people are more likely to develop fatty liver disease, also known as nonalcoholic steatohepatitis (NASH). This occurs when the liver becomes clogged with fat. Cirrhosis is a condition in which excess fat damages the liver or causes scar tissue to form, and Fatty liver disease normally has no symptoms, but it can

develop to liver failure if left untreated. Losing weight, exercising, and avoiding alcohol consumption are the only ways to reverse or manage the illness. [25].

Pregnancy in Young Women with Obesity:

With the rise in young adults who are overweight or obese at the time of conception, it is critical that they receive sound nutritional advice at a time when they are most likely to accept it in order to improve pregnancy outcomes. In developed countries, there has been a trend toward less stringent monitoring of pregnancy weight gain, while in emerging economies, there has been a trend toward more intensive interventions aimed at improving maternal nutrition and avoiding the negative effects of small for gestational age (SGA) births. For overweight and obese women, current US recommendations indicate total pregnancy weight gains of 7–11.5 kg and 5–9 kg, respectively, for overweight and obese women. [26].

Obese young women experience increased maternal and foetal risks during pregnancy [27, 28]. Hypertension and pre-eclampsia, as well as gestational diabetes (GDM), are among these risks [29]. Miscarriage and stillbirth rates are also higher in pregnant women with gestational obesity [30]. Because young women may present to obstetric care later than older women for a variety of reasons, earlier antenatal care could potentially enhance outcomes.

Obesity and Lung Function/Respiratory Disease:

Through mechanical and metabolic processes, excess weight inhibits respiratory function. The accumulation of abdominal fat, for example, might impede diaphragm descent and, as a result, lung expansion, whereas the accumulation of visceral fat can diminish chest wall flexibility, sap respiratory muscle strength, and narrow airways in the lungs. (31) Lung function may be hampered by cytokines produced by the low-grade inflammatory state that comes with obesity. Obesity has also been linked to asthma and obstructive sleep apnea, two common respiratory diseases. Obesity raised the probability of acquiring asthma in both men and women by 50% in a meta-analysis of seven prospective trials including 333,000 individuals. (32) Obesity is also a major contributor to obstructive sleep

apnea (OSA), which affects one out of every five adults; one out of every 15 adults has moderate or severe OSA. Daytime sleepiness, accidents, hypertension, cardiovascular disease, and premature death are all linked to this disorder. Obesity affects between 50 and 75 percent of people with OSA. (31) Small weight loss appears to be beneficial in the treatment of sleep apnea in clinical trials. (33) and (34).

Obesity and Cancer:

The link between fat and cancer is less evident than the link between diabetes and cardiovascular disease. This is due in part to the fact that cancer is a collection of separate diseases rather than a single disease, however, an expert panel set up by the World Cancer Research Fund and the American Institute for Cancer Research concluded in 2007 that there was convincing evidence of a link between obesity and cancers of the oesophagus, pancreas, colon and rectum, breast, endometrium, and kidney, as well as a possible link between obesity and gallbladder cancer. [36] Obesity in the abdomen and weight gain in adulthood have also been associated to a variety of malignancies. Obesity is linked to malignancies of the breast, colon, and rectum, endometrial, oesophagus, kidney, ovary, and pancreas, according to a later comprehensive review and meta-analysis. [35] Because obesity has been linked to a reduction in immunocompetence in humans, hence immune system changes may play a role in the increased cancer incidence rates in obese people. According to Moulin et al., very obese people have significantly decreased natural killer (NK) cell cytotoxic activity when compared to normal individuals of the same age and gender, as well as inferior defence against invaders such precancerous and cancerous cells [46]. After 6 months of gastric bypass surgery, weight loss (26 percent less than initial weight) is associated with an increase in NK cytotoxic activity [46]. Lynch et al. recently discovered that the frequency of omental invariant NKT (iNKT) cells was reduced in individuals with extreme obesity compared to lean healthy people, implying that the omentum plays a new function in immune modulation and tumour immunity [47]. Therefore, obesity is the cause of 20% of cancer deaths in women and about 14% of cancer deaths in men, according to data published over the last 25 years. These rates are second only to smoking in terms of the number of malignancies that could have been avoided [48]. According to Jaggers et al., there is a positive multivariable-adjusted

correlation between cancer mortality and abdominal obesity, which raises cancer mortality risk by up to 24% [49]. Obesity has also been linked to an increase in the incidence and mortality of malignancies of the colon, endometrium, kidneys, and breast (in postmenopausal women) in epidemiological studies [50, 51].

Diseases of the bones, joints, muscles, connective tissue, and skin:

Overweight people are more likely to get osteoarthritis. The trauma correlated with the level of excess body weight may be straightforwardly related to the development of knee and ankle osteoarthritis [37]. Overall increase osteoarthritis in non-weight-bearing joints, on the other hand, suggests that some aspects of the overweight syndrome affect cartilage and bone metabolism regardless of weight bearing. A major portion of the cost of being overweight is due to increased osteoarthritis, and excess weight is linked to a number of skin abnormalities. Stretch marks, also known as striae, are frequent and are caused by the forces exerted on the skin by increasing lobular fat deposits. Many overweight people develop acanthosis nigricans, which causes deeper pigmentation in the folds of the neck, knuckles, and extensor surfaces, although it is not linked to an increased risk of cancer. Hirsutism in women could be a result of their altered reproductive state [21].

Obesity and hypertension:

Hypertension is a component of the metabolic syndrome that commonly coincides with obesity and is also a risk factor for cardiovascular disease. [38]. Although the exact processes behind the link between obesity and hypertension are unknown, adipose tissue has been shown to produce angiotensinogen, angiotensin converting enzyme (ACE), and angiotensin receptor 1 (AT 1) [39,40]. Obesity also increases renin activity and aldosterone levels [41]. These changes increase plasma volume and cause vascular smooth muscle contractions, both of which can lead to an increase in blood pressure. According to ganglionic nerve studies, heart rate variability studies, and renal norepinephrine spillover studies [42], obesity is related with a sympathovagal system imbalance. Due to the activation of 1-adrenoreceptors in the myocardium, this enhanced sympathetic nervous system activation may also contribute to higher blood pressure in the setting of obesity, resulting in an increased left ventricular (LV) dP/dt (rate of rise of LV pressure).

Due to alpha1-adrenoreceptor activation, increased sympathetic tone associated with obesity may cause arterial vasoconstriction, which can raise blood pressure. Finally, obesity is linked to a low-grade inflammatory condition in the body. Interleukin-6 (IL-6) and tumour necrosis factor- (TNF-) are proinflammatory cytokines produced by adipose tissue, and these can control other inflammatory markers including C-reactive protein (CRP) [43]. This increased inflammation is now being linked to an increase in blood pressure [44]. The 7th report of the Joint National Committee (JNC) on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure recommends weight loss as a first step based on these mechanisms. Weight loss is related with a dose-dependent improvement in hypertension [45]. Thiazide-type diuretics, ACE inhibitors, AT1 receptor blockers, and -adrenergic blockers, all of which are listed as initial therapies for Stage 1 hypertension in the 7th JNC report, are also rational therapies to consider in the obese patient with hypertension based on the mechanisms described above.

Obesity and Type 2 Diabetes Mellitus:

Type 1 diabetes, type 2 diabetes, prenatal diabetes, mature onset diabetes of the young, drug-induced diabetes, diabetes secondary to pancreatic damage, and diabetes secondary to pancreatic damage are all examples of diabetes mellitus (52). Type 2 diabetes mellitus (T2DM) accounts for up to 90% of all diagnosed diabetic cases in adults and is frequently related with obesity of varied degrees. BMI over 25 kg/m2 is present in 50-90 percent of T2DM patients, depending on ethnicity, age, and gender, and patients with BMI over 35 kg/m2 are about 20 times more likely to develop T2DM than those with BMI in the normal range (18.5-24.9 kg/m2 for Caucasians) (52, 53). Indeed, T2DM rates have been rising in both industrialised and developing nations in response to confirmed obesity prevalence trends (54, 55); as a result, the term "diabesity" has been coined to represent this twin epidemic (55-56).

Cardiovascular risk:

Obesity is a well-known independent risk factor for cardiovascular disease (CVD) and one of the leading causes of disorders such dyslipidemia, insulin resistance, high blood pressure (HBP) or hypertension, and atherosclerosis in both adults and children [57] The development of atherosclerosis is influenced by obesity and increasing adipose tissue. White adipose tissue (WAT) and brown adipose tissue (BAT) are two types of adipose tissue that are involved with metabolic and inflammatory systems and have protective effects on energy homeostasis. WAT secretes peptides and proteins that affect obesity, insulin resistance, inflammatory and immunological activities, atherosclerosis, and cardiovascular disease via modulating biological and physiological circumstances [58] And a diponectin is a peptide generated in adipose tissue that is expressed at high levels by lean, healthy persons but becomes dysregulated in those who are obese [59]. Obesity is characterised by an increase in adipose tissue and a decrease in adiponectin levels, limiting its ability to control inflammatory processes and thereby maintaining the inflammatory state. Adipocyte dysregulations contribute to body homeostasis imbalances and pro- and anti-inflammatory pathways, which contribute to obesity-induced metabolic problems and vascular breakdown, resulting in cardiometabolic changes [59]. Inflammatory cell infiltrate occurs in the adipose tissue, the pancreas, and other tissues in tandem with the development of obesity [60]. In adolescents with metabolic syndrome, this inflammatory state can be diagnosed early [61], and a link between inflammatory biomarkers and cardiovascular events has been demonstrated [62].

Obesity Prevention:

Obesity is a complicated etiology, necessitating a diverse prevention and treatment strategy at both the community and individual level. [63] The social ecology model can be used to identify the human and environmental factors that influence obesity, making intervention development easier. [64] Obesity prevention, both primary and secondary, necessitates participation and collaboration from a variety of sources, including the government, policymakers, legislative powers, and the healthcare system. Figure 2 depicts a selection of interventions that have been applied in several nations, placed on a modified social ecology model. No country

has yet successfully devised a population-level approach to reverse obesity's growing trends. [65].

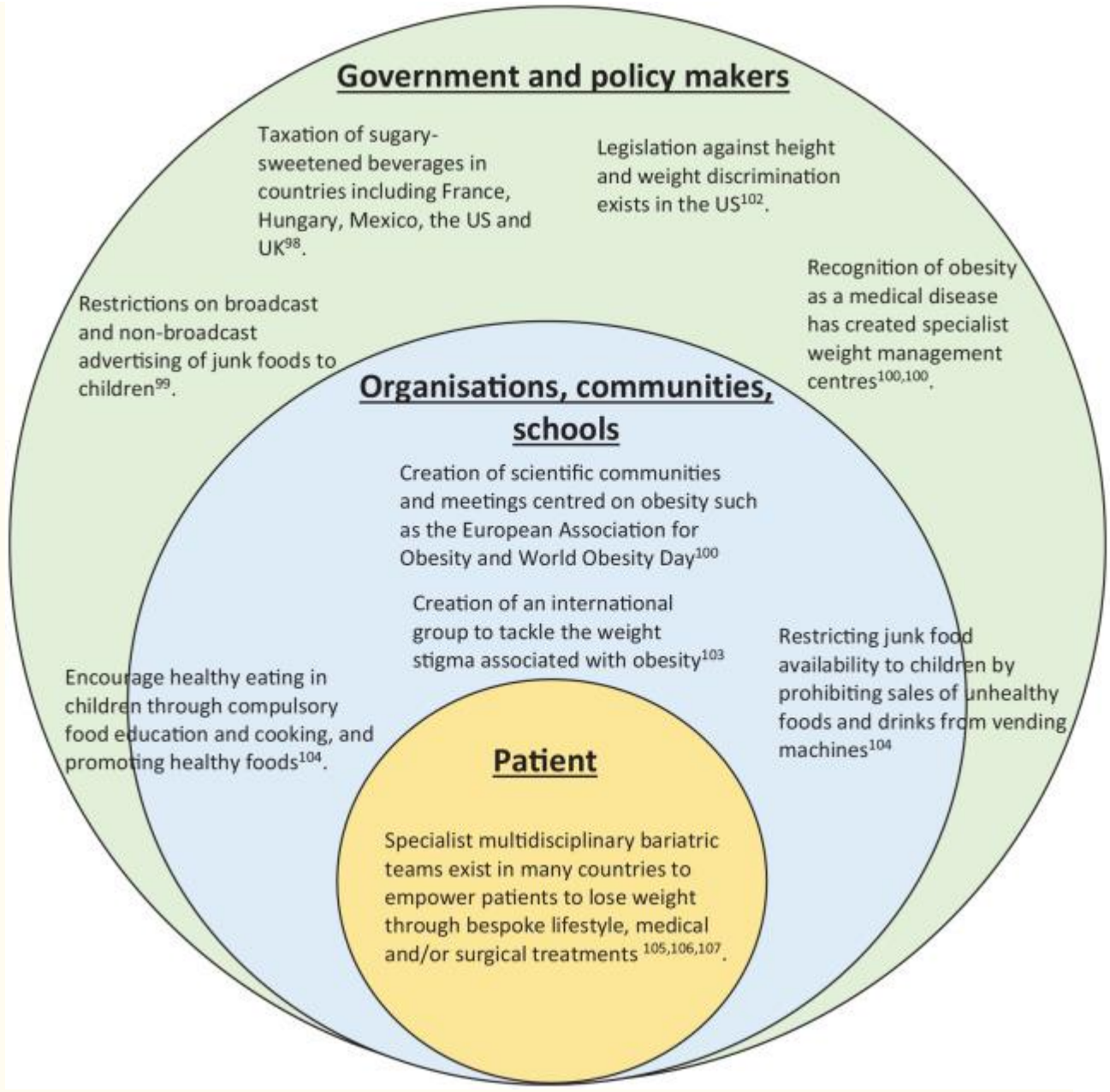


Figure 2 **Government and policy makers**

Obesity prevention policies aim to change the food environment so that healthy choices are easier to make, as well as the physical activity environment to encourage higher levels of physical activity and discourage sedentary behaviour. A

wide range of policy issues could have an impact on food ecosystems. Fiscal food policies, obligatory nutrition panels on the formulation and reformulation of manufactured foods, food and nutrition labelling implementation, and limiting marketing and advertising prohibitions on unhealthy foods are among these topics [66]. Urban planning policies, transportation policies, and organisational policies on the supply of physical activity facilities are all policy areas that influence physical activity surroundings [67] Education about excellent nutrition and a healthy weight should also be included in school curricula to enable all children to understand how to choose the right foods. These educational themes should be reflected in the foods served during the school's breakfast and lunch programs. [68].

Conclusions

The global prevalence of obesity continues to grow at an exponent. That is why obesity should be considered a real disease. Worldwide, the risk of developing diseases such as: arterial hypertension, dyslipidemia, type 2 diabetes, coronary heart disease, cerebral angiopathy, cholelithiasis, arthropathy, spherocytosis, sleep apnea increases, some tumors, increasing morbidity and mortality. Therefore, work on preventing obesity was very important because of its dire consequences.

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