

Health Consequences of Obesity and Overweight

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Abstract: Obesity is a condition in which the natural energy reserve, stored in the fatty tissue of humans and other mammals is increased to a point where it is associated with certain health conditions or increased mortality. Although, obesity is an individual clinical condition, it is increasingly viewed as a serious and growing public health problem. Excessive body weight has been shown to predispose to various diseases particularly cardiovascular diseases, diabetes mellitus type 2, sleep apnea and osteoarthritis. Obese people are seen to be less active than lean people. A controlled increase in calorie intake of lean people did not make them less active; correspondingly when obese people lost weight they did not become more active. Weight stigma also known as weightism, weight bias and weight-based discrimination, refers to invidiously discriminatory attitudes towards overweight/obese individuals that influence interpersonal interactions. Weight stigma reflects internalized attitudes towards overweight and obese people and affects how these people are treated. Combined diet and exercise as well as drug therapy is effective for the prevention and management of obesity and overweight.

Key words: Weight stigma, overweight, obesity, cardiovascular diseases, body mass, index

INTRODUCTION

Obesity can be defined in absolute or relative terms. In practical settings, obesity is typically evaluated in absolute terms by measuring Body Mass Index (BMI) and also in terms of its distribution through waist circumference or waist-hip circumference ratio measurements. In addition, the presence of obesity needs to be regarded in the context of other risk factors and comorbidities (NHLBI Obesity Education Initiative, 1998). BMI is a simple and widely used method for estimating body fat (Mei *et al.*, 2002). BMI was developed by the Belgian statistician and anthropometrist Adolphe Quetelet in 1871. BMI is calculated by dividing the subject's weight by the square of his/her height, typically expressed either in metric or US Customary units, Metric:

$$\text{BMI} = \text{kg m}^{-2}$$

Where:

kg = The subject's weight in kg

m = The subject's height in metres or US/Customary

$$\text{BMI} = \text{lb} * 703 \text{ in}^{-2}$$

where, lb is the subject's weight in pounds and in is the subject's height in inches

The current definitions commonly in use establish the following values agreed in 1997 and published in 2000 (WHO, 2000).

- A BMI <18.5 is underweight
- A BMI of 18.5-24.9 is normal weight
- A BMI of 25.0-29.9 is overweight
- A BMI of 30.0-39.9 is obese
- A BMI of 40.0 or higher is severely (or morbidly) obese

A BMI of 35.0 or higher in the presence of at least one other significant comorbidity is also classified by some bodies as morbid obesity (<http://www.nice.org.uk> <http://www.surgery.usc.edu>).

In a clinical setting, physicians take into account race, ethnicity, lean mass (muscularity), age, sex and other factors which can affect the interpretation of BMI. BMI overestimates body fat in persons who are very muscular and it can underestimate body fat in persons who have lost body mass for example the elderly (NHLBI Obesity Education Initiative, 1998). Mild obesity as defined by BMI alone is not a cardiac risk factor and hence BMI cannot be used as a sole clinical and epidemiological predictor of cardiovascular health (Romero-Corral *et al.*, 2006).

WAIST CIRCUMFERENCE

BMI does not take into account differing ratios of adipose to lean tissue nor does it distinguish between differing forms of adiposity, some of which may correlate more closely with cardiovascular risk. Increasing understanding of the biology of different forms of adipose

tissue has shown that visceral fat or central obesity, known as male-type or apple-type obesity has a much stronger correlation particularly with cardiovascular diseases, than the BMI alone (Yusuf *et al.*, 2004). The absolute waist circumference (>102 cm in men and >88 cm in women) or waist-hip ratio (>0.9 for men and >0.85 for women) are both used as measures of central obesity (Yusuf *et al.*, 2004). In a cohort of almost 15,000 subjects from the National Health and Nutrition Examination Survey (NHANES) III study, waist circumference explained obesity-related health risk significantly better than BMI when metabolic syndrome was taken as an outcome measure (Janssen *et al.*, 2004).

BODY FAT MEASUREMENT

An alternative way to determine obesity is to assess percent body fat. Doctors and scientists generally agree that men with >25% body fat and women with >30% body fat are obese. However, it is difficult to measure body fat precisely. The most accepted method has been to weigh a person underwater but underwater weighing is a procedure limited to laboratories with special equipment.

Two simpler methods for measuring body fat are the skinfold test in which a pinch of skin is precisely measured to determine the thickness of the subcutaneous fat layer or bioelectrical impedance analysis usually only carried out at specialist clinics. The routine use of bioelectrical impedance analysis is discouraged. Other measurements of body fat include Computed Tomography (CT/CAT scan), Magnetic Resonance Imaging (MRI/NMR) and Dual energy X-ray Absorptiometry (DXA) (Vanhecke *et al.*, 2006).

RISK FACTORS AND COMORBIDITIES

The presence of risk factors and diseases associated with obesity are also used to establish a clinical diagnosis. Coronary heart disease, type 2 diabetes and sleep apnea are possible life-threatening risk factors that would indicate clinical treatment of obesity. Smoking, hypertension, age and family history are other risk factors that may indicate treatment.

CAUSES OF OBESITY AND OVERWEIGHT

Lifestyle: Most researchers have concluded that the combination of an excessive nutrient intake and a sedentary lifestyle are the main cause for the rapid acceleration of obesity in Western society in the last quarter of the 20th century (Bleich *et al.*, 2007). Despite the widespread availability of nutritional information in

schools, doctor's offices on the internet and on groceries, Lin *et al.* (1999) stressed that it is evident that overeating remains a substantial problem leading to obesity and overweight in developed countries.

Dietary intake in itself is insufficient to explain the phenomenal rise in levels of obesity. An increasingly sedentary lifestyle due to industrialization has also contributed a significant role to the problem. Less well established lifestyle issues which may influence obesity include a stressful mentality and insufficient sleep (CDCP, 2008).

Genetics: As with many medical conditions, the caloric imbalance that results in obesity often develops from a combination of genetic and environmental factors. Polymorphisms in various genes controlling appetite, metabolism and adipokine release predispose to obesity but the condition requires availability of sufficient calories and possibly other factors to develop fully. A study conducted by Frayling *et al.* (2007) identified the following as contributing factors related to genetics:

- Common mutations in the *FTO* gene
- Heterozygotes having a 30% increased risk of obesity while
- Homozygotes are faced with a 70% increased risk.

On a population level, the thrifty gene hypothesis postulates that certain ethnic groups may be more prone to obesity than others and the ability to take advantage of rare periods of abundance and use such abundance by storing energy efficiently may have been an evolutionary advantage in times when food was scarce. Individuals with greater adipose reserves were more likely to survive famine. This tendency to store fat is likely maladaptive in a society with stable food supplies (Chakravarthy and Booth, 2004).

Medical illness: Certain physical and mental illnesses and particular pharmaceutical substances may predispose to obesity. Apart from the fact that correcting these situations may improve the obesity, the presence of increased body weight may complicate the management of others. Medical illnesses that increase obesity risk include several rare congenital syndromes such as hypothyroidism, Cushing's syndrome and growth hormone deficiency (Rosen *et al.*, 1993). Certain medications like steroids, atypical antipsychotics and some fertility medication may cause weight gain.

Mental illnesses may also increase obesity risk, specifically some eating disorders such as bulimia nervosa binge eating disorder and compulsive overeating

(also known as food addiction) can lead to weight gain and obesity (Rosen *et al.*, 1993). Smoking cessation is a known cause for moderate weight gain as nicotine suppresses appetite.

Microbiological aspects: The role of bacteria colonizing the digestive tract in the development of obesity has recently become the subject of investigation. Bacteria participate in digestion (especially of fatty acids and polysaccharides) and alterations in the proportion of particular strains of bacteria may explain why certain people are more prone to weight gain than others. Human digestive tract is generally either member of the phyla of bacteroidetes or of firmicutes. In obese people, there is a relative abundance of firmicutes (which cause relatively high energy absorption) which is restored by weight loss (Ley *et al.*, 2006; Zagorsky, 2004; Christakis and Fowler, 2007).

EFFECTS OF OBESITY ON HEALTH

A large number of medical conditions have been associated with obesity. Health consequences such as osteoarthritis, obstructive sleep apnea and social stigma are categorized as being the result of either increased fat mass or diabetes, cancer, cardiovascular disease and non-alcoholic fatty liver disease resulting from increased number of fat cells (Bray, 2004). Mortality is increased in obesity with a BMI of over 32 being associated with a doubled risk of death. There are alterations in the body's response to insulin known as insulin resistance, a proinflammatory state and an increased tendency to thrombosis called prothrombotic state (Manson *et al.*, 1995). Disease associations may be dependent or independent of the distribution of adipose tissue. Central obesity (male-type or waist-predominant obesity, characterised by a high waist-hip ratio) is an important risk factor for the metabolic syndrome, the clustering of a number of diseases and risk factors that heavily predispose for cardiovascular disease. These are diabetes mellitus type 2, high blood pressure, high blood cholesterol and triglyceride levels (combined hyperlipidemia) (Grundy, 2004).

Apart from the metabolic syndrome, obesity is also correlated with a variety of other complications as follow:

Cardiovascular: Congestive heart failure, enlarged heart and its associated arrhythmias and dizziness, cor pulmonale, varicose veins and pulmonary embolism.

Endocrine: Polycystic Ovarian Syndrome (PCOS), menstrual disorders and infertility.

Gastrointestinal: Gastroesophageal Reflux Disease (GERD), fatty liver disease, cholelithiasis (gallstones), hernia and colorectal cancer.

Renal and genitourinary: Erectile dysfunction, urinary incontinence, chronic renal failure, hypogonadism (male), breast cancer (female), uterine cancer (female), stillbirth.

Integument (Skin and appendages): Stretch marks, acanthosis nigricans, lymphedema, cellulitis, carbuncles, intertrigo.

Musculoskeletal: Hyperuricemia (which predisposes to gout), immobility, osteoarthritis, low back pain.

Neurologic: Stroke, meralgia paresthetica, headache, carpal tunnel syndrome, dementia, idiopathic intracranial hypertension.

Respiratory: Dyspnea, obstructive sleep apnea, hypoventilation syndrome, Pickwickian syndrome, asthma.

Psychological: Depression, low self esteem, body dysmorphic disorder, social stigmatization (Esposito *et al.*, 2004; Ejerblad *et al.*, 2006; Whitmer *et al.*, 2005).

While being severely obese has many health ramifications, those who are somewhat overweight face little increased mortality or morbidity. Osteoporosis is known to occur less in slightly overweight people.

MANAGEMENT OF OBESITY

Exercise: Shaw *et al.* (2006) reported that a meta-analysis of randomized controlled trials by the international Cochrane Collaboration found that exercise combined with diet resulted in a greater weight reduction than diet alone. The mainstay of treatment for obesity and overweight is an energy-limited diet and increased exercise. Previous studies have shown that diet and exercise programs have consistently produced an average weight loss of approximately 8% of total body mass. While not all dieters will be satisfied with this outcome, studies have shown that a loss of as little as 5% of body mass can create large health benefits (Lin *et al.*, 1999). A more intractable therapeutic problem appears to be weight loss maintenance. Studies have shown that dieters who manage to lose 10% or more of their body mass in studies, 80-95% will regain that weight within 2-5 years (McMillan-Price *et al.*, 2006). This finding supports the fact that the body has various mechanisms to maintain weight at a certain set point.

Diets: Various dietary approaches have been proposed, some of which have been compared by randomized controlled trials: A comparison of Dr. Atkins' diet, Slim-Fast plan, Weight Watchers and Rosemary Conley's found no significant differences (Truby *et al.*, 2006). A comparison of Atkins diet, Zone diet, Weight Watchers and Ornish diet noted that all the 4 diets resulted in modest statistically significant weight loss at 1 year with no statistically significant differences between diets (Dansinger *et al.*, 2005).

Low carbohydrate versus low fat: The Nurses' Health Study, an observational cohort study found that low carbohydrate diets based on vegetable sources of fat and protein are associated with less coronary heart disease (<http://en.wikipedia.org/wiki/Obesity>; Halton *et al.*, 2006). A meta-analysis of randomized controlled trials by the International Cochrane Collaboration in 2002 concluded that fat-restricted diets are no better than calorie restricted diets in achieving long term weight loss in overweight or obese people (Pirozzo *et al.*, 2002).

A recent meta-analysis that included randomized controlled trials published after the Cochrane review (Samaha *et al.*, 2003; Foster *et al.*, 2003) found that low-carbohydrate, non-energy-restricted diets appear to be at least as effective as low-fat, energy-restricted diets in inducing weight loss for up to 1 year. However, potential favorable changes in triglyceride and high density lipoprotein cholesterol values should be weighed against potential unfavorable changes in low density lipoprotein cholesterol values when low-carbohydrate diets to induce weight loss are considered (Nordmann *et al.*, 2006). The Women's Health Initiative Randomized Controlled Dietary Modification Trial conducted by Howard *et al.* (2006a, b) found that a diet of total fat to 20% of energy and increasing consumption of vegetables and fruit to at least five servings daily and grains to at least six servings daily resulted in no reduction in cardiovascular disease (Howard *et al.*, 2006a, b), an insignificant reduction in invasive breast cancer (Prentice *et al.*, 2006) and no reductions in colorectal cancer (Beresford *et al.*, 2006).

Low glycaemic index: The glycaemic index factor is a ranking of foods based on their overall effect on blood sugar levels. Low glycaemic index foods such as lentils provide a slower more consistent source of glucose to the bloodstream, thereby stimulating less insulin release than high glycaemic index foods such as white bread (Thomas *et al.*, 2007). The glycemic load is the mathematical product of the glycemic index and the carbohydrate amount (Brand-Miller *et al.*, 2003).

In a randomized controlled trial that compared four diets that varied in carbohydrate amount and glycemic index, McMillan-Price *et al.* (2006) concluded that the high-carbohydrate, low-glycemic index diet was the most favorable.

THERAPY

Pharmacotherapy: People with a BMI of over 30 should be counseled on diet, exercise and other relevant behavioral interventions and set a realistic goal for weight loss. If these goals are not achieved, pharmacotherapy can be offered. The patient needs to be informed of the possibility of side-effects and the unavailability of long-term safety and efficacy data of the drugs (Dansinger *et al.*, 2007). Using anti-obesity drug to diabetic patients, Norris *et al.* (2005) found that fluoxetine and sibutramine can achieve statistically significant weight loss over 12-57 weeks. The magnitude of weight loss is modest however, the long-term health benefits remain unclear because the safety of sibutramine is uncertain and there is a paucity of data on other drugs for weight loss or control in persons with type 2 diabetes. Norris *et al.* (2005) reported that the medication most commonly prescribed for diet/exercise-resistant obesity is orlistat because it helps to reduce intestinal fat absorption by inhibiting pancreatic lipase. Other drug therapy may consist of phentermine, diethylpropion and bupropion. For more severe cases of obesity, stronger drugs such as amphetamine and methamphetamine may be used on a selective basis (Snow *et al.*, 2005).

In patients with BMI >40 who fail to achieve their weight loss goals (with or without medication) and who develop obesity-related complications, referral for bariatric surgery may be indicated. Those requiring bariatric surgery should be referred to high-volume referral centers as the evidence suggests that surgeons who frequently perform these procedures have fewer complications (Snow *et al.*, 2005).

Dietary counseling interventions: A clinical practice guideline by the US Preventive Services Task Force (USPSTF) concluded that the evidence is insufficient to recommend for or against routine behavioral counseling to promote a healthy diet in unselected patients in primary care settings but that intensive behavioral dietary counseling is recommended in those with hyperlipidemia and other known risk factors for cardiovascular and diet-related chronic diseases (Pignone *et al.*, 2003). Intensive counseling can be delivered by primary care clinicians or by referral to other specialists such as nutritionists or dietitians (Dansinger *et al.*, 2007). A

meta-analysis of randomized controlled trials concluded that dietary counseling interventions produce modest weight losses that diminish over time (Pignone *et al.*, 2003; Dansinger *et al.*, 2007).

Bariatric surgery: Bariatric surgery, otherwise known as weight loss surgery is the use of surgical interventions in the treatment of obesity. As every surgical intervention may lead to complications, it is regarded as a last resort when dietary modification and pharmacological treatment have proven to be unsuccessful. Weight loss surgery relies on various principles; the most common approach is by reducing the volume of the stomach, this is by adjusting the gastric banding and vertical banded gastroplasty. This process will reduce the length of bowel that food will be in contact with thereby directly reducing absorption. Bowel shortening operations can be performed laparoscopically and it is irreversible. Encinosa *et al.* (2006) warned that complications from weight loss surgery are frequent.

CONCLUSION

In several human cultures, obesity was associated with physical attractiveness, strength and fertility. Obesity was considered a symbol of wealth and social status in cultures prone to food shortages or famine. But in modern Western culture, the obese body shape is widely regarded as unattractive and many negative stereotypes are commonly associated with obese people. Obese children, teenagers and adults can also face a heavy social stigma. Obese children are frequently the targets of bullies and are often shunned by their peers. Although, obesity rates are rising amongst all social classes in the West, obesity is often seen as a sign of lower socio-economic status.

Most obese people have experienced negative thoughts about their body image and some take drastic steps to try to change their shape including dieting, the use of diet pills and even surgery. In recent years, obesity has come to be seen more as a medical condition and even being referred to as an epidemic in modern Western culture. Government agencies and private medical practitioners have warned about the adverse health effects associated with overweight and obesity.

The cause in most cases is a sedentary lifestyle because most people do not participate in any leisure-time physical activity. Overweight and obesity are easily determined by calculating the Body Mass Index (BMI); this index uses the weight and height to determine body fat. An index of BMI that range from 25-29.9 is considered overweight and anything over 30 is noted as obese. Individuals with a BMI over 30 increase the risk of several health hazards.

Family members may express stigmatizing attitudes towards loved ones who are obese. Children who are overweight and obese may confront stigma by parents and siblings and obese adults may experience stigma from spouses and other relatives. Weight stigma can also lead to social isolation, poorer interpersonal relationships and self-blame.

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