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Obesity: Complications and Management Strategies

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ABSTRACT

Obesity is a chronic metabolic disease characterized by an increase in body fat stores. The prevalence of obesity in the developed world is increasing. Obesity is associated with and contributes to a shortened life span, type 2 diabetes mellitus, cardiovascular disease, some cancers, kidney disease, obstructive sleep apnea, gout, osteoarthritis, and hepatobiliary disease, among others. Weight loss reduces all of these diseases in a dose-related manner the more weight lost, the better the outcome. In this review article available evidence and recommendations for nonpharmacological management of obesity, including dietary therapy, physical activity, and behavioral therapy, in addition to pharmacotherapy are discussed.

INTRODUCTION

Definition

Obesity can be defined as excess accumulation of body fat arising from a sustained or a periodic positive energy balance which happens when energy intake exceeds energy expenditure. Obesity can be observed as a defined cluster of non-transmissible diseases called "New World Syndrome," creating a massive socioeconomic and civil health burden in poorer countries[1]. Consequently, an elevated body mass index (BMI), which expresses body weight (in kilograms) as a function of body height (in meters^2) as a surrogate measure of body fatness, is the most widely accepted definition of obesity[2].

Prevalence

Organization (WHO) has declared obesity as the largest global chronic health problem in adults which is increasingly turning into a more serious problem than malnutrition[3]. In recent years the prevalence of obesity has increased reaching epidemic levels. Worldwide, an estimated number of overweight and obese people increased from 857 million in 1980 to 2.1 billion in 2013. This is one-third of the world's population. Globally, an increase in the section of adults with a body-mass index (BMI) of 25 kg/m2 or greater, was found between 1980 and 2013 from 28.8% to 36.9% in men, and from 29.8% to 38.0% in women. In the same period, the number of kids and teenagers who are overweight and obese has increased significantly in developed countries by 23.8% in boys and 22.6% in girls. It has also increased in kids and teenagers in developing countries, from 8.1% to 12.9% in boys and from 8.4% to 13.4% in girls. In 2010, overweight and obesity were estimated to cause 3-4 million deaths i.e., 3.9% of years of life lost and 3.8% of disability-adjusted life-years worldwide [4]. It has been further projected that 60% of the world's population, i.e. 3.3 billion people, could be overweight (2.2 billion) or obese (1.1 billion) by 2030 if recent trends continue [5].

According to a recent study, India is just behind the US and China in the global hazard list of the top 10 countries with the highest number of obese people. Also, it was observed that the BMI values were similar in males and females; however, there were more overweight or obese (BMI≥25 kg/m2) females (6.6%) than males (3.5%). In a few areas, obesity and its subsequent diseases are posing a massive public health problem [6].

Classification

In clinical practice, the body fatness is usually estimated by BMI. BMI is calculated as measured body weight (kg) divided by measured height squared (m2). Patients with a BMI of 25 kg/m2 or greater are classified as being overweight. Pre obesity and obesity class I, II and III (extreme obesity) are defined as a BMI of 25 kg/m2 to 29.9 kg/m2, 30 kg/m2 to 34.9 kg/m2, 35 kg/m2 to 39.9 kg/m2, and 40 kg/m2 or greater, respectively. [7][8]

Table No. 1:- BMI categories [7]

Category	**BMI** (kg/m^2)
Underweight	<18.5
Healthy weight	18.5–24.9
Pre-obese state	25.0–29.9
Obesity grade I	30.0–34.9
Obesity grade II	35.0–39.9
Obesity grade III	≥40

Classification based on fat distribution in the body:- [9]

Android:-

Android is the male type of obesity where excess fat is marked in the upper half of the body. Android type of obesity is likened to the shape of an apple. The shoulders, face, arms, neck, chest and upper portion of the abdomen are bloated. The stomach gives a stiff appearance. The back seems to be erect but the neck is compressed and there will be protruding chest because of the bulk in the stomach. The lower portion of the body the hips, thighs, and legs are thinner beyond proportion in comparison with the upper part. In these persons the vital organs affected will be mostly the heart, liver, kidneys, and lungs. Android type of obesity is a major risk for heart damage and heart disease due to high cholesterol.

Gynoid:-

In this type, the lower part of the body has extra flesh. This type of obesity is also common to both sexes though females are more affected. Gynoid type of obesity is similar to the shape of pears. The flesh is somewhat flabby in the abdomen, thighs, buttocks, and legs. The face and neck mostly give a normal appearance. In some persons, the cheeks may be drawn too. As

these persons grow old the whole figure assumes a stooping posture and the spine is never erect due to the heavy hips and thighs. These vital organs affected mostly the kidneys, uterus, intestines, bladder, and bowls. But the functions of these organs sometimes have a direct effect on the heart. In this type of obesity, exercises or dieting will not help appreciably in reducing weight. One should have more patience and undertake proper treatment to achieve the goal of reducing weight and preventing further weight gain.

The third type:-

Besides Android and gynoid, there is one more type of obesity. Some people do not belong to any of the above types of obesity. Their whole body from head to toe looks like a barrel. Their gait is more to rolling rather than walking. The fat tissues in their body hinder the movement of all the internal organs and consequently affect their brisk functioning. For them, any exercise is difficult due to the enormous size of the body. So such a person should follow a strict diet and do plenty of exercises.

HEALTH CONSEQUENCES:-

Apart from being a major contributor to chronic disease burden and mortality, obesity particularly abdominal obesity is also closely related to the metabolic syndrome, a cluster of diseases that encompasses the following conditions described in figure 1**.** [10] Though obesity itself is not a disease per se, it is a major risk factor for developing type II diabetes, cardiovascular disease, hypertension, hypercholesterolemia, hypertriglyceridemia, nonalcoholic fatty liver and certain types of cancer at later ages [11][12][13]. In 2006, the International Diabetes

Figure No. 1: Numerous co-morbid conditions associated with obesity[10]

Federation published the latest definition of the metabolic syndrome describing a cluster of factors associated with an increased risk for atherosclerotic cardiovascular disease (CVD) and diabetes **[14].** For a person to be diagnosed with the metabolic syndrome the following criteria have been defined: central obesity measured by waist circumference plus two additional factors such as raised triglycerides (>150 mg/dl), reduced HDL cholesterol (<40-50 mg/dl), raised blood pressure (>130 mm Hg systolic or >85 mmHg diastolic) or raised fasting plasma glucose (>100mg/dl) [15][16]**.** These defined criteria are important to diagnose people with metabolic syndrome early and to initiate lifestyle interventions and treatment before the development of diabetes and CVD.

FACTORS ASSOCIATED WITH OBESITY

Demographic Factors: Gender, Age and Ethnicity:-

Gender

Women generally have a higher prevalence of obesity (BMI >30 kg/m2), especially after the age of 50 years, whereas men usually have a higher prevalence of overweight (BMI 25 to 29.9kg/m2) [17][18].

Age

A BMI increase with age has been documented in several cross-sectional studies (Boyle et al., 1994; Seidell et al., 1995; Flegal et al., 1998). The older the subjects, the higher the mean BMI and other prevalence of obesity in both men and women, at least up to the age of 50 to 60 years[19][20].

Ethnicity

The prevalence of obesity has been shown to vary across ethnic groups [17]. These differences have been suggested to be partly due to a genetic predisposition for obesity, which becomes apparent especially when individuals are exposed to an affluent lifestyle, such as Pima Indians in Arizona or Australian Aboriginals in an urban environment[1].

Socio-cultural Factors: Education and Family Situation:-

Educational Level

The socio-economic gradient in obesity is abundantly accepted in the literature. Especially in women, a strong inverse association between obesity and socioeconomic status (SES), mostly assessed by educational level, has been reported in numerous affluent populations [21][22][23].

Marital Status

Marital status is linked with BMI and obesity, although this association is not well recognized [24]. Several but not all cross-sectional studies have shown married or cohabiting subjects to have a higher BMI than subjects living alone. Overweight tends to rise after marriage [25].

Number of Children

Childbearing has been recommended to be a provider to obesity in women, with pregnancy belonging to the vulnerable period for enlargement of obesity**.** The effect of childbearing on body weight may be due to environmental factors rather than being purely biological[1].

Dietary Intake, Physical Activity, Alcohol Consumption, and Smoking:-

It is important to note that weight changes observed in populations over time are generally so small that they are unlikely to be detected by existing methods for measuring energy expenditure and energy intake in the population **[26][27].**

Food Choices and Dietary Intake

Nutrition is of critical importance in establishing a positive energy balance. Of the nutritional factors related to obesity, dietary fat intake is widely believed to be the primary determinant of body fat **[28].** High-fat diets have been suggested to promote obesity by increasing energy intake, further increasing the likelihood of a positive energy balance and weight gain [29].

Physical Activity

Physical activity is adversely associated with BMI in numerous cross-sectional studies and obese subjects have been observed to be physically less active than the non-obese [30][31]. Perception of weight status and dieting behavior in Dutch men and women[32].

Alcohol Consumption

Epidemiological findings regarding the association of alcohol consumption with bodyweight have been controversial. Alcohol is a considerable component of the diet in many countries, providing about 3 to 9% of daily energy intake **[33].** Similar to measuring food intake, measuring alcohol consumption is liable for reporting errors and being influenced by cultural differences **[34][35].**

COMPLICATIONS OF OBESITY:-

Metabolic-Hormonal Complications:-

Metabolic syndrome showed some mild adverse reactions, such as type II diabetes, insulin resistance, hyperinsulinemia, dyslipidemia, hypertension, gout, and sleep disorders.

Abnormalities of hormones and other circulating factors employed include cytokines, ghrelin, growth hormone (GH), hypothalamic-pituitary-adrenal (HPA) axis and leptin and renin-angiotensin system[36][37].

Diseases of Organ Systems:-

The following medical conditions are also more common in obese people than in those of normal weight: cardiac and vascular disease such as cerebrovascular disease, congestive heart failure, coronary heart disease, hypertension, and thromboembolic disease. The respiratory system abnormalities are obesity hypoventilation syndrome and sleep apnea. The reproductive system abnormalities are hormonal complications in females, males and obstetric complications[38][39].

Cancer:-

The important consequences (complications) of obesity include increased incidence of cancer in the breast, colon, female reproductive system, cervix, endometrium, ovary, gall bladder, kidney and prostate[40][41].

Mechanical Complications of Obesity:-

Arthritis and increased intra-abdominal pressure are a common problem in obese individuals due to trauma of excess weight bearing[42][43].

Surgical Complications:-

Surgical procedures have several risks, particularly if general anesthesia is used. Morbid obesity increases the risk of post-operative wound infections, increasing the risk that someone will develop a blood infection or die from overwhelming infection[44].

Psycho-Social Complications:-

Multiple aspects of psycho-social functioning include: psychological, social complications and economic impact[45].

MANAGEMENT OF OBESITY:-

- Dietary Control
- Physical Activity
- Pharmacotherapy
- Surgical treatment

Dietary Control:-

Obesity is a prevalent global health problem affecting all age groups and leads to many complications in the form of multi- metabolic and hormone disease. The daily requirements of persons with moderate physical activity vary with age and sex, (3200- 2550 kcal for males in a temperate climate and 2300-1800 kcal for females). 800-1000 kcal/day ranges are frequently used in weight reduction programs. Fasting or semi-starvation is sometimes proposed as a means of weight reduction in obesity[46]. Maintaining a well-balanced diet (rich in fibers and low in fats and containing multiple vitamins) will provide the body with nutrients required to function properly. Nutrition education is important for weight management (e.g. low-fat food may still cause weight gain since both protein and carbohydrates can be metabolically converted to fat). Low-calorie diets (<1200 kcal/day) and very low-calorie diets (<800 kcal/day) may be associated with diverse effects such as increased uric acid level, increased risk of gall stone formation, loss of lean body mass, electrolyte disturbances and mild liver dysfunction [47].

Physical Activity:- [48]

Weight gain and obesity are responses to long term positive energy balance where:

Energy Balance = Energy Intake – Energy Expenditure

Energy balance involves an equilibrium between calorie intake and energy utilization (physical activity, basal metabolism, and adaptive thermogenesis). The development of overweight and obesity is a consequence of the easy and cheap availability of high-calorie foods, which is combined with a sedentary lifestyle. A variety of exercises such as walking, cycling, swimming, and aerobics are effective and easy to implement. Regular physical activity is an essential component to lose weight. To lose weight, one must achieve a negative

energy balance (i.e., decreased energy intake and increased energy expenditure). Overweight patients who participate in at least 30 min of moderate physical activity most days of the week, or who have moderate to high cardiorespiratory fitness have decreased all-cause mortality than those who are sedentary and unfit. Exercise as a treatment for obesity is most effective when combined with diet and weight-loss programs. Exercise alone without dietary changes will have a limited effect on weight because one has to exercise a lot to lose one pound. However, regular exercise is important to maintain a healthy weight for the long term. Another advantage of regular exercise as part of a weight- loss program is a greater loss of body fat versus lean muscle in comparison to diet alone.

Pharmacotherapy:-

To date, pharmaceutical agents had a limited role in anti-obesity treatments. Along with lifestyle modifications, the pharmacological approach to weight management includes strategies adopted to inhibition of absorption from the gastrointestinal tract, increasing energy expenditure, or reducing the sensation of hunger to make dieting more tolerable. Although a few FDA approved drugs like orlistat and sibutramine are available in the market, they are not preferred for long time usage owing to considerable adverse effects. Recently the most widely used anti-obesity drugs dexfenfluramine and fenfluramine have been withdrawn from the market due to unacceptable side effects such as cardiac vascular damage, hypertension, postpartum hemorrhage, and pulmonary hypertension.

Table No. 2:- Mechanism of action of anti-obesity drugs [49]

Sr. No.	Drugs	The main mechanism of action	Introduced -withdrawn	Side effects
1	Emphatic (Bupropion with Zonisamide)	Noradrenalin/dopamine reuptake inhibitor and anticonvulsant	Phase II testing	Nausea, Headache, Insomnia, anxiety
2	Fen-Phen (fenfluramine/phentermine)	Serotonin/noradrenalin releasers	1992-1997 (only in the USA)	Pulmonary Hypertension, Heart disease,
3	Phentermine(Fasti n)	Noradrenalin releaser, sympathomimetic	1959-present	Only for short term use in patients without hypertension
4	Orlistat	Gastric and pancreatic lipase inhibitor	1999-present	Fatty and oily stools
5	Sibutramine	Serotonin/noradrenaline reuptake inhibitor	1997-2010	Increased risk for stroke and myocardial infarction
6	Rimonabant	CBI receptor antagonist	2006-2008,(only in Europe)	Depression and anxiety
7	Contrave (bupropion with naltrexone)	Noradrenalin/dopamine reuptake inhibitor and opioid receptor antagonist	Declined in 2011 may be refilled	Cardiovascular side effects
8	Qsymia	Noradrenalin releaser and anti-convulsant	2012-present (Only in the USA)	Dizziness, headache, insomnia
9	Lorcaserin	Serotonin 2C agonist	2012-Present, (in the USA only)	Dizziness, headache, insomnia
10	Saxenda– liraglutide(rDNA origin)subcutaneous solution - injection	Acylated glucagon-like peptide-1 (GLP-1) agonist	2014 (Latest drug)	Gastrointestinal side effects including nausea diarrhea, vomiting, constipation, influenza, fatigue , Hypertension, Thyroid gland disturbance, Pancreatitis

Surgical treatment:- [48]

The only option today that effectively treats morbid obesity is Bariatric (weight loss) surgery people for whom more conservative measures such as diet, exercise and medication have failed. Bariatric surgery also contributes significantly to resolving comorbidities and regains quality and quantity of life.

Bariatric surgery help, many people to reduce or eliminate some health-related obesity problems they are

The decrease in the workload of the heart

- Lowers blood pressure
- Lowers blood sugar
- Lowers cholesterol levels

Surgical treatment is preferred when:-

- Persons with a BMI between 35 and 40 who have another condition such as obesity-related type 2 diabetes, heart disease or sleep
- People with a BMI greater than 40
- Women with 80 pounds over their ideal body weight and Men with 100 pounds over their ideal body weight.

CONCLUSION

Creating the conditions for healthy living in our modern environment, including the prevention of obesity, is one of the great challenges for humankind. Obesity, besides impairing quality of life, is associated with numerous chronic diseases. Fortunately, weight reduction improves the management of many of these diseases, especially T2D. Although global obesity prevalence has not decreased, more therapeutic options are available today, thus improving the management of patients with obesity and related comorbidities.

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