

PJN

ISSN 1680-5194

PAKISTAN JOURNAL OF
NUTRITION

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Review Article

Obesity, Body Measurements and Health: A Review

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Abstract

Obesity concern increases over time as its epidemic increases. Multiple causes are associated with weight and obesity can be the result of one or more of these causes. Adiposity, especially visceral type, has a negative effect on body health, which is a risk factor for several chronic diseases and can lead to death. Therefore, it is important to assess the health of the body by measuring adiposity level. Body mass index, waist circumference and visceral adiposity index are some of these available methods. Diet restriction which is one of the interventions used to eliminate excess weight, does not take into account the type of food to be ingested and as a result of that, fat free mass would be lost instead of body fat mass. Healthy lifestyle habits considered to be more effective in controlling body weight. However, increasing responsibilities of governments and health care institutions to address obesity epidemic calls for the development of diverse strategies to manage its consequences and to ensure healthy living.

Key words: Body fat, chronic disease, obesity, physical activity, visceral adiposity

Received: April 06, 2019

Accepted: April 12, 2019

Published: August 15, 2019

Citation: M. Alawneh, I.R. Dabbour, Mohammed O. Ibrahim and S.M. Herzallah, 2019. Obesity, body measurements and health: A review. Pak. J. Nutr., 18: 805-809.

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Obesity is known as an excessive accumulation of fat in adipose tissue¹. Obesity is an epidemic, its prevalence is increasing over the time². According to the World Health Organization (WHO), statistics made in 2016 showed that more than 1.9 billion adults were overweight and over 650 million of these adults were obese³. The prevalence was nearly tripled since 1975³. Despite increasing awareness about obesity and its adverse effects on health, the incidence is still elevated⁴. Increasing body fat level is due to complicated factors that can affect and interact together in different ways to contribute to obesity⁴. Therefore, this raises the responsibility of governments and health organizations in facing this challenge and to think more deeply about the problem of obesity, how to treat it or even prevent its incidence^{5,6}.

The etiology of obesity: There are several risk factors associated with obesity. These factors include⁴:

- **Dietary intake:** excessive intake of saturated, animal source and trans fat associated with increasing body weight compared with unsaturated fats⁷. Refined grains and low total fiber intake, sugar-sweetened beverages, sweets and desserts also have the same impact as saturated fats⁸. On the other hand, high intakes of fruits, vegetables, nuts, yogurt and whole grains have lower effect on weight gain⁸
- **Physical activity and sleep duration:** Exercises, especially jogging and running have a great impact on weight loss and maintaining healthy weight⁴. Decreasing sleeping time for less than 7 h per night linked with weight gain⁹
- **Genetic effect:** Genes have its role in body composition⁴. Furthermore, poor life style can interact with the susceptible gene and exacerbate its effects¹⁰⁻¹²
- **Environmental effect:** High countries' density, whether by population or facilities, increases physical activity and hence reducing obesity risk¹³
- **Hormonal imbalance:** Fats and simple sugars which are usually the main composition of industrial foods stimulate insulin production and elevate its level more rapidly than other macronutrients. The longer and the higher insulin secretion is, the more likely the body is to store fat

Measuring adiposity: It is worth to predict individual's health based on measuring body fat level. There is no single method

that can determine body fat accurately, instead of that, several methods are available for assessing adiposity level¹⁴. Adiposity measurements include:

- **Body mass index (BMI):** BMI is the most common method used to predict body fat level. Camacho and Ruppel² defined the BMI as the ratio of the weight in kilogram to the height in meter squared (kg m^{-2}). BMI classifies individuals according to body weight into: underweight: <18.5 , normal weight: $18.5-24.9$, overweight: $25-29.9$, obese ≥ 30 . This classification gives an indicator about the risk of chronic disease; however it can't define fat distribution nor differentiate between different fat types¹⁵
- **Waist circumference (WC):** WC is the circumference in between the lower rib and the upper part of the iliac bone¹⁵. It is an indicator of abdominal obesity; the most dangerous type of fat. The normal range of WC for men is ≤ 102 cm, whereas in women it is ≤ 88 cm¹⁶
- **Waist to hip ratio (WHR):** WHR is the ratio of two measurements; waist circumference and hip circumference¹⁵. It should be less than 1 for men and less than 0.85 for women¹⁴. Similar to WC, WHR can assess abdominal fat accumulation, although WC seems to be better indicator¹⁷
- **Skin-fold thickness:** Different calipers are used to measure fat layers under skin for several parts of body. These measurements are applied to special equations that can be used to determine fat percent¹⁵
- **Dual energy x-ray absorptiometry (DEXA):** This is an accurate method that can measure fat mass, lean mass and mineral density of bone. DEXA uses two x-ray beams pass through the body. Nevertheless, this technique can't differentiate different types of fat¹⁵
- **Computerized tomography and magnetic resonance imaging:** These are the most accurate methods that use imaging technique to define body fat type¹⁵
- **Visceral adiposity index (VAI):** VAI is a mathematical method used to assess visceral adiposity by identifying each of BMI, WC, triglyceride (TG) and high density lipoprotein cholesterol (HDL-C) values. VAI is considered to be 1 for a healthy individual with normal adipose distribution¹⁸. The equation is an indicator for future cardiometabolic deterioration¹⁹.

$$VAI = \left(\frac{WC}{39.68 + (1.88 \times BMI)} \right) \times \left(\frac{TG}{1.03} \right) \times \left(\frac{1.31}{HDL - C} \right) \text{ for men}^{19}$$

$$VAI = \left(\frac{WC}{39.58 + (1.89 \times BMI)} \right) \times \left(\frac{TG}{0.81} \right) \times \left(\frac{1.52}{HDL - C} \right) \text{ for women}^{19}$$

Calculating body weight: Ideal body weight (IBW) is a mathematical equation used for estimating body health based on weight value. A linear equation is used by IBW to define the target weight that is suitable for each height²⁰:

$$Wt = a \times Ht + b$$

However, the drawbacks of this concept is that it gives only one single weight value and body weight estimation wouldn't be precise at shorter or taller height²⁰. On the other hand, BMI concept used to address IBW limitations as it put a range for target weight and divides subjects into definite groups according to fat level. Therefore, IBW can be replaced with BMI²¹.

A new invited mathematical model is established and successfully combined these two previous concepts into one equation that can predict weight and IBW at any values of BMI and height. The equation is sex-independent and can be calculated at both US and metric system²¹.

$$Wt(Ib) = [5 \times BMI + (BMI \div 5)] \times (Ht + 60in)$$

Or

$$Wt(kg) = 2.2 \times BMI + 3.5 \times BMI \times (Ht - 1.5m)$$

The main advantages of this equation are²¹:

- An accurate equation that can calculate IBW at any given BMI
- Can define how much weight is added by an increase of 1 point in BMI: each 5lb + [(Ht + 60in) ÷ 5] lb of body weight is added
- Can estimate BMI value for each subject at each height
- Tells if the subject is whether obese or not and how much weight is needed to be lost to reach IBW

Obesity and related health problems: Although obesity causes deterioration of body health, its role depends primarily on the distribution of fat within the body¹⁴. Excessive adiposity, especially central type is a major risk factor for chronic diseases. The most important of which are: diabetes, hypertension, coronary heart disease, as well as elevated risk of cancer and mortality. However, weight gain at age of

eighteen could be a major responsible for such problems⁴.

Increased concerns about the accumulation visceral fat rather than other fat types as being a main responsible for cardiometabolic health deterioration. One study confirms the risk of visceral obesity as a biomarker for converting metabolically healthy obesity (MHO) to metabolically unhealthy phenotype¹⁹. Metabolic health can be defined as the absence of all metabolic risk factors: elevated levels of fasting plasma glucose, blood pressure, TG, C-reactive protein and homeostatic model assessment of insulin resistance and lower level of HDL-C⁵. Metabolically healthy obesity would have one or none of these abnormalities. Measuring adiposity by VAI is a useful tool for predicting such conversion¹⁹.

Treatment and intervention: Knowing and treating causes is a valuable tool for prevention of any problem. Un-effective strategies of some public healthcare organizations are due to concentrating efforts in treating symptoms rather than causes. Considering obesity mainly as a result of [imbalance between energy consumed and energy expended]²² can lead to misunderstanding this problem. Calories imbalance concept blames obese individual primarily as failing to have self-control during eating and in order to stop gaining weight calories consumed should be reduced. By focusing in calorie solely rather than its source, restricted energy intake can cause malnutrition or loss of fat free mass. Taking into account the effect of food composition in regulating hormonal response, which appears more reliable in estimating obesity cause compared to calorie-focused thinking, the responsibilities of governments and food industries must be increased to ensure accessing healthy food and preventing harmful food that promote excess fat storage².

The role of physical activity on maintaining normal weight is well known. Practicing moderate aerobic exercise (AE) alone without calorie restriction results in weight loss at small percentage but as the intensity and frequency of AE increase, weight loss will be as well. Resistance training (RT) compared with AE would not be effective in reducing body weight but in turn, it can improve body composition and increase fat free mass. However, combining diet restriction with exercise will show better results in weight reduction and maintaining lean body mass²³.

Non Exercise Activity Thermogenesis (NEAT) stand for energy expenditure as a result of non-structured or planned physical activity such as standing and walking. Increasing NEAT by enhancing lifestyle habit can maintain weight and prevent weight gain²³. Weight reduction improve insulin resistance and metabolic syndrome and reduce the risk of obesity related diseases²⁴.

Strategies for promoting health: Not all obese individuals are metabolically unhealthy, nor all normal weight individuals are healthy²⁵. Healthy lifestyle habits improve in body health, lower the incidence of chronic disease and mortality rate, independent of weight status²⁶.

Health at Every Size (HAES) approach is an effort that concentrates on enhancing lifestyle pattern by consuming healthy food, practicing physical activity and eliminating ethical disparities between individuals. This approach doesn't aim to reduce weight but rather aims to improve health in all body sizes. Long-lasting behavioral changes induced by HAES approach promote managing weight and prevent long-lasting weight gain⁵.

The National Center for Chronic Disease Prevention and Health Promotion (NCCDPHP) of Centers for Disease Control and Prevention (CDC) funded a program as an attempt to control and prevent chronic diseases. The State Public Health Actions to Prevent and Control Diabetes, Heart Disease, Obesity and Associated Risk Factors and Promote Health School (State Public Health Action) program which was funded by NCCDPHP is now adopted in 50 different states in America. The program consists of 4 main strategies. These strategies take into consideration health promotion at both individual and population level and after education and intervention, the program anticipates commitment to a healthy lifestyle and chronic disease management⁶.

CONCLUSION

Poor lifestyle habit is a main responsible for fat accumulation. Elevated body fat level, particularly visceral fat is associated with metabolic health deterioration, several chronic diseases and can lead to death. Accurate knowledge about obesity epidemic helps to address the prevalence of the problem. Therefore, this increases the responsibilities of governments and healthcare organizations to raise awareness about the need to change bad habits and adhere healthy practices to keep body healthy as long as possible.

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