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Diet and Obesity

Olariike Oyindasola Kayode

Abstract

Obesity is a complex disease that involves an excessive amount of body fat. It is a medical problem that increases the risk of other diseases, such as heart disease, diabetes, high blood pressure and certain cancers. Although there are genetic, behavioral, metabolic and hormonal influences on body weight, obesity occurs when you take in more calories than you burn through exercise and daily activities that is when energy intake exceeds energy expenditure. Diet plays an important role in the pathogenesis of obesity; fatty foods are energy dense and gives 9calories per gram compared to carbohydrate and protein that gives 4calories per gram. Also, if physical activity is inadequate, excess consumption of fat can results into weight gain. It does not take as much energy (about 3%), to convert and store dietary fat as it does to convert and store glucose. Fats are easily stored by the body. The aim of this chapter is to provide an understanding of physiological causes and effects of obesity as this will help to promote positive food choices. It is probable that an understanding of dietary patterns and how it relates to obesity will go a long way in the treatment of this complex problem.

Keywords: Food, Diet, Dietary Patterns, Obesity and Dietary fat

1. Introduction

Excessive body weight is a growing health problem worldwide. It is a well-known risk factor in cardiovascular disease, diabetes, hypertension, and cancers, among other conditions [1]. According to World Health Organization, obesity has been considered as one of the leading threats to future public health.

Obesity is a complex health issue resulting from a combination of causes and individual factors such as behavior and genetics [2]. Behaviors can include physical activity, inactivity, dietary patterns, medication use, and other exposures. Although there are genetic, behavioral, metabolic and hormonal influences on body weight, obesity occurs when you take in more calories than you burn through exercise and normal daily activities that is when energy intake exceeds energy expenditure. Even though the cause of obesity is complicated, dietary habit or lifestyle plays an important role in developing obese conditions [3].

The increasing westernization, urbanization and mechanization occurring in most countries around the world is associated with changes in the diet towards one of high fat, high energy-dense foods and a sedentary lifestyle [4]. Nutrition transition in developing countries leads to dietary intakes of micronutrient – poor, energy – dense foods, which may be important determinants of overweight/obesity [5].

There is also a direct relationship between the amount of dietary fat and the degree of obesity. High-fat diets induce greater food intake and weight gain than high-carbohydrate diets as indicated by animal studies [6]. Contributing factors are caloric density, satiety properties and post-absorptive processing. The satiating effects after meals with a high fat:carbohydrate ratio is less than for meals with a lower ratio.

Mediterranean pattern of nutrition, has been described as containing high proportion of mono-unsaturated fat acids versus saturated fats and contributes in the preservation of body weight, while expands longevity and life expectancy. This pattern of nutrition has been adopted by many countries and it is diversified according to the cultural and socio-economic features of each country. Several research studies have commented on the beneficial effects of the Mediterranean diet in the preservation or decrease of body weight, in the primary or secondary prevention of coronary disease, in the maintenance of high density cholesterol (HDL) and triglycerides within normal rates, as well as in the significant reduction in mortality rates [7–9].

Current recommendations for weight management emphasize the importance of healthy eating patterns that include a variety of nutrient-dense foods, limit portions of energy-dense foods, and reduce overall energy density [10].

A unifying factor for weight loss across dietary patterns is energy density [11]. When a diet's energy density is reduced; it allows individuals to consume satisfying amounts of food for fewer calories. The goal of dietary therapy in the management of obesity is to reduce the total number of calories consumed.

2. Physiological causes and effects of obesity

Obesity is a complex disease that involves an excessive amount of body fat. It is a medical problem that increases your risk of other diseases and health problems, such as heart disease, diabetes, high blood pressure and certain cancers. Although there are genetic, behavioral, metabolic and hormonal influences on body weight, obesity occurs when you take in more calories than you burn through exercise and normal daily activities that is when energy intake exceeds energy expenditure.

Even though the cause of obesity is complicated, dietary habit or lifestyle plays an important role in developing obese conditions [3, 12]. Lifestyle changes and nutritional habits, such as irregular meal patterns; mainly skipping breakfast, consumption of foods and beverages of low nutritional value and sub-optimal intake of dairy products, fruits and vegetables, intake of refined carbohydrates such as sugar sweetened soft drinks are all contributing factors to the development of obesity [12–15].

Obesity as a complex disorder has multiple etiological factors. The primary factor which is considered as a driver of obesity is obesogenic environment and unhealthy eating behavior. Secondary factors such as genetic and neuroendocrine factors, and diseases such as hypothyroidism and polycystic ovary syndrome are also related to excessive weight [16].

In a study carried out among undergraduates in Nigeria observed a significant relationship between vegetable consumption and Body Mass Index ($X^2 = 16.031$, p -value = 0.001) and there exist no significant relationship between cereals consumption and body mass index ($X^2 = 8.916$, p -value = 0.710) [17].

Obesity has been shown to be a predisposing factor in the rising prevalence of morbidity and mortality associated with non – communicable diseases like type-2 diabetes mellitus, hypertension, cancer, stroke among adults [18].

Overweight and obesity increases the likelihood of various diseases, particularly heart diseases, type2 diabetes, breathing difficulties during sleep, certain types of cancer and osteoarthritis [19].

3. Dietary fat and obesity

Fat are of various types, some are more beneficial to health than others. Those found in foods are known as dietary fats, the body needs fat to function fully as it

has a lot of functions in the body and is essential to health. For instance, fat soluble vitamins (Vitamins A, D, E and K) cannot be transported in the absence of fat. However, a diet with too much fat can increase body weight and also increase the risk of cardiovascular disease.

Dietary fats are believed to play an important role in the development of heart disease [20]. The National health institutions has recommended to reduce the intake of dietary fat to prevent CVDs [21].

3.1 Healthy versus unhealthy fat

The healthy fat are primarily unsaturated fats:

Monounsaturated fat: This type of fat is found in a variety of foods and oils. Eating foods rich in monounsaturated fats improves blood cholesterol levels, which in turn decrease the risk of heart disease and may also help decrease the risk of type 2 diabetes.

Polyunsaturated Fat: This fat is found mostly in plant-based foods and oils. Omega-3 fatty acids, which is a polyunsaturated fat has been attributed to low rate of heart disease [22]. Also, it helps to raise HDL cholesterol level [23].

Oils such as canola oil, olive oil, corn oil, sunflower oil and peanut oil are made up of monounsaturated and polyunsaturated fats and are liquid at room temperature. Fish such as tuna, salmon, trout, mackerel, herring and sardines are high in omega-3 fatty acids. Plant sources of omega-3 fatty acids are soybean oil, flaxseed oil, and nuts (walnuts, butternuts).

3.2 Unhealthy fats

Saturated fats and trans fat are often termed unhealthy fats, this is due to the fact that both raise LDL cholesterol levels. High level of LDL cholesterol in the blood increases the risk of heart disease and stroke. A larger amount of saturated fats is from animal sources, including meat and dairy products. Foods high in saturated fat include fatty beef, pork, butter, lard and cream, poultry with skin. Plant-based oils, such as coconut oil, palm oil also contain saturated fats, but do not contain cholesterol.

Trans fat is a product of a process that adds hydrogen to liquid vegetable oils to make them more solid and also refer to as partially hydrogenated oils. These partially hydrogenated oils increase LDL cholesterol and lowers HDL cholesterol which in turn increase the risk of cardiovascular disease. Foods high in trans fat include fried foods, such as French fries, stick margarines and shortenings, pastries, packaged foods, baked goods and pizza dough.

Fatty foods are energy dense and give 9calories per gram compared to carbohydrate and protein that gives 4calories per gram. Also, if physical activity is inadequate, excess consumption of fat can results into weight gain. Also, it does not take as much energy (about 3%), to convert and store dietary fat as it does to convert and store glucose or protein. Fats are quickly and easily stored by the body.

Obesity is a multifactorial and complex affectation that is characterized by a long-term excess energy intake(EI) above energy expenditure (EE) and epidemiological evidence have suggested that a high-fat diet promotes the development of obesity [24].

There is also a direct relationship between the amount of dietary fat and the degree of obesity. An overview of animal studies had indicated that high-fat diets induce greater food intake and weight gain than high-carbohydrate diets [25]. Contributing factors are caloric density, satiety properties and post-absorptive processing. The satiating effects after meals with a high fat:carbohydrate ratio is less than for meals with a lower ratio. It has been reported that the most important variable influencing meal size is the nutrient content of the range of foods consumed and not the level of hunger. Thus dietary fat has a weak effect on satiety and

periodic exposure to a high-fat meal, particularly when hunger is high, is sufficient enough to lead to overconsumption of energy as fat in obese patients.

3.3 Influence of dietary fat on weight gain

An important determinant of body fat is the percentage of dietary energy from fat. Several mechanisms have been proposed to explain why high fat intake might lead to greater body fat [26]. Dietary fat is the most energy dense macronutrient in the diet, providing 9 kcal/g as opposed to 4 kcal/g for carbohydrate or protein; this could lead to overconsumption of energy if food volume is regulated. Fat adds greater flavor and palatability to foods, which could thus increase their consumption.

Fat has a lower thermogenic effect than carbohydrate and protein and this inhibit energy expenditure. A positive energy balance can be the result of overconsumption of energy, perhaps because a high-fat diet has a lower satiating effect per joule than a low-fat diet. A series of studies has produced robust evidence that the fattening effect of dietary fat is linked mainly to the higher energy density of fatty foods compared with carbohydrate and protein rich foods.

In addition, when studied under careful metabolic conditions for short periods, carbohydrate produces a greater thermogenic effect than fat, suggesting that dietary fat may be utilized more efficiently and accumulate as body fat [27]. Carbohydrate intake, but not fat intake, is regulated; thus, individuals on a high-fat diet would tend to consume more total energy to gain the required amount of carbohydrate than would someone on a low-fat diet [28]. Although these mechanisms may seem compelling at face value, foods are not eaten in isolation, and the energy for weight of foods is more determined by the water and fiber content.

Different types of fat contain the same amount of energy, although there are differences in their respective influence on energy balance, energy expenditure and satiety. Low-fat diets and in weight-maintenance diets, have been shown to be affected by the quality of dietary fat. Animal studies have shown that rats fed a diet rich in safflower oil polyunsaturated fats accumulate less body fat than rats fed a diet rich in beef tallow which is a saturated fat [29].

Monounsaturated was found to induce a lower level of postingestive satiety and a larger subsequent energy intake than polyunsaturated and saturated fat in a study on the effect in lean subjects of high-fat meals, differing in fatty acid composition [30].

4. Dietary patterns and obesity

Dietary patterns that have inverse relationship with obesity include vegan diet, Mediterranean diet and prudent diet. Western diet is directly associated with obesity.

4.1 The vegan diet

This is a form of vegetarian diet that eliminates meat and animal product, this diet is beneficial to health because it reduces the intake of cholesterol and saturated fat that is predominant in animal product. It has been proven that those who practice a vegan diet minimize their overall risk of coronary heart disease, obesity and high blood pressure.

4.2 The Mediterranean diet

This diet recommends the use of plant based oil as alternative to butter, it emphasizes adding vegetables to each meal. Avoidance of meat is recommended,

though not eliminated. This diet has been proven to help with depression, in addition to controlling blood sugar levels and helping with weight loss. Whole grains, nuts and herbs are also used in larger amounts.

4.3 Prudent diet

This diet protects against heart disease, stroke, and other common diseases. It consists of fruits, vegetables, whole grains, legumes, nuts, fish, and low-fat dairy products rather than refined or processed foods, red meats, high concentrated sweets, eggs, and butter.

4.4 Western diet

This diet is characterized by high intake of processed food, red meat, high-sugar foods and pre-packaged foods, that increase the risk of chronic illness. Eating junk foods, which are part of the western diet, could impair the part of the brain tied to self-control, in turn result to overeating and weight gain.

5. Dietary management of obesity

Recommendations for weight management emphasize the importance of healthy eating patterns which include consumption of nutrient-dense foods, limiting portion size of energy-dense foods, and reduce overall energy density. A unifying factor for weight loss across dietary patterns is energy density, when a diet's energy density is reduced; individuals consume satisfying amounts of food for fewer calories. The goal of dietary therapy is to reduce the total number of calories consumed.

The optimal diet for prevention of weight gain, obesity, metabolic syndrome, and type 2 diabetes is fat-reduced, fiber-rich and high in low-energy density carbohydrates (fruit, vegetables, and whole grain products). The Mediterranean eating pattern that emphasizes intake of low-energy dense fruits, vegetables, legumes, seafood, and dairy foods has proved effective in the management of obesity. However, higher amounts of fat (30–40% of total energy), especially from olive oil, are recommended with the Mediterranean diet. Even with this level of healthy fats, the Mediterranean diet recommends high proportion of fruit and vegetable which can help to keep the overall diet relatively low in energy density.

It has been established that different types of carbohydrate have varying effects on metabolism and health. Some carbohydrates are healthier than others; those with lower glycemic indexes (or GI) have a slower and flatter blood glucose response. They take longer to digest and can help us feel full thus preventing overeating and weight gain. Lower GI foods are less refined (or processed) such as whole grains, legumes, fruit, and vegetable. High GI foods are refined carbohydrate and contribute to weight gain.

Many high-carbohydrate foods common to Western diets produce a high glycemic response, promoting postprandial carbohydrate oxidation at the expense of fat oxidation, thus altering fuel partitioning in a way that may be conducive to body fat gain [31].

5.1 Daily intake patterns that can help to lower dietary energy density

Breakfast: The pattern of food consumption over a day as either meals or snacks could affect weight management. Epidemiological studies have also found breakfast consumption to be associated with lower body weights and lower daily energy

density. If individuals consume breakfast daily, including higher amounts of protein and fiber during breakfast may help increase satiety, decrease energy intake, and lower dietary energy density.

Snacking: Snacks are often refers to processed, high-calorie items like chips and cookies. Snacking refers to the consumption of foods and beverages between regular meals, regardless of whether the food is healthy [32]. Many a times people consume snacks when appetizing food is available; even though they are not hungry. Snacking in the absence of hunger leads to the consumption of fat, sugar, and sodium-rich foods [33]. Unnecessary snacking promotes “weight gain and poor nutrition” [33].

If snacks should be consumed, it should be chosen wisely; high energy-dense snacks, nutrient-poor snacks (such as chips, cookies, confectionary) may be associated with high BMI should be limited [32]. However, lower – energy dense snacks (such as fruit and vegetable) which enhance satiety and improves diet quality should be consumed in large amount.

5.2 Manage fat to lower energy density and moderate energy intake

Evidence from multiple clinical trials shows that both low- and moderate-fat diets combined with an energy restriction can be used to achieve weight loss. High-fat foods are energy dense, low-fat diet is therefore recommended for weight loss. Also, there is need for moderation of portion size to stay within recommended energy intakes. Methods for moderating fat intake include switching to lower-fat alternatives such as grilled chicken instead of fried chicken or low-fat Greek yogurt instead of sour cream. Also, the amount of solid fats, which contain saturated and trans fat should decrease, and to substitute with oils containing polyunsaturated and monounsaturated fats to improve diet quality and overall health.

5.3 Add more protein and fiber to meals

Protein and fiber have been suggested to promote satiety or feelings of fullness. The most satiating macronutrient is protein, incorporating more protein in the diet may increase satiety and decrease daily energy intake. Patients should be encouraged to incorporate recommended amounts of lean protein sources such as grilled chicken breast, legumes, or low-fat dairy to create satisfying low-energy-dense meals. Dietary fiber is thought to promote feelings of fullness by increasing chewing time, promoting stomach expansion, and decreasing absorption efficiency. Studies show that increasing fiber at meals can lead to decreased energy intake and increased ratings of fullness. Also, diets containing higher amounts of fiber are associated with lower body weights and reduced disease risks.

6. Conclusion

Dietary fat induces overconsumption and weight gain through its low satiety properties and high caloric density. Obese and post-obese subjects do not appear to adapt to dietary fat, and therefore fat storage is increased. Both total fat and individual fatty acids have to be considered when reaching conclusions about dietary fat and obesity. The optimal diet for prevention of weight gain, obesity, metabolic syndrome, and type 2 diabetes is fat-reduced, fiber-rich and high in low-energy density carbohydrates (fruit, vegetables, and whole grain products).

Conflict of interest

The authors declare no conflict of interest.

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