



## Review Article

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Received on: 04/12/13 Revised on: 23/01/14 Accepted on: 02/02/14

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DOI: 10.7897/2277-4343.05115

**ABSTRACT**

Obesity is becoming a substantial health problem in the world, especially the industrialized countries. It is associated with serious medical, psychological, economical and social implications, virtually affecting all age groups. In this review, we focus on the definition of obesity, its classification, causes, current status and management. The causes of obesity are given in a short review of the pathophysiology of obesity including hypertrophic versus hyper-cellular obesity, hormonal influences on appetite, odour detection threshold and leptin. The main problems associated with obesity are co morbidities including hypertension, diabetes mellitus, obstructive sleep apnoea, reflux oesophagitis, cancer and osteoarthritis. Obesity management methods reviewed are medical (non-surgical) treatment including weight-loss programs, pharmacologic therapy where conventional and herbal medicines are used. Examples of the herbal medicines including, Guarana (*Paullinia cupana*), Guar Gum (*Cyamopsis tetragonoloba*), Ginseng (*Panax ginseng*), Flaxseed (*Linum usitatissimum*), Ginger, Green tea and glucomannan were discussed.

**Keywords:** Obesity, Management, Medical, Medicinal plants**INTRODUCTION****Obesity status**

Obesity, a state of excess fat stored in the body, is becoming a substantial health problem in the world, especially in the industrialized countries. The prevalence of obesity is increasing rapidly worldwide. With this growing rate, obesity represents a pandemic that if not well managed as well as urgent attention is given to it, it will have a potential impact on individuals' health as well as governments and economies. It is estimated that more than 1.7 billion adults are overweight while at least 300 million of them are considered clinically obese<sup>1</sup>. Obesity is a complex condition that often co-exists with under-nutrition in the developing countries. It is associated with serious medical, psychological, economical and social implications, affecting all age groups virtually. It is a major contributor to the global burden of chronic disease and disability<sup>2</sup>.

**Classification of obesity**

There are several definitions and classifications for degrees of obesity. The most widely accepted classification is that of the World Health Organization (WHO), based on Body Mass Index (BMI). The BMI is being defined as the weight of the individual (in kilograms) being divided by the square of the height (in meters). It estimates the ideal weight of the individual based on their height and size<sup>2</sup>.

**Table 1: BMI Values and Classification of Obesity (WHO 2008 classification)**

Classification	BMI (kg/m <sup>2</sup> )
Underweight	< 18.5
Normal Range	18.5 – 24.9
Overweight (pre-obese)	25.0 – 29.9
Obese	≥ 30.0
Class I obesity	30.0 – 34.9
Class II obesity	35.0 – 39.9
Class III obesity	≥ 40.0

Class III obesity is further classified into more descriptive subgroups.

- Severe obesity - BMI > 35 kg/m<sup>2</sup>
- Morbid obesity - BMI > 40 kg/m<sup>2</sup>
- Super obese - BMI > 50 kg/m<sup>2</sup>
- Super- super obese - BMI > 60 kg/m<sup>2</sup>

**Pathophysiology of obesity**

Obesity is a multi factorial condition caused mainly by genetic and environmental factors interaction. It cannot be explained by one theory. Therefore, below are the most commonly accepted theories.

**Hypertrophic versus hyper-cellular obesity**

The adipocyte, the cellular basis for obesity, is either increased in number or size in obese individuals. The enlarged fat cells, the so called hypertrophic obesity, are typical of android abdominal obesity. On the other hand hyper-cellular obesity is more typical of people who develop obesity early in their life, during childhood or adolescence. It is also invariably a feature of severe obesity. Hypertrophic obesity starts usually later in life, namely in adulthood. It responds better to weight reduction procedures and measures. In contrast, hyper-cellular obesity may not respond well through non-surgical measures and interventions.

**Hormonal influences on appetite**

Many hormones, in addition to acting as neurogenic signals and neurotransmitters, affect appetite. Melanocortin hormone modifies appetite through its action on melanocortin receptors. Endo-cannabinoids hormones enhance absorption of nutrients, stimulate lipogenesis and increase appetite. There are several gut hormones that induce satiety: cholecystokinin, neuropeptide YY (PYY) and glucagon like peptide-1 (GLP-1). Leptin and amylin are also potent hormones. On

contrary ghrelin, which is secreted from the stomach fundus, is a major hunger hormone.

**Odour detection threshold**

Feeding behaviour is a complex process in which smell plays an important role. The odour detection threshold, the lowest concentration of a substance that can be detected by an individual, was found to be different when measured in different individuals<sup>3</sup>. The smelling capacity is reduced by increased circulating insulin, thus reducing the pleasantness of food. Therefore, the action of insulin in the olfactory bulb may affect the satiety process and thus may be of interest clinically in the pathogenesis of obesity<sup>3</sup>.

**Leptin**

Leptin, a 167 amino acid peptide that is synthesized in the adipose tissue, plays a major role in body-weight by regulating the satiety signal to the hypothalamus. It thus reduces dietary intake and lipogenesis while modulating carbohydrate metabolism and energy expenditure leading to prevention of weight gain<sup>4</sup>. Feng *et al.* have described that obese individuals actually don't have leptin deficiency, but they are actually resistant to it<sup>4</sup>. Therefore, elevated levels of circulating plasma leptin are found in these individuals.

**Impact of obesity on individuals and health providers**

Obesity has much burden on governments and health providers. In the United States alone, the annual cost to manage obesity is approximately \$190.2 billion which accounts for 20.6 % of national health expenditures, a recent study showed<sup>5</sup>. An obese individual incurs \$2741 more in medical costs annually when compared with a non-obese. In addition, the lost productivity because of obesity costs approximately \$73.1 billion annually, and

about \$121 billion is spent each year on weight-loss services and products<sup>6</sup>. Accounting for 300,000 deaths each year in the USA alone, morbid obesity is projected to be the leading cause of death, overtaking smoking<sup>6</sup>. Dindo and Moorhead concluded that obesity shortens the life expectancy with the increasing BMI, which results in a proportional shorter life span<sup>7,8</sup>.

**Obesity related co-morbidities**

Obesity is associated with a host of potential co morbidities that significantly increase the risk of morbidity and mortality in obese individuals. Although no cause-and-effect relationship has been clearly demonstrated for all of these co morbidities, amelioration of these conditions after substantial weight loss suggests that obesity probably plays an important role in their development.

**Hypertension**

The relationship between hypertension and obesity is well established both in adolescents as well as adults. Researches are still going on to study the mechanisms through which obesity causes hypertension. It has been found that activation of the sympathetic nervous system plays an important role in the pathogenesis of obesity related hypertension. During the early stages of obesity, the body retains sodium a result of increase re-absorption in the renal tubules. The volume of the extracellular-fluid (ECF) is increased and the kidney fluid apparatus system is re-set to a hypertensive level, consistent with a hypertension status because of fluid overload. Plasma rennin, angiotensinogen and aldosterone levels significantly increase in obesity. Other humeral factors that may predispose to hypertension include: insulin resistance, leptin and other neuropeptides<sup>9</sup>.

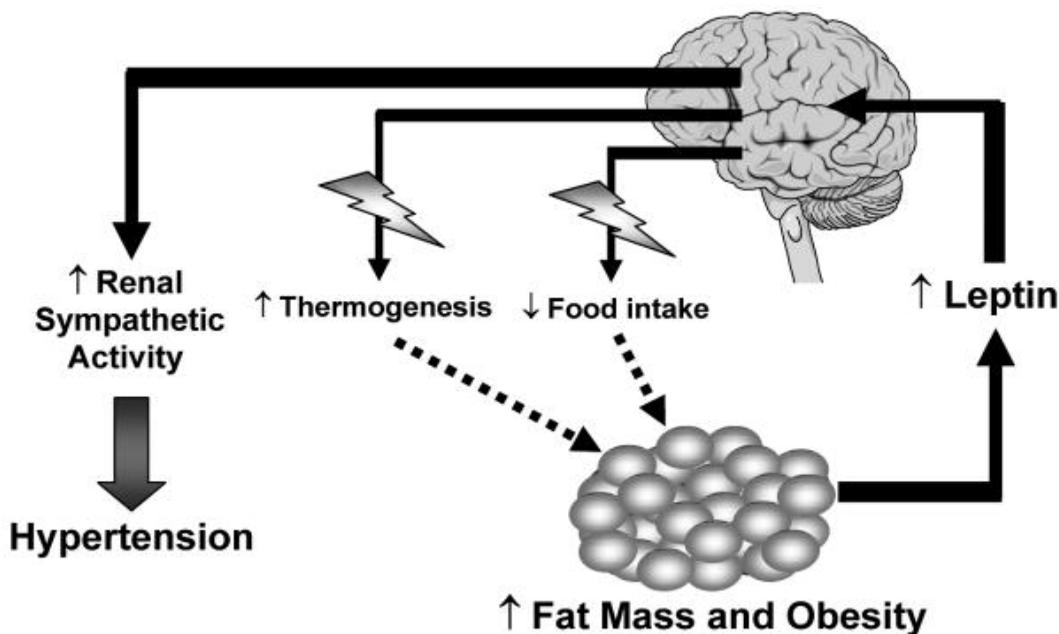


Figure 1: The mechanism of hypertension causing by obesity

The understanding of how obesity is linked to hypertension and the exact mechanism, by which it happens, is essential to develop successful strategies for treatment.

### Diabetes Mellitus

Obesity and diabetes mellitus are both major causes of morbidity and mortality worldwide. Evidence from the literature indicates that obesity and overweight are associated with a higher risk to develop diabetes mellitus, and that intentional weight loss helps in reducing that risk. It is estimated that almost 300 000 adults in the US die annually of obesity related causes, and that diabetes is the number six cause of death. Correspondingly, both obesity and diabetes generate immense health care costs.

### Obstructive Sleep Apnoea

Evidence from epidemiological studies suggests that there are links between obstructive sleep apnoea (OSA) and obesity. The pharyngeal airways structure may collapse in patients with OSA, which is due to central fat deposition. The lung volume is reduced due to the excessive fat deposition centrally that may decrease the longitudinal tracheal traction forces and pharyngeal wall tension. The volume of the lung depends on the pharyngeal airway patency, and thus contribute significantly to the development of obstructive sleep apnoea in obese patients<sup>10</sup>.

### Reflux Oesophagitis

An association between obesity and GERD symptoms has been reported; however, study results have been inconsistent and it is not known whether an association persists after adjusting for other known GERD risk factors<sup>11</sup>. Overweight and obesity are strong independent risk factor of GERD symptoms and oesophageal erosions. The amount or composition of dietary intake does not appear to be a likely explanation for these findings.

### Cancer

Obesity is one of the important causes of cancer along with smoking. Recently, the obesity-cancer relation has received much attention. Epidemiological research studies have shown that obesity is also associated with increased risk of several cancer types. Types of cancers that are found to be linked to obesity include: breast, oesophagus, gastric, colon, liver, endometrium, kidney, gallbladder, pancreatic and leukaemia. It has also been found that obesity may lead to poorer response to treatment and increased mortality related to cancer. The mechanisms underlying the link between obesity and malignancy are not well understood. These include factors that are related to cellular signalling as well as growth factors.

Table 2: Mechanisms linking Obesity to cancer

1	Modulation of energy balance and calorie restriction
2	Growth factors
3	Signalling pathways
4	Inflammatory processes

Among the signal pathways that link cancer and obesity is the PI3K/Akt/mTOR cascade, which is considered as a target of many of the factors that regulate the cell proliferation and growth in obesity. Understanding the cellular and molecular mechanisms of the obesity-cancer link is important to develop potential treatment. The relation between cancer and obesity underscores the recommendations to maintain a healthy body weight and BMI as one of the most important factors to prevent cancer<sup>12</sup>.

### Osteoarthritis

A study by Losina *et al* found that knee osteoarthritis due to obesity resulted in a substantial decrease in the number of quality of life as well as quality adjusted life years<sup>13,14</sup>. The overload effect of overweight and obesity on the joint cartilage explains part of the increased risk of developing osteoarthritis in these individuals, especially for the knee osteoarthritis. Recently, many studies showed the relationship and link between obesity and osteoarthritis. Although there is enough evidence that mechanical factors contribute to the joint destruction in obese people, osteoarthritis is considered as a systemic disorder caused by circulating mediators and factors that affect the cartilage and this may explain the diversity of the pathophysiology of osteoarthritis<sup>15</sup>.

### Obesity Management

#### Medical (non-surgical treatment)

The first step in obesity treatment starts with a comprehensive management of the lifestyle (i.e. diet, physical exercise, behaviour modification). As obesity is considered as a chronic condition, effective management must be highly motivated and undertaken by a committed health team with good experience in obesity management. This team should be a multi-disciplinary team and may include a physician, a psychiatrist or a psychologist, a physical exercise therapist, a dietician, and other specialists, depending on other co morbidities of that individual patient.

#### Weight-loss programs

Weight-loss programmes are systematic and go through phases with the 3 major ones of any successful programs are as follows:

- Initial screening phase
- Weight loss phase
- Maintenance phase - This can conceivably last for the rest of the patient's life but ideally lasts for at least 1 year after the weight-loss program has been completed

Evidence from literature supports the use of a well established weight loss programs. A recent RCT found that commercially available programs used for weight loss are more successful and affordable than those provided by the primary care practice led by specially trained staff<sup>16</sup>.

#### Pharmacologic therapy

Few pharmacological drugs can be used in obesity treatment. The limitation in their use is that they are used mainly to maintain weight loss rather than producing it.

So they are not actually cure, with the advantages and benefits fade away when the drug is stopped. As all medications have more risks inherently than exercise or diet do, pharmacological therapy should only be used in individuals in whom the benefits justify the risks<sup>16</sup>.

#### **How do herbal products cause weight loss?**

Overweight is the symptom of fundamental imbalances in your body, emotions, and mind.

Most herbal weight loss products work by:

- Increasing urination and/or bowel movements
- Stimulating the central nervous system (speeds up the body's mental and physical activity; caffeine is a central nervous system stimulant)
- Increasing serotonin levels, a chemical in the brain that creates a "feeling of fullness"

However, herbal preparations will not produce permanent weight loss. Also, herbal weight-loss products contain many ingredients, some of which have serious side effects and can lead to dangerous health situations (toxicities). Most people who sell herbal products have limited knowledge how these products work and wouldn't be able to tell you about reported problems with the herbs or how they might affect the drugs you may be taking. Many herbal manufacturers also make "false claims" about the health benefits of these products. For all of these reasons and lack of proven health benefits, use of herbal products as weight-loss aids is not encouraged.

#### **Guarana**

Guarana (*Paullinia cupana*) is a diuretic that's useful in helping in losing weight. It also stimulates the nervous system and helps in fighting depression and coping with stress. Guarana thus helps to avoid emotional eating, one of the chief causes of weight gain<sup>17</sup>. Guarana has among the highest concentrations of caffeine in any plant. It may contain up to 3.6 % to 5.8 % caffeine by weight. There's some evidence that guarana – when used along with other supplements – may promote weight loss. It's uncertain if the guarana specifically was responsible. Because caffeine is a stimulant that has been shown to improve mood and aid weight loss, guarana may very well also have these effects. As a weight loss supplement, caffeine may work best when combined with the polyphenol compounds in green tea. Combining guarana with polyphenols may have a similar effect. The safety of using guarana for weight loss is unknown. The side effects of guarana are generally the same as the side effects of caffeine. They include sleep problems, anxiety, restlessness, upset stomach, and quickened heartbeat. Long-term use of caffeine may result in tolerance and psychological dependence.

#### **Guar Gum (*Cyamopsis tetragonoloba*)**

It is a fibre from the seed of the guar plant. Guar gum is obtained from the Indian cluster bean. Since it contains lots of fibre, eating guar gum gives you a feeling of fullness that prevents you from overeating. It also decreases bad cholesterol (LDL) and helps control diabetes. Although evidence for the effectiveness of fibre

products as appetite suppressants is lacking, they remain popular ingredients in OTC weight loss preparations<sup>18</sup>.

#### **Ginseng (*Panax ginseng*)**

Ginseng is responsible for reducing blood sugar levels and helps to lose the weight. A constituent of red ginseng, ginsenoside Rg3, has the ability to inhibit differentiation of the cells that store energy as fat. The findings showed the ginsenoside effectively inhibited this differentiation, making cells less able to complete the fat storage process<sup>19</sup>. Leptin is a hormone that helps regulate body weight. In an evaluation of the anti-obesity effect of wild ginseng in obese, leptin-deficient mice, wild ginseng was administered orally to mice at levels up to 200 mg/kg for 4 weeks. The mice showed a loss of body weight and a decrease in blood glucose levels when compared to the control mice<sup>19</sup>.

#### **Flaxseed (*Linum usitatissimum*)**

The seed of the flax plant has a coating of mucilage. This coating swells when exposed to water. If you soak whole flaxseeds in water and eat them, they act as bulking agents in your stomach and give you a feeling of fullness. They are neither digested nor absorbed by the body when soaked whole. By giving the patient a feeling of fullness, they prevent them from overeating and help them to lose weight<sup>20</sup>.

#### **Ginger (*Zingiber officinale*)**

Han, a Japanese researcher, says ginger creates thermogenesis, an action that boosts metabolism. He led a study in which rats fed ginger extract lost weight while maintaining a high-fat diet. A great deal of anecdotal evidence also shows a connection between ginger consumption and weight loss in humans. Ginger cleanses the body by reducing the stomach's acidity and purging the digestive system of food lodged in it. This lodged food can cause weight gain, and the purging helps you lose it<sup>21</sup>.

#### **Green Tea (*Camellia thea*)**

Green tea boosts the body's metabolism and helps it to burn fat. Green tea is very beneficial in helping lose weight<sup>22</sup>.

Obese mice that were fed a compound found in green tea along with a high-fat diet gained weight significantly more slowly than a control group of mice that did not receive the green tea supplement<sup>22</sup>.

#### **Glucomannan**

Glucomannan is a dietary fibre derived from the tubers of *Amorphophallus konjac*. Konjac flour (made from these tubers) is used to make a jelly called konyaku, a common food product in Japan. Fibre-containing foods, such as oats, are known to help reduce cholesterol and relieve constipation and may also help regulate blood sugar and assist in weight reduction by creating a feeling of fullness<sup>23</sup>.

#### **CONCLUSION**

In this review we have discussed the various aspects of obesity including causes and nonsurgical management.

Commercially available programs used for weight loss are more successful and affordable than those provided by the primary care practice led by specially trained staff. Due to the adverse risks, which might be serious, pharmacological therapy should only be used in individuals in whom the benefits justify the risks. The use of herbs in obesity management is limited by the fact that the herbal products are not standardized and are prescribed by nonprofessional people. The first step in obesity treatment starts with a comprehensive management of the lifestyle (i.e. diet, physical exercise, behaviour modification) and should be maintained as an effective and safe obesity management measure.

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#### Cite this article as:

Ahmed Ahmed, Shehab Naglaa Ahmed. Obesity medical management. *Int. J. Res. Ayurveda Pharm.* 2014;5(1):69-73 <http://dx.doi.org/10.7897/2277-4343.05115>

Source of support: Nil, Conflict of interest: None Declared