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STHOULYA: W.S.R. TO ANATOMICAL STUDY OF OBESITY

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ABSTRACT

Ayurveda is the ancient system of medicine in the world. *Ayurveda* the science of life deals with every aspect of life. *Ayurveda* has two main objectives *"Swasthasya Swasthya Rakshanam, aaturasya vikaarprashmam cha"* (protection and promotion of health and secondly cure from the diseases). To fulfill these main objectives, various Samhita texts were composed. In *Charak Samhita*, *Acharya Charaka* has mentioned the symptoms of *Prashasta Purusha* (Ideal person). According to *Acharya Charaka* any person who has balanced proportion of muscles, Compactness, strong sense organs, who can tolerate any type of disease by his body strength, who can easily tolerate excessive hunger and thirst, sunlight, cold and various physical activities, who can digest easily any type of food, withstand signs of old age and who has proper growth of muscles and who does not get prone to diseases is known as *Prashasta Purush. Charak Samhita* described eight kinds of men who are undesirable nature in respect of their body (Physique). Eight *'Nindya prakrities'* (undesirable constitution) according to the body constitution are described as are *Atidirgha* (very tall), *Atihriswa* (very short stature), *Atigaura* (very fair colored or complexion), *Atikrishna* (very black colored or complexion), *Atiloma* (with excessive body hair), *Aloma* (absence of body hair), *Atikrisha* (excessive thin or emaciated persons) and *Atisthula* (obese or overweight). Amongest all the undesirable persons, *Atisthula* (the over-obese) and the over lean are most despicable. This review article attempts to have a bird's eye view on *Atisthula* among all the *Ashtonindatiya Purusha* mentioned in *Ayurvedic* science and anatomical review of obesity.

KEYWORDS: *Atisthula, Ayurveda, Prashasta Purusha.*

INTRODUCTION

According to *Acharya Charaka*, people who are *Atisthula* are more liable to be at a health risk than *Atikrisha*. Over-obesity is caused by over-saturation, intake of heavy, sweet, cold and fatty diet, indulgence in day-sleeping and exhilaration, lack of mental work and genetic defect. There is excess of fat in him and further only fat is accumulated and not the other dhatus so, thus the life-span is shortened, because of laxity, softness and heaviness of fat there is hampering in movement, due to non-abundance of semen and the passage having been covered with fat, there is difficulty in sexual intercourse, due to disequilibrium of dhatus there is debility, foul smell is due to defect and nature of fat and also sweating, due to association of Medas with Kapha, its oozing nature, abundance, heaviness and intolerance to physical exercise there is over-sweating, because of intensified Agni (digestion) and abundance of Vayu in belly there is excessive hunger and thirst. The person is called as over obese who, due to excessive increase of fat and muscles, has pendulous buttocks, abdomen and breasts and suffers from deficient metabolism and energy.

The over-obese has eight defects

- *Aayusho Hras* (Shortening of life-span)
- *Javoparodh* (hampered movement)
- *Krucch Vyavayta* (difficulty in sexual intercourse)
- *Dourbalya* (debility)
- *Dourgandhya* (foul smell)
- *Swedabadh* (over-sweating)
- *Kshudhatimatram* (too much hunger)
- *Pipasaatiyog* (excessive thirst).[1]

According to modern the terms "overweight" and "obesity" refer to body weight that is greater than what is considered normal or healthy for a certain height. Overweight is generally due to extra body fat. However, overweight may also be due to extra muscle, bone, or water. People who have obesity usually have too much body fat. Body mass index (BMI) is one way to tell if anyone is at a healthy weight, overweight, or have

obesity. The BMI is a measure, based on the weight in relation to the height. The greater person's BMI, the greater risk of health problems from overweight and obesity. Obesity is often multi-factorial, based on both genetic and behavioural factors. many factors may cause weight gain and affect how much weight the body stores. When anyone takes more calories from food or beverages and runs away from physical activity and spends more time in sitting or sleeping, body stores the extra calories. Over time, if anyone continue to consume more calories than he burns off, he will likely gain weight. Excessive weight gain may lead to overweight or obesity.[2]

Health risks of overweight and obesity

- Type 2 diabetes: About 8 out of 10 people with type 2 diabetes are overweight or have obesity.
- High blood pressure: High blood pressure can strain the heart, damage blood vessels, and raise the risk of heart attack, stroke, kidney disease, and death. Overweight and obesity may raise the risk for certain health problems such as high blood pressure.
- Heart disease
- Stroke
- Sleep apnea
- Metabolic syndrome: Metabolic syndrome is a group of conditions that put anyone at risk for heart disease, diabetes, and stroke. These conditions are high blood pressure, high blood glucose levels, high triglyceride levels in the blood, low levels of HDL cholesterol (the "good" cholesterol) in the blood.
- Too much fat around the waist.
- Fatty liver diseases.
- Osteoarthritis: Being overweight or having obesity may raise the risk of getting osteoarthritis by putting extra pressure on your joints and cartilage.
- Gallbladder diseases: Gallstones may form if bile contains too much cholesterol.
- Some cancers: Overweight and obesity may raise your risk of developing certain types of cancer.
- Kidney disease: Obesity itself may promote kidney disease and quicken its progress.
- Pregnancy problems: Overweight and obesity raise the risk of health problems that may occur during pregnancy. Pregnant women who are overweight or obese may have a greater chance of developing gestational diabetes.[3]

Classification of Obesity according to BMI.[4]

Classification	BMI Cut-Off Points (kg/m²)
Healthy Weight	18.5-24.99
Overweight (including obesity)	≥25.00
Obese	≥30.00
Severely Obese	≥40.00

Types of obesity

Android=Abdominal=Central=Apple shaped body type

Typical characteristics of the apple body shape are a large bust, narrow hips and a full midsection. This makes the body appear like an apple shape. It is clinically more important as disease are more concerned.

Characteristics of the Apple Shaped body

- Waist hip ratio - > 0.85 for women 1 for men
- Rounder, wider shoulder line and flattish bottom
- Average to big bust
- Ribcage and back appear somewhat wide
- Fullness around the mid-section
- Little to undefined waistline
- Narrow hips
- Weight gains are first visible in the central torso/tummy area.

Gynaecoid=Peripheral=Pear shaped body type

Characteristics of the Pear Shaped body

- Subcutaneous fat deposition.
- Shoulders are narrower than hips and may be sloped
- Full hips and / or thighs
- Legs are likely full or muscular
- Weight gains tend to first be visible around the hips, thighs and lower midriff.[5]

Adipocytes/ lipocytes / fat cells

Adipocytes are the cells that primarily compose adipose tissue, specialized in storing energy as fat. Adipocytes are derived from mesenchymal stem cells which give rise to adipocytes through adipogenesis. There are two types of adipose cells: white adipose cells contain large fat droplets, only a small amount of cytoplasm and flattened, noncentrally located nuclei and brown adipose cell contain fat droplets of differing size, a large amount of cytoplasm, numerous mitochondria, and round, centrally located nuclei. The colour of brown adipose is attributed to its relatively high density of mitochondria and its extensive vascular supply.[6]

Adipose tissue

Adipose tissue, or fatty tissue, connective tissue consisting mainly of fat cells (adipose cells, or adipocytes), specialized to synthesize and contain large globules of fat, within a structural network of fibres. In humans, the distribution of adipose tissue in the body can vary depending on sex. In general, men accumulate fat around the waist, and women tend to accumulate more fat around the hips than the waist. Geneticists have

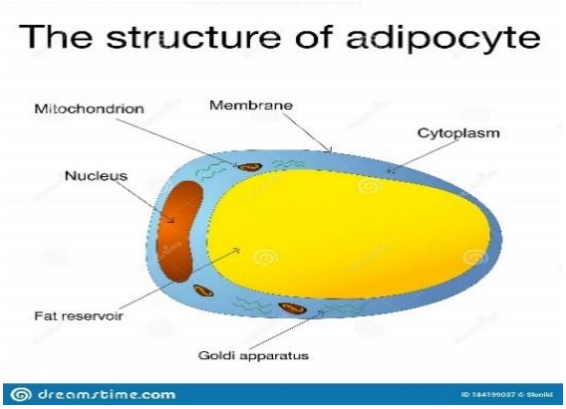
located distinct regions in the human genome that are associated with fat distribution, and several genes in particular appear to have a greater influence on waist-to-hip ratio in women than in men. Because these genes are involved in regulating the activities of fat cells.[7]

In humans, adipose tissue is located beneath the skin (subcutaneous fat), around internal organs (visceral fat), in bone marrow (yellow bone marrow), intermuscular (Muscular system) and in the breast (breast tissue). Adipose tissue is found in specific locations, which are referred to as adipose depots. Adipose tissue contains many small blood vessels. In the integumentary system, which includes the skin, it accumulates in the deepest level, the subcutaneous layer, providing insulation from heat and cold. Around organs, it provides protective padding. However, its main function is to be a reserve of lipids, which can be oxidised to meet the energy needs of the body and to protect it from excess glucose by storing triglycerides produced by the liver from sugars, although some evidence suggests that most lipid synthesis from carbohydrates occurs in the adipose tissue itself.[8]

Types of adipose tissue

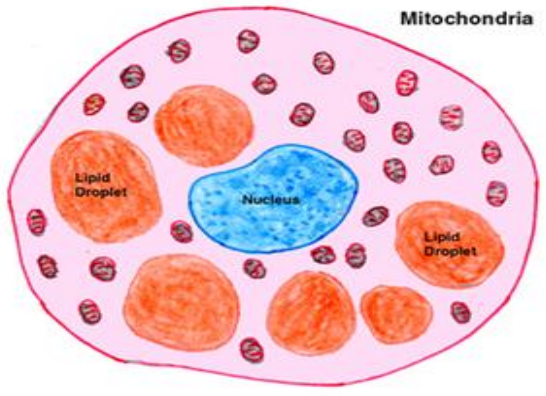
1. Yellow/White or Unilocular adipose tissue: White adipose, the most common type, provides insulation, serves as an energy store for times of starvation or great exertion, and forms pads between organs. When muscles and other tissues need energy, certain hormones bind to adipose cells and trigger the hydrolysis of triacylglycerol, resulting in the release of energy-rich fatty acids and glycerol a process known as lipolysis. It secretes, for example, cholesterol, retinol, steroid hormones, prostaglandins, and proteins known as "adipokines." Some of these molecules may be associated with pathologies such as obesity, insulin resistance. it can account for as little as 3% of total body weight in elite athletes or as much as 70% in the morbidly obese. With the development of obesity, WAT undergoes a process of tissue remodeling in which adipocytes increase in both number (hyperplasia) and size (hypertrophy). Metabolic derangements associated with obesity, including type 2 diabetes, occur when WAT growth through hyperplasia and hypertrophy cannot keep pace with the energy storage needs associated with chronic energy excess.[9]

Cell structure: Each adipocyte cell has a large, central, uniform, lipid packed central vacuole which, as it enlarges, pushes all the cytoplasm, the nucleus and all the other organelles to the edge of the cell, making it look a bit like a band or ring under the microscope.[10]



2. Brown adipose tissue (BAT): In mammals, BAT is involved in process of thermogenesis. It produces heat metabolizing fatty acids, generates heat and actually consumes energy. Brown adipose tissue (BAT) is found in fetuses and newborn. In humans, the percentage of brown adipose found in the body decreases with age. In adult humans, this type of adipose tissue is practically absent. The active brown adipose tissue in adult humans is present at discrete sites, such as in the upper trunk (in cervical, supraclavicular, paravertebral, pericardial, mediastinal, and mesenteric areas). In other animals, however, particularly those that hibernate (e.g., grizzly bears and black bears), it is found in adults and plays an important role in survival. Species that hibernate experience a drop in body temperature and a slowing of metabolism during winter dormancy, which allows them to conserve energy. Brown adipose, by consuming energy, releases heat, which is vital for awakening and emergence from dormancy.

Cell structure: Brown fat cells are unilocular and multilocular (containing multiple vacuoles) and multilocular cells have much higher numbers of mitochondria, this means they are better at generating heat.



Functions of adipose tissue

For a long time, adipose tissue has been considered only as a passive fuel reservoir. Now, it is also considered to be an endocrine organ which secretes several bioactive factors (hormones like leptin and resistin. growth factors,

cytokines). The most important adipose tissue hormones include leptin (satiety factor) and adiponectin. These biofactors circulate through the organism and carry information to other metabolically active organs such as liver, pancreas, muscle, and brain. These factors are of key importance in the pathophysiology of many metabolic disorders (e.g. type 2 diabetes mellitus). Different localizations of the adipose tissue have different roles in the human body. For example, abdominal fat has a different metabolic profile than the rest of the fat in the body, and it has the biggest influence in inducing insulin resistance. Parietal fat has an important role in thermoregulation, while visceral fat provides the cushion-like support for internal organs, protecting them from mechanical injuries. During reduced caloric intake, the amount of parietal adipose tissue decreases, while the visceral fat remains undiminished. In contrast to white, brown adipose tissue transforms chemical energy into heat. That way it prevents obesity, other metabolic disorders, and hypothermia.[11]

Fat is an active part of endocrine system. Among these hormones, leptin and resistin play important roles in regulating weight and glucose metabolism. Leptin and resistin work in both similar and opposite ways, and they interact with each other. Circulating concentrations of leptin and resistin are elevated in models of obesity and rodents fed a high-fat diet.

Leptin

The leptin molecule is 16 kDa in size and comprises 167 amino acids (including a 21 amino acid secretory signal sequence). Leptin is satiety hormone that help to regulate energy balance by inhibiting hunger. Leptin is opposed by the action of hormone ghrelin (hunger hormone). Both leptin and ghrelin hormones act on receptors in the arcuate nucleus of the hypothalamus to regulate food intake and energy balance. Food intake, total body fat, as well as several hormones regulate leptin secretion. Studies demonstrated that the concentration of circulating leptin decreases during fasting or energy restriction but increases during refeeding, overfeeding as well as during surgical stress. These effects provide an overview of how various pathways regulate the leptin signaling system to maintain body mass. For example, when the fat cells increase, leptin levels increase proportionally, then bind to leptin receptors (LEP-R) in the brain that send signals to inhibit food intake and increase energy expenditure. However, when a positive energy balance (i.e., caloric intake exceeds energy expenditure) is sustained for critical periods, weight is gained. The major role of leptin in body-weight regulation is to signal satiety to the hypothalamus and thus reduce dietary intake and fat storage while modulating energy expenditure and carbohydrate metabolism, preventing further weight gain.[12] Obese people have unusually high levels of leptin. This is because in some obese people, the brain does not respond to leptin, so they keep eating despite adequate (or excessive) fat stores, a concept known as 'leptin resistance'. This causes the fat cells to produce even more leptin.[13]

Resistin

Resistin also known as adipose tissue-specific secretory factor (ADSF) or C/EBP-epsilon-regulated myeloid-specific secreted cysteine-rich protein (XCP1) is a cysteine-rich peptide hormone secreted from white adipocytes. Resistin, a hormone secreted from adipose tissue, resists insulin action and impairs glucose homeostasis in rodents. This, in turn, leads to the development of type 2 diabetes mellitus (T2DM). Resistin appears as a connecting link between visceral obesity and diabetes.[14] It increase high blood levels of bad cholesterol (LDL), accelerates the accumulation of LDL in arteries; increasing risk of heart disease. It is secreted more by visceral fat.

Adiponectin

Adiponectin is a hormone and an adipokine protein that affects several metabolic processes and is mainly known for its insulin-sensitizing and anti-inflammatory effects. Energy-storing cells in the white adipose tissue called adipocytes primarily produce and release adiponectin. Other types of cells can produce adiponectin, including skeletal muscle cells, heart muscle cells and endothelial cells. Adiponectin promotes fat storage in subcutaneous fat pads instead of visceral fat pads, liver or skeletal muscle. People with obesity have decreased levels of adiponectin.[15]

Locations of adipose tissue

1. Present in superficial fascia over the most of the body.
2. Adipose tissue fills several hollow spaces of the body- paravertebral gutter, Orbits, axilla.
3. Most of the space of the marrow cavities of the long bones in form of the yellow bone marrow.
4. Epicardial fats
5. Kidney – in form of perinephric fat, in renal sinus.
6. Greater omentum and lesser omentum
7. Other peritoneal folds of the intestine & and of abdominal viscera
8. Breast etc.

Obesity and fat deposition

1. Visceral
2. Superficial
3. Ectopic

1. Visceral: Visceral fat, also known as organ fat or intra-abdominal fat, is located inside the peritoneal cavity, packed in between internal organs and torso. Visceral fat is composed of several adipose depots including mesenteric, epididymal white adipose tissue (EWAT), and perirenal fat. An excess of adipose visceral fat is known as central obesity/ visceral obesity, the "pot belly" or "beer belly" effect, in which the abdomen protrudes excessively.

This body type is also known as "apple shaped". Abnormally high deposition of visceral adipose tissue is known as This body composition phenotype is associated with medical disorders such as metabolic syndrome, cardiovascular disease and several malignancies including prostate, breast and colorectal cancers.[16]

2. Superficial: The subcutaneous tissue also called the hypodermis, hypoderm, subcutis, superficial fascia, is the lowermost layer of the integumentary system in vertebrates. Subcutaneous fat is the layer of subcutaneous tissue that is most widely distributed. It is composed of adipocytes, which are grouped together in lobules separated by connective tissue. Fat around the hip, thigh, buttock is subcutaneous fat. They possess less health risk compared to visceral fat.
3. Ectopic: Storage of triglyceride in the tissue other than adipose tissue, that are supposed to contain only small amount of fats, such as liver, skeletal muscle, heart, pancreases. They interfere the cellular functions & hence organ function.

DISCUSSION

A person having balanced proportion of muscles, having balanced musculature, has got tolerance for hunger, thirst, the sun, the cold and exercise is known as *Prashasta Purusha* (ideal person) according to *Acharya Charaka*. In the same chapter *Acharya Charaka* told eight despicable persons, further stated that Obese and Lean individuals are more despised among above eight despised persons. Amongst all *Atisthula* have excess of fat, intolerance to physical exercise, having over sweating, too much hunger and excessive thirst. These symptoms are just opposite to *Prashasta Purush*. *Acharya Sushruta* have also said the same that the moderate state of built or constitution is the best among all. Modern science also describes the benefits of having a healthy body composition, i.e. healthy body composition normalise the blood pressure level, Improves quality of sleep, Improves mood and self-confidence, Increases energy and endurance throughout the day, Reduces pain in joints, hips and lower back, Improves blood circulation-leading to lower risk for heart disease, highers fertility rates and lower risk for pregnancy related complications, Improves breathing, respiration and lung function, Improves glucose tolerance and insulin sensitivity.

CONCLUSION

As we can see the beneficial effects of a good built on health according to both *Ayurvedic* and modern perspective and dangerous effects of *Atisthulta* on health. Along with it we also have seen the review on *Atisthula* as well as anatomical changes seen in the Obese person. obesity increase the fatty tissue in the body, obesity affects the different areas of the body like having obesity greatly increases the risk of stroke, which happens when blood stops flowing to the brain, Fat stored around the neck can make the airway too small, which can make breathing difficult, obesity increases the risk of developing gallstones. This is when bile builds up and hardens in the gallbladder. In people with obesity, the heart needs to work harder to pump blood around the body. This leads to high blood pressure, or hypertension. Obesity can cause deteriorating bone density and muscle mass. Rashes can occur where the skin of body fat folds, this condition known as acanthosis nigricans can also occur. we reach on the final conclusion that obesity affects nearly every part of the body. So medium sized body type is generally considered the ideal body type to live disease free life.

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