Ayurveda Meets Modern Nutrition: Exploring the Pathophysiology and Management of Obesity

Shashidhar Doddamani[1], Ajay kumar M.[2], Tumakuru Nataraj Sowmya[3], Hari V.[4], Rajasamarsen Modi[5], Sadashiv S.O.[2], Sharangouda J. Patil[6*] and Chaithra B.[7*]

[1]Central Ayurveda Research Institute, CCRAS, Ministry of AYUSH, Government of India, Bengaluru, Karnataka, India

[2]Department of Studies in Food Technology, Davangere University, Davanagere, Karnataka, India

[3]Department of Biotechnology and Bioinformatics, School of Life Sciences, JSS Academy of Higher Education and Research, Mysuru, Karnataka, India

[4]Department of Pharmacology, M. B. School of Pharmaceutical Sciences, Mohan Babu University, A Rangampeta, Tirupathi, Andhra Pradesh, India

[5]Department of Botany, Government First' Grade College, Naubad, Bidar, Karnataka, India

[*6]Department of Zoology, NMKRV College for Women, Bengaluru, Karnataka, India

[*7]Department of Zoology, Vijaya College, Bengaluru, Karnataka, India

[*]**Corresponding Authors:**

Email ID: shajapatil@gmail.com, chaithraphd@gmail.com

ABSTRACT

Obesity, a chronic and multifactorial metabolic disorder, has emerged as a significant global health challenge. According to Ayurveda, it is defined as *Atisthaulya*, a condition characterized by *Vikrita Vriddhi* (abnormal increase) of *Medodhatu* (adipose tissue), leading to excessive body weight, diminished vitality, and imbalances in the bodily systems. Modern science correlates obesity with excessive fat accumulation, insulin resistance, hormonal dysregulation, and increased risk of comorbidities like cardiovascular disease. This review integrates Ayurvedic principles with contemporary nutritional science to explore the etiology, pathogenesis, classification, and management of obesity. Classical Ayurvedic texts highlight the role of inappropriate diet (*Ahara*), sedentary lifestyle (*Vihara*), mental state (*Manasa*), and genetic predisposition (*Bijadoshaja*) as key causative factors. The *Medovaha Srotas* (fat-carrying channels) become obstructed due to excessive accumulation of *Ama* (metabolic toxins), leading to derangement in *Agni* (digestive fire) and further lipid deposition. Nutritionally, improper energy intake, low physical activity, and hormonal imbalances such as leptin resistance and reduced adiponectin are pivotal in obesity development. Management strategies emphasize a tailored Ayurvedic diet rich in high-fiber, low-calorie foods, lifestyle modifications, herbal formulations, and therapies like *Udvartana* (dry powder massage) and *Takra* (buttermilk therapy). Globally, the rising trend of obesity-affecting both adults and children—underscores the urgency of integrating holistic and evidence-based approaches. This paper highlights the relevance of Ayurvedic concepts in modern obesity management and suggests that combining ancient wisdom with modern nutrition may offer effective, sustainable solutions. This review advocates for an integrative, patient-centric model that can enhance outcomes and reduce the global burden of obesity

Keywords: Ayurveda, Metabolic disorders, Nutritional Science, Obesity, Pathophysiology..

1. INTRODUCTION

According to Ayurveda, Obesity is a condition in which Medodhatu (Fatty Tissue) is in a state of Vikrita Vriddhi (Abnormal increase). In Ayurveda, obesity, termed *Atisthaulya*, is considered a pathological increase of *Medodhatu* (fat tissue). A person who due to extensive growth of fat and flesh is unable to work and disfigured with pendulous buttocks, belly and breasts is called Atisthula and condition is termed as Atisthaulya (Agarwal, *et al.,* 2024.) According to Charaka Samhita, *"Ahara sambhavam vastu rogaushadha samanvitam"* that means all bodily tissues and functions are formed and sustained through food, and it is the root of health and longevity."

Obesity is a widespread and complex condition seen globally, yet it is often overlooked until associated health issues become

evident. It is also referred to as the "New World Syndrome" (Nammi, et al., 2004). Obesity is a metabolic disorder, identified when an excessive amount of body fat accumulates to a level that negatively impacts health. While commonly associated with increased body weight, a slim yet highly muscular person may be classified as overweight without having excess fat. Although not a direct or indicator of excess weight, the most commonly utilized method for assessing obesity is the body mass index (BMI).

Obesity can affect individuals of any age, is more prevalent in females, and its increasing rate among children is particularly alarming. An individual experiencing a sense of heaviness and increased body mass due to excessive accumulation of adipose tissue is referred to as Sthula, and this state is identified as Sthaulya.

According to Acharya Charaka, a person exhibiting a disproportionate and abnormal rise in Medadhatu (lipid tissue) along with Mamsadhatu (muscular tissue), resulting in a sagging or drooping appearance of the hips, abdomen, and chest region, and showing an enlarged body size without a corresponding enhancement in physical strength or vitality, is described as a Sthula Purusha. The impairment or imbalance in Medovaha Srotas (the bodily channels responsible for transporting fat) leads to eight distinct conditions, which were considered disgraceful or undesirable in society, with Sthaulya being one among them (Agnivesh, 2014).

The literary material related to obesity and nutrition in the context of ayurveda has been collected from several published data analysed and presented.

2. AYURVEDIC AND NUTRITIONAL PERSPECTIVES ON OBESITY

An Ayurvedic suitable nutritious diet plays a crucial role in the effective management of obesity. It emphasizes balanced meals tailored to an individual's body constitution (dosha), promoting proper digestion and metabolism. Incorporating natural, wholesome foods helps reduce excess body fat while maintaining overall health and vitality.

2.1 Classification of Sthaulya (Obesity) According to Charaka

The manifestation of Sthaulya (obesity) can be classified based on causative factors, manifestations, and duration as follows:

1. **Hina Sthaulya (BMI 25-30 kg/m²) – Overweight**

This is a mild degree of overweight without any associated complications or secondary diseases, typically lasting less than a year.

2. **Madhyama Sthaulya (BMI 30-40 kg/m²) – Obesity**

This represents a moderate degree of overweight, where there are minimal complications and no secondary diseases. The duration of this condition ranges from 1 to 5 years.

3. **Adhika Sthaulya (BMI > 40 kg/m²) – Morbid Obesity**

This is an advanced stage of obesity, characterized by excessive weight, complications, and the presence of secondary diseases. The condition lasts for more than 5 years and is associated with all 8 undesirable effects of obesity.

2.2 Causative factors for Obesity

Acharya Sushruta emphasized that both the nature and amount of *Ahara* (diet) are key elements involved in the manifestation of *Sthaulya*. (Bhatt & Khader, 2020).

not only a diet, physical, metal and emotional factors; Agnivesh, 2014, reported that Bijadoshaja Nidana (hereditary or genetic predispositions) is also a causative factor of sthaulya "Beyond dietary habits, physical inactivity, mental, emotional, and hereditary (Bijadoshaja) factors contribute to Sthaulya."and table-1 show the general causative factors for obesity.

Shashidhar Doddamani, Ajay kumar M, Tumakuru Nataraj Sowmya, Hari V.,
Rajasamarsen Modi, Sadashiv S.O., Sharangouda J. Patil and Chaithra B.

Figure 1: Causative factors for Obesity

Table 1: According Ayurveda Endogenous factors of Obesity (Agarwal, *et al.,* 2024)

Ahartmaka	Viharatmaka	Manasa	Anya
Adhyashana (Taking food after lunch or dinner)	Avyayama (No Exercise)	Harshanityatva (Happiness)	Amarasa (Indigestion)
Atisampurna (Binge eating)	Avyavaya (No sexual activities)	Atichintana (No worries)	Snighda, Madhura Basti sevena (Enema which contain Oily and sweet drugs)
Ati Brimhana (Over nourishment)	Diwaswapa (Day sleeping)	Manasonivritti (Idle Mind)	Tailabhyanga (Oil Massage)
Guru Ahara Sevana (Taking food which is heavy to digest)	Sukha (Very comfortable sleeping)	Priyadarshana	Snigdha Udvartana (Powder massage with oily drugs)
Madhura Ahara sevana (Excessive use of Sweets)	Atisnana Sevana (Excessive Bathing)		
Shleshmala Ahara Sevana (Food which will increase Kapha)			

2.3 Pathogenesis of Obesity in the context of Ayurveda

Adult-onset obesity is characterized predominantly by adipose cell hypertrophy with minimum hyperplasia. The subcutaneous tissue, the retroperitoneal tissues and epicardium, adipose tissue in obesity may be extended to the tissues, where it is normally absent excessive lipid deposition, diminished lipid mobilization and diminished lipid utilization are the three main components in pathogenesis of obesity. Excessive lipid deposition is due to increased food intake, hypothalamic

lesions, and adipose cell hyperplasia. Increased food intake in the form of carbohydrates, proteins and fats by metabolic process lastly converts into fats and gets stored in fat depots. Diminished lipid metabolism is due to either decrease in lipolytic hormones, abnormality of autonomous innervating thyroxine and adrenaline which stimulates mobilization of unsaturated fatty acids from adipose tissue, abnormality of these two causes diminishes lipid mobilization, increases lipid deposition and ultimately leads to obesity.

Acharya Charaka has correlated an increased desire to eat with increased Agni in the morbidly obese. Recent evidence suggests that leptin and ghrelin had shown their influence on appetite. As ghrelin is produced from the stomach, and leptin is produced by the adipose tissue of fat storage reserves in the body, which is responsible for short-term and long-term appetite control respectively in the body (Hamann, & Matthaei, 1996).

Obesity is associated with decrease adiponectin and increase level of leptin hormone in adipose tissue. Insulin resistance in adipose tissue (fat cells) result in a flux of FFA (Free fatty acid) from the adipose tissue to the liver causing insulin resistance in the liver and the peripheral tissue. Fatty acid block glucose oxidation and glucose transport, but they also cause atherogenic activity by inducing production in the liver of very low-density lipoprotein (LDL) particle that leads to the elevation of TG (triglycerides) and apolipo protein B (Apo-B) and the lowering of high density lipoprotein (HDL-c). An increase in triglycerides in addition to high LDL-c levels, significantly increases the risk for coronary heart disease (CHD) (Steinmetz, *et al.,* 2001; Pushpa et al., 2025). Diminished lipid utilization is either due to, defective lipid oxidation, defective thermogenesis or inactivity. Diminished lipid utilization is the main pathology in obesity.

The leptin deficiency or leptin resistance leads to develop overfeeding tendency, which is caused by some genetic and acquired forms of obesity. These findings suggest the genetic inputs in overweight and obesity, which is quite comparable to the Ayurvedic lexicons. Leptin stops one to feel hungry and satiety. So, if leptin is absent, one feel hunger and overfeeds and becomes obese (Rao*, et al.,* 2012; and Raina, 2011).
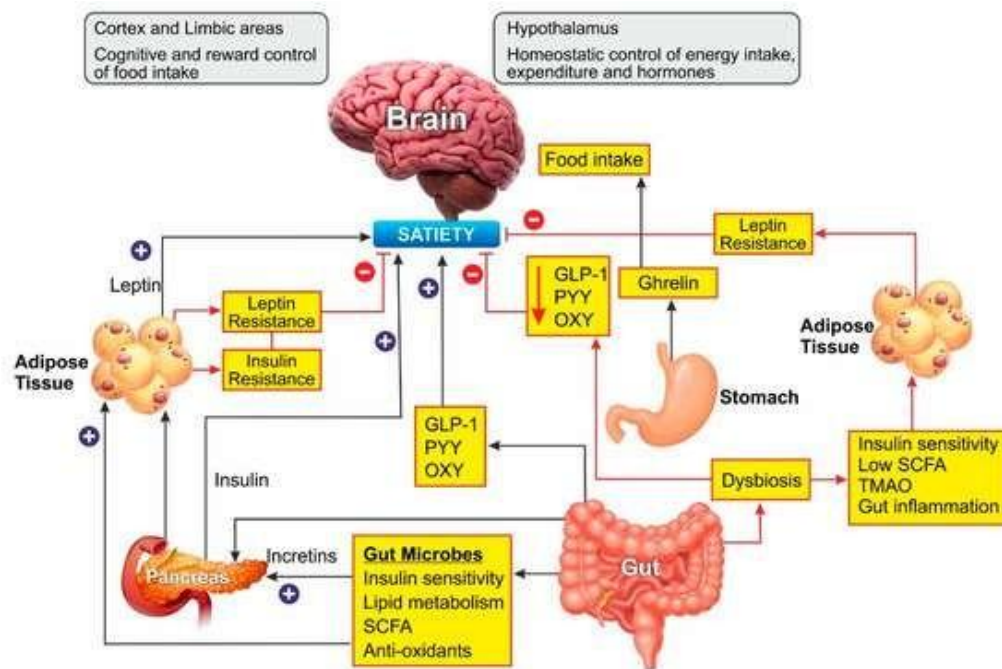

Figure 2: Pathogenesis of Obesity in the context of Ayurveda and their Mechanisms

The Nidana of Sthaulya can be broadly classified under, Aharatmaka Nidana like, food that is heavy to digest, excessive eating, having meal before the digestion of previous meal , Viharatamaka Nidana such as lack of physical exercise, day time sleeping, sedentary lifestyle, Bijadoshaja Nidana (genetic factors) (Agnivesh, 2014) and others like Manasika Nidana (psychological factors) also play important role. Acharya Susruta mentioned that, quality and quantity of Ahara (food) is an important component involved in causing Sthaulya (Bhatt, & Khader, 2020).

In the sequence of seven *Dhatus* (body tissues) described in Ayurveda, *Medodhatu* is the fourth, derived from *Mamsa Dhatu* (muscle tissue). *Medodhatu* can be likened to fat reserves, while *Rasa-Raktagata Sneha* (lipids in blood) corresponds to triglycerides or cholesterol. *Medodhatu* has two components: the *Poshaka* (nourishing, mobile part), comparable to circulating lipids, and the *Poshya* (static, stored part), similar to adipose tissue, located in *Medodharakala* (abdomen, hips, and breasts). Due to the previously mentioned causative factors, food remains improperly digested, forming *Ama* (toxic byproducts), which excessively nourishes *Medodhatu*, leaving other *Dhatus* undernourished—leading to *Sthula* (obesity).

Shashidhar Doddamani, Ajay kumar M, Tumakuru Nataraj Sowmya, Hari V.,
Rajasamarsen Modi, Sadashiv S.O., Sharangouda J. Patil and Chaithra B.

This results in blockage of *Medovaha Srotas* (fat-carrying channels), aggravating *Vata*. The disturbed *Vata* enters the *Koshta* (gut), intensifying *Jatharagni* (digestive fire), increasing appetite, rapidly digesting food, and further producing more *Medodhatu* and *Ama*, ultimately resulting in *Sthaulya*. (Bhatt & Khader, 2020)

2.4 Symptoms of Different Kinds of Obesity (Gacche, et al., 2021; Bhatt & Khader, 2020)

- Medomamsa ativriddhi (Excessive growth of Muscle & Fat tissue)

- Chala Sphik-Udara-Stana (Pendulous Buttocks - Abdomen - Breast)

- Ayatha Upachaya Utsaha (Disproportionate strength with his physical growth).

- Ayusho Hrasa (Deficient in longevity)

- Javoparodha (Less energy levels)

- Krich chra Vyavaya (Difficulty during Sexual Intercourse)

- Daurbalya (Weakness)

- Daurgandhya (Bad Smell)

- Swedabadha (Excessive Sweating)

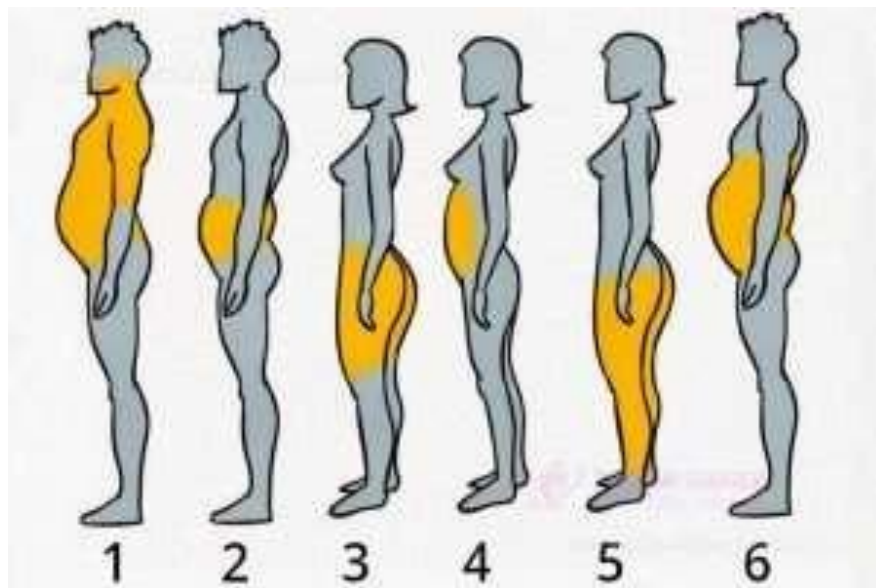- Ati Kshudh (More Hunger)

- Ati Pipasa (Excessive Thirst)

Figure 3: Symptoms of Different Kinds of Obesity among the Population

3. SUITABLE AND UNSUITABLE DIET/FOOD FOR OBESE PATIENT

Diet must be nutritionally adequate but must be lower in calories, with vitamins and mineral supplements. A mixed balanced diet is a sensible approach to long term weight reduction. The protein should be of high quality so that essential amino acid can be utilized to maintain lean body mass. Food, high in fiber should be used liberally because of their low caloric density and table- 2 shows the suitable and unsuitable food with respect to obesity.

Change in diet coupled with increasing inactive lifestyle has sparked off epidemics of obesity in several Asian countries. There has been a significant increase in the consumption of fats and every dense food with a concurrent reduction in physical activity. With the rapid pace of industrialization and economic progress, today more and more jobs are becoming sedentary and dietary patterns are also changing with a decline in cereal intake and increase in the intake of sugar and fats (Agarwal, *et al.,* 2024).

A formulation prepared from Vidanga, Nagara, Yavakshara, ash powder of black iron along with honey, powder of Yava and Amalaka is also an excellent weight-loss drug. Similarly, Bilvadi Panchamula (five major roots) mixed with honey and Shilajatu along with the juice of Agnimantha are also very effective preparations for weight-loss. A diet consisting of Prashatika, Priyangu, Shyamaka, Yavaka, Yava, Jurnahva, Kodrava, Mudga, Kulattha, Chakramudgaka, Adhaki along with Patola and Amalaka is very effective in tackling obesity and maintaining good health. Honey water and alcoholic preparations

may be taken as postprandial drinks that help in reducing excessive fat and muscle tissues, while also alleviating Kapha Dosha. (Itani, *et al.,* 2023)

According to survey by Nutrition Foundation of India, 45 % of women and 29% of men in urban area of the country are overweight. India is in 7th place in terms of obesity index (Gujarathi, *et al.,* 2013).

Table 2: Suitable and Unsuitable Food for Obesity

Ahara Varga (Food)	Pathya (Suitable)	Apathya (Unsuitable)
Shuka Dhanya (Food grain)	Yava (Barley), Venuyava (foxtail millet), Kodrava, (little millet) Nivara (barnyard millet)	Wheat, New Rice, Rice
Shami Dhanya (Pulses)	Mudga (Green gram), Rajmasha (Red Kidney beans), Kullatha (Horse gram), Masura (Masoor Dal), and Adhaki (pigeon pea)	Masha (Black Gram), Tila (Sesame Seed)
Shaka Varga (Vegetables)	Vrintaka (Brinjal), Patrashaka (leafy vegetable), Patola (sponge gourd),	Madhuraphala (sweet kind of fruit)
Drava (Liquid Stuff)	Takra (Butter Milk), Madhu (Honey), Ushnodaka (Warm Water), Dugdha (Milk), Til taila (sesame oil).	Ikshu (Sugar Can), Navnita (fresh butter), Ghrita (Ghee), Dadhi (curd or yogurt)
Mamsa (Meat)	Rohita Matsya (Rohita fish)	Anupa (Meat from animals), Audaka (meat from aquatic animals)

4. MANAGEMENT/TREATMENT OF OBESITY

The term obesity is defined as an excess storage of energy in the body in the form of fat. Obesity is an increase in body weight beyond the limitation of skeletal and physical requirements as the result of excessive accumulation of body fat. BMI (Body Mass Index) more than 30 kg /m^2 is also used for diagnosing obesity.

Table 3: Nutritional status on the WHO and "Asian criteria" values

Nutritional status	WHO criteria BMI cut-off	"Asian criteria" BMI cut-off
Underweight	<18.5	<18.5
Normal	18.5-24.9	18.5-22.9
Overweight	25-29.9	23-24.9
Pre-obese	-	25-29.9
Obese	≥30	≥30
Obese Type 1 (obese)	30-40	30-40
Obese Type 2 (morbid obese)	40.1-50	40.1-50

5. CURRENT STATUS OF OBESITY ACCORDING TO WORLD HEALTH ORGANIZATION

According to the World Health Organization, in 2022, one out of every eight people globally was living with obesity. Since 1990, the rate of adult obesity worldwide has more than doubled, while obesity among adolescents has increased fourfold. In the same year, 2.5 billion adults aged 18 and above were considered overweight, with 890 million of them living with obesity. Furthermore, 43% of adults in this age group were overweight, and 16% were classified as obese. In 2022, 37 million children under the age of five were reported to be overweight. Additionally, over 390 million children and adolescents aged 5 to 19 were overweight, including 160 million who were living with obesity.

Shashidhar Doddamani, Ajay kumar M, Tumakuru Nataraj Sowmya, Hari V.,
Rajasamarsen Modi, Sadashiv S.O., Sharangouda J. Patil and Chaithra B.

Overweight and obesity are characterized by abnormal or excessive fat buildup that poses a threat to health. A Body Mass Index (BMI) above 25 is classified as overweight, while a BMI over 30 is categorized as obese. In 2019, approximately 5 million deaths from non-communicable diseases (NCDs) were attributed to BMI levels above the optimal range.

The prevalence of overweight and obesity continues to rise among both adults and children. Between 1990 and 2022, the global proportion of children and teenagers aged 5–19 affected by obesity increased fourfold—from 2% to 8%. Similarly, the percentage of adults aged 18 and above living with obesity more than doubled, rising from 7% to 16%.

Obesity, as discussed in both Ayurveda and modern medical sciences, is a multifactorial condition with physiological, genetic, psychological, and lifestyle-based etiologies. In Ayurveda, obesity or *Sthaulya* is perceived not only as a physical imbalance but also a consequence of impaired digestion and metabolic fire (*Agni*), improper dietary practices (*Ahara*), sedentary lifestyle (*Vihara*), and psychological factors (*Manasika Nidana*) (Agarwal et al., 2024; Bhatt & Khader, 2020; Garg et al., 2023).

Acharya Charaka's detailed exposition on *Atisthaulya* emphasizes its detrimental impact on physical appearance, strength, and vitality, with characteristic symptoms such as pendulous body parts (*Chala Sphik-Udara-Stana*), excessive hunger (*Ati Kshudh*), thirst (*Ati Pipasa*), bad odor (*Daurgandhya*), and fatigue (*Daurbalya*) (Agnivesh, 2014; Gacche et al., 2021). These ancient observations align significantly with contemporary descriptions of metabolic syndrome, which includes insulin resistance, hormonal imbalance (leptin and ghrelin), and the abnormal lipid profile associated with adipose tissue dysfunction (Hamann & Matthaei, 1996; Steinmetz et al., 2001; Dakshayini et al., 2023).

From a nutritional standpoint, obesity arises due to an energy imbalance between calories consumed and expended. Excessive intake of calorie-dense, low-fiber, and high-fat foods along with declining physical activity has contributed to the obesity epidemic globally, including in Asian countries where traditional diets are rapidly being replaced by modern, processed foods (Agarwal et al., 2024; Doddamani et al., 2024). WHO statistics reflect a startling growth in obesity prevalence—from 7% to 16% in adults and 2% to 8% in adolescents between 1990 and 2022, with obesity now affecting one in eight people globally (WHO, 2022; Ekambaram et al., 2025).

Ayurveda emphasizes the role of *Medovaha Srotas* (fat-carrying channels), and their dysfunction results in excessive *Medodhatu* formation. Improperly digested food forms *Ama*, which not only clogs these channels but also leads to undernourishment of other *Dhatus* (tissues) and systemic imbalances. This correlates with the modern understanding of adipokine imbalances, such as decreased adiponectin and elevated leptin levels, resulting in insulin resistance and systemic inflammation (Rao et al., 2012; Raina, 2011).

Management of obesity in Ayurveda involves a holistic approach—correcting dietary patterns, enhancing digestive fire, detoxifying the body, and balancing bodily doshas. Therapeutic dietary regimens rich in barley (*Yava*), green gram (*Mudga*), and lean meats such as *Rohita Matsya*, coupled with lifestyle modifications like regular exercise and sleep regulation, are recommended. Use of herbal formulations like *Vidanga*, *Yavakshara*, *Agnimantha*, and *Shilajatu* are effective in mobilizing fat and correcting metabolism (Itani et al., 2023).

Furthermore, obesity has been classified into three stages—*Hina Sthaulya*, *Madhyama Sthaulya*, and *Adhika Sthaulya*—based on BMI ranges and associated complications. This stratification aligns with the WHO and Asian criteria for nutritional assessment and enables stage-wise management (Agarwal et al., 2024).

Genetic predisposition (*Bijadoshaja Nidana*) plays a vital role in both Ayurvedic and contemporary perspectives. Recent genetic and endocrinological studies have shown that leptin resistance or deficiency can drive compulsive feeding behavior, mirroring the Ayurvedic idea of *Agnimandya* and *Vata vitiation* within *Koshta* (Hamann & Matthaei, 1996; Agnivesh, 2014).

Thus, obesity is a classic example where traditional knowledge and modern science converge. The integrative approach of Ayurveda—focusing on personalized nutrition, mental well-being, and sustainable lifestyle practices—offers a valuable framework for preventing and managing obesity alongside conventional medical practices.

6. CONCLUSION

Obesity is not merely a condition of excess weight, but a complex disorder involving metabolic, psychological, genetic, and lifestyle factors. From an Ayurvedic perspective, it is the result of the abnormal increase in *Medodhatu* due to *Ama* accumulation, impaired digestion, and the vitiation of *Vata*, *Kapha*, and *Medovaha Srotas*. These concepts remarkably mirror the modern understanding of hormonal imbalances, insulin resistance, and dyslipidemia. Integrating Ayurvedic dietary principles with modern nutritional science provides a holistic pathway for sustainable obesity management. Emphasis on individualized diet planning, use of traditional herbal formulations, regular physical activity, and lifestyle modifications are critical in reversing the pathology of obesity. Given the alarming rise in obesity rates globally, particularly in children a nd adolescents, there is an urgent need to explore complementary and alternative systems of medicine such as Ayurveda. Bridging traditional wisdom with contemporary evidence-based strategies may not only enhance clinical outcomes but also promote preventive health. In conclusion, obesity requires a multidimensional management strategy, and Ayurveda provides timeless principles that, when effectively combined with modern interventions, can lead to improved health and well-being

Shashidhar Doddamani, Ajay kumar M, Tumakuru Nataraj Sowmya, Hari V., Rajasamarsen Modi, Sadashiv S.O., Sharangouda J. Patil and Chaithra B.

across populations. "Harnessing both ancient and modern wisdom can provide a multifaceted approach to tackle the rising obesity epidemic worldwide."

REFERENCES

[1] Agarwal, V., Das, A. K., & Mishra, A. (2024). A Systematic Ayurvedic approach to manage Sthaulya (obesity)- A review.

[2] Agnivesh, C. S. (2014). Ayurveda Dipika commentary by Chakrapani Dutta. *Chaukamba Orientalia,* 5-9.

[3] Bhatt, K. L., & Khader, A. (2020). Obesity: An Ayurveda prospective. *Journal of Ayurveda and Integrated Medical Sciences, 5*(04), 328-331.

[4] Dakshayini, P. N., Roy, U. B., Kolgi, R. R., Singh, S. R., Sharma, S., Shrivastava, R., & Patil, S. J. (2023). Efficacy of phytoextracts on female reproduction and impact on diabetes mellitus. *Journal of Advanced Zoology, 44*(4), 1154–1160.

[5] Doddamani, S., Kumar, R., Anchan, V., Sindhu, C. V., Athira, A. G., Bhat, S., Makhija, D., Kachare, K., Srikanth, N., Acharya, R. N., & Patil, S. J. (2024). Exploring the health status, nutritional deficiencies, dietary patterns, and laboratory investigation among tribal populations of villages in HD Kote, Karnataka: A cross-sectional study. *Journal of Advanced Zoology, 45*(3), 567-573.

[6] Ekambaram, G., Sankaranarayanan, N., Nagarajan, P., Palanisamy, P., Mani, T., Raman, V., Kaliaperumal, R., Port Louis, L. R., & Patil, S. J. (2025). Integrative nutrition strategies and cardiovascular therapy from macronutrients to micronutrients. In A. Chatterjee, T. Sarkar, N. Bansal, & K. Adhikary (Eds.), *Impact of yoga and proper diet on cardiopulmonary function* (pp. 273-304). IGI Global Scientific Publishing. https://doi.org/10.4018/979-8-3693-8267-7.ch009

[7] Gacche, A. M., Bondre, A. U., Sheikh, M. Y. M. S., & Borkar, B. E. (2021). Sthaulya in Ayurveda and its management: A review. *World Journal of Pharmaceutical Research, 10(11),* 2024-2053.

[8] Garg, S., Hari, V., Sangeetha Menon, S. R., Gaviraj, E. N., Tiwari, K. J., Rajashekar, M., Yadav, L., & Patil, S. J. (2023). Studies on the effects of *Adansonia digitata* Lin's fruits on diabetes. *Journal of Advanced Zoology, 44*(S4), 52-64.

[9] Gujarathi, R., & Gujarathi, J. (2013). Managing obesity through Ayurveda. *IJBPAS, 2*(5), 1188-1198.

[10] Hamann, A., & Matthaei, S. (1996). Regulation of energy balance by leptin. *Experimental and Clinical Endocrinology & Diabetes, 104*(04), 293-300.

[11] Itani, N., Keshwa, K., Pathak, D., & Sevatkar, B. K. (2023). Exploring the impact of Ayurvedic approaches on obesity: A scientific research perspective. *Journal of Ayurveda and Integrated Medical Sciences, 8*(8), 206-215.

[12] Madhavakara. (2000). *Madhava Nidana* (Shastri Sri Sudarshana, Ed.). Chaukhamba Sanskrit Sansthana, Varanasi, chapter 34, Sloka 2-5.

[13] Nammi, S., Koka, S., Chinnala, K. M., & Boini, K. M. (2004). Obesity: An overview on its current perspectives and treatment options. *Nutrition Journal, 3*, 1-8.

[14] Paikrao, S., & Thakar, A. B. (2021).Role of Panchakarma procedures in the management of Sthaulya (obesity). *Medicine,* 2021

[15] Pushpa, T. C., Malathi, H., Binorkar, S. V., Premalatha, S. J., Myrene, R. D., Warad, V., & Patil, S. J. (2025). Herb-drug interaction of traditional Indian herbs used for treatment of diabetes mellitus: An evidence-based review. *Cuestiones de Fisioterapia, 54*(2), 499-512.

[16] Raina, G. S. (2011). Obesity being the major health burden needed to be chased: A systemic review (2000 - 2010). *Journal of Applied Pharmaceutical Science*, 238-245.

[17] Rao, C. R., Chakraborty, R., & Sen, P. K. (2012). *Bioinformatics in human health and heredity*. Elsevier Newyork, 28, p.01-546.

[18] Steinmetz, A., Fenselau, S., & Schrezenmeir, J. (2001). Treatment of dyslipoproteinemia in the metabolic syndrome. *Experimental and Clinical Endocrinology & Diabetes, 109*(04), 548-559.

.