

## Review Article

# Millets in the dietary management of childhood obesity: bridging modern nutrition and Ayurvedic principles

Himanshu Rawat<sup>1\*</sup>, Nisha K. Ojha<sup>2</sup>

<sup>1</sup>Department of Ayush and Ayush Education, Government of Uttarakhand, India

<sup>2</sup>Department of Kaumarbhritya, National Institute of Ayurveda, Deemed to Be University (De Novo), Jaipur, Rajasthan, India

**Received:** 07 March 2026

**Accepted:** 24 May 2026

### \*Correspondence:

Dr. Himanshu Rawat,

E-mail: [himanshu.r1919@gmail.com](mailto:himanshu.r1919@gmail.com)

**Copyright:** © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

### ABSTRACT

Childhood obesity is a growing public health concern, with long-term implications for physical and metabolic well-being. Conventional approaches often fall short in offering sustainable solutions. In this context, traditional dietary systems like Ayurveda offer promising alternatives. Millets, long valued in Ayurvedic literature, are recognized for their Laghu (light) and Ruksha (dry) qualities, which help regulate Kapha Dosha and Meda Dhatu (fat tissue), both implicated in the pathology of obesity. Modern nutrition also supports the inclusion of millets due to their low glycaemic index and high dietary fibre content, which aid in weight regulation and metabolic health. Hence, an attempt has been made to review the utility of millets as functional foods in managing childhood obesity from both Ayurvedic and contemporary perspectives. The findings suggest that millets like finger millet, foxtail millet, barnyard millet, and pearl millet not only support healthy digestion and stimulate Agni (digestive fire), but also assist in reducing Ama (toxins) and balancing Doshas. These properties align with their documented benefits in modern nutritional studies, including improved glycaemic control, enhanced satiety, and reduction in adiposity. Overall, millets represent a culturally acceptable, nutritionally sound, and Ayurvedically validated approach to preventing and managing childhood obesity.

**Keywords:** Millets, Childhood obesity, Ayurveda, Meda Dhatu, Functional foods

### INTRODUCTION

Encouraging the whole family to adopt healthier eating habits and creating a supportive, mindful mealtime atmosphere can greatly reinforce positive behaviour and discourage emotional or unconscious eating. These lifestyle changes not only help create long-term habits that lower the risk of conditions like type 2 diabetes, hypertension, and joint-related issues, but they also help achieve gradual and sustainable weight loss. Important elements of successful dietary adjustments include controlling portion sizes, reducing the intake of sugary drinks, and minimizing the consumption of processed snacks.

Millets are valuable addition to health-focused diets due to their impressive nutritional content and health-supporting

properties. Grains like foxtail millet, barnyard millet, finger millet (ragi), kodo millet and pearl millet (bajra) are naturally low in fat while being rich in fibre, protein and essential vitamins and minerals.<sup>1</sup> The rich fibre content in millets helps enhance satiety and manage hunger, leading to a natural reduction in overall calorie consumption.<sup>2</sup> Moreover, their low glycaemic index ensures a slow and steady release of glucose into the bloodstream, which helps maintain stable energy levels and manage hunger effectively.<sup>3</sup>

Replacing refined grains such as white rice or maida (refined wheat flour) with millets in everyday meals can support weight management and improve metabolic function. Their adaptability in the kitchen makes them a sustainable and nutritious part of the diet, suitable for dishes like salads, upma, flatbreads and porridges.

Scientific studies highlight that millets are rich in bioactive compounds, complex carbohydrates, magnesium and antioxidants. Their slow digestion process aids in appetite regulation, supports healthy fat metabolism, and ensures a steady supply of energy, factors that contribute positively to weight control.

In Ayurveda, obesity (*Sthoulya*) is primarily attributed to an imbalance of *Kapha Dosha* and an excessive accumulation of *Meda Dhatu* (fat tissues). Millets are considered beneficial in this context due to their *Laghu* (light) and *Ruksha* (dry) qualities, along with their astringent (*Kashya*) and pungent (*Katu*) taste, which help pacify *Kapha* and reduce fat buildup. Acharya Charaka highlights the *Guru-Apatarpana* approach for managing conditions like obesity. It involves the intake of heavy, yet non-nourishing foods that curb excessive nutrition without overburdening digestion. Millets align well with this principle, making them a suitable dietary choice in Ayurvedic obesity management.<sup>4</sup>

### Understanding obesity in children

A significant public health concern, childhood obesity is characterized by an excessive accumulation of body fat that can harm a child's physical and emotional well-being. The body mass index (BMI) for age percentile is one of the most often used methods for determining a child's obesity; individuals who score higher than the 95th percentile are generally considered obese.<sup>5</sup> The percentage of youngsters who are overweight or obese has dramatically increased in recent years. The World Health Organization (WHO) estimates that in 2022, the disease impacted about 39 million children under the age of five worldwide.<sup>6</sup>

This disorder is complicated and is caused by a confluence of behavioural, environmental, and hereditary factors. Although a child's vulnerability may be influenced by genetics, lifestyle factors including poor eating habits, which include consuming sugary drinks, fast food, and highly processed snacks frequently, as well as a lack of physical activity, are important contributors.<sup>7</sup>

Beyond just being overweight, childhood obesity is linked to major health problems like type 2 diabetes, high blood pressure, abnormal cholesterol levels, and joint troubles.<sup>8</sup> Furthermore, the psychological effects can be severe because many obese kids experience social rejection, bullying, and low self-esteem, which raises their risk of developing anxiety and depression.<sup>9</sup> Tackling childhood obesity requires a well-rounded approach that involves not just the child but also parents, educators and healthcare provide. Key measures include promoting nutritious eating habits, consistent physical activity and minimizing inactive lifestyles.

### Role of dietary modification in obesity

An effective strategy for preventing and managing obesity involves adopting healthier dietary habits. This includes

reducing calorie intake by limiting sugar, saturated fats, and refined carbohydrates, while increasing consumption of nutrient-dense foods like fruits, vegetables, whole grains, legumes, lean proteins, and healthy fats. These foods promote satiety and support overall nutrition. Portion control, regular meals, and avoiding processed snacks help maintain energy balance.

Sustainable, gradual dietary changes are more effective than crash diets. Personalized meal plans, nutritional education, and learning healthy cooking techniques enhance adherence. In severe cases, dietary changes may be supported by physical activity, behavioral therapy, or medical interventions.<sup>10</sup>

### Concept of obesity in Ayurveda

Obesity, known in Ayurveda as *Sthoulya* or *Medoroga*, is seen as a deeper imbalance in the body's physiological forces, or *Doshas*, especially *Kapha Dosha*, rather than just being a problem of excess fat. An abnormal increase in *Meda Dhatu* (fat tissue) and occasionally *Mamsa Dhatu* (muscular tissue) causes *Sthoulya*, which manifests as noticeable flabbiness, particularly around the abdomen and hips, according to Ayurveda.<sup>11</sup>

Charaka Smahita explains that *Sthoulya* (obesity) primarily results from *Meda Dhatu* Vridhhi, which is the abnormal accumulation of fat caused by impaired digestion. When the digestive factors (*Agni*) are weakened, it leads to formation of *Ama* (undigested food) that disrupts nutrient absorption. Consequently, nutrients tend to accumulate in fat tissue, leaving other important tissues such as muscles and bones deprived and weakened.

To address obesity, Ayurveda recommends a comprehensive approach focused on balancing the *Dosha*, strengthening digestion, and improving overall health through diet, herbal treatments, lifestyle modifications, and conscious living.<sup>12</sup>

Acharya Charaka describes obesity as *Santarpanoth Vyadi*, meaning a disease that arise from over-nourishment or excessive intake of food. He vividly describes the obese person as:

"*Bahu Dosha, Alpa Bala, Alpa Ayu, Alpa Satva*" (one with excess *Doshas*, poor strength, short lifespan, and weak mental endurance).

### Causes of obesity in Ayurveda (Nidana)

Excessive intake of *Guru* (heavy), *Snigdha* (unctuous), *Madhura* (sweet), and *Shita* (cold) foods involves overeating or eating without true hunger, lack of *Vyayama* (exercise or physical activity), daytime sleeping (*Divaswapna*), leading to *Kapha* accumulation, psychological causes like stress, emotional eating, attachment to food and genetic tendencies and poor digestion.

### *Samprapti (pathogenesis)*

The impaired digestive factors lead to formation of undigested foods and improper conversion of food into nutrients. This results in excessive nourishment of *Meda Dhatu*, while other *Dhatus* are depleted. The body's metabolism becomes sluggish, leading to further fat accumulation and weakening of Vata and Pitta functions.

### *Signs and symptoms (Lakshana) of Sthaulya*

It involves excessive accumulation of fat in the hips, thighs, and abdomen, the body feels heavy and lethargic, excessive sweating, breathlessness with light exercise, poor appetite with frequent hunger pangs, and weakness in endurance and physical strength.

### *Unique Ayurvedic viewpoint*

In Ayurveda, obesity (*Sthaulya*) is considered more than just a physical issue, it also involves disturbances in mental and emotional states. An excess of Tamas (mental dullness) and Rajas (emotional unrest) can lead to unhealthy eating behaviours and overeating. These factors, combined with physical imbalances, cause an abnormal increase in *Meda Dhatu* (fat tissues) and the accumulation of Ama (undigested food), which blocks the body's channels (*Srotorodha*). This blockage is believed to contribute significantly to chronic diseases such as *Prameha* (diabetes) and cardiovascular problems. From an Ayurvedic standpoint, obesity is a complex condition characterized by weak digestion (*Mandagni*), the build-up of toxins, imbalance of *Dosha* especially Kapha and the influence of mental and emotional factors. Effective treatment focuses not only on weight loss but also on reigniting digestive fire, eliminating toxins, reducing excess fat, and restoring *Dosha* harmony.

## METHODS

### *Design*

This narrative review aimed to explore the role of millets as functional foods in the management of childhood obesity, bridging traditional Ayurvedic perspectives with contemporary scientific evidence. The review focused on evaluating millet-based dietary strategies as part of a comprehensive and sustainable approach to addressing this escalating public health concern. Classical Ayurvedic texts, particularly from Kaumarbhritya (paediatrics), along with the *Brihat Trayi* (Charaka Samhita, Sushruta Samhita, and Ashtanga Hridaya) and the *Laghu Trayi* (Madhava Nidana, Sharangadhara Samhita, and Bhava Prakasha), were examined to gather traditional insights. Additionally, classical Nighantus such as Dhanvantari Nighantu, Raj Nighantu, and Kaideva Nighantu were reviewed for references to *Sthaulya* (obesity) and dietetic interventions applicable to children. To complement this traditional framework, a digital literature review was conducted using databases such as PubMed, the AYUSH Research Portal,

Digital Helpline for Ayurveda Research Articles (DHARA), Google Scholar, and the official websites of public health and nutrition organizations. The search spanned literature published between 2001 and 2024, using keywords including "millets," "childhood obesity," "childhood overweight," "low glycaemic index grains," "dietary fibre," "Ayurveda," "*Sthaulya*," "Shamana Chikitsa," "nutritional interventions," and "functional foods."

### *Eligibility criteria*

This review included studies that explored the role and underlying mechanisms of millets in the management of obesity. Studies were eligible if they examined the effects of millets either as part of dietary interventions or as described in Ayurvedic literature. Both Ayurvedic and biomedical studies were included. Studies were included if they examined the physiological, biochemical, or molecular mechanisms through which millets influence obesity-related parameters. Studies were excluded if they did not involve millet-based interventions, lacked clearly defined outcome measures, focused solely on non-dietary or pharmacological treatments, or included editorials, commentaries, or review articles without original research data. Additionally, studies that did not align with Ayurvedic principles or failed to mention relevant traditional contexts were also excluded.

## RESULTS

The present review was undertaken to explore the role of millets as functional foods in the management of obesity, with particular emphasis on their relevance in both Ayurvedic and contemporary scientific contexts. A total of 86 relevant publications from the period 2001 to 2024 were identified through a systematic search, comprising observational, interventional, and mechanistic studies. The search focused on grains categorized as *Shuka Dhanya* in Ayurvedic texts and millets recognized in modern nutrition science, particularly in relation to their impact on *Sthaulya* (obesity), with a special interest in paediatric populations.

Of these, 10 studies were found to be directly aligned with the core objectives of the review. These selected studies were analysed in detail to understand the mechanisms through which millets exert anti-obesity effects, including modulation of glycaemic response, enhancement of satiety through dietary fibre, improvement in lipid metabolism, and support for gut microbiota diversity. Traditional Ayurvedic descriptions of millets were examined for their *Rasa* (taste), *Guna* (properties), *Vipaka* (post-digestive effect), and their categorization under *Kapha-Medohara* (fat-reducing) grains.

The findings from these 10 studies were synthesised thematically to propose an integrative model of millet-based intervention for obesity management. This model reflects a convergence of classical Ayurvedic wisdom with evidence from nutritional science and metabolic research,

offering a promising, holistic approach to dietary regulation in both paediatric and general obesity contexts.

## OBSERVATION

### Types of millets used for obesity

Millets are a diverse group of small-seeded cereal grains that have been traditionally consumed in many parts of the world due to their rich nutritional profile and adaptability

to harsh growing conditions. Several types of millets are particularly noted for their potential benefits in managing obesity, thanks to their high dietary fibre, low glycaemic index, and abundance of essential nutrients.<sup>13</sup>

Commonly used millets are foxtail millet (*Setaria italica*), finger millet (*Eleusine coracana*), barnyard millet (*Echinochloa frumentacea*), kodo millet (*Paspalum scrobiculatum*), pearl millet (*Pennisetum glaucum*), and little millet (*Panicum sumatrense*) (Table 1).

**Table 1: Properties of different millets useful in management of obesity.**

Millet name	Key nutritional constituents (modern science)	Mechanism in obesity management (modern)	Ayurvedic properties <sup>17,18</sup>	Ayurvedic actions in obesity ( <i>Sthoulya</i> ) <sup>19</sup>
<b>Foxtail millet<sup>20</sup></b>	High dietary fibre, low glycaemic index, rich in magnesium and tryptophan	Improves insulin sensitivity, promotes satiety, regulates lipid metabolism.	<i>Laghu</i> (light), <i>Ruksha</i> (dry), <i>Tikta</i> (bitter), <i>Kashaya</i> (astringent), <i>Ushna</i> (hot potency)	Pacifies <i>Kapha</i> , enhances <i>Agni</i> , reduces <i>Meda</i> ; helps in <i>Lekhana</i> (scraping of fat)
<b>Barnyard millet<sup>21</sup></b>	High in resistant starch, low GI, rich in iron and B-complex vitamins	Slows glucose absorption, improves gut health, controls appetite.	<i>Laghu</i> , <i>Ruksha</i> , <i>Tikta</i> , <i>Kashaya</i> , <i>Ushna</i>	Improves digestion, balances <i>Kapha</i> , has <i>Meda-nashak</i> (fat reducing) action
<b>Kodo millet<sup>22</sup></b>	Rich in polyphenols, fibre, and antioxidants	Anti-inflammatory, antioxidant activity supports metabolic balance, reduces oxidative stress.	<i>Laghu</i> , <i>Ruksha</i> , <i>Tikta</i> , <i>Kashaya</i> , <i>Ushna</i>	<i>Deepana</i> (appetizer), <i>Lekhana</i> , <i>Kapha-hara</i> , promotes <i>Shodhana</i> (purifying)
<b>Finger millet<sup>23</sup></b>	High calcium, fibre, and tryptophan; contains amino acids (methionine, lysine)	Enhances satiety, builds lean muscle, reduces cravings	<i>Guru</i> (heavy), <i>Madhura</i> (sweet), <i>Snigdha</i> (unctuous)	May increase <i>Kapha</i> if overused; better when processed or combined with warming agents
<b>Pearl millet<sup>24</sup></b>	High in magnesium, phosphorus, fibre; contains lignans and phytonutrients	Lowers cholesterol, reduces water retention, boosts metabolism	<i>Laghu</i> , <i>Ushna</i> , <i>Tikta</i> , <i>Kashaya</i>	<i>Kapha-Vata hara</i> , <i>Lekhana</i> , stimulates <i>Agni</i> , promotes <i>Shoshana</i> (drying)
<b>Little millet<sup>25</sup></b>	Contains phenolic acids, antioxidants, and complex carbs; good fibre content	Enhances digestion, regulates lipid profile, antioxidant protection	<i>Laghu</i> , <i>Ruksha</i> , <i>Tikta</i> , <i>Kashaya</i> , <i>Ushna</i>	Pacifies <i>Kapha</i> , reduces <i>Meda</i> , supports <i>Vatanulomana</i> (regulation of <i>Vata</i> )

Millets are highly nutritious grains recognized for their positive impact on weight management and metabolic health. One of their standout features is their rich dietary fibre content, typically ranging between 7% to 14%. This fibre helps slow digestion, promoting a longer lasting feeling of fullness, which can reduce overall food intake and help curb overeating.<sup>14</sup> Another notable advantage of millets is their low glycaemic index (GI), which ensures a gradual release of glucose into the blood stream. This helps maintain stable blood sugar levels and lowers the risk of insulin resistance which is an important factor in obesity and related metabolic disorders. In addition, millets are abundant in complex carbohydrates that supply sustained energy without causing sudden spikes or drops in blood glucose, thereby helping to control frequent hunger. They also offer a wealth of essential micronutrients such as iron, magnesium, phosphorous and B complex vitamins, which play vital role in hormone balance, energy production and

overall bodily functions.<sup>15</sup> Moreover, millet contain health promoting bioactive compounds like polyphenols and antioxidants that combat inflammation and oxidative stress which is a common issue in individual with obesity.<sup>16</sup>

### Mechanism by which millets help in weight loss

Millets are nutrient-dense grains that support weight management through multiple mechanisms. Their high fibre content delays gastric emptying, enhances satiety, and reduces calorie intake. With a low glycaemic index, millets promote steady glucose release, preventing insulin spikes that trigger fat storage. Rich in resistant starch, millets like barnyard and foxtail support gut microbiota diversity, enhancing metabolism and reducing inflammation. Additionally, millets provide magnesium, which improves insulin sensitivity and aids in glucose and lipid metabolism. These properties make millets effective

in regulating appetite, supporting metabolic health, and aiding sustainable weight loss, positioning them as a valuable addition to obesity management strategies (Table 2).

### **Ayurvedic explanation of millets in obesity**

According to Ayurveda principles, obesity (*Sthoulya*) is mainly attributed to an imbalance involving increase *Meda Dhatu* (fat tissue) and aggravated *Kapha Dosha*. This condition is typically accompanied by symptoms such as heaviness, fatigue, excessive fat accumulation, and shortness of breath.

A key underlying cause, as per Ayurveda, is impaired digestion (*Agnimandya*), which results in improper tissue nourishment and the accumulation of *Ama* (undigested food). Traditional Ayurveda texts including *Bhavaprakash Nighantu*, highlights millets as *Kudhanya* for their metabolic benefits and their potential help to reduce excess fat. Millets are valued for their specific attributes, which includes the following.

#### **Properties of millets**

##### *Laghu Guna (lightness)*

Enhances digestion and absorption by supporting digestive fire (*Agni*).

##### *Ruksha and Kashaya Rasa (dry and astringent tastes)*

Help dry excessive moisture and fat, balancing *Kapha* and reducing *Meda Dhatu*.

##### *Ushna Virya (hot potency)*

Stimulates metabolism and helps eliminate toxins (*Ama*).

##### *Lekhana Karma (scraping action)*

Aids in removing excess fat and impurities from the body's tissues.

Millets, traditionally referred to as *Kudhanya* in classical texts like *Bhavaprakash Nighantu* (under *Dhanya Varga*), are commonly recommended in managing *Sthoulya* (obesity) through diet. These grains are generally described as *Ruksha* (dry), *Laghu* (light) and possess *Tikta* (bitter) and *Kashya* (astringent) taste. Such characteristics are believed to pacify aggravated *Kapha Dosha* and promote the breakdown (*Lekhana* property) of excess *Meda Dhatu* (fat tissues).

Millets also exhibit *Usha Virya* (hot potency), which supports the activation of *Jatharagni* (central digestive

factor) and addresses *Agnmandhya* (weakened digestive factors), a central factor in the development of obesity.

Specific types like foxtail, kodo and barnyard millets are particularly valued in *Lekhaniye Ahaha-Vihara*, a therapeutic approach that combines diet and lifestyle to target fat reduction. Their consumption encourages for individual dealing with obesity because of their *Kapha*-balancing nature, ability to enhance digestive strength (*Agni*) and effectiveness in eliminating surplus fat.

The bitter and astringent qualities of these grains help to reduce excess oiliness in the body, while their lightness ensures that digestion remain efficient. Additionally, millets contribute to *Shroto-Shodhaha* (cleansing of bodily channels), which is essential in reducing fat and restoring systemic balance.

Therefore, integrating *Kudhanya* into regular diet is considered a therapeutic strategy in Ayurveda, owing to their properties that harmonize *Dosha*, enhance digestion and assist in the natural elimination of adipose buildup.<sup>26</sup>

#### **Incorporation of millets into daily diets for children in various forms**

Incorporating millets into children's diets significantly enhances nutrition due to their high content of protein, fibre, calcium, iron, magnesium, and B vitamins, all of which are crucial for growth, immunity, and brain development.

Their fibre supports digestion, prevents constipation, and promotes satiety, aiding in healthy weight management. As complex carbohydrates with a low glycaemic index, millets provide sustained energy and help maintain stable blood sugar levels, reducing obesity risk.

Naturally gluten-free and easy to digest, they suit children with sensitivities. Rich in antioxidants and micronutrients like zinc and iron, millets support learning and concentration. Versatile in recipes, they foster lifelong healthy eating habits when introduced early (Table 3).

#### **Precautions and considerations during millets consumptions**

While millets offer numerous health advantages, consuming them in large quantities without adequate hydration may lead to dryness and imbalance, especially in individuals with a dominant *Vata Dosha*, who are more prone to such effects.

To maintain internal harmony and support digestion, it is advisable to combine millets with warming spices such as cumin and ginger, and include nourishing fats like ghee or sesame oil in their preparation (Table 4).

**Table 2: Awareness of disease caused by dog bite.**

Millet	Mechanism in weight reduction
<b>Foxtail millet</b>	Rich in dietary fibre and complex carbohydrates with a low glycaemic index, it slows glucose release, prevents insulin spikes, and promotes satiety. Contains tryptophan, which helps regulate appetite and mood. Its slow digestibility reduces post-meal hunger. <sup>20</sup>
<b>Barnyard millet</b>	High in resistant starch and fibre, it acts as a prebiotic, supporting gut health and better glycaemic control. Low in calories and enhances satiety. Micronutrients support metabolic function. <sup>21</sup>
<b>Kodo millet</b>	Rich in antioxidants and phenolic compounds that reduce oxidative stress and inflammation. These compounds help modulate lipid metabolism and inhibit fat cell formation. High fibre improves digestion and satiety. <sup>22</sup>
<b>Finger millet</b>	Contains calcium, fibre, and essential amino acids like methionine and tryptophan, supporting muscle mass and metabolism. Slows gastric emptying for longer fullness. Should be used moderately due to slightly higher GI. <sup>23</sup>
<b>Pearl millet</b>	Packed with magnesium, phosphorus, and lignans that aid fat metabolism and thermogenesis. Insoluble fibre reduces fat absorption and supports cholesterol excretion. Has mild diuretic effects to reduce bloating. <sup>24</sup>
<b>Little millet</b>	Rich in flavonoids, phenolics, and fibre, it provides antioxidant and lipid-lowering effects. Supports triglyceride reduction, digestive health, satiety, and reduced energy intake through slow-digesting carbs. <sup>25</sup>

**Table 3: Common dietary forms of millets and their methods of preparation.**

Millet in dietary form	Method of preparation
<b>Millet porridge</b>	Cook foxtail or pearl millet into a soft porridge using milk and jaggery or honey.
<b>Millet idli/dosa</b>	Prepare fermented idlis or dosas using finger or little millet flour.
<b>Millet upma</b>	Use broken millet grains in place of semolina to make savory upma.
<b>Millet pancakes/chillas</b>	Mix millet flour with spices and chopped vegetables to make savory pancakes or chillas.
<b>Millet khichdi</b>	Cook millets with lentils and vegetables for a nutritious khichdi.
<b>Millet biscuits or cookies</b>	Bake biscuits or cookies using millet flour as a base for healthy snacks.
<b>Millet rotis/chapatis</b>	Replace wheat flour with barnyard or kodo millet flour to make flatbreads.
<b>Millet snacks</b>	Roast or puff millet grains for light and healthy snack options.
<b>Millet laddoos or energy balls</b>	Use roasted millet or flour with jaggery and nuts to roll into laddoos or energy bites.
<b>Millet smoothies</b>	Blend cooked millet or millet flour into fruit smoothies for added fibre and nutrients.

**Table 4: Precautions and considerations during millets consumptions.**

Consideration	Details
<b>Gradual introduction</b>	Prevents bloating and digestive discomfort
<b>Antinutritional factors</b>	Soaking, sprouting, fermenting reduces phytates and tannins
<b>Glycaemic index variability</b>	Prefer whole/minimally processed forms; monitor blood sugar levels
<b>Dosha compatibility</b>	Balance according to individual constitution ( <i>Vata, Pitta, Kapha</i> )
<b>Portion control</b>	Even though millets are nutritious, it’s important to keep your calorie intake in check.
<b>Food allergies</b>	Be aware of any possible allergies or food sensitivities.
<b>Medication interactions</b>	Time spent in space and when taking medications
<b>Cooking methods</b>	Utilize conventional techniques to improve nutrient availability and digestion.

**DISCUSSION**

The global rise in obesity has become a major public health concern, driving the prevalence of non-communicable diseases like heart disease, type 2 diabetes, and certain cancers. According to the WHO, obesity rates have nearly tripled since the 1970s, highlighting the urgent need for sustainable dietary interventions. Millets are nutrient-rich,

small-seeded grains such as barnyard millet, ragi, foxtail millet, bajra, and little millet—are gaining attention for their health benefits.

High in fibre and complex carbohydrates, and with a low glycaemic index, millets help regulate blood sugar, control appetite, and promote satiety, making them effective in obesity and weight management strategies.<sup>27</sup>

The dietary fibre in millets helps slow down the process of stomach emptying, leading to prolonged feelings of fullness. This not only aids digestion but also contributes to better blood sugar regulation and reduces overall food intake. Millets are also rich source of B complex vitamins and essential minerals such as iron, magnesium and phosphorous, all of which are vital for various metabolic processes.

Moreover, these grains contain powerful antioxidant, including flavonoids and phenolic acids, which help combat oxidative stress and inflammation, a common underlying factor on obesity and related metabolic disorders. Research has shown that replacing refined grains with millet-based options can significantly improve weight related and metabolic health outcomes.<sup>28</sup> For instance, evidence from randomized clinical trials shows that individuals who substitute millets for polished rice tend to experience reduction in waist size, body fat percentage and overall BMI. Additionally, eating millets has been linked to improved lipid profiles, such as lower levels of triglycerides and LDL cholesterol and higher levels of HDL cholesterol.<sup>29</sup>

Another ecological benefit of millets is that they are naturally hardy crops that need less water and fertilizer, which makes them appropriate for growing in semi-arid areas. Millets are not commonly consumed in metropolitan areas, despite their many advantages, because of a lack of awareness, availability, and culinary application skills. In order to close this disparity, government programs might incorporate millets into school meals and subsidized food distribution systems to promote their adoption, and public health initiatives should concentrate on raising millet awareness through educational campaigns.

According to Ayurveda, childhood obesity is associated with a rise in *Kapha Dosha* and the accumulation of *Meda Dhatu*, or fat tissue. Poor eating habits and weak digestive function (*Agni*) are thought to be the main contributors to incorrect metabolism and fat buildup. The main treatment for this illness, according to Ayurvedic scriptures, is food and lifestyle changes. Since millets are characterized as *Laghu* (light) and *Ruksha* (dry), qualities that aid in balancing *Kapha* and reducing extra adipose tissue, they fit in nicely with Ayurvedic concepts in this context. Consuming millets helps strengthen the digestive system, supports the elimination of *Ama* (undigested food) and contributes to maintaining internal balance within the body. In Ayurvedic practice, millets are valued not only as a nutritional food source but also for their therapeutic effects in managing obesity, particularly by improving digestion and promoting healthy elimination.

Incorporating millets into daily meals aligns with traditional approaches to healthy while also delivering essential nutrients. Their dual action – supporting both digestive and metabolic function, makes them a well-rounded, sustainable and culturally relevant choice for obesity management.

## CONCLUSION

Millets provide a holistic approach to tackling obesity by integrating time tested Ayurvedic insights with modern nutritional knowledge. Their ability to enhance satiety, regulated blood sugar, support metabolism, and maintain internal energy balance makes them particularly useful in managing lifestyle-related health issues. Known for their rich nutrient profile and therapeutic value, millets also represent a sustainable and culturally resonant food option. As global efforts intensify to find enduring solutions to obesity, millets emerge as a traditional crop with promising relevance for the future.

*Funding: No funding sources*

*Conflict of interest: None declared*

*Ethical approval: Not required*

## REFERENCES

1. Devi PB, Vijayabharathi R, Sathyabama S, Malleshi NG, Priyadarisini VB. Health benefits of finger millet (*Eleusine coracana* L.) polyphenols and dietary fiber: A review. *J Food Sci Technol*. 2014;51(6):1021-40.
2. Nambiar VS, Dhaduk JJ, Sareen N, Shahu T, Desai R. Potential functional implications of pearl millet (*Pennisetum glaucum*) in health and disease. *J Appl Pharm Sci*. 2011;1(10):62-7.
3. Anitha S, Kane-Potaka J, Tsusaka TW, Tripathi D, Upadhyay S, Kavishwar A, et al. Acceptance and impact of millet-based mid-day meal on the nutritional status of adolescent school-going children in a peri-urban region of Karnataka State in India. *Nutrients*. 2019;11(9):2077.
4. Agnivesha CS, Pandey K and Chaturvedi G, editors. Vidhyotini Hindi Commentary by Shastri SN. Reprint ed. Sutra Sthana 21/20. Choukhamba Bharati Acad. 2008:414.
5. Centers for Disease Control and Prevention. Childhood obesity facts. Atlanta (GA): CDC. 2022. Available at: <https://www.cdc.gov/obesity/data/childhood.html>. Accessed on 25 February 2025.
6. World Health Organization. Obesity and overweight. Geneva: WHO. 2023. Available at: <https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight>. Accessed on 25 February 2025.
7. Sahoo K, Sahoo B, Choudhury AK, Sofi NY, Kumar R, Bhadoria AS. Childhood obesity: causes and consequences. *J Family Med Prim Care*. 2015;4(2):187-92.
8. Biro FM, Wien M. Childhood obesity and adult morbidities. *Am J Clin Nutr*. 2010;91(5):1499S-505S.
9. Halfon N, Larson K, Slusser W. Associations between obesity and comorbid mental health, developmental, and physical health conditions in a nationally representative sample of US children aged 10 to 17. *Acad Pediatr*. 2013;13(1):6-13.

10. Stokes A, Collins CE, Callister R. Dietary approaches to obesity treatment. In: StatPearls. Treasure Island (FL): StatPearls Publishing. 2023.
11. Bishnoi S, Singhal H, Rai D. Childhood obesity and its exploration in Ayurveda: a review. Int J Health Sci Res. 2024;14:5.
12. Kumar Y, Joshi P, Patel H, Sahu K, Rathour G. Overview of Sthaulya (obesity) management in Ayurveda. J Ayurveda Integr Med Sci. 2025;9:10.
13. Saleh ASM, Zhang Q, Chen J, Shen Q. Millet grains: nutritional quality, processing, and potential health benefits. Compr Rev Food Sci Food Saf. 2013;12(3):281-95.
14. Thathola A, Sharma S, Jaiswal A. Nutritional and functional properties of millets and their potential use in managing diabetes and obesity. J Food Sci Technol. 2019;56(7):3010-20.
15. Chandrasekara A, Shahidi F. Content of insoluble bound phenolics in millets and their contribution to antioxidant capacity. J Agric Food Chem. 2010;58(9):6706-14.
16. Pathak V, Majumder K, Gupta N, Sharma D, Khanna S, Sinha N. Antioxidant and anti-inflammatory effects of millets in metabolic health: a systematic review. Nutrients. 2020;12(6):1725.
17. Agnivesha CS, Pandey K and Chaturvedi G, editors. Vidhyotini Hindi Commentary by Shastri SN. Reprint ed. Sutra Sthana 27/8. Choukhamba Bharati Acad. 2008:527.
18. Bhavamishra BN, Chunekar KC, editors. Hindi Commentary by Pandey GS. Reprint ed. Dhanya Varga. Chaukhambha Bharati Acad. 2002:185-210.
19. Vagbhata AH, Tripathi B, editors. Nirmala Hindi Commentary. Reprint ed. Sutrasthana 6/1-10. Chaukhamba Sanskrit Pratishthan. 2014:73.
20. Choi Y, Jang S. Anti-obesity effects of *Setaria italica* (foxtail millet) in high-fat diet-induced obese mice. Nutr Res Pract. 2014;8(6):544-9.
21. Veena S, Geetha K. Nutritional and functional quality of barnyard millet: A review. Int J Chem Stud. 2018;6(4):1729-33.
22. Pradhan RC, Naik SN, Bhatnagar N, Swain S. Moisture-dependent physical properties of kodo millet grain. Biosyst Eng. 2010;106(4):598-606.
23. Shobana S, Krishnaswamy K, Sudha V, Malleshi NG, Anjana RM, et al. Finger millet (Ragi) as a source of dietary calcium and other nutrients: A review. J Food Sci Technol. 2013;50(1):1-16.
24. Malik R, Agarwal M. Effect of pearl millet (*Pennisetum glaucum*) based diet on lipid profile of hyperlipidemic subjects. Int J Food Nutr Sci. 2012;1(3):37-42.
25. Chandrasekara A, Shahidi F. Content of insoluble bound phenolics in millets and their contribution to antioxidant capacity. J Agric Food Chem. 2010;58(11):6706-14.
26. Bhavamishra BN, Chunekar KC, editors. Hindi Commentary by Pandey GS. Reprint ed. Dhanya Varga. Chaukhambha Bharati Acad. 2002:185.
27. Singh AK, Kumar P, Singh M. Nutritional and therapeutic potential of millets: A review. Clin Nutr ESPEN. 2021;41:16-24.
28. Pathania S, Sharma A, Bhatia R. Millets: A solution to modern lifestyle disorders. Clin Epidemiol Glob Health. 2020;8(2):450-7.
29. Anitha S, Kane-Potaka J, Tsusaka TW, Botha R, Rajendran A, Givens DI, et al. A systematic review and meta-analysis of the potential of millets for managing and reducing the risk of developing diabetes mellitus. Front Nutr. 2021;8:687428.

**Cite this article as:** Rawat H, Ojha NK. Millets in the dietary management of childhood obesity: bridging modern nutrition and Ayurvedic principles. Int J Community Med Public Health 2026;13:3211-8.