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Systematic Review

Herbal wisdom in childhood obesity: a systematic review on the role of ayurvedic drugs and therapies

Himanshu Rawat[1]*, Megha Negi[2], Nisha Kumari Ojha[3]

[1]Department of Ayush and Ayush Education, Government of Uttarakhand, Dehradun, India
[2]Department of Samhita and Sanskrit, Gangasheel Ayurvedic Medical College and Hospital, Bareilly, Uttar Pradesh, India
[3]Department of Kaumarbhritya, National Institute of Ayurveda, Deemed to Be University (De Novo), Jaipur, Rajasthan, India

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***Correspondence:**
Dr. Himanshu Rawat,
E-mail: himanshu.r1919@gmail.com

ABSTRACT

Childhood obesity is a growing global health concern linked to metabolic disorders and future chronic diseases. Conventional management has limited long-term success, whereas Ayurveda offers a holistic approach through individualized diet, herbal formulations, Panchakarma therapies, and lifestyle modifications. The objective of this systematic review was to critically evaluate and synthesize the available evidence regarding the safety, efficacy, and effectiveness of Ayurvedic interventions in the management of childhood obesity. The study reviewed randomized controlled trials (RCTs), non-RCTs, and case studies on the management of childhood obesity in Ayurveda. They were retrieved through Ayurveda research databases and Medical Journal databases such as Medline, Scopus, Web of Science, and other directories of open access journals. Hand searching was done using predefined search terms. The search was limited to articles published till July 2024. Study selection followed the symptomatology of childhood obesity. The data were documented and extracted using study ID and design, sample size, duration, interventions, outcomes, and result. Quantitative synthesis was not attempted as we aimed at only systematic review. Of the identified records, 16 studies met the inclusion criteria. Ayurvedic herbal formulations, Panchakarma therapies, dietary regulation, lifestyle modifications, and yoga were the most commonly evaluated interventions. Overall, these approaches improved body weight, BMI, waist circumference, lipid profile, digestive function, and overall well-being, with combined therapies demonstrating the most favourable clinical outcomes. Ayurvedic interventions show promise for childhood obesity; however, robust multicentre RCTs are needed to confirm effectiveness and safety.

Keywords: Childhood obesity, Ayurveda, Sthaulya, Meda Dhatu, Triphala

INTRODUCTION

One of the most important public health issues of the twenty-first century is childhood obesity. Childhood obesity is defined by the World Health Organization (WHO) as abnormal or excessive fat buildup that poses a health risk. Childhood obesity is identified when a child's body weight is much higher than what is generally expected for their age and height.[1] Health professionals often use the body mass index (BMI) percentile, adjusted for age and sex, to assess this condition. As per guidelines from the Centres for Disease Control and Prevention (CDC), a child is considered overweight if their BMI is between the 85th and 95th percentile, and classified as obese if it goes beyond the 95th percentile.[2] Childhood obesity has seen a significant and rapid rise worldwide, and India reflects this disturbing pattern. As reported in the Indian Journal of Community Medicine (20022), more than 14.4% of Indian children aged 5 to 19 fall into the overweight or obese category explaining an increase

that marks a stark contrast to figures from previous decades.[3] The National Family Health Survey-5 (2019-21) also reported an upward trend in the number of overweight children, indicating the growing magnitude of this health issue. Key contributors include longer hours spent in front of screens, lack of physical activity, increasing urban development, and the widespread availability of energy-dense but nutrient poor foods.[4]

Ayurveda offers a traditional approach that may help in managing childhood obesity. Rooted in ancient Indian medical wisdom, this holistic system stresses importance of balance in Ahara (diet), Vihara (lifestyle) and Achara (personal conduct). Understanding obesity through the Ayurvedic lens involves concept of Medoroaga (fat tissues diseases), which is associated with disorders related to fat metabolism. Treatments often include natural substances like Triphala, Guggulu and Mustaka, known for their properties that support fat reduction and improve metabolic function. Furthermore, incorporation of Dinacharya (daily habits), Ritucharya (seasonal adjustments), and practices like yoga can promote mental well-being and regulate metabolism, playing preventive and therapeutic role in childhood obesity.

Despite growing burden of childhood obesity, evidence regarding effectiveness of ayurvedic interventions remains scattered across individual clinical studies. Herbal formulations, Panchakarma therapies, dietary regulation and lifestyle modifications have shown promising outcomes; however, a comprehensive synthesis of available evidence is lacking. Therefore, present systematic review undertaken to critically evaluate and synthesize published literature on Ayurvedic interventions for childhood obesity and to provide evidence regarding their safety, efficacy, and therapeutic effectiveness.

METHODS

Designs

This systematic review aimed to explore Ayurvedic approaches to managing childhood obesity and to examine how these traditional methods can be aligned with current scientific understanding. The review focused in particular on evaluating the role of Ayurvedic dietary practices and principles as part of a broad and sustained effort to tackle this growing public health issue. Classical Ayurvedic texts including those from Kaumarbhritya (paediatrics) and major compendia such as the Bṛihat Trayi (Charaka Samhita, Sushruta Samhita, and Ashtanga Hridaya) and Laghu Trayi (Madhava Nidana, Sharangadhara Samhita, and Bhava Prakasha) were reviewed. Classical Ayurvedic texts such as Dhanvatantar Nighantu, Raj Nighantu and Kaideva Nighantu were carefully examined for insights related to Sthaulya (obesity), including its root causes and treatment approaches, especially concerning children. To complement this traditional knowledge, and extensive digital literature review was also performed using sources like PubMed, the AYUSH research portal, DHARA (Digital helpline for Ayurveda research article), Google Scholar and official websites of health and nutrition organizations. Only the years 2001 through 2024 were included in the search.

Eligibility criteria

Inclusion criteria comprised clinical studies involving human participants of any age or sex, diagnosed with overweight or obesity (BMI ≥25 or clinical diagnosis of Sthaulya), who received Ayurvedic herbal formulations either as mono-herbal or polyherbal interventions. Eligible study designs included RCTs, quasi-experimental studies, pre-post interventions, animal or in vitro study, and case series/reports with clearly defined outcomes such as weight, body mass index (BMI), waist circumference, lipid profile, body fat percentage, and glycaemic markers. Studies were excluded if they lacked herbal formulations, involved non-Ayurvedic interventions, had incomplete outcome data, or were editorials, commentaries/reviews without original data.

Information sources

Search methods for identification of studies were grouped under headings of electronic searchers. We searched the following Ayurveda and Medical Journal databases such as AYUSH Research Portal, DHARA (Digital Helpline for Ayurveda Research Abstracts), MEDLINE via PubMed and CAM on PubMed, PubMed Central, Cochrane Library (Cochrane Central Register of Controlled Trials), NISCAIR Online Periodicals Repository (NOPR), Cochrane Complementary Medicine trial register, Web of Science, Scopus, Embase, Directory of Open Access Journals (DOAJ), Google Scholar, Open Access Databases, Free Medical Journals database, for ongoing trials clinical trial registry of India, World Health Organization.

Hand searching

Hand search was done for those which are not indexed in any electronic database using Ayurveda Research Database (ARD), thesis works, conference proceedings, newsletters, bibliographies, and souvenirs.

RESULTS

The present systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to comprehensively evaluate the available evidence on Ayurvedic interventions for childhood obesity, with particular emphasis on herbal formulations and Panchakarma therapies. A systematic literature search identified 44 potentially relevant records from electronic databases and other sources, including observational and interventional studies from both Ayurvedic and contemporary scientific literature, which were

subsequently screened according to predefined eligibility criteria. Of these, 16 studies were found to be directly aligned with the objectives of the review. An in-depth analysis revealed that Ayurvedic herbal medicines, especially those categorized under Medohara (anti-obesity) and Lekhana (scraping) Dravyas, were frequently used in clinical studies. These include classical formulations such as Triphala Guggulu, Navaka Guggulu, Medohara Vati, Varadi Kashaya Vati, and Lekhaniya Mahakashaya combinations. Ingredients commonly found in these preparations include Guggulu (*Commiphora wightii* (Arn.)), Triphala [Amalaki (*Emblilca officinalis* Gaertn), Haritaki (*Terminalia chebula* Retz.), Bibhitaki (*Terminalia bellirica* (Gaertn.) Roxb.)], Trikatu [*Pippali* (*[Piper longum* L.), Shunthi (*Zingiber officinalis* Rosc), Maricha (*Piper nigrum* Linn)], Musta (*Cyperus rotundus* L.), and Vidanga (*Embelia ribes* Burm.f.), all which described in Ayurvedic texts as possessing Deepana (appetite stimulant), Pachana (digestive stimulant), Kapha-Medohara (fat and phlegm reducing), and Shothahara (anti-inflammatory) properties. Several studies incorporated polyherbal combinations tailored to individual Prakriti (constitution) and disease status, adhering to classical guidelines from texts like Charaka Samhita, Ashtanga Hridayam and Bhavaprakasha (Figure 1).

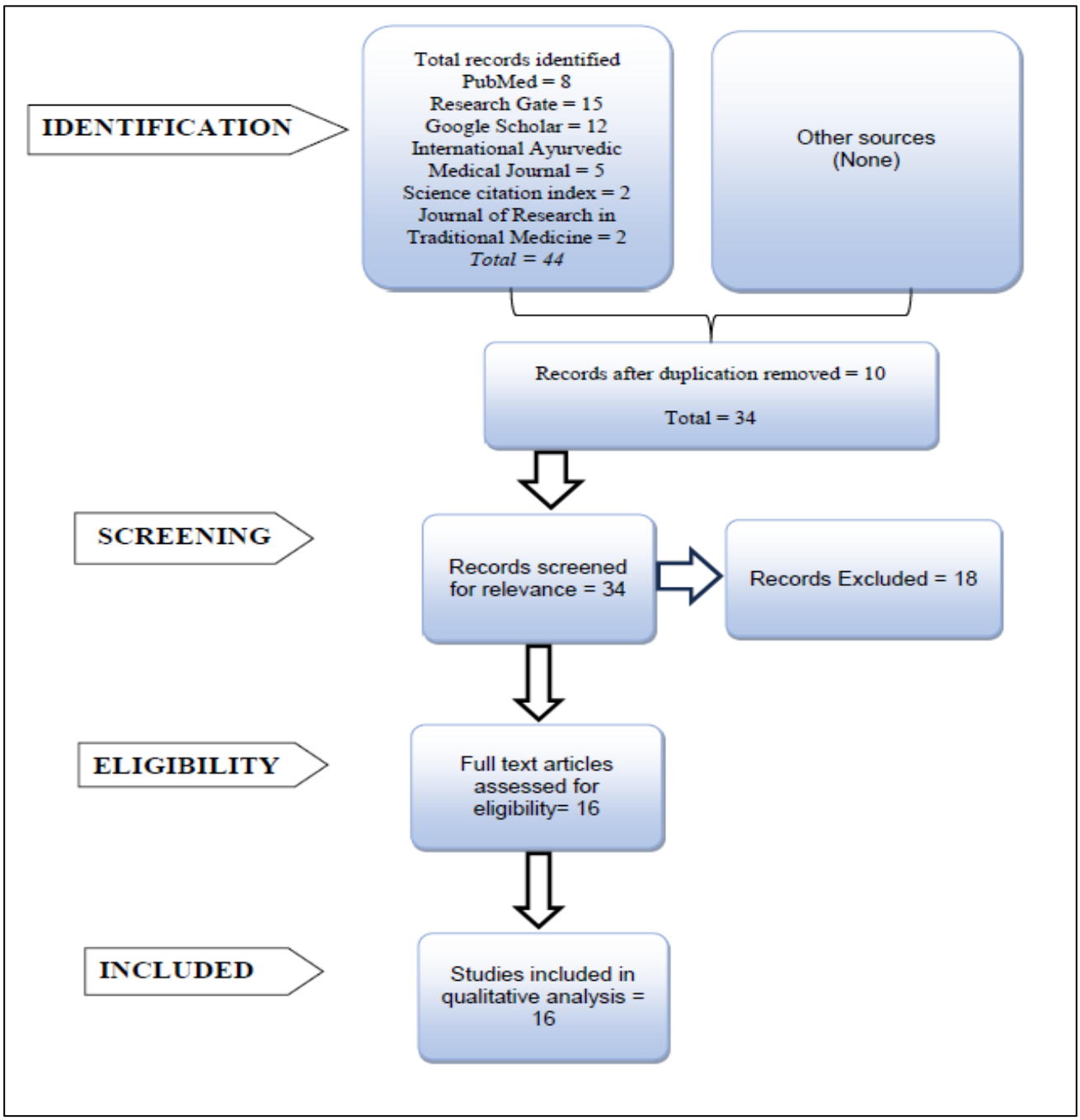

Figure 1: PRISMA flow chart for the study.

Selected studies were further analysed based on dosage, duration, outcomes, and pharmacological basis of intervention. Panchakarma therapies, particularly Lekhana Basti (therapeutic scraping enema), Udwartana (therapeutic powder massage), and Virechana (therapeutic purgation), were also shown to play a critical adjunctive role in reducing Medodhatu (fat tissue) and regulating Agni (digestive/metabolic fire) in children with obesity.

The evidence compiled from these sixteen studies was synthesized thematically to generate a holistic Ayurvedic framework for management of paediatric obesity.

This framework integrates herbal pharmacotherapy, Panchakarma, personalized dietetics, and lifestyle counselling, validated by clinical outcomes like reduction in BMI, waist circumference, triglyceride levels, and improvement in digestion and energy.

Findings reaffirm relevance of Ayurvedic treatment strategies in contemporary management of childhood obesity and provide a platform for integrative clinical application supported by traditional wisdom and modern research methodology.

RESULTS

The present review compiles and analyses clinical studies and classical references to evaluate the role of Ayurveda in the management of childhood obesity. Emphasis has been placed on Ayurvedic interventions such as herbal formulations and Panchakarma therapies.

The following observations summarize the findings from selected studies, highlighting the methodologies, interventions, and outcomes to understand the efficacy and scope of Ayurvedic treatment in the paediatric obesity management.

Useful drugs in managing childhood obesity

The below table compiles key clinical, experimental, and case studies that evaluated efficacy of various Ayurvedic drugs and interventions notably Guggulu, Triphala, Vrikshamla, Musta, Haridra, Shunthi, Vacha, Pippali, Shilajit, Kokum and Punarnava, either individually or in polyherbal formulations.

Across diverse study designs and populations, these herbs have consistently shown beneficial effects in reducing body weight, BMI, waist circumference, lipid profiles, and improving digestion, energy levels, and overall metabolic health.

Mode of action of ayurveda drugs in managing obesity

The Ayurvedic approach to managing childhood obesity is deeply rooted in the principles of Agni Deepana (digestion and metabolism enhancing) and Ama Pachana (digesting undigested food), which are considered foundational in addressing the root cause of Sthaulya (obesity). According to classical texts, obesity arises primarily due to Mandagni (low digestive factors), which leads to the accumulation of Ama (undigested food), or toxic by-products of incomplete digestion.

Herbs like Trikatu (a combination of Pippali, Shunthi, and Maricha), Chitraka, and Musta are well known for stimulating digestive activity, increasing metabolic efficiency, and clearing digestive channels. From a modern perspective, these herbs enhance thermogenesis, regulate lipid metabolism, and modulate gut microbiota, contributing to improved energy balance.

Another key mechanism is Lekhana (scraping) and Medohara (fat-reducing) action of certain herbs like Guggulu, Haridra, Triphala, and Vrikshamla. These formulations are traditionally used to reduce excessive Meda Dhatu (fat tissues) and normalize Kapha Dosha. Scientific studies have validated the presence of bioactive compounds such as guggulsterones and hydroxycitric acid, which inhibit fat production, mobilize stored fat, and suppress appetite.[40]

Herbs such as Triphala, Punarnava, and Guduchi also exhibit Srotoshodhana (channel-cleansing) activity by detoxifying metabolic pathways and improving hepatic and renal function. These actions align with modern findings on their anti-inflammatory, antioxidant, and hepatoprotective properties.[41]

Obesity, being a Kapha-Meda (fat tissues) dominant disorder, is also managed by regulating Dosha (regulatory functional factors of the body) balance. Herbs like Pippali, Vacha, and Chitraka pacify Kapha and stimulate Agni (digestive factors), thereby reducing fat deposition. They are also known to improve insulin sensitivity and promote thermogenic activity, helping in the long-term regulation of body weight.[42]

Importantly, certain drugs such as Guduchi, Shilajit, and Triphala possess Rasayana (rejuvenating) properties, which are essential in paediatric care. These help in nourishing Dhatus (major structural components of the body) while correcting metabolic dysfunctions and boosting immunity.[43]

Lastly, several herbs exert effects on the neuroendocrine system, which plays a significant role in obesity. Herbs like Vrikshamla, Haridra, and Shunthi have been found to influence hormones such as leptin, insulin, and the cortisol.

For instance, curcumin (from Haridra) and gingerol (from Shunthi) have been shown to reduce leptin resistance, suppress pro-inflammatory cytokines, and improve glycaemic control, mechanisms that are now recognized as crucial in combating obesity.[44]

Table 1: Summary of Ayurveda clinical and experimental studies on the management of childhood obesity.

Author(s)	Sample size	Study period	Study design	Study intervention	Dosage schedule	Outcome measures
Naram et al (2024)[5]	60 children	3 months	Randomized controlled trial	Polyherbal tablets: Mednil (Guggulu, Triphala, Trikatu, Musta) and Suhruday (Arjuna, Punarnava, Shilajit). Used alongside Ayurvedic diet and modified Panchakarma (Obetox protocol).	Mednil and Suhruday tablets twice daily after meals; Panchakarma (Basti, Virechana) every 15 days.	Significant reduction in weight, BMI, waist-hip ratio, triglycerides, LDL; improved energy and digestion
Goyal et al (2013)[6]	80 patients	Not specified	Clinical study	Use of Agnimanthadi compound (Agnimantha, Shyonaka, Gambhari, Patala, Brihati), and Vashpa Svedana (steam therapy)	Agnimanthadi decoction: 50 ml twice daily; Vashpa Svedana (steam therapy): once daily for 21 days.	Marked reduction in weight, BMI, and other symptoms in patients of Sthaulya (obesity)
Tikoo et al (2012)[7]	Animal study	21 weeks	Experimental study	Animal study using Kal-1 formulation: Guduchi, Haridra, Amla, Yashtimadhu, Guggulu, and Neem.	Kal-1 administered orally in doses of 5, 20, and 75 µg daily for 21 weeks.	Significant reduction in body weight, fat pads, fasting blood glucose, and improved immune-metabolic parameters.
Chandake et al (2024)[8]	Not specified	12 weeks	Randomized, double-blind, RCts	Traushnadya Churna (Pippali, Chitraka, Nagara), with daily yoga and an Ayurvedic diet regimen.	Trayushnadya Churna: 3 g twice daily with lukewarm water; Yoga sessions: 30 mins/day.	Significant decrease in weight, BMI, WC, and improved QoL.
Damor et al (2022)[9]	40 children	6 weeks	Clinical study	Varadi Kashaya Vati (Triphala, Trikatu, Kutki, Musta); Navak Guggulu (Guggulu, Haritaki, Amalaki, Shunthi, Pippali, Maricha, Vidanga, Chitraka).	Varadi Kashaya Vati: 250 mg and Navak Guggulu: 500 mg twice daily with lukewarm water.	Observed reduction in weight and BMI among children.
Rathore et al (2024)[10]	1 patient	5 months	Case study	Sequential Panchakarma: Udwartana (therapeutic powder massage) (Chickpea flour + Triphala), Snehana (therapeutic oleation) with Tila Taila, Swedana (sudation therapy), Virechana (therapeutic purgation) with Trivrit Lehya, and matra Basti (a form of unctuous enema) with Bala taila.	Udwartana: daily for 30 days, followed by Snehana-Swedana; Virechana on day 31; Basti monthly.	Achieved weight loss of 23 kg and BMI reduction over 5 months.
Verma et al (2019)[11]	1 patient	Not specified	Case report	Customized Panchakarma (Udwartana with Triphala + barley flour), yoga-based physical therapy, low-fat Ayurvedic diet. Herbs: Musta, Gokshura, Arjuna.	Udwartana (therapeutic powder massage) -15 days; Yoga 5x/week; dietary regulation daily.	Significant improvement in functional capacity, quality of life, and musculoskeletal pain.
Rioux et al (2019)[12]	17 participants	3 months	Pilot study	Whole-systems protocol using Dosha-based herbs (Triphala, Guggulu, Musta), Yoga sessions (Asanas, Pranayama), and ayurvedic lifestyle guidance (Dinacharya and Ritucharya)	Tailored herbal therapy per dosha; Yoga 3x/week; lifestyle counselling weekly.	Demonstrated feasibility and potential benefits in weight loss and health outcomes.
Prajapati et al (2019)[13]	1 patient (16-year-old Hindu male student in the 11th standard)	8 weeks	Case report	The intervention involved administration of Triphalaguduchyadi Vati (Triphala (Haritaki, Bibhitaki, Amalaki), Guduchi, Pippali, Trikatu (Sonth, Marich, Pippali), Vidanga), along with Ayurvedic dietary recommendations and lifestyle counselling.	Triphalaguduchyadi Vati: 2 tab twice daily after meals, adjuvant Pathya: Light, low-fat, fiber-rich diet and lifestyle modifications advised, including daily routine and physical activity.	Reduction in weight and BMI Improved digestion and elimination Better energy levels reported by the patient.

Continued.

Author(s)	Sample size	Study period	Study design	Study intervention	Dosage schedule	Outcome measures
Kishore et al (2017)[14]	165 obese patients	12-week treatment phase followed by a 2-week post-treatment follow-up	Prospective, open-label, multicentre clinical trial conducted at three peripheral centres of the Central Council for Research in Ayurvedic Sciences	Vyoshadi Guggulu: 1.5 grams, administered twice daily before meals with lukewarm water. Haritaki Churna: 3 grams, administered twice daily before meals with lukewarm water	Both formulations were administered for 12 weeks. Patients were followed up for an additional 2 weeks without medication to assess the sustainability of the treatment effects.	Statistically significant reductions in BMI, WC and HC and waist-hip ratio ($p<0.001$). Significant decrease in serum cholesterol levels from mean of 187.79 mg/dL at baseline to 183.84 mg/dL at 84 days ($p<0.022$). Positive changes in bowel regularity and energy levels.
Deborah et al (2019)[15]	Single-patient case study involving a 28-year-old obese male.	4 months	Interventional case study with a phased approach: Month 1: Morning walking. M 2: Morning walking combined with dietary modifi-cations. M- 3 and 4: Morning walk, dietary modifi-cations, and administration of Navaka Guggulu tablets	This study focused on Navaka Guggulu (Guggulu, Haritaki, Bibhitaki, Amalaki, Shunthi, Maricha, Pippali, Chitraka, Vidanga) Navaka Guggulu is a modified Guggulu-based formulation that targets Meda Dhatu (fat tissue) and improves Agni (digestive fire).	Two tablets of Navaka Guggulu taken daily during the third and fourth months, alongside continued walking and dietary regi	Weight reduction: 0.5 kg after the first month. 0.8 kg after the second month. 4.7 kg after the fourth month. Decrease in total cholesterol, triglycerides, low-density lipoprotein (LDL), and very low-density lipoprotein (VLDL).
Khandelwal et al (2023)[16]	100 children (Group A=50, group B=50)	3 months	Randomized controlled trial	Group A was treated with Shilajatu-based formulation (Shilajit capsules), while Group B was managed with Yavadi Churna. Both interventions aimed at reducing excess Meda and correcting Agni. Shilajit Capsule: Purified Shilajatu Yavadi Churna: Barley (Yava), Haridra, Daruharidra, Musta, Pippali.	Group A (Shilajit capsules): 250 mg twice daily with lukewarm water. Group B (Yavadi Churna): 3 grams twice daily with lukewarm water. Dietary advice: Low-glycaemic index diet and restriction of calorie-dense foods. Activity: Advised yoga and brisk walking for 30 minutes daily.	Group A showed marked reduction in lipid profile parameters and fat %. B-exhibited enhanced digestive strength, weight loss, and BMI improvement. Both groups reported positive changes in energy levels and digestive health
Dole et al (2020)[17]	40 children (aged 10-14 years)	60 days	Open-label interventional clinical study	This study evaluated efficacy of Lekhan Basti (medicated enema for fat scraping) combined with Ayurvedic diet and yoga in obese children. Basti is known for its role in cleansing, nourishing, and regulating Vata and Meda. Niruha Basti (therapeutic decoction enema): Eranda Moola, Dashamoola Kashaya, Madanaphala, Gomutra, Saindhava Anuvasana Basti (therapeutic unctuous enema): Tila Taila processed with Triphala, Vacha, and Trikatu.	Lekhan Basti: 16-day protocol (8 Niruha Basti + 8 Anuvasana Basti). Diet: Pathyahara (low-fat, high-fibre diet), avoidance of curd, fried, and sugary food. Yoga: Daily sessions of Pranayama, Surya Namaskar, and specific Asanas (30-45 mins/day).	Significant reduction in weight and BMI. Improvement in digestive strength, bowel movement, and physical stamina. Better sleep patterns and reduction in fatigue.

Continued.

Author(s)	Sample size	Study period	Study design	Study intervention	Dosage schedule	Outcome measures
Giri et al (2018)[18]	24 children (12 in each group)	30 days	Comparative clinical study	Group A was administered Triphala Guggulu, while Group B received Varunadi Kashayam, both classical formulations for Medoroga (obesity-related disorders). Triphala Guggulu: Haritaki, Bibhitaki, Amalaki, Guggulu, Pippali Varunadi Kashayam: Varuna, Daruharidra, Gokshura, Haritaki, Amalaki.	Group A (Triphala Guggulu): 500 mg tablet twice daily after meals Group B (Varunadi Kashayam): 15 ml twice daily before meals. Lifestyle advice: Regulated food habits, physical activity, no junk foods or aerated drinks.	Group A showed greater reduction in BMI and weight circumference. Group B had better improvement in lipid metabolism and digestive fire (Agni). Both groups showed improved appetite control and energy levels.
Deshpande et al (2021)[19]	30 children	45 days	Single-arm Clinical Study	The study assessed the effect of Udvartana (therapeutic powder massage) with Triphaladi Churna and internal administration of Guggulu Panchapala Churna in obese children. Triphaladi Churna: Triphala, Musta, Chitraka Guggulu Panchapala Churna: Guggulu, Triphala, Trikatu, Chitraka, Vidanga.	Udvartana: 30 minutes daily before bath for 30 days. Guggulu Panchapala Churna: 3 g twice daily with lukewarm water. Diet: Laghu (light) diet, avoidance of curd and fried food.	Decrease in body weight, waist circumference, and BMI. Improved skin tone, circulation, and metabolism. Reduction in *Kapha* symptoms like lethargy and heaviness.
Raval et al (2022)[20]	40 patients (20 in each group)	60 days	Randomized comparative clinical study	This study compared Medohara Vati with Nimbadi Guggulu in reducing body weight and managing childhood obesity. Medohara Vati: Triphala, Kutki, Guggulu, Trikatu, Vrikshamla Nimbadi Guggulu: Nimba, Guggulu, Haridra, Amalaki, Guduchi	Group A (Medohara Vati): 500 mg tablet twice daily with lukewarm water Group B (Nimbadi Guggulu): 250 mg tablet thrice daily before meals Both groups were advised daily physical activity and avoidance of heavy and cold food	Group A had better fat reduction and metabolism enhancement. Group B showed significant improvement in appetite control and lipid profile. Both groups experienced improved Agni and daily routines.

Table 2: Comparative Ayurveda and modern pharmacological mechanisms of medicinal herbs used in the management of childhood obesity.

Herb	Ayurveda mode of action	Modern scientific mode of action
Guggulu *(Commiphora wightii* (Arn.)*)*	Lekhaniya (scraping), balances Kapha and Vata, breaks down Meda (fat tissues).	Guggulsterones enhance thyroid function and lipid metabolism, reduce cholesterol and triglycerides.[21]
Triphala	Rasayana (rejuvenating), balances all Doshas (regulatory functional factors of the body), detoxifies, reduces Kapha and Meda (fat tissues).	Antioxidant, improves lipid metabolism, enhances insulin sensitivity.[22]
Vrikshamla *(Garcinia indica* (Thouars) Choisy*)*	Appetite suppressant, curbs excessive Kapha	Hydroxycitric acid inhibits fatty acid synthesis enzyme ATP-citrate lyase, reduces fat synthesis and appetite.[23]
Musta *(Cyperus rotundus* Linn*)*	Deepana (digestion and metabolism enhancing), Pachana (enhancing digestion), reduces Ama (undigested food).	Anti-inflammatory and antioxidant compounds improve metabolic function.[24]
Haridra *(Curcuma longa* Linn*)*	Reduces Kapha, anti-inflammatory, supports digestion.	Curcumin modulates adipokines, reduces inflammation, improves insulin sensitivity.[25]
Shunthi *(Zingiber officinalis* Rosc.*)*	Enhances Agni (digestive factors), reduces Kapha and Ama (undigested food).	Gingerol increases metabolic rate, promotes lipid oxidation, thermogenic effects.[26]

Continued.

Herb	Ayurveda mode of action	Modern scientific mode of action
Guduchi *(Tinospora cordifolia* (Willd.) Hook. f. and Thomson)	Rasayana (rejuvenating), balances Doshas (regulatory functional factors of the body), aids detoxification.	Immunomodulatory, enhances insulin secretion, improves glucose metabolism.[27]
Arjuna *(Terminalia arjuna* (Roxb. exDC.) Wight and Arn.)	Cardio-protective, manages Meda Dhatu (fat tissues) imbalance.	Lowers LDL cholesterol and triglycerides, supports cardiovascular health.[28]
Vacha *(Acorus calamus* L.)	Stimulates nervous system, enhances digestion, reduces Kapha.	Neuroprotective effects, may influence metabolism via central nervous system.[29]
Punarnava *(Boerhaavia diffusa* L.)	Diuretic and anti-inflammatory, reduces water retention.	Exhibits diuretic effects, reduces lipid accumulation, hepatoprotective properties.[30]
Chitraka *(Plumbago zeylanica* Linn)	Strong digestive and carminative, enhances Agni (digestive factors), reduces Kapha and Meda (fat tissues).	Stimulates metabolism, anti-inflammatory due to plumbagin content.[31]
Pippali *(Piper longum* L.)	Stimulates digestion and metabolism, reduces Ama (undigested food) and Kapha.	Piperine enhances thermogenesis, metabolic rate, and bioavailability of nutrients.[32]
Gokshura *(Tribulus terrestris* L.)	Balances Kapha and Vata, supports urinary health, reduces water retention.	Diuretic properties, may affect lipid metabolism.[33]
Shilajit *(Mineral resin)*	Rasayana (rejuvenating), enhances metabolism, balances Doshas (regulatory functional factors of the body).	Improves mitochondrial function and energy production.[34]
Kokum *(Garcinia indica* L.)	Balances Pitta and Kapha, improves digestion, reduces fat.	Antioxidant and anti-inflammatory (garcinol) properties.[35]
Amalaki *(Emblica officinalis* Gaertn)	Rasayana (rejuvenating), Tridoshaghna (balances all three regulatory functional factors of the body), Lekhana (scrapping property).	Antioxidant, lipid-lowering, anti-inflammatory.[36]
Bala *(Sida cordifolia* L.)	Balya (improves immunity), Brimhana (improves strength), Vatahara (pacify Vata Dosha).	Thermogenic, anti-inflammatory, lipid lowering.[37]
Bibhitaki *(Terminalia belerica* Roxb.)	Lekhana (scrapping property), Kapha-Medohara (reduces fat tissues)	Lipid-lowering, digestive stimulant.[38]
Daruharidra *(Berberis aristata* DC.)	Pitta-Kapha Shamaka (pacify Pitta and Vata Dosha)	Anti-inflammatory, hypoglycaemic.[39]

Table 3: Ayurveda therapeutic principles and their modern scientific correlates with key herbs in managing childhood obesity.

Ayurveda concept	Modern Correlate	Key Herbs
Agni Deepana (digestion and metabolism enhancing)	Thermogenesis, metabolic boost	Trikatu, Chitraka, Musta
Medohara (fat-reducing) and Lekhana (scraping)	Lipid mobilization, appetite regulation	Guggulu, Haridra, Vrikshamla
Srotoshodhana (channel-cleansing)	Detoxification, liver support	Triphala, Guduchi, Punarnava
Kapha-Meda (fat tissue) balancing	Hormonal and metabolic regulation	Vacha, Chitraka, Shilajit
Rasayana (rejuvenating)	Mitochondrial and immune enhancement	Guduchi, Triphala, Shilajit
Hormonal regulation	Leptin/insulin modulation	Haridra, Shunthi, Vrikshamla

DISCUSSION

The reviewed clinical and experimental studies collectively reinforce the therapeutic potential of Ayurvedic formulations and interventions in managing obesity, particularly among paediatric populations. Most interventions demonstrated significant improvements in anthropometric measures such as body weight, BMI, and waist-hip ratio, alongside enhanced metabolic and digestive functions. Polyherbal formulations like Mednil and Suhruday, and classical preparations such as Vyoshadi Guggulu, Triphala Guggulu, and Navaka Guggulu showed consistent efficacy in weight reduction and lipid profile modulation.[45-47] These combinations typically included well-documented anti-obesity herbs like Guggulu, Triphala, Trikatu, and Musta, which exhibit digestive stimulation, lipid-lowering, and detoxifying actions. Panchakarma therapies were frequently employed, either independently or adjunctively, enhancing outcomes through their fat-reducing and metabolic balancing effects. Notably, interventions integrating dietary and lifestyle modifications (e.g., low-fat, high-fibre diets and yoga sessions) proved more effective than standalone therapies. Overall, the evidence supports Ayurveda's integrative model, targeting digestion, Agni (metabolism), and Meda (fat tissue), as a viable approach for addressing obesity, particularly in children and adolescents, where early intervention is critical.

The integration of Ayurvedic knowledge with modern pharmacological evidence reveals promising avenues in managing childhood obesity through herbal interventions. The herbs listed in the table no.2 reflect a holistic approach that targets the multifactorial pathology of obesity, particularly in paediatric populations, by modulating digestion, metabolism, fat accumulation, and systemic inflammation. Herbs like Guggulu, Triphala, Bibhitaki, and Chitraka are categorized as Lekhaniya (scrapping) and Medohara (fat reducing), which align well with modern findings showing lipid-lowering, thermogenic, and metabolic enhancement properties. Take Guggulu, for instance has long been used in conditions involving Kapha and Meda (fat tissues), and modern research attributed its benefits to guggulsterones, which help regulated thyroid activity and fat metabolism. Herbs such as Shunthi, Pippali and Chitraka, traditionally employed to enhance Agni (digestive factors), are now understood to stimulated heat production and raise metabolic rates, suggesting their potential in managing obesity linked to sluggish digestion. Ayurvedic drugs like Guduchi, Haridra and Tripahala are known for their rejuvenating and cleansing role have been supported by scientific findings highlighting their anti-inflammatory, anti-oxidant and insulin-sensitizing effects, which address both metabolic dysfunction and systemic inflammation in obesity. Similarly, herbs like Gokshura and Punarnava aid in reducing fluid retention in obesity and support liver health, countering common issues in obese children such as water accumulation and metabolic imbalance. Daruharidra and Bala contribute through immune modulation and heat generation, while Shilajit and Amalaki support cellular energy production and mitochondrial health, pointing to their role in overall revitalization and improve metabolic performance.

CONCULSION

Childhood obesity poses significant long-term risks to both physical and mental well-being, making it an increasing concern worldwide. Ayurveda offers a holistic and sustainable approach that targets the cause of obesity, unlike conventional medicine which often focuses primarily on dieting and medication. According to Ayurvedic principles, obesity arise mainly due to imbalances in the Dosha (regulatory functional factors of the body) particular Kapha and Meda (fat tissues), that need to be restored, along with the removal of metabolic waste and the regulation of digestive factors. Herbal formulations with properties such as Deepana (appetite stimulant), Pachana (digestive stimulant), Lekhana (scraping) and Medohara (anti-obesity) help in manage fat accumulation, stimulate metabolism and improve overall health without harmful side effects. Furthermore, adopting functional foods like millets and following Ayurvedic lifestyle practice aligned with daily and seasonal rhythms contribute to long term prevention and control of obesity. Thus, Ayurveda presents valuable alternative that supports balanced growth and addressed the multifaceted nature of obesity in children.

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