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A comprehensive review of Ayurvedic herbal drugs and procedures in the management of childhood obesity

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General Note

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ABSTRACT

Obesity is growing at a brisk rate worldwide. Childhood obesity is good determinant to adult obesity and related co-morbidities like dyslipidemia, type 2 diabetes mellitus, coronary artery disease, skin cancers and so on. There is steep increase in the prevalence of

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childhood obesity in last two decades all over world including India. *Ayurveda* provides multiple modalities like *Pathya Aahar*(healthy diet), *Pathya Vihara* (healthy life style), *Panchkarma* therapy (purifying procedures) and herbal drugs which have been used over centuries for well being of human race. There are plenty of drugs which are known to have beneficial effect in *Sthaulya* i.e. obesity. In this article various drugs possessing antiobesity and hypolipidemic actions are reviewed with recent studies validating their use in childhood obesity. Thus *Ayurveda* can provide an alternative and useful resource for managing childhood obesity with use of healthy diet, modified lifestyle, treasure of herbal drugs and *Panchkarma* procedures.

Key words: childhood obesity, ayurveda, herbal, panchkarma, lekhana

1. INTRODUCTION

Childhood obesity is rapidly growing as an epidemic all over the world. India is also having same trends. India is a fast developing country, currently undergoing major epidemiological, nutritional, life style and demographic transitions. These changes in life style are liable to increase obesity in all age groups. The prevalence of obesity was estimated 5.5 per cent in 2001-2005, 4.0 per cent in 2006-2010 and 4.6 per cent since 2010. This observation shows a high incidence which almost invariable for last 15 years. However, combined overweight/obesity and overweight prevalence demonstrated a growing drift. The prevalence of overweight towered from 9.7 per cent prior to 2001 to 13.9 per cent in studies accounted after 2010. The combined trend followed a parallel pattern increasing from 15.9 per cent prior to 2001 to 16.3 per cent from 2001-2005. The value then increased to 17.4 per cent in the 2006-2010 period, finally reaching 19.3 per cent in studies reported after 2010.[1]

This increased prevalence has augmented risk for insulin resistance (syndrome X) and central obesity, both predecessor of diabetes, CHD and other 'life style' disorders. It is now emerging convincingly that these disorders begin in childhood (or even earlier, in fetal life), and manifest due to interactions and accumulation of various risk factors, throughout the life course.[2]

2. MATERIAL & METHODS

Classical Ayurvedic texts were searched for the reference of obesity and its management. Various drugs single as well as compound formulations, used in the management of obesity were compiled. Various search engines like medline, scopus, google scholar, science direct, pubmed were searched for recent studies (studies after 2000 A.D.) on single and compound ayurvedic drugs useful in obesity. The experimental, animal and clinical studies found supportive of ayurvedic drugs in management of obesity and dyslipidemia were reviewed. The key word used were childhood obesity, obesity, ayurvedic drugs, botanical names of various useful drugs, navaka guggulu, amritadya guggulu, lekhana basti. Various review articles, clinical trials and animal studies found on search engines as whole or abstract were critical reviewed for their contents & study parameters and included in this article on the merit of positive results.

3. ETIOLOGY & MEASUREMENT OF CHILDHOOD OBESITY

Etiology of childhood obesity is multi- factorial. Interactions between genetic, neuro-endocrine, metabolic, psychological, environmental and socio- cultural factors are clearly evident in childhood obesity. Certain life style changes due to rapid urbanization have adverse interplay with so called thrifty genotypes resulting in obesity early in life. Urbanization related intake behaviors that have been shown to promote obesity include frequent consumption of meals at fast-food outlets, consumption of oversized portions at home and at restaurants, consumption of high calorie foods, such as high-fat, low-fiber foods, and intake of sweetened beverages. These behaviors are cultivated in an environment in which high calorie food is abundant, affordable, available, and easy to consume with minimal preparation as is the case of urban cities throughout the country. Television viewing and other sedentary activities have also been related to childhood obesity.[3]

For children and adolescents, overweight and obesity are defined using age and sex specific normograms for body mass index (BMI). Children with BMI equal to or exceeding the age-gender-specific 95th percentile are defined obese. Those with BMI equal to or exceeding the 85th but are below 95th percentiles are defined overweight and are at risk for obesity related co-morbidities.[4]

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4. AYURVEDIC PERSPECTIVE OF OBESITY

Obesity is well documented in *Ayurveda* as *Sthaulya*. It is classified under *Santarpanotha Vikara*, a group of life style disorders caused by faulty dietary habits and sedentary life styles. Main causative factors behind *Sthaulya* are improper diet containing *Guru*(heavy), *Snigdha* (unctuous), *Madhur* (sweet) & *Sheeta* (cold) food items, faulty dietary habits with excessive eating, sedentary life styles like poor exercise routine, excessive sleep etc., psychological factors & habits and most importantly *Beeja Dosha* i.e. genetic factors. The main pathogenesis is obstruction of channels by *Aamadosha* resulting in aggravated condition of *Vata Dosha*. This aggravated *Vata Dosha* increases digestive fire resulting in excessive appetite & delayed satiety. By this mechanism there is excessive production of *Meda Dhatu* (adipose tissue). The classical symptoms described are *Chal Sphika-Udara-Stan* (loose and wobbling buttocks, abdomen and chest).[5] The co-morbidities described are reduced life expectancy[5], *Prameha* (Diabetes Mellitus), *Pidika* (Skin disorders), *Vata Vikara* (Neurological disorders like stroke etc).[6]

5. MANAGEMENT

The management of *Sthaulya* is well enumerated in *Ayurveda* texts. The main principles of treatment are use of diet, *Panchakrma* procedures, drugs & life style which have the *Aptarpana* property. Various modalities used should be pacifier of *Vata, Kapha* & *Meda Dhatu*[7] and should possess *Virukshaniya* and *Chedaniya* properties.[6] Here we have enlisted various single (Table1)as well as compound formulations of drugs (Table 2) which are described in *Ayurvedic* classics and are being used in the treatment of obesity. Recent experimental, animal and clinical trials of these drugs are also compiled and reviewed in support of evidence based medicine.

Table 1 List of single herbs indicated for obesity in various *Ayurvedic* texts[6,8,9,10]

S. No.	Sanskrit Name	Scientific / English Name	Part used
1	Guduchi	*Tinospora cordifolia* (Willd)	Stem
2	Mustaka	*Cyperus rotundus* Linn.	Rhizome
3	Vidanga	*Embelia ribes* Burm	Fruit
4	Nagara	*Zingiber officinale* Rosc.	Rhizome
5	Amalaka	*Emblica officinalis* Gaertn.	Fruit
6	Yava	*Hordeum vulgare* L.	Seed
7	Agnimantha	*Premna mucronata* Roxb.	Root bark, Leaves
8	Guggulu	*Commiphora mukul* Engl.	Resin
9	Haritaki	*Terminalia chebula* Retz.	Fruit
10	Madhu	Honey	Whole
11	Rasanjana/Daruharidra	*Berberis aristata* DC.	Root & Stem
12	Gomutra	Cow's urine	Whole
13	Kushtha	*Saussurea lappa* C.B. Clarke	Root
14	Haridra	*Curcuma longa* Linn.	Rhizome
15	Vacha	*Acorus calamus* Linn.	Root & Underground stem

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16	Ativisha	*Aconitum heterophylum* Wall.	Root (rhizome)
17	Kutaki	*Picrorhiza kurroa* Royle ex Benth	Root (underground stem)
18	Chitraka	*Plumbago zeylanica* Linn.	Root bark
19	Chirabilwa	*Holoptelea integrifolia* Planch.	Bark
20	Hemavati	*Iris ensata* Thunb.	Root
21	Shilajatu	Black Bitumen	Whole

Table 2

List of herbal & herbo-mineral formulations indicated for obesity in various ayurvedic texts [9, 10,11,12]

1	***Triphala***	***Amalaki, Vibhitaki, Haritaki***
2	*Lekhaniya Mahakashaya*	*Mustaka, Kushtha, Haridra, Daruharidra, Vacha, Ativisha, Katurohini, Chitraka, Chirbilva, Haimvati*
3	*Briht Panchmoola*	*Bilva, Gambhari, Shyonaka, Agnimantha, Patala*
4	*Takrarista*	*Hapusha, Kunchika, Dhanyaka, Azazi, Karavi, shati, Pippali, Chitraka, yavani, Ajmoda,Pippalimoola, Hastipippali & Takra*
5	*Vachadi Gana*	*Vacha, Mustaka, Devadaru, Nagara, Ativisha, Haritaki*
6	*Haridaradi Gana*	*Haridra, Daruharidra, Madhuyashti, Kalashi,Indrayava*
7	*Navaka Guggulu*	*Vyosha, Triphala, Chitraka, Vidanga, Mustaka, Guggulu*
8	*Amritadi Guggulu*	*Guduchi, Truti, Vidanga, Vatsaka, Kalinga, Pathya, Amalaki, Guggulu*
9	*Vidangadya Lauha*	*Triphala, Vidanga, Mustaka, Kana, Nagara, Bilva, Chandana, Hrivera, Patha, Ushira, Bala & Lauha Bhasma*

6. USEFUL SINGLE DRUGS

GUGGULU (*Commiphora mukul*)

Guggulu, a plant resin obtained from *Commiphora mukul* is widely used to treat obesity and associated hyperlipidemia. It is enlisted as best drug for *Meda* (Adipose tissue) and *Vata dosha* as per Charak.[13]

Gupta et al have shown in a trial that when 500mg alcoholic extract of Guggulu resin in capsule form is given twice a day for three months in obese adolescents, relieves the symptoms of obesity like Nidradhikya, Dourbalya, Alaysya etc. Appreciable reduction in hyperlipidaemia was observed reducing total cholesterol, serum triglyceride, serum LDL but maintain the level of HDL level in blood.[14]

HARIDRA *(Curcuma longa)*

Turmeric is known to have *Tikta* (bitter) & *Katu* (pungent) taste, *Ruksha* (dry) & *Ushna* (hot) properties. It pacifies *Pitta* & *Kapha*,[15] and is described as best drug for *Prameha* (Daibetes)[16].

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In an animal study Kim et al divided rats into four groups (n=6 per group): a normal diet group comprised rats fed the AIN76A rodent diet; a high-fat diet-induced obese group with rats fed a 60% high-fat diet; a *Garcinia cambogia* treated group (positive control) with rats fed a 60% high-fat diet with *G. cambogia* 500 g/kg body weight (b.w.)/day; and a fermented *C. longa* L. 50% ethanolic extract treated group (FCE50) with rats fed a 60% high-fat diet with FCE50 500 g/kg b.w./day. Each group received the appropriate vehicle or sample daily by gastric intubation for 12 weeks. Study showed that FCE50 administration suppressed body weight gain and reduced white adipose tissue weight, serum triglyceride (TG), and cholesterol in high-fat diet-induced obese rats. These results can be associated with the suppression of adipocyte differentiation and lipogenesis with a decrease in the mRNA expressions of fatty acid synthase, acetyl-CoA carboxylase, adipocyte protein 2, and lipoprotein lipase induced by FCE50 administration. This study suggests that Curcuma longa can be used for the prevention of obesity via suppressing adipogenesis and promoting lipolysis.[17]

Experimental studies have shown that turmeric helps to reduce cholesterol levels and regulate blood sugar level. Its antioxidant property prevents from free radical damage and decrease oxidative stress and thus prevents cardiovascular complications associated with obesity.[18]

MUSTKA (*Cyperus rotundus*)

Mustaka is best drug for *Sangrahi*, *Deepana* (boosts digestive fire & appetite) and *Pachana* (augments digestive process).[13]
Athesh et al in an experimental study administered aqueous tuber extract of *Cyperus rotundus* L. (ATECR) in high fat cafeteria diet (HFCD) fed obese rats. The results of this study depict that ATECR regulates serum lipid profiles, reduces the oxidative stress and decreases adipose tissue mass and body weight gain.[19]

In another experimental study, administration of 45 or 220 mg/kg/day of *C. rotundus* tubers hexane extract for 60 days in obese Zucker rats produced a significant reduction in weight gain without affecting food consumption or inducing toxicity. In vitro, 250 microg/mL of this extract was able to fuel lipolysis in 3T3-F442 adipocytes signifying that this herb possesses activators of beta-adrenoreceptors (AR). The binding assay performed on the rat beta3-AR isoform, known to induce thermogenesis, demonstrated that *C. rotundus* tubers extract can consistently and effectively bind to this receptor.[20]

ATIVISHA (*Aconitum heterophyllum*)

Ativisha is well known drug for pediatric ailments in *Ayurveda*. It is best drug for *Deepana* (boosts digestive fire & appetite), *Pachana* (augments digestive process) and pacifier of all three *dosha*.[13]

In an experimental study the methanol extract of *A. heterophyllum* was orally administered in diet-induced obese rats for four weeks. This treatment markedly lowered total cholesterol, triglycerides and apolipoprotein B concentrations in blood serum. It also showed positive effects (increase) on serum high-density lipoprotein cholesterol (HDL-c) and apolipoprotein A1 concentrations. An increase in fecal fat content is also a sign of the hypolipidemic effect of *A. heterophyllum*. The significant hypolipidemic effect of *A. heterophyllum* may be linked to its ability to inhibit HMGR activity and block intestinal fat absorption. The increase in HDL-c may be linked to its ability to activate LCAT enzyme.[21]

APAMARGA (*Achyranthes aspera*)

Apamarga possesses bitter & pungent taste, hot potency and has property of reducing *Kapha*, *Vata* & *Meda* (adipose tissue).[22]

Naveed et al showed in an animal study on hyperlipidemic rats, that four-week oral administration of *A. aspera* seed saponins exerted a significant decrease of total cholesterol, total triglycerides and LDL-C and a significant increase of HDL-C level. Treatment with *A. aspera* seed saponins also demonstrated a significant improvement of serum antioxidant status in tested animals.[23]

VIDANGA (*Embelia ribes*)

Vidanga is widely used drug for worm infestations in *Ayurveda*. It is *Katu* (pungent) in taste, possesses *Tikshna* (sharp), *Ruksha* (dry)& *Laghu* (light) properties and pacifies *Vata* & *Kapha Dosha*.[24]

Iram et al investigated the anti-obesity effects of the aqueous extract of *Embelia ribes* by feeding a high-fat diet to rats for 42 weeks. Body weights at 2-6 weeks and adipose tissue weights were found significantly lower in rat fed the high-fat diet containing aqueous extract of *Embelia ribes* than in the controls fed the high-fat diet. This study propose that the antiobesity effects of aqueous extract of *Embelia ribes* may be through down regulation of leptin, TNF-α, SREBP1γ, and PPARγ2 gene expression.[25]

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Uma et al demonstrated that after twenty days administration of ethanolic extract of *E. ribes* burm (200 mg/kg) to diabetic rats result in significantly decreased blood glucose, serum total cholesterol, and triglycerides, and increase in HDL- cholesterol levels.[26]

VACHA (*Acorus calamus*)

Vacha is *Katu* (pungent), *Tikta* (bitter) in taste, hot in potency, possesses *Kapha* & *Vata* pacifier properties[27] and is useful *Lekhana* (Anti adipogenesis) drug.[4]

The roots and rhizomes of *Acorus calamus*, are useful for weight loss and reducing LDL cholesterol and triglycerides. Based on animal studies, alcoholic or aqueous extracts of calamus roots and rhizomes decreased cholesterol and triglyceride levels and increased the concentration of HDL during the period of an atherogenic diet.[28]

Other experimental studies suggest that β-asarone (active component of calamus oil) exerts anti-adipogenic activity, in part by suppressing the expression of adipogenic transcription factors.[29]

Aqueous extract of *Acorus calamus* have a good pancreatic lipase inhibitory activity.[30]

METHIKA (*Trigonella foenum graecum*)

In a clinical study on dyslipidemic patients Fenugreek (*Trigonella foenum graecum*) seeds (FG) were used after extracting with hexane & alcohal to remove its lipid content and the saponins respectively. The patients were divided into 3 groups of 6 each: Group I received placebo 50 gm (rice powder and Bengal gram powder in equal measures); Group II -placebo 25 gm + FG 25 gm and Group III -FG 50 gm. Patients were directed to take each 50 gm pack orally before lunch and dinner every day for 20 days. In this study groups II and III serum cholesterol, triglycerides and VLDL levels were significantly decreased when compared to group I. FG powder given orally before food at 25 and 50 gm twice a day may have hypolipidemic effect in hypercholesterolaemic patients.[31]

An animal study found that fenugreek seed extract decreases the body weight gain induced by a high-fat diet in obese mice. This extract also decreases plasma triglyceride gain induced by oil administration. Consequently, fenugreek seed extract is anticipated to avert the obesity induced by a high-fat diet.[32]

SHIGRU (*Moringa oleifera*)

Shigru is *Katu* (pungent), *Tikta* (bitter) in taste, hot in potency, possesses *Tikshna* (prompt), *Laghu* (light), *Ruksha* (dry), *Deepana* properties and pacifies *Vata, Kapha* & *Meda* (adipose tissue).[33]

In an animal study, the methanolic extract of Moringa oleifera leaves (MEMOL) was evaluated for antiobesity activity in high fat diet-induced obesity (HFD) in rats. Treatment of obese rats with MEMOL for 49 days resulted in a significant change in body weight, total cholesterol, triglycerides, and LDL level along with a significant increase in body temperature. MEMOL treated rats also showed a significant decrease in the level of liver biomarkers, organ weight, and blood glucose level. This study pointed out that the rats treated with MEMOL have significantly reduced the body weight without any change in the feed intake and also elicited noteworthy thermogenic effect to act as hypolipidemic and thermogenic property in obesity related disorders.[34]

KATUKA (*Picrorrhiza kurroa*)

Katuka is described as *Bhedaniya* & *Lekhaniya* drug in *Charak Samhita*.[10]

Hyeung et al in an animal study administered the water extract of *Picrorrhiza kurroa* (PR) at doses of 50, 100 and 200 mg/kg, orally, once a day for 12 weeks in a high fat diet feeding hyperlipemic mouse. The observations at the end of study indicate that liver weight, serum aspartate transferase (AST), alanine transferase (ALT), low density lipoprotein (LDL), triglyceride and total cholesterol levels were significantly reduced by the treatment. On the contrary, serum HDL level seems not affected by *P. kurroa* water extract.[35]

MADHU (Honey)

Old Madhu is well described as *Meda* & *Sthaulya Hara* (anti adepogenesis & anti obesity) and possesses *Lekhana* property.[36]

Suhana et al conducted a study on high fat diet (HFD) rats with administration of honey or orlistat for four weeks. Significant reductions in excess weight gain and adiposity index were observed in rats fed with Gelam honey compared to HFD rats. The levels of plasma glucose, triglycerides, and cholesterol, plasma leptin and resistin, liver enzymes, renal function test, and relative organ weight in Gelam and Acacia honey treated groups were reduced significantly when compared to rats fed with HFD only. Similar results were also displayed in rats treated with orlistat, but with hepatotoxicity effects. The study concluded that consumption of honey can be used to manage obesity by regulating lipid metabolism and appears to be more efficient than orlistat.[37]

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In another experimental study which was conducted on high fat diet fed Wistar albino rats, *Madhu* mixed with *Triphala Kashaya* and processed with *Triphala Kashaya* was administered for 48 days. Reduction in body weight, blood lipid and organ weight were recorded and compared statistically with the mean values of groups treated with pure honey and honey processed with water. Results indicate reduction in body weight in all treated groups. *Triphala Kashaya Samskarita Madhu* treated animals exhibited remarkable reduction in body weight, serum triglycerides, total cholesterol, LDL, VLDL and elevated HDL levels. Changes pertaining to vital organ weight (liver, heart and kidney) were also corresponding with reduction in body weight of treated group animals.[38]

GUDUCHI (*Tinospora cordifolia*)

An animal study has shown the effect of petroleum ether extract of *Tinospora cordifolia* stems on obesity in rats using cafeteria diet- and antipsychotic drug (sulpiride)-induced obesity. Petroleum ether (50 and 100 mg/kg, p.o.) extract of *Tinospora cordifolia* was administered for 40 and 28 successive days and it showed significant antiobesity effect in cafeteria diet- as well as sulpiride-induced obese rats respectively, as indicated by significant decrease in body weight and serum cholesterol, glucose and triglycerides; and significant increase in HDL-cholesterol as compared to respective cafeteria diet and sulpiride treated control rats. The study proposes a this action might be due to increase in dopaminergic transmission, since the extract protected the animals against sulpiride-induced obesity.[39]

7. COMPOUND DRUG FORMULATIONS

VACHADI CHURNA

In a clinical study *Vachadi Churna* was evaluated in 30 obese patients for 30 days. *Vachadi Churna* is a combination of *Vacha (Acorus calamus), Musta (Cyperus rotundus), Devadaru (Cedrus deodara), Shunti (Zingiber officinale), Ativisha (Aconitum heterophyllum)* and *Haritaki (Terminalia chebula)* in equal ratio. The drug was administered for 30 days in a dose of 3gm twice daily with luke warm water before meals. The results were encouraging statistically significant improvement in body weight & BMI, with overall good improvement in 53.33% subjects and moderate improvement in 46.67% subjects.[40]

KARSHANIYA YAVAGU

In a clinical placebo controlled study 60 patients were divided in two groups namely A and B. Group A was given *Karshaniya Yavagu* and Group B was given Placebo (Starch capsule) for 90 days. The study formulation *Karshaniya Yavagu* is prepared from *Gavedhuka* (*Coix lacryma-jobi*) boiled for 30 minutes with 6 times water and was given with 5 ml honey in 80 ml dose daily on empty stomach in early morning for 90 days. Results of study show statistically significant improvement in body weight of obese patients in group A i.e. *Karshaniya Yavagu* group .[41]

AMARITADYA GUGGULU

In a clinical study; *Amritadya Guggulu* in a dose of 1g twice a day for a period of two months was given to 15 obese patients. Results indicated that *Amritadya Guggulu* reduced mean body weight, abdomen circumference, mid-thigh circumference and mid arm circumference and mean BMI in statistically highly significant manner ($p<0.001$). The improvement in excessive thirst, drowsiness, digestive capacity were statically highly significant ($p<0.001$).[42]

HARIDRADI VATI & NAVAKA GUGGULU

In a clinical study effectiveness of *Haridradi* tablet and *Navaka Guggulu* tablet in management of *Atisthoulya* (obesity) was assessed in 30 patients. Patients were randomly divided into two groups, Group A (*Haridradi* tablet) and Group B (*Navaka Guggulu* tablet) comprising of 15 patients each and given 1-gram tablet twice a day with lukewarm water for a period of 30 days. *Haridradi* tablet showed good results in reducing the weight (85.8kg to 83.2kg), reducing the waist circumference (2.4cm) and abdominal circumference (2.16cm). Other associated symptoms of obesity got reduced significantly. However, there was not much difference in the results between the groups & both groups have statistically significant result in weight reduction.[43]

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8. PROCEDURAL TREATMENT PROTOCOLS

NAVAK GUGGULU & UDVARTANA

Kulakarani in a clinical study on 30 obese subjects reveals that the combined effect of *Navak Guggulu* and *Udavartana Churna* is very beneficial to reduce the weight & BMI of the patient without any adverse effect. The treatment protocol was also effective for the management of dislipidemia.[44]

LEKHANA BASTI

Lekhana Basti is the treatment modality in which special formulation of *Tikshna* drugs are administred to large intestine through anorectal route. *Lekhana Basti* is aimed basically for *Apatarpana* (emaciation) of the body, as *Basti* is the fastest *Apatarpana*.

In a clinical study lekhana basti was given for 16 dyas followed by Amritadi Guggulu for next 32 days along with routine of healthy diet and exercise in obese patients. The results were compared with that of placebo group. The difference between reduction in BMI,SFT, weight *vaksha pramana, udara praman* and lipid profile between the two groups were significant with P >0.05. The high reduction, in levels of VLDL and triglyceride cholesterol SFT, *udara* and *spik pramana* shows that *lekhana basti* has significant role in the management of *sthoulya*.[45]

In another clinical trial, Lekhana Basti was given for 21 days in dyslipidemic paitents and results were compared with the control group where Triphala guggulu was given. Study reveals that with Lekhana Basti, there was a decrease of about 4.99% in S. cholesterol, 9.13% in S. low density lipoprotein (LDL), and 0.36% in S. apolipoprotein B. Lekhana Basti was found to have significant reduction of objective parameters like weight, body mass index (BMI), body fat percentage, body circumferences such as chest, abdomen, hip, pelvis, mid-thigh circumference, etc., and skin fold thickness as biceps, triceps, mid-arm, and abdominal skinfold thickness.[46]

9. DISCUSSION

Ayurveda bestow an insight to the treatment of childhood obesity by modification of diet, life style and use of herbal drugs. These herbs have effectively been used for centuries without any adverse effect reported. *Ayurveda* governs that drugs which are of opposite properties to that of *Aama*, *Kapha*, *Vata* & *Meda* will be beneficial in the management of *Sthaulya* i.e. obesity. Out of abundant drugs mentioned in *Ayurvedic* texts a few representative are mentioned here. These all drugs possess *Katu*, *Tikta* taste, *Ushna* Potency, *Ruksha*, *Tikshna*, *Laghu* properties and are pacifier of *Vata* & *Kapha Dosha*. Thus they provide all essential properties required to subvert the pathogenesis of obesity. These drugs by the virtue of their properties decrease production of *Aama*, *Kapha* & *Meda* and also pacify *Vata Dosha*. Hence they provide good efficacy in the prevention and management of childhood obesity.

Moreover, recent experimental, animal & clinical studies have proven the positive effect of various *Ayurvedic* herbs in the management of obesity and related co-morbidities like hyperlipidemia, Diabetes mellitus etc. There are different mechanisms of action of these herbs by which they have a positive effect on the management of obesity. A few documented actions of herbs, in prevention & treatment of obesity are- pancreatic lipase inhibitors, adipocyte differentiations inhibitors, appetite suppressants, energy expenditure stimulants, lipid metabolism regulators etc.[47] The above mentioned drugs have shown one or more of these mechanisms in controlling obesity & hyperlipidemia.

10. CONCLUSION

In conclusion, *Ayurveda* possess a huge treasure of herbal medicine which can be employed in the management of childhood obesity. Efficacy and safety of these herbs is once again revalidated by various recent animal & clinical studies. However most of the work done is either animal studies or clinical trials with limited sample size. These drawbacks may be corrected in forthcoming research studies so that revalidation process may become flawless.

FUTURE ISSUES

As the incidence of childhood obesity is looming high and it is resulting in more and more co-morbidities and complications, there is need to look for alternative therapies to control childhood obesity. There is acute need of clinical trials to prove efficacy and safety of ayurvedic drugs to control the epidemic of childhood obesity.

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