CHILDHOOD OVERWEIGHT/OBESITY AND CO MORBIDITIES: AN AYURVEDIC APPROACH

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ABSTRACT
Worldwide estimates of childhood overweight / obesity shows increasing trends and continues each year. Many researches show that the childhood overweight / obesity is epidemic and has impact on every domains of life including the health. The consequences of childhood obesity are extensive and include medical as well as psychosocial co morbidities. The major co morbidities associated with childhood obesity are metabolic risk factors and other systemic disorders. Ayurveda, the ancient science of life also highlighted the overweight / obesity (staulya) and its consequences along with the details of causative factors, pathophysiology and line of management with exercise (vyayam / vihar), dietary modifications (Ahar), medications and some body - purification / detoxification (panchakarma) methods. Ayurvedic line of management includes the holistic approach taking in consideration of causative factors (Ahar-viharaj hetu), biochemical changes (Samprapti), the different stages of the disease (Agnimandya, Dhatvagnimandya, Ama, Kleda, Srotorodha, Doshapradop avastha) and accordingly the accordingly the line of management of the disease (Ahar, Vihar, Dravyachikitsa, Yuktiyapashraya chikitsa, vayayam, etc). Overweight/ obesity is hard to treat as it needs the multi-systemic approach of managements including dietary and medicinal managements. The Ayurvedic principles of the disease progress & co morbidities should be taken in consideration to control the childhood overweight / obesity to control the complications in further life. This article highlights the co morbidities of childhood overweight/obesity along with its Ayurvedic approach described in ancient ayurvedic literature.

KEYWORDS: Childhood overweight and co-morbidities, Sthaulya, Childhood obesity, overweight and Ayurveda.

INTRODUCTION
Overweight/obesity in children is becoming more common. Obesity is due to an imbalance between energy consumption and energy expenditure. Overweight/obese children do not have low energy needs. They have high energy needs to support their high body weight. Overweight/obesity is a health concern in itself and also increases the risk of other serious health problems such as high blood pressure, diabetes and psychological distress.

An obese child tends to become an obese adult. There is no evidence that any drug treatment is effective in treating obesity in children. It requires multi angle approach to control the overweight/obesity. Obesity in children may be prevented and treated by increasing physical activity/decreasing physical inactivity (e.g. TV watching) and encouraging a well-balanced and healthy diet. Lifestyle changes involve making small gradual changes to behaviour.[1]

Ancient scholars of Ayurveda describes the overweight/obesity (sthaulya) is a disease of bad fat (Meda Dhatu). The malformed fat (meda / kleda) obstructs the Vata so that the Vayu get obstructed in koshtha (stomach - digestive system) which stimulates the digestive fire (Agni) and whatever the diet in the stomach (koshtha) get digested and absorbed fast and the patient demands more food. The disease is hard to treat. Due to this disease pathology only bad fat (meda / kleda) get formed. As per the basic principles of Ayurveda regarding digestion and metabolism - only bad fat (meda) get formed; the other body elements (Dhatus) not formed properly due to the channel obstruction (Srotorodhi). This obstruction (Srotorodhi) causes malformed body elements (Dhatus); leading to different co-morbidities which are low quality and duration of life, early old changes (catabolism), difficulty in sexual
Activity, fatigue (Daurbalya), bad body odour, hyper sweating, and patient always feels hungry & thirsty.[2]

Overweight/obesity is not a single system disease. It causes different co-morbidities at different levels by metabolic, systemic and tissue changes. To avoid and control these overweight/obesity co-morbidities multi-systemic approach of management is needed. Ancient scholars of Ayurveda described the causes, pathology, co-morbidities and its management in detail at different levels. So these different angles of the disease process and its management details are need to be considered while controlling overweight/obesity. Family support is necessary for treatment to succeed. Generally the aim of treatment is to help children to maintain their weight (so that they can grow into it). Most children are not obese because of an underlying medical problem but as a result of their lifestyle. So this article describes the progress of obesity and its co-morbidities at different levels.

**Overweight/Obesity**[3]

Obesity is an important paediatric public health problem associated with risk of complications in childhood and increased morbidity and mortality throughout adult life. The prevalence of childhood obesity has increased, and the prevention and treatment of childhood obesity has emerged as an important focus of paediatric research and clinical care. Obesity or increased adiposity using the body mass index (BMI); which is an excellent proxy for more direct measurement of body fat. BMI = weight in kg / (height in meters)^2. Children >2year old with a BMI >95th percentile meet the criterion for obesity, and those with a BMI between 85th and 95th percentiles fall in the overweight range.

**Overweight/Obesity Co-Morbidities**[3,4,5]

Complications of paediatric obesity occur during childhood and adolescence and persist into adulthood. An important reason to prevent and treat paediatric obesity is the increased risk for morbidity and mortality later in life. The Harvard Growth Study found that boys who were overweight during adolescence were twice as likely to die from cardiovascular disease as those who had normal weight. More immediate co morbidities include type 2 diabetes, hypertension, hyperlipidemia and non-alcoholic fatty liver disease. Insulin resistance increases with increasing adiposity and independently affects lipid metabolism and cardiovascular health. Non-alcoholic fatty liver disease occurs in 10-25% of obese adolescents and can progress to cirrhosis.

In adults, the combination of central obesity, hypertension, glucose intolerance and hyperlipidemia is the metabolic syndrome. Persons with the metabolic syndrome are at increased risk for cardiovascular morbidity and mortality.

There is increasing evidence that obesity may be associated with chronic inflammation. Adiponectin, a peptide with anti-inflammatory properties, occurs in reduced levels in obese patients as compared to insulin sensitive, lean persons. Low adiponectin levels correlate with elevated levels of free fatty acids and plasma triglycerides as well as a high BMI, and high adiponectin levels correlate with peripheral insulin sensitivity. Adipocytes secrete peptides and cytokines into the circulation, and pro-inflammatory peptides such as interleukin (IL)-6 and tumor necrosis factor-α (TNF-α) occur in higher levels in obese patients. Specifically, IL-6 stimulates production of C-reactive protein (CRP) in the liver. CRP is a marker of inflammation and might link obesity, coronary disease and subclinical inflammation.

Some complications of obesity are mechanical, including obstructive sleep apnea and orthopaedic complications. Orthopaedic complications include Blount disease and slipped femoral capital epiphysis.

Mental health problems can coexist with obesity, with the possibility of bidirectional effects. These associations are modified by gender, ethnicity and socioeconomic status. Self-esteem may be lower in obese adolescent girls compared to non-obese peers. Some studies have found an association between obesity and adolescent depression. There is considerable interest in the co-occurrence of eating disorders and obesity.

Insulin resistance: a higher amount of insulin is needed to maintain normoglycemia, thus insulin: glucose ratio is elevated. Decrease in insulin leads on to decrease in insulin mediated glucose uptake and results in hyperglycaemia and type diabetes. Acanthosis Nigricans (AN): refers to hyperpigmented velvety skin behind the neck, axilla and groin. AN is associated with obesity, insulin resistance & type 2 diabetes mellitus.

Dyslipidemia: obesity is associated with elevation of plasma triglycerides and VLDL, weight reduction usually normalizes this.

Metabolic syndrome as defined by WHO in adults (1998) is – insulin resistance plus any two of the following
1. Abdominal obesity (waist hip ratio of >0.9, BMI >30)
2. Dyslipidemia (triglyceride >150, HDL<35)
3. Blood Pressure >140/90

Hypertension: systolic BP has positive correlation with BMI and waist-hip ratio. PCOD; insulin regulates ovarian androgens through LH, hence in females hyperinsulinemia is associated with hirsutism, acne and menstrual irregularities. High LH levels may over stimulate the ovaries and possibly the cause of cystic overies. An earlier onset of puberty is also likely with exogenous obesity and advanced bone age.
Pickwickian syndrome: hypoventilation and hypercapnia associated with obesity. Non-alcoholic fatty liver diseases and Poor body image hence depression.

<table>
<thead>
<tr>
<th>Disease</th>
<th>Possible Symptoms</th>
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<tbody>
<tr>
<td><strong>Cardiovascular</strong></td>
<td></td>
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<tr>
<td>Dyslipidemia</td>
<td>HDL&lt;40, LDL&gt;130, total cholesterol &gt;200</td>
</tr>
<tr>
<td>Hypertension</td>
<td>Systolic Blood pressure &gt;95% for sex, age &amp; height</td>
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<td><strong>Endocrine</strong></td>
<td></td>
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<tr>
<td>Type 2 diabetes mellitus</td>
<td>Acanthosis nigrans, polyuria, polydipsia</td>
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<tr>
<td>Metabolic syndrome</td>
<td>Central adiposity, insulin resistance, dyslipidemia, hypertension, glucose intolerance</td>
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<tr>
<td>Polycystic ovary syndrome</td>
<td>Irregular menses, hirsutism, acne, insulin resistance, hyperandrogenemia</td>
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<tr>
<td><strong>Gastrointestinal</strong></td>
<td></td>
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<tr>
<td>Gallbladder disease</td>
<td>Abdominal pain, vomiting, jaundice</td>
</tr>
<tr>
<td>Non-alcoholic fatty liver disease (NAFLD)</td>
<td>Hepatomegaly, abdominal pain, dependent edema, increased transaminases, can progress to fibrosis, cirrhosis.</td>
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<tr>
<td><strong>Neurologic</strong></td>
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<tr>
<td>Pseudotumor cerebri</td>
<td>Headache, vision changes, papilledema</td>
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<tr>
<td><strong>Orthopaedic</strong></td>
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<tr>
<td>Blount disease (tibia vara)</td>
<td>Severe bowing of tibia, knee pain, limp</td>
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<tr>
<td>Musculoskeletal problems</td>
<td>Back pain, joint pain, frequent strains or sprains, limp, hip pain, groin pain, leg bowing.</td>
</tr>
<tr>
<td>Slipped capital femoral epiphysis</td>
<td>Hip pain, knee pain, limp, decreased mobility of hip</td>
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<tr>
<td><strong>Psychological</strong></td>
<td></td>
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<tr>
<td>Behavioural complications</td>
<td>Anxiety, depression, low self-esteem, disordered eating, signs of depression, worsening school performance, social isolation, problem with bullying or being bullied</td>
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<tr>
<td>Asthma</td>
<td>Shortness of breath, wheezing, coughing, exercise intolerance</td>
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<tr>
<td>Obstructive sleep apnea</td>
<td>Snoring, apnea, restless sleep, behavioural problems</td>
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**Sthaulya karan (Causes of Obesity)**[^6]

Ingestion of foods which are hard to digest (guru or which are more in quantity) will lead to production of large quantity of essence of food which is in the Ama state (inadequately digested). This Ama (improperly processed essence) getting mixed with kapha residing in dhatus (tissues) makes them weak and causes obesity. Excessive hunger, thirst, sweating, difficulty in breathing, too much of sleep, inability to withstand exertion, lassitude; decrease of life span, strength and vigour, bad smell of the body and stammering (hoarseness of voice) and increase of medas (adipose tissue, fat) – all these occur due to excess of nourishment.

The channels (tissue pores, blood vessels, lymphatic ducts etc) become blocked by fat. Vata moving especially inside the alimentary tract, causes increase of digestive activity. Because of this, there will be great increase of hunger and thirst, which in turn, burn away the body just as fire and wind burn up a tree which has a big cavity inside it; by the presence of fat, at the (site of) origin of the channels of sweat, increase in secretary activity (moisture) and association of kapha – all make for profound increase of sweat.

This increase (of fat) is similar to the increase of vata and others, “that which has undergone increase first will only undergo further increase” (but not others which have not increased first)” on this analogy there will be disparity between medas (fat) and other dhatus. The increased medas (fat) will soon produce difficulty in breathing, etc; fever, enlargement of abdomen, rectal fistula, diabetes, loss of movement of the thighs, nodules, abscesses and such other diseases.

**Metabolism of Meda (fat) in Sthaulya (overweight/obesity)**[^6]

Sthaulya is the disease of Medodhatvagni Vikriti. The good and potent Dhatvagni is responsible for the maintenance of healthy Dhatus through proper metabolism at Dhatu level. Due to specific Dhatvagni Vikriti (Mandya) there will be improper formation and accumulation of respective Dhatus. Medo Vridhi manifesting as Sthaulya is one such disorder. Vagbhata has described that Jatharagni, has its fractions known as Dhatvagnis situated at the level of tissues.

Several endocrine hormones determine the metabolic state of our body. These endocrine hormones may come under the preview of Dhatvagni. For example, Medodhatvagni may include glucocorticoids, insulin, glucagon etc. If glucagon levels are excess, lipolysis occurs which is equivalent to Medokshaya. Along with these hormones, all enzymes involved in lipid metabolism may also be regarded as Medo Dhatvagni.
When a person indulges in the said Nidanas (causative factors) of Shthaulya there will vitiation of Dhhatvagni leading to improper Rasa Vriddhi and Kapha Vriddhi which are identified by Angagaurav (heaviness), Alasya (laziness), Tandra, Nidradhiyak (sleepiness) etc. Further, these Dhhatvagni Vikriti when gets involved with Meda Dhatu, there will be production of various clinical features like Chala - Spikh - Udara - Stana etc. and in later stages it manifests with Ashta Doshas of Shthaulya.

Co-morbidities of obesity/overweight in Ayurveda[2]
Ayurveda scholars describes eight co-morbidities due to the medicorog i obesity which are low quality and duration of life, early old changes (catabolism), difficulty in sexual activity, fatigue (Daurbalya), bad body odour, hyper sweating, patient always feels hungry & thirsty.
1. Decreased life span: due to obstruction of the channels only bad fat get formed and reduction in the quality formation of other body constituents (Dhatus)
2. Javoparodh: lack of excitement, early geriatric changes – due to the low quality formation and lack of formation of other uttarotter dhaus.
3. Kricchavyavanata: low quality formation of shukra dhatu (Sperm and other reproductive components) along with obstruction by the bad fat (meda).
4. Daurbalya: the dhatus (body constituents) get formed in un-equilibrium which lands in fatigue.
5. Daurangadya: the sweat (sweda) is by-product (malai) of the medo dhatu (fat). Due to the dhathvagnimandyata (hormonal and metabolic changes) the sam sweda (low quality / bad kind sweat) get formed; which smells bad. Also the meda (bad fat collection) smells bad causing bad body odour.
6. Swedabadh: formation of bad quality fat in high amount causes formation of high quantity of sweat. Again due to the looseness of fat (meda) the more kleda (metabolic changes) get formed causing high sweating.
7. & 8. Atikshudha & Atitrishna: due to obstruction of the vayu the digestive fire in the stomach / digestive system get stimulated and causes the patient hungry and thirsty.
Meda undergoing vriddhi (increase) produces all the premonitory symptoms of Prameha (diabetes), obesity and its complications and other symptoms of increase of kapha, rakta and mamsa.

Management of Overweight/obesity (Atisthula chikitsa)[3]
A person is said to be very obese when he has lack of enthusiasm (in physical activities) disproportional to the growth of his body, and has movement of the buttocks, abdomen and breasts. Such a person should be given such foods which mitigate Vata, Kapha and Medas (fat) such as horsegram, small barely, jower, black millet, green gram etc. Aristas (medicated liquors), honey water, mastu (whey) and takra (buttermilk) as drinks; drugs which possess the properties of penetrating, hot in potency, dry and scarifying; those who wish to retain their body thin should also be prescribed worry, sexual intercourse, physical exercise, purificatory therapies (emesis, purgation etc) avoidance of sleep, dry bathing (without anointing oil) and massaging the body (without anointing oil or other fatty materials).

Vyayam (Exercise)[8]
An activity which produces tiredness to the body is known as Vyayam (Exercise). Lightness of the body, increased capacity to work, keen appetite, reduction of body fat and parts of the body becoming distinct and firm are the good effects of exercise. Strong persons and those who are accustomed to fatty foods, should do exercise to half their capacity during cold seasons (Hemant, Shishir) and Vasant ritu (Spring) for others and in other seasons it should be still less.

Udvartana: massaging the body mitigates kapha, liquefies the fat, makes the body parts firm and is best for the health of the skin.

Ushnajala (Warm water therapy):[9] Boiled water cures distension of the abdomen, disorders of Vata and Kapha, thirst, cough, difficulty in breathing, pain in flanks, accumulation of fat. Hot water stimulates digestion, digest the undigested material, is good for throat, easy to digest and purifies the urinary bladder (urinary tract).

Takra (Buttermilk):[10] Takra (buttermilk) is easily digestible, astringent and sour, kindles digestion, and mitigates kapha and vata, cures edema, enlargement of the abdomen.

Madya (Medicated wines):[11] Beneficial for obese person, capable of entering minute pores, and cleansing them (sukshma srotogami), mitigate vata and kapha.

For the diseases which are caused by Santarpas (excess food intake, over nutrition) there is no treatment other than Apatarpan (fasting, less intake of food, under nutrition).[12]

Kapha upakram (treatment for kapha)[13]
The treatment for kapha (which has undergone increase) are: strong purificatory therapies (emesis and purgation) with drugs possessing dryness, pungent, bitter and astrigent taste, use of foods possessing the same properties; use of wines which are strong, old and pleasant; activities such as running, jumping, swimming, keeping awake without sleep, fighting with arm, fighting with weapons, sexual intercourse, physical exercises, dry massage, bath and application of dry powders to the body.

Honey, soups of grains or pulses, emesis, fasting, inhalation of smoke, mouth gargles, avoidance of comfort and regimen prescribed for vasant ritu (spring) are all to be observed especially for benefit.
Proghakta aushadhi sevan (medication before food): the medication to control the overweight; should be given before food for making the body thin.\(^{14}\) Shaulya (obesity) is langhan yogya vyadhi (can be controlled by dieting/diet modification).\(^{15}\)

Langhan phalam (benefits of dieting): feeling of the hunger and thirst together, purity of the heart (mind), and throat (voice), diminution in the severity (virulence) of the disease, improvement of enthusiasm and disappearance of stupor (lassitude) are the benefits of langhana (thinning) therapy.\(^{16}\)

**DISCUSSION**

The co-morbidities of the overweight/obesity are associated with the metabolic, hormonal and biochemical changes of the disease progress. The pathology and details of the disease progress described by ancient ayurvedic scholars highlights the multi-systemic and holistic approach for the overweight management.

The management of the disease requires not only the avoidance of causative factors but also the basic concepts of Agni (digestive fire), Dhatvagni, Srotasas (nutritive channels), Srotasavarodh (obstruction), doshanuloman, etc details.\(^{7}\)

Due to the srotas (channels) obstruction the next dhatus are not get formed properly and causes the ayurhas (low quality of life); causing disequilibrium of the body elements landing in to fatigue. Javoprodh (lack of stamina/libido) and Krichhravvyavata (having problems with sex) reflects the metabolic & hormonal changes.\(^{2}\)

Daurgandhya (bad smell), Swedabadhata (sweating), Atikshuda (high hunger) and Atirishna (high thirst) reflect the metabolic and biochemical changes which are occurred due to overweight/obesity. These are the early changes in obesity. So by knowing such changes; early management plans can be introduced to the obese patients having family history.

Vyayam (exercise) promotes the laghavata (lightness); as feeling of heaviness is there in obese person which get relieved by exercise. Exercise also reduces the bad fat (kleda/Aam) and increases the good quality of sweat which also helps to clear the nutritive channels (Srotoshodhan, Swedasya kledavidhruti). Application of medicinal plans powder (Udvartan) reduces the bad smell and increases the circulation towards the skin and muscle tissue along with reduction of badly accumulated fat (Aam/Kleda), Buttermilk, old medicated wines (Asav/Arishtha), lukewarm medicated water penetrates the minute channels of nutrition (sukshma srotanugami) and relieves the obstruction caused by bad fat (Aam/Kleda); resulting in good quality tissue formation. This will result good quality tissue (Sara dhatu) formation.\(^{8,9}\)

Obesity/overweight is not controlled by only diet or medication or exercise individually but the combination of three as per the severity of the disease and age, tolerance, feasibility, etc of the patient. Ayurvedic principles of management considered the details of the co-morbidities and the cell level changes of the disease progress of the disease in detail; so that the management of shaulya (overweight/obesity) include the multi-systemic approach. The management plans such as exercise, buttermilk, old wines, bad fat treatment, and medication by different methods and at different time, etc proves the same.\(^{7}\)

As obesity is hard to control and childhood obesity have dangerous outcomes in adulthood, this holistic approach of the disease progress and management of Ayurveda can be applied for the childhood obesity/overweight.

The co-morbidities described by latest evidences along with the details of disease pathology, complications and line of management described by ancient ayurvedic scholars should be considered while treating the overweight child.

In the context of co-morbidities of childhood overweight obesity, Dhatvagni-vaiśhämya (disregulation of metabolic paths), Ama-Nirmiti (production of unassimilated toxic residue), Srotorodh (accumulation of bio-waste), Dosh-prakop, Dhatu-shaitiliya (loss of cohesiveness and quality of Dhatu) are important vyadhi-sankar ghatak (factors of co-morbid pathology) for the therapeutic targets.

**CONCLUSION**

Ayurveda the science of life describes all the co-morbidities of overweight/obesity in detail. As obesity management needs multi-angle approach of management; the multidisciplinary approach of management should be considered to control childhood overweight/obesity. The process of the disease and the details of co-morbidities along with their different management plans at different stages should be taken in consideration while controlling the childhood overweight/obesity.

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