

Review Article

Childhood Obesity: Etiology and Management

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ABSTRACT

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World Health Organization (WHO) reported that developed and developing, both countries are suffering from childhood obesity. Childhood obesity has increased nationally and internationally. This can be reduced by focusing on prevalence, cancer association with obesity, risk factors and preventive measures of worldwide childhood obesity. Vitamin D and calcium both are inversely associated with obesity in children. So, supplementation of both micro-nutrients is warranted in childhood obesity. Some natural products in the form of diet are also helpful in reduction of obesity namely; prebiotics, probiotics and fatty acids.

Keywords: Obesity; Overweight; Factors; Consequences**INTRODUCTION:**

The prevalence of obesity in children was increased from 4.2% in 1990 to 6.7% in 2010. During the survey from 2009 to 2010, it was estimated that 2 to 5 year old children have 12% obesity and that of 6 to 19 year old children have 18%. In developing countries (China Mexico, Thailand), prevalence of childhood obesity is higher. For example, The World Health Organization (WHO) reported that in 2013, 42 million children of < 5 year old were obese. Out of which, 75% belongs to developing countries (Magrone and Jirillo, 2015). Obesity rate is higher in rural areas of United States than in urban communities because they have limited access to healthy food due to poverty (Calancie et al., 2015).

All over the world, 43 million children are estimated to be obese or overweight. If this rate of obesity carried on, the prevalence of obesity is expected to be extended over 60 million in 2020.

Overweight and obese children undergoes physical and psychological health problems including: hyperlipidemia, hypertension, insulin resistant (IR), infertility, some forms of cancer, sleep disturbances in childhood, inflammation, depression, metabolic syndrome and cardiovascular diseases that leads to death at the age of 40-55 years (Peterson, 2015; Sahoo et al., 2015). Overweight or obesity gained by the women leads to the gestational diabetes during pregnancy and give birth to the baby with excessive weight birth; that is the predictor of childhood obesity or overweight. Mothers who smoked during pregnancy are also at the risk of high weight birth. Breastfeeding reduces the risk of obesity (Mahmood, 2015). According to a report, developed as well as developing, both countries are at the risk of childhood obesity. In 2013, it were estimated that 23.8% of boys and 22.6% of girls in developed countries and 12.9% of boys and 13.4% of girls in developing countries were obese. Lack of physical activity, large birth weight, increased television viewing, parental obesity, maternal tobacco smoking during pregnancy, nutritional

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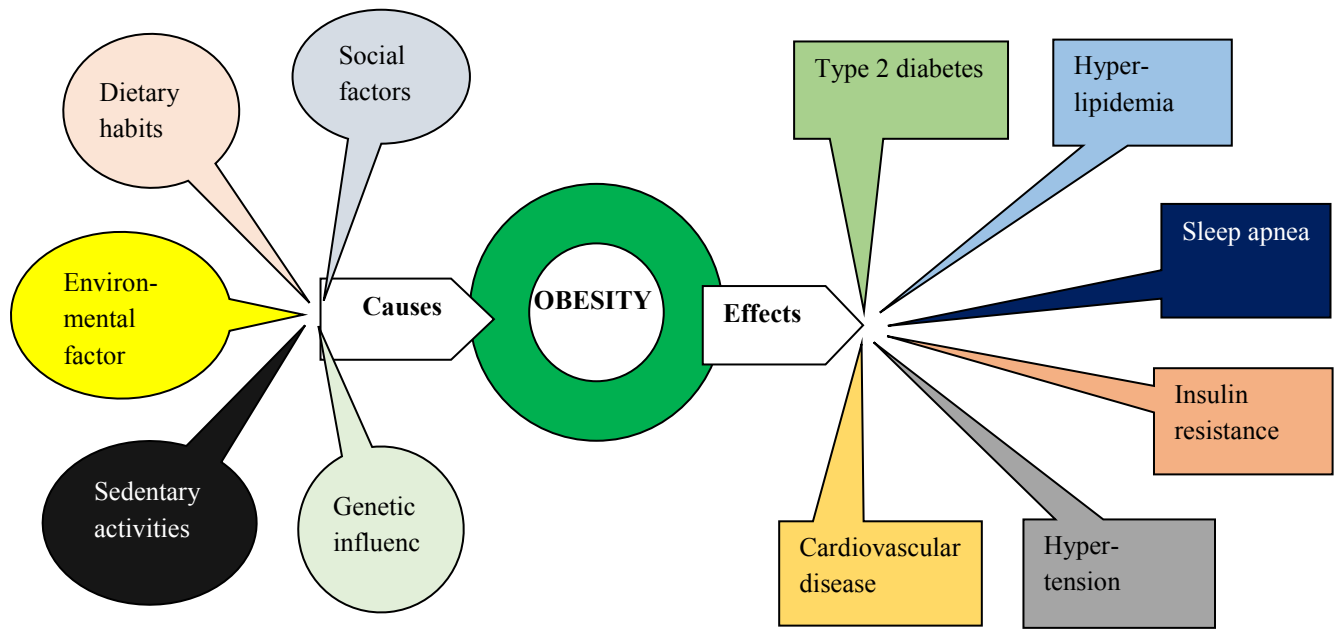


Figure 1: Causes & Effects in Childhood Obesity

factors, genetic and epigenetic influence all are the causes of increase in childhood obesity worldwide. WHO has been reported that approximately 200 million men and 300 million women are obese and expected to rise in number around 2.3 billion overweight and 700 million obese in 2015. This report shows that Females are at higher risk of obesity as compared to males (de Onis, 2015).

Abnormal or excessive accumulation of fat, which is hazardous to health, is referred to as obesity. According to WHO, obesity is defined as excessive fat accumulation in the body that causes distortion in health. Calorie intake is higher than energy expenditure in obesity (energy imbalance). Consumption of easy and cheap foods containing high calories is the major consequence of obesity (Wang et al., 2015). Risk factors includes: genetics, diet, lifestyle and environmental factors. According to a research study, 40% to 70%

phenotypic variations related to obesity are heritable. Obesity leads to several diseases including cardiovascular diseases, dyslipidemia, liver disease, hypertension, type 2 diabetes mellitus, insulin resistance and cancer of various types. Metabolic dysregulation, sleep apnea, impaired lipid profile, elevated systolic and diastolic blood pressure all are the risks associated with obesity. Methods to measure obesity includes: body mass index (BMI), waist circumference, waist-to-hip ratio, skin fold thickness, bioelectric impedance analysis (BIA), underwater weighing (densitometry), computerized tomography (CT) and magnetic resonance imaging (MRI). Out of these, BMI is cheap and accurate to measure obesity but it only measures raw fatness (Kendrick et al., 2015).

Body mass index (BMI) = Weight (kg)/ height² (m)

85th percentile BMI is considered for overweight children and that of 95th percentile for obese children (Claussnitzer et al., 2015).

1.1 Risk Factors

Energy imbalance is a major cause of obesity. Behavioral, environmental, psychological and biological factors are also important in childhood obesity. Lower intake of calcium and vitamin D deficiency both are harmful for health and plays a role in obesity (Guerra et al., 2015).

1.1.1 Behavioral Factors

1.1.1.1 Nutritional Behaviors: Fast food contains high calories with low healthy nutrients. Processed foods are also rich with fats, salt and sugar e.g. chips, baked goods, and candy. These energy dense foods are responsible for childhood obesity. Calcium rich diets decreases 21% risk of insulin resistance and diabetes that are the consequences of obesity (Ozanne, 2015).

Sugary drinks contains higher calories but are quickly consumed to increase the feelings of hunger. That is why, intake of these drinks increases BMI. In addition to soda, all sweet drinks are Sugary drinks including juices (Karnik and Kanekar, 2015).

1.1.1.2 Sedentary Behavior: The time spent on television screen has direct relation with obesity. A school going children is at higher risk of obesity due to watching television more than two hours a day. Watching television and playing computer games are associated with increased prevalence of obesity. Research indicates the number of hours children spend watching TV correlates with their consumption of the most advertised goods, including sweetened cereals, sweets, sweetened beverages, and salty snacks (Cunha et al., 2015). A parents report indicates that they prefer their children to watch television instead they go outside for games because parents are able to keep an eye on their children. School-going children, especially adolescent girls, which do not take part in sports

and physical education, have greater risk of obesity (Sonntag et al., 2015).

1.1.2 Environmental Factors

School-going children, to whom parents drove to school, have greater chance of physical activity as compared to those who walked or cycled. Family environment is another factor to develop habits of children. Meal time, food type and amount of food consumed by the family affects the weight gain of a child. Whether family members have physical activities or not, play a crucial role in habits of children (Skinner et al., 2015). Children, facing stress at home or misunderstanding between parents or have any distances among parents, are at higher risk of obesity (Pase et al., 2015).

1.1.3 Social Factors

Obese children have low self-confidence, low self-esteem and poor academic performance. Reason is, school-going obese children cannot participate in any physical activity due to slow speed and problem in breathing. They face negative comments from their peers. To avoid all of these, they spend more time at home and have less social interaction due to fewer friends. Academic performance is also very poor in obese children due to severe health problems caused by obesity. These may include: fatty liver disease, sleep apnea, Type 2 diabetes, asthma, hepatic steatosis (fatty liver disease), cardiovascular disease, high cholesterol, gallstones, glucose intolerance, insulin resistance, and orthopedic problems (Siraj and Williams, 2015).

1.1.4 Genetic Factor

Obesity can also be inherited from overweight parents to children due to sharing family environment. This heritable obesity is may be due to hormonal disorders that induces change in energy intake and expenditure, leading to increase in obesity. According to a study, 25-40% obesity is heritable (Reaves et al., 2015).

1.1.5 Is there any relationship between cancer and obesity?

Expert panel of International Agency for Research on Cancer (IARC) reported in 2002 that some type of cancers can be treated by weight loss. On the behalf of IARC report, many research studies were further conducted, showing the link of obesity with various types of cancers including colon, esophagus, endometrium, breast (in post-menopausal women), prostate, liver, kidney, gallbladder and pancreas (Sonntag et al., 2015). Obesity alters the metabolism and releases the signaling molecules e.g. endocrine, growth and inflammatory mediators. These factors increases the risk of breast cancer (Reaves et al., 2015).

1.1.6 Role of Vitamin D Deficiency in Obesity

Lower serum levels of vitamin D have been observed in obese children as compared to lean people. Obesity and vitamin D have same risk factors i.e. poor diet and lack of physical activity. Vitamin D deficiency in childhood obesity causes inflammation, insulin resistance, type 2 diabetes mellitus (in future) and osteoporosis that leads to growth retardation and skeletal deformities (rickets) in children. Major causes of vitamin D deficiency are reduced exposure to sunlight, excessive practice of sun screens/blocks, air pollution and lower consumption of vitamin D-fortified foods (Cheryl et al., 2015).

As vitamin D is soluble in fat, stored in adipocytes. So, the bioavailability of vitamin D is reduced in obese people and hypothalamus promotes the cascade of reactions, leading to increase in hunger and decrease of energy utilization. These reactions upgrade the level of parathyroid hormone that triggers the lipogenesis and adipogenesis, responsible for obesity (Dastan and Delice, 2015).

1.1.7 Role of Calcium in Obesity

There is an inverse relationship between calcium intake and obesity. Low level of calcium enhances the level of calcitriol that leads to the accumulation of calcium in adipocytes through vitamin D receptor. This increase of intracellular calcium enhances the activity of fatty acid synthase and inhibit hormone-sensitive lipase. In return of which

lipolysis will inhibited and lipogenesis will be increased, leading to fat accumulation. Calcitriol also expresses 11 β -hydroxyl steroid dehydrogenase-1 which converts cortisone into cortisol, involved in the deposition of fat in abdominal region (Dastan and Delice, 2015).

1.1.8 Role of Family Income in Obesity

Family income plays an important role in childhood obesity. Children who grew-up well-off in their childhood are less likely to be obese than those who grew up in lower income households. Reason behind this fact is that people having higher income status have easier approach to healthy food and exercise facilities that helps to maintain healthy weight.

Gender differences are also there. Boys are not significantly associated with family income. While, the girls with lower income background suffers more significantly for their weight as compared to those belonging to higher income status (de Onis, 2015).

1.2 Prevention of Childhood Obesity

Many research reports have been investigated that within 45 minutes of bicycling, walking, dancing and running, the energy expenditure of 165 kg child is 90, 135, 180 and 125 respectively (Calancie et al., 2015). There are some preventions and treatments for childhood obesity mentioned below.

1.2.1 Pre-natal education

Before conception and after pregnancy, maternal body weight should monitored. No weight gain during pregnancy to avoid diabetes. Balanced diet rich with high nutritional values should be recommended to mother. Pregnant mother should strictly avoid from smoking (responsible for high weight birth) (Guerra et al., 2015).

1.2.2 Breast Feeding

If a baby is breastfed for six months exclusively, the risk of childhood obesity is reported to be reduced. More than this period of breastfeeding,

4% of obesity risk decreased in later life. Solid food should have high nutritional values. Snacks should not be provide to infants in excess amount [Erem, 2015).

1.2.3 Preschool Education

Parents should develop healthy food eating habits in children. Excessive use of vegetables and fruits in diet should encourage and discourage the intake of fast foods and sweet soft drinks. Monitor body weight to avoid quick body fat (Diase et al., 2015).

1.2.4 Maintenance of Physical Activity

World Health Organization (WHO) concluded in a research that 5-17 years old children, who have had engaged in a physical activity on daily basis, have many health advantages. Those health benefits includes: improved body fitness e.g. cardiorespiratory fitness and muscular strength, decreased body fat, enhanced bone health, favorable cardiovascular and metabolic health biomarkers, decreased anxiety and depression. According to WHO guidelines, 5-17 years old children and young people should have 60 minutes long physical activity on daily basis and daily physical activity should be aerobic (exercise), intense and vigorous gradually (Schaefer et al., 2015).

1.2.5 Vitamin D Supplementation

Vitamin D is a hormone present in two forms namely D2 and D3. There is an inverse relationship between obesity and vitamin D. Deficiency of it is harmful for health e.g. rickets in children. Synthesis of vitamin D in skin is proceeded by the conversion of 7-dehydrocholesterol (in epidermal layers of skin) to pre-vitamin D in the presence of ultraviolet light (wavelength = 209-315 nm). So, sun exposure is very important for the synthesis of vitamin D to prevent obesity. Vitamin D is present in very rare food sources namely fish liver oils, fish, organ meats (rich with vitamin D), egg yolks and sun-dried mushrooms (less amount of vitamin D). Countries where fish is not consumed, fortified foods and supplements should consume such as

breakfast cereals, milk, milk products, grain products, pastas, margarine, and some brands of orange juice (Cheryl et al., 2015).

1.2.6 Anti-obesity effect of calcium

Calcium sufficiency reduces the obesity. Calcium obtained from dairy sources is more effective than acquired from food supplemented with calcium. Diets rich with calcium helps to suppress calcitriol and reduces the production of cortisol in adipose tissues, leading to decreased body fat. Supplemented and nutritive calcium excrete fat from the body by forming insoluble complexes in the intestine (Erem, 2015).

1.2.7 Anti-obesogenic effects of Natural Products

Some natural products are involved in prevention of obesity by improving intestinal microbiota. Even a small change in intestinal microbiota causes obesity in children. Products includes: prebiotics, Probiotics and fatty acids (Schaefer et al., 2015).

1.2.7.1 Prebiotics: It is non-digestible fiber that improves the composition of gut bacteria. Galacto-oligosaccharides and fructo-oligosaccharides are prebiotics present in infant formula diet, stimulates the growth of Bifidobacteria. Non-alcoholic steatohepatitis (NASH), a common disease in obese children, is treated by oligofructose (prebiotics) as it reduces level of aminotransferase and insulin (Diase et al., 2015).

1.2.7.2 Probiotics: A strain of bacteria present in gut is *Lactobacillus gasseri* (LG2055). This strain reduces the abdominal fat mass by introducing it in obese people. Inflammatory bowel disease and obesity can be treated through fecal microbiota transplantation and metabolic syndrome (consequence of obesity) is prevented by manipulation of intestinal microbiota from donor to recipient. *Lactobacillus rhamnosus* is another bacterial strain responsible for prevention of obesity in infants during 2 years (after delivery), if it is given to pregnant mothers before 4 months of delivery up to 6 months after delivery. A research

study revealed that synbiotics (prebiotics + probiotics) are involved in reduction of obesity if lactobacilli (probiotics) and fructo-oligosaccharides (prebiotics) are given to obese children. This treatment also reduces tumor necrosis factor- α (TNF- α) and interleukin-6 (IL-6) (Magrone and Jirillo, 2015).

1.2.7.3 Fatty Acids: These are important in energy stored in body and formation of membranes. Some fatty acids namely: n-3 poly unsaturated fatty acids (PUFAs) and their derivatives, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) reduces plasma triglyceride levels and body weight. These are also helpful in reducing hypoxia in adipose tissues (Magrone and Jirillo, 2015).

2. Conclusion

Obesity is an inflammatory disease. It has both physical and psychological impacts on health. Obese children suffers from many chronic diseases such as cardiovascular and digestive diseases. Fat-dense foods, such as fast foods, and lack of physical activity are responsible for obesity. Prevalence of obesity can be reduced all over the world by focusing on factors involved in obesity. Balanced diet and daily aerobic exercise decreases the risks of obesity. Parents should encourage healthier food references and good lifestyle. Some dietary supplementations, vitamin D and calcium intake, are also necessary because natural foods cannot fulfill the requirement of micronutrients. So, obesity in children can be ruled out from society by all of these preventive measures.

REFERENCES

- Calancie L, Leeman J, Jilcott Pitts SB, Khan LK, Fleischhacker S, Evenson KR, et al. (2015) Nutrition-Related Policy and Environmental Strategies to Prevent Obesity in Rural Communities: A Systematic Review of the Literature, 2002–2013. *Prev Chronic Dis*, 12:1-16.
- Cheryl L Perry, Deanna M Hoelscher, Harold W Kohl. (2015) Research contributions on childhood obesity from a public-private partnership. *International Journal of Behavioral Nutrition and Physical Activity*, 12: 1-7.
- Claussnitzer, M., Dankel, S.N., Kim, K.H., Quon, G., Meuleman, W., Haugen, C., Ghunk, V., Sousa, I.S., Beaudry, J.L., Puviandran, V., Abdennur, N.A., Liu, J., Svensson, P.A., et al., (2015) Obesity Variant Circuitry and Adipocyte Browning in Humans. *N Engl J Med*, 373: 895-905.
- Cunha K. A., Elma Izze da Silva Magalhães, Laís Monteiro Rodrigues Loureiro, Luciana Ferreira da Rocha Sant’Ana, Andréia Queiroz Ribeiro, Juliana Farias de Novaes. (2015) Calcium intake, serum vitamin D and obesity in children: is there an association? *Rev Paul Pediatr*, 33(2):222–229.
- Dastan I., Delice E. (2015) A Review of Global Childhood Obesity Epidemic and Potential Determinants. *Izmir Review of Social Sciences*, 2(2): 57-71.
- de Onis M. (2015) Preventing childhood overweight and obesity. *J pediatr (Rio J)*, 91(2) 105-107.
- Diase, K. A., Green, D. J., Ingul, C. B., Pavey, T. G. and Ombes, J. S. (2015) Exercise and Vascular in Child Obesity: A Meta-Analysis. *Pediatrics*, 136(3): 649-659.
- Erem, C. (2015) Prevalence of Overweight and Obesity in Turkey. *IJC Metabolic and Endocrine*, 8: 38-41.
- Guerra, P.H., Silveira, J.A. and Salvador, E.P. (2015) Physical activity and nutrition education at the school environment aimed at preventing childhood obesity: evidence from systematic reviews. *Pediatrics*, 312: 9.
- Karnik, S. and Kanekar, A. (2015) Childhood Obesity: A Global Public Health Crisis. *Int J Prev Med*, 3(1): 1-7.
- Kendrick J. G., Carr, R. R., Marray H. H. Ensom. (2015) Pediatric Obesity: Pharmacokinetics and Implications for Drug Dosing. *Clinical therapeutics*, 37(9): 1897-1923.
- Magrone, T. and Jirillo, E. (2015) Childhood Obesity: immune response and nutritional approaches. *Frontiers in IMMUNOLOGY*, 6(76): 1-13.
- Mahmood, L. (2015) the childhood obesity epidemic: A mini review. *Journal of medicine and public health*, 5(1): 6-9.
- Ozanne, S. E. (2015) Epigenetic Signatures of Obesity *N Engl J Med*, 372:973-974.
- Pase, V.M., Ong, K.K. and Lakshman, R. (2015) Factors influencing obesogenic dietary intake in young children (0–6 years): systematic review of qualitative evidence. *BMJ*, 5(9):1-6.
- Peterson C. A. (2015) Vitamin D deficiency and childhood obesity: interactions, implications and recommendations. *Nutrition and Dietary Supplements*, 7:29-39.
- Reaves, D.K., Ginsburg, E., Bang, J.J. and Fleming, J.M. (2015) Persistent organic pollutants and obesity: are they potential mechanisms for breast cancer promotion? *POPs, obesity and breast cancer*, 22: 69-86.
- Sahoo, k., Sahoo, B., Choudhury, A.K., Sofi, N.Y., Kumar, R. and Bhadoria A.S. (2015) Childhood obesity: causes and consequences. *J Family Me d Prim Care*, 4(2): 187-192.
- Schaefer S.E., Camacho-Gomez, R., Sadeghi, B., Kaiser, L., German, J.B., de la Torre A (2015). Assessing Child Obesity and Physical Activity in a Hard-to-Reach Population in California’s Central Valley. *Prev Chronic Dis*, 12:140-577.

Siraj, E.S. and Williams, K.J. (2015) Another Agent for Obesity — Will This Time Be Different? *N Engl J Med*, 373: 82-83.

Skinner, A.C., Perrin, E.M., Moss, L.A. and Skelton, J.A. (2015) Cardio metabolic Risks and Severity of Obesity in Children and Young Adults. *N Engl J Med*, 373: 1307-1317.

Sonntag, D., Schneider, S., Mdege, N., Ali, S. and Schmdit, B. (2015) Beyond Food Promotion: A Systematic Review On the Influence of the Food Industry On Obesity-Related Dietary Behavior among Children. *Nutrients*, 7: 8565-8576.

Wang, Y., Cai, L., Wu, Y., Wilson, R. F., Weston, C., Fawole, O., Bleich, S.N., Cheskin, L. J., Showell, N. N., Lau, B. D., Chiu, D. T., Zhang, A., Segal, J. (2015) what childhood obesity prevention programs work? A systematic review and meta-analysis. *Epub*. 16(7):547-65.