Childhood Obesity: Burden, Risk Factors and Interventions

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Introduction

Children are affected by a wide range of Non-Communicable Diseases (NCDs), such as cancer, diabetes, chronic respiratory diseases and congenital heart diseases. Most of the behavioral risk factors for NCDs start during childhood and often lead to intermediate risk factors such as obesity, hypertension and dyslipidemia early in life, even in childhood and adolescence. Among the risk factors, obesity is of particular concern in children as it is associated with a wide range of health complications and an increased risk of premature onset of illnesses, including diabetes and heart disease. Rising at an alarming rate, childhood obesity has recently been termed "exploding nightmare" by World Health Organization (WHO). Childhood obesity is complex and the effectiveness of interventions indicates that novel approaches are required. A combination of community partnerships, government support and scientific research is necessary in order to develop the best recommendations for prevention of obesity.

Burden of Childhood Obesity Worldwide and in India

Worldwide, the prevalence of combined overweight and obesity rose by 27·5% for adults and 47·1% for children between 1980 and 2013. Childhood obesity prevalence rates are higher in high-income countries (HICs) but in absolute numbers, there are more overweight and obese children living in low- and middle-income countries (LMICs) than in HICs. [1] In Asia, the 2010 prevalence rate of 4.9% equates to approximately 18 million children. [2] If current trends continue, over 70 million infants and young children will be overweight or obese by 2025, the vast majority living in LMICs. [1] These countries including India have had high rates of child undernutrition, but now childhood obesity is also rising rapidly. [3] Childhood obesity is often under- recognized as a public health issue in these settings, where culturally, an overweight child is often considered to be healthy.

With a rapid demographic and socioeconomic transition, India is becoming the epicenter of epidemics of both adult and childhood obesity, especially in urban populations. Although the age-standardized rates are low, in absolute terms India is the country with the third-highest level of obesity in the world. Over the years, epidemiological studies have reported a consistent increase in the prevalence of childhood overweight and obesity in the subcontinent. Age-standardized prevalence of overweight in children under 5 years of age, comparable estimates, 2014 is <5% for India. A systematic analysis conducted as part of the Global Burden of Disease study 2013 reported that 5.3% of males and 5.2% of females aged < 20 years in India were overweight. The overall prevalence of obesity among males and females in the above age category was 2.3% and 2.5% respectively. [1] A study conducted among 24,842 school children in south India showed that the proportion of overweight children increased from 4.94% in 2003 to 6.57% in 2005. [4] Socio-economic trends in childhood obesity in India are also emerging. A study from northern India reported a childhood obesity prevalence of 5.59% in the higher socio-economic strata when compared to 0.42% in the lower socio-economic strata. But now it is spreading in lower socio-economic groups as well. [5] Another school based study in 2011 reported the prevalence of overweight and obesity in 8 and 18 year old children, respectively, as 14.4% and 2.8% by International Obesity Task Force (IOTF) cutoffs, 14.5% and 4.8% by Center for Disease Control (CDC) cutoffs, and 18.5% and 5.3% by World Health Organization (WHO) cutoffs. [6]

Childhood Obesity: Pathophysiology, Determinants and Measurement

During childhood, level of body fat change begins from high adiposity during infancy. Body fat decreases for about 5.5 years until the period called adiposity rebound, when it's typically at lowest level. Adiposity then increase until early adulthood. Childhood obesity is a complex condition and increases the child's risk for psychological effects, gastrointestinal complications, asthma, musculoskeletal impairment, non-alcoholic liver disease, cardiovascular disease and diabetes. [7] Being obese as a child, increases the likelihood of being obese as an adult. In addition, childhood obesity can contribute to behavioral and emotional difficulties, lead to stigmatization and poor socialization and appears to impair learning. [8] Risks once thought to be either genetic or acquired may be a combination of both, i.e., environmentally induced effects on gene expression (epigenetic effects). [9] The growing body of literature about chronic disease suggests a life-course approach for tackling risk factors. The intergenerational passage of obesity risk is a newly recognized issue. It reveals how the epidemic of obesity, now evident in adults will be perpetuated into future generations.

Longitudinal studies suggest that for some NCD-related co-morbidities, the negative health consequences may present even if normal weight is attained in adulthood, suggesting that childhood obesity leaves a permanent imprint. Childhood obesity originates from the interplay between biological and contextual factors. The biological factors include parental factors such as maternal over and under nutrition prior to conception and during pregnancy, which change the way the child responds to nutritional experiences in early life. Evidence shows strong relationship between fetal undernutrition, early-life exposure to obesity and type 2 diabetes. [10]

During infancy, eating and exercise behaviors are established including the biological set-points for appetite and food preference have profound long-term consequences. [11] Individual obesity is a result of a complex interplay among genetically determined body habitus, appetite, nutritional intake, physical activity and energy expenditure. Environmental factors determine levels of available food, preferences for types of food, levels of physical activity and preferences for types of activities. Children today are developing and growing within an increasingly obesogenic environment that results in energy imbalance. Nutrition and physical activity transitions have resulted in the exposure of children to ultra-processed, energy-dense, nutrient poor foods, reduced opportunities for physical activity both in and out of school and an increase in the time spent on sedentary leisure activities. With globalisation and urbanization, the exposure to the obesogenic environment is increasing in both high income countries and low middle income countries.

Changes in food industry relate in part to social changes, fewer families routinely prepare food, food industry prepare meals with high levels of calories, simple carbohydrates and fat, price of many foods have declined, marketing pressure and consumption of high carbohydrates beverages. Working mothers or single-parent families may also increase the demand for take away foods or increase the frequency of eating out and cause reliance on pre-prepared foods. The higher per capita income also increases the family's economic capacity and thus the affordability to buy high calorie foods from restaurants. The variety of convenience foods available in the market, school canteens and the role of media in sensitizing the parents and children to these changes could have also undoubtedly contributed to childhood obesity.[12]

Mass media with deliberate, and sometimes unethical, target marketing strategies at children. Impulse marketing influences to buy unhealthy products. [13] Increasingly sedentary work style, pressure for academic performance has led to less of outdoor activities. The Central Board of Secondary Education (CBSE) 2007 fact sheet reported that only 30% of adolescents played regularly for at least 1 hour a day. [14] In addition, changing modes of transportation, that is, people prefer driving to

cycling or walking even for short distances, and increasing mechanization and use of labor-saving devices at home are also contributing factors. [15]

Overweight kids also suffer from sleep apnea, which means they do not sleep well at night, which in turn affects their performance in schools. Obese girls have more incidents of PCOD, often resulting in delayed and irregular periods, which causes hormonal changes as they grow and may also lead to infertility in the long run. Whereas male obese kids have more chances of developing Type 2 diabetes, hypertension and sleep apnea. When bullied, most obese kids suffer in silence. They suffer from poor body image, which leads to increased comfort eating, behavioral issues and poor academic performance. It is often seen that since they are laughed at by friends and classmates at school, they start missing school and instead spend more hours on internet or TV.

How to Measure Childhood Obesity

According to WHO, overweight and obesity for under 5 years defined as the proportion of children with weight-for-height Z-score values more than 2 SDs and more than 3 SDs, respectively, from the WHO growth standard median. Overweight and obesity for 5 to 19 years is defined as overweight is BMI for age > 1 standard deviation above the WHO Growth Reference median and obesity is greater than 2 standard deviations above the WHO Growth Reference median.

Body mass index (BMI) is a measure used to determine childhood overweight and obesity, For children and teens, BMI is age and sex specific and is often referred to as BMI for age. A child's weight status is determined using an age and sex specific percentile for BMI rather than the BMI categories used for adults. This is because children's body composition varies with age and sex. Therefore, BMI levels among children and teens need to be expressed relative to other children of the same age and sex. Although BMI is the simplest means to identify children who are overweight and obese, it does not necessarily identify children with abdominal fat deposits that put them at greater risk of health complications. [16]

The World Health Organization (WHO), U.S. Centers for Disease Control and Prevention (CDC), and International Obesity Task Force (IOTF) each have definitions of overweight and obesity in children and adolescents. At different ages, these criteria give somewhat different estimates of overweight and obesity prevalence. In preschool girls, the WHO BMI cut off points for overweight and obesity are much higher than those of the International Obesity Task Force. One recent Czech study found that using the International Obesity Task Force cutoff, about 15 percent of 5-year-old girls were overweight as compared to only about 3% by WHO. [17] There's clearly a need to harmonize these international standards for childhood obesity.

➢ **WHO Child Growth Standards (birth to age 5)** [18]

Obese: Body mass index (BMI) > 3 standard deviations above the WHO growth standard median

Overweight: BMI > 2 standard deviations above the WHO growth standard median

➢ **WHO Reference 2007 (ages 5 to 19)** [19]

Obese: Body mass index (BMI) > 2 standard deviations above the WHO growth standard median

Overweight: BMI > 1 standard deviation above the WHO growth standard median

➢ **US. Centers for Disease Control and Prevention (CDC)**

CDC Growth Charts [20]: In children ages 2 to 19, BMI is assessed by age- and sex-specific percentiles

Obese: BMI = 95th percentile or greater, Overweight: BMI = 85th to < 95th percentile

In children from birth to age 2, the CDC uses a modified version of the WHO criteria [21]

➢ **International Obesity Task Force (IOTF)** Provides international BMI cut points by age and sex for overweight and obesity for children age 2 to 18. [22] The cut points correspond to an adult BMI of 25 (overweight) or 30 (obesity).

Indian Scenario

Difference in body composition has been seen in Asian-Indian children living in Europe and the United States of America (USA). Despite small abdominal viscera and low muscle mass, Indian neonates preserve body fat during their intrauterine development and are relatively obese at birth compared to Caucasians. Studies showed that this "thin fat phenotype" persists in postnatal life and results in a significant difference in the body fat content of Indian children compared to other ethnic groups.[10,23,24] The pathogenesis of diabetes is influenced not only by the quantity of fat stored but also by its location. Excessive visceral fat, as indicated by abdominal obesity, is one of the strong predictors of insulin resistance and diabetes in Asian Indian adults. It is now evident that children and adolescents of Indian origin are also susceptible to abdominal obesity.

The coexistence of severe malnutrition and childhood obesity could have a pivotal role in the exponential increase in prevalence of diabetes among Indians. Further, body composition and fat distribution, which are influenced by both genetic and environmental factors, may contribute to the pathophysiology of diabetes in the Indian context. However, the magnitude of the problem among children and adolescents in India is unclear due to paucity of well-conducted nationwide studies and lack of uniformity in the cut-points used to define childhood overweight and obesity. Over the years, there has been a lack of consensus on the various cut-points or definitions used to classify obesity and overweight in children and adolescents. There is lack of national representative data on obesity in children from India with its widely varying geographical, social and cultural norms. A systematic review of prevalence data from 52 studies in India was done .The pooled data after 2010 estimated a combined prevalence of 19.3 per cent of childhood overweight and obesity which was a significant increase from the earlier prevalence of 16.3 per cent reported in 2001-2005.

The most commonly used definition for childhood overweight and obesity in India was IOTF, WHO and CDC. Others included Gomez classification, India specific cut-points were found in the Agarwal charts (used by Indian Academy of Paediatrics (IAP)), Eliz Health Path for Adolescents and Adults (EHPA) etc. [25,26] The key studies for children are from the National Family Health Surveys (NFHS) and National Nutrition Monitoring Bureau (NNMB) surveys.[27-31] In under-fives the prevalence of obesity was below 2 per cent in all the studies. In children above 5 year, the prevalence of obesity varied between 2 to 8 per cent.

Multi dimensional approach to fight against childhood obesity

Interventions aimed at preventing childhood obesity would lead to both a reduction in comorbidities in children and to a reduction of the long-term burden of NCDs. Life-course studies suggest that interventions in early life, when biology is most 'plastic' and amenable to change, are likely to have the greatest positive sustained effects on health.[32] This life-course model applies to both HICs and LMICs, and to populations in transition. New scientific evidence highlights the need for a multifaceted approach including a focus on the life-course dimension; thus the need to intervene even before conception and also to reduce the exposure of the pregnant woman, infant, child and adolescent to an obesogenic environment. No single intervention can halt the rise of the growing epidemic; therefore, actions that address both the obesogenic environment and developmental factors are required. Body image and the perception of healthy body weight, especially for infants and young children, can be influenced by cultural values and norms, and these will be important considerations in the development of interventions.

1. Tackle the obesogenic environment and norms

The major goals of addressing the environmental component include IMPROVING HEALTHY EATING AND PHYSICAL ACTIVITY BEHAVIORS. As the child enters the educational environment, nutrition and physical activity education should be included in the curriculum. Multisectoral approaches to improving

the intake of healthy foods and non-alcoholic beverages can be strengthened by standardized system of food labeling. Where access to healthy foods is limited, ultra-processed foods are often the only alternative available and affordable. There is evidence that unhealthy food and non-alcoholic beverage marketing is related to childhood obesity.[33] The increasing number of voluntary efforts by industry and communities suggest that the need for change is widely agreed. Any attempt to tackle childhood obesity should, therefore, include a reduction in exposure of children to power of marketing unhealthy foods.[34] Overall, the rationale for and effectiveness of taxation measures to influence consumption are well-supported by the available evidence.[35,36] Recently in India Kerala government is planning to tax junk food at 14.5%.The 'fat tax' will be levied on burgers, pizzas and processed foods served in organized fast-food outlets, including some international brands..

Recent evidence shows that physical activity declines from the age of school entry and less than 20% of the global population is sufficiently active, as defined by WHO guidelines of physical activity, by the age of 13-15 years. Low physical activity is fast becoming the social norm in most countries and is an important driver of the obesity epidemic. Physical activity behaviors can also be established in childhood and are subject to social and environmental factors. Furthermore, family and cultural factors can influence whether these behaviors are reinforced or not during the childhood period of continued plasticity. Urban planning and design has the potential to both contribute to the problem and the opportunity to form part of the solution, through increased recreational space and by supporting walking and cycling for active transport.

2. Preconception and pregnancy:

Evidence shows that maternal undernutrition, overweight or obesity, excess maternal hyperglycemia (including gestational diabetes), smoking or exposure to toxins are preconceptional or gestational influences that increase the likelihood of obesity during infancy and childhood. This period is also a good opportunity for promoting awareness of the importance of exclusive breastfeeding for 6 months and healthy complementary infant feeding. For example, appetite control and food preference are largely set early in life and exclusive breastfeeding and the timely introduction of appropriate complementary foods can influence those set points.

3. Infant and young child:

Breastfeeding is core to optimizing infant development and evidence supports that is prevents childhood obesity. Given changes in women's lifestyles and roles, the ability to breastfeed outside of the home and sustain breastfeeding is essential. Policies that establish rights of women and responsibilities of employers are needed. World Breastfeeding Week (2016) focused on this issue with theme" BREASTFEEDING AND WORK-LET'S MAKE IT WORK" Guidelines that address both under nutrition and obesity risk are clearly needed for some countries like India where both conditions co-exist. Family attitudes to eating and perceptions of body shape also appear to be important. Several strategies in this age group have also supported parents and caregivers to ensure minimal television/screen viewing, encourage active play, establish healthy eating behaviors and diets, promote healthy sleep routines and role-model healthy caregiver and family lifestyles.

Among the American Academy of Pediatrics (AAP) (2016) recommendations:

1. For children younger than 18 months, avoid use of screen media other than video-chatting. Parents of children 18 to 24 months of age who want to introduce digital media should choose high-quality programming, and watch it with their children to help them understand what they're seeing.
2. For children ages 2 to 5 years, limit screen use to 1 hour per day and parents should co-view media with children.

3. For children ages 6 and older, place consistent limits on the time spent using media, and the types of media, and make sure media does not take the place of adequate sleep, physical activity and other behaviors essential to health.

4. School-age child and adolescent:

There is an evidence base to support interventions in school settings .Increasing access to and promotion of, lower energy-density foods and to water as an alternative to sugar sweetened non-alcoholic beverages, are actions necessary to make the environment less obesogenic and to establish healthier behavioral norms. Physical activity provides fundamental health benefits for children and adolescents, including increased cardio respiratory and muscular fitness, reduced body fatness and enhanced bone health, as well as reduced symptoms of depression and improved psychosocial outcomes.

According to WHO, in order to improve cardio respiratory and muscular fitness, bone health and cardiovascular and metabolic health biomarkers, children and youth aged 5–17 should accumulate at least 60 minutes of moderate- to vigorous-intensity physical activity daily. Amounts of physical activity greater than 60 minutes provide additional health benefits. Most of the daily physical activity should be aerobic. Vigorous-intensity activities should be incorporated, including those that strengthen muscle and bone, at least 3 times per week. Increasing physical activity without decreasing caloric intake is unlikely to result in weight loss. It can increase aerobic fitness and decrease percent body fat even without weight loss. JUST AS FAMILY MEAL, FAMILY ACTIVITY IS RECOMMENDED.As stated before marketing of unhealthy food is highly influential in eating habits of children, it should be regulated.

5. Treat children already affected by obesity to improve their current and future health

There is no effective pharmacotherapy resulting in reversal of excess adiposity in children and adolescents. Evidence reviews of childhood obesity show that family-focused behavioral lifestyle interventions can lead to positive outcomes in weight, BMI and other measures of body fatness. The health sector in each country varies considerably and will have different challenges in responding to the need for provision of treatment services for those affected by obesity. Primary health-care services are important for the early detection and management of obesity and its associated complications, such as diabetes. Based on behavior change theories, treatment includes specifying target behaviors, self monitoring, goal setting, stimulus control and promotion of self efficacy and self management skills.

Conclusion

The challenge of childhood obesity is one that must be taken as urgent and serious in all populations. Experts warned that early prevention was the need of the hour to avoid an entire generation from falling prey to heart ailments, hypertension and diabetic complications. The increasing rates of childhood obesity cannot be ignored and governments need to accept their central role as the principal agents in addressing the issue. There is an understandable tendency to see obesity as a problem for the health sector, but preventing childhood obesity demands the coordinated contributions of government ministries and institutions responsible for policies on education, food, agriculture, commerce and industry, finance/revenue, sport and recreation, media and communication, environmental and urban planning, transport and social affairs.

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