FACTORS THAT PINPOINTS THE POTENTIAL DETERMINANTS OF OBESITY AMONGST SCHOOL GOING ADOLESCENTS: LITERATURE REVIEW

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ABSTRACT

Aim: The World Health Organization (WHO) describes overweight and obesity as one of today’s most important public health problems and the problem of overweight and obesity is not confined only to developed countries but also prevalent in developing countries. The main objective of this study was to review the available literature to understand the relationship between obesity among children and adolescents and various factors incriminating for it. Methods: Databases were searched using the terms 'obesity' and 'child', 'adolescent', physical activity', 'risk factors, 'lifestyle', 'Dietary habits' and socioeconomic status(or variations on these terms). In order to limit the potential literature, the main focus was on the reviews, both general and relating to specific aspects of obesity. Results: The findings of the various studies are similar as the relationship among socioeconomic status and adolescent obesity may result from number of underlying reasons, including unhealthy eating patterns, engaging in less physical activity, more sedentary behaviour. These factors tend to co-occur and are likely to contribute to increase the risk of obesity in children & adolescents. Conclusion: This review suggests that there are gaps in knowledge, pinpointing one or two main cause is difficult in the given data as potential determinants of obesity are intertwined and multiple. There is need for more reliable measures of dietary intake and activity levels and needs transformation in the lifestyle of adolescents through feasible ways.
KEYWORDS: Adolescents, Obesity, Overweight, SES.

INTRODUCTION
The last quarter of the twentieth century has seen childhood obesity emerging as an epidemic in developed countries and is also cause of concern worldwide as it is being reported in significant numbers from nations previously considered poor or developing. It is no longer a problem of the affluent countries only.[1] Prevalence varies within the country because of differences in lifestyle, mainly in the dietary patterns, and physical activity. In addition to this urbanisation and industrialisation are the main culprits for the increase in the prevalence of adolescent obesity.

The causes of childhood obesity are multi-factorial viz socio-economic status, race/ethnicity, media and marketing and the physical environment influence energy consumption and expenditure. Most factors of overweight and obesity do not work in isolation and solely targeting one factor may not go to make a significant impact on this growing problem.

To date, research has been unable to isolate the effects of a single factor due to the co-linearity of the variables as well as research constraints.[2] Specific causes for the increase in prevalence of childhood obesity are not clear and establishing causality is difficult since longitudinal research in this area is limited. Such research must employ long study times to discern if there is an interaction of factors leading to an increase in the prevalence or the prevention of obesity during childhood and adolescence. Underreporting of total food intake, misreporting of what was eaten, and over reporting physical activity are all likely potential biases that may affect the outcomes of studies in this area.[3]

Prevalence of Obesity
As prevalence of obesity depends heavily on the definition used and on a number of other factors (for example, the age and representativeness of the sample, or survey, the timing of the study or survey, whether or not height and weight are measured or self reported), summarising recent prevalence estimates around the world is problematic. In almost all countries to date that have reported on prevalence it is continuing to increase, and dramatic increases have been typical, showing rapid environmental and lifestyle changes in recent years.[4] For the developed world, estimates from 2000 onward using national definitions (such as BMI >95th centile) suggest that 10%–25% of the pediatric population was obese.[4,5,6,7-16] In England in 2003 for example, 28% of 2–11 year olds were overweight or
obese (BMI >85th centile), up from 22% in 1995, while 14% were obese (BMI >95th centile), up from 10% in 1995. In the developing world, prevalence of overweight and obesity has also increased dramatically in recent years. A few exceptions have been described, notably in sub-Saharan Africa and much of the former Soviet Union (where extreme economic hardship has limited the epidemic). Using the international definitions at least 10% of school age children are overweight or obese worldwide, and this is highest in the Americas (32%), then Europe (20%), and the Middle East (16%). In the developed world prevalence of pediatric obesity is generally as common in boys as girls. The picture with respect to sex differences in prevalence in the developing world is more complex and difficult to predict. In the developed world pediatric obesity is generally more common in children and adolescents from families of lower socioeconomic status, but the magnitude of these socioeconomic differences in prevalence is quite limited. In the developing world the picture is again more complex: higher socioeconomic status has usually been associated with higher risk of pediatric obesity, although as the epidemic progresses in the developing world lower socioeconomic status may become more of a risk for obesity. In the USA youth prevalence of obesity is much higher in some ethnic minorities than in the general population. Evidence from outside the USA is limited at present but suggests that some ethnic minority groups may also be at higher risk. Again, reasons for differences are complex and not entirely clear at present.

Childhood obesity affects both developed and developing countries of all socio-economic groups, irrespective of age, sex or ethnicity. It has been estimated that worldwide over 22 million children under the age of 5 are obese, and one in 10 children is overweight. A wide range of prevalence levels exist, with the prevalence of overweight in Africa and Asia averaging well below 10 per cent and in the Americas and Europe above 20 per cent. The proportion of school-age children affected will almost double by 2010 compared with the most recently available surveys from the late 1990s up to 2003. Obesity has become a serious public health concern affecting a significant portion of the population in countries like the US. Overall, among adults aged at least 20 yr in 1999-2002, 65.1 per cent were overweight and 30.4 per cent were obese. Among children aged 6 through 19 yr in 1999-2002, 31.0 per cent were overweight and 16.0 per cent were obese. Asian countries are not immune to this phenomenon. A study done on school going adolescent found the overall overweight adolescents were 22.8 percent, of which 28.1 percent boys, 18.8 percent girls were overweight.
Lifestyle Associated Risk Factors of obesity

Obesity has a complex etiology, resulting from the combined effects of genes, environment, lifestyle and their interactions. Although the genetic background is crucial to explain the susceptibility to most chronic diseases, the modernization and urbanization process affecting aboriginal populations has brought about major changes that are most likely contributing to the high prevalence of obesity and diabetes reported.\cite{28} Most aboriginal populations today have changed their diet and physical activity patterns to fit an industrialized country model. They now derive their diet completely or in large part from Western foods and live sedentary and physically inactive lives. Under these circumstances they develop high rates of obesity, insulin resistance and type 2 diabetes.\cite{29,30}

Sedentary behaviour has also been associated with body composition and BMI. For example, children who watch more television have been shown to have higher skin fold thickness, while one study has suggested that approximately 17.0 percent of early adult overweight may be attributable to watching television for two or more hours daily in childhood.\cite{31} The prevalence of overweight and obesity was significantly lower (3.1 percent) among the adolescents who participated in outdoor games ($p < 0.004$) than among the non-participants (9.7 percent). It was also significantly higher ($p < 0.001$) among the adolescents who did not perform any household activities (18.6 percent) compared with those participating in various household chores (4.7 percent). Similarly, overweight and obesity were marginally higher among adolescents who were not involved in physical activities such as walking, cycling, and jogging. The prevalence of overweight among adolescents who were sedentary, watching television $\geq$ 3 hours/day, was significantly higher (10.4 percent) compared with those who watched 0 or <3 hours/day (5.9 percent to 6.3 percent).\cite{32} The prevalence of overweight was lower (15.1%) among those who walked to school than in those using other modes of transport and it was statistically significant ($p=0.0001$). Daily Participation in active sport was present among 29.3% of the subjects and the prevalence of overweight was significantly ($p=0.0001$) lower among this group of adolescents.\cite{33}

Eating meals as a family every day is associated with a lower rate of obesity as well as getting good lifestyle habits such as eating balanced meals and getting enough sleep. About 89.0 percent of the boys ate with their family members and about 12.3 percent of them were obese, while about 10.9 percent boys did not eat with their family members daily out of them about 19.6 percent were obese and this was found to be statistically significant.\cite{34}
Watching television, using the computer, and playing video games occupy a large percentage of children’s leisure time, influencing their physical activity levels. It is estimated that children in the United States are spending 25.0 percent of their waking hours watching television and statistically, children who watch the most hours of television have the highest incidence of obesity.[35,36] This trend is apparent not only because little energy is expended while viewing television but also because of the concurrent consumption of high-calorie snacks. The risk of overweight was 21 times higher among those participating < two hour/week in any type of physical activity, 7.3 times higher among those who reported watching television and playing games on the computer for ≥ four hours/day.[61]

Currently, schools are decreasing the amount of free play or physical activity that children receive during school hours. Only about one-third of the elementary children have daily physical education, and less than one-fifth have extracurricular physical activity programs at their schools. Daily enrolment in physical education classes among high school students decreased from 42.0 percent in 1991 to 25.0 percent in 1995, subsequently increasing slightly to 28 percent in 2003.[37] Outside of school hours, only 39.0 percent of children ages 9-13 participate in an organized physical activity, although 77.0 percent engage in free-time physical activity.[38]

**Physical environment**

Experts have increasingly looked to the physical environment as a driver in the rapid increase of obesity in the United States.[39] In urban and suburban areas, the developed environment can create obstacles to being physically active. In urban areas, space for outdoor recreation can be scarce, preventing kids from having a protected place to play, neighbourhood crime, unattended dogs, or lack of street lighting may also inhibit children from being able to walk safely outdoors; and busy traffic can impede commuters from walking or biking to work as a means of daily exercise. Additionally, in-school environments have an impact on children’s health. In a study of available school environments such as courts, fields and nets for physical activity in middle schools, environmental characteristics including the area type and size, supervision, temperature and organized activities explained 42.0 percent of the variance in the proportion of girls who were physically active and 59.0 percent of the variance in boys.[40] Obesity is related to an imbalance between energy input and output, the size of which may be very small if over a long period.[41] One review suggests that in children, an imbalance of around 2%, which is the equivalent of around 30 calories or 15 minutes of TV instead of
playing a day, may lead to obesity.[42] Behavioural determinants therefore include excess energy intake and/or inadequate energy expenditure,[43] although the emphasis given to these 'Big Two', and the neglect of other plausible contributors to the secular increase in obesity has recently been questioned.[44] In respect of energy intake, dietary surveys do not suggest a secular increase among children and adolescents. However, the results of such studies may be confounded by an increasing trend towards greater under-reporting, to the extent that reported intake may be below the estimated required physiological minimum, especially among older girls. Regular consumption of high energy-dense fast foods and sugary drinks which are associated with less satiation and so insufficient compensation via subsequent reductions in intake, increased portion size, eating outside the home and snacking have been particularly implicated in promoting weight gain. This is especially the case among older children, who are less influenced by biological cues of satiety.[45,46] In respect of energy expenditure and physical activity, assessment is difficult,[19] and evidence for secular trends is scarce because of the absence of suitable baseline data.[47] However, a decline in UK adolescent energy intake from the 1930s to the 1980s with no concurrent change in body mass, increasingly pervasive electronic and screen-based entertainment, greater car travel and reduced walking or cycling, together with evidence of reductions in fitness in developed countries all point to lower activity levels.[48,49-51]

**Socioeconomic Status affects prevalence of obesity**

In respect of socioeconomic status (SES), studies suggest higher rates of obesity among low income groups in richer countries, and high income groups in poorer ones.[52,53] It is suggested that this is because in developing nations, higher SES individuals have become globalized, with easy access to relatively cheap, calorie-dense foods, while those of lower SES remain localized and undernourished.[54] Within the US, increases have also been greatest among children and adolescents from the lowest income families, so increasing SES disparities.[55] However, not all studies in developed countries find SES differences[56,57,58] and among those that report separately, there is some evidence that SES differences may be clearer among females than males.[59,60]

A multivariate logistic regression analysis revealed that the risk of overweight was two times higher among the adolescents of high SES, 21 times higher among those participating < two hour/week in any type of physical activity, 7.3 times higher among those who reported watching television and playing games on the computer for ≥ four hours/day.[61]
Findings from studies suggest that the effects of race/ethnicity and SES on the prevalence of childhood obesity cannot be individually determined because they are collinear. Therefore evidence is often inconsistent as a result of the difficulty of separating the overlapping factors.\cite{62} Furthermore, the relationship among race/ethnicity, SES, and childhood obesity may result from a number of underlying causes, including less healthy eating patterns (e.g., eating fewer fruits and vegetables, more saturated fats), engaging in less physical activity, more sedentary behavior, and cultural attitudes about body weight.\cite{63} Clearly these factors tend to co-occur and are likely to contribute jointly to differentials in increased risk of obesity in children.

**Nutritional Intake**

According to a large body of dietary survey data collected in the USA, it appears that some dietary patterns are consistently observed among adolescents, and put them at risk of unhealthy eating: the consequence of snacking, usually on energy-dense but otherwise nutrient-poor items; meal skipping; irregular eating patterns; and a wide use of fast food for meals and snacks. These food habits may also apply in varying degrees to adolescents in other parts of the world. Other eating behaviors generally recognized as common among adolescents are eating away from home, low intake of fruits and vegetables, and in some instances, of dairy products as well; and weight concerns leading to faulty dieting practices, particularly in girls.\cite{64,65,66} Adolescents may also try unconventional dietary practices, such as vegetarian diets, which may reflect their propensity to adopt social causes and explore different philosophies.\cite{67} Breakfast is often missed: more than 50% of respondents in the National Adolescent School Health Survey (US Dept Health and Human Services, 1989). Snacking was reported by 90% in the same survey. Only 39% reported eating nutritious snacks, the others describing snacks of “junk” food: chips, soda, sweets and cake.\cite{68} Wisely chosen snacks are important, Fast foods are popular choices among adolescents, and this can contribute to high intakes of saturated fat. Based on NHANES II and the National Adolescent School Health Survey, it was observed that adolescents who obtained breakfast and lunch foods from sources other than home or school were more likely to consume high-fat, low nutrient dense snacks, as well as dieting over the previous year.\cite{69}

The nutritional compositions of children’s diets as well as the number of calories consumed are of interest to determine the effect of food consumption on childhood obesity. Various studies had been done to understand the complexity that exists between food intake and
increased prevalence of obesity. A study showed that from 1977-78 to 1994-96 the away from home food intake increased from 20.0 to 30.0 percent.\textsuperscript{[70]} In other study daily total energy intake did not significantly increase for children 6-11, but did increase for adolescent girls and boys (ages 12-19 years) by 113 and 243 kilocalories, respectively.\textsuperscript{[71,72]} Daily total energy intake that children derived from energy dense (high calorie) snacks increased by approximately 121 kilocalories between 1977 and 1996.\textsuperscript{[73]} There has been a decline in breakfast consumption - especially for children of working mothers. Portion sizes increased between 1977 and 1996. Average portion sizes increased for salty snacks from 1.0 oz to 1.6 oz and for soft drinks from 12.2 oz to 19.9 oz.\textsuperscript{[74]}

Several studies have been published that attempt to link children’s diets with the onset of obesity. However, none have been able to show a causal link between diet and obesity.\textsuperscript{[75,76]} Two such studies include the Bogalusa Heart Study and a USDA Economic Research Service study.

Children and adolescents of affluent families are presently overweight than in the past, possibly because of decreased physical activity, sedentary lifestyle, altered eating patterns and increased fat content of the diet. A study conducted in one public school of Delhi catering to the affluent segment of population, out of 870 students only in 25.0 percent nutrient intake was assessed through the 24-hour dietary recall methodology. It was found that 17.0 per cent of all adolescent boys and girls had their energy intake 100\% or more, as compared to their recommended daily allowance (RDA).\textsuperscript{[77]} In a study it was found that the risk of overweight was 5.6 times higher among those who ate chocolates daily in addition to a normal diet.\textsuperscript{[78]}

**CONCLUSION**

The increase in childhood obesity over the past several decades, together with the associated health problems and costs, is a cause of grave concern among health care professionals and parents. An epidemic-like increase in the proportion of obesity would be largely attributed to the transformation in the lifestyles of young children from being physically active and consuming more of home cooked food to being more and more home bound, spending time on the internet, video games and TV, as well as the easy accessibility of fast food with growing prosperity.
Available research showed that there are a number of root causes of obesity in children. Selecting one or two main causes or essential factors is next to impossible given in the current data, because the potential influences of obesity are multiple and intertwined. There are large gaps in knowledge, limiting the ability to pinpoint a particular cause and determine the most effective ways to combat childhood obesity. Another research gap stems from lack of a prospective longitudinal study that links dietary and other behavior patterns to development of obesity. Another complication of current data is that there is a need for more precise and reliable measures of dietary intake and activity levels, as individual recall of events and diet are not the most dependable sources for information.

Similar kind of a change in lifestyle is also taking place quite steadily in children of developing countries, especially in urban areas and more so in the affluent class. Intervention is, therefore, a necessary step at school level itself for the prevention of non-communicable diseases.

REFERENCES
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36. Torgan, op.cit


