Original Article

Consequences of childhood and adolescent obesity

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Obesity, increasingly recognized as a chronic disease, is associated with physical, psychosocial and economic consequences to society. With the burgeoning global epidemic, health care workers must rally together to understand, treat and prevent obesity and its complications.

Key words: adolescent, childhood, economic consequences, obesity, physical, psycho-social.

Introduction

Obesity is an escalating epidemic affecting many demographic groups, including children and adolescents. Globally, an estimated 22 million children under five years of age are overweight.[1] In the United States, the number of overweight children and adolescents has doubled in the last two to three decades, and similar doubling rates are also observed worldwide, including the developing countries, and regions where increased Westernisation of behaviour and dietary lifestyles is evident.[1] Obesity has been reported in many Asian countries, and in Singapore, the School Health Survey reported that the prevalence of obesity in the year 2000 was 10.8% in children aged 6–7 years, 14.7% in those aged 12–13 years, and 13.1% in those aged 15–16 years.[2]

The significance of childhood and adolescent obesity arises from data which indicates that childhood obesity tends to predict adult obesity, and overweight children are more likely to become obese adults. Based on epidemiological tracking, the risk ratio of an obese infant or preschooler becoming an obese adult was estimated to be 1.8.[3] However, after adjustment for parental obesity, the odds ratio for obesity in adulthood associated with childhood obesity ranged from 1.3 (95% confidence interval, 0.6–3.0) for obesity at one or two years of age to 17.5 (7.7–39.5) for obesity at 15–17 years of age.[4] The relative risk of obesity in adulthood appears to increase with the age of the obese child or adolescent. In addition, parental obesity more than doubles the risk of adult obesity in children less than 10 years of age.[4]

Sugimori *et al.* studied the temporal course of obesity by tracking 479 Japanese children over 12 years.[5] Among children who were obese at 17 years, most could be tracked from primary school. The earlier the child was detected to be obese, the greater the body mass index at 17 years of age. The Fels longitudinal study tracked 338 children through 25 years, and concluded that the earlier a child was obese, the more obese he would be, and the earlier a child would become obese in later life.[6] The body mass index at adolescence was noted to be an important predictor of adult obesity.

Increasingly, obesity is now recognized as a chronic disease, the root of many other chronic diseases, and should not be just dismissed as a weakness of self-discipline and gluttony. The Harvard Growth study which followed up 508 children through 24 913 person years, accumulated over 55 years, concluded that overweight in adolescence increases the mortality from coronary heart disease, stroke and colorectal cancer, and increases the morbidity from these diseases, including gout and arthritis.[7] As a result of the global obesity epidemic, many chronic diseases are now appearing in childhood rather than in adulthood. Obesity results in physical and psychosocial consequences to the affected individual. It also poses a significant economic burden to society.

Physical consequences

Childhood obesity is associated with mechanical and metabolic consequences which result in many chronic diseases. The two main mechanical complications encompass orthopaedic problems and obstructive sleep apnoea syndrome.

Obese children are at risk of joint disease in the lower limbs which bear the brunt of excess weight. The associated orthopaedic diseases include bilateral tibia vara (bowed legs which result in knee pain and affects mobility), slipped upper femoral epiphyses, which causes hip pain and arises from abnormal forces acting on the femoral growth plate, and pes planus, which is caused by poor foot arches. Some of these

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orthopaedic problems may predispose to osteoarthritis in adulthood. More significantly, they affect the ability of the child to exercise, thus commencing a vicious cycle, with increasing and worsening obesity and joint disease.

Obstructive sleep apnoea syndrome results from excessive fat in the neck, which causes partial obstruction of the upper airways during sleep. This predisposes to nocturnal hypoxemia and hypercarbia. The resultant increased sympathetic nervous activation causes recurrent arousal, increase in vasoconstriction and predisposes to cardiac arrhythmias. Individuals who are >29 kg/m^2 have been reported to be 10 times more likely to develop obstructive sleep apnoea syndrome. Affected obese children will snore, choke, pause and gasp during sleep. The poor quality of sleep often results in daytime somnolence, with neurocognitive defects including lapses in concentration and memory.[8]

However, it is the metabolic consequences of obesity that have been extensively researched in recent years. The Metabolic Syndrome X refers to a cluster of metabolic abnormalities associated with central and visceral obesity, hypertension, dyslipidemia and insulin resistance that is often accompanied by type 2 diabetes mellitus. Central fat, in contrast to peripheral fat, represents the visceral fat depot that enters the portal venous system first, and potentially has a greater effect on liver function and the regulation of lipolysis. At the liver, the increased free fatty acid increases insulin resistance, resulting in increased glucose output. At the pancreas, the elevated free fatty acids induce abnormalities in insulin secretion, and at the skeletal muscle, the free fatty acids decrease glucose transport through changes in the insulin transduction signal. All these three mechanisms contribute to hyperglycaemia and will predispose to the development of Type 2 diabetes mellitus.

At the vasculature, the elevated free fatty acids increase the sensitivity to α-adrenergic stimuli and causes vasoconstriction and hypertension. The dyslipidemia is predominantly an increase in low-density lipoprotein and triglycerides. Fatty streaks in the vessels of children have been correlated with serum cholesterol levels. By 19 years of age, 2% of autopsies have already demonstrated advanced atherosclerosis.[9]

Non-alcoholic steatohepatitis (NASH) is characterized by a fatty liver which is hyperechoic on ultrasound, and is associated with elevated serum alanine aminotransferrase levels.[10] Histological examination demonstrates steatosis and peri-portal fibrosis. NASH has been identified in 20–60% of adults with obesity, with about one-third having significant portal fibrosis or cirrhosis. Franzese *et al.* reported elevated liver aminotransferrase levels in 25% of obese children.[11] The pathogenesis is still unclear, but a two-hit hypothesis attempts to explain the liver disease in predisposed individuals.[12] The first insult arises from the development of a fatty liver. The second insult is believed to arise from the production of lipid peroxidation products that injure the liver cells and stimulate liver fibrosis. This was the basis for the use of Vitamin E, an antioxidant to treat NASH in obese children, in a pilot trial reported by Lavine *et al.*[13]

Psychosocial consequences

Obesity can have very significant psychosocial consequences. Obese children and adolescents may encounter prejudice and discrimination, which often begins from an early age. Stafferi *et al.* reported children only 6 years of age who labelled silhouettes of an overweight child as 'lazy, dirty, stupid, ugly, cheats and lies'.[14] In another study, almost all obese and overweight adolescent girls reported that they had been teased or received negative comments because of their weight.[15] Venes *et al.* found that college students rated embezzlers, cocaine users, shoplifters and blind people as more suitable marriage partners than obese individuals.[16] Even physicians were found guilty of prejudice against their obese patients, and the disparagement of obese individuals persists as one of the last socially accepted forms of prejudice.[15,17,18]

Among non-obese girls, overweight concerns and body image concerns are prevalent across ethnic groups at 13 Californian public elementary schools.[19] For obese children, the body image dissatisfaction is common, and can be extreme. Some obese adolescent girls describe themselves as 'ugly and despicable', and view themselves with hostility and contempt. Severe distress can be painful and tormenting. Mood changes have been documented. Black *et al.* found that 19.3% of obese individuals had a major depressive disorder, with 10.0% presenting with bipolar disorders.[20]

Bruche best describes the psychosocial consequences of obesity in children:[21]

> The lot of fat children is a sad one. They are bashful and ashamed of their shapeless figures yet unable to conceal them. Wherever they go, they attract attention. … Obesity is a serious handicap in the social life of a child, even more so of a teenager. Obesity does not have the 'dignity' of other diseases, and it is not always taken seriously, even by adults.

The detrimental consequences of poor self-esteem include significantly increased rates of sadness, loneliness and nervousness in obese adolescents, compared to those who were not obese. These obese individuals were more likely to engage in high-risk behaviours such as smoking and alcohol consumption.

Economic consequences

For obese children, adolescents and adults, there is the burden of direct medical costs covering the costs of prevention, diagnosis and treatment. This would include the costs of hospitalisation care, physician services, and medication to treat obesity and its complications. There are also indirect costs that refer to the value of lost output through the cessation of productivity, caused by morbidity and mortality. Morbidity costs are wages lost by people who are unable to work because of illness. Mortality costs are the value of future earnings lost by people who die prematurely. In many countries, obesity accounts for 2–4% of total health care costs. These costs could have been cut if the population had maintained a healthy weight.

Conclusion

With the current epidemic of obesity, it can be predicted that there will be a significant increase in the physical, psychosocial and economic consequences of obesity in the near future. It is for this reason that 'the battle of the bulge' must intensify, as health care providers rally together in a valiant attempt to curb excessive weight gain starting from childhood.

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