

## Is Obesity taking toll on Cognitive Functions of Children and Adolescents?

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### *Letter to the Editor*

Dear Sir,

The prevalence of childhood obesity has been rising continuously over the past two decades and it has become a major health problem both in developed and developing countries including India (Ebbeling, Pawlak, & Ludwig, 2002). Traditional Indian culture upholds certain myths and misconceptions about childhood obesity such as a fat child is a healthy child, plumpness passes away with growth spurt over the years, fatness in an offspring is indicative of the prosperity of his or her family, and childhood is the age to eat and relax. But unlike the past, today obesity is recognized as a major health risk condition. Childhood is a time of constant cognitive development for children so it becomes imperative to provide adequate stimulation to children in their early years of life. However, rapid urbanization and lifestyle changes have significantly increased the popularity of fast foods, soft drinks and sedentary way of living. Physical inactivity in the form of increased television

viewing and computer use are the common lifestyle trends adopted by the children in present-day India and frequently turn out to be the causative or maintaining factors of childhood obesity. Childhood obesity has come up as an epidemic in today's world but the major concern lies in its affect on physical, emotional and cognitive development of children. Recent literature reported negative association of childhood obesity with cognitive functions of children. The association of higher body mass index (BMI) and reduced performance on various cognitive tests has been relatively well established in adults (Elias, Elias, Sullivan, Wolf, & D'Agostino, 2003; Fagundo et al., 2012). Recent work suggests that the relationship of obesity and cognitive functioning may not be limited to grown-ups only. It can also be observed in children and adolescents.

A relatively recent surge of interest has been seen in researchers to examine neuro-

cognitive aspects of childhood obesity. As it is important to understand the role of underlying brain mechanisms of eating and exercise behaviors of children with obesity and, how does brain respond to food cues in these children which affect their eating behavior. Number of recent cross-sectional and prospective studies has attempted to look at the structural and functional differences in brain of obese and non-obese children. These studies have used various cognitive/neuro-psychological tests and different imaging techniques to understand the neuro-cognitive basis of childhood obesity. Some of the recent cross-sectional studies stated inverse association of cognitive functions and childhood obesity specifically in the realm of intelligence (Miller et al., 2006; Yu et al., 2009), executive functions (Verdejo- Garcia et al., 2010; Lokeen et al., 2009; Schwartz et al., (2013) and memory (Li et al., 2008; Abdel-Nabi et al., 2010).

Researchers have also proposed different mechanisms to explain this association. One such proposition is that the neural centres of impulsivity may foster impaired control of food intake in obese children and lead to overeating and subsequent weight gain (Cortese et al., 2008). The effect of overweight/obesity on the brain has also

been observed in the form of subclinical inflammation and vascular changes that may also impair the performance on some of the cognitive function tests (Gustafson , Rothenberg, Blennow, et al., 2003; Gustafson, Lissner, Bengtsson, Björkelund, & Skoog, 2004). Alternatively, Joseph and colleagues (2011) observed and pointed out the shared neuro-cognitive connections between eating behaviour and physical activity. Physical exercise improves executive functions and indirectly influences the eating behavior through executive functions.

Why obese individuals perform poorly on cognitive function tests?

The inverse association of childhood obesity and cognitive function has been supported by ample western literary evidence, available from a variety of cross-sectional and longitudinal studies, and additionally substantiated by recent systematic reviews and meta-analysis. However, the underlying mechanism of this association of obesity and lower cognitive functions are uncertain. Some of the postulated mechanisms are:

Literature report similarities in underlying brain mechanisms of drug addiction and obesity (Volkow & Wise., 2005; Wang et al., 2001) and substance users were found to

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have poorer performance on executive functions task (response inhibition, mental flexibility) relying mainly on the neural circuits within the prefrontal cortex (Vardejo-Garcia et al., 2006). These similarities could be a possible reason for the similar cognitive deficits in individuals with obesity and substance use.

Alternatively, in an MRI study, group of obese adolescents showed significant decrease in grey matter volume of orbitofrontal cortex (a brain region responsible for behavioral inhibition and impulse control) compared to their lean counterparts. The reason for this finding was attributed to the obesity as well as associated insulin resistance in obese adolescents (Maayan et al., 2011).

Smith et al. (2011) explained the bi-directional association of obesity and neuro-cognition, wherein obesity can be a cause or consequence of these cognitive deficits. Children having deficits in executive function are predisposed to engage in lifestyle behaviors that lead to obesity. In another way, obesity can be a cause of these deficits as it impacts the brain in the form of

low-grade systemic inflammation, elevated lipid levels and insulin resistance in obese individuals.

Overall the literature supports inverse association between obesity and cognitive functions in children and adolescents specifically in the realm of executive functioning. However, the evidence is mixed in the areas of general intellectual functioning, learning, memory, and language. Although these studies do not provide causal explanations for their findings but the inverse association of childhood obesity and cognitive functions is a cause of considerable concern as it can also affect academic performance and attainment of other skills by obese children (Mond, Stich, Hay, Kraemer, & Baune, 2007; Sigfusdottir, Kristjansson, & Allegrante, 2007). So it becomes imperative to assess the obese children comprehensively to understand the sequel of obesity on cognitive, behavioral and emotional development of children.

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