

## keynote article

# Emotional/behavioral disorders and obesity in childhood: a clinician's perspective

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Associations between emotional and behavioral disorders and weight status have been reported in adults and children. Depression and anxiety are the most frequently reported manifestations among obese individuals. In the other direction, weight change is a common characteristic of emotional/behavioral disorders. Though the direction of causality between emotional-behavioral symptoms and obesity is not always clear, both behavioral and biologic pathways are believed to mediate these relations.

## Childhood obesity epidemic

Obesity is generally defined as the excessive accumulation of fat in the adipose tissue, to the extent that health may be impaired. Obesity results from an imbalance between caloric intake and energy expenditure and it is a consequence of our modern lifestyle (Barlow & and the Expert Committee, 2007). A child's cognitive and emotional development, together with health-related behaviors, constitute an important factor in the development of obesity. In addition, familial factors such as family structure, lifestyle, nutritional environment, meal patterns and family stressors are equally important in the development and maintenance of obesity (Bathrellou et al., 2010). During the last decade, the rapid worldwide increase in the prevalence of childhood obesity has alarmed clinicians, health care researchers, public health services and the general public. Evidence from nationally representative samples of US children, assessed every 5 years, has shown that obesity prevalence has in-

creased from 5% between 1963 and 1970 to 17% between 2003 and 2004 (Ogden et al., 2006), whereas comparable increases have been noted more recently in European countries (Pigeot et al., 2009). In parallel to the obesity epidemic, an increase in obesity-related morbidity has been reported in children, including metabolic syndrome manifestations, diabetes type 2 and non-alcoholic fatty liver disease (Kassi, Pervanidou, Kaltsas, & Chrousos, 2011; Weiss et al., 2004). At the same time, psychological symptoms and disorders related to obesity, such as depression, anxiety, low self esteem, chronic fatigue and sleeping difficulties are expected to increase, as well. Clinicians working with children and adolescents are now faced with a large number of obese children with concurrent obesity-related physical and psychological symptoms and signs, as well as frank metabolic and behavioral disorders.

## Childhood obesity and emotional/behavioral disorders: epidemiologic and clinical findings

There is evidence today that obesity, anxiety and depression may commonly co-exist in youths (Reeves, Postolache, & Snitker, 2008). In a general population sample of children 9-16 years old, studied longitudinally, chronic obesity was associated with psychopathology, more specifically, oppositional defiant disorder in boys and girls and depressive disorders in boys (Mustillo et al., 2003). Another study revealed that childhood overweight may increase the risk for mood disorders in adulthood, especially among overweight girls who become obese women (Sanderson, Patton, McKercher, Dwyer, &

Venn, 2011). Furthermore, children and adolescents at the highest quartiles of Body Mass Index (BMI), have a higher prevalence of concurrent depression, suggesting that associations between these two conditions are more likely to exist in individuals with more severe obesity (Onyike, Crum, Lee, Lyketsos, & Eaton, 2003). On the other direction, a large prospective study in children followed up into adulthood, showed that anxiety disorders and depression were associated with a higher weight in females than in girls without anxiety and depression and that differences in BMI z-scores were largest in adolescents and young adults in whom depression was present at an early age (Anderson, Cohen, Naumova, & Must, 2006). In addition to emotional problems, externalizing behaviors (the group of behavior problems that are manifested in childrens outward behavior, such as hyperactivity, aggression or delinquency) also have been associated with an increased BMI in children as young as 24 months of age (Achenbach, 1978; Anderson, He, Schoppe-Sullivan, & Must, 2010). This study in two-year old children, showed that irrespective of race, an average difference of three quarters of a BMI unit was predicted between children with high and low levels of externalizing behavior. In addition, this average difference in BMI was stable through the age of 12 among white children, and gradually doubled with age among non-white children. Other epidemiologic studies produced similar results: in a longitudinal Australian study, higher teacher-reported conduct problems were more noted in overweight preschool children than in their normal-weight peers, (Sawyer et al., 2006). An earlier study had revealed no association between behavioral problems and obesity at the age of 5 years, however, at age 14 overweight girls had over twice the odds of concurrent total behavioral problems; no such association was noted in boys (Lawlor et al., 2005). Attention Deficit Hyperactivity Disorders (ADHD) is the most common behavioral disorder in children, affecting 5-10% of school

aged kids, especially males. Furthermore, ADHD is highly comorbid with other emotional (anxiety, depression) and behavioral (oppositional-defiant disorder, conduct disorder) disorders in the lifespan. During the last decade, a number of studies investigated associations between ADHD and obesity in young age groups. These studies examined both the prevalence of ADHD in obese individuals and the weight status of patients with ADHD. The majority of these studies revealed that a) ADHD patients had higher BMI scores than subjects free of any symptoms (Cortese et al., 2008; Spencer et al., 1996) and b) obese individuals had a higher prevalence of ADHD than normal weight subjects and this prevalence was higher in those in the higher quartiles of BMI (Lawlor et al., 2005; Sawyer et al., 2006). Evidence from a large study in children and adolescents aged 5 to 17 years, from the 2003-2004 National Survey of Children's Health, showed that children and adolescents with ADD/ADHD had approximately 1.5 times the odds of being overweight (Waring & Lapane, 2008). In a clinical population of obese children followed at the outpatient obesity clinic of our Pediatrics Department, we found a high prevalence of symptoms of anxiety and/or depression: children were almost five and four times more likely to report symptoms of anxiety and depression, respectively, than children in the general population. Among these kids, BMI z-scores were higher in those with anxiety and/or depression than in those free of any symptoms. Symptoms of Attention Deficit Disorder (ADD) were also higher in this cohort than in the general population. Children with a high level of ADD symptoms had a higher BMI z-score and a greater number of Metabolic Syndrome parameters than obese children without such symptoms (Pervanidou & Chrousos, in press).

### **Mechanisms linking obesity to anxiety and depression**

A number of behavioral and emotional para-

meters connect obesity to anxiety and depression in children. Similarly to adults, children suffering from anxiety and/or depression are typically characterized by poor adherence to self-care activities, by sedentary habits and lack of physical exercise, excessive television and internet viewing and disturbed eating behaviors, such as emotional eating and consumption of comfort foods (Pervanidou & Chrousos, in press). Indeed, a study in overweight children and adolescents, 8-18 years old, showed that increased anxiety and depression were associated with emotional eating and loss of control over eating, whereas in the same study, emotional eating mediated relations between anxiety and loss of control (Goossens, Braet, Van Vlierberghe, & Mels, 2009). The researchers assumed that in overweight children, emotional eating is a way of coping with anxiety, because it provides distraction and comfort from painful negative emotions. Recent research has also indicated that less sleep time is associated with a higher BMI, while disordered sleep is another common characteristic of both emotional disorders and obesity. Sleep problems are prominent in adult and adolescent anxiety and depression, and, on the other hand, obese children are at risk of developing sleep apnea and the obesity-related hypoventilation syndrome, which are associated with decreased nighttime sleep. Lastly, low self esteem and feelings of guilt and failure characterize both obesity and emotional disorders and contribute to the vicious cycle between stress and obesity (Pervanidou & Chrousos, in press).

In addition to abnormal behaviors, biological pathways may contribute to the development of obesity in children and adolescents. Anxiety disorders and depression are characterized, in most cases, by dysregulation of the stress system, through increased secretion of the stress hormones corticotropin-releasing hormone (CRH), cortisol and the catecholamines norepinephrine and epinephrine, a state that might lead to cent-

ral obesity and the metabolic syndrome. This state of dysregulation, characterized by increases or decreases of CRH, cortisol, catecholamines, and other molecules, such as interleukin-6 (IL-6), affects also several organ systems of the body, leading to further behavioral and physical abnormalities. In developing organisms, chronic alterations in the secretion of stress hormones may have additional effects on the timing of puberty, cognitive development and physical growth (Chrousos, 2009; Chrousos & Gold, 1992; Pervanidou & Chrousos, 2010).

### **Mechanisms linking ADHD and obesity**

Associations between ADHD and obesity, in both directions, as evidenced by epidemiologic and clinical studies, suggest that either ADHD symptoms contribute to obesity development and/or the reverse (obesity may lead to ADHD) or ADHD and obesity share a common mechanism that leads to both conditions (Cortese et al., 2008).

Impulsivity represents a cluster of symptoms that characterize individuals with ADHD, whereas impulsive eating behaviors have been reported in patients with both ADHD and obesity (Altfas, 2002). Disturbed eating behaviors, such as binge eating and emotional eating, have also been reported in ADHD patients, while a greater percentage of bulimia nervosa has been noted in women with ADHD compared to those without (Surman, Randall, & Biederman, 2006). Similarly, higher percentages of bulimic symptoms were found in children with ADHD, corrected for concurrent anxiety and depressive symptoms. Both deficient inhibitory control and delay aversion, basic mechanisms related to impulsivity in ADHD may explain abnormal eating behaviors leading to obesity. In addition to impulsivity, inattention problems and organizational difficulties may also cause difficulties in adherence to proper self health care.

Another mechanism through which obesity may lead to ADHD manifestations is sleep disordered breathing (SDB) (Cortese & Penlver, 2010). SDB is a group of disorders characterized by abnormalities of respiratory pattern (pauses in breathing) or the quantity of ventilation during sleep. Obstructive sleep apnea (OSA), the most common of this group of disorders describes the repetitive or partial collapse of the pharyngeal airway during sleep and the need to arouse to resume ventilation. There is some evidence that SDB, through disrupted sleep and the associated intermittent hypoxia and hypercapnia may lead to ADHD symptoms (Chervin, Ruzicka, Archbold, & Dillon, 2005). Since obesity is associated to SDB, especially OSA, it is possible that obesity is associated to ADHD through SDB in a subgroup of patients (Cortese & Penlver, 2010).

Regarding the common biological pathways leading to both obesity and ADHD, the reward deficiency syndrome has been proposed to underlie both disorders. The dopaminergic reward system is a brain circuit that normally provides the feeling of reward. When this system is insufficient, it can lead to the use of immediate rewards, such as substance use, risk behaviors and inappropriate eating, which are detrimental. Today, there is evidence that patients with ADHD as well as obese individuals with disordered eating may suffer from an insufficient reward system. The dopamine receptors D2 (DRD2) and D4 (DRD4) are normally involved in this circuit, while alterations in DRD2, and to a lesser extent DRD4, have been associated with the ADHD phenotype. Interestingly, similar alterations have also been associated with obesity (Cortese et al., 2008).

### Implications for the clinical practice

From a clinicians perspective, screening for emotional-behavioral symptoms and disorders appears to be essential in understanding and treating childhood obesity. Implications of research

linking emotional and behavioral symptoms and disorders with obesity extend beyond improving our understanding of the development of the metabolic syndrome and consequent atherosclerosis and cardiovascular disease. Research has shown that anxiety and depression are associated with an increased risk for diabetes type 2, partly through their association with obesity and the metabolic syndrome, whereas both behavioral and biological mechanisms mediate such relations. Findings from existing research suggest that a more comprehensive approach to pediatric patients with obesity may provide novel methods of obesity management. It is also of great importance to incorporate stress management techniques and coping skills in obesity prevention and treatment strategies. ■

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