de Campora, Gaia; Linshield, Dawn; Giromini, Luciano. Childhood overweight and obesity: extending the knowledge through the lens of the emotion regulation paradigm. Nova Publisher. 2015. pp: 169-178.

in

Madeline L. Bryant
Handbook of Emotion Regulation: Processes, Cognitive Effects and Social Consequences

Chapter

CHILDHOOD OVERWEIGHT AND OBESITY: EXTENDING THE KNOWLEDGE THROUGH THE LENS OF THE EMOTION REGULATION PARADIGM

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ABSTRACT

Childhood overweight and obesity have serious consequences in terms of health care use and expenditures. Both are associated with increased mortality, impaired quality of life, as well as with comorbid conditions such as diabetes, cardiovascular disease, and musculoskeletal disease. Though various medical and psychological theories on the causes of childhood overweight and obesity have been proposed, to date the complex etiology underlying these phenomena remains only partially understood. It is clear that when one or both the parents are overweight or obese, the risk that the child also is overweight or obese increases dramatically.

However, the precise extent to which biological and psychological factors interact with each other to promote these conditions has yet to be determined.

A recently proposed unifying hypothesis, regarding childhood overweight and obesity, attributes the construct of emotion dysregulation (ED) a key role. Broadly defined as an inability to influence the experience of one's own emotions, indeed, ED likely affects both the overall eating habits of the parents (with obvious implications for their weight and health), and the parent-child relationships (with important implications for the early, mother-child feeding interactions).

The aim of this chapter is to review some of the major evidences supporting the role of ED in the development of childhood overweight and obesity. First, we review the literature linking ED to eating behaviors.

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Next, we summarize the empirical findings supporting the intergenerational transmission of ED as well as overweight and obesity. Lastly, we review some recent research data showing the link between eating behaviors and neurobiological aspects.

BEFORE THE ONSET OF A DISEASE: IN UTERO INFLUENCES

It is important to consider features associated with infant weight gain in order to fully appreciate early causes of obesity. The impact of the in utero environment on infant growth and later childhood obesity is fascinating and still the source of much investigation. According to Barker (1998), the in utero environment directly impacts the infant metabolic profile and the risk for developing chronic disease later in life. For example, birth weight is believed to be the result of fetal exposures while in utero. In fact, there is a linear relationship between infant birth size and weight and risk for adult obesity. Those with extremely large or small birth size and weight are at greater risk for obesity as well as development of metabolic disease.

In addition, neonatal adiposity and increased birth weight are linked to gestational weight gain, level of inflammation experienced during pregnancy, triglyceride concentrations in utero, and maternal BMI. Furthermore, maternal diabetes is associated with increased fat mass at birth, BMI, and risk for developing type 2 diabetes as a child or adult. Maternal smoking is also linked to increased risk for overweight and obesity among children age five to seven.

A number of animal studies have also demonstrated that a maternal diet high in fat can cause the fetal liver to be malprogrammed, increased fat accumulation among offspring, and adult development of metabolic syndrome.

In fact, maternal nutrition prior to conceiving a child has important implications. In a study involving ewes, increased fetal blood pressure as well as adult development of impaired glucose signaling has been linked to maternal under nutrition near the time of conception. Consequently, these maternal characteristics may have a twofold impact on the programming of a child's metabolic profile, which would lead to increased risk for later development of metabolic dysfunction as well as obesity (Young et al., 2012).

The in utero environment clearly has a critical impact on a child's future health. Intervention during pregnancy, however, is complicated if not impossible. The first real opportunity to impact the child's health occurs in the first weeks after birth. Intervention during infancy is the second opportunity. Intervention at this stage is easier than with older children because common feeding problems have not typically developed yet among infants and because infants have a uniform diet. Much scientific research (Monteiro and Victora, 2005; Ong and Loos, 2007) have agreed that there is a link between early infant weight gain and increased risk for obesity as well as development of related comorbid conditions later in life. Specifically, systematic reviews have estimated that the odds of developing obesity later in life is between 1.4 and 5.7 times greater when an infant demonstrates rapid growth during his/her first two years of life (Young et al., 2012).

While the in utero and early postnatal periods have important implications on pediatric obesity, the vast majority of research has focused on the impact of familial or societal factors. For example, there is considerable evidence linking parental obesity to obesity amongst his/her children.

Other factors, such as having a sedentary versus active lifestyle, food preference, and eating habits are also components in the association between parental obesity and obesity amongst his/her children. Far less research, however, has investigated risk factors for pediatric obesity (Graziano, Calkins and Keane, 2009).

OPENING A WINDOW: EMOTION REGULATION AS A FRAMEWORK TO UNDERSTAND OVERWEIGHT IN INFANCY

There is a large body of research about the link between emotion regulation and eating disorders. However, less attention has been paid to this paradigm for understanding parenting influences on children's development of self-regulation of energy intake. Taking a step back, the ability to regulate emotions is due to the early skill of the baby to self-regulate his/her own primary needs and internal physical and emotional states. Self-regulation refers to the ability to control one's attention, impulses, and emotions thereby allowing that person to appropriately respond to the environment (Muraven and Baumeister, 2000). It is a skill that develops at a young age and can be experienced as short-term affect regulation, such as calming down through engaging in thumb-sucking behavior, or long-term affect regulation, such as delaying gratification (Fischer and Munsch, 2012).

Regarding eating behaviors, Frankel et al. (2012) explains that self-regulation of energy intake among children relates to their capacity to respond to feelings of hunger or satiety by eating or not eating. This ability is typically strengthened through a mutually responsive parent-child relationship, one that is coordinated, cooperative, and displaying positive emotions (Anderson, Lemeshow and Whitaker 2014).

For children, this ability to self-regulate can become problematic, specifically in terms of risk for later development of eating disorders, if they are surrounded by food or food cues (because of their cultural environment or socio-economic status) or if their parents do not have the skills necessary to teach them how to appropriately response to such food cues.

In fact, parents may themselves have a poor ability to self-regulate their food intake, which would negatively impact their child's abilities in this area. Such an inability to control food intake has been described by some as a brain-related impairment in which the perceived reward received from consuming food supersedes the capacity to moderate food intake (Halbestadt et al., 2013). Because the neuro-cognitive structures associated with this reward system are still developing, children and adolescents are especially susceptible to these self-regulatory failures (Halbestadt et al., 2013).

Several cross-sectional studies and some prospective longitudinal studies have found a link between the regulation of our own internal physical and emotional states and eating regulation patterns. This research has also demonstrated an association between self-regulation and overweight/obesity. For example, infant emotional reactivity related to food has been found to project overweight among 9 year old children (Agras, Hammer, McNicholas and Kraemer, 2004). Furthermore, children from age three to five with poorer self-regulation abilities, specifically a limited ability to delay gratification, were at considerably higher risk for being overweight through age 12 (Francis and Susman, 2009; Seeyave et al., 2009; as cited by Fischer and Munsch, 2012).

Similarly, children age nine with poorer self-regulation abilities were often found to be overweight at age 15 (Duckworth et al., 2010; Tsukayama et al., 2010; Fischer and Munsch, 2012).

TRAJECTORIES AND FEATURES OF EMOTIONALLY DYSREGULATED BEHAVIORS

Self-regulation chiefly involves the capacity to override impulses, to refrain from engaging in unwanted behaviors, and to delay gratification by inhibiting immediate desires (Puder et al., 2010). Impulsive behaviors can be defined to include numerous different things; however, they are often categorized as either reward-related impulsivity or insufficient inhibitory control. Reward-related impulsivity refers to a sensitivity to a reward or a failure to delay gratification. Insufficient inhibitory control refers to an inability to overrule an automatic response to a stimuli. Both of these impulsive features have been associated with obesity (Nederkoorn, 2009). Indeed, impulsivity is believed to underlie, at least to some degree, poor self-regulation regarding eating behavior such that increased impulsivity leads to more difficulty inhibiting food intake. As such, impulsivity likely has significant implications on the development, maintenance, and treatment of obesity (Nederkoorn, Braet, Van Eijs, Tanghe, Tanghe and Jansen, 2006).

But what happens if a variety of food is offered? In other words, is the obesogenic environment by itself or the individual traits the most powerful predictor of eating behavior? As explained by Guerrieri et al. (2008), sensitivity to the food reward had little impact on caloric intake when the food offered was monotonous. When a variety of food was offered, however, children who were reward-sensitive consumed far more calories than the less reward-sensitive children. Consequently, the obesogenic environment may have an important impact in the recent increase in obesity in childhood. Furthermore, research suggests that response inhibition may be a factor that maintains overeating behavior in an obesogenic environment while reward sensitivity may a fundamental cause of overeating (Guerrieri et al., 2008). Research findings have also showed that children who are more impulsive are often the most overweight and that increased impulsivity can predict decreased weight loss (Nederkoorn, Braet, Van Eijs, Tanghe and Jansen, 2009).

Recent investigations have also purposed a neurobiological explanation underlying impulsivity. Findings from neuroscience have shown that dopamine dysfunction is associated with overweight. Research has also found that reward sensitivity is linked to the mesolimbic dopamine system, which impacts sensory pleasure (Puder and Munsch, 2010). In fact, the rewarding outcome of food appears to be mediated by dopamine. For example, individuals might compensate for low dopamine activity by increasing food consumption as well as by ingesting food that is energy-dense, which in turn help to activate this dopamine system (Puder and Munsch, 2010). Additionally, inhibitory control has been linked to the prefrontal cortex, which is believed to regulate this ability to control one's impulses. Research has indeed found that for overweight children, food is experienced as more rewarding and it is more difficult for those children to inhibit their response to food temptations. This likely increases the probability that they will consume more food and gain more weight (Halsesbadt

et al., 2013). In other words, these neurobiological mechanisms are associated with emotion dysregulation and could dramatically increasing the risk for overeating in absence of hunger.

Research has also tied impulsivity and later development of obesity to the vagus nerve. Indeed, the vagus nerve plays a key role in the parasympathetic control of the heart frequency, which is linked to emotion regulation and impulsivity (Appelhans and Luecken, 2006). In addition, some afferents of the vagus nerve are connected to the gastric mucosa (the inner surface of the stomach), which is where the "satiety hormones," i.e., leptin and ghrelin, are released (Erlanson-Albertsson, 2010). Leptin, more specifically, is secreted when the amount of fat stored in the body reaches a given point, so as to reduce the sensation of hunger. Ghrelin, conversely, has a stimulatory effect on appetite, and its secretion is inhibited by ingestion of food. Taken together, this suggests that from a bio-physiological point of view, emotion regulation and eating behavior share some common paths.

TREATMENT ROUTES: HOW AND WHEN?

Deciding *how* and *when* to treat childhood overweight and obesity is not an easy task. Dietary modifications alone, in the absence of physical activity and/or psychological interventions, have not yet proven to be effective (Spear et al., 2015). A more appropriate approach would probably consist of integrating multiple intervention strategies, including psychological (e.g., behavioral therapy) and physiological (e.g., exercising) support. Although prevention is a more desirable solution compared to treatment, there is some uncertainty as to *when* to intervene.

Classic dietary approaches used in the treatment of childhood overweight and obesity include low carbohydrate, low fat, low calorie, and Mediterranean style food (Crocker et al., 2009). Behavioral management strategies include (but are not limited to) reducing the time spent watching TV, increasing physical activity, and changing general eating habits.

Focused, individual psychological training might further support the child's motivation to make changes in eating as well as exercising habits. Moreover, psychological support might also be directed to the entire families, so as to promote a general approach to changing the family's attitude toward eating and physical activity as well as to determine and achieve specific goals in terms of weight loss.

In fact, the home environment appears to be fundamental to the outcome of any obesity condition treatments, and the interventions conducted involving both the child and his/her parents are largely more effective than those that only focus on the child (Epstein, Valoski and Wing, 1990). Lastly, another intervention strategy that appears to be effective is one that involves promoting healthy habits at school (Crocker et al., 2009).

Crocker et al. (2009) have summarized the American Academy of Pediatrics recommendations for approaching obesity treatment in childhood. Briefly, during the first three to six months of treatment the focus is on dietary and lifestyle changes, with a gradual escalation in the intensity of the required modifications. Subsequently, if this initial intervention did not achieve the targeted outcome, the case may be referred to other physician experts of obesity to consider medical intervention and surgery.

As mentioned above, there is some uncertainty as to *when* to intervene. According to Whitaker (1997), if both the child and the parents are obese, and the child is between 3 and 9

years of age, treatment may be particularly important because the parents may still positively influence their child's attitude toward changing eating behavior and lifestyle. When the child is older than 9 years of age, the impact of his/her parents on the child's treatment is much more limited. However, in any case, the decision as to whether to begin a treatment or not should always depend on the obesity status of the child. This is particularly true if the child has already reached 10 years of age. Also, it should be noted that even if they are not treated, many obese children will not be obese in adulthood. Accordingly, the benefits and risks of any forms of intervention should be accurately evaluated in any case, both from a physical and psychological perspective.

CONCLUSION

The World Health Organization (WHO) has described overweight and obesity as one of the most significant concerns of the 21st century. An estimated 10% of children and 23.3% of adults are overweight and 2.3% of children and 9.8% of adults are obese (Kelly et al., 2008; Lobstein et al., 2004; as cited by Fischer and Munsch, 2012). Overweight and obesity are likely to carry on from childhood into adulthood and are linked to mental health as well as serious medical problems (WHO, 2006, 2009; Lavie et al., 2009; as cited by Fischer and Munsch, 2012).

Several investigations related to diverse research fields have been trying to explore the risk and causal factors underlying this condition. A multifaceted pattern seems to be emerging as a result of this extensive research. Psychological aspects combined with neurological and autonomic factors of functioning represent a pathway often associated to severe overweight and obesity. However, these factors also work independently in leading toward the onset of overweight and obesity. Among the psychological factors, emotion and self-regulation are the most representative aspects underlying the risk for developing obesity during infancy. As previously stated, self-regulation is a complex control system that becomes increasingly sophisticated and integrated as a child develops. Among toddlers, these self-regulation skills can predict both pediatric obesity as well as common changes in BMI development. In fact, research suggests that emotion regulation in particular is key to predicting normative variations in BMI. Nevertheless, more severe weight problems are better predicted by reward sensitivity/inhibitory control and emotion regulation abilities combined. Consequently, toddlers with higher reward sensitivity, lower inhibitory control, and poorer emotion regulation abilities are more likely to be overweight and at higher risk for early childhood obesity. Such findings supports the notion that poorer emotion regulation abilities may not be a mere consequence of obesity but in fact an significant risk factor for it (Graziano, Calkins and Keane, 2009). While most research studies are not yet able to describe the specific mechanism that ties emotion regulation to obesity, a few longitudinal investigations (de Campora, Giromini, Larciprete, Li Volsi and Zavattini., 2014; de Campora, D'Onofrio and Zavattini, 2014a) suggested that there is an intergenerational transmission of overweight beginning during pregnancy. Indeed, maternal emotion dysregulation measured during the third trimester of gestation would represent an index of risk for the subsequent onset of overweight of the baby.

Aside from the psychological factors, research has also noted the key role of the autonomic nervous system, specifically the vagus nerve, in the development of childhood obesity (Berthoud, 2008; Graziano, Calkins and Keane 2009; Kral, Paez and Wolfe, 2009). Although this link has not yet been established, it seems apparent given that the vagus nerve has a major role in the nutrient-handling periphery system of the brain.

However, it is important to appreciate the reciprocal influence of physiological and psychological factors. Indeed, psychological interventions are important to prevent and/or reduce obesity, as well as to begin lifestyle changes towards more healthy habits.

However, medical interventions, such as bariatric surgery, also contribute to both weight loss and lifestyle modifications (Berthoud, 2008).

Although some strong evidence has emerged, there is limited research clearly linking body weight of children and adults to self-regulation abilities among children. This is because previous studies have failed to control for factors such as BMI, socioeconomic status, self-assessed parenting skills, and psychological well-being when assessing the relationship between childhood obesity and self-regulation abilities among children. Studies comparing clinical groups to control subjects on self-regulation, specifically impulse and emotion regulation, may offer important information regarding "the disorder-specificity of the process" (Fischer and Munsch, 2012, p. 5). In other words, future investigations may clarify whether emotion dysregulation leads to obesity, instead of bulimic symptoms, binge eating disorder, substance abuse or gambling. Ultimately, further research is needed. This research should have strong foundations in theory so as to better facilitate interdisciplinary collaboration, which would be more informative and beneficial to all disciplines. For example, future research could help examine brain regions associated with the regulation of food motivation among individuals who are of healthy weight (Bruce, 2011) as well as among obese individuals who show dysregulated behaviors. Such research will be more enlightening than studies focusing solely on specific brain regions or on behavioral aspects of obesity. Examining the interface between the brain regions (Bruce, 2011), the behavioral tendency, the emotion regulation skills, and the autonomic nervous system will be crucial to gaining a better understanding of the development of appetitive and eating behaviors in the early childhood.

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