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Mini Review

Body Mass Index in Underweight Children and their Trajectories of Internalizing and Externalizing Problems from Childhood to Early Adolescence. Is there a Link?

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Abstract

A growing research literature has increased interest in early problematic trajectories. Researchers have sought to trace individual-level trajectories of externalizing and internalizing symptoms from early childhood, since the past decade to recent years. Such approach derives from evidence that severe behavioral and emotional disorders in pre-schools frequently pave the way for psychopathology in middle childhood and beyond. Early emotional and behavioral issues were observed in literature contributing to antisocial and depressive psychopathological disorders in children, adolescents, and adults. Identifying children at risk for severe and persistent internalizing and externalizing problems in their early development (including risks due to body mass index variations) is therefore of great importance. This mini-review aims to summarize the state of the art of this topic, to inform researchers and clinicians.

Keywords: *Body Mass Index; Underweight Children; Trajectories*

Internalizing and externalizing problems may develop as early as in the first years of life and can place children on a developmental pathway to peer problems, negative interactions with parents, delinquency, and other negative social and behavioral outcomes [1-5]. Internalizing problems of early childhood typically appear in the form of withdrawal, anxiety, fearfulness, and depression, whereas externalizing problems usually take the form of explicit disruptive or oppositional behaviors such as aggression, defiance, and hyperactivity [6-8]. Externalizing problems cover a wide range of symptoms that often are accompanied by social and educational troubles in children and adolescents and that regularly give cause for concern to parents, teachers, and the society [9,10]. We look at both internalizing and externalizing problems within a developmental psychopathology conceptual framework, that is concerned with individual differences in the origins, course, and outcomes of normative and psychopathological developmental processes [11,12].

Interest in early problematic trajectories has fueled a growing research literature. From the past decade to recent years, researchers have sought to trace individual-level trajectories of externalizing and internalizing problems from their origins in early childhood. These efforts stem from evidence that extreme behavioral and emotional difficulties in preschool frequently pave the way to psychopathology in middle childhood and beyond [13-16]. Early emotional and behavioral problems have been found leading to child, adolescent, and adult antisocial and depressive psychopathological problems. Therefore, it is of great importance to identify children at risk for high and continuous internalizing and externalizing problems early in development [17,18]. Initial attempts aiming to trace these domains across early childhood were focused on normative (i.e. average) trajectories [19-21] and showed that externalizing and internalizing problems both change in frequency or level across this period, but in opposite directions: disruptive behaviors peak at around age 2 years and then

steadily decline whereas anxiety, withdrawal, and dysphoria gradually increase. Research in the field of children's psychopathological risk encompasses food-related issues concerning obesity and under nutrition. Undernutrition represent opposite extremes on the spectrum of adiposity, and both are routinely quantified in terms of weight and height relative to the child's age.

BMI has been used since the 1960 to assess obesity in adults and more recently in children. Many countries now have their own national reference centile charts for BMI for age. International BMI cut offs for child overweight and obesity, based on data from six countries, have been developed, covering the age range 2-18 years, based on the adult cut-offs of 25 and 30 at 18 years.

Much has been written about the widespread of child obesity and literature reports a very wide-ranging role of studies and articles related to BMI and behavior in children. Some evidence suggests that obesity and behavioral problems are closely linked in children and as we are living in a society undergoing enormous changes in diet and activity, BMI tracking is still very important between childhood and adolescence. Thus, many studies and research have examined the prediction of adult behavioral and emotional problems from developmental trajectories of externalizing and internalizing behavior. Wang., *et al.* [22], by examining tracking patterns of body mass index (BMI) as well as their predictors between childhood and adolescence, showed that an individual's initial relative BMI, parental nutritional status (obesity and underweight), and fat intake were predictors of tracking of both fatness and underweight. Moreover, Bradley., *et al.* [23] examined reciprocal relations between body mass index, internalizing problems and externalizing problems from infancy through middle childhood, finding out that BMI and behavior problems showed stability across measurement occasions, being higher BMI associated with increased likelihood of developing internalizing problems, as children move into middle childhood. Findings from this type of study offer further evidence that becoming overweight can carry a diverse array of negative consequences for well-being in children. And although the association between BMI and internalizing appears relatively weak in middle childhood, findings from other studies are consistent with research suggesting that being overweight can lead to internalizing behavior such as withdrawal, anxiety, and somatic complaints.

It is very important to underline that the tracking of body weight has generally focused on overweight status and externalizing problems of children or adolescents. This can be explained with the fact that externalizing behavior causes many disturbances for the child and his/her social environment and also because externalizing behavior is among the most prevalent mental health problems in childhood and adolescence [8,24].

Over the past 20 years, most studies on this topic have demonstrated that externalizing symptoms decline as children grow up [25,26]. While toddlers and preschool children often display a high level of externalizing behavior [24], school age children usually show a gradual decrease [27,28]. Considering these results, further recent studies have identified distinct trajectories of obesity development in children. In this regard, Magee., *et al.* [29] identified four distinct developmental trajectories of body mass index (BMI) during childhood (2-12 y.) (High Risk Overweight; Early Onset Overweight; Later Onset Overweight and Healthy Weight) and indicated that factors such as parental overweight, parent education, parent smoking and child birth weight were significant predictors of these trajectories; Shankaran., *et al.* [30] assessed the predictive value of body mass index (BMI) at earlier ages on risk of overweight/obesity at age of 11 years and showed that risk for obesity in adolescence starts in early childhood as children in higher BMI categories at young ages (usually) take a higher risk of overweight; also Reef., *et al.* [9], aimed to examine the prediction of adult behavioral and emotional problems from developmental trajectories of externalizing behavior in a 24-years longitudinal population-based study. Although, as previously stated, most part of research results reported in literature are concerned with obesity and overweight, along with possible links between them and behavioral development during childhood and adolescence, little is known about malnutrition-meaning undernutrition-in infants, children, (and adolescents). Underweight poses a considerably larger public health problem internationally, and in the developed world anorexia nervosa is the third most common chronic condition of adolescence.

Considering the importance of the findings of main research in literature as far as obesity and overweight are concerned, the same examination would be necessary for the undernutrition field, especially regarding early childhood risk factors including child, family, and

environmental risk factors, trajectories of behavioral and emotional problems. Some recent studies have been recently following this line of research.

Linabery., *et al.* [31] showed that parental obesity influences infant body size, providing strong evidence of the importance of maternal BMI to infant BMI growth. On the other hand, Melchior., *et al.* [32], indicated that negative childhood events were associated with an increased likelihood of concurrent internalizing symptoms, which sometimes persisted into adulthood. This means that common negative events can precipitate the onset of internalizing symptoms. Still regarding this issue, Holm-Denoma., *et al.* [33], investigated psychosocial circumstances under which children develop excessive body mass, showing that child BMI at age 2, household income, and parents' psychopathology, externalizing behaviors at age 2 predicted increased body mass at age 10. Finally, Wake., *et al.* [34], with the aim to quantify the range of physical and psychosocial health problems, concluded that deviation from normal weight is associated with health differences in children and adolescents that vary by morbidity and age (comorbidities varied with BMI category).

Along with the before mentioned line of research and considering what we said, it's very important to determine the extent to which externalizing and internalizing behavior in early childhood is related to body mass index (BMI) in early childhood and through age 11 - 12 and to evaluate whether these associations differ by sex and gender. Understanding the factors that give rise to this association is important.

Conclusion

In this perspective, it's also important to underline that investigating the trajectories of behavioral and emotional problems over time can also inform the timing and construction of interventions [35]. The Fanti's study at al National Institute of Child Health and Human Development Study of Early Child Care [5] suggested that high pure and co-occurring internalizing and externalizing problems may start as early as the second year of life. And according to Dodge and Pettit [36], preventive interventions should start early in life before antisocial outcomes or other types of psychopathology become inevitable. In support of this general idea, prior work provided evidence that interventions during toddlerhood are successful in reducing externalizing [37], internalizing [38] and co-occurring behavioral and emotional problems [39].

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