Nutritional Education Interventions in Children

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Childhood obesity is a global public health issue and is linked to metabolic syndrome, which increases the risk of comorbidities such as type 2 diabetes, cardiovascular diseases and cancer. Social, economic and cultural factors influence changes in nutrition and lifestyle characterized by poorer diets and reduced physical activity.

adolescents children dyslipidemia hyperglycemia hypertension insulin resistance metabolic risk metabolic syndrome nutritional intervention obesity

1. Introduction

Obesity is a worldwide pandemic that affects all countries, ages and socioeconomic groups. Since 1980, the prevalence of childhood obesity has doubled and tripled in low- and high-income countries, respectively [1][2][3][4]. Closely linked to this widespread health crisis is the increasing prevalence among obese children and adolescents of metabolic syndrome (MetS) [5][6][7][8][9], which includes central adiposity, elevated blood pressure, dyslipidemia and impaired glucose metabolism. MetS is also linked to cardiovascular disease and type-2 diabetes, and MetS in children appears to persist into adulthood [10][11]. Moreover, long term follow-up has shown that 50–80% of obese children become obese adults [12][13], with a high risk of developing the aforementioned morbidities [14][15], in addition to several forms of cancer [16][17].

This public health problem is primarily due to changes in nutrition and lifestyle (including poor dietary habits, decreased physical activity, and increased inactivity, primarily linked to screen exposure) influenced by social, economic and physical environments [18][19][20]. The alarm raised by the World Health Organization (WHO) in the 1990s has led to the development of measures to fight the obesity epidemic, including strategies to counteract obesogenic environments [21]. In this regard, the childhood period is a particularly important window of opportunity to establish healthy habits, thereby improving nutritional and metabolic status during the pediatric period and protecting against future chronic diseases. Among the prevention strategies used are education interventions, which can reach large numbers of at-risk children and adolescents during their formative years in a cost-effective manner [22][23]. Importantly, it has been shown that it is more difficult to treat obesity through lifestyle changes in adulthood than in childhood [24].

2. Current Insights on Nutritional Education Interventions in Children

This entry assesses the effects of nutritional education interventions on the risk of MetS in children and adolescents and reveals a beneficial impact in reducing abdominal obesity. However, data regarding the effects of interventions on the remaining components of MetS, including dyslipidemia, hypertension, fasting hyperglycemia and insulin resistance, are inconclusive.

The beneficial effect of nutritional education interventions on abdominal obesity in pediatric populations constitutes an important finding for several reasons. First, central adiposity appears to be the predominant diagnostic criteria for MetS [25][26] and related comorbidities [27][28] as reported in the literature. Moreover, abdominal adiposity is an outcome sensitive to changes in nutrition and lifestyle [29][30], which are the main components of the evaluated education interventions. Regarding primary outcome measures, WC is used as an indicator of abdominal adiposity in several published definitions of pediatric MetS (Cook [31], de Ferranti [32], Cruz [33], Ford [34], and International Diabetes Federation Consensus [35]). Only Weiss [36] uses body mass index (BMI) z-scores. In this regard, it should be noted that there are certain drawbacks to using BMI to identify metabolic risk and even obesity. BMI has high specificity but low sensitivity to detect excess adiposity and fails to identify over a quarter of children with an excess body fat percentage [27][37][38]. Assessment of central adiposity by measuring WC, waist-to-height ratio or waist-to-hip ratio (the parameters included in our review) is thus even more important when evaluating a pediatric population [27][28]. Compared with BMI, WC is a better indicator of obesity-related health risk. Thus, for a given WC value, overweight and obese individuals and normal-weight individuals could have comparable health risks [38][39]. It should also be noted that the most recent overview of Cochrane reviews [40] assessing educational interventions in children with overweight and obesity reported a slight reduction in body-weight status, as determined using BMI z-scores, in children of all ages, and states that the decrease in BMI z-score required to ameliorate any comorbidities is unclear, suggesting that the inclusion of body composition indices (e.g., WC) may be useful to this end. Given that current scientific evidence distinguishes between metabolically healthy and unhealthy obese patients [41][42] and normal weight but metabolically obese [43][44][45] individuals, our systematic review has the added value of including an entire pediatric population, not just obese children and adolescents.

Our abdominal obesity findings indicate that by providing access to a particularly vulnerable age group (children and adolescents from the general population), the school setting offers a valuable opportunity to begin early health promotion and obesity prevention. Some studies have reported that interventions targeting middle or high school pupils are more effective than those focused on elementary schools [46][33][47], while other authors have suggested that interventions targeting children aged 2–5 years may have a greater effect on obesity prevention and management [48]. However, our findings indicate a beneficial impact across all ages evaluated.

The effects of nutritional education interventions on the remaining components of MetS remain unclear. However, some evidence suggests improved outcomes in lipid profile, specifically in triglycerides, blood pressure, fasting glucose and HOMA IR, more frequently in adolescents. These results may be explained by the fact that nutritional education interventions target changes in diet and lifestyle, which more rapidly modify adiposity, and this is consistent with the beneficial effect observed in abdominal obesity. In addition, alterations in the metabolic profile are slowly and progressively developed over a long time, being more easily detected in pubertal children as reported in the literature [9][49]. Longitudinal studies including longer interventions and follow up times beyond adolescence may help to better track the impact of the nutritional education interventions on these metabolic variables.

Interestingly, of the three included studies that measured blood pressure, the two that reported significant beneficial effects involved interventions targeting both children and their parents. The participation of family members, which may positively condition the health behaviors of children, may explain this beneficial effect. In agreement with these findings, several studies [50][51] have demonstrated that screening for cardiovascular risk (CVR) factors in school children predicts CVR in parents, suggesting not only a genetic component but also a potentially modifiable influence of family lifestyle.

No studies were excluded from our review for a high risk of bias. Although none of the studies indicated whether participants and personnel were blinded, in all cases the outcomes recorded were objective measures, and therefore we concluded that the risk of biased results was low. In several of the included studies, we observed a risk of bias resulting from the randomization process, although all studies sought to minimize this risk (e.g., by selecting similar clusters and/or conducting extensive baseline comparative analyses).

A key factor to consider is the duration of any intervention and its impact in adulthood. One of the longitudinal studies included in this review conducted the longest intervention described in the literature to date by recruiting infants who were followed up into early adulthood [52]. In the intervention group, the authors observed a significant reduction in the prevalence of MetS in individuals aged 15–20 years, demonstrating that repeated infancy-onset dietary counseling was effective in preventing MetS in adolescence. Finally, several authors have reported that children and adolescents with MetS have an increased risk of developing type-2 diabetes and atherosclerosis in adulthood [53]. There is thus a need for long-term intervention trials specifically assessing the effects in adulthood of reducing cardiometabolic risk factor exposure during childhood. Future follow-up of the participants in the trials included in this review may reveal whether the intervention effect persists and is reflected in cardiometabolic morbidity in middle age.

Theoretically, the potential beneficial effect of nutritional education interventions on MetS can be explained by changes in the distribution of or inter-relations between individual components of MetS. This phenomenon, which has been described by other authors [54][55], should be considered when interpreting final outcomes, as intervention effects on individual components may be less pronounced than effects on clusters. Given the heterogeneity of the studies included in this review in terms of design (with/without family involvement, age of participants at recruitment), follow-up period (which ranged from 12 weeks to 20 years) and intervention type (school-based workshops, home visits to mothers, dietary counseling or dietary intervention), the aforementioned phenomenon could not be assessed. Further, more homogeneous studies should be conducted in order to clarify the influence of these types of interventions on MetS and clustered MetS components. Moreover, by identifying the most effective components of these interventions, intervention strategies could be tailored to the profiles of the individuals likely to benefit most. Stratification by age could help identify interventions better suited to children than adolescents, or vice versa. Additional research will be required to determine whether the benefits of nutritional education interventions in individuals with abdominal obesity persist into adulthood, for example by delaying the development or progression of cardiovascular disease.

3. Conclusions

The results of this entry support the beneficial effects of nutritional education interventions on abdominal obesity in children and adolescents. However, evidence regarding the impact on dyslipidemia, hypertension, fasting hyperglycemia and insulin resistance is inconclusive.

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