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Review

The effect of participation in school-based nutrition education interventions on body mass index: A meta-analysis of randomized controlled community trials

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ABSTRACT

Objective. The aim of this study was to evaluate the effectiveness of school-based nutrition education interventions in reducing or preventing overweight and obesity among children and adolescents.

Methods. We conducted a systematic search of 14 databases until May 2010 and cross-reference check in 8 systematic reviews (SRs) for studies published that described randomized controlled trials conducted in schools to reduce or prevent overweight in children and adolescents. An additional search was carried out using PubMed for papers published through May 2012, and no further papers were identified. Body mass index (BMI) was the primary outcome. The title and abstract review and the quality assessment were performed independently by two researchers. The software EPPI-Reviewer3 was used to store, manage and analyze all data. This SR is registered at ClinicalTrials.gov (NCT00985972).

Results. From the 4888 references initially retrieved, only 8 met the eligibility criteria for a random-effects meta-analysis. The total population consisted of 8722 children and adolescents. Across the studies, there was an average treatment effect of −0.33 kg/m^2 (−0.55, −0.11 95% CI) on BMI, with 84% of this effect explained by the highest quality studies.

Conclusion. This systematic review provides evidence that school-based nutrition education interventions are effective in reducing the BMI of children and adolescents.

Contents

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Introduction

From 1990 to 2010, the number of overweight children under five increased worldwide by an average of 0.8 million children per year. If the rate continues rising steadily until 2020, the number of overweight pre-school children on the planet will be 59.4 million, representing 9.2% of the entire population in this age group (de Onis et al., 2010; UN, 2012).

The greatest increases in body mass occur in childhood and adolescence, and childhood overweight and obesity tend to persist into adulthood. Recognizing this fact, it is important to build healthy environments around strategic sites to protect children from psychosocial, metabolic and mechanical morbidities of overweight and obesity, as they constitute the fifth leading risk factor of global mortality (Freedman et al., 2005; Han et al., 2010; Hughes et al., 2011; Li et al., 2004; Lira et al., 2010; Nobre et al., 2006; Singla et al., 2010; Van Gaal et al., 2006; Wardle et al., 2006; WHO, 2009).

The school environment has been considered a promising site for health promotion, as its organizational structure facilitates the development of interventions with multi-professional and multi-component approaches. School educational background allows both direct (e.g. classroom activities) and indirect (e.g. parental involvement) actions to protect children's health. In addition, children and adolescents dedicate a large portion of their time to school (Hughes et al., 2011; Pérez-Rodrigo et al., 2001; Silveira et al., 2011; Wardle et al., 2006, 2007).

In this context, the aim of this review was to enhance the body of evidence, filling the gap left by past systematic reviews, regarding the effectiveness of school-based nutrition education interventions in reducing body mass index (BMI) in children and adolescents (Brown and Summerbell, 2009; CRD, 2012; Gonzalez-Suarez et al., 2009; Jaime and Lock, 2009; Perez-Morales et al., 2009; Silveira et al., 2011; Zenzen and Kridli, 2009). To our knowledge, this is the first systematic review (SR) with a meta-analysis (MA) that exclusively includes randomized controlled trials (RCTs) that address school-based nutrition education, places no limits on the date of publication and uses BMI as the primary outcome.

Methods

Design and search strategy

This SR is part of a larger project called the "Physical Activity and Nutrition Education Systematic Review Project," and the research protocol is registered at ClinicalTrials.gov (NCT00985972). The design followed the guidelines in Centre for Reviews and Dissemination: guidance for undertaking reviews in health care (CRD, 2008), and all stages of the study, including the MA, were carried out using the web-based software Eppi-Reviewer 3 (Eppi-Centre, Social Sciences Research Unit, Institute of Education, University of London).

The search was performed in 14 electronic databases (PubMed/Medline, EMBASE, ISI Web of Knowledge, CENTRAL–Cochrane, ERIC, CINAHL, LILACS, PsycInfo, SPORTDiscuss, ASSIA, Physical Education Index, Social Care Online, Social Services Abstracts, and Sociological Abstracts) until May 5, 2010, with no filters for date of publication or language, with the exception of languages based on logograms (e.g., Chinese and Japanese). The search strategy was developed in PubMed and when required was adapted to each database. The keywords were organized as follows: (school) AND ((physical activity) OR (physical education) OR (exercise) OR (physical fitness) OR (sports) OR (nutrition) OR (nutritional science) OR (child nutrition sciences) OR (nutrition education) OR (diet) OR (energy intake) OR (energy density) OR (calories) OR (calorie) OR (food) OR (fruit) OR (vegetable)) AND ((weight) OR (obese) OR (overweight) OR (weight reduction) OR (anthropometric) OR (anthropometry) OR (nutritional status) OR (nutrition assessment) OR (body mass index) OR (BMI) OR (body weights and measures) OR (waist circumference) OR (adipose tissue)) AND (randomized controlled trial[ptyp] AND (child[MeSH:noexp] OR adolescent[MeSH])).

Additionally, we performed a cross-reference check using eight related SRs (Brown and Summerbell, 2009; Gonzalez-Suarez et al., 2009; Jaime and Lock, 2009; Knai et al., 2006; Lavelle et al., 2012; Perez-Morales et al., 2009; Van Cauwenberghe et al., 2010; Zenzen and Kridli, 2009). To look for updates, we conducted the search in PubMed/Medline (the database that retrieved the most number of relevant studies in the original search) until May 23, 2012, but no additional RCTs were retrieved.

Randomized controlled community trials were eligible for this SR if they met the following criteria: 1) the intervention and control groups were contemporaneous and received the same cumulative duration of treatment or non-treatment; 2) participants were 5–18 years of age (we made no exclusions based on anthropometric classification, country, ethnic group, socioeconomic status, or gender); 3) the study reported body mass index as an outcome; 4) interventions were school-based nutrition education interventions administered by health professionals or school teachers; and 5) there were no representative sample of children with eating disorders, dyslipidemia, mental or physical disabilities, diabetes or anemia. After-school interventions and data from articles addressing impacts of interventions after varying follow-up periods were not considered.

The selection of titles and abstracts and the methodological quality assessment (MQA) were completed independently by two authors (JS and PG). In cases of disagreement or doubt, a senior researcher was consulted (MN or JT). For the MQA, we combined two tools: a modified version of the Quality Assessment Tool for Quantitative Studies of Effective Public Health Practice Project (EPHPP, 2009), which we designated a score ranging from −1 (weak) to +1 (strong), instead a classification (weak, moderate, strong), for seven covered areas (selection bias, study design, confounders, data collection method, withdrawals and dropouts, intervention integrity and analysis) resulting an overall score ranging from −5 to +7. Blinding was not considered, as we were evaluating education interventions; and, the Grading Recommendations Assessment, Development and Evaluation (GRADE, 2012) system, which points were assigned according to the type of evidence and effect size and deducted from the quality, consistency and directness, as proposed by the BMJ Clinical Evidence (ClinicalEvidence, 2012), resulting an overall score ranging from −2 to +7.

According to the distribution of the two assessment tools' scores in tertiles, papers were classified as follows: A, high quality (EPHPP ≥ 4 and GRADE ≥ 3); B, regular quality (EPHPP ≥ 4 and GRADE = 2); or C, low quality (EPHPP ≤ 3 or GRADE ≤ 1).

Data extraction and statistical analysis

One researcher (JS) extracted the following data: total number of participants in each group, study length, theoretical framework, intervention components, anthropometric outcome (BMI in kg/m^2), characteristics of randomization and data analysis.

We conducted the meta-analysis using the DerSimonian and Laird random-effects model because we assumed that there is heterogeneity in the characteristics of the studies (e.g., length of time and type of intervention) that influences the variability beyond chance (Egger et al., 2001; Riley et al., 2011). The percentage of variation across studies due to the heterogeneity was measured using the I^2 statistic. Heterogeneity was quantified using the Cochran's Q statistic (Egger et al., 2001). A subgroup analysis by intervention duration was conducted a posteriori because there were data available for this purpose.

The mean treatment effect across the studies was summarized as the mean difference between exposed and non-exposed groups (weighted mean difference) with a 95% confidence interval (95% CI). This method weights studies according to the group size, the standard deviation and the mean response (effect size) (Egger et al., 2001).

For trials that did not take clustering effects into account or did not describe the intracluster correlation coefficient, we applied the value of 0.02 to avoid overestimating the intervention effect, as recommended in the literature (Higgins and Green, 2011; Sichieri et al., 2009). Publication bias was assessed subjectively using a funnel plot.