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Research report

Influence of weight-loss diets with different macronutrient compositions on health-related quality of life in obese youth

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ABSTRACT

The aims of this study were to compare the effects of weight-loss diets of different macronutrient compositions on weight and health-related quality of life (HRQOL), and to examine the relationship between changes in HRQOL parameters and weight loss during weight-loss programs in obese adolescents.

Seventy one adolescents (12–18 years, BMI > 95th percentile) were randomly allocated to one of three 12-week diet regimens: low-carbohydrate low-fat (LCLF), low-carbohydrate high-fat (LCHF) or high-carbohydrate low-fat (HCLF) diets. Weight, height and fat-mass were measured, and the PedsQL 4.0 questionnaires were administered to the participants at baseline and at the end of the intervention.

Significant similar reductions in BMI, BMI-SDS, and fat percentage occurred in all groups. A significant improvement in HRQOL was found only in the LCLF and HCLF groups. For the entire sample, positive correlations were found between emotional and psychosocial functioning at baseline and the reduction in BMI, BMI-SDS, and fat percentage. By multiple regression analysis, higher baseline emotional functioning and BMI-SDS were significant predictors to higher reduction in BMI-SDS during the intervention. Our results support the importance of evaluating and improving psychosocial functioning before initiation of a weight-loss intervention program in adolescents, and the importance of low-fat diets in weight-loss interventions for adolescents.

Introduction

The prevalence of pediatric obesity has increased dramatically worldwide (Zeller & Modi, 2006) as well as in Israel (Huerta, Gdalevitch, Haviv, Bibi, & Scharf, 2006) in the past decade, accompanied by a growing body of literature on the adverse consequences of obesity on health (Kiess et al., 2001; Sorof, Lai, Turner, Poffenbarger, & Portman, 2004). In youth, obesity also poses a considerable risk of psychosocial impairment and poor developmental adaptation (Gortmaker, Must, Perrin, Sobol, & Dietz, 1993). Recent studies showing an association between impaired health-related quality of life (HRQOL) and obesity in children and adolescents (i.e. De-Beer et al., 2007; Pinhas-Hamiel et al., 2006; Ravens-Sieberer, Redegled, & Bullinger, 2001; Zeller & Modi, 2006) suggest a need for early weight-management interventions. An improvement in HRQOL after weight-loss interventions has been reported in obese adults, even after small to moderate weight loss (Kolotkin, Meter, & Williams, 2001), and in obese children and adolescents who participated in an in-patient rehabilitation program in Germany (Ravens-Sieberer et al., 2001).

However, whether HRQOL variables can serve as pretreatment predictors of weight management remains unclear. In the only studies of this issue to date, Teixeira, Going, and Houtkooper (2002), Teixeira, Going, and Houtkooper (2004), Teixeira, Going, Sardinha, and Lohman, (2005) found that obese women with lower HRQOL at the beginning of a weight-loss program, particularly in the areas of work, health and self-esteem, were more likely to drop out or to finish the study less successfully than the other participants. Data on the influence of the composition of weight-loss diets on psychosocial parameters are also sparse. Most of the studies so far have been short-term and all included only adults. They suggest that the manipulation of carbohydrate and protein intake might be associated with changes in psychological measures, although the results were inconsistent (Benton, 2002; Fischer, Colombani, & Wenk, 2004; Latner & Schwarts, 1999; Markus et al., 1998). The single long-term study,

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conducted by Galletly et al. (2007), in 28 women with polycystic ovary syndrome, revealed that high-protein, low-carbohydrate diets were associated with a significant improvement in psychosocial parameters (depression and self-esteem) compared to low-protein, high-carbohydrate diets, with no difference in the amount of weight loss between the two. Indeed, improved psychological well-being may have been responsible for the better compliance of obese women to a 12-week reduction program based on a high-protein low-fat diet than on a high-carbohydrate low-fat diet (Noakes, Keogh, Foster, & Clifton, 2005).

Data on the effectiveness and safety of low-carbohydrate diets in children are limited (Bailes, Strow, Werthammer, McGinnis, & Elitsur, 2003; Nanoff, Zwiauer, & Widhalm, 1989; Sondike, Copperman, & Jacobson, 2003; Sothern, Despinasse, Brown, Suskind, & Udall, 2000; Willi, Oexmann, Wright, Collop, & Key, 1998). Most studies reported considerable weight loss, with no significant adverse effects, and good compliance in the short term.

The main aims of the present study were as follows: (1) To compare the effects of weight-loss diets of different macronutrient composition on anthropometric parameters and HRQOL in adolescents. (2) To examine the possible relationship between changes in HRQOL parameters during weight-loss programs for adolescents and improvements in anthropometric parameters. We hypothesized that the HRQOL in obese adolescents would be low and would improve after weight loss, and that the change in HRQOL would correlate with the improvement in anthropometric measures. Because of a lack of previous research in adolescents, we were unable to formulate a hypothesis regarding the effect of diet composition on anthropometric and HRQOL parameters in adolescents, or the specific HRQOL parameters that would significantly correlate with changes in anthropometric parameters.

Methods

The study was approved by the local Ethics Committee for Research in Humans of the Israel Ministry of Health. Written informed consent was obtained from all participants and their parents/legal guardian.

Participants

The study sample included 71 adolescents aged 12–18 years, attending the Institute of Endocrinology and Diabetes at Schneider Children's Medical Center of Israel between January and March 2005. Only subjects with a body mass index (BMI) above the 95th percentile for age and sex were considered eligible. Other exclusion criteria were presence of a chronic disease (such as diabetes, renal, heart or liver diseases, thyroid function disorder, or diagnosed psychological disorder), current treatment with a weight-loss-inducing medication, and participation in another weight-loss study or slimming diet within the previous 2 months.

Study design

The intervention program was conducted over the 12-week period from March to June 2005. Participants were randomly allocated to one of three diet groups:

Group a: Low-carbohydrate (60 g, 20%), high-protein (150 g, 50%), low-fat (40 g, 30%); LCLF.
Group b: Low-carbohydrate (60 g, 20%), low-protein (60 g, 20%), high-fat (80 g, 60%); LCHF.
Group c: High-carbohydrate (150–180 g, 50–60%), low-protein (60 g, 20%), low-fat (40 g, 30%); HCLF.

All three diets were limited to 1200 kcal/day. The 60-g limit of carbohydrates in the LCLF and LCHF diets was based on the definition of Bravata et al. systematic review of low-carbohydrate diets (Bravata et al., 2003).

All participant received menus and detailed instruction according to their diet group. In order to increase the compliance to the diet regiment, once a month during the 3 months of intervention all participants received three new different detailed menus according to their diet group. An example of one menu and written instructions for each group is presented in Appendix A. As part of the intervention, they attended weekly sessions with a dietitian and a psychologist. For some sessions, the participants were requested to fill out self-report food diaries. All subjects received a general recommendation to engage in regular physical activity.

Measures

Anthropometric parameters were measured once a week throughout the 12-week intervention. Subjects were weighed without shoes in light clothing using standard calibrated scales. Standing height was measured using a commercial Harpenden–Holtain stadiometer. BMI was calculated as weight in kilograms divided by height in meters squared. To compare BMI values across different ages and by sex, the BMI-standard deviation scores (BMI-SDS) was calculated as measured BMI minus mean BMI for age and gender divided by the adequate standard deviation (SD) according to the growth charts of the Centers for Disease Control and Prevention (Kuczmarski et al., 2002). The new CDC growth charts have been reported to be adequate for assessing Israeli children (Goldstein, Haelyon, Krolik, & Sack, 2001).

Fat-mass percentage was evaluated after overnight fasting by bioimpedance analysis using a single-frequency, 50-kHz leg-to-leg bioimpedance system combined with a digital-scale body composition analyzer (TBF-300, Tanita Corporation of America Inc., Arlington Heights, Illinois).

Questionnaire

The Pediatric Quality of Life Inventory (PedsQL) 4.0 is a generic HRQOL measure developed for children and adolescents (Varni, Seid, & Kurtin, 2001). Scores are calculated for each of the four core subscales (physical functioning, eight items; emotional functioning, five items; social functioning, five items; and school functioning, five items, as well as the two broad domains: physical and psychosocial functioning), and total score. The scales are standardized, ranging from 0 to 100, with higher scores representing better quality of life. The PedsQL has been shown to be reliable and valid, with internal consistency reliability coefficients approaching or exceeding 0.70. For the present study, we used the Hebrew version of the PedsQL 4.0, which has been linguistically validated (The PedsQL Organization) and was previously applied in a study of normal-weight and obese Israeli children and adolescents (Pinhas-Hamiel et al., 2006). The internal consistency (Cronbach α) of the PedsQL in the present study was 0.78.

The PsdsQL 4.0 questionnaires (Hebrew version) were administered to the participants before and after the 12-week intervention.

Statistical analyses

All values are presented as mean $\pm$ SD.

The study was powered using the effect size statistic by Cohen (1998), defined as the difference between two treatment groups divided by the pooled SD. The present study was powered to detect a 4.0% difference in baseline BMI between each pair of the three