



Changes in eating behavior and plasma leptin in children with obesity participating in a family-centered lifestyle intervention

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ABSTRACT

The goal of childhood obesity lifestyle interventions are to positively change body composition, however it is unknown if interventions also modulate factors that are related to energy intake. This study aimed to examine changes in eating behaviors and plasma leptin concentrations in overweight and obese children participating in a 1-year family-centered lifestyle intervention. Interventions were based on Canadian diet and physical activity (PA) guidelines. Children were randomized to 1 of 3 groups: Control (Ctrl; no intervention), Standard treatment (StnTx: 2 servings milk and alternatives/day (d), 3x/wk weight-bearing PA), or Modified treatment (ModTx: 4 servings milk and alternatives/day; daily weight-bearing PA). Study visits occurred every 3-months for 1-y; interventions were held once a month for 6-months with one follow-up visit at 8-months. Ctrl received counselling after 1-y. Caregivers completed the Children's Eating Behavior Questionnaire (CEBQ) and reported on diet and activity. Plasma leptin were measured from morning fasted blood samples. Seventy-eight children (mean age 7.8 ± 0.8 y; mean BMI 24.4 ± 3.3 kg/m²) participated; 94% completed the study. Compared to baseline, at 6-months StnTx reduced Emotional Overeating and Desire to Drink scores ($p < 0.05$) while Food Responsiveness scores were reduced in both StnTx and ModTx ($p < 0.05$). At 1-year, scores for Desire to Drink in StnTx remained reduced compared to baseline ($p < 0.05$). Plasma leptin concentrations were significantly lower in ModTx at 6-months compared to baseline ($p < 0.05$). This study resulted in intervention groups favorably changing eating behaviors, supporting the use family-centered lifestyle interventions using Canadian diet and PA recommendations for children with obesity.

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1. Introduction

Long term food intakes can be mediated by many factors, such as the tonic protein leptin (Harrold & Halford, 2013) and by eating behaviors. The hormone leptin is released into circulation by

adipose tissue among other sites (Klok, Jakobsdottir, & Drent, 2007) and compared to normal-weight children, children with obesity often present with higher circulating leptin that declines with decreases in body mass index (BMI) after dietary (Ibarra-Reynoso Ldel, Pisarchyk, Perez-Luque, Garay-Sevilla, & Malacara, 2015), physical activity (Gutin et al., 1999), or lifestyle (Siegrist et al., 2013) focused interventions. Similarly, studies have shown that eating behaviors are related to a child's weight status (McCarthy et al., 2015) and that children with obesity score differently in their responses to satiety cues, rate of meal consumption, sensitivity to environmental cues (i.e., emotional stress), and desire to drink (Parkinson, Drewett, Couteur, Adamson, & Gateshead Millennium Study Core, 2010; Spence, Carson, Casey, & Boule, 2011). However, whether changes in leptin concentrations that change in response to changes in BMI are also associated with changes in eating behaviors in children with obesity has not been reported.

Abbreviations: BAZ, body mass index for-age and-sex z-score; %BF, percentage body fat; BL, baseline; BMI, body mass index; CEBQ, Children's Eating Behavior Questionnaire; Ctrl, Control; FM, fat mass; FMI, fat mass index; LM, lean mass; ModTx, Modified treatment; PA, Physical activity; StnTx, Standard treatment; %Δ, percent change

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There has been growing interest in the effects of milk products on modulating body weight in children (Moore, Bradlee, Gao, & Singer, 2006) as their effects induce satiety therefore reduce energy intake (Mehrabani et al., 2016). While there are many appetite hormones involved in the episodic control of food intake, the tonic signal leptin is known for its long-term regulation of dietary intake (Klok et al., 2007). Therefore, should changes in leptin concentrations be associated with reductions in adiposity due to increased servings of daily milk products in addition to being associated with changes in eating behaviors would be of interest to interventions conveying realistic dietary messages to children with obesity.

In Canada, children 4–8 years of age are recommended to consume 2 servings of milk and milk products per day. Canadian children are also encouraged to participate in weight-bearing types of physical activities 3 times per week, which not only affect body composition, but also strengthens muscles and bones (Canadian Society for Exercise Physiology., 2015). In previous work, we showed that children randomized to intervention groups, specifically to the standard (i.e., follow Canadian diet (Health Canada, 2011) and activity guidelines (Canadian Society for Exercise Physiology., 2015)) and modified (i.e., consume 4 servings per day of milk and milk products plus participate in daily weight-bearing types of activity) groups significantly reduced body mass index for-age and-sex z-scores by -0.3 ± 0.4 and -0.7 ± 0.6 , respectively, compared to relatively no change (i.e., -0.1 ± 0.3) in the control group (no intervention) following a 1-year family-centered lifestyle intervention (Cohen, Hazell, Vanstone, Rodd, & Weiler, 2016). Whether these children also changed eating behaviors and plasma leptin concentrations has not been reported. Therefore, this paper aimed 1) to examine changes in eating behaviors and plasma leptin concentrations in overweight and obese children participating in a 1-year family-centered lifestyle intervention and 2) to determine if children randomized to the modified intervention group (i.e., increase milk and milk product intakes and participate in daily weight-bearing types of activity) resulted in changes in eating behaviors and leptin concentrations after 1-year. This study reports on secondary outcomes from a previously published randomized controlled trial (Cohen et al., 2013; Cohen et al., 2016).

2. Materials and methods

2.1. Recruitment and inclusion criteria

Recruitment for the McGill Youth Lifestyle Intervention with Food and Exercise (MY LIFE) Study took place from 2011 to 2013 in greater Montréal (Québec, Canada). Eligibility included healthy 6- to 8-year-old children with no known illness, who were overweight (85–97 percentile) or obese (>97 percentile) as per the World Health Organization (WHO) weight-for-height body mass index (BMI) cut-off criteria (World Health Organization, 2012). This study has been reviewed and approved by McGill University Faculty of Medicine Institutional Review Board (A09-M52-10B), Lester B. Pearson School Board and the English Montreal School Board (Trial Registration: ClinicalTrials.gov: NCT01290016).

The recruitment strategy has been published elsewhere (Cohen et al., 2013). At baseline (BL), parents consented and children assented to participate. Using a computer-generated list, a dietitian randomized and allocated (1:1:1) children to 1 of 3 groups (Standard [StnTx], Modified [ModTx] or control [Ctrl]) by sex and BMI percentile for age (overweight or obese) (World Health Organization, 2012). Socio-demographics were also surveyed at BL. Follow-up visits occurred every 3 months for 1-year at the Mary Emily Clinical Nutrition Research Unit (Sainte-Anne-de-Bellevue, QC, Canada). This paper reports on data collected when plasma leptin was analyzed, specifically at baseline, 6-months (end of

intervention phase) and 12-months (end of study).

2.2. Interventions

At BL, all groups participated in a standard teaching of Canada's Food Guide (Health Canada, 2011) and physical activity (PA) (Canadian Society for Exercise Physiology., 2015) guidelines by a registered dietitian. StnTx and ModTx participated in a total of 6 interventions which were held at the end of each month for the first 5-months of the study, then a final "relapse prevention" session at the end of the 8th month. The Ctrl group received the interventions after 1-year.

All interventions followed the same educational platform, but were tailored to meet the needs of the families and children by identifying barriers to meeting goals and strategizing how to achieve them considering all members of the family. Discussions concerning eating behaviors were included in each intervention as deemed fit by the dietitian. The only differences between StnTx and ModTx were the amount of milk and milk product intakes they were guided to consume (i.e., StnTx: 2 servings/day; ModTx: 4 servings/day) and the time allotted to weight-bearing physical activities per week (i.e., StnTx: 3 times/week; ModTx: daily). The goal of 60 min of moderate-to-vigorous PA and maximum of 2-h of screen time per day were encouraged to in both StnTx and ModTx, as were Canada's Food Guide recommended servings for vegetables and fruit, grain products and meat and alternatives. Canadian nutrition guidelines are based on similar principals as those for children in the United States (United States Department of Agriculture.). Specifically, Canada's Food Guide to Healthy Eating recommends children 4–8 years of age to consume 5 servings/day of vegetables and fruit (e.g., 1 serving = $\frac{1}{2}$ cup (125 mL) fruit; 1 cup (250 mL) leafy vegetable), 4 servings/day of grain products (e.g., 1 serving = 1 slice of bread (35 g) or $\frac{1}{2}$ cup (125 mL) cooked pasta, rice), 2 servings/day of milk and milk products (e.g., 1 serving = 1 cup (250 mL) milk; 50 g (1.5 oz.) cheese; $\frac{3}{4}$ cup (175 g) yogurt) and 1 serving/day of meat and alternatives (e.g., 1 serving = 75 g meat, fish or poultry; 2 eggs) (Health Canada, 2011). Details concerning the education and intervention topics are published elsewhere (Cohen et al., 2013).

2.3. Outcomes

2.3.1. Eating behaviors

The Child Eating Behavior Questionnaires (CEBQ) (Wardle, Guthrie, Sanderson, & Rapoport, 2001) consists of eight scales that reflect different eating styles. Questions are surveyed using a 5-point Likert scale where eating behaviors are identified as: never, rarely, sometimes, often, and always. This questionnaire contains 35 questions that are categorized using 8 subscales ($n = \#$ of questions): 1. Food Responsiveness ($n = 5$); 2. Enjoyment of Food ($n = 4$); 3. Slowness in Eating ($n = 4$); 4. Food Fussiness ($n = 6$); 5. Satiety Responsiveness ($n = 5$); 6. Emotional Overeating ($n = 4$); 7. Emotional Undereating ($n = 4$); and 8. Desire to Drink ($n = 3$). Questions were scored as per Wardle and colleagues (Wardle et al., 2001). Specifically, for each participant, the score for each subscale was calculated as the sum of the individual questions divided by the total number of questions. These subscales were further grouped into 2 categories: (1) Food Approach, or pro-intake scores, which comprises of the total scores of Food Responsiveness, Enjoyment of Food, Emotional Overeating and Desire to Drink questions; and (2) Food Avoidance, also called anti-intake scores, which sums up scores identified from the headings Slowness in Eating, Food Fussiness, Satiety Responsiveness and Emotional Undereating. The CEBQ was completed during each study visit by the caregiver and analyzed at the end of the trial.

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