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Reducing variety enhances effectiveness of family-based treatment for pediatric obesity

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Abstract

Basic research has shown that increasing variety increases energy intake, and repeated consumption of the same food increases habituation to those foods and reduces consumption. Twenty-four families with overweight/obese 8–12 year-old children and overweight/obese parents were randomly assigned to 6 months of usual family based treatment (FBT) or FBT plus reduced variety of high energy-dense foods (FBT+Variety). Intention to treat mixed model ANOVA showed between group differences in child percent overweight (FBT + Variety –15.4% vs. FBT –8.9%, $p = 0.017$) and parent BMI (FBT + Variety –3.7 kg/m² vs. FBT –2.3 kg/m²; $p = 0.017$). Positive relationships were observed between child zBMI and parent BMI changes ($r = 0.51$, $p = 0.018$), and between reductions in food variety of high energy-dense foods and reductions in child zBMI ($r = 0.54$, $p = 0.02$) and parent BMI ($r = 0.45$, $p = 0.08$). These pilot data suggest that reducing the variety of high energy dense foods and repeating meals within the context of FBT resulted in improved child and parent weight changes at six months. This represents easy to implement changes that reduce choice and may reduce response burden on families. Reducing variety may be a complement to standard FBT that enhances weight loss. Long term studies are needed to assess maintenance of these changes.

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Contributors

LHE Designed the study, CK developed the protocol along with LHE, HR and TOD, RAP and LHE conducted statistical analyses, LHE wrote the first draft of the manuscript and all authors contributed to and have approved the final manuscript.

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Keywords

Pediatric obesity; variety; habituation

Introduction

Repeated consumption of a food within a meal is associated with habituation and reduction in energy intake for that food (Epstein, Temple, Roemmich, & Bouton, 2009b). Presenting a variety of foods slows down the rate of habituation and increases energy intake for high energy or low energy dense foods (Epstein et al., 2009a; Temple, Giacomelli, Roemmich, & Epstein, 2008b). These effects can persist over days, resulting in long-term habituation (Epstein, Carr, Cavanaugh, Paluch, & Bouton, 2011). Obese people consume a greater variety of particular categories of high energy dense foods than leaner peers (McCrory et al., 1999).

Raynor and colleagues have attempted to translate reducing variety into adult weight control. In comparison to recent weight losers, those who showed long-term success consumed less variety in foods, especially for food groups high in fat density (Raynor, Jeffery, Phelan, Hill, & Wing, 2005). From 0 to 6 months, participants in an 18 month behavioral weight loss program showed decreased variety of high-fat foods which was related to weight loss, and maintenance of weight loss (Raynor, Jeffery, Tate, & Wing, 2004). Raynor and colleagues found reduced hedonics but no differences in consumption over four days (Raynor & Wing, 2006) and reduced hedonics but no differences in weight loss over eight weeks for those consuming reduced variety of snack foods (Raynor, Niemeier, & Wing, 2006). Reducing variety of high energy dense snack foods reduced energy intake, but showed no differences in 18 month weight change (Raynor, Steeves, Hecht, Fava, & Wing, 2012).

This study was designed to develop more powerful approaches to translate research on dietary variety to interventions with families building upon laboratory research on habituation (Epstein et al., 2011; Epstein et al., 2009a; Epstein et al., 2009b; Temple et al., 2008b) and field/clinical research on variety (Raynor, 2012; Raynor et al., 2005; Raynor et al., 2004; Raynor et al., 2006; Raynor et al., 2012; Raynor & Wing, 2006). This pilot research extends the research by Raynor and colleagues by utilizing a family-based approach for obese children and their parents, which can engage social support to encourage behavior change, by reducing variety across all meals and snacks, rather than focusing only on snacks, and by using leftovers to repeat meals across days and repeat foods over different meal occasions, such as eating leftover dinner for lunch the next day. The aims of the pilot study were to assess effects of variety of both child and parent weight loss, and to assess whether reduced variety of high energy-dense foods was associated with weight loss.

Methods

Participants and Design

Participating families had 8–12 year-old children over the 85th Body Mass Index (BMI = kg/m²) percentile, who were not taking weight altering drugs, were reading at or above a third grade level, and had one overweight/obese (BMI ≥ 25) parent willing to attend treatment meetings. Neither family member was participating in an alternative weight control program, or had current dietary or exercise restrictions or psychiatric problems. Twenty-four families were randomized to Family-Based Treatment (FBT, n=11) or FBT + reducing variety (FBT+Variety). Twenty-one families were seen to develop treatment methods, and provide therapists experience with the intervention. This research was approved by the Health Sciences IRB at the University at Buffalo.

Procedures

Families attended twelve weekly meetings, two biweekly meetings, and one monthly meeting. Family members were weighed at the start of each meeting. Each session included separate large group meetings for parents and children which lasted approximately 50–60 minutes, and small group counseling for 2–3 families which lasted 20–30 minutes. Families were provided workbooks, food and activity reference guides, a cook book, handouts and internet access to review program materials.

Components of Treatment

Traffic Light Diet—Traffic Light Diet foods are categorized as GREEN, YELLOW, and RED, based upon their energy and fat content. In general, GREEN (GO) foods are high in nutrient density and low in fat (0–2 gms), YELLOW (CAUTION) foods include 2–5 gms of fat per serving, and RED (STOP) foods are low in nutrient density and include more than 5 gm of fat. Modified foods from the Fats, Oils, and Sweets group are considered RED foods, as these foods contribute few nutrients to the diet and compete for consumption of healthier foods. Combination foods (e.g., pizza, hamburger, lasagna, etc.) were considered RED foods if their energy density is higher than a common serving size of that combination food. Participants were instructed to consume between 1,000 – 1,500 calories per day, with a goal of 2 servings of RED foods per day and instructed to eat the recommended number of servings based on the USDA Dietary Guidelines for Americans (U.S. Department of Agriculture & U.S. Department of Health and Human Services, 2010). Families were encouraged to increase variety of fruits and vegetables to increase intake of healthy foods (Blanchette & Brug, 2005; Cullen et al., 2003). All families were instructed to use meal plans to increase adherence to the diet.

Families in FBT+Variety identified two RED foods they would choose from monthly. These were RED foods usually consumed, rather than introducing new RED foods to their diet. They were instructed to pick one entree and one snack food. Families in FBT+Variety developed meal plans that repeated entrees and included leftover foods, reduced variety of RED foods, and were encouraged to repeat weekly meal plans over the month. When participants' weight decreased to the non-obese range, they were given the option of eating an additional 100 calories in the form of Green and Yellow foods until no more weight loss

or weight gain occurred, and encouraged to maintain calorie intake consistent with weight maintenance.

Activity—Both groups received information about physical activity and the positive effects of exercising. The exercise goal was to increase physical activity through structured and lifestyle activity to get 60 minutes/day of moderate to vigorous physical activity.

Behavioral Treatment—All families self-monitored weight, eating and activity behaviors. They were encouraged to model healthy behaviors for family members, and modify their environments to maximize behavior change. Positive reinforcement included praise, stickers and points for meeting dietary goals and weight loss. Points were exchanged for mutually agreed upon reinforcers chosen from a reinforcement menu that included privileges and activities that the child indicated they liked and the parent agreed to provide. Reinforcers were individualized between families, and determined based on child and parental agreement on a reinforcement menu. Reinforcers could include special time with parents and family members, staying up late on the weekend, having a sleep-over, or a family trip or gathering. Reinforcers did not include food or material gifts. Preplanning and problem solving facilitated decision making for difficult eating and activity situations.

Measurement

Height and weight measurements were taken at 0 and 6 months by staff blind to treatment assignment using a digital weight scale and stadiometer calibrated daily. BMI percentile was used to classify children as overweight. Percent overweight was calculated as the percentage of the average BMI value for children based on age and sex (Kuczmarski et al., 2002). Demographics were assessed using the MacArthur Network Sociodemographic Questionnaire (Stewart, 2004).

While variety is a common part of many food guidelines (U.S. Department of Agriculture & U.S. Department of Health and Human Services, 2010), there is no agreed upon method to assess variety. Children and parents completed three 24-hour food recalls at baseline and six months. The recalls provided item details, including factors that influence the food or beverage taste profile. Variety was coded for Traffic Light Diet categories. To differentiate variety, foods were coded as different if they had different ingredients (ie. pepperoni pizza vs. cheese pizza), different methods of preparation (ie. fried haddock with breading vs. baked haddock with seasonings), or different toppings or condiments (plain baked potato with salt and pepper versus baked potato with butter or sour cream). Beverages were a separate category, and beverage variety was computed. Toppings and condiments were counted as they contributed to a complex food, and if it was RED, the food was counted as a RED food. Three day food recalls were scored using Nutritionist Pro, version 5.2 (AXXYA Systems, 2014), based on a multipass approach in which the basic information was first obtained, then reviewed for details, and re-reviewed for completeness. Recalls were scored by one research assistant, and a second research assistant independently coded 5 food records, with agreement on coding food group and variety of 96%. Child and parent general adherence to program goals were reported based on 18 targeted behaviors for children and 25 for parents rated on a 5 point scale, from 1 = never to 5 = always.

Analytic Plan

Between group differences in child percent overweight and parent BMI were analyzed using mixed model ANCOVA based on available weekly, biweekly and monthly values, controlling for baseline. Contrasts tested for change from 0–6 months. To compute percent overweight, weekly height was estimated assuming linear growth from 0–6 months. If six month height was not available, growth was estimated based on usual growth for children that age and sex (Kuczmarski et al., 2002). Between group changes from 0–6 months in calories, macronutrients and variety of child and parent RED foods and fruits and vegetables were assessed at the family level for families who provided 0 and 6 month data (11 in FBT +Variety, 7 in FBT). Analyses were completed using SYSTAT(Systat Software, 2002) and SAS (Littell, Milliken, Stroup, & Wolfinger, 1996).

Results

No differences were observed in child or parent characteristics (Table 1). Greater reductions in child percent overweight ($p=0.02$) and parent BMI ($p=0.02$) were observed for FBT +Variety than FBT (Figure 1). Changes in child percent overweight and parent BMI were related ($r=0.51$, $p=0.018$). Average adherence was not different between groups for children (3.1 ± 0.6 vs 3.4 ± 0.80 , $p=0.55$) or parents (3.4 ± 0.6 vs 3.7 ± 0.5 , $p=0.33$). Group differences in fat calories were observed at the family level (FBT+Variety=711.1 to 350.8 vs FBT=653.9 to 494.0, $p=0.027$), along with an overall change across groups (690.9 to 401.3 $p<0.001$). Overall reductions across groups were observed for total (2004.5 to 1513.1, $p<0.001$) and carbohydrate calories (998.2 to 816.2, $p=0.001$). Variety of RED foods showed a significant change by family (FBT+Variety=20.2 to 12.6, FBT=19.7 to 16.8, $p=0.01$). A trend in increase in variety of fruits and vegetables was observed (2.0 to 2.7; $p = 0.059$), with similar changes by group ($p=0.46$). Change in variety of child and parent RED foods were related to changes in child percent overweight ($r=0.54$, $p=0.024$) or parent BMI ($r=0.45$, $p=0.08$).

Discussion

This pilot study suggests reducing variety can enhance treatment effects for children and parents participating in FBT. The treatment took advantage of multiple ways to repeat food tastes, and was designed to simplify the process of weight loss, by making shopping easier, and reducing cooking and the number of meals prepared. Limiting variety over multiple food groups, rather than just snacks, and repeating entrees, using leftovers, repeating meal plans and controlling portion size of reduced variety foods may have contributed to the improved efficacy as opposed to the previous research (Raynor et al., 2006; Raynor et al., 2012; Raynor & Wing, 2006). A trend ($p<0.06$) towards increasing fruit and vegetable variety suggests more intensive treatment targeting fruit and vegetable intake (Epstein et al., 2001; Epstein, Paluch, Beecher, & Roemmich, 2008a) may be needed to increase those components of healthy eating.

This pilot provides proof of concept, but there are intervention details to be evaluated to maximize treatment effects. For example, how many repetitions are needed to produce long-term habituation, and what is the ideal interval between food presentations? Repeating the flavors of the same foods within a meal may speed up meal habituation, and repeating the

same flavors across multiple meals in the same day may promote habituation for that day, but will introducing new flavors the next day act as a dishabituator? We have shown that repeating similar, though not identical, foods can result in habituation (Epstein et al., 2013), supporting the idea that there is a stimulus generalization gradient, and habituation to a broader class of foods may be observed. Also, it is not known if habituation is observed to all types of foods, or if it is better to focus on foods with specific macronutrient or taste profiles (Myers & Epstein, 1997).

Strengths of the study include the randomized design, use of a well-validated treatment, and the translation of a theoretical approach to ingestive behavior (Epstein et al., 2009b). Despite these strengths, there are study limitations. This pilot was implemented in a small sample of families, focusing only on the initial response to treatment, and new methods to assess variety using food recalls were used.

These results suggest habituation and variety research can be translated to interventions, but research is needed to identify the optimal way to use this research to complement standardized weight control interventions. New ways to harness the power of this ubiquitous phenomenon may lead to new and innovative approaches to treatment of obesity.

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Highlights

- Reducing variety has been shown to reduce energy intake in laboratory and field studies
- Reducing variety of RED foods to two per month improved parent and child weight loss
- Child and parent weight losses were related

Figure 1.

Changes in child percent overweight and parent BMI over six months by group. Mixed model ANCOVA controlling for baseline values showed greater reductions of child percent overweight for the FBT+Variety group from 0–6 months (FBT+Variety=−15.4% vs. FBT=−8.9%; $t(270) = 2.40$, $p = 0.02$), as well as greater reductions in parent BMI (FBT+Variety −3.7 kg/m² vs. FBT −2.3 kg/m²; $t(265) = 2.40$, $p = 0.02$).

Table 1

Baseline characteristics of children and parents in obesity treatments groups.

Characteristics	Groups					
	Child			Parent		
	FBT + Variety	FBT	p	FBT + Variety	FBT	p
N	13	11		13	11	
Gender (F/M)	8/5	6/5	0.73	12/1	10/1	0.90
Age	10.5 ± 1.4	10.5 ± 1.4	0.99	43.5 ± 7.8	41.3 ± 6.9	0.43
% Minority (non-minority/minority)	8/5	6/5	0.73			
Parental education				18.6 ± 3.3	16.7 ± 3.5	0.19
zBMI	2.3 ± 0.4	2.2 ± 0.4	0.73			
Percent Overweight	82.2 ± 45.1	64.0 ± 27.2	0.23	81.1 ± 35.1	70.2 ± 31.4	0.41
BMI	31.1 ± 7.5	27.9 ± 3.0	0.21	39.5 ± 7.1	37.2 ± 6.8	0.44
Weight	162.8 ± 50.1	138.9 ± 23.0	0.16	242.4 ± 45.0	229.7 ± 48.8	0.51

Note- FBT + Variety refers to family-based treatment incorporating reduced variety of high energy dense foods; FBT refers to family-based treatment; % minority refers to the percent of families who are not Caucasian; parental education is highest parental education.