

**FOOD FOR THOUGHT: AN INTERNET-BASED TREATMENT PROGRAM FOR
CHILDHOOD OBESITY.**

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ABSTRACT

One in five children in the US is now overweight and the prevalence of obesity is increasing in adults and children. The cause of this recent epidemic is thought to be unhealthy eating and sedentary lifestyle. Treatment of childhood obesity is extremely difficult, but may reduce obesity-related morbidity and treatment costs in adulthood. Intensive treatment interventions for obese school-aged children that involve parents have led to marked and sustained weight loss. However, such specialized treatment is not widely available and is expensive. The Internet is a way to efficiently deliver obesity treatment, and Internet access is available in the majority of homes with children in the United States.

Food for Thought is an integrated, Internet-delivered 16-week intervention that targets parents of overweight 3 to 6 year olds as the agent of change for the family. Program goals were for the child to: 1) Eat 5 servings of fruit and vegetables each day, 2) Eat no more than 3 servings of high fat, high sugar, low nutritional value foods each day, and 3) Spend less than 2 hours each day watching TV, playing videogames or playing on the computer. The child's behavior change was the main focus of the intervention, but basic education on healthy nutrition and healthy activity for children and adults, and healthy parenting behaviors around eating were included. Parents learned how to use behavior change techniques to identify areas for improvement, set goals and make changes to reach those goals, and used on-line logs to monitor their child's intake of fruit and vegetables and their sedentary behaviors. In addition parents received a pedometer to self-monitor walking. A moderated discussion board was available for participants to ask questions and share problems and successes. Parents used the program for one to two hours per week, at their convenience.

Pilot data from five families are reported. Dietary intake, sedentary behaviors and the BMI were measured before and after the 16-week intervention. All measures for the child and parent changed in the desired direction following the intervention, but few changes reached statistical significance, likely due to the small sample. Children showed the most improvements with significant changes in the median number of daily servings of vegetables (increased from 1 to 2 servings per day, $P=0.045$), soda consumption (decreased from 3 to 1 per day, $P=0.039$), and weekday TV viewing (decreased from 4 to 2 hours/day, $P=0.042$).

This study demonstrated that *Food for Thought* could be delivered over the Internet in the community setting, and suggested that this program may be an effective way to treat obesity in young children. We are planning future studies to further develop the program and evaluate its effectiveness and cost, and are applying for a Clinical Research Grant in Obesity from the NIH to support this work.

LAY SUMMARY

There is an epidemic of childhood obesity in the United States. Treatment of obesity in children is difficult, but may reduce obesity related mortality, morbidity and treatment costs in adulthood. We developed and pilot tested *Food for Thought*, an Internet-based treatment program that targeted parents of overweight children who are between 3 and 6 years old. The program included education about healthy diet, healthy activity and healthy parenting, and participants learned behavior change techniques to identify and address areas for improvement. We pilot tested the program in five families in St Louis, and measured the child and parent's dietary intake, sedentary behaviors and BMI before and after the 16-week intervention. All measures for the child and parent changed in the desired direction following the intervention, but few changes reached statistical significance, likely due to the small sample. Children showed the largest improvements with significant changes in the number of daily servings of vegetables (increased from 1 to 2 servings per day, $P=0.045$), and soda consumption (decreased from 3 to 1 per day, $P=0.039$), and weekday TV viewing (decreased from 4 to 2 hours/day, $P=0.042$). This study demonstrated that *Food for Thought* could be delivered over the Internet in the community setting, and suggested that this program may be an effective way to treat obesity in young children. The program will be modified and evaluated in future studies.

INTRODUCTION

One in five children in the United States is now overweight (1, 2) and the prevalence of obesity is increasing in adults and children (3). The consequences of this rapid increase in pediatric obesity are extensive. Psychological problems for obese children include social stigmatization and a disturbed body image (4, 5). Medical problems include elevated blood pressure, sleep disturbances, osteoarthritis, and increased risk for cardiovascular disease and type 2 diabetes (6-8). After age 3, overweight children are more likely to become overweight adults (9, 10), a condition associated with increased morbidity and premature mortality (11-14). In the United States, the costs of childhood obesity and related co-morbidities are estimated to be over \$70 billion a year (15). The cause of this recent obesity epidemic is attributed to unhealthy eating and sedentary lifestyle (4,6 -16).

Prevention and treatment of obesity in children may reduce obesity related mortality, morbidity and treatment costs in adulthood (5, 16). However, treatment of childhood obesity is extremely difficult and affordable effective treatment programs are lacking. The current standard of care for overweight children is advice from the primary care physician, most frequently in the form of recommendations to the parent on how to modify activity and eating behaviors (16). However, few community physicians are trained in obesity management, and most lack the time to provide effective counseling to parents. (17, 18) Interventions beyond the current standard of care are needed.

The Internet provides a way to efficiently deliver intensive behavioral modification and social support programs for treatment of childhood obesity. Although research on Internet-based approaches to the treatment of obesity is limited (19), an Internet-delivered weight loss intervention for adults was moderately successful (20). The aims of this project were twofold, 1) to develop *Food for Thought*, an Internet-delivered program targeted at the parents of obese young children, and 2) to assess the feasibility of using *Food for Thought* to treat obese children in the community setting.

METHODS

Participants

Parents of overweight or obese 3 to 6 year olds (sex- and age-specific Body Mass Index (kg/m^2) $\geq 85^{\text{th}}$ percentile according to the 2000 CDC Growth Charts for the United States) were eligible to participate in the study. Families were excluded if they did not have access to the Internet for at least 2 hours each week, or the parent or child had a chronic medical problem requiring a special diet or restricted physical activity, took prescription medications that significantly affected his or her weight, or was currently in a supervised weight loss program. In addition, families were excluded if the parent had significant alcohol problems, had used street drugs in the past year, had a history of addiction to a prescribed medication, or had gastric bypass surgery or an eating disorder. The study was approved by the Washington University Human Studies Committee.

The Intervention – Food for Thought

Conceptual Model

The *Food for Thought* program was based on social learning theory, (21) and used behavior change techniques that have been shown to work in long-term weight management to help parents modify their child's and their own eating and physical activity habits. (22, 23)

These techniques included stimulus control, self-monitoring and behavioral contracting. For each targeted behavior, parents learned how to monitor current behavior, set goals for change, identify barriers to change, problem-solve to overcome the barriers, maintain the change and prevent relapse. Realistic and gradual changes were encouraged in order to maximize the potential for long-term behavior change and minimize participants' frustration. (1)

The goals of the program were for the child to: 1) Eat 5 servings of fruit and vegetables each day, 2) Eat no more than 3 servings of high fat, high sugar, low nutritional value foods each day, and 3) Spend less than 2 hours each day watching TV, playing videogames or playing on the computer.

Program Content

The program included basic education on nutrition and physical activity for children and adults, healthy parenting behaviors around eating, and healthy body image. The child's behavior change was the main focus of the intervention, but information about how to improve the behaviors of the parents and the rest of the family was included. Parents were encouraged to model healthy eating and physical activity for their children.

A modification of Epstein's traffic light diet was used to guide healthy nutrition. (24) Using the USDA's Food Guide Pyramid as its foundation, the diet uses a color-coded food exchange system, mainly based on fat content and nutritional value, with some coding based on sugar content. For this study, foods were grouped into two categories: red and green foods. Red foods were those high in fat, calories, and/or sugar and low in nutrition, such as French fries and donuts. Green foods were those low in fat and calories and high in nutrition, and included all fruits and vegetables.

All new material was additive, but each session had its own goals and education materials. Sessions about healthy nutrition focused on increasing fruit and vegetable intake, decreasing red food intake, appropriate portion size, and stocking the pantry. To reinforce program content, parents monitored food intake using the on-line food log, selecting red and green foods from drop down lists as well as recording portion size. Sessions about healthy activity focused on reducing sedentary behaviors, as well as increasing physical activity. Tips, fun activities and recipes were provided throughout the sessions to help keep the content relevant, fun, and useful. The website also included a moderated discussion board for parents to ask questions about weekly topics and to share any advice, problems or success stories. A clinical psychology doctoral student moderated the discussion board with close supervision by a licensed clinical psychologist. The moderator answered any questions posted to the board as well as updated parents on local activities in the community consistent with the goals of the program. Each session included supplemental resources such as links to more recipes, nutrition information for fast food restaurants, serving size information and lists of local farmer's markets. These resources were also compiled in a resource list on the homepage of *Food for Thought*.

At the start of the program, each family was given The New American Plate placemat to provide a visual reference on appropriate portion sizes (www.aicr.org). Each parent was provided with a pedometer (Accusplit Eagle 120XL, the equivalent of the Yamax Digiwalker 200), and encouraged to set a goal of 10,000 steps per day, consistent with expert recommendations for adults to achieve an "active" lifestyle. (25, 26).

Program Implementation

Food for Thought comprised 12-sessions delivered over 16 weeks (once a week for 8 weeks, then once every 2-weeks). Participants were asked to spend 1-2 hours each week using the program. To ensure privacy, all communication between the browser and the server was encrypted, each participant used a unique login and password, and only login names were used on the discussion board to maintain anonymity. *Food for Thought* was programmed in HTML and PHP, using Dreamweaver 8 (Macromedia, Inc, San Francisco, CA) as a text editor. The website was hosted by WebFreaks US (Webfreaks International, LLC, Tampa, FL).

Procedures

Families were recruited from WU PAARC, a practice-based research network of 60 community pediatricians affiliated with Washington University School of Medicine in St Louis. Interested parents completed a brief eligibility assessment during a telephone interview with a research assistant. Both parents of each eligible child were encouraged to participate.

All eligible participants attended an introductory session at the University research office. At this meeting, parents and children had their height and weight measured, and completed all baseline questionnaires. Each parent was instructed how to use the internet-based program and the discussion board, given a login name and password, and given a pedometer and an American plate placemat. Follow-up measurements occurred at a 16-week post-intervention visit and included an additional semi-structured interview to assess satisfaction with the program. Due to scheduling difficulties, the follow-up visits were conducted individually rather than as a group. The baseline and follow-up visits each lasted about 90 minutes, and childcare was provided.

Measurement

Demographic information was collected at baseline including the participant's relationship to the index child, their age, gender, and ethnicity, and the parents' level of education. All height and weight measurements of both the parent/guardian and child were taken wearing street clothes, but without shoes. Weights were measured to the nearest 0.25 lb with a balance beam scale that was calibrated daily. Heights were measured to the nearest 0.25 inches using a rigid vertical height rod. For both weight and height, the average of three measures was calculated and then converted to the Body Mass Index (BMI). (cdc.gov).

Validated instruments were used to measure secondary endpoints including food intake and activity level. The *Physical Activity & Nutrition Behaviors Monitoring Form* (PANBMF) was used to measure TV viewing and exercise, and consumption of soda, fast food, milk, and fruit and vegetables. The PANBMF is a 23-item instrument that was developed by the North Carolina Department of Health and Human Services and was intended for use in a range of ages, including preschool children. At each measurement (baseline and follow-up), the parent completed this instrument twice, once for their child and once for themselves. Questions assessed the number of hours of TV watched on a typical school day (weekday) and a typical weekend day, and the number of days in the past week that the respondent exercised for at least 20 minutes that made them sweat or breathe hard. Dietary questions enquired about the number of servings in a typical day of soda, chips, milk, vegetable and fruit, and the number of meals eaten in a fast food restaurant per week. Dietary fat consumption over the past seven days was

assessed using the PACE+ Dietary Fat Screener, a 21-item measure developed for use with adolescents. (27)

Satisfaction and acceptability of the program were assessed using a brief, self-reported questionnaire developed by the investigators, and by a 20-minute structured interview conducted by one of the investigators. On the questionnaire, participants rated how helpful they found the program overall, as well as individual program components and topics using a 4-point likert scale (extremely, very, somewhat, not at all helpful). In addition they recorded if the amount of information presented was too much, too little or just right, and the frequency they used various program components. Participants' perceptions regarding the intervention were explored during the interview, and participants were asked to suggest improvements.

Data Analysis

Continuous variables are reported as the mean (standard deviation) or median (range), and categorical data as percentages. Before-after comparisons of parent and child behaviors and BMIs were done using the Wilcoxon matched-pairs signed-rank test. A probability of $P \leq 0.05$ (2-tailed tests) was used to establish statistical significance for all comparisons. All statistical analyses were done using STATA 7.0 (Stata Corp.1997. *Stata Statistical Software: Release 7.0* College Station, TX: Stata Corporation) or SPSS (SPSS Inc., Predictive Analytics, Chicago, Ill).

RESULTS

Study participants are described in Table 1. All children had an initial BMI $\geq 95^{\text{th}}$ percentile for gender and age. Only 5 of the 9 participants were available for follow-up, all female children. One child returned to live with his mother who was not interested in participating, one family declined the follow-up interview, and two families could not be reached for follow-up by phone or mail. Of those who participated in the follow-up assessment, three were Caucasian, one was African American, and one was Hispanic.

Pre/post measurements for the child and parents' BMI, dietary intake and sedentary behaviors are presented in Table 2. Although all measures for the child and parent changed in the desired direction following the intervention, few changes reached statistical significance, likely due to the small sample size. Children showed the largest improvements with significant changes in the number of daily servings of vegetables (increased from 1 to 2 servings per day, $P=0.045$), and soda consumption (decreased from 3 to 1 per day, $P=0.039$), and weekday TV viewing (decreased from 4 to 2 hours/day, $P=0.042$).

Overall, parents found the program helpful (2 very, 3 somewhat), and were likely to recommend it to others (4 very likely, 1 somewhat). Parents rated the information provided about nutrition (general and red and green foods), portion size, sedentary and physical activities, parenting, and the specific behavioral goals as the most helpful aspects of the program. Three of five parents who used the child activity log rated it as very helpful, as did 3 of 4 who used the food log. Fewer parents logged their own food intake (Of 4, 2 rated very helpful) and activities (Of 3, 2 rated very helpful). The least used features of the program were the "tips (2)," recipes (1), discussion board (2), and the section about preventing relapses (1). Parents thought the amount of information presented for most topics was just right.

In the post-hoc interviews, all parents stated that they liked the web-based format and found it to be very convenient and easy to use. One parent was not familiar with computers and stopped using the program after missing a few weeks consecutively. Parents had the most

difficulty with the monitoring, and preferred to monitor using a paper rather than an electronic record. Parents differed in how much time they spent on the website, with some parents logging on more frequently for shorter durations (10-15 minutes) and others reading the whole session in one sitting (30-60 minutes). All parents reported that their child's eating behaviors had improved since starting the program, but only 2 felt that their own eating habits had improved. In addition, participants described qualitative improvements such as "We are being more active," and "The program made us more aware of what and how much we were eating." Suggestions for improvement included ensuring that both parents were educated in how to use the program, and letting participants know that they could use the program retrospectively if a session was missed.

DISCUSSION

In the US, the prevalence of obesity in children and adolescents has tripled in the past 20 years. (28, 29) Childhood obesity confers a risk of adult obesity, and significant obesity-related medical and psychosocial problems. (4-14) The cause of this epidemic has been attributed to increases in unhealthy eating and sedentary behaviors. (4, 6-16) Treatment of childhood obesity is usually done by the child's primary care physician and is time-consuming, difficult, and frustrating. (30) Most primary care physicians lack competency in nutritional education and psychosocial behavioral modification, and management often includes general rather than specific advice (31). The lack of reimbursement for obesity treatment is another barrier to translating effective treatment approaches into clinical practice. (16) Although intense interventions involving behavioral counseling and nutritional education have been effective for older children and adolescents, (22, 23, 29), few studies have addressed the management of obesity in children 2 to 5 years old. (29). For young children, parents play a key role in establishing healthy eating and activity behaviors, and are an important role model for these behaviors (23, 32). However, data suggest that many parents and caregivers of young children do not practice healthy eating and activity behaviors themselves. (33, 34) Parent participation in programs utilizing behavior weight change strategies for treatment of overweight school-aged children has led to marked and sustained weight loss (22). However, such specialized, intensive treatment is expensive and is not widely available, and has not been used for very young children.

Food for Thought is a 16-week intervention that could be used to prevent or treat childhood obesity. This novel program targets parents as the agents of change for young children (3 to 6 years old) who are overweight or obese, and uses common sense advice aimed at improving the nutritional quality of the child's diet and reducing sedentary behaviors, particularly TV watching. Dietary advice is focused on decreasing portion size and increasing the child's fruit and vegetable intake to "5 servings-a-day," an easily remembered target that is in line with national recommendations. (35) Increasing the intake of healthy foods has been shown to result in a decreased intake of high-fat/high-sugar foods (36). Advice about healthy activity is focused on reducing sedentary behaviors to 1-2 hours per day, a target recommended by the American Academy of Pediatrics. (37) Targeting a reduction in sedentary behaviors, primarily TV watching, will increase physical activity, (38) and will also reduce the child's exposure to food and beverage advertising for calorie-dense low-nutrient foods (39)

Preliminary data suggest that the *Food for Thought* program can help parents change their young child's unhealthy eating behaviors and activities at a time when new healthier behaviors can become the norm for life. Although the small number of participants limited our

ability to demonstrate statistically significant changes, all targeted behaviors changed in the desired direction, and statistically significant improvements did occur in the child's intake of vegetable and soda, and in their week day TV watching. The program has the potential to benefit the parents and other family members, (22, 23) but we were unable to demonstrate significant benefits with this exploratory study. More intensive interventions that have targeted the parent as the only agent of change to treat childhood obesity have also failed to change the parent's weight status. (32)

The *Food for Thought* program is delivered over the Internet. This small pilot study has demonstrated the feasibility of delivering the *Food for Thought* program in this way in the community setting. Although not universal, access to the Internet is commonly available in the U.S., and the majority of homes with children have computers (70%) and Internet connections (62%)(40). Distribution of the treatment program through the Internet widens the net of potential users, and may increase compliance as these programs are accessible at all times and are not subject to common barriers to obesity treatment, such as cost and difficulties with scheduling or transportation (19). Participants in this pilot study found this method of program delivery to be convenient and easy to use.

Next Steps

We are encouraged by this preliminary evaluation of *Food for Thought*. We will modify the program to facilitate and extend program access, such as adding a brief video orientation section in lieu of the introductory office visit. In addition, we are interested to learn if encouraging patients to attend their pediatrician's office for monthly BMI measurements during *Food for Thought* would improve outcomes. We are planning future studies to develop these additions to the program and evaluate them in the community setting. We are applying for a Clinical Research Grant in Obesity from the NIH (R21, PA-06-256) to support this work.

Treatment of childhood obesity is difficult, and affordable, effective treatment programs are lacking. We believe that *Food for Thought* is an innovative program that has the potential to improve longevity and health by reducing morbidity and mortality associated with childhood and adult obesity, and that the program has broad applicability to a large population.

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Table 1
Characteristics of Study Population

Characteristic	N (%), Mean (sd) or median (range)
Child	
N	9
Age (years)	
Mean (sd)	5.52 (1.1)
Median (range)	5.83 (3.7 – 6.7)
Female gender	7 (78%)
Health insurance	
Self-pay	1 (11%)
Private insurance	6 (67%)
Medicaid	2 (22%)
Race	
White	7 (78%)
Black	1 (11%)
Other	1 (11%)
Hispanic/Latino	1 (11%)
Family	
Household type	
2-parent	8 (89%)
1-parent	1 (11%)
Family size	
1-child	4 (44%)
2-child	4 (44%)
3-child	1 (11%)
Mother's education	
College, no degree	2 (22%)
Certificate or Associates degree	3 (33%)
Bachelors degree	2 (22%)
Graduate or professional degree	2 (22%)

Table 2. Effect of Food for Thought on BMI, diet and exercise for children and parents

Variable	Child			Parent		
	Pre	Post	P-value*	Pre	Post	P-value*
BMI (Kg/m²)						
Mean (sd)	23.36 (2.7)	22.19 (2.4)	0.43 (t-test)	32.63 (8.0)	35.88 (9.9)	
Median (range)	23.24 (19.1 - 28.1)	23.57 (18.5 - 23.9)	0.5	28.36 (24.2 - 48)	39.13 (23.5 - 48.5)	0.69
Diet						
Daily servings of:						
Vegetables						
Mean (sd)	1.1 (0.6)	1.8 (0.8)		1.7 (0.7)	1.8 (0.8)	
Median (range)	1 (0 - 2)	2 (1 - 3)	0.0455	2 (1 - 3)	2 (1 - 3)	0.32
Fruit						
Mean (sd)	1.7 (1.0)	2.2 (0.8)		1.7 (0.7)	1.8 (0.8)	
Median (range)	2 (0 - 3)	2 (1 - 3)	0.157	2 (1 - 3)	2 (1 - 3)	0.56
Fruit and vegetables						
Mean (sd)	2.8 (1.4)	4 (1.0)		3.3 (1)	3.6 (1.1)	
Median (range)	3 (1 - 5)	4 (3 - 5)	0.0545	3 (2 - 5)	4 (2 - 5)	0.32
Soda						
Mean (sd)	3.1 (1.5)	0.6 (0.6)		1.9 (1.2)	0.6 (0.9)	
Median (range)	3 (1 - 6)	1 (0 - 1)	0.0394	1 (1 - 4)	0 (0 - 2)	0.0339
French fries/chips						
Mean (sd)	1.3 (0.9)	0.8 (0.5)		0.9 (0.6)	0.4 (0.5)	
Median (range)	1 (0 - 3)	1 (0 - 1)	0.32	1 (0 - 2)	0 (0 - 1)	0.16
Milk						
Mean (sd)	1.6 (1.1)	2.2 (1.1)		0.6 (0.9)	1.4 (0.9)	
Median (range)	2 (0 - 3)	2 (1 - 4)	0.56	0 (0 - 2)	2 (0 - 2)	0.16
Weekly fast food meals						
Mean (sd)	1.1 (1.0)	0.8 (0.8)				
Median (range)	1 (0 - 3)	1 (0 - 2)	0.48			

Variable	Child			Parent		
	Pre	Post	P-value*	Pre	Post	P-value*
Weekly red foods (PACE)†						
Mean (sd)	31.8 (12.4)	23.8 (3.9)		25.4 (15.9)	19 (2.6)	
Median (range)	27 (20 – 60)	22 (20 – 28)	0.58	21 (16 – 67)	20 (15 – 22)	0.35
Sedentary Behaviors						
Hours of TV on weekdays						
Mean (sd)	4.3 (2.2)	2 (0.7)		3 (1.9)	2.2 (1.3)	
Median (range)	4 (1 – 7)	2 (1 – 3)	0.0422	3 (1 – 7)	2 (1 – 4)	0.68
Hours of TV on weekends						
Mean (sd)	2.3 (0.9)	3.2 (1.3)		1.6 (0.9)	2 (1.4)	
Median (range)	2 (1 – 4)	3 (2 – 5)	0.08881	1 (1 – 3)	1 (1 – 4)	0.32
Total hours TV/week						
Mean (sd)	6.7 (2.5)	5.2 (1.9)		4.6 (2.1)	4.2 (2.7)	
Median (range)	6 (3 – 11)	5 (3 – 8)	0.0522	4 (2 – 9)	3 (2 – 8)	0.89
Exercise						
Days in last week when exercised for at least 20 minutes						
Mean (sd)	4.3 (2.2)	4.6 (2.3)		3.0 (1.9)	2.6 (1.1)	
Median (range)	4 (1 – 7)	4 (2 – 7)	0.78	3 (1 – 7)	3 (1 – 4)	1.0

*P-values calculated using sign rank test for paired nonparametric data

†Red foods were defined as those high in fat, calories, and/or sugar and low in nutrition.