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Brief Report: Examination of the Association Between Lifestyle Behavior Changes and Weight Outcomes in Preschoolers Receiving Treatment for Obesity

E.S Kuhl¹, L.M Clifford¹, N.F. Bandstra¹, S.S. Filigno¹, G. Yeomans-Maldonado¹, J.R. Rausch¹, and L.J. Stark¹

¹Division of Behavioral Medicine and Clinical Psychology, Cincinnati Children's Hospital Medical Center, Cincinnati, OH

Abstract

Objective: Preschoolers (ages 2–5) have been significantly underrepresented in the obesity treatment outcome literature despite estimates that 12.1% are already obese. As such, little is known regarding the most important intervention targets for weight management within this age-group. The aims of this study were to a) examine lifestyle behavior changes for 30 obese preschoolers participating in a weight control intervention and b) explore which lifestyle behavior changes predicted changes in BMI z-score.

Methods: Preschooler height, weight, diet (three 24-hour recalls), physical activity (accelerometry), and television use (parent-report) were measured at baseline and post-treatment (6 months). A linear regression was conducted to examine pre- to post-treatment changes in diet (intake of calories, sugar-sweetened beverages, fruits and vegetables, and sweet and salty snacks) and activity (moderate-vigorous activity and television use) behaviors on changes in BMI z score.

Results: Despite significant reductions in sugar-sweetened beverage intake and television use, and increases in fruit and vegetable intake, only reductions in absolute caloric intake significantly predicted reductions in BMI z score.

Conclusions: Our findings suggest attaining healthy caloric goals may be the most important component of weight control interventions for preschoolers. Future research using innovative methodologies, such as the Multiphase Optimization Strategy, may be helpful to prospectively identifying the lifestyle behavior changes that are most effective in helping families to achieve healthy weight outcomes for preschoolers and thereby improve intervention efficiency and decrease treatment burden for families.

Keywords

obesity; intervention; preschool; behavioral

Introduction

The preschool obesity treatment outcome literature remains in its infancy despite the prevalence of obesity exceeding 10% within this age-group for the last decade (Ogden, Carroll, Curtin, Lamb, & Flegal, 2010; Ogden, Carroll, Kit, & Flegal, 2012). Expert recommendations suggest the goals for obesity intervention in children ages 2–5 years-old are weight maintenance or weight loss at no more than 1 pound per month until preschoolers achieve a BMI 85th percentile (Barlow, 2007). Lifestyle behavioral interventions appear to be a promising approach to weight control for preschoolers (Boles, Scharf, & Stark, 2010; Epstein, Valoski, Koeske, & Wing, 1986; Stark et al., 2011). However, the specific diet and activity behaviors that are associated with preschool weight control are less clear (Kuhl, Clifford, & Stark, 2012). Refining interventions to include only those behavior changes that are most associated with positive weight outcomes is important to improving intervention effectiveness and decreasing treatment burden for families.

This secondary data analysis had two aims: a) to examine diet and activity changes for preschoolers participating in a weight control intervention, and b) to explore which lifestyle behavior changes were associated with changes in preschooler BMI *z* score (*z*-BMI). Data were collected within the context of a pilot study that focused on developing and testing the feasibility and initial efficacy of a family-based, behavioral program for weight management in preschoolers. As this study was an iterative process, some data from the earlier iterations (*n*=18) has already been published in a manuscript on comparative treatment effectiveness (Stark et al., 2011). Data for the 42 families participating in the later iterations has not been published. We include data for participants in the first iteration within the current study as the focus and scope of the current manuscript is concerned with behavior changes associated with weight outcomes and not treatment effects. Based upon the extant literature for behavioral correlates of obesity in preschoolers (Kuhl et al., 2012), we hypothesized that decreases in mean daily absolute caloric intake, consumption of sugar-sweetened beverages (SSB; fluid ounces), and television use (minutes) would be significant predictors of decreases in preschooler *z*-BMI.

Methods

Participants

Families were recruited from suburban Midwestern pediatric practices if they had a child ages 2–5 years old whose BMI 95th percentile but who was <100% over their ideal body weight. At least one of the preschooler's parents also had to be overweight (BMI 25). Exclusion criteria were non-English speaking, living >50 miles from the medical center, having a disability or illness that would interfere with moderate physical activity, taking medication or diagnosed with a condition associated with weight gain, or enrolled in another weight management program. Sixty families (26% of all who were reached by phone and solicited for participation) were randomized to one of three intervention groups: 1) a one-time pediatrician education visit (*n*=23), 2) 18-session behavior and nutrition education program that alternated between group sessions and individualized home visits (*n*=23), or 3) 10-session behavior and nutrition education program with group sessions only (*n*=14). Nine families withdrew after randomization and an additional six dropped out during treatment,

leaving data for 45 families potentially eligible for analysis. Families who dropped out did not differ significantly from families who completed treatment on any preschooler or caregiver demographic or anthropometric variables.

Because we were interested in examining the effect of individual treatment components on changes in *z*-BMI, treatment groups were collapsed for data analysis. Readers are referred to the original publication for a complete description of the recruitment procedures and the content and format for the pediatrician counseling and behavior and nutrition education treatment program (Stark et al., 2011). The institutional review committee approved the parent study and informed consent was obtained prior to data collection.

Treatment Components

Irrespective of treatment condition, all families received the following lifestyle behavioral recommendations (components) for their preschoolers (Barlow, 2007; Spear et al., 2007): 1) decrease or eliminate sugar sweetened beverages (SSBs), 2) increase fruit and vegetable (FV) intake, 3) increase moderate-vigorous activity (MVPA) to 60 minutes per day, and 4) decrease television use to 120 minutes per day.

Measures

All measures were completed at baseline and post-treatment (6 months) except demographic information [preschooler sex, parent and preschooler age and race/ethnicity, and family socioeconomic status; (Hollingshead, 1975)], which was only collected at baseline. Standard anthropometric procedures (Cameron, 1986) were used to collect preschoolers' height and weight measurements. Centers for Disease Control and Prevention growth curves were used to calculate child *z*-BMI (Kuczmarski et al., 2000). Three 24 hour dietary recalls (2 week days, 1 weekend day) were used to assess treatment components one (SSB intake) and two (FV intake). Trained dietitians used the multiple-pass methodology to obtain recalls of preschoolers' diets from their parents. This methodology has been validated against doubly labeled water and deemed accurate for estimates of energy intake at the group level for young children aged 3–7 years old (Johnson, Driscoll, & Goran, 1996; Reilly et al., 2005). Diet diary data were also used to examine changes in preschoolers' intake of sweet and salty snacks (SSS; e.g., chips, candy, desserts) and absolute caloric intake given mixed evidence regarding the specific dietary changes that are associated with pediatric weight control (Spear et al., 2007). Diet data was analyzed using the Minnesota Nutrient Data Systems Software (version 5.0; NDS, 2004). One participant was excluded due to incomplete dietary recall data. Component three (physical activity) was assessed using accelerometers (MTI model GT1M). Activity data was captured in 15-second epochs and categorized into light, moderate, and vigorous using cut-offs established for preschoolers (Pate, Almeida, McIver, Pfeiffer, & Dowda, 2006). Eight participants were excluded because they did not have the minimum of three valid days of accelerometer data at either baseline or post-treatment (a valid day was defined as wearing the accelerometer for 60% of the child's waking hours; Masse et al., 2005). Component four (minutes of television use) was assessed by parents completion of a daily activity diary.

Data Management and Analysis

Mean daily FV, SSB, SSS, and absolute caloric intake was tabulated by summing preschoolers' daily intake for each variable and dividing this total by three (number of diet diary days). Mean daily minutes of MVPA and television use was calculated by summing the total daily minutes recorded for each activity divided by the number of available days for accelerometer and daily activity data, respectively (ranged from three to seven days). Change in mean daily intake of FVs, SSB, SSS, and absolute calories and minutes spent engaging in MVPA and television use was calculated separately for each behavior by subtracting baseline mean values from post-treatment mean values.

Only participants with complete anthropometric, diet recall, and activity data were included for analysis ($n=36$). No significant between groups differences were found regarding lifestyle behaviors at baseline by preschooler sex or iteration of the trial in which they participated. Further, no associations were found between baseline levels of lifestyle behaviors and preschooler age or z -BMI. Thus, data for all preschoolers was analyzed as a whole. Paired sample t -tests were used to examine changes in all independent and dependent variables of interest from baseline to post-treatment. A single regression model was used to test our hypothesis regarding lifestyle behavior changes that would predict changes in z -BMI. Specifically, changes in FV, SSB, SSS, absolute caloric intake, MVPA, and television use from baseline to post-treatment were regressed onto changes in z -BMI. All analyses were performed using SAS version 9.2 (SAS, SAS Institute, Cary, North Carolina).

Results

The final sample included 36 preschoolers who were a mean age of 55.75 months ($SD=11.55$), 58% were girls, 86% were White, and 78% were from middle-to-upper class backgrounds (Hollingshead score >4.0). Preschoolers experienced a significant decrease in z -BMI (mean $=-0.21$, $SD=0.32$; $t_{35}=-3.93$, $p<0.001$) from baseline (mean $=2.34$, $SD=0.54$) to post-treatment (mean $=2.13$, $SD=0.57$). As is shown in Table 1, preschoolers significantly increased their FV intake and significantly decreased their intake of SSBs and television use from baseline to post-treatment. While preschoolers also increased their MVPA and decreased their absolute caloric and SSS intake, these changes were not statistically significant. Lifestyle behavior changes were not associated with preschooler age and did not differ significantly by preschooler sex. Results of our regression analysis revealed that only changes in absolute daily caloric intake ($\beta=0.52$, $p=0.01$) predicted decreases in z -BMI (see Table 2).

Discussion

Lifestyle behavioral interventions appear to be an efficacious approach to weight control for preschoolers (Epstein et al., 1986; Boles et al., 2011; Stark et al., 2011). Less is known about which diet and activity behaviors are most associated with positive weight outcomes for young children (Kuhl et al., 2012). Answering this question is important to refining interventions and decreasing treatment burden to preschoolers and their families. Findings from our study begin to address this gap. The modest diet and activity changes observed for preschoolers in our study support the literature suggesting that lifestyle behavior

modification in early childhood is particularly challenging (Kuhl et al., 2012). Ensuring preschoolers consume a healthy diet and are physically active is undoubtedly important to their overall growth and development. However, it may be that prescription of multiple behavioral changes concurrently is overwhelming for families and limits their success in achieving any one particular lifestyle change. Based upon our finding that only decreases in caloric intake were associated with preschooler weight outcomes, an alternative treatment approach may be to start by prescribing a single goal of decreasing preschoolers' caloric intake to age- and gender-based recommendations (Gidding et al., 2005). In conjunction with emphasizing healthy caloric intake, families could be provided with a variety of healthful strategies (e.g., portion-control or replacing high-calorie foods with fruits and vegetables) to assist in meeting this target. Once calorie targets are reached, efforts could then shift to helping families focus on specific food group changes to further improve the quality of preschoolers' diet (e.g., increasing fruit and vegetable intake if this was not a strategy used to achieve calorie decreases).

Findings of our study are preliminary and must be interpreted within the context of the study limitations. Our sample size was small, so replication within studies that are fully powered to detect significant effects is necessary before finite conclusions can be made regarding which lifestyle behavior changes are associated with preschool weight control. Parent report was used to measure changes in preschooler diet and television use and may be impacted by social desirability and recall bias. For example, future studies should consider using TV allowance units to objectively measure changes in preschoolers' television use. Recruitment of more socioeconomically diverse samples is also imperative as our sample was primarily Caucasian and from middle-to-upper class backgrounds. The number of behavioral changes we examined for their relation to preschooler weight outcomes was not comprehensive. Future studies should examine additional components that might influence preschooler weight outcomes such as parent lifestyle behavior change (Epstein, 1993; Wrotniak, Epstein, Paluch, & Roemmich, 2005).

Finally, while our study provides preliminary evidence of lifestyle behavior changes associated with weight outcomes for preschoolers, the differential effectiveness of each component could not be examined as diet and activity changes recommendations were provided within the context of a multi-component intervention. Future research should focus on a prospective evaluation of the impact of each lifestyle component in order to develop interventions composed only those components identified as effective. The Multiphase Optimization Strategy (MOST; Collins et al., 2011) is an innovative strategy to treatment development that is particularly well suited for this research direction. Instead of conducting dismantling studies after a multi-component intervention has been deemed efficacious in a large-scale randomized controlled trial, MOST proposes using a fractional factorial experimental design to determine the effectiveness of individual components and selected combinations of components first. Components tested are those that appear promising in achieving the desired treatment outcome. Once effective components are identified, then an optimized intervention comprised of these components is tested in a comparative effectiveness trial. MOST could thus be used to explore the questions raised based upon the outcomes of the current study regarding the differential effectiveness of decreasing caloric intake through setting caloric goal compared to making specific dietary changes such as

increases in fruit and vegetable intake, decreasing SSB intake, and decreasing television use on preschool weight control.

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Table 1

Means (Standard Deviations) for diet and activity behaviors

	Baseline	Post-treatment	Change
FVs (servings) ^a	3.26 (2.04)	4.42 (3.10)	1.16 (3.03) [*]
SSB (fluid ounces)	5.08 (4.51)	3.27 (4.43)	-1.82 (4.22) [*]
Sweet/Salty snacks (servings)	3.85 (2.03)	3.63 (2.33)	-0.22 (2.04)
Calories	1436.86 (289.92)	1364.38 (316.49)	-72.48 (351.93)
MVPA (minutes)	81.63 (31.54)	86.01 (29.18)	4.37 (18.13)
Television (minutes)	155.41 (84.67)	128.45 (64.63)	-26.96 (69.34) [*]

^{*}
 $p < 0.05$

^a One serving= ¼ cup sliced fruit or cooked vegetables, ½ piece of whole fruit, or ½ cup of leafy green vegetables

FV=fruits and vegetables; SSB=sugar-sweetened beverages; MVPA=moderate and vigorous physical activity

Table 2Regression Analysis Summary of Lifestyle Behavior Change Predictors of Changes in *z*-BMI

	<i>B</i>	<i>SE B</i>	β	95% Confidence Interval
FV (servings)	−0.014	0.019	−0.129	−0.053, 0.026
SSB (fluid ounces)	0.014	0.013	0.191	−0.011, 0.040
Sweet/Salty snacks (servings)	−0.025	0.033	−0.159	−0.093, 0.043
Caloric intake	0.00	0.00	0.523 **	0.000, 0.001
MVPA (minutes)	−0.004	0.003	−0.20	−0.009, 0.002
Television use (minutes)	0.000	0.00	0.05	−0.001, 0.002

 $R^2=0.35$; $F_{6, 35}=2.61$, $p<0.05$ **
 $p=0.01$