Changes in Parent Motivation Predicts Changes in Body Mass Index z-Score (zBMI) and Dietary Intake Among Preschoolers Enrolled in a Family-Based Obesity Intervention

Jason Van Allen, PhD, Elizabeth S. Kuhl, PhD, Stephanie S. Filigno, PhD, Lisa M. Clifford, PhD, Jared M. Connor, BA, and Lori J. Stark, PhD

Division of Behavioral Medicine and Clinical Psychology, Cincinnati Children’s Hospital and Medical Center, Cincinnati, OH, USA

All correspondence concerning this article should be addressed to Jason Van Allen, PhD, Department of Psychology, Texas Tech University, Mailstop 42051, Lubbock, TX 79409, USA.
E-mail: jason.vanallen@ttu.edu

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Objectives To examine whether changes in parent motivation over the course of a pediatric obesity intervention are significantly associated with long-term changes in treatment outcomes. Methods Study hypotheses were tested with a secondary data analysis of a randomized controlled trial (N = 42). Study analyses tested whether baseline to posttreatment change in total score for a self-report parent motivation measure (Parent Motivation Inventory [PMI]) was significantly associated with baseline to 6-month follow-up changes in body mass index z-score (zBMI), dietary variables, and physical activity. Results Increases in PMI were significantly associated with decreased zBMI, decreased consumption of sugar-sweetened beverages and sweets, and increased consumption of artificially sweetened beverages. Conclusions Given that increases in parent motivation were associated with some treatment benefits, future research should evaluate the impact of directly assessing and targeting parent motivation on weight outcomes for preschoolers participating in a weight management program.

Key words diet; parent motivation; pediatric obesity; preschool obesity.
Gortmaker, 2006). Thus, to enhance treatment efficacy, it is crucial to identify modifiable parent characteristics that could be targeted within the context of preschool obesity interventions to enhance treatment outcomes.

Consistent with conceptual models of health behavior change, such as the Health Action Process Approach (Schwarzer, Lippke, & Luszczynska, 2011) that theorizes motivation is integral in the development of behavior change intentions, a small number of studies have investigated the role of parent motivation in pediatric weight management. For example, studies have found that parent motivation is significantly associated with obesity treatment initiation for adolescents (Dhingra, Brennan, & Walkley, 2011), consumption of sugar-sweetened beverages (SSBs) among preschool children (Goodell, Pierce, Amico, & Ferris, 2012), and weight loss for school-aged children participating in an obesity intervention (O’Neil et al., 2010). Gunnarsdottir, Njardvik, Olafsdottir, Craighead, & Bjarnason (2011) found that one (parental confidence) of the three parent motivation subdomains assessed (importance, readiness, and parental confidence) in their study was associated with changes in child BMI for school-aged children participating in a weight control intervention.

Despite these promising findings, limitations in this small literature base challenge our understanding of the contribution of parent motivation to the process of pediatric weight management. First, the two studies to examine parent motivation within the context of a pediatric obesity intervention focused exclusively on weight outcomes (BMI) and not how parent motivation impacted the lifestyle behavior changes likely associated with weight outcomes (Dhingra et al., 2011; O’Neil et al., 2010). Second, only one study has focused on parent motivation and weight outcomes for preschoolers (Goodell et al., 2012). Finally, all of the aforementioned studies used baseline motivation as a predictor of outcomes, and none have examined changes in motivation across treatment. Research suggests that motivation may fluctuate over time and that this change may be a stronger predictor of treatment outcomes compared with baseline measures of motivation (Nock & Kazdin, 2003). It may be that as parents go through treatment and build up the skills to change lifestyle behaviors related to obesity for themselves and their children, their motivation for weight loss improves. Therefore, testing associations of change provides support for potential causal mechanisms that could be experimentally manipulated in future research (Hertzog & Nesselroade, 1987), and may be clinically meaningful when clinical variables are included. For example, if research indicates that changes in motivation are associated with changes in clinical outcomes, then an experimental confirmation of this finding via direct manipulation would provide evidence that parent motivation is an important target within the context of preschool weight control interventions.

The present study was designed to inform and extend the literature by examining the role of parent motivation in predicting a comprehensive set of child outcomes following participation in an obesity intervention for preschoolers. Collecting a comprehensive set of outcomes is potentially beneficial because it allows for the testing of proximal measures of health behavior (e.g., fruit and vegetable [FV] consumption, SSB consumption, physical activity) that are amenable to more immediate changes, in addition to (rather than exclusively) testing measures of body composition that are slower to change (e.g., BMI percentile). Additionally, the current study builds on previous cross-sectional research by examining how change in parental motivation is associated with prospective change in child’s weight-related outcomes. Finally, this study extends current research in this area to early childhood by examining associations between parent motivation and health behavior and weight outcomes within a preschool-age sample. It was hypothesized that increases in parent motivation pre- to posttreatment would be significantly associated with decreases in prescooler BMI z-score (zBMI) and increases in moderate and vigorous physical activity (MVPA) between pretreatment and 6-month follow-up. With regard to dietary variables, it was hypothesized that increases in parent motivation would be associated with increased consumption of FVs and whole grains, and decreased consumption of sweets, SSBs, artificially sweetened beverages, and salty snacks.

**Methods**

Data were collected as part of a randomized controlled trial to develop and pilot a family-based preschool weight control intervention (Learning about Activity and Understand Nutrition for Child Health [LAUNCH]) compared with an enhanced standard of care (ESC) pediatrician visit (Stark et al., 2011). LAUNCH is a 6-month clinic and home-based family behavioral intervention designed to help parents and preschoolers increase healthy eating and activity levels (see Stark et al., 2011 for a detailed overview). LAUNCH treatment outcomes were assessed at baseline, posttreatment (6 months postbaseline), and 6-month follow-up (6 months posttreatment). Because the objective of the present study was to examine the association between change in parental motivation and changes in child lifestyle behaviors, rather than the examination of
treatment effects or comparisons of results across groups, LAUNCH and ESC groups were collapsed for all analyses to preserve statistical power. In addition to zBMI, physical activity and dietary variables were included as study outcomes because they were primary targets of intervention content in both treatment groups.

**Participants**

Families were recruited from Midwestern pediatric practices. Inclusion criteria were (a) preschooler BMI ≥95th percentile for sex-and-age and <100% over mean BMI; (b) preschooler aged 2 to 5 years; (c) at least one parent with a BMI ≥ 25; and (d) medical clearance for participation. Families were excluded if (a) preschoolers had a disability or illness that contraindicated moderate physical activity, a medical condition or medication contributing to weight gain, or active participation in another weight management program; (b) they were not English speaking; or (c) they lived >50 miles from the medical center. Recruitment and retention are detailed in Figure 1. Table I provides demographic characteristics, including age, gender, and ethnicity, of the final sample of 42 families included in analyses. The Hollingshead Index (Hollingshead, Unpublished manuscript), a measure of socioeconomic status based on caregivers’ marital status, education, and employment/occupation, was calculated for each participant and is also included in Table I. Scores on this index range from 8 to 66, with higher scores indicative of higher socioeconomic status. Parental consent was obtained for all participants. All study procedures were approved by the institutional review board of the pediatric medical center.

**Measures**

**Parent Motivation Inventory**

The Parent Motivation Inventory (PMI) is a 25-item self-report measure of parent motivation to participate in treatment and change parent and/or child behavior. Parents rate each item using a 5-point Likert scale ranging from “strongly disagree” to “strongly agree” (Nock & Photos, 2006). The PMI was adapted for use in the current study. Ten of the original 25 PMI items were retained. Fifteen items were adapted, with 10 items worded to reflect motivation for changes in diet only, and 5 items worded to reflect motivation for changes in diet and activity. Examples of items from the PMI include “My child’s diet and physical activity have to improve soon” and “I believe that I am capable of learning the skills needed to change my child’s diet.” Internal consistency of the adapted PMI was strong (pretreatment: 0.97; posttreatment: 0.94) and similar to the original PMI (0.96; Nock & Photos, 2006).

**Anthropometric Data**

Preschoolers’ heights and weights were measured using standard anthropometric procedures (Cameron, 1986). Specifically, children were weighed on a Scaletronix digital scale and measured on a Holtain stadiometer in underwear and a paper gown without shoes by a trained staff member. Weights and heights were measured in triplicate, and the average was used to calculate zBMI using a SAS program available through the Centers for Disease Control and Prevention (2005).

**Physical Activity Data**

Preschoolers’ physical activity data were measured using an Actigraph GT1M accelerometer (Actigraph LLC, Pensacola, FL). Participants were asked to wear the accelerometer for 7 days (5 weekdays and 2 weekend days) during all waking hours. Similar to previous studies using accelerometers with preschool children, at least 5 hr of data were necessary for a single day’s data to be considered valid (Byun, Dowda, & Pate, 2011; Dowda et al., 2001; Pfeiffer, Dowda, McIver, & Pate, 2009; Williams et al., 2007). Children in the current sample had a mean wear time of 11.43 hr. Further, a minimum of three valid days was required for participant data to be included in study analyses. The Actigraph GT1M provides data in 15-s epochs, which are categorized as light, moderate, or vigorous based on established cutoffs (Pate, Almeida, McIver, Pfeiffer, & Dowda, 2006). Mean daily MVPA for each preschooler was tabulated by summing minutes of moderate and vigorous activity for each valid day, and dividing by the total number of valid days at each time point.

**Dietary Methods**

**24-Hr Dietary Recalls**

Three random 24-hr dietary recall interviews (two weekdays, 1 weekend day) were conducted with caregivers to assess preschoolers’ diets at each time point using the multi-pass methodology (Guenther, DeMaio, Ingwersen, & Berlin, 1995). This methodology has been validated and deemed accurate for estimates of energy intake at the group level for children aged 3–7 years (Johnson, Driscoll, & Goran, 1996) and has been used to assess food types in the National Health and Nutrition Examination Survey of children aged 2–19 years (Keast, Fulgoni, Nicklas, & O’Neil, 2013). Recalls were collected in person (first recall) and by telephone by a trained dietitian from the General Clinical Research Center. The interviewer began the recall with the first meal of the previous day and asked additional probes to parents about condiments, beverages, and cooking method that might accompany each meal or snack if the parent did not spontaneously report
these details. In addition, before the recalls, parents were trained using a two-dimensional food portion size guide (adapted from Van Horn et al., 1993), as estimations of portion sizes for foods consumed are significantly enhanced by training on food models of different volumes and dimensions (Weber et al., 1999; Yuhas, Bolland, & Bolland, 1989).

Data Entry and Analysis
Twenty-four-hour diet recall data were analyzed using the Minnesota Nutrition Data System for Research (NDSR) software, version 5.0. Food group variables generated by the NDSR software were collapsed to create the following food categories: FVs (servings of FVs, excluding 100% fruit juice, avocados, potatoes, legumes, and fried vegetables), whole grains (e.g., breads, pasta, cereal), sweets (chocolate candy, nonchocolate candy, and desserts), and artificially sweetened beverages (artificially sweetened soft drinks, fruit drinks, tea, coffee and coffee substitutes, and waters). Artificially sweetened beverages were not a primary target of the intervention; however, they were included in study analyses as a separate variable. Despite some evidence indicating that artificially sweetened beverages may not promote child weight loss and may have a
countercintuitive weight gain effect (Brown, de Banate, & Rother, 2010; Rodearmel et al., 2007), parents may substitute artificially sweetened beverages for SSBs because they are consistent with treatment principles as lower-calorie lower-fat beverage options. A variable for SSBs was created using the definition provided by Wang, Bleich, and Gortmaker (2008), which included regular soda, fruit drinks, and sweetened teas and waters. Finally, a variable for salty snacks was generated based upon Bachman, Reedy, Subar, and Krebs-Smith (2008), which included chips, popcorn, crackers, nuts and seeds, but modified to exclude candy to ensure separate categories for sweet and salty snacks. Preschoolers’ mean daily intake for each food (servings size for preschool child) and beverage (fluid ounces) variable was calculated as the daily intake summed across three days and divided by three (number of 24-hr dietary recalls).

**Statistical Analyses**

All analyses were conducted using SPSS statistical software, version 20. Multiple analyses of variance were conducted to evaluate whether any significant differences were present among demographic variables with respect to change in total PMI, zBMI, dietary variables, or physical activity. Next, hierarchical multiple regressions were conducted to test whether baseline to posttreatment change in total PMI would be significantly associated with baseline to 6-month follow-up change in zBMI, dietary variables, and average daily MVPA. The baseline to 6-month follow-up period was selected to examine associations with outcomes that include both the active intervention phase (i.e., baseline to posttreatment) and the 6-month period that followed treatment. An analysis across these two separate periods provides the opportunity to model prospective data rather than examine cross-sectional associations alone. Using such a time frame is also beneficial given that healthy weight change is often a slow process.

For each regression used to test residual change in study outcomes (zBMI, dietary variables, and MVPA), baseline values for each outcome were entered into Step 1, with study outcome values at the 6-month follow-up set as the dependent variable. Next, standardized residuals for baseline to posttreatment change in PMI scores were entered into Step 2. Standardized residuals were calculated by regressing and saving posttreatment PMI scores onto baseline PMI scores. Thus, change in PMI and study outcomes should be interpreted as residualized change scores. This method of change analysis adjusts for baseline differences in study variables and is more flexible for use in small samples than latent change analyses (MacKinnon, 2008).

**Results**

Descriptive information for all independent and dependent variables of interest is presented in Table II. Residual change in PMI, zBMI, MVPA, and dietary variables did not differ significantly based upon preschooler age, ethnicity, sex, or family Hollingshead score.

Primary study analyses indicated that residual change in PMI was significantly associated with residual change in zBMI, such that increases in PMI over the course of the intervention predicted decreases in zBMI at 6-month follow-up ($R^2 = .091, F [2, 40] = 15.202, p < .001$). Further, increases in PMI scores were significantly associated with decreases in SSBs ($R^2 = .380, F [2, 40] = 3.580, p < .05$) and sweets ($R^2 = .110, F [2, 40] = 7.732, p < .05$) and increases in artificially sweetened beverages ($R^2 = .132, F [2, 40] = 13.135, p < .001$). Residual change in PMI was not associated with residual change in any other dietary variables or in MVPA. Hierarchical regression results are presented in more detail in Tables III and IV.

Post hoc analyses tested whether change in PMI was associated with change in zBMI from baseline to posttreatment and from posttreatment to 6-month follow-up. These analyses were conducted to determine whether change in zBMI from baseline to posttreatment was the driving factor for the overall effect described above, or whether change in PMI during the active treatment phase had a lasting effect (per the regression model) on change in zBMI from posttreatment to 6-month follow-up. Results indicated that change in PMI from baseline to posttreatment were not significantly associated with change in zBMI during the same
(but approached statistical significance; $R^2/C_1 = .019$, $F[2,40] = 70.176$, $p = .071$). Alternatively, change in PMI from baseline to posttreatment was significantly associated with change in zBMI from posttreatment to 6-month follow-up ($R^2/C_1 = .019$, $F[2,40] = 39.690$, $p < .05$).

### Discussion

Despite the important role of parents in promoting diet and activity changes during the preschool years, our study is only the second to explore the role of parent motivation in preschool weight control efforts and is the first to examine parent motivation dynamically across an intervention and its relation to long-term preschool obesity intervention outcomes 6 months after the end of treatment. Our inclusion of dietary and activity outcomes also begins to provide a more comprehensive understanding of the role of parent motivation in the process of weight change in early childhood. Among parents in our sample, increases in motivation that occurred during their intervention period (but approached statistical significance; $R^2/C_1 = .019$, $F[2,40] = 70.176$, $p = .071$). Alternatively, change in PMI from baseline to posttreatment was significantly associated with change in zBMI from posttreatment to 6-month follow-up ($R^2/C_1 = .019$, $F[2,40] = 39.690$, $p < .05$).
participation predicted reductions in preschooler zBMI, SSB intake, and consumption of sweets, and increases in artificially sweetened beverage intake 6 months posttreatment. Although we were not powered to test mediators of the association between PMI and study outcomes, it may be that as parents become more motivated to improve their child’s health, they are more likely to change their behavior and environment in ways that promote a healthier lifestyle.

Consistent with previous findings (Kuhl et al., 2014), it appears that changes in diet may have had the greatest impact on residual change in zBMI, given that residual change in parent motivation was associated with some dietary variables but not MVPA. However, it is important to note that mean daily preschooler MVPA in our sample was already in excess of intervention recommendations at baseline (60 min; Barlow, 2007), which may have limited parent motivation to further increase preschooler activity and subsequently the variability in this outcome over time. Further, it is notable that changes in parent motivation were not related to change in FV consumption at a statistically significant level, but demonstrated a trend consistent with study hypotheses that approached statistical significance ($p = .07$). Another interesting finding related to dietary changes is that parents reported increases in artificially sweetened beverages in combination with decreases in SSBs, and these changes were associated with residual change in parent motivation. Interventionists recommended that parents offer water and skim milk as beverage choices, but parents may have viewed artificially sweetened beverages as a compromise between preschooler preference (e.g., sweet-tasting beverage) and intervention goals (e.g., reduction in calories). Though inconclusive at this time, some research suggests a link between artificially sweetened beverages and obesity in children (Brown, de Banate, & Rother, 2010; Rodearmel et al., 2007). Moreover, exposure to artificial sweeteners in early childhood can increase a child’s preference for sugary foods overall (Liem, Mars, & De Graaf, 2004). Thus, healthy alternatives may have the added benefit of positively shaping preschoolers’ beverage preferences in the long term when parents generally have less control over their child’s beverage choices.

Though preliminary, our findings support the potential value in more directly assessing and targeting parent motivation within preschool weight management interventions. Further, although study findings are likely unsurprising to a pediatric psychologist, this study contributes uniquely to the empirical literature by examining associations between parent motivation and a comprehensive set of outcomes, as well as by testing long-term associations postintervention. Results suggest that assessments of change in parent motivation throughout treatment could help clinicians identify families who may be experiencing barriers to making lifestyle changes, and allow clinicians to prioritize efforts to increase parent motivation for change as needed. Generally, providing healthy lifestyle recommendations is likely insufficient for all families to be successful in improving weight outcomes for children. Results of this study suggest that incorporating strategies to enhance motivation (e.g., promoting readiness and confidence to make changes) could be used to enhance session content. Health providers may benefit from targeting various aspects of parent motivation assessed by the PMI (e.g., concern for child’s health, willingness to actively participate in change, confidence in making change) by providing additional psychoeducation, implementing motivational interviewing strategies, or encouraging active parent participation. Further, parent responses to individual items on the PMI could help clinical researchers identify themes (e.g., unwillingness to make personal change) that are more prominent for some caregivers than others, and intervention studies could be individualized (and bolstered) toward such themes to promote efficiency in care.

<table>
<thead>
<tr>
<th>Dependent variable and block</th>
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<th>SE B</th>
<th>β</th>
<th>ΔR²</th>
<th>ΔF</th>
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<tbody>
<tr>
<td><strong>zBMI at 6-month follow-up</strong></td>
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<tr>
<td>Step 1 (zBMI at baseline)</td>
<td>.611</td>
<td>.133</td>
<td>.584</td>
<td>.341</td>
<td>21.21**</td>
</tr>
<tr>
<td>Step 2 (residual change in PMI)</td>
<td>− 196</td>
<td>.078</td>
<td>− 302</td>
<td>.091</td>
<td>6.402*</td>
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<tr>
<td><strong>Moderate and vigorous physical activity (MVPA) at 6-month follow-up</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Step 1 (MVPA at baseline)</td>
<td>.560</td>
<td>.124</td>
<td>.600</td>
<td>.360</td>
<td>20.266**</td>
</tr>
<tr>
<td>Step 2 (residual change in PMI)</td>
<td>−2.648</td>
<td>3.611</td>
<td>− 100</td>
<td>.010</td>
<td>.538</td>
</tr>
</tbody>
</table>

*Note.* Change in study variables represents residual change associated with regression analyses.

*p ≤ .05; **p ≤ .01.
Study findings should be considered within the context of methodological and statistical limitations. As is typical of regression-based analyses, shared error variance may contribute to the degree of association between study variables. Future studies should examine these associations using advanced statistical analyses (e.g., structural equation modeling) that more effectively control for error variance among study measures. The small sample size and statistical power of this study prevented the use of such analyses, and subsequent investigations would benefit from testing these associations in a larger sample. In addition, participant attrition contributed to the small sample size available for study analyses and may have been the result of low baseline parent motivation. Thus, study results may only generalize to parents with higher initial motivation to change their preschooler’s weight. The vast majority of participants in this study were Caucasian—testing study analyses among more sociodemographically and racially diverse samples would improve the generalizability of findings. Further, this study was not designed to test an experimental manipulation of parent motivation, so it is unclear whether increases in parent motivation due to treatment content would result in subsequent improvements to study outcomes. Moreover, this study did not collect PMI data at 6-month follow-up, which prevented an examination of bidirectional associations between PMI and study outcomes. Thus, the sequence of these relationships may be an important topic for future investigations. Also, analyses included only participants who provided complete study data (i.e., study completers), which introduces potential biases in the observed effect estimates. Finally, this study was not designed to examine the role of parents’ motivation to initiate treatment. Different processes may be involved in parents’ motivation to initiate a treatment program versus parents’ motivation to continue participating and to adhere to treatment recommendations. Future studies are needed to better understand factors associated with parent motivation at various stages of treatment.

In conclusion, this study was among the first to assess change in parent motivation in overweight preschool-aged children as a predictor of multiple diet and health-related outcomes. Our findings suggest that increases in parent motivation were a significant predictor of reduced consumption of sweets and SSBs, increased consumption of artificially sweetened beverages, and a reduction in zBMI. Future research should evaluate the differential impact of interventions that directly target parent motivation compared with those that do not, and examine which specific motivation-based intervention components have the largest impact on outcomes.

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