The Impact of Environmental, Parental and Child Factors on Health-Related Behaviors among Low-Income Children

Salma M.A. Musaad¹, Katherine E. Speirs², Jenna T. Hayes³, Amy R. Mobley⁴, Nurgul Fitzgerald⁵, Blake L. Jones⁶, Angela VanBrackle⁷ and Madeleine Sigman-Grant^{7*}

*Author to whom correspondence should be addressed

1 Family Resiliency Center
Department of Human and Community Development
University of Illinois at Urbana-Champaign
2031 Doris Kelley Christopher Hall
904 W. Nevada
Urbana, IL 61801
Email: Salma M.A. Musaad: smusaad@illinois.edu

2 Department of Family Studies and Human Development
Norton School of Family and Consumer Sciences
University of Arizona
650 N Park Ave
315-L McClelland Park
Tucson, Arizona 85721-0078
Email: kspeirs@email.arizona.edu

3 University of Nevada, Reno
Human Development and Family Studies
1664 N. Virginia St./Mail Stop 0140
Reno, NV 89557
Email: jennah@unr.edu

4 Department of Nutritional Sciences
University of Connecticut
3624 Horsebarn Road Extension Unit 4017
Storrs, CT 06269-4017
Email: amy.mobley@uconn.edu

5 Department of Nutritional Sciences
Rutgers, The State University of New Jersey
26 Nichol Avenue
Room 229A
New Brunswick, NJ 08901
Email: nurgul.fitzgerald@Rutgers.edu

6 Department of Human Development and Family Studies
Purdue University
1202 W. State St.
West Lafayette, IN 47907-2055

47 Email: blakejones@purdue.edu

48

49 7 At the time of this study: University of Nevada, Reno Cooperative Extension

50 8050 Paradise Rd., Suite 100

51 Las Vegas, NV 89123

52 E-mail: angela.vanbrackle@nmss.org; sigman-grantm@unce.unr.edu

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Abstract

Multi-level factors act in concert to influence child weight-related behaviors. This study examined the simultaneous impact of variables obtained at the level of the home environment (e.g., mealtime ritualization), parent (e.g., modeling,) and child (e.g., satiety responsiveness) with the outcomes of practicing healthy and limiting unhealthy child behaviors (PHCB and LUCB, respectively) in a low-income U.S. sample. This was a cross sectional study of caregivers of preschool children ($n = 432$). Caregivers were interviewed using validated scales. Structural equation modeling was used to examine associations with the outcomes. Adjusting for study region, demographics and caregiver's body mass index, we found significant associations between PHCB and higher mealtime ritualizations (β : 0.21, 95% confidence interval [CI]: 0.11; 0.32, more parental modeling (β : 0.39, 95% CI: 0.27; 0.49) and less parental restrictive behavior (β : -0.19, 95% CI: -0.29; -0.10). More parental covert control (β : 0.44, 95% CI: 0.35; 0.54), more parental overt control (β : 0.14, 95% CI: 0.03; 0.25) and less parental permissive behavior (β : -0.25, 95% CI: -0.34; -0.09) were significantly associated with LUCB. Findings suggest the synergistic effects of mealtime ritualizations and covert control at the environmental-level and parental modeling, overt control, restrictive and permissive behavior at the parent-level on the outcomes. Most factors are modifiable and support multidisciplinary interventions that promote healthy child weight-related behaviors.

Keywords

Child weight-related behaviors; home environment; Structural Equation Modeling; parent feeding behavior; parenting behavior.

Introduction

The prevalence of overweight or obesity (body mass index [BMI] $\geq 85^{\text{th}}$ or $\geq 95^{\text{th}}$ percentile for age and gender) among U.S. preschool children (2-5 years) decreased from 26.7% in 2009-2010 (Ogden, Carroll, Kit, & Flegal, 2012) to 22.8% in 2011-2012 (Ogden, Carroll, Kit, & Flegal, 2014). However, low-income and minority preschoolers are disproportionately obese (CDC, 2011; Ogden et al., 2014). For example, by 6 months of age the proportions of infants receiving human milk and juice among Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) participants (22% and 8%, respectively) (Deming et al., 2014) and low-income African Americans (15% and 62%, respectively) (Thompson & Bentley, 2013) is the opposite of that among infants from predominantly Non-Hispanic White and higher educated families (69% and 4%, respectively) (Deming et al., 2014). Moreover, compared to high income White mothers, low-income Hispanic mothers exhibit more controlling feeding styles and are less likely to exclusively breastfeed (Gross et al., 2014). This disparity is partially driven by early determinants including parental feeding practices and behaviors (Cartagena et al., 2014; Dixon, Peña, & Taveras, 2012) that lead to persistent weight gain (Gross et al., 2014).

The period from birth till five years is critical for establishing healthy weight-related behaviors among children (e.g., eating fruits and vegetables (Grimm, Kim, Yaroch, & Scanlon, 2014; Valmórbida & Vitolo, 2014), and being physically active (Telama et al., 2014) as well as routines that limit unhealthy behaviors (e.g., consumption of fatty/sugary foods and sugar-sweetened beverages (Bjelland et al., 2013; Park, Pan, Sherry, & Li, 2014), television viewing (Pagani, Fitzpatrick, & Barnett, 2013), which affect child weight (Huang, Lanza, & Anglin, 2014; Pan et al., 2014) and may be more prevalent among low-income children (Cantoral et al., 2016; Perrin et al., 2014). Additional factors include parental weight (Fuemmeler, Lovelady, Zucker, & Østbye, 2013), parental eating behaviors (Mitchell, Farrow, Haycraft, & Meyer,

2013), parental feeding practices and styles (Morrison, Power, Nicklas, & Hughes, 2013; Shim et al., 2016), food availability in the home (Trofholz, Tate, Draxten, Neumark-Sztainer, & Berge, 2016) and resiliency (Sigman-Grant, Hayes, VanBrackle, & Fiese, 2015; Veitch, Arundell, Hume, & Ball, 2013). These factors act at multiple levels including the home environment, the parent and the child (Dixon et al., 2012). However, few studies have the breadth to examine how these factors are related to early weight-related behaviors. Moreover, there is limited evidence on which factors to focus on, in order to develop effective and sustainable obesity-prevention interventions (Stea et al., 2016), particularly among low-income families (Anderson, Newby, Kehm, Barland, & Hearst, 2015; Hillier-Brown et al., 2014). Considering that most of these factors are modifiable and likely act simultaneously, it is critical to explore them using a systems-based approach (Sigman-Grant et al., 2015) to provide evidence for developing family-centered interventions (Dev, McBride, Fiese, Jones, & Cho, 2013; Kellou, Sandalinas, Copin, & Simon, 2014).

The objective of this study was to determine the simultaneous association of environment-, parent- and child-level factors with two outcomes of child behaviors (practicing healthy and limiting unhealthy child behavior [PHCB and LUCB, respectively]) using a structural equation model (SEM) after controlling for study region, demographic variables and caregiver's BMI. The central hypothesis is that at least one variable at each level (environment-, parent- and child) would be associated with each outcome (PHCB and LUCB) after adjusting for demographic and parental characteristics. Study results can inform decisions for designing effective health promoting strategies among low-income families with preschool-aged children.

Methods

The study design has been previously reported (Hayes, VanBrackle, & Sigman-Grant, 2015; Speirs, Hayes, Musaad, VanBrackle, & Sigman-Grant, 2016). A summary of the study design and participants are given below.

Participants and study design

Primary caregivers ($n = 432$) who had at least one child aged three to five years were recruited. Caregivers had to be non-pregnant, able to speak and understand English and meet at least one criterion for determining low-income status: receipt of federal food assistance, medical assistance, and/or enrollment in Head Start (HS) or Early HS.

Caregivers were recruited from HS and Early HS programs, preschool and WIC programs in six study regions: Southern Nevada, Northern Nevada, Connecticut, Oklahoma, New Jersey and California. Caregivers, considering their youngest three to five year old child, participated at recruitment locations. Following verbal consent, trained investigators read 196 questions (of which 21 collected demographic information) and recorded participants' answers. The process averaged 45 minutes. Caregivers received small gifts (e.g., jump rope, children's book) to compensate for their time. The appropriate Institutional Review Board in each state approved this study, with comprehensive approval by the lead institution (blinded for review).

Dependent variables

Composite scores for PHCB and LUCB were used as outcomes (Table 1). Scores were calculated by summing across the five PHCB items and the four LUCB items. The PHCB and LUCB items were selected following exploratory and confirmatory factor analyses (Speirs, Hayes, Musaad, VanBrackle, & Sigman-Grant, 2016) of a 16-item behavioral checklist (Dickin,

Lent, Lu, Sequeira, & Dollahite, 2012). Higher values indicate more frequent use of healthy child behaviors and less frequent use of unhealthy child behaviors, respectively.

Cronbach's alpha (α) was 0.64 (raw and standardized) for the PHCB composite score and 0.49 (raw) and 0.53 (standardized) for the LUCB composite score. The Cronbach alpha values are reasonable given the small number of items in each score. This is expected given the relative heterogeneity of the items in terms of the concepts being assessed and the observed variability of the responses (Cortina, 1993; Streiner, 2003).

Independent variables

We examined 21 potentially modifiable independent variables at three levels: environment, parent, and child. The parent-level independent variables were further divided into four thematic groups (see below). Unless otherwise stated, original items were used as per author guidelines. All subscales were examined (e.g., factor analysis) in order to confirm structure and reliability in this sample.

Environment-level

The Family Ritual Questionnaire (Fiese & Kline, 1993) was used to calculate three subscales describing family routines (mealtime ritualization, commitment to cultural events and traditions and commitment to yearly celebrations). Mealtime ritualization scores were calculated using the mealtime routines dimension after removing three items (final number of items = 5, α = 0.67). Commitment to cultural events and traditions and commitment to yearly celebrations (8 items, α = 0.82 and 7 items, α = 0.76, respectively) scores were created by combining items from four dimensions (weekend celebrations, yearly celebrations, religious holidays, cultural traditions) with nine non-relevant items removed. Higher scores indicate more mealtime ritualization and commitment to overall routines, respectively. The family sense of coherence

(FSOC) scale assesses the respondent's perception of the family's ability to overcome everyday challenges (Antonovsky & Sourani, 1988). Higher scores indicate stronger FSOC (26 items, $\alpha = 0.87$). The family economic strain scale provides a subjective evaluation of the family's financial situation (Hilton & Devall, 1997). Three items not pertinent to this homogenous low-income sample were removed (Hayes, VanBrackle, & Sigman-Grant, 2015). Higher scores indicate more economic strain (10 items, $\alpha = 0.91$). Covert control (managing the child's food) (Ogden, Reynolds, & Smith, 2006) was included at the environmental-level as it is undetected by the child (5 items, $\alpha = 0.75$).

Parent-level

Concerns and perceptions of weight: Responses measuring caregiver's concern about child eating (1 item) and weight (2 items) (Birch, Fisher, Grimm-Thomas, Markey, Sawyer, & Johnson, 2001; Crawford, Timperio, Telford, & Salmon, 2007) were coded as unconcerned vs. any level of concern. Responses to one other item were used to assess caregiver's perception of child's current weight (Birch et al., 2001; Crawford et al., 2007) and were combined into two groups: the non-overweight group was created by combining responses of very underweight ($n = 2$), underweight ($n = 31$) and normal weight ($n = 379$); the overweight group was created by combining responses of overweight ($n = 18$) and very overweight ($n = 2$). Caregiver's perception of her own weight (Birch et al., 2001) (one item) and child silhouettes, which represent a figurative assessment of parental perception of child's weight (1 item) (Collins, 1991; Stunkard, Sørensen, & Schulsinger, 1983) also were collected.

Feeding practices: The parental dietary modeling scale (PDMS) (Tibbs, Haire-Joshu, Schechtman, Brownson, Nanney, Houston, & Auslander, 2001) measures the frequency at which caregivers model healthful dietary behavior for their children (4 items, $\alpha = 0.59$). Overt control

over child diet assesses detectable caregiver control of the child's eating (Ogden et al., 2006) (4 items, $\alpha = 0.74$).

Feeding styles dimensions: The Caregiver's Feeding Styles Questionnaire (CFSQ) assesses the caregiver's approach to modifying children's eating behavior (Hughes, Power, Orlet Fisher, Mueller, & Nicklas, 2005). The demandingness dimension was calculated following removal of two items (final number of items = 17, $\alpha = 0.88$). The responsiveness dimension was also calculated by taking the mean of 5 items then dividing the mean by the demandingness score ($\alpha = 0.73$).

Parenting behaviors: A modification of the Parent Behavior Questionnaire (PBQ), which measures the general environment in which parenting behaviours are expressed (Robinson, Mandleco, Olsen, & Hart, 1995), was used. The modified version, called the PBQ–Head Start (PBQ-HS) (Coolahan, McWayne, Fantuzzo, & Grim, 2002), was tailored for use with low-income parents of preschoolers. Scores for responsive, restrictive and permissive behaviors were calculated (15 items, $\alpha = 0.84$; 12 items, $\alpha = 0.77$; 12 items, $\alpha = 0.83$, respectively).

Child-level

An abbreviated version of the Children's Eating Behavior Questionnaire (CEBQ), which measures child eating style (Wardle, Guthrie, Sanderson, & Rapoport, 2001), was used. Two subscales were calculated (satiety responsiveness and food responsiveness) (Wardle, Guthrie, Sanderson, & Rapoport, 2001) (5 items, $\alpha = 0.65$ and 5 items, $\alpha = 0.64$, respectively).

Control variables

All models were adjusted for study region in order to ensure control of any unmeasured confounding effects caused by region. This conservative approach was used to ensure validity of findings across all regions. Additionally, the SEM model was adjusted for demographic

characteristics (child gender, number of people living in the household, race/ethnicity) as well as caregiver's education level, employment status, marital status and participation in assistance programs. Since caregivers' weight influences their perception of (Towns & D'Auria, 2009) and concern for (Brown & Lee, 2011) their child's weight, caregiver's BMI (kg/m^2) was used to adjust the SEM. It was calculated using measured height and weight and divided into two groups: non-overweight (underweight, < 18.5 and normal weight, $18.5 - < 25$) and overweight (overweight, $25 - < 30$ and obese, ≥ 30) (NHLBI, 2000).

Statistical analysis

All analyses were performed using the Statistical Analysis Software (version 9.3, 2011, SAS Institute Inc). The relationships among the independent variables were explored using the Spearman's rank correlation coefficient (Spearman's rho) when continuous or tetrachoric correlation when categorical. Point biserial correlation was used to determine the correlation between a continuous with a binary variable. Except for categorical variables, all the independent variables were standardized (mean = 0, standard deviation (SD) = 1) (Fan & Lv, 2008) for modeling. Relationships between the independent and dependent variables were analyzed in three stages.

Stage 1: Variable selection

The association of independent variables at the environment-level (six variables tested together in one group), parent-level (13 variables separated into four thematic groups) and child-level (two variables tested together in one group) with each outcome (PHCB and LUCB) was examined using general linear models. Each outcome was tested in a separate model. Thus, there was a total of 12 models tested (six groups tested for each of two outcomes). Models were tested before and after logarithmically transforming the outcomes. Since the results were similar, the untransformed outcomes were used for simpler interpretation.

This approach was taken due to several reasons. First, some of the independent variables are known to evaluate similar concepts (e.g., concern about the child eating too much when you are not around him/her and concern for child weight now (Birch et al., 2001). Second, grouping helps reduce noise and redundancy, issues that jeopardize selection of informative independent variables (Derksen & Keselman, 1992; Ratner, 2010). Lastly, independent variables may weakly correlate with the outcome in univariate regression but more strongly correlate with the outcome when grouped with other variables (Fan & Lv, 2008).

The model with the highest adjusted coefficient of multiple determination (R^2), which measures the proportion of the variance in the outcome that is explained by all the independent variable(s) after being adjusted by the number of independent variables in the model (SAS Institute Inc., 2009), was selected. This method was appropriate because the intention was to preserve the level- and group-specific variables while determining the optimal combination that was most strongly associated with each outcome.

Stage 2: Multiple regression

Variables resulting from the variable selection stage were collectively tested as independent variables in two multiple regression models, one for each outcome. The models were adjusted only for study region. The model F value and adjusted R^2 were examined to ensure model validity and good fit (F value with $p < 0.05$, adjusted $R^2 > 20\%$).

Stage 3: SEM

In order to confirm multiple regression findings, independent variables associated with each outcome in Stage 2 ($p < 0.10$) were tested in one SEM. The purpose of this stage was to confirm the observed associations of the independent variables identified in stage two while simultaneously accounting for the inter-correlations among the independent variables as well as adjusting for study region, demographic variables (child gender, number of people living in

household, child race/ethnicity, parental level of education, parental employment status, marital status and participation in assistance programs) and caregiver's BMI. The SEM was composed of two parts: the measurement model consisting of two latent variables (one per outcome with a loading of one for scaling), and a structural model defining the relationship between latent and independent variables. Error variance of latent variables was fixed as $([1 \text{ minus standardized } \alpha] \text{ multiplied by sample variance; Choi, Bowleg, \& Neilands, 2011})$. Independent variables were treated as observed (exogenous). No dummy variables were created for independent and demographic variables that have more than two categories; hence for the purpose of model estimation these variables were treated as continuous. Direct paths are shown in Fig 1 using single-ended arrows. Covariances were specified between independent variables if they were previously grouped in one theme and between the caregivers' perception of her own weight and her BMI. Significant covariances are presented in Fig 1 using double ended arrows. Model fit was assessed using Chi-square statistic ($p > 0.05$ indicates good fit), Standardized Root Mean Square Residual (SRMSR, < 0.08), Adjusted Goodness of Fit (GFI, > 0.95), Root Mean Squared Error Approximation (RMSEA, < 0.05) and Bentler's Comparative Fit Index (CFI > 0.95) (Hendrie, Coveney, \& Cox, 2011; Hu \& Bentler, 1999; Kenny, 2015). Missing data were handled using full information maximum likelihood (Allison, 2012). The missingness patterns were examined to find any systematic bias in the distribution of the independent and dependent variables among those with missing observations in comparison to those with non-missing observations. Standardized path coefficients (β) are reported for significant paths and interpreted as the number of *SDs* the outcome will change per *SD* increase in the independent variable, or an increase by a higher unit in the categorical independent variables. Bias-corrected and accelerated 95% confidence intervals (CIs) for the β s were estimated using bootstrap resampling with

replacement (Barker, 2005; Haukoos & Lewis, 2005; Nevitt & Hancock, 2000). Significance was determined using the absolute value of the t-statistic (t-value > 1.96 is statistically significant at $p < 0.05$).

Results

Sample description

Sample characteristics are shown in Table 2. The children had a mean age ($\pm SD$) of 52.2 ± 8.7 months; fewer than half were female (48.6%). Caregivers were all female with a mean age of 30 years. The majority were overweight (65.1%); less than half (44.4%) were Hispanic/Latino. Over half had some college/technical school or higher education (57.4%), about half were employed (52.8%) and over half were married or lived with a partner (63.4%).

Independent variables

Table 3 describes the independent variables by level, group (for parent-level variables), as well as number of items, range of responses and n (%) or means (SD). Table 4 presents the correlations between independent variables. Correlations > 0.5 were observed, such as between caregiver's perception of child's current weight and child silhouette ratings (0.79).

Stage 1: Variable selection

Results of the variable selection are shown in Table 5. Of the 21 tested variables, 16 were selected for the model predicting PHCB; 13 for LUCB.

Stage 2: Multiple regression

Table 6 presents the multiple regression findings that test the associations of the independent variables with each outcome. The nine independent variables with $p < 0.10$ are bolded.

Stage 3: SEM

The SEM used 373 observations (86.3% of total sample), two latent variable outcomes and nine independent variables. The smallest proportion coverage (non-missingness) was 86.3% (> 70% is ideal). There were two missingness patterns detected (missing 1 [$n = 58$] and 3 variables [$n = 1$]). No differences among those not missing any variable and those missing ≥ 1 variable were noted. The model yielded a significant Chi-square (19.2; $df = 8$; $p = 0.01$). Other indices supported adequate model fit: SRMSR (0.0088), adjusted GFI (0.9738), RMSEA (0.0568) and Bentler's CFI (0.9912). Both outcomes loaded significantly on their latent variables with standardized coefficients of 0.82 for PHCB ($t\text{-value} = 37.9$) and 0.92 for LUCB ($t\text{-value} = 45.1$) (not shown), indicating that the latent variables accounted for a large proportion of the variance in outcomes ($0.82^2 = 67\%$; $0.92^2 = 85\%$, respectively). Figure 1 portrays the SEM specifications. Table 7 lists the β values (95% CI) for relationships between tested independent variables with latent variable outcomes. Not all paths were significant. Significant paths by level were as follows:

Environment-level: PHCB latent variable was associated with more mealtime ritualizations ($\beta = 0.21$). LUCB latent variable was associated with more parental covert control ($\beta = 0.44$).

Parent-level: PHCB latent variable was associated with more parental modeling ($\beta = 0.39$) and less parental restrictive behavior ($\beta = -0.19$). LUCB latent variable was associated with more parental overt control ($\beta = 0.14$) and less parental permissive behavior ($\beta = -0.25$).

Child-level: no significant associations were observed.

Having an overweight caregiver was associated with less LUCB ($\beta = -0.13$) but was not associated with PHCB. Several covariances among the independent variables were significant, including within-group variables.

Discussion

Regarding healthy child behaviors at the environment-level, following a mealtime ritual was associated with healthier behaviors. This finding is supported by the literature (Newman, Tumin, Andridge, & Anderson, 2015) and carries beneficial health effects for low-income children (Yoo, Slack, & Holl, 2010). One can argue that the positive effect of mealtime routines was driven by a correlation with the PHCB item that asks about frequency of caregiver eating a meal with the child. However, mean raw scores for the mealtime routine scale significantly increased with increasing frequency of responses to all PHCB items (not shown). At the parent-level, the strongest effect was observed for modeling, suggesting that it is an important driver of healthy child behaviors. Additionally, findings suggest that children of caregivers who behave in a restrictive fashion (e.g., criticizing and lack of warmth) are less likely to practice healthy child behaviors (e.g., eating fruits and vegetables).

Children of parents that practiced covert and overt control over the child's diet practiced more limiting of unhealthy behaviors. Parental covert control, the strongest environmental factor identified by the SEM, affects the home food environment (e.g., avoiding buying certain foods) (Ogden et al., 2006). Compared to overt control (detectable by the child [Ogden et al., 2006]), greater covert (undetectable) control was associated with three-times more LUCB. Ogden and colleagues (Ogden et al., 2006) also observed that, in contrast to overt control, covert control was not associated with higher social class, suggesting that covert control had a stronger effect in a low-income sample such as ours. Our finding also agrees with Ogden and colleagues' observation that more covert control was associated with intake of fewer unhealthy snacks and more strongly correlated with restriction (Ogden et al., 2006). Permissive parents exhibit low levels of parental guidance and limit-setting (Coolahan, McWayne, Fantuzzo, & Grim, 2002).

Our finding of a negative association of permissive caregiver behavior with LUCB reinforces the adverse effect of lack of parental attentiveness on the limiting of unhealthy child behaviors.

Study strengths include the staged approach for testing the association of multi-level independent factors, use of previously validated scales, inclusion of participants from several states/regions and a considerable sample size. It is acknowledged that the use of self-reported caregiver information regarding child behavior tempers findings by introducing potential bias. Additionally, child weight was not included in the analyses either as an independent or dependent variable. This is a possible limitation as child weight was found to predict parental feeding practices (e.g., restriction and pressure to eat) in similarly-aged children (Jansen et al., 2014). However, other measures related to child weight, namely the caregiver's perception of their own and their child's weight, were included in the variable selection stage from which perception of their own weight was selected for the multiple regression model with the LUCB outcome. Moreover, the SEM model was adjusted for caregiver's BMI in order to account for confounding caused by caregiver weight status. Other limitations include the cross sectional design preventing causality assessment and other factors that influence child weight-related behaviors.

Conclusions

The SEM confirmed the hypothesis that at least one variable at the environment- and parent-level was associated with each outcome after adjusting for multiple demographic and parental characteristics. Moreover, the independent variables demonstrated significant covariances among themselves. Despite that, the SEM confirmed three significant relationships per behavior outcome, all in the expected direction including mealtime ritualizations and covert control at the environment-level and parental modeling, overt control, restrictive and permissive

377 behavior at the parent-level. Inconsistent with the hypothesis, no variable was significant at the
378 child-level.

379 No one single factor stood out as the overwhelming influence on child weight-related
380 behaviors among low-income families, re-enforcing that interventions must take a holistic
381 approach. Indeed, some factors that appeared important in single-outcome traditional regression
382 models were not as significant in SEM (and vice versa). Study findings suggest that interventions
383 would benefit from simultaneously focusing on the home environment, parental feeding practices
384 and parenting behaviors in promoting healthy weight-related behaviors and reducing the
385 frequency of unhealthy weight-related behaviors among children of low-income caregivers.

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FIGURE LEGEND

Figure 1. The structural equation model specification and significant direct path standardized coefficients.

PHCB, practicing healthy child behavior; LUCB, limiting unhealthy child behavior; SNAP, Supplemental Nutrition Assistance Program; WIC, Special Supplemental Nutrition Program for Women, Infants, and Children; SNAPed, SNAP Education; EFNEP, Expanded Food and Nutrition Education Program; BMI, body mass index; HS, high school; GED, general educational development; SRMSR, Standardized Root Mean Square Residual; GFI, Adjusted Goodness of Fit; RMSEA, Root Mean Squared Error Approximation; CFI, Bentler's Comparative Fit Index.

The model was adjusted for study region (Southern Nevada = 0, Northern Nevada = 1, Connecticut = 2, Oklahoma = 3, New Jersey = 4, California = 5), child gender (1 = male, 2 = female), number of people living in household, race/ethnicity (1 = Hispanic/Latino, 2 = Non-Hispanic/Latino Black or African American, 3 = Non-Hispanic/Latino White, 4 = other), caregiver's level of education (1 = HS degree or less (includes GED), 2 = some college/technical school or more), employment status (1 = employed, 2 = unemployed/homemaker), marital status (1 = married/living with partner, 2 = separated/divorced/widowed, 3 = single), participation in SNAP/WIC/School Lunch (1 = yes, 0 = no), Medicaid/Head Start/SNAPed/EFNEP/Other (1 = yes, 0 = no) and caregiver's BMI (kg/m^2) (1 = non-overweight, 2 = overweight).

Except for categorical variables with 2 levels, all the independent variables were standardized (mean = 0, standard deviation = 1).

Coding scheme: mealtime ritualization and commitment to yearly celebrations (1 = not true to 3 = very true), covert control, overt control and satiety responsiveness (1 = never to 5 = always), which best describes how you see your current weight? (1 = underweight, 2 = normal weight, 3 = overweight), modeling (1 = never to 5 = almost always/always), parenting behaviors (1 = almost never to 4 = almost always). In the item 'which best describes how you see your current weight?' there were no responses in category 3.

Relationships between the outcomes with continuous scales indicate a higher score on the scale; relationships with categorical variables compare a higher vs. lower category. Direct path relationships that were tested are indicated using solid, single-headed arrows; standardized coefficients are presented if significant (absolute t-value > 1.96, $p < 0.05$) and dashed if non-significant. Only significant covariances among the independent variables are shown using double-headed arrows.

Table 1. Description of the PHCB and LUCB composite scores.

PHCB			LUCB		
Items	Response options	Mean $\pm$ <i>SD</i>	Items	Response options	Mean $\pm$ <i>SD</i>
1. How many days each week does your child usually eat fruits (including fresh, frozen, and canned)?	1 = None 2 = 1-2 days/wk 3 = 3-4 days/wk 4 = 5-6 days/wk 5 = Every day	4.18 $\pm$ 1.0	1. How often does your <u>child</u> drink regular (NOT diet) soda, fruit drinks, kool-aid, gatorade, or things such as Sunny Delight?	5 = < 1 day/wk 4 = 1-3 days/wk 3 = 4-6 days/wk 2 = Once/day 1 = 2+ times/day	3.93 $\pm$ 1.26
2. How many days each week does your child usually eat vegetables (including fresh, frozen, and canned)?	1 = None 2 = 1-2 days/wk 3 = 3-4 days/wk 4 = 5-6 days/wk 5 = Every day	3.86 $\pm$ 1.14	2. How much time does your child spend watching TV, using the computer, or playing video games?	5 = < 1 hr/day 4 = 1-2 hrs/day 3 = 3-4 hrs/day 2 = 5-6 hrs/day 1 = 7+ hrs/day	3.79 $\pm$ 0.75
3. How often does your child play actively for at least 60 minutes a day -- actively enough that he/she breathes a little harder or his/her heart beats faster?	1 = < 1 day/wk 2 = 1-2 days/wk 3 = 3-4 days/wk 4 = 5-6 days/wk 5 = Every day	4.28 $\pm$ 1.01	3. How often does your child usually eat take out, delivery, or fast foods (such as burgers, fried chicken, pizza, Chinese food)?	5 = Almost never 4 = 1-2 days/wk 3 = 3-4 days/wk 2 = 5-6 days/wk 1 = Every day	4.25 $\pm$ 0.64
4. How often do you eat together with your child at least one meal a day?	1 = Almost never 2 = 1-2 days/wk 3 = 3-4 days/wk 4 = 5-6 days/wk 5 = Every day	4.50 $\pm$ 0.93	4. How often are high-fat or high-sugar snacks available at home for your child to eat? This includes chips, candy, cookies, and sweets.	5 = Almost never 5 = < half the time 3 = Half the time 2 = > half the time 1 = Almost always	3.42 $\pm$ 1.16
5. How often are fruits available at home for your child to eat?	1 = Almost never 2 = < half the time 3 = Half the time 4 = > half the time 5 = Almost always	4.70 $\pm$ 0.68			
	Composite score	21.52 $\pm$ 3.08		Composite score	15.39 $\pm$ 2.46
	Minimum, maximum	11.0, 25.0		Minimum, maximum	7.0, 20.0
	Median	22.0		Median	16.0

PHCB, practicing healthy child behavior; LUCB, limiting unhealthy child behavior; *SD*, standard deviation.

The scores were calculated by summing across the items. Higher values indicate more frequent behaviors.

Table 2. Characteristics of the study sample ($n = 432$)^{*}.

Characteristic	Number (%) or Mean $\pm$ SD
Study region	
Southern Nevada	150 (34.7)
Northern Nevada	169 (39.1)
Connecticut	22 (5.1)
Oklahoma	9 (2.1)
New Jersey	40 (9.3)
California	42 (9.7)
Child age (months)	52.2 $\pm$ 8.7
Child BMI z-score	0.56 $\pm$ 1.1
Child gender	
Female	210 (48.6)
Caregiver's age (years)	29.9 $\pm$ 7.5
Caregiver's BMI	
Overweight	278 (65.1)
Non-overweight	149 (34.9)
Household size	
2	34 (7.9)
3	93 (21.5)
4	142 (32.9)
5	86 (19.9)
6 or more	77 (17.8)
Number of children	
1	110 (25.5)
2	172 (39.8)
3	90 (20.8)
4	35 (8.1)
5 or more	25 (5.8)
Caregiver's race/ethnicity	
Hispanic/Latino	192 (44.4)
Non-Hispanic/Latino Black or African American	82 (18.9)
Non-Hispanic/Latino White	101 (23.4)
Other	57 (13.2)
Education	
HS degree or less (includes GED)	184 (42.6)
Some college/technical school or more	248 (57.4)
Employment status	
Employed	228 (52.8)
Unemployed/homemaker	204 (47.2)
Marital status	
Married/living with partner	274 (63.4)
Separated/divorced/widowed	64 (14.8)
Single	94 (21.8)
Participation in SNAP/WIC/School Lunch	348 (80.6)
Participation in Medicaid/Head Start/SNAPed/EFNEP/Other	387 (89.6)

^{*} Percentages may not add up to 100 due to rounding.

SD, standard deviation; BMI, body mass index; HS, high school; GED, general educational development; SNAP, Supplemental Nutrition Assistance Program; WIC, Special Supplemental Nutrition Program for Women, Infants, and Children; SNAPed, SNAP Education; EFNEP, Expanded Food and Nutrition Education Program.

Table 3. Description of the independent variables tested with the outcomes of PHCB and LUCB, by level and thematic group ($n = 432$).

Level	Thematic group	Independent variables	Number of items	Possible range of the score	Number (%) or Mean score $\pm SD$	References
Environment		Mealtime ritualization	5	1-3	2.5 $\pm$ 0.4	1
		Commitment to cultural events and traditions	8	1-3	2.2 $\pm$ 0.5	
		Commitment to yearly celebrations	7	1-3	2.6 $\pm$ 0.4	2
		FSOC		1-7	5.6 $\pm$ 0.7	
		Family economic strain	10	1-5	2.7 $\pm$ 0.9	3
		Covert control over child diet	5	1-5	3.4 $\pm$ 0.8	4
Parent	Concerns and perceptions of weight	How concerned are you about your child eating too much when you are not around him/her?	1			5,6
		Concerned			156 (36.1)	
		Unconcerned			276 (63.9)	
		How concerned are you about your child's weight now?	1			
		Concerned			116 (26.9)	
		Unconcerned			316 (73.2)	
		How concerned are you about your child becoming overweight?	1			
		Concerned			211 (48.8)	
		Unconcerned			221 (51.2)	
		Which best describes how you see your child's current weight?	1			5,7
		Child perceived as overweight			20 (4.6)	
		Child perceived as non-overweight			412 (95.4)	
		Which best describes how you see your current weight?	1			5
		Overweight			0	
		Normal weight			160 (37.0)	
		Underweight			272 (62.9)	
Feeding practices		Child silhouettes	1	1-7	3.3 $\pm$ 1.1	8,9
		Modeling	4	1-5	3.9 $\pm$ 0.7	10
		Overt control over child diet	4	1-5	3.9 $\pm$ 0.8	4
	Feeding styles dimensions	Demandingness	17	1-5	2.8 $\pm$ 0.7	11,12
		Responsiveness	5 items divided	1-5	1.3 $\pm$ 0.2	

Level	Thematic group	Independent variables	Number of items	Possible range of the score	Number (%) or Mean score $\pm$ <i>SD</i>	References
			by demandingness score			
	Parenting behaviors	Responsive behavior	16	1-4	3.6 $\pm$ 0.4	13
		Restrictive behavior	12	1-4	1.7 $\pm$ 0.4	
		Permissive behavior	12	1-4	1.7 $\pm$ 0.5	
Child		Satiety responsiveness	5	1-5	2.8 $\pm$ 0.7	14
		Food responsiveness	5	1-5	2.7 $\pm$ 0.7	

PHCB, practicing healthy child behavior; LUCB, limiting unhealthy child behavior; *SD*, standard deviation; FSOC, Family Sense of Coherence.

Coding scheme: mealtime ritualization, commitment to cultural events and traditions and commitment to yearly celebrations (1= not true to 3 = very true), family economic strain, covert control, overt control, feeding styles dimensions and satiety and food responsiveness (1 = never to 5 = always), parental concerns (0 = unconcerned, 1 = concerned), which best describes how you see your child's current weight? (0 = non-overweight, 1 = overweight), which best describes how you see your current weight? (1 = underweight, 2 = normal weight, 3 = overweight), child silhouettes (1 = thinnest to 7 = largest), modeling (1 = never to 5 = almost always/always), parenting behaviors (1 = almost never to 4 = almost always). FSOC answer options vary.

Table 4. The correlations between the unstandardized independent variables that were tested with the outcomes of PHCB and LUCB ($n = 432$).

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1 Mealtime ritualization	—																				
2 Commit. cultural events and traditions	.34**	—																			
3 Commit. yearly celebr.	.22**	.44**	—																		
4 FSOC	.31**	.33**	.26**	—																	
5 Family economic strain	-.09	-.08	-.01	-.41**	—																
6 Concern about child eating too much	.04	.06	-.12**	-.08	.03	—															
7 Concern about child's weight now	-.04	.01	-.09*	-.18**	.10*	.56**	—														
8 Concern about child becoming overweight	-.01	.04	-.12**	-.18**	.14**	.62**	.48**	—													
9 Which best describes how you see your child's current weight?	-.03	-.01	-.04	-.01	.08	.58**	.36**	.64**	—												
10 Which best describes how you see your current weight?	-.04	.01	.03	-.02	.17**	.02	-.04	-.06	-.23**	—											
11 Child silhouettes	-.04	.00	.01	-.07	.07	.25**	.06	.30**	.79**	-.12	—										
12 Modeling	.29**	.10*	.09*	.34**	-.18**	-.10*	-.17**	-.08	-.04	.04	-.10*	—									
13 Covert control	.22**	.11*	.01	.22**	-.11*	.05	.01	-.01	.06	.03	-.10*	.45**	—								
14 Overt control	.23**	.09	.05	.18**	-.06	.10	.01	-.06	-.00	-.08	-.00	.23**	.21**	—							
15 Demandingness	-.02	.06	-.01	-.16**	.14**	.04	.16**	.08	-.12**	-.16**	.13**	-.16**	-.02	.06	—						
16 Responsiveness	.19**	.16**	.12*	.35**	-.15**	-.03	-.12**	-.02	.01	.06	-.08	.29**	.20**	.06	-.55**	—					
17 Responsive behavior	.16**	.18**	.20**	.28**	.04	-.16*	-.16*	-.10	-.04	.03	.00	.26**	.25**	.25**	.05	.29**	—				
18 Restrictive behavior	-.14**	.00	-.09	-.27**	.17**	.09*	.14**	.10*	-.06	-.05	.12*	-.26**	-.20**	-.04	.35**	-.44**	-.09*	—			
19 Permissive behavior	-.23**	-.03	-.18**	-.36**	.23**	.17**	.21**	.15**	.03	-.02	.05	-.36**	-.23**	-.18**	.28**	-.37**	-.13**	.38**	—		
20 Satiety responsiveness	-.07	-.04	-.08	-.15**	.14**	-.12*	.06	.02	-.05	.04	.09	-.05	.01	-.11*	.34**	-.27**	-.04	.09	.15**	—	
21 Food responsiveness	.09	.15**	.09	.00	.02	.29**	.08*	.09*	.02	.04	.01	.01	.03	.11*	.13*	-.15**	.01	.26**	.25**	-.07	—

PHCB, practicing healthy child behavior; LUCB, limiting unhealthy child behavior; FSOC, Family Sense of Coherence.

The relationship between the independent variables was explored using the Spearman's rank correlation coefficient (Spearman's rho), tetrachoric correlation or point biserial correlation.

Coding scheme: mealtime ritualization, commitment to cultural events and traditions and commitment to yearly celebrations (1= not true to 3 = very true), family economic strain, covert control, overt control, feeding styles dimensions and satiety and food responsiveness (1 = never to 5 = always), parental concerns (0 = unconcerned, 1 = concerned), which best describes how you see your child's current weight? (0 = non-overweight, 1 = overweight), which best describes how you see your current weight? (1 = underweight, 2 = normal weight, 3 = overweight), child silhouettes (1 = thinnest to 7 = largest), modeling (1 = never to 5 = almost always/always), parenting behaviors (1 = almost never to 4 = almost always). FSOC answer options vary.

* $p < 0.05$; ** $p < 0.01$

Table 5. Variable selection (stage 1) for the outcomes of PHCB and LUCB.

Level	Thematic group	Independent variables	PHCB		LUCB	
				Model adjusted R^2		Model adjusted R^2
Environment		Mealtime ritualization	X	0.18	X	0.26
		Commitment to cultural events and traditions	X		X	
		Commitment to yearly celebrations	X		X	
		FSOC	X			
		Family economic strain	X		X	
		Covert control over child diet	X		X	
Parent	Concerns and perceptions of weight	How concerned are you about your child eating too much when you are not around him/her?	X	0.04		0.01
		How concerned are you about your child's weight now?	X			
		How concerned are you about your child becoming overweight?	X			
		Which best describes how you see your child's current weight?				
		Which best describes how you see your current weight?			X	
		Child silhouettes	X			
	Feeding practices	Modeling	X	0.15	X	0.27
		Overt control over child diet			X	
	Feeding styles dimensions	Demandingness		0.08		0.02
		Responsiveness	X		X	
	Parenting behaviors	Responsive behavior	X	0.12		0.13
		Restrictive behavior	X		X	
		Permissive behavior	X		X	
Child		Satiety responsiveness	X	0.002	X	0.02
		Food responsiveness			X	

PHCB, practicing healthy child behavior; LUCB, limiting unhealthy child behavior; FSOC, Family Sense of Coherence.

Except for categorical variables with 2 levels, all the independent variables were standardized (mean = 0, standard deviation = 1). The association of the independent variables with each outcome was tested in separate variable selection models. The combination of variables to retain was selected by the software based on the highest adjusted coefficient of multiple determination (R^2). Selected variables are marked as X.

Coding scheme: mealtime ritualization, commitment to cultural events and traditions and commitment to yearly celebrations (1 = not true to 3 = very true), family economic strain, covert control, overt control, feeding styles dimensions and satiety and food responsiveness (1 = never to 5 = always), parental concerns (0 = unconcerned, 1 = concerned), which best describes how you see your child's current weight? (0 = non-overweight, 1 = overweight), which best describes how you see your current weight? (1 = underweight, 2 = normal weight, 3 = overweight), child silhouettes (1 = thinnest to 7 = largest), modeling (1 = never to 5 = almost

always/always), parenting behaviors (1 = almost never to 4 = almost always). In the item ‘which best describes how you see your current weight?’ there were no responses in category 3.

Table 6. Results of 2 multiple regression models (stage 2) for the association of independent variables with PHCB and LUCB outcomes.

Level		(Model 1, <i>n</i> = 372) PHCB <i>β</i> (95% CI)	(Model 2, <i>n</i> = 378) LUCB <i>β</i> (95% CI)
Environment	Mealtime ritualization	0.21 (0.11; 0.30)***	0.09 (-0.01; 0.18) [†]
	Commitment to cultural events and traditions	-0.08 (-0.18; 0.03)	-0.05 (-0.15; 0.06)
	Commitment to yearly celebrations	0.11 (-0.0005; 0.21) [†]	-0.08 (-0.18; 0.03)
	FSOC	0.02 (-0.09; 0.14)	NA
	Family economic strain	-0.05 (-0.15; 0.05)	0.02 (-0.07; 0.11)
	Covert control over child diet	0.05 (-0.05; 0.15)	0.39 (0.29; 0.48)***
Parent	Concerns and perceptions of weight		
	How concerned are you about your child eating too much when you are not around him/her?		
	Concerned	-0.13 (-0.34; 0.09)	NA
	Unconcerned (referent)		
	How concerned are you about your child's weight now?		
	Concerned	0.009 (-0.21; 0.23)	NA
	Unconcerned (referent)		
	How concerned are you about your child becoming overweight?		
	Concerned	-0.15 (-0.35; 0.05)	NA
	Unconcerned (referent)		
	Which best describes how you see your current weight?		
	Normal weight	NA	0.23 (0.05; 0.41) [*]
	Underweight (referent)		
	Child silhouettes	0.03 (-0.07; 0.12)	NA
	Feeding practices		
	Modeling	0.31 (0.20; 0.41)***	0.08 (-0.02; 0.19)
	Overt control over child diet	NA	0.10 (0.01; 0.19) [*]
	Feeding styles dimensions		
	Responsiveness	0.06 (-0.05; 0.17)	-0.08 (-0.18; 0.02)
	Parenting behaviors		
	Responsive behavior	0.01 (-0.09; 0.11)	NA
	Restrictive behavior	-0.10 (-0.21; 0.0005) [†]	-0.06 (-0.16; 0.04)
	Permissive behavior	0.04 (-0.06; 0.15)	-0.23 (-0.33; -0.12)***
Child	Satiety responsiveness	-0.01 (-0.11; 0.08)	-0.12 (-0.21; -0.03) ^{**}
	Food responsiveness	NA	-0.04 (-0.13; 0.06)

PHCB, practicing healthy child behavior; LUCB, limiting unhealthy child behavior; β , standardized regression coefficient; CI, confidence interval; NA, not applicable (not tested); FSOC, Family Sense of Coherence.

Except for categorical variables with 2 levels, all the independent variables were standardized (mean = 0, standard deviation = 1).

Coding scheme: mealtime ritualization, commitment to cultural events and traditions and commitment to yearly celebrations (1 = not true to 3 = very true), family economic strain, covert control, overt control, feeding styles dimensions and satiety and food responsiveness (1 = never to 5 = always), parental concerns (0 = unconcerned, 1 = concerned), which best describes how you see your current weight? (1 = underweight, 2 = normal weight, 3 = overweight), child silhouettes (1 = thinnest to 7 = largest), modeling (1 = never to 5 = almost always/always), parenting behaviors (1 = almost never to 4 = almost always). In the item 'which best describes how you see your current weight?' there were no responses in category 3.

Both models were adjusted for study region. PHCB: $F(21, 350) = 9.11, p < 0.0001$; adjusted $R^2 = 0.315$. LUCB: $F(18, 359) = 12.61, p < 0.0001$; adjusted $R^2 = 0.357$. Independent variables that were selected for inclusion in the structural equation model for the respective outcome ($p < 0.10$) are bolded.

[†] $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table 7. Direct path relationships between the independent variables with the latent variable outcomes (PHCB and LUCB) using the structural equation model (stage 3) ($n = 373$).

Level		PHCB latent variable β (95% CI)	LUCB latent variable β (95% CI)
Environment	Mealtime ritualization	0.209 (0.105; 0.317) *	0.030 (-0.058; 0.139)
	Commitment to yearly celebrations	0.096 (-0.017; 0.220)	NA
	Covert control over child diet	NA	0.438 (0.346; 0.543) *
Parent	Which best describes how you see your current weight?		
	Normal weight	NA	0.029 (-0.074; 0.172)
	Underweight (referent)		
	Modeling	0.395 (0.267; 0.491) *	NA
	Overt control over child diet	NA	0.135 (0.029; 0.251) *
	Restrictive behavior	-0.198 (-0.295; -0.101) *	NA
	Permissive behavior	NA	-0.246 (-0.341; -0.089) *
Child	Satiety responsiveness	NA	-0.082 (-0.197; -0.005)

PHCB: practicing healthy child behavior; LUCB: limiting unhealthy child behavior; β : standardized path coefficient; CI: confidence interval; NA: not applicable (not tested).

Except for categorical variables with 2 levels, all the independent variables were standardized (mean = 0, standard deviation = 1).

Coding scheme: mealtime ritualization and commitment to yearly celebrations (1 = not true to 3 = very true), covert control, overt control and satiety responsiveness (1 = never to 5 = always), which best describes how you see your current weight? (1 = underweight, 2 = normal weight, 3 = overweight), modeling (1 = never to 5 = almost always/always), parenting behaviors (1 = almost never to 4 = almost always). In the item ‘which best describes how you see your current weight?’ there were no responses in category 3.

Relationships between the outcomes with continuous scales indicate a higher score on the scale; relationships with categorical variables compare a higher vs. lower category. Bias-corrected and accelerated 95% CIs were obtained using bootstrapping.

* Absolute t-value > 1.96 ($p < 0.05$)