Assessing Family Level Behaviors for Obesity Prevention: Development and Preliminary Validation of the Family Stage of Change Tool

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We applied the Transtheoretical Model (TTM) to develop the Family Stage of Change (FSOC) screening tool. Our goal was to provide practitioners an instrument that measures families' readiness to change obesity preventing behaviors, in order to optimize family-focused obesity-prevention intervention strategies. We evaluated instrument validity by comparing responses on the FSOC to related items on a validated family behavioral and environmental assessment (Family Nutrition and Physical Activity Assessment; FNPA) shown to predict child BMI. Study participants included parents and caregivers (N = 146) of children ages 2-14 years recruited through preschool, elementary, and middle school listservs. Descriptive analyses were conducted on the demographic data, and correlations were run to examine associations between FSOC and FNPA items, domains, and total scores. Strong positive correlations were observed between the individual items (0.44 to 0.75, $p < 0.001$), domain scores (0.57 to 0.8, $p < 0.001$), and mean total FSOC and FNPA scores (0.78, $p < 0.001$) suggesting the FSOC is measuring family level behaviors. Test-retest reliability was evaluated on a subsample of participants (n = 57), and item by item correlations ranged from 0.75 to 1.0, $p < 0.001$. Our findings suggest the FSOC is a valid and reliable instrument and has the potential to meet an identified need related to family-directed, obesity prevention efforts.

Key words: family-level behavior change, obesity prevention, intervention

Introduction

Significant strides have been made over the last decade to stem the rise in childhood obesity (Ogden, Carroll, Kit, & Flegal, 2014). The change in trajectory may be due to a shift away from efforts targeting individual child-level behavior change toward an emphasis on creating environments that support children's ability to enact obesity preventing behaviors (Institute of

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Medicine, 2012). School and family home settings likely have the greatest potential to impact child obesity, with the strongest evidence for effective prevention programs attributable to school-based efforts (Wang et al., 2013). Though the importance of the family home environment on children's risk for obesity is evident (Davison & Birch, 2002; Davison, Francis, & Birch, 2005; Ihmels, Welk, Eisenmann, & Nusser, 2009a; Ihmels, Welk, Eisenmann, Nusser, & Myers, 2009b; Johnson, Welk, Saint-Maurice, & Ihmels, 2012), few family-based interventions have proven effective at influencing children's obesity risk (Wang et al., 2013).

The ability of families to support children's healthful eating and physical activity behaviors may not be as simple as having adequate knowledge of what to do or valuing these behaviors (Gruber & Haldeman, 2009). Other, more complex factors, have been shown to impede families' ability to change healthful eating and physical activity behaviors. For example, children in families of lower socioeconomic status (SES) tend to have less access to physical activity supports (e.g., portable play equipment), live in areas where neighborhood safety is perceived as a barrier to physical activity (Gable, Chang, & Krull, 2007), have greater access to media in their bedrooms that tends to promote more sedentary time (Tandon et al., 2012), and have less access to healthy foods compared to more affluent families (Treuhaft & Karpyn, 2010). Family-level policies around physical activity may also be impacted by SES, as evidenced by data suggesting low income families tend to have more restrictive physical activity rules compared to families of higher SES (Tandon et al., 2012). Additional factors such as conflicts between work and family-life (Roos, Sarlio-Lähteenkorva, Lallukka, & Lahelma, 2007), child-care needs and responsibilities (Eyler et al., 2002), and geography (rural versus urban) have also been shown to impact healthy eating and physical activity behaviors and/or obesity risk (Liu et al., 2012). Thus, it is challenging to develop effective, family-focused, obesity prevention strategies without an understanding of how a myriad of complex factors may influence families' ability to implement those strategies.

Interpersonal factors, such as matching child and parent behaviors, provide additional challenges. Since children do not have volitional control over their home environment and parents provide the context for children's obesity preventing behaviors, understanding family dynamics and subsequent family-level behavior is critical to the development of effective intervention strategies. Gruber and Haldeman (2009) suggested that in order to "more effectively advance the notion that family be considered as a central unit for making behavior changes that support healthy eating and physical activity habits" (p. A106), we must recognize and understand how family behavior influences the development of childhood overweight and obesity. Toward this end, several home environment assessment tools have been developed that include family-level behaviors (Bryant et al., 2008; Gattshall, Shoup, Marshall, Crane, & Estabrooks, 2008; Ihmels et al., 2009a; Pinard et al., 2014). Of these, the Family Nutrition and Physical Activity (FNPA) Screening Tool and more recently the Comprehensive Home Environment Survey (CHES), have been associated with child BMI (Ihmels et al., 2009b; Pinard et al., 2014). Data derived from

these instruments support that family level behaviors such as providing healthy snacks, limiting access to unhealthy snacks and providing opportunities for family active time are associated with child BMI (Ihmels et al., 2009b; Pinard et al., 2014). However, what is still lacking is a theoretical framework for family-level obesity-preventing behavior *change*. As such, our goal was to develop a theory-based screening instrument to guide family-level obesity-preventing behavior change.

The Transtheoretical Model (TTM) of Behavior Change is a comprehensive, integrative model describing intentional behavior change that can be applied to a variety of behaviors, populations, and settings (DiClemente et al., 1991). The TTM characterizes current behaviors and behavioral intent along a continuum represented by five distinct stages of change through which individuals may progress: precontemplation, contemplation, preparation, action, and maintenance. In the TTM, change processes (and therefore intervention strategies) differ across and are applied optimally at each stage of change. For example, behavior change strategies (e.g., removing sugar sweetened beverages from the pantry) are more likely to result in positive changes for individuals in preparation or action stages, whereas individuals in contemplation will be more receptive to strategies that increase knowledge (e.g. sharing a fact sheet about sugar sweetened beverages and child health) (Prochaska, Velicer, DiClemente, & Fava, 1988). Stages-of-change theory has been applied successfully to address childhood obesity among clinical populations (Crabtree, Moore, Jacks, Cerrito, & Topp, 2010) and in school settings (Driskell, Dyment, Mauriello, Castle, & Sherman, 2008; Mauriello et al., 2010). However, the applicability of TTM to childhood obesity prevention in the family home environment, where family-level behaviors include enactment of family-home policies and practices not under the volitional control of the child, is not well understood.

Our objective was to apply the TTM to the development and validation of an instrument to 1) measure family-level readiness to change obesity preventing behaviors and 2) guide the development and implementation of intervention strategies that align with families' ability to make the changes necessary to prevent child obesity. Our target population was families of preschool through middle school aged children (2-14 years).

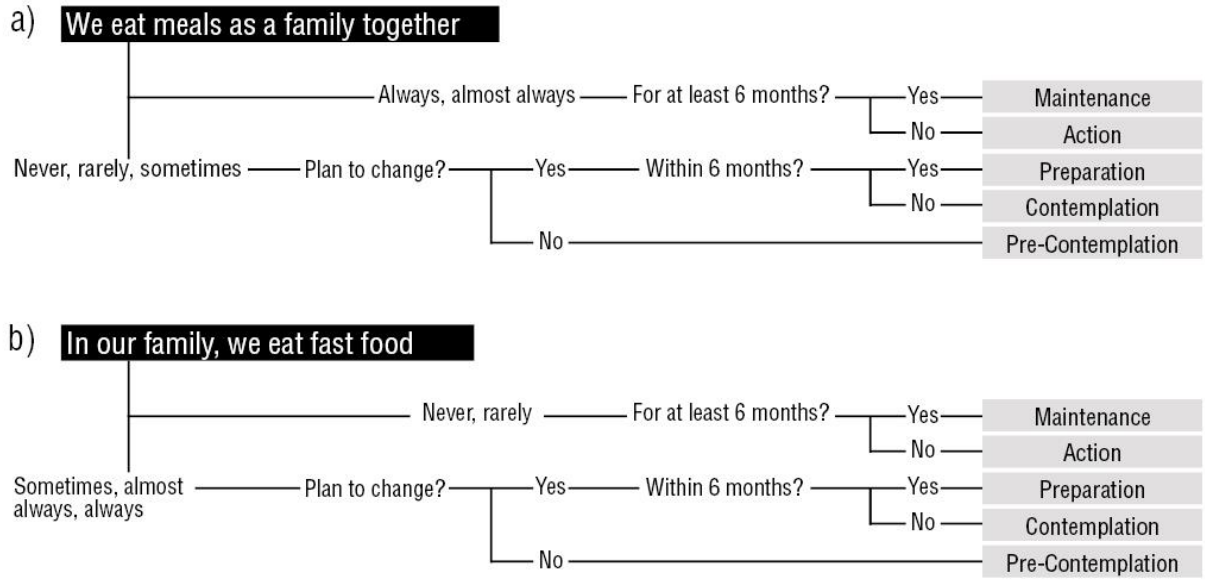
The first step in this process was the development of the Family Stage of Change (FSOC) Screening Tool. The FSOC was designed to measure family readiness to enact the obesity preventing behaviors shown to influence child BMI (Ihmels et al., 2009b). The next step was to confirm the FSOC's validity in order to confidently apply it in practice. The purpose of this report is to summarize the development and evaluation of the FSOC Screening Tool for use in understanding family readiness to change obesity preventing behaviors. This study was approved by the Oregon State University Institutional Review Board.

Methods

Survey Development and Delivery

The development of the FSOC instrument was driven by a desire to match childhood obesity intervention strategies targeting the family home environment with families' readiness to implement those strategies. Thus, we needed a valid measure of family obesity-preventing behaviors as a launch point. The Family Nutrition and Physical Activity (FNPA) Screening Survey is a valid measure of the family home nutrition and physical activity environment which consists of 21 items assessing child and family behaviors, family policies, and home environmental characteristics shown to influence child BMI (Ihmels et al., 2009b). Twelve of the twenty-one items measured by the FNPA are specific to family (versus individual) behaviors and include *eating behaviors* (*n* = 6), *physical activity behaviors* (*n* = 3), *screen time behaviors* (*n* = 2) and *sleep time behaviors* (*n* = 1). These twelve FNPA items were adapted and included in the FSOC by applying a staging algorithm to each item based on the TTM (DiClemente et al., 1991) (Figure 1).

Figure 1. Application of the TTM Staging Algorithm to Create FSOC "Support Statement" (a) and "Barrier Statement" (b) Items



The FNPA items are single statements, evaluated on a Likert scale, that reflect how often (*almost never*, *sometimes*, *usually*, *almost always*) a family reports engaging in a particular behavior, such as eating meals together as a family (e.g., "Our family eats meals together…"). To construct the FSOC Tool, we applied the staging algorithm constructed by DiClemente and colleagues (1991) to the FNPA statement (a) as shown in Figure 1.

This process was followed for all FNPA statements where the desirable behavior was reflected in a response of *always* or *almost always*. We identified these statements as support statements. Statements where the desired behavior was reflected by a response of *never* or *rarely* (e.g., "Our family eats fast food…") were identified as barrier statements. This required a different application of the staging algorithm (Figure 1, statement b).

Each FSOC item was coded by applying a score of 1 (*Precontemplation*) through 5 (*Maintenance*) based on respondents' answers for that item. Stage scores were calculated item by item and by summing the scores of items within each domain (*eating* (n = 6), *physical activity* (n = 3), *screen time* (n = 2), *sleep behavior* (n = 1)). An overall mean stage of change score can also be calculated. The content, layout, and format of questions were piloted among parents and caregivers, practitioners, and content experts, resulting in a final version for validation testing.

Participants and Procedures

The target population included parents or caregivers of children ages 2-14. The survey went out through preschool, elementary, and middle school electronic mailing lists in a single school district. Participating schools included two public elementary schools, a public middle school, and a private preschool that serves a university community and families eligible for Head Start. The elementary schools (n = 2) included a school with a high proportion of families eligible for free and reduced meals (70%), and a school with a low proportion of families eligible for school meal programs (17.8%). The middle school fell in between (31.3% eligible for school meal programs); the district average was 36.5%. Our sample pool reflected a diverse socioeconomic cross-section of families. The survey was disseminated via school listservs at the preschool and elementary schools and via a parent listserv at the middle school. The total number of children enrolled in these schools was 1,303. However, not all families had signed up to receive school emails. As such, the number of families who received the survey via email dissemination is unknown. Within a month of dissemination, 146 surveys were returned, with a subsample of respondents (n = 57) opting to complete the FSOC twice, permitting an evaluation of validity on the full sample and test-retest reliability on the subsample. In addition to filling out the FSOC and the FNPA, participants were asked to fill out a brief questionnaire requesting information such as their child/children's grade level, age, race and ethnicity, and household characteristics regarding eligibility for free and reduced meals, parent/caregiver education, and food insecurity status.

Analytic Approach

Descriptive analyses were conducted on the demographic data, and correlations were run to examine relationships between items from the FSOC and FNPA. The first series of correlations to assess validity was done on single equivalent items from both surveys. Scores for each of the four measured domains (Eating Behaviors, Physical Activity Behaviors, Screen Time Behaviors,

Sleep Behaviors) were created by summing and averaging subsamples of similar items. For example, the FSOC Physical Activity domain score reflects the mean score of three items related to family physical activity behaviors. Table 1 presents the individual FNPA items (column 1) that were adapted for the FSOC in comparison to the FSOC items (column 2), nested within domains (Eating Behaviors, etc.). A second series of correlations was examined comparing mean FNPA domain scores to mean FSOC domain scores. Total scores were also calculated for the twelve FSOC items and related FNPA items, and the means of these scores were correlated.

Table 1. FNPA Family Behavior Statements and Corresponding FSOC Statements, Nested within Behavior Domains

FNPA Statements (Statement #)	FSOC Statements (Statement #)
Domain 1: Eating Behaviors (*n* = 6)	
Our family eats meals together... (2)	We eat meals together as a family. (1)
Our family eats while watching TV/computer/electronic games... (3)	Our family eats meals and/or snacks while watching TV/computer or playing electronic games. (3)
Our family eats fast food... (4)	In our family we eat fast food. (4)
Our family uses microwave or 'ready to eat' foods... (5)	In our family we eat microwavable or ready-to-eat foods. (5)
Our family monitors eating of chips, cookies, and candy... (9)	In our family we limit eating of chips, cookies, and candy. (2)
Our family uses candy or sweets as a reward for good behavior... (10)	In our family we use candy/sweets as a reward for good behavior. (6)
Domain 2: Physical Activity Behaviors (*n* = 3)	
Our family provides opportunities for physical activity... (14)	In our family we make time for physical activity. We also provide support so our children can play actively and do organized physical activities and/or sports. (8)
Our family encourages our child to be active every day... (15)	In our family we encourage our children to be active every day. (7)
Our family finds ways to be physically active together... (16)	In our family we find ways to be active together. (9)
Domain 3: Screen Time Behaviors (*n* = 2)	
Our family limits the amount of TV/games/computer our child watches... (12)	In our family we limit the time children can spend watching TV/computer and playing electronic games. (10)
Our family allows our child to watch TV/games/computer in his/her bedroom... (13)	In our family we allow children to watch TV/computer or play electronic games in their bedroom. (11)
Domain 4: Sleep Behaviors (*n* = 1)	
Our family has a daily routine for our child's bedtime... (19)	In our family we have a daily bedtime routine for our children. (12)

Finally, we evaluated test-retest reliability via correlational analyses comparing the first and second responses provided by participants who completed the FSOC twice (n = 57). All data analyses were performed using Stata/IC 12.1 (StataCorp LP, 2011(Release 12), College Station, TX).

Results

A true response rate was not possible to calculate as schools provided enrollment data rather than the number of families subscribed to email lists. Enrollment data refers to the number of children enrolled (N = 1,303 at the time the study was conducted) as opposed to the number of potential families contacted. As such, an estimated response rate (11.2%) based on enrollment is likely significantly lower than a response rate based on the number of families contacted. Of the 146 respondents, 91.1% reported *White* as their child's race, 5.48% reported *Asian*, 5.48% reported *American Indian or Alaska Native*, 2.74% reported *Black or African American*, and 1.37% reported *Native Hawaiian or Other Pacific Islander*. In addition, 9.59% of respondents indicated that their child was of Hispanic ethnicity. The majority of the respondents (71.92%) were from households with two adults, 12.33% reported living in a household with three adults, and 9.59% were in single parent households. In our sample, 6.85% of children lived in more than one household. Most respondents (63.01%) reported that their children were not eligible to receive free or reduced meals, whereas 21.91% indicated their children were eligible for free or reduced meals, and 9.59% did not know if their children were eligible. A minority of our sample (15%) would be classified as food insecure based on their response to how often they worried that their food would run out before they had enough money to buy more. The majority of our sample (77.4%) reported having a college degree, 15.75% reported having completed 1 to 3 years of college, and 1.37% reported having graduated from high school as their highest year of school completed.

Mean FNPA and FSOC item, domain, and total scores are presented in Table 2. Correlations of single similar items between FSOC and FNPA are presented in Table 3. Overall, correlations ranged from 0.44 to 0.75. Correlations above 0.5 were considered strong, positive correlations. Only the correlation between FNPA item #15 (*Our family encourages our child to be active every day*) and FSOC item #7 (*In our family we encourage our children to move more every day*) fell below this threshold with a value of 0.44. Despite this lower than desirable correlation, all the single item correlations were statistically significant ($p < 0.001$). The domain specific correlations ranged from 0.57 to 0.8 ($p < 0.001$), Table 4. The correlation between the mean total FSOC score and the mean score of the corresponding twelve FNPA items was also strong, positive (0.78), and statistically significant ($p < 0.001$).

Table 2. Mean FNPA and FSOC Scores by Item and Domain

Domain 1: Eating Behaviors (*n* = 6)			
FNPA Item	***M* (*SD*)**	**FSOC Item**	***M* (*SD*)**
2 (*n* = 146)	3.41 (0.62)	1 (*n* = 146)	4.54 (1.14)
3 (*n* = 146)	3.47 (0.69)	3 (*n* = 145)	3.74 (1.66)
4 (*n* = 145)	3.45 (0.51)	4 (*n* = 143)	3.97 (1.61)
5 (*n* = 146)	3.51 (0.57)	5 (*n* = 143)	3.97 (1.55)
9 (*n* = 146)	3.50 (0.74)	2 (*n* = 146)	4.47 (1.15)
10 (*n* = 146)	3.54 (0.61)	6 (*n* = 142)	4.11 (1.52)
FNPA EB (*n* = 145)	3.48 (0.32)	FSOC EB (*n* = 142)	4.13 (0.87)
Domain 2: Physical Activity Behaviors (*n* = 3)			
FNPA Item	***M* (*SD*)**	**FSOC Item**	***M* (*SD*)**
14 (*n* = 146)	3.56 (0.62)	8 (*n* = 141)	4.74 (0.77)
15 (*n* = 146)	3.66 (0.50)	7 (*n* = 142)	4.78 (0.78)
16 (*n* = 146)	3.02 (0.86)	9 (*n* = 140)	4.17 (1.25)
FNPA PAB (*n* = 146)	3.41 (0.56)	FSOC PAB (*n* = 140)	4.57 (0.67)
Domain 3: Screen Time Behaviors (*n* = 2)			
FNPA Item	***M* (*SD*)**	**FSOC Item**	***M* (*SD*)**
12 (n = 146)	3.32 (0.87)	10 (*n* = 140)	4.30 (1.24)
13 (*n* = 145)	3.63 (0.66)	11 (*n* = 140)	4.14 (1.54)
FNPA STB (*n* = 145)	3.48 (0.62)	FSOC STB (*n* = 140)	4.22 (1.15)
Domain 4: Sleep Behaviors (*n* = 1)			
FNPA Item	***M* (*SD*)**	**FSOC Item**	***M* (*SD*)**
19 (*n* = 146)	3.69 (0.57)	12 (*n* = 140)	4.80 (0.76)

Table 3. Correlations of Single FSOC and FNPA Items

	FSOC											
FNPA	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
2	0.59											
9		0.5										
3			0.73									
4				0.58								
5					0.62							
10						0.69						
15							0.44*					
14								0.58				
16									0.64			
12										0.7		
13											0.75	
19												0.57

Note: All correlations were statistically significant with $p < 0.001$; * denotes a correlation lower than desirable. The number of observations varied between 139 and 146, due to missing data.

Table 4. Correlations per Domain Between FSOC and FNPA

	FSOC			
FNPA	**EB**	**PAB**	**STB**	**SB**
EB	0.77			
PAB		0.72		
STB			0.8	
SB				0.57

Note: $p < 0.001$ for all correlations. The number of observations varied between 139 and 141. EB= Eating Behaviors; PAB= Physical Activity Behaviors; STB= Screen Time Behaviors; SB= Sleep Behaviors.

Test-retest reliability analyses produced correlations ranging from 0.75 to 1.0 (Table 5). The majority of correlations were positive and strong (above 0.9), with the exception of FSOC Item 2 (*In our family, we limit eating of chips, cookies, and candy*) which had a correlation of 0.75. All correlations reflected strong, positive, statistically significant relationships ($p < 0.001$).

Table 5. Correlations of FSOC reliability test

FSOC	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	0.94											
2		0.75										
3			0.94									
4				0.99								
5					0.90							
6						0.93						
7							0.94					
8								0.90				
9									0.91			
10										0.93		
11											0.96	
12												1.00

Note: $p < 0.001$ for all correlations. The number of observations varied between 55 and 57.

Discussion

The lack of strong empirical evidence supporting the effectiveness of obesity prevention efforts targeting the family home was the catalyst for development of the FSOC, a tool designed to assess family readiness to change obesity preventing behaviors. To evaluate the potential utility of the FSOC as an intervention tool, we tested the validity of the FSOC by comparing it to a validated measure of family level behaviors predictive of child BMI (Ihmels et al., 2009b). We also assessed test-retest reliability of the FSOC instrument via a subset of participants who completed the FSOC twice. Results of validity tests showed strong, positive correlations between the individual items, domain scores, and mean total FSOC and FNPA scores, suggesting

that both questionnaires are measuring family level behaviors in similar ways. Families who scored high on the FNPA tended to score high on the FSOC. One single item comparison, the correlation between FSOC item 7 (*In our family we encourage our child to move more every day*) and FNPA item 15 (*Our family encourages our child to be active every day)* was less than desirable (0.44), though still a strong, positive, statistically significant relationship ($p < 0.001$). After further review of the instrument, we believe the statement associated with FSOC Item 7 (provided above) may have been vague or confusing for respondents. As a result, we revised the statement to read: *In our family we encourage our kids to be active every day.* Preliminary data on this revised version show stronger, positive correlations between FNPA #15 and the rewritten FSOC item #7 ($r = 0.59$, $p < .001$; $n = 117$; unpublished data). In addition, results of reliability analyses showed that the FSOC had strong test-retest reliability. Almost all observed correlations were larger than 0.9, implying that respondents largely provided the same answers each time they filled out the FSOC. Only one item (FSOC Item 2) had a correlation below 0.9 (.75), but nevertheless still showed a strong, positive correlation.

Practical Application

There have been several instruments developed in recent years that measure family home environment characteristics, policies, and family behaviors associated with obesity (Bryant et al., 2008; Michelle A Ihmels et al., 2009b; Pinard et al., 2014). Data collected using these and other similar instruments have contributed significantly to our understanding of family-level factors that influence child and adult obesity (Johnson et al., 2012; Maitland, Stratton, Foster, Braham, & Rosenberg, 2013). However, despite the development of robust assessments of the home environment, few home-based interventions have successfully promoted long-lasting behavior change and subsequent changes in weight status among participating families (Showell et al., 2013). The current literature purports a need for the development or application of a theoretical framework that explains family behavior *change* (Gruber & Haldeman, 2009). The FSOC was developed upon the theoretical framework provided by the Transtheoretical Model of Behavior Change (DiClemente et al., 1991). As a result, the FSOC captures the temporal and intentional aspects of obesity-preventing behaviors shown to predict change in child weight status, and provides insight into families' readiness to change behaviors. Thus, the FSOC may have the potential to help practitioners better craft intervention messages and strategies that are more congruent with families' abilities to implement said strategies. For example, suppose three families score similarly on FNPA item #3, indicating that they "usually" eat meals as a family while watching TV. As practitioners, we may look at those data and assume this is low hanging fruit, and develop a goal setting strategy designed to provoke a change in this particular behavior. However, if we employ the FSOC, we may learn that there is considerable variability in their intent or readiness to change. One family may indicate they have no intent to change this behavior (pre-contemplation), a second family responds they plan to change that behavior (but not in the next 6 months; contemplation), and the third family indicates they plan to change

within 6 months (preparation). Thus, a one-size-fits-all approach is likely to fail. The transtheoretical model posits that behavior change strategies provided to pre/contemplators (e.g., increasing awareness of the pros and cons of behavior change), differ from the strategies for those in preparation (e.g., goal setting). This is what makes the FSOC unique. It was designed as a practitioner tool to aid in the development of targeted family-level, obesity preventing behavior change.

While the tool demonstrates strong validity, the study has its limitations. We did not randomly select the schools to disseminate the surveys. Rather, we approached several schools in the local community, and gained approval for survey dissemination from four. Thus, the sample is not representative of the general population. Furthermore, only 21.91% of respondents reported their children were eligible for school meal programs, which is lower than the district average of 36.5%. Thus, the findings may not be generalizable in a more diverse population. Given the limitations associated with school listservs, we were unable to calculate response rate or to compare respondents to non-respondents. As such, we may have some unidentifiable response bias (e.g., higher rates of healthy families responding to our invitations to complete the survey).

Despite these limitations and the need for additional testing among more diverse populations, the FSOC has the potential to meet an identified need related to family-directed, obesity prevention efforts. Creating home environments that support healthy weight development is a complex endeavor that requires more than simply informing parents about nutrition and physical activity recommendations. Families must be convinced to make obesity prevention a priority and must be ready to enact behavioral and environmental changes that will support preventive efforts. We hypothesize that the FSOC will enable improved targeting of family-level intervention strategies and promote better success in changing family-level behaviors associated with healthy weight development.

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