



Development and validation of the Multidimensional Home Environment Scale (MHES) for adolescents and their mothers



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ABSTRACT

The home environment is an important setting for the development of weight status in adolescence. At present a limited number of valid and reliable tools are available to evaluate the weight-related comprehensive home environment of this population. The goal of this research was to develop the Multidimensional Home Environment Scale which measures multiple components of the home. It includes psychological, social, and environmental domains from the perspective of an adolescent and the mother. Items were generated based on a literature review and then assessed for content validity by an expert panel and focus group in the target population. Internal consistency reliability was determined using Cronbach's α . Principal components analysis with varimax rotation was employed for assessment of construct validity. Temporal stability was evaluated using paired sample t-tests and bivariate correlations between responses at two different times, 1–2 weeks apart. Associations between adolescent and mother responses were utilized for convergent validity. The final versions contained 32-items for adolescents and 36-items for mothers; these were administered to 218 adolescents and mothers. The subscales on the questionnaires exhibited high construct validity, internal consistency reliability (adolescent: $\alpha = 0.82$, mother: $\alpha = 0.83$) and test-retest reliability (adolescent: $r = 0.90$, $p < 0.01$; mother: $r = 0.91$, $p < 0.01$). Total home environment scores were computed, with greater scores reflecting a better health environment. These results verify the utility of the MHES as a valid and reliable instrument. This promising tool can be utilized to capture the comprehensive home environment of young adolescents (11–14 years old).

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1. Introduction

The prevalence of obesity among adolescents in the United States (US) remains a serious public health problem, as over one-third of children aged 6–19 years are overweight (BMI-for-age > 85 th percentile) or obese (BMI-for-age > 95 th percentile) (Ogden, Carroll, Kit, & Flegal, 2014). The high rate of obesity is associated with immediate adverse health consequences such as asthma (Sutherland, 2008), sleep apnea (Sutherland, 2008), decreased insulin sensitivity (D'Adamo & Caprio, 2011), and psychosocial problems (negative body image (Vander Wal & Mitchell, 2011), smaller social networks (Puder & Munsch, 2010), and decreased quality of life (Forste & Moore, 2012)). In the long term, obese children are at a higher risk for hyperlipidemia (Franssen, Monajemi, Stroes, & Kastelein, 2011), nonalcoholic fatty liver (Han, Lawlor, & Kimm, 2010), orthopedic skeletal abnormalities (Jannini,

Doria-Filho, Damiani, & Silva, 2011), and metabolic syndrome (Van Villet et al., 2011).

Adolescence is a time of biological and psychosocial changes (McNaughton, 2011) which may impact behaviors related to healthy body weight status (Berge et al., 2014; Eaton et al., 2010). In this period, greater autonomy occurs for food choices, yet adolescents remain influenced by their home environment (Baranowski, Cullen, Nicklas, Thompson, & Baranowski, 2003; Campbell, Crawford, & Ball, 2006; Glanz, Sallis, Saelens, & Frank, 2005), with its psychological, social, and environmental features (Foltz et al., 2012). Research on some aspects of the home environment, such as availability of foods, and favorable dietary (Campbell et al., 2007) and weight (Boyle et al., 2015) outcomes is reported in the extant literature. In elementary school children, fruit and vegetable availability and accessibility in the household were significantly positively associated with higher fruit and vegetable intake (Cullen et al., 2003). These findings extend to adolescents, with positive relationships between presence of unhealthy foods and savory snack consumption in boys and girls and sweet snack intake in girls only (Campbell et al., 2007). Food availability also has been negatively linked to BMI percentile in 14–17 year olds (Boyle et al., 2015), as were parent modeling and self-efficacy in the home environment of middle school adolescents (Young, Fors, & Hayes, 2004).

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A number of instruments have been developed to measure social and physical attributes of the home that foster or impede healthful dietary behaviors; both validity and reliability reports for these scales have been published (Bryant et al., 2008; Gattshall, Shoup, Marshall, Crane, & Estabrooks, 2008; Couch, Glanz, Zhou, Sallis, & Saelens, 2014; Pinard et al., 2014; Project EAT (Eating for Teens), 2010). In 2008 Bryant et al. designed the Healthy Home Survey for parents of young children (3–8 years). Components measured in the 66-item instrument were food availability, eating practices, media and the physical environment. This survey exhibited a wide range of validity ($Kappa = 0.07–0.96$) and reliability ($ICC = 0.22–1.00$), with perishable foods displaying the lowest values (Bryant et al., 2008). This restricts its utility, yet it remains useful for assessment of some physical and social correlates of eating behavior and physical activity in young children.

For older children (8–13 years), Gattshall (2008) created the Healthy Environment Survey, which consisted of 10 subscales regarding food availability/accessibility, role modeling, and parental policies in relation to fruit/vegetable intake and sugar sweetened beverages/snacks and physical activity (Gattshall et al., 2008). It documented the perspective of the parent on child nutrition (BLOCK kid's food frequency questionnaire) (Hunsberger, O'Malley, Block, & Norris, 2015) and physical activity (accelerometer data). Adequate internal consistency reliability ($\alpha > 0.6$) and test-retest reliability ($ICC > 0.6$) were observed for most items. In 2014, Couch also published a scale containing an extensive description of the home food environment of young children and its impact on diet quality and weight status (6–11 years) (Couch et al., 2014). Socio-cultural practices related to eating such as encouragement/modeling and family rules showed strong positive while permissive parenting exhibited negative relationships with fruit and vegetable intake, but not BMI. Although both of the above instruments excluded assessment of psychological determinants of weight status, these remain appropriate for assessment of social and physical features of the home environment that impact weight outcomes of this age group of children.

The Comprehensive Home Environment Survey, was created for a wider range of children, ages 5–17 years, spanning various stages of childhood (Pinard et al., 2014). This 181-item scale comprised physical measures such as availability and accessibility to foods and physical activity opportunities, as well as familial factors (parental policies to support healthy eating and exercise). Psychometric analysis revealed excellent internal consistency ($\alpha = 0.74–0.92$) and temporal stability ($r = 0.73–0.96$) (Pinard et al., 2014). Although children over the ages of 9 years were involved in completion of a portion of the survey, validity and reliability were based on parent report. Evaluation of the home from the perspective of the parent only may lead to biased results, as adolescent perceptions of their home environment may have a great degree of influence on their behavior. Also, this scale does not consider psychological variables within the home environment; this is important, as it is conceivable that adolescents are able to exercise control over their food environment in some instances, but not others.

Project EAT (Eating Among Teens) survey is a multidimensional tool consisting of individual, environmental, and behavioral factors related to dietary intake and weight status of adolescents. This 221-item survey explores multiple contexts in which adolescent behavior occurs. Subscale analysis resulted in a range of internal consistency ($\alpha = 0.24–0.94$) and test-retest reliability ($r = 0.40–0.94$), with rigorous psychometrics for a significant portion of the subscales. Although individual factors were integrated, they were not evaluated in reference to the home specifically and displayed less than ideal or missing psychometrics (eating in response to emotional cues: $\alpha = 0.24$, $r = N/A$; attitudes: $\alpha = 0.51$, $r = 0.77$), thus limiting the usefulness of these measures. Despite inclusion of the home as one of the settings on this instrument, items were limited to social and physical attributes and the built environment was not a main focus (Project EAT (Eating Among Teens), 2010). The built environment, characteristics of the space surrounding the home, is another area of influence on adolescent weight status

(Larson, Wall, Story, & Neumark-Sztainer, 2013). Assessments of this construct by project EAT were conducted primarily using the Geographic Information Systems (GIS). The presence of convenience stores and access to parks and recreational space using this GIS were associated with BMI in boys and girls (Larson et al., 2013). Use of GIS captures spatial information regarding the physical structure, which offers great utility. Yet it excludes social characteristics of the built environment and the subjective experience of adolescents in their own neighborhood, both of which may impact obesity.

Current methods to measure the home food environment of adolescents have several shortcomings such as inadequate psychometrics, nonspecific age group design, and exclusion of the perspective of the adolescent. In addition, instruments to date lack an assessment of psychological responses to dietary behaviors within the home and inclusion of the built environment. Exploration of the various levels of influence – psychological, social, and environmental – in a context-specific manner is critical. To our knowledge, a scale does not exist that is specific to the home environment that exhibits rigorous psychometrics with psychological, social, and environmental features from the perspective of both the adolescent and mother. This research will utilize a new instrument, the Multidimensional Home Environment Scale (MHES), to examine the comprehensive home environment of adolescents.

Mothers are of special interest because their food intake (Fisher, Mitchell, Smiciklas-Wright, & Birch, 2002; Nicklas et al., 2001) and weight status (Strauss & Knight, 1999) are related to that of their children, presumably due to their role as "gatekeepers" of food in the household (Campbell et al., 2007). Thus, mothers and their adolescents will be assessed in this study, as they provide much of the physical and social context in which adolescent food choices are made (Pinard et al., 2014). When mothers are the preparer of meals, their consumption of fruit, vegetable and high-fat foods are positively associated with that of other family members (Hannon, Bowen, Moinpour, & McLerran, 2003). Therefore, it is not surprising that unhealthy eating behaviors of mothers are associated with a higher BMI of their adolescents (Gallant et al., 2013). The goal is to develop a valid and reliable tool for measurement of the comprehensive home and built environment, with inclusion of the mother as a modulator.

2. Materials and methods

2.1. Scale development

Steps in the development of the scale are presented in Fig. 1. First, a literature search of hypothesized and confirmed factors in the home environment known to be associated with obesity was conducted. Operational definitions of constructs were established by the expert panel and items to reflect each subscale were generated. The panel ($n = 10$) of PhDs and RDs in Nutrition evaluated the items for readability, item difficulty, content and bias. Subsequently, readability and comprehension were determined by a focus group of adolescents, ages 11–14 years ($n = 7$). Adolescents were asked to read the questions and identify any words that required further clarification. Qualitative input from the expert panel and focus group was incorporated in the final version of the questionnaire. Questions were created at a fourth-grade reading level, using three scoring systems (frequency, open response, and Likert format). Likert scales ranged from 1 = strongly disagree to 5 = strongly agree for a total of 5 points. Items that were excluded at this stage did not have strong theoretical support based on the review of the panel.

2.2. Study design and subjects

A total of 228 mothers and adolescents (114 dyads) were recruited from middle schools, summer camps, online posts, and word-of-mouth. Enrollment criteria for mothers were: 1) ability to read and write English; 2) child between 11–14 years old; and 3) access to the

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