Measures of the home environment related to childhood obesity: a systematic review

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Abstract

Objective: Due to a proliferation of measures for different components of the home environment related to childhood obesity, the purpose of the present systematic review was to examine these tools and the degree to which they can validly and reliably assess the home environment.

Design: Relevant manuscripts published between 1998 and 2010 were obtained through electronic database searches and manual searches of reference lists. Manuscripts were included if the researchers reported on a measure of the home environment related to child eating and physical activity (PA) and childhood obesity and reported on at least one psychometric property.

Results: Of the forty papers reviewed, 48% discussed some aspect of parenting specific to food. Fifty-per cent of the manuscripts measured food availability/accessibility, 18% measured PA availability/accessibility, 20% measured media availability/accessibility, 30% focused on feeding style, 23% focused on parenting related to PA and 20% focused on parenting related to screen time.

Conclusions: Many researchers chose to design new measures for their studies but often the items employed were brief and there was a lack of transparency in the psychometric properties. Many of the current measures of the home food and PA environment focus on one or two constructs; more comprehensive measures as well as short screeners guided by theoretical models are necessary to capture influences in the home on food and PA behaviours of children. Finally, the current measures of the home environment do not necessarily translate to specific sub-populations. Recommendations were made for future validation of measures in terms of appropriate psychometric testing.

Keywords
Child obesity
Home environment
Measurement
Psychometrics

The prevalence and severity of childhood overweight have increased significantly in the past three decades1–5. Negative sequelae from being overweight during childhood include being at a higher risk for a number of chronic and acute conditions4 as well as negative social and psychological outcomes5. The source for the majority of childhood obesity cases can be attributed to energy imbalance which has been linked to changes in the food and physical activity (PA) environments6,7.

The home environment has been documented as one that can either facilitate or inhibit healthful eating and PA, and caregivers play a key role in the development of the social and physical environment within a household8,9. From a social environment perspective, caregivers serve as role models for PA, dietary and media behaviours and influence the child’s health behaviours and weight status through parenting strategies and feeding styles10–21. In addition, a child participates in more PA when a greater amount of space and active toys are available in the home22,23. Likewise, access to food items can impact consumption24,25. Similarly, when more screen opportunities are available, children are more likely to engage in sedentary behaviour26,27.

Some researchers have conducted reviews of the home food environment28,29, while others have described measures of the community food environment30. There have also been a number of literature reviews on interventions targeting families to improve PA, diet and weight status in children31–36. In each case there has been a consistent call for assessing relevant home environment variables with validated measures. To develop an accurate assessment of the influence of the home environment it is important to have strong conceptual models and appropriate validation methodology37. Several groups of
Researchers have worked independently over the past few decades developing measures of caregiver influence on childhood obesity that are pertinent to specific programmes of research. As a result there is a wide variety of measures available that range in scope (i.e. constructs assessed). The disadvantage of having multiple measures of the home environment is the limited ability to compare results across studies. Owing to the proliferation of measures of different components of the home environment there is a need to provide clarity on which tools are available and the degree to which these can validly and reliably provide a comprehensive assessment of the home environment. Therefore, the purpose of the present systematic review is to examine the scope, reliability and validity of measurement tools of the home environment as it relates to childhood obesity.

**Design**

**Evidence acquisition**

Manuscripts published between 1990 and 2010 were searched for in the following databases: MEDLINE, PYSCLIT, CINAHL, ERIC and PsychINFO. The inclusive dates were selected since no review on measurement of the home environment has been conducted previously (only reviews of correlates and interventions) and we wanted to include the full spectrum of research in this area. Measurement work in this area conducted prior to 1990 is very limited, and measures from that time have generally been incorporated into existing literature. Citations of the articles resulting from the searches were also scanned for inclusion. Once relevant manuscripts validating measures were identified, further measurement articles were searched for using the title of the measure as a search term. Relevant studies were considered if the manuscript reported on a measure of the home environment related to children’s diet, PA and weight status while also reporting at least one indicator of reliability or validity.

Measures were included if they were used in families with children between birth and 18 years of age, if they were completed by a child or an adult, and, for the latter, only if the adult measure was in reference to the home environment. The format could be paper-and-pencil, telephone/in-person interview, or completed by the researcher through direct observation.

Key terms utilized in the search included those defined by a Conceptual Model for Eating and Physical Activity Environment\(^{(38)}\): food physical environment, the food social environment, PA physical environment, PA social environment, media physical environment and media social environment, as well as terms related to psychometric properties. In each case (i.e. food, PA, media), the physical environment included availability and accessibility and the social environment included caregiver role modelling and policies (Fig. 1).

Exclusion criteria were: (i) unpublished literature reviews; (ii) manuscripts utilizing only a qualitative methodology; (iii) those not specific to children; and (iv) those in language other than English. Further, articles were also excluded if they (v) did not report on at least one of the following psychometric properties: test–retest reliability, inter-rater reliability, internal consistency, criterion validity, convergent validity, divergent validity, predictive validity or factorial validity. Two authors reviewed each manuscript and coded for home environment constructs and psychometric testing in order to meet criteria for inclusion.
Results

Overall, the combined search strategies identified 2606 unique manuscripts. After reviewing the abstracts of these studies, 2463 were eliminated; another 109 were eliminated upon reading the full manuscript. The main reason for excluding articles was that the study did not report on any psychometric properties of the measure (see Table 1 for a summary of psychometrics). An additional six manuscripts were added from screening reference lists, yielding a total of forty manuscripts included in the present review. Of these forty manuscripts overlapping constructs assessed included: 48% (n = 19) some aspect of the food social environment(18,23,36,38,43,45,47,54–65); 50% (n = 20) food physical environment(18,36,38–47,54,55,57,59,61–63,65); 18% (n = 7) PA physical environment(23,38,48,51,52,63); 20% (n = 8) media physical environment(23,27,38,49,51–53,63); 30% (n = 12) food social environment(38,57,60,63,66–70,72–74); 23% (n = 9)(23,38,48,52,54,56,60,63,64) parenting related to PA; and 20% (n = 8) PA and media social environment(23,27,38,52,53,60,63,64).

Psychometric properties across measures

Within each manuscript, internal consistency was the most commonly reported indicator of reliability (70%) followed by test–retest reliability (38%) and inter-rater reliability (8%). Only 5% reported on all three reliability indicators. Predictive and factorial validity were reported for 58% and 25% of the measures, respectively. However, convergent (8%) and criteria (10%) validity were rarely reported and no study provided all indicators of validity (Table 1).

Food availability and accessibility

Several researchers have developed measures of the availability and accessibility of healthy and less healthy foods in the home with most emphasis placed on fruits and vegetables(18,36,38–47,54,55,57,59,61–63,65). While no gold standard exists for examining availability and accessibility of foods, some trials have used in-home inventories. This procedure involves a researcher checking food items that they observe as being present in the home(39,40). Despite the validity of in-home inventories conducted by researchers, it is often not feasible to conduct this type of resource-intensive assessment and a checklist format completed by participants may be more practical. Many of the checklists focus on availability and accessibility of fruit and vegetables(11,40–45) and some on less healthful foods(18), while others include a full range of food groups to reflect the typical US diet(46). Availability has also been assessed most basically by asking whether caregivers purchase foods on their child’s request and if foods are visible(47). When compared with consumption behaviours, the availability and accessibility of specific foods were related(11,18,40–45,47).

Fruit and vegetable availability and accessibility checklists have displayed moderate internal consistency even when availability and accessibility scales are collapsed (i.e. median $\alpha = 0.69$)(49). When compared with researcher observation, sensitivity and specificity were generally supported with higher false positive rates in the case of perishable items which tend to be consumed at a faster rate(41). Additionally, some studies indicate that caregivers are more likely to report greater availability of fruits and vegetables than their children and that self-reported intake is more likely to correlate with the children’s report(42,43). Furthermore, the scales showed improved internal consistency when children reported ($\alpha = 0.82–0.92$)(42,43). In the case of a more comprehensive checklist, agreement between the researcher and the participant (criterion validity) was substantial, supporting measure validity(46).

Physical activity availability and accessibility

Seven studies assessed PA availability and accessibility. Checklists are a commonly used method to assess these components of the home environment(23,38,48,51,52,63). In one comprehensive and well-validated measurement of the PA environment Sirard et al.(49) asked participants to record whether they had specific equipment in categories and each item was multiplied by the score of accessibility. From this, researchers could rank the overall quality of the home environment score by a ratio of activity-to-media equipment(49). The researchers recommended that this instrument be used in conjunction with other measurements (e.g. home food availability) to identify obesogenic home environments(49).

While these PA scales displayed moderate to high test–retest reliability (intra-class correlation coefficient (ICC) =0.72–0.99)(48,49) one exception was for having a covered area outdoors and having active toys, where the internal consistency was low to moderate ($\alpha = 0.43–0.77$)(48). Criterion validity, established by comparing the responses from the participant to those that were observed by the researcher, was generally high (Pearson $r = 0.67–0.98$)(49).

Media equipment availability

In a technology- and media-driven world, sedentary activities are often determined by the opportunities the child has to engage in screen behaviours(50). Typically caregivers complete an inventory of items in their home that may encourage or support children’s screen-based behaviours: television, digital video disc player, video games and others(27,53,52). Similar to the assessment of fruit and vegetable availability, some researchers take a simple approach and inquire how many televisions are in the home and whether the child has a television in his/her bedroom(52,53). With these measures, only the test–retest reliability was reported and the agreement between tests was high in each case (91–99% agreement(27), ICC = 0.54–0.92(51), ICC = 0.79–0.90(52)).
<table>
<thead>
<tr>
<th>Authors</th>
<th>Construct assessed</th>
<th>Participants</th>
<th>Sample low-income</th>
<th>Culture/ethnicity</th>
<th>Inter-rater reliability</th>
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<tr>
<td><strong>FOOD PHYSICAL AND SOCIAL MEASURES</strong></td>
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<tr>
<td>Cullen et al. (27)</td>
<td>FV availability and accessibility, feeding style, parental role modelling and policies of healthy eating</td>
<td>4th–6th grade students (n = 230)</td>
<td>No</td>
<td>25% African American, 29% European American, 37% Mexican American, 9% Asian</td>
<td>Not assessed</td>
<td>Pearson</td>
<td>$\alpha = 0.19-0.88$</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Account for</td>
<td>Not assessed</td>
</tr>
<tr>
<td>Campbell et al. (18)</td>
<td>Unhealthy food availability, policies for healthy eating (meal and eating environment, parenting consistency)</td>
<td>Parents of adolescents mean age 13:0 (±0.2) years (n = 347)</td>
<td>No</td>
<td>Not reported (study conducted in Australia)</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>$\alpha = 0.44-0.82$</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Regression models</td>
<td>Not assessed</td>
<td>Not assessed</td>
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<tr>
<td>Vereecken et al. (68)</td>
<td>Parental policies and role modelling regarding eating</td>
<td>Parents of pre-school children in Belgium, mean age 4:7 (±1:0) years (n = 346)</td>
<td>No</td>
<td>Not reported (study conducted in Belgium)</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>$\alpha = 0.71-0.94$</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Spearman correlations between intake and variables, $r = 0.16-0.59$</td>
<td>Not assessed</td>
<td>Not assessed</td>
</tr>
<tr>
<td>Campbell et al. (58)</td>
<td>Parental role modelling and policies for healthy eating, FV availability</td>
<td>Parent-child dyads, mean age of children 6:1 years (n = 560)</td>
<td>Yes, range of SES</td>
<td>Not reported (study conducted in Australia)</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>$\alpha = 0.64-0.90$</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Regression accounted for 2.8–11.7% of the variance in outcome variables, $r = 0.09-0.33$</td>
<td>Not assessed</td>
<td>Not assessed</td>
</tr>
<tr>
<td>Young et al. (26)</td>
<td>FV availability, policies for healthy eating, parental modelling</td>
<td>Students aged 12–16 years (n = 366)</td>
<td>33% reported free or reduced-price lunch</td>
<td>82% Caucasian, 6% African American, 4% multi-racial, 3% Asian, 3% Hispanic, 3% American Indian</td>
<td>Not assessed</td>
<td>$\alpha = 0.65-0.85$</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Regression supported variables predicting FV consumption accounting for 39% of the variance</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td></td>
</tr>
<tr>
<td>Neumark-Sztainer et al. (61)</td>
<td>Parental policies and role modelling of healthy eating, availability of FV</td>
<td>Children and adolescents at middle and high schools, mean age 14:9 (±1:7) years (n = 3957)</td>
<td>No</td>
<td>School districts serving SES-diverse populations</td>
<td>Not assessed</td>
<td>$\alpha = 0.43-0.81$</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Pearson correlations with outcome variables, $r = 0.09-0.33$</td>
<td>Support for a 13-factor solution</td>
<td>Not assessed</td>
<td>Not assessed</td>
</tr>
<tr>
<td>Wilson et al. (65)</td>
<td>FV availability and accessibility, parental policies for health eating (all types) availability</td>
<td>Children aged 10–12 years (n = 141)</td>
<td>No</td>
<td>83%, European American, 6% African American, 4% Native American, 8% ‘other’</td>
<td>Not assessed</td>
<td>95% agreement between researchers</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Pearson $r = 0.36-0.48$</td>
<td>Not assessed</td>
<td>Not assessed</td>
</tr>
<tr>
<td>Rosno et al. (36)</td>
<td>FJ/V availability and accessibility</td>
<td>Parents of overweight children aged 6–18 years, mean age 11:6 (±2:5) years (n = 63)</td>
<td>No</td>
<td>48% white, 33% Mexican American, 8% black, 11% Asian/other</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>$\alpha = 0.69$</td>
<td>Not assessed</td>
<td>Pearson correlation to intake, $r = 0.11-0.54$</td>
<td>Not assessed</td>
<td>Not assessed</td>
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<tr>
<td>Hearn et al. (46)</td>
<td>FJ/V availability</td>
<td>Parents of 4th–6th grade children interviewed; mean age of parents 42:1 years (n = 22)</td>
<td>No</td>
<td>Not assessed (study conducted in Australia)</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Sensitivity and specificity: 34.5–42.0% (75.9% agreement; false positive: 19.4–20.6%; false negative: 3.6–4.1%)</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
</tr>
<tr>
<td>Marsh et al. (41)</td>
<td>FV availability</td>
<td>Parents of 4th–6th grade children interviewed; mean age of parents 42:1 years (n = 48)</td>
<td>No</td>
<td>Not assessed (study conducted in Australia)</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>$\alpha = 0.30-0.85$</td>
<td>Not assessed</td>
<td>For children with high FJ/V preferences, FJ/V availability predicted consumption; both availability and accessibility were significantly related to consumption for children with low FJ/V preferences</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td></td>
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<tr>
<td>Cullen et al. (43)</td>
<td>FV availability and accessibility</td>
<td>Children with non-participating parents (26% African American, 31% European American, 31% Hispanic, 12% Asian; children with participating parents 22% African American, 32% European American, 33% Hispanic, 13% Asian)</td>
<td>No</td>
<td>Not assessed</td>
<td>$\alpha = 0.30-0.85$</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
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</table>
Table 1 Continued

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<tr>
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<tr>
<td>De Bourdeaudhuij et al.</td>
<td>Parental role modelling and policies for nutrition, food availability</td>
<td>Children aged 10–11 years (n = 326)</td>
<td>No</td>
<td>76 % in Norway, 99 % in Spain, 100 % in Portugal, 82 % in Denmark and 99 % in Belgium</td>
<td>Not assessed</td>
<td>ICC = 0.42–0.88</td>
<td>α = 0.13–0.93</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Significant Spearman correlations in appropriate directions, r = −0.20–0.54</td>
<td>Not assessed</td>
<td>Not assessed</td>
</tr>
<tr>
<td>Cullen and Thompson</td>
<td>FV availability</td>
<td>Parents of children aged 9–12 years (n = 67)</td>
<td>Mostly African American</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>α = 0.82–0.92</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
</tr>
<tr>
<td>Cullen et al.</td>
<td>FV availability and accessibility, parental policies for healthy eating</td>
<td>Parents of 6th grade children, interviewed (n = 109)</td>
<td>61 % African American, 67 % Hispanic American, 54 % Euro-American</td>
<td>Not assessed</td>
<td>Pearson r = 0.09–0.92</td>
<td>α = 0.06–0.84</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
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<tr>
<td>Fukerson et al.</td>
<td>Food availability</td>
<td>Sample 1 (criterion validity): n = 51 adults; sample 2 (construct validity), parents of a child 10–17 years (n = 349)</td>
<td>Sample 1: 68 % white, 14 % black, 6 % American Indian, 2 % Asian, 4 % Hispanic; sample 2: 99 % white</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Sensitivity and specificity for food groups in range 0.70–0.95</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
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<tr>
<td>Dave et al.</td>
<td>Parental role modelling and policies related to nutrient, FV availability and accessibility</td>
<td>Parents of children in 1st–5th grade (n = 184)</td>
<td>Mostly Hispanic</td>
<td>Not assessed</td>
<td>α = 0.69–0.87</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Support for a 6-factor solution</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
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<tr>
<td>Evans et al.</td>
<td>FV availability and accessibility, parental policies for healthy eating</td>
<td>Parents of children in 4th–5th grade (n = 31)</td>
<td>27 % low SES</td>
<td>50 % African American</td>
<td>Not assessed</td>
<td>α = 0.67–0.94</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td></td>
</tr>
<tr>
<td>van Assema et al.</td>
<td>Parent–child dyads with children aged 12–14 years, mean child age 12.7 years, mean parent age 41.9 years (n = 502)</td>
<td>Not reported</td>
<td>(participants were Dutch)</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Significant ρ = −0.24–0.92</td>
<td>Not assessed</td>
<td>Not assessed</td>
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FOOD SOCIAL ENVIRONMENT – FEEDING STYLE

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<tr>
<td>Birch et al.</td>
<td>Feeding style</td>
<td>Sample 1: parents of 5–9-year-old girls (n = 394); sample 2: parents of 8–11-year-old children (n = 148); sample 3: parents of 7–11-year-old children (n = 126)</td>
<td>Sample 1: 29% &lt; SUS 35 000 pa</td>
<td>85 % non-Hispanic white, 9 % African American, 4 % Hispanic; sample 3: 90 % Hispanic, 6 % non-Hispanic white</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>α = 0.70–0.92</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Support for a 7-factor model</td>
<td>Not assessed</td>
<td>Not assessed</td>
</tr>
<tr>
<td>Robinson et al.</td>
<td>Feeding style</td>
<td>Parents of children (mostly mothers), mean age of child 8–4 (n = 0–4 years) (n = 95)</td>
<td>Yes</td>
<td>44 % white, 20 % Asian, 3.8 % African American, 19.3 % Hispanic, 9.7 % multi-ethnic, 0.7 % Native American, 1.3 % Pacific Islander</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>α = 0.61–0.64</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td></td>
</tr>
<tr>
<td>Kremil and Warschburger</td>
<td>Feeding style</td>
<td>Mothers of 3–6-year-olds (n = 219)</td>
<td>33.5 % below poverty level</td>
<td>94.5 % German nationality</td>
<td>Not assessed</td>
<td>Pearson r = 0.41–0.78</td>
<td>α = 0.73–0.93</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Feeding strategies accounted for 22–2 % of eating habits</td>
<td>Not assessed</td>
<td>Not assessed</td>
</tr>
<tr>
<td>Wardle et al.</td>
<td>Feeding style</td>
<td>Families with same-sex twins, mean age 4 years (n = 214)</td>
<td>No</td>
<td>No information</td>
<td>Not assessed</td>
<td>Pearson correlation r = 0.76–0.83</td>
<td>α = 0.69–0.92</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Compared subscale results to weight status of the family, not related diet behaviours</td>
<td>Not assessed</td>
<td>Not assessed</td>
</tr>
<tr>
<td>Joyce and Zimmer-Gembeck</td>
<td>Feeding style</td>
<td>Caregivers to children aged 4–8 years, mean age 5.7 (n = 0–9) years (n = 247)</td>
<td>No</td>
<td>94 % white (study conducted in Australia)</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>α = 0.60–0.83</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Predicted BMI Z-score with PFDO subscales, related health behaviours not tested</td>
<td>Not assessed</td>
<td>Not assessed</td>
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<tr>
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<td>Convergent validity</td>
<td>Predictive validity</td>
<td>Factorial validity</td>
<td>Content validity</td>
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<tr>
<td>Arredondo et al.</td>
<td>Feeding style</td>
<td>Latino mothers of children K-grade 2 (n 287)</td>
<td>40% made &lt; $US 1500/month</td>
<td>Latino</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>α = 0.72–0.87</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Monitoring, reinforcement and discipline correlated with healthy eating and unhealthy eating (r = −0.17–0.45)</td>
<td>Not assessed</td>
<td>Not assessed</td>
</tr>
<tr>
<td>Ogden et al.</td>
<td>Feeding style</td>
<td>Study 1: parents of children aged 4–11 years (n 2397); study 2: parents of children (n 61)</td>
<td>No</td>
<td>Study 1: 80% white</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>α = 0.63–0.83</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Significant correlation with CFQ subscales, Pearson r = 0.26–0.53 CFQ, F(9,518) = 3.17, P &lt; 0.001; Parenting Dimensions Inventory, F(27,602) = 2.26, P &lt; 0.001</td>
<td>Not assessed</td>
<td>Not assessed</td>
</tr>
<tr>
<td>Hughes et al.</td>
<td>Feeding style</td>
<td>Parents of children aged 3–6 years (n 231)</td>
<td>Yes</td>
<td>43% African American, 56% Hispanic</td>
<td>Not assessed</td>
<td>Pearson r = 0.62–0.85</td>
<td>α = 0.58–0.86</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
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</table>

**PHYSICAL ACTIVITY AND/OR MEDIA PHYSICAL AND SOCIAL MEASURES**

<table>
<thead>
<tr>
<th>Authors</th>
<th>Construct assessed</th>
<th>Participants</th>
<th>Sample low-income</th>
<th>Culture/ethnicity</th>
<th>Inter-rater reliability</th>
<th>Test–retest reliability</th>
<th>Internal consistency</th>
<th>Criteria validity</th>
<th>Convergent validity</th>
<th>Predictive validity</th>
<th>Factorial validity</th>
<th>Content validity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hume et al.</td>
<td>Parental role modelling and policies for PA, PA availability</td>
<td>Grade 5 and 6 children, mean age 11–1 years (n 39)</td>
<td>No</td>
<td>Not reported (study conducted in Australia)</td>
<td>Not assessed</td>
<td>ICC = 0.72–0.88</td>
<td>α = 0.43–0.77</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
</tr>
<tr>
<td>Sirard et al.</td>
<td>PA availability and accessibility (6 media)</td>
<td>Parent–child dyads with children aged 10–18 years (n 31)</td>
<td>No</td>
<td>52% white, 19% African American, 6% Mexican American, 6% Native American, 6% Asian</td>
<td>Not assessed</td>
<td>ICC = 0.87–0.99; x = 0.42–1.00</td>
<td>Not assessed</td>
<td>Pearson r = 0.67–0.98</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
</tr>
<tr>
<td>Rosenberg et al.</td>
<td>PA and media availability</td>
<td>Adolescents (n 189); mean age 14–6 years, parents of adolescents (n 171; mean age 45–60 years), and parents of younger children (n 116; parents' mean age 39–6 years; children's mean age 6–3 years)</td>
<td>No</td>
<td>62% white (participants from 3 US cities)</td>
<td>Not assessed</td>
<td>Between parent and child agreement, ICC = 0.49–0.93</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Availability of equipment predicted media behaviour, ΔR² = 0.00–0.15</td>
<td>Not assessed</td>
<td>Not assessed</td>
</tr>
<tr>
<td>Timperio et al.</td>
<td>PA and media availability and role modelling</td>
<td>Boys and girls aged 10–12 years (n 344)</td>
<td>Yes</td>
<td>Not reported (study conducted in Australia)</td>
<td>Not assessed</td>
<td>ICC = 0.79–0.90</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
</tr>
<tr>
<td>van Zutphen et al.</td>
<td>Policies regarding TV, TV availability</td>
<td>Parents of children aged 4–12 years (n 1926)</td>
<td>Yes</td>
<td>Not reported (study conducted in Australia)</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Mann-Whitney, Kruskal-Wallis and ANOVA supported differences in TV viewing based on variables measures (P &lt; 0.05)</td>
<td>Not assessed</td>
<td>Not assessed</td>
</tr>
<tr>
<td>Salmon et al.</td>
<td>Availability of media equipment, parental role modelling and policies regarding screen time</td>
<td>Parents of children 10–12 years old, mean age 11–5 years (n 927)</td>
<td>30% low SES</td>
<td>Not reported (study conducted in Australia)</td>
<td>Not assessed</td>
<td>ICC = 0.60–0.83</td>
<td>α = 0.061</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Significant f tests between subscales and TV viewing and PA levels</td>
<td>Not assessed</td>
<td>Not assessed</td>
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</table>

**COMBINED FOOD AND PHYSICAL ACTIVITY MEASURES**

<table>
<thead>
<tr>
<th>Authors</th>
<th>Construct assessed</th>
<th>Participants</th>
<th>Sample low-income</th>
<th>Culture/ethnicity</th>
<th>Inter-rater reliability</th>
<th>Test–retest reliability</th>
<th>Internal consistency</th>
<th>Criteria validity</th>
<th>Convergent validity</th>
<th>Predictive validity</th>
<th>Factorial validity</th>
<th>Content validity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Golan and Weizman</td>
<td>Role modelling of eating behaviours and PA, availability of unhealthy foods (stimulus)</td>
<td>Mothers of children aged 6–11 years (n 60)</td>
<td>No</td>
<td>Not reported (study conducted in Israel)</td>
<td>Pearson r = 0.81–0.94</td>
<td>Pearson r = 0.78–0.90</td>
<td>α = 0.78–0.88</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Correlation between child's weight loss and change in FEAHQ score, Pearson r = 0.46–0.73</td>
<td>Not assessed</td>
<td>Expert panel supported items</td>
</tr>
<tr>
<td>Authors</td>
<td>Construct assessed</td>
<td>Participants</td>
<td>Sample low-income</td>
<td>Culture/ethnicity</td>
<td>Inter-rater reliability</td>
<td>Test–retest reliability</td>
<td>Internal consistency</td>
<td>Criteria validity</td>
<td>Convergent validity</td>
<td>Predictive validity</td>
<td>Factorial validity</td>
<td>Content validity</td>
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<tr>
<td>Gattshall et al.</td>
<td>All dimensions</td>
<td>Parents (mean age 40 years) of children aged 8–12 years (mean age 10.5 years)</td>
<td>No</td>
<td>61.3% white, 61.1% black, 3.3% Asian, 3.8% American Indian, 23.6% Latino</td>
<td>Pearson ( r = -0.08 )</td>
<td>Pearson ( r = 0.43 )</td>
<td>( \alpha = 0.59 )</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Pearson correlations with outcome variables, ( r = 0.14 )</td>
<td>Not assessed</td>
<td>Not assessed</td>
</tr>
<tr>
<td>Larios et al.</td>
<td>Policies for diet, PA and media, feeding style</td>
<td>Phase 2: mothers of children kindergarten – 2nd grade (n=91); phase 3: mothers of children in elementary school (n=714)</td>
<td>37% made &lt;£1500/month Latina mothers</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>( \alpha = 0.81 )</td>
<td>Not assessed</td>
<td>Significant correlations with corresponding CFQ subscale</td>
<td>Significant correlations with behavioural strategies related to PEAS subscales</td>
<td>Five-factor structure supported with 7–24.5% of variance accounted for</td>
<td>Not assessed</td>
<td></td>
</tr>
<tr>
<td>Spurrier et al.</td>
<td>PA and media availability, role modelling of PA, parental policy regarding PA, media and diet</td>
<td>Parents of pre-school children (n=280)</td>
<td>Not reported (study conducted in Australia)</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Significant ANOVA between inventory subscales and screen time, PA and diet behaviours</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td></td>
</tr>
<tr>
<td>Bryant et al.</td>
<td>ALL dimensions</td>
<td>Parents of children aged 3–8 years (n=85)</td>
<td>10.5% &lt;£1500/month 72.9% white and 23.5% black</td>
<td>Not assessed</td>
<td>% agreement = 84.4–95.6</td>
<td>Not assessed</td>
<td>% agreement = 80.5–96.3</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td></td>
</tr>
<tr>
<td>Pearson et al.</td>
<td>Parental role modelling and policies for PA and eating</td>
<td>Respondents selected from post codes from high, mid, low income levels</td>
<td>Not reported (study conducted in Australia)</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Pearson ( \chi^2 ) test revealed differences in diet and PA behaviours based on variables measured (OR = 0.4–2.6)</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td></td>
</tr>
<tr>
<td>Ihmels et al.</td>
<td>Policies for TV, parental role modelling for TV, diet and PA</td>
<td>Parents of 1st grade children (n=438)</td>
<td>34% &lt;£20 000 pa 68.0% Caucasian, 11.6% African American, 11.5% Hispanic, 4.8% Asian (4.1% ‘other’)</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>( \alpha = 0.72 )</td>
<td>Not assessed</td>
<td>Not assessed</td>
<td>Significant Pearson correlations with outcome variables, ( r = -0.02 )</td>
<td>Support for a 5-factor solution accounting for 5–17% of variance</td>
<td>Not assessed</td>
<td></td>
</tr>
<tr>
<td>Total (n=40)</td>
<td>40 (100%)</td>
<td>16 (40%)</td>
<td>15 (38%)</td>
<td>28 (70%)</td>
<td>4 (10%)</td>
<td>3 (8%)</td>
<td>23 (58%)</td>
<td>1 (3%)</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

FV, fruit and vegetable; availability and accessibility – physical environments; parental policies/rules, role modelling – social environments; FJV, fruit, juice and vegetable; PA, physical activity; TV, television; SES, socio-economic status; ICC, intra-class correlation coefficient; CFQ, Child Feeding Questionnaire; PFDQ, Parent Feeding Dimensions Questionnaire; FEAHQ, Family Eating and Activity Habits Questionnaire; PEAS, Parenting Strategies for Eating and Activity Scale.
Role modelling and policies

Beyond the physical environment in the home, caregivers are also responsible for establishing the social environment that influences health behaviours\(^{(18,27,36,47,48,51,56–58)}\). Some researchers focus on social support for healthy eating and PA\(^{(36,55)}\), while others use different terminology for a similar construct, such as asking children how often they were active with family members and if somebody at home encouraged them to be active\(^{(54)}\). Another method to consider is how caregivers can socially influence health behaviours in their children is to examine rules and policies that they implement, including meal formality and consistency\(^{(18,27,47)}\) as well as role modelling of healthy eating and PA\(^{(51,56–59)}\).

Overall, caregiver role modelling, support and rules and policies were all significant predictors of dietary intake and PA behaviours\(^{(18,27,36,47,48,51,56–58)}\). Specifically, rules, policies and social support regarding media supported less screen time in children. Caregiver role modelling is a consistent correlate of positive health behaviours in children and not necessarily within the same behaviour domain (i.e. diet or PA). Internal consistencies ranged from moderate to high \( (\alpha = 0.64–0.94)\)\(^{(18,27,36,47,58)}\) and test–retest reliability was high \( (ICC = 0.61–0.90)\)\(^{27,48}\).

A good example of a measure developed and validated with a focus on caregiver role modelling and policies is the Parenting Strategies for Eating and Activity Scale (PEAS\(^{(60)}\)). The PEAS was tested in a sample of Latino women to evaluate a wider range of parenting strategies and demonstrated moderate to high internal consistency \( (\alpha = 0.81–0.82)\)\(^{(60)}\). Construct validity was established for the PEAS by correlating the subscales with the appropriate subscales of a child feeding questionnaire.

Multiple components of the home environment

In attempts to assess multiple components of the home environment (e.g. those outlined in the Conceptual Model for Eating and Physical Activity Environment), several researchers have developed measurement tools with multiple subscales. These measurement tools contain a range of constructs and psychometric qualities which make them appropriate for use in different instances.

For comprehensive assessments of both environmental and behavioural components, Neumark-Sztainer et al.\(^{(51)}\) developed a 221-item questionnaire assessing a range of socio-environmental, personal and behavioural factors associated with dietary intake among adolescents\(^{(61)}\). Items identified to be relevant for the current review were availability of vegetables and family meal patterns as a source of caregiver role modelling, which demonstrated moderate internal consistency \( (\alpha = 0.63–0.78)\)\(^{(51)}\) and test–retest reliability \( (r = 0.66–0.69)\)\(^{(177)}\).

An example of a tool to assess multiple attitudinal and caregiver practices is the Home Nutrition Questionnaire developed by Dave et al.\(^{(62)}\). Six factors were identified in a low-income and mainly Hispanic population: child’s preferences for fruit and vegetables, caregiver practices that promote fruit and vegetables, caregiver role modelling, perceived cost of fruit and vegetables, perceived benefits of fast food and eating while watching television. The internal consistency of the scales was moderate to high \( (\alpha = 0.69–0.87)\)\(^{(62)}\).

Bryant et al.\(^{(63)}\) assessed multiple components of the home environment in their Healthy Home Survey (HHS) including food, media and PA availability and accessibility, caregiver role modelling and policies for eating and PA. The test–retest was high for most items except fresh fruit. Validity (in-home assessments) estimates were lowest for sweet snacks \( (\kappa = 0.00)\) and fresh vegetables \( (\kappa = 0.23)\) and highest for frozen fruit \( (\kappa = 0.87)\) and dried fruit \( (\kappa = 0.85)\). Food accessibility showed good reliability (biased-adjusted kappa (PABAK) = 0.96) and poor validity (PABAK = 0.85). The results of the HHS suggest that measurement of variety and quantity of foods may be a better indicator than presence or absence alone.

Finally, Gattshall et al.\(^{(58)}\) developed and tested the Home Environment Survey (HES) which assesses a breadth of home environment variables including the availability and accessibility of food and PA, caregiver role modelling and policies for healthy eating and PA. The internal consistencies were moderate to high for these scales \( (\alpha = 0.66–0.84)\), except for the accessibility of fat and sweets scale \( (\alpha = 0.59)\) and accessibility for fruits and vegetables was reduced to a single item due to poor reliability. As the researchers suggest, perhaps the internal consistency was lower on these subscales because they were too broad (i.e. ‘How often do you store high-calorie foods in a place that was known but not seen?’). Another theory could be that the items were too embedded (they ended up being confusing for the participant because they had too much information ‘embedded’, so that the participant could not cognitively interpret the construct). Test–retest and inter-rater reliabilities were low to high \( (r = 0.49–0.99)\) and \( r = 0.22–0.70 \) respectively, indicating some differences between caregiver report of the home environment. The subscales showed strong predictive validity for both the child and caregiver.

Screeners or short measures

Short screeners are useful as a brief and easy-to-administer tool to assess the overall home environment ‘at a glance’, giving the researcher a gross estimate of the family’s home environment. Only three screeners are described in the literature which assess the overall impact of the home environment related to childhood obesity. Ihmels et al.\(^{(64)}\) developed and tested the Family Nutrition and Physical Activity (FNPA) screening tool for familial environment and behaviours that may predispose a child to become overweight. This is a twenty-one-item screening tool was developed based on established Evidence Analyses procedures of the American Dietetic Association, which demonstrates high content validity. The FNPA assesses...


Feeding style

Feeding style has received much attention in research, largely separate from the home environment, but is relevant to the social food environment as it is closely related to policies for healthy eating. Birch et al.\(^\text{66}\) established the Child Feeding Questionnaire (CFQ), a seven-factor model which focused on two broad categories: (i) parental perceptions and (ii) concerns for and use of child feeding practices. Seven factors included: perceived responsibility for the child’s weight, perceived parent weight, perceived child weight, concern about child weight, pressure to eat, restriction and monitoring, and all subscales had high internal consistency (\(\alpha \geq 0.71\))\(^\text{66}\).

Many researchers have modified or simply used certain subscales of the original CFQ based on their research questions. In the interest of having a child’s perspective on feeding style, the CFQ has been adapted from a parent-reported tool to a child-reported one\(^\text{65}\). With an emphasis on controlling feeding styles in a low-income population, it was concluded that previous findings of control being related to greater body weight of the child may not apply to younger children (aged 8–9 years) of diverse ethnic and sociodemographic backgrounds\(^\text{67}\). The internal consistency of the control scale was low (\(\alpha = 0.61\))\(^\text{67}\). Similarly, Ogden et al.\(^\text{68}\) wanted to expand the concept of child feeding to differentiate between overt and covert control, with overt control defined as controlling a child’s food intake in a way that the child can detect while covert control cannot be detected by the child\(^\text{68}\). The two control scales had adequate internal consistency (\(\alpha = 0.78–0.83\))\(^\text{68}\).

Beyond controlling feeding styles, some researchers have developed items to reflect slightly different constructs from the CFQ: emotional feeding, instrumental feeding, prompting or encouraging child to eat, and control over eating\(^\text{69}\). These four subscales demonstrated moderate internal consistency (\(\alpha = 0.65–0.85\)) and test–retest reliability (\(r = 0.67–0.83\))\(^\text{69}\). Hughes et al.\(^\text{70}\) wanted to expand the concept of child feeding to include dimensions of Maccoby and Martin’s\(^\text{71}\) typology of general parenting (demandingness and responsiveness) regarding the child’s eating: parent-centred and child-centred strategies\(^\text{70}\). These two scales revealed high test–retest reliability (\(r = 0.82–0.85\)) and convergent validity was supported by the subscales being correlated with the appropriate subscales on the CFQ\(^\text{70}\). Similarly, Joyce and Zimmer-Gembeck\(^\text{72}\) assessed multiple parental feeding-specific dimensions including: supportiveness, structure, coerciveness and chaos (\(\alpha = 0.72–0.92\)). Arredondo et al.\(^\text{73}\) adapted the CFQ based upon focus groups with Latina mothers and yielded a five-factor measure: monitoring, discipline, control, limit setting and reinforcement (\(\alpha = 0.72–0.87\)). Kroller and Warschburger\(^\text{74}\) tested parental feeding strategies through translated items from two measures assessing restriction, monitoring, pressure, rewarding, child’s control and modelling. These scales demonstrated adequate internal consistency (\(\alpha = 0.75–0.93\)) and moderate test–retest reliability (Pearson \(r = 0.41–0.78\))\(^\text{74}\).

Discussion

Several reviews of childhood obesity interventions focusing on the home or caregiver involvement have been conducted\(^\text{31,34}\). These reviews conclude that behavioural interventions including the family are effective; however, the mechanism of change is unclear\(^\text{75}\). In order for research in the area of the home environment and childhood obesity to move forward a greater emphasis on appropriate measurement is necessary. The current review assessed measures of the home environment in a broad sweep of the literature in order to gain a better understanding of appropriate measures of these complex constructs using a conceptual model as a guiding framework\(^\text{58}\). The literature review resulted in forty manuscripts describing measurement of different aspects of the home environment. The sample would have been much larger had we included manuscripts describing measurements that did not have any supporting reliability and validity; however, it was the purpose of the review to describe those measures which have some psychometric evaluation. The reader is directed to Table 1 as a resource tool to identify and evaluate the measurement tools available assessing different components of the home environment. Table 1 describes the measurement tools, identifies which constructs are assessed, which population the tool was validated with, whether this sample included specific sub-populations (i.e. low-income, racial/ethnic minorities) and the results of any psychometric testing.

The objective of the current review was to assess the degree to which measurement tools of the home environment can validly and reliably provide assessment. The overall finding was that although many of the reviewed measurement tools have supporting psychometric properties, there is no consistency across similar types of measures (i.e. checklists \(v\) subscales \(v\) screeners) as to which psychometric properties are appropriate as supporting evidence. For example, Bollen and Lennox...
warn that not all types of scales lend themselves to item covariance (i.e. internal consistency). Further, causal indicators of the latent construct do not necessarily need to be related to each other to provide meaningful assessment of the latent construct. Table 2 was developed as part of the review to help guide researchers in the validation of measurement tools utilizing specific types of psychometric properties for certain types of scales for assessing the home environment (checklists, subscales or screeners). One method of validation that is often overlooked is assessing other variables that are effects, or outcomes, of the latent construct. This method should be employed more often when building measurement and theoretical models in concert with survey development and validation.

In conducting the present review, it was evident that many researchers chose to design new measures for their studies and often the tools employed were brief with a lack of reporting of psychometric properties. This is also evident in the number of measures that researchers have employed that were not included in the current review as they did not report any psychometric properties. When considering the psychometric findings, the data support the conclusion that the measures have adequate reliability, but that evidence of validity is more equivocal. It is important to note that although a measure is reliable, that does not support the validity. Based upon the results of the current review, there is a need for more measurement studies assessing the validity of measurement tools.

While additional validity studies are needed, it is also critical to test existing measures in diverse samples as current measures of the home environment may not necessarily translate to specific sub-populations. The majority of existing efforts to validate home environment measures did not seek out specific populations that experience obesity at disproportionate rates, such as low-income and/or ethnic/minority families. Future measurement efforts may want to focus on assessing the home environment of these hard-to-reach families in order to garner a better understanding of the factors that influence these important health behaviours, especially as many obesity prevention interventions currently target at-risk populations.

Despite limitations across studies, several researchers have designed and tested aspects of the home environment. For example, Bryant et al. and Gattshall et al. have both put forth two comprehensive measures of the home environment assessing both social and physical environments that influence childhood obesity. Conversely many research studies call for brevity in measurement, and screening tools that asses key components of the home environment that place children at risk for becoming obese have utility. Currently there are only three screening tools are evident in the literature. Further research that expands these measures is warranted.

Although closely related to policies and role modelling of healthy eating and PA, child feeding is a unique construct which has been studied extensively. The CFQ...
has been employed, manipulated and tested by a number of researchers, as have the factors involving caregiver perceptions and concerns regarding child feeding practices. Researchers should consider child feeding in their assessment of the social home environment related to nutrition. In addition to social aspects of the home environment, reporting of physical components by adults ∈ children has yielded interesting results. A few studies showed that when children reported availability of food items in the home, the internal consistency improved. One explanation is that caregivers may be more biased because they are motivated to appear as good providers of more healthful food options for their children. However, this requires further investigation along with validation studies.

The conceptual model guiding the present review did not include the influence of siblings on behaviours within the home. Future research on the home environment may choose to include sibling variables and acknowledge the complexity of familial influences. However, a strength of the review is that it was guided by a theoretical model that was expanded (e.g. feeding style incorporated), resulting in a comprehensive review of measures of the home environment related to childhood obesity. Multiple measures assessing similar constructs of the home environment currently hinder a comparative analysis across studies. Many of the current measures of the home food and PA environment focus on one or two constructs; more comprehensive measures are necessary to capture influences in the home on food and PA behaviours of children. This calls for a more concerted effort to gain a better understanding of familial influences on childhood obesity. Once consistency in the measurement of the family and home environment has been established, the quality of the validation studies should be assessed.

Conclusions

The current review provides a summary and evaluation of measurement tools available in the assessment of the home environment related to childhood obesity. Practitioners can reference the available tools for use in assessing programmatic outcomes while researchers can review the available tools and use the guidance provided for future validation studies. The results of the current review clearly identify a need for comprehensive tools, assessment of specific constructs and short screeners. If more deliberate action is taken to improve and validate existing tools and create new ones with greater emphasis on appropriate measurement models and forms of psychometric testing, the evidence base behind childhood obesity interventions and epidemiological studies focusing on the home environment will be advanced.

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References


