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Psychometric properties of the Food Environment Assessment Survey Tool (FEAST) in people with mobility impairment

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Abstract

Objective: Approximately one in ten adults under the age of 65 in the USA has a mobility impairing disability. People with mobility impairment generally have poorer dietary habits contributing to obesity and related negative health outcomes. This article presents the psychometric properties of the Food Environment Assessment Survey Tool (FEAST) instrument that measures barriers to accessing healthy food from the perspective of people with mobility impairment (PMI).

Design: The current study presents cross-sectional data from two sequential independent surveys.

Setting: Surveys were administered online to a national sample of PMI.

Participants: Participants represented PMI living throughout the USA. The pilot FEAST survey involved 681 participants and was used to shape the final instrument; 25 % completed a retest survey. After following empirically and theoretically guided item reduction strategies, the final FEAST instrument was administered to a separate sample of 304 PMI.

Results: The final twenty-seven-item FEAST instrument includes items measuring Neighbourhood Environment, Home Environment, Personal Control and Access to Support (Having Help, Food Delivery Services, Parking/Transportation). The final four scales had acceptable intra-class correlations, indicating that the scales could be used as reliable measures of the hypothesised constructs in future studies.

Conclusions: The FEAST instrument is the first of its kind developed to assess the food environment from the perspective of PMI themselves. Future studies would benefit from using this measure in research and practice to help guide the development of policy aimed at improving access to healthy food and promoting healthy eating in community-dwelling PMI.

Keywords
Disabled persons
Nutrition assessment
Healthy eating
Public health
Built environment
Obesity

Access to healthy and affordable food is essential for maintaining good health and is linked to healthy eating[1–4]. The food environment plays an important role in the ability to access healthy and affordable food. The Ecologic Model of Obesity posits that physical and social environmental factors and processes directly and indirectly impact healthy eating and other health behaviours related to obesity[5,6]. The Ecologic Model of Obesity provides a framework for examining ecologic factors such as micro-level neighbourhood and home environments that can also influence healthy eating[6,7]. Dynamic linkages (exo- and meso-levels) such as social processes including Access to Support (e.g., transportation, personal assistance) also influence healthy eating[6,8].

Approximately 61 million adults living in communities in the USA have a disability. Mobility disability is the most common type of disability, with almost one in eight US adults affected[9]. People with mobility impairment generally have insufficient nutrient intake, consume fewer fruits and

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vegetables, and are more likely to exceed daily recommendations for saturated fat intake than those without mobility impairment[10]. Lack of healthy eating among people with mobility impairment (PMI) has been attributed in part to ecologic barriers stemming from their physical and social environment, placing PMI at higher risk for obesity and weight-related complications[11]. For example, in the USA, 38·2 % of adults living with a disability are obese compared with 26·2 % of adults without a disability[12].

Successfully accessing healthy food is partially dependent on area of residence. For example, the macro-level distribution of food outlets such as grocery stores and supermarkets can vary by geographic location[13,14]. People with mobility impairment may also face micro-level barriers in addition to barriers related to proximity and neighbourhood location[15]. One study comparing urban and suburban stores reported that fewer than half (46 %) of urban stores surveyed had an entrance that would allow an individual requiring a ramp or level entrance to gain access compared with nearly all (88 %) of suburban stores that did have accessible entrances[13]. Another study documented that having adequate space, ease of entry and accessible amenities such as restrooms also facilitated access to healthy food outside the home[15]. Physical limitations facing PMI may mean that environments that are easy to navigate for some may be nearly impossible for others.

Even in the micro-level home environment, PMI may have a high dependence on others for healthy eating, representing a link between people within the same or across different micro-level environments[6]. Getting healthy food to the home may mean obtaining transportation from friends or arranging for public transit[15]. Food delivery services can bring food to the door, but PMI may have trouble getting it into their home. Others have reported that the home environment may not have the flexibility for easy cooking opportunities[16]. People with mobility impairment have reported problems with inaccessible kitchens, where inadequate storage space forces them to place food out of reach, and food preparation and cooking surfaces (e.g., open flame cooktops) are at an awkward or dangerous height[16].

Few studies have explored ecologic barriers to healthy eating for PMI. This gap may be due, in part, to a lack of a clear guiding model or specific instrument for operationalising barriers to healthy eating in PMI. The Ecologic Model of Obesity offers a useful guiding framework by accounting for the multiple levels of the ecologic milieu in which a person with mobility impairment lives[6]. The Food Environment Assessment Survey Tool (FEAST) study was designed to address this gap using a pilot survey and then a separate sample for a final survey. Previously, we reported on the development of content for an instrument to measure barriers to healthy eating from the perspective of PMI[16]. In this article, we report on the pilot testing, refinement and psychometric performance of the FEAST instrument items with respect to theoretically guided dimensions representing the Neighbourhood Environment, the Home Environment, Access to Support and Personal Control.

Method

Participants

To be eligible for the pilot survey and final questionnaire administration (described below), participants had to (1) have had a chronic health condition or disability causing impaired mobility for a minimum of 1 year, (2) be at least 18 years of age, (3) live in the USA and (4) have access to a working phone or computer with internet access.

Recruitment

To create awareness of the FEAST research project, social media accounts on Facebook, Instagram and Twitter were established 4–7 months prior to the launch of the survey. We engaged with the community of PMI on these platforms by posting original content regarding relevant current events and by 'liking' and commenting on posts from, and relevant to, members of this community. The FEAST research account on Facebook and Instagram gained traction with the online community of PMI, but only limited engagement was achieved through Twitter. We contacted and joined active groups on Facebook to bolster FEAST research awareness.

Of 681 participants in the FEAST pilot, most (59·2 %; *n* 402) learned of the FEAST pilot study through Facebook, 13·8 % (*n* 94) from Twitter, 12·4 % (*n* 84) from the FEAST website, 8·2 % (*n* 56) from Instagram, 3·5 % (*n* 24) from other services and 2·8 % (*n* 19) from previous participants (two participants did not respond to the question). In the FEAST final administration (*n* 304), 58·4 % (*n* 177) learned from Facebook, 21·1 % (*n* 64) from Twitter, 12·9 % (*n* 39) from the FEAST website, 5·3 % (*n* 16) from Instagram, 1·7 % (*n* 5) from the FEAST Community Advisory Board and 0·7 % (*n* 2) from earlier phases of the FEAST study (one participant did not respond to the question).

Organisations that offered services to PMI were contacted via email or telephone and asked to distribute the survey information. Respondents were asked to invite others to generate additional publicity. Participants who had completed earlier portions of the research and who lived in rural areas were contacted and asked to help with forwarding the information about the survey in their area. Frequent outreach by the research team to Facebook groups with a majority of male members helped to increase the number of men in the sample.

Food Environment Assessment Survey Tool instrument

The initial forty-two FEAST pilot instrument items were constructed to reflect participant responses to a structured nominal group technique study (previously reported).

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Participants reported on questions about barriers designed to represent a variety of settings and guided by hypothesised model underlying dimensions of Neighbourhood Environment, Home Environment, Access to Support and Personal Control[16]. The FEAST Community Advisory Board consisted of six men and women with mobility impairing disabilities as previously described and provided input from their lived experience throughout the process[16]. The initial FEAST pilot items were constructed in response to questions about barriers experienced when grocery shopping (*n* 16; e.g., 'Not having affordable, reliable or regular transportation, like a personal car, a friend's car, or a transit service', 'Not being able to reach things that are on high or deep shelves, inside crates, inside a freezer, or in the refrigerator case'), eating in restaurants (*n* 7; e.g., 'There is not enough space at the restaurant in between and around tables.', 'Restrooms in restaurants are not accessible.'), meal planning or preparing food at home (*n* 14; e.g., 'Not having enough accessible pantry, refrigerator or storage space to keep food.', 'My kitchen is too small or not designed for me to move around easily in it.') and using food delivery services (*n* 4; e.g., 'Food delivery services are too expensive, either outright or after delivery fees and tip.', 'Not being able to access quickly food that is delivered to my home from a meal or grocery delivery service.')[16]. A series of five cognitive interviews was conducted with three men and two women with mobility impairment to assess content validity and refine the items[17,18]. The instrument was modified for clarity based on the cognitive interview feedback and FEAST Community Advisory Board input, for the preliminary FEAST pilot instrument. The FEAST instrument analyses are described below and yielded a final instrument with Likert-type items with responses as never = 1, rarely = 2, sometimes = 3, often = 4 or always = 5.

Measure administration

A similar process was followed for both the FEAST pilot and FEAST final instrument administration. The FEAST consent form and screening questions were distributed to potential participants as a URL link via email. After completion of the consent form and screening questions, for the FEAST pilot only, each participant was randomly assigned to one of three versions of the survey through REDCap software, all three having the same items, but with each presenting the items in a different order using randomisation sequences. REDCap assigned an equal number of participants to each of the survey versions throughout the study to achieve balanced participant representation and minimise the influence of question order effects on results. The FEAST research team was blinded to the automated randomisation sequence to reduce potential researcher bias during participant recruitment. Participants were sent a separate email invitation with a link to the FEAST pilot instrument after being randomly assigned to an item order. Participants were offered up to five additional reminders to complete the survey paced once every 3 d over a 2-week period.

Test–retest subsample

A test–retest reliability protocol was used with FEAST pilot data to evaluate consistency of participant responses to individual items over time. Two weeks following initial completion of the FEAST pilot instrument, a randomly selected sample of 25 % of the participants were sent an email invitation to complete the instrument again.

Food Environment Assessment Survey Tool final administration

After measure development procedures described below were conducted with data from the FEAST pilot instrument, the FEAST final instrument, with the refined, final set of questions was administered to the FEAST final sample; that is, a new set of participants. Upon completion of data collection, further psychometric analyses were conducted on the final items to confirm representation in the four domains of Neighbourhood Environment (*n* 11), Home Environment (*n* 5), Access to Support (*n* 8) and Personal Control (*n* 4). Items are shown in online supplementary material, Supplemental Appendix Table 1.

Quality control

Quality control was achieved by designing a protocol that required active participant engagement at multiple points. First, using the electronic consent form, participants entered date of birth and age as separate values. Participant date of birth and age were then cross-referenced to validate participant age. On this form, participants were required to provide an electronic signature, which served as an additional measure to minimise phishing and other fraud. After completing the consent form, participants were then emailed a link to the survey as an additional strategy for preventing phishing and cyber-attacks. Prior to accessing the FEAST pilot instrument, participants were required to provide a functioning email address in the consent form. REDCap was programmed to send a unique link to the survey to the email address provided. This required the email address to be a real domain and for the participant to access the email. Email verification is a commonly used, effective deterrent to phishing and cyber-attacks.

Completion and duplicate checking

Efforts were made to prevent participants from completing the same survey more than once and to exclude participants who were to participate only in other portions of the study. Despite these efforts, it was still possible that we received data from the same participant for the FEAST pilot and final administrations due to repeated outreach efforts through social media platforms and community organisations. Participants who engaged in earlier portions of the study were asked to refrain from participating in the surveys. A modest remuneration was offered for

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survey participation to reduce the appeal of repeated attempts. Cross-referencing of email addresses across phases of the research identified twenty-one repeat participants, whose data were excluded from the analyses. One participant was removed from the survey due to participation in a cognitive interview during an earlier phase of the study.

Analyses

First, an exploratory factor analysis, using maximum likelihood estimation with Promax rotation in SPSS version 26, was conducted using data from all forty-two FEAST items included in the FEAST pilot instrument to identify constructs and relationships among the measured items. Test–retest reliability calculations (using intra-class correlation coefficients (ICC)) were then conducted to ensure consistency of reporting. Items with a test–retest ICC below 0·30 were deleted or modified to enhance clarity. The poor performance of these items was next investigated by triangulating information gleaned from earlier cognitive interviews and seeking guidance from our Community Advisory Board about why these items might have performed poorly (e.g., wording, relevance).

Next, items were evaluated via an inter-item correlation matrix. Items that had loaded on the same factor in the exploratory factor analysis as items with low test–retest coefficients and were highly related to these items were retained; the poorly performing items were eliminated. Items that were highly related to each other ($rs > 0{\cdot}40$) were considered to be potentially redundant indicators of constructs and candidates for elimination to reduce the overall number of items. Redundancy was evaluated based on expert opinion and construct representation according to prior hypothesised dimensions of Neighbourhood Environment barriers, home barriers, Access to Support and Personal Control.

Internal consistency reliability of each of the subscales derived from the final FEAST instrument was evaluated using Cronbach's alpha.

Results

The pilot and final FEAST surveys included a total of 681 and 304 participants, respectively. Table 1 represents the socio-demographic characteristics of the FEAST pilot and final samples. More than half in each sample were males (55·1 and 66·0 %, respectively). The mean age of the participants was 38·7 years (SD 8·6) in the pilot and 36·1 years (SD 8·7) in the final. The majority were White non-Hispanic (70·1 and 68·8 %), followed by Hispanic (13·5 and 11·2 %), reported annual household income of $76 000 or below (51·2·and 73·6 %) and spoke English at home (87·8 and 93·8 %). In the FEAST pilot, forty-five states and the District of Columbia had at least one respondent; the FEAST final had at least one participant from thirty-six states. Regional representation is summarised in Table 1[19].

Table 1 Socio-demographic characteristics of participants in FEAST pilot and final

	FEAST pilot (*n* 681)		FEAST final (*n* 304)	
Category	*n*	%	*n*	%
Gender				
Male	374	55·1	200	66·0
Female	301	44·3	103	34·0
Missing	4	0·6	0	0
Age (M/SD)	38·7	8·6	36·1	8·7
Race/ethnicity				
White	474	70·1	209	68·8
African American	39	5·8	29	9·5
Latinx	91	13·5	34	11·2
Native American	23	3·4	9	3·0
Asian	49	7·2	10	3·3
Annual household income				
$76 000 and below	349	51·2	223	73·6
$76 001 and above	332	48·8	80	26·4
Language spoken at home				
English	560	87·8	271	93·8
Spanish	10	1·6	1	0·3
English and Spanish	68	10·7	17	5·9
Geographic region				
Southwest	79	12·1	30	11·8
Southeast	110	16·8	44	17·3
Midwest	126	19·3	43	16·8
Northeast	80	12·2	24	9·41
West	259	39·6	114	44·7

Statistical and *a priori* theoretical rationales were used to create an appropriate set of scales (composites) based on empirical observations from the FEAST pilot data. The initial exploratory factor analysis using all forty-two FEAST items yielded four factors with eigenvalues > 1. Of these, one factor (factor 1) stood out, having a much larger eigenvalue of 15·57 than the other three (1·63, 1·36 and 1·20, respectively). Factor 1 was strongly correlated with other factors (r 0·73 with factors 2 and 3; r 0·57 with factor 4). Factor loadings and high correlations among the items suggested a high overall 'environmental' influence (see online supplementary material, Supplemental Appendix for details on factor loadings in Table A1 and factor correlation matrix in Table A2).

Next, five items with test–retest ICC lower than 0·30 were considered to be poorly performing items and excluded from further analysis. In consideration of previous theoretical and qualitative work[16], four scales were constructed: Neighbourhood Environment (eleven items), Home Environment (five items), Personal Control (four items) and Access to Support, which comprised three subscales (i.e., Having Help with two items, Food Delivery Services with three items and Parking/Transportation with three items). The descriptive statistics for the FEAST scales are in Table 2.

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Table 2 Descriptive statistics for the pilot initial and retest administrations of the FEAST scales, and paired *t* tests comparing initial and retest scores

		FEAST pilot administration (*n* 677)		FEAST pilot retest administration (*n* 121)		
Scale	Range	M	SD	M	SD	*t*
Neighbourhood Environment	11–55	33·06	7·29	32·88	7·85	0·52
Home Environment	5–25	14·79	4·00	14·79	4·10	0·66
Personal Control	4–20	11·64	2·78	11·45	3·04	2·46*
Access to Support	8–40	23·90	5·04	23·23	5·35	1·26
Having Help	2–10	5·61	1·54	5·55	1·61	0·43
Food Delivery Services	3–15	9·07	2·22	8·69	2·20	0·13
Parking/Transportation	3–15	9·23	2·36	8·99	2·49	0·73

*$P < 0·05$.

Table 3 Test–retest intra-class correlations and 95 % CI for FEAST instrument scales in FEAST pilot administration (*n* 121)

		95 % CI
Scale	Intra-class correlation	Lower, upper
Neighbourhood Environment	0·82	0·75, 0·89
Home Environment	0·74	0·65, 0·81
Personal Control	0·68	0·56, 0·76
Access to Support	0·74	0·64, 0·81
Having Help	0·53	0·39, 0·65
Food Delivery	0·60	0·47, 0·70
Transportation	0·65	0·53, 0·74

The test–retest ICC of the FEAST scales ranged from 0·53 to 0·82 (median 0·66; see online supplementary material, Supplemental Appendix Table 3). Neighbourhood Environment had the highest ICC value of 0·82 (95 % CI 0·75, 0·89). The second highest ICC were for Home Environment (0·74; 95 % CI 0·65, 0·81) and Access to Support (0·74; 95 % CI 0·64, 0·81), followed by that for Personal Control (0·68; 95 % CI 0·56, 0·76). The three subscales of Access to Support had ICC values as follows: 0·60 (95 % CI 0·47, 0·70) for Food Delivery Services, 0·53 (95 % CI 0·39, 0·65) for Having Help and 0·65 (95 % CI 0·53, 0·74) for Parking/Transportation. These results are presented in Table 3.

The mean differences in scale scores between test–retest administrations of the FEAST items were 0·18 for Neighbourhood Environment, 0·01 for Home Environment, 0·19 for Personal Control and 0·46 for Access to Support. For Access to Support subscales, mean differences were 0·06 for Having Help, 0·31 for Food Delivery Services and 0·24 for Parking/Transportation (see Table 2). Paired *t* tests showed that the differences between initial and retest responses to Personal Control items was significant ($t[120] = 2·46$, $P = 0·015$), but no other significant between-administration differences were found (Access to Support: $t[120] = 1·26$, $P = 0·209$; Neighbourhood Environment: $t[120] = 0·65$, $P = 0·524$; Home Environment: $t[120] = 0·44$, $P = 0·661$).

In FEAST final administration, the final twenty-seven-item version of the FEAST instrument was administered once. Cronbach's alphas for Neighbourhood Environment, Home Environment, Personal Control and Access to Support were 0·85, 0·74, 0·62 and 0·82, respectively. Three subscales for Access to Support, that is, Having Help, Food Delivery Services and Parking/Transportation, were 0·53, 0·60 and 0·61, respectively.

Discussion

The purpose of the current study was to test the psychometric properties of the FEAST instrument to measure theoretically and empirically derived ecologic barriers to healthy food access from the perspective of PMI[6,16]. Accurate measurement of barriers to obtaining and consuming healthy food is an important first step in generating interventions and health promoting practices to enhance healthy eating in PMI. The final instrument represents theoretically guided domains and contains twenty-seven Likert-type items. Careful and systematic evaluation of the FEAST instrument is important prior to establishing its validity under various contexts.

Given limited literature focused on availability and accessibility of goods and services for PMI[16], the current study exclusively examined the constructs of salient ecologic barriers that influence healthy eating from the perspective of PMI. The initial factor analysis identified four factors, with one dominant factor and high inter-correlations among the factors. The retained items had high factor loadings, suggesting that the items represent constructs relating to various types of environmental barriers.

The final four scales had acceptable ICC, indicating that the scales could be used as reliable measures of the hypothesised constructs in future studies. Of the four scales, Neighbourhood Environment and Home Environment had the highest ICC values (>·0·70)[20]. Of note, these scales had more items than did the Access to Support and Personal Control scales. Items were constructed based on early qualitative work conducted with the priority

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population. The items described herein and their performance as scales are consistent with findings from earlier FEAST work where participants identified more barriers in neighbourhood stores, restaurants and the home having to do with interior architecture and practical accessibility concerns rather than Access to Support and individual Personal Control issues[16]. The relatively poor performance of the Access to Support scale may represent the diversity of its three constituent subscales, Having Help, Food Delivery Services and Parking/Transportation. Although conceptually these three subscales reflect having support to get healthy food from the store or restaurant and into the body, they may be conceptually distinct in other ways. Further work is warranted to determine whether these are more useful individually as distinct scales or collectively as subscales of the larger scale.

To our knowledge, this is the first study to develop and test a measure of barriers to healthy eating using a well-established theoretical framework. Strengths of the study include a sizeable and diverse sample, representing men and women in urban and rural locations throughout the USA; a systematic mixed-method, rigorous study design including multiple test administrations; and a citizen-science approach that included members of the community for whom the instrument was developed in the research. Nevertheless, the current study has several limitations that warrant mentioning. First, because there is no other validated instrument in this domain, it is not possible to calculate criterion validity of the FEAST instrument. The samples were recruited largely via social media platforms, which may have limited our ability to capture the full range of possible participant responses. For the test–retest portion of the FEAST pilot, only 25 % was sampled, and the final *N* assessing the ICC is low compared with the total sample. Although the most commonly spoken language of the USA is English, using solely an English language version of the instrument may have been a barrier in understanding the instrument or participating at all.

The twenty-seven-item FEAST instrument is the first of its kind developed to assess the food environment from the perspective of PMI. We used a rigorous mixed-method development strategy to produce an instrument that is reliable and valid. Future studies are warranted to apply the FEAST instrument in research and practice to help guide policy decisions designed to improve access to healthy food and promote healthy eating in PMI.

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Supplementary material

For supplementary material accompanying this paper visit https://doi.org/10.1017/S1368980021002068

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