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DEVELOPMENT OF THE HOME AND COMMUNITY ENVIRONMENT (HACE) INSTRUMENT

Julie J. Keysor,[1] Alan M. Jette[2] and Stephen M. Haley[2]

From the [1]Department of Rehabilitation Science, [2]Center for Rehabilitation Effectiveness, Sargent College, Boston University, Boston, Massachusetts, USA

Objective: **To develop and pilot test the Home and Community Environment instrument (HACE), a self-report measure designed to characterize factors in a person's home and community environment that may influence level of participation.**

Design: **A cross-sectional survey.**

Subjects: **Sixty-two adults recruited from community organizations and an outpatient rehabilitation center.**

Methods: **Six environmental domains were assessed: (i) home mobility; (ii) community mobility; (iii) basic mobility devices; (iv) communication devices; (v) transportation factors; and (vi) attitudes. Descriptive statistics, Kappa statistics and Kruskal-Wallis tests were used to ascertain whether persons were capable of assessing characteristics of their environment, could do so reliably and whether the distribution of environmental factors differed by type of living situation.**

Results: **Participants were capable of characterizing their home environment and most aspects of their community with acceptable reliability. The median percent agreement of the 6 environmental domains ranged from 75% to 100% (median Kappa values ranged from 0.47 to 1.0). Percent agreement for individual HACE items ranged from 58% to 100%. The lowest reliability values were observed in the community mobility domain. As hypothesized, individuals who lived in private homes characterized home and community mobility factors differently from those who lived in multi-unit complexes; evidence of HACE's validity.**

Conclusion: **HACE is a promising self-report instrument for assessing characteristics of an individual's home and community environments. Additional research is needed to assess its utility for rehabilitation research.**

Key words: environment, assessment.

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Correspondence address: Julie J. Keysor, Department of Rehabilitation Science, Programs in Physical Therapy, Sargent College, Boston University, 635 Commonwealth Avenue, Boston, MA 02215, USA. E-mail: jkeysor@bu.edu

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INTRODUCTION

The rehabilitation field has long emphasized the importance of a person's environment on their recovery, health status and participation in activities of daily living. There is growing research interest in this area, particularly in relation to exploring how and to what extent a person's environment influences their health outcomes (1–6). Recent research in this area is examining how the environment impacts physical activity behaviours (7–10), satisfaction with living area (11), falls among elderly people (12) and participation in activities of daily living (1, 13–18).

Environmental factors are believed to be crucial determinants of people's participation in activities of daily living, including engaging in social, vocational and leisure roles (19–24). The International Classification of Functioning, Disability and Health (ICF) posits that physical, social and attitudinal aspects of a person's environment influence activity (defined as specific actions and tasks of individuals) and level of daily participation (defined as a person's involvement in life situations) (25). Specifically, the ICF posits that a person's environment is a contextual factor that could either enhance or restrict ones' level of function or involvement in life activities. Understanding how specific factors in one's environment affect the ability to participate in life's roles is imperative for those working in rehabilitation; it can have significant relevance to clinical decisions involving individual patients, influence health policy decisions, as well as influence the allocation of scarce healthcare resources.

Several formidable challenges are faced by the researcher in pursuing environmental assessment. The first is conceptual. To study the complex interplay between environmental factors and participation, researchers need to know which measurable environmental factors represent the circumstances in which individuals live their daily lives. Fougeyrollas (20) suggests that the organization and context of society contains social, cultural and physical dimensions – factors in these dimensions can become obstacles or supports to individual functioning. Fougeyrollas's taxonomy of environmental factors includes socioeconomic organization (e.g. family structure, political systems and economic systems), social roles (e.g. law, values and attitudes), nature (e.g. geography, climate and time) and development (e.g. architecture, land development and technology) (26). The ICF, on the other hand, specifies 5 environmental domains: products and technology; natural environment and human-made changes; support and relationships; attitudes; and services, systems and policies (25). The Craig Hospital Inventory of Environmental Factors (CHIEF) assesses 5 domains that are similar to the ICF taxonomy: (i) attitudes

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and support; (ii) services and assistance; (iii) physical and architectural; (iv) policies; and (v) work and school (1). Shumway-Cook et al. (17), in contrast, focus on the physical domain and identify 8 dimensions: (i) temporal; (ii) physical load; (iii) terrain; (iv) postural transitions; (v) distance; (vi) density; (vii) attentional demands; and (viii) ambient conditions. To our knowledge there is no consensus on which environmental domains should be measured to study the importance of the environment in the lives of people with major disabilities.

The second challenge is one of measurement. To date, there has been little evidence that identifies which environmental factors either facilitate or restrict a person's level of participation. A few existing environmental instruments do document an individual's perceptions of the degree to which environmental factors influence his or her daily life participation or the frequency with which aspects of the physical environment are encountered or avoided (1, 18, 21). One notable self report approach is the Craig Hospital Inventory of Environmental Factors (CHIEF), an instrument that assesses the extent to which a person with disabilities encounters environmental factors related to attitudes and support, services and assistance, physical and architectural, policies, and work and school and the person's perceived impact of each environmental factor on their daily life (1). Instruments such as the CHIEF are important for identifying relevant environmental domains and for illuminating their perceived impact on a person's daily life. However, a perception of environmental impact is not direct evidence of its actual influence on a person's level of participation. Measuring a person's perception of environmental barriers does not allow the researcher to examine empirically whether the presence or absence of such a factor in a person's environment is directly associated with variation in a person's level of participation. In other words, if the research question is "do environments that are more restrictive hinder a person's participation in daily life activities," the researcher needs to assess first the extent to which environments vary in the presence or absence of degree of restrictive factors, and then to correlate differences in the person's environment with their actual level of participation in daily life. To examine which environmental factors affect peoples' involvement in daily activities, we need carefully to characterize whether a person's environment contains elements that are believed to facilitate or restrict participation. The environment assessment needs to identify the extent to which various factors are present, i.e. "does the environment have …", rather than identifying whether an individual perceives that aspects of his or her environment restrict participation in daily life. Once the environmental factors are identified, they can be correlated with level of participation to examine which factors influence subsequent participation.

Approaches for assessing the environment independent of the assessment of a person's level of activity or participation do exist (11, 17). One promising approach is a structured, observational protocol developed by Shumway-Cook and her colleagues (17). This approach provides an evaluation of specific factors comprising the physical domain of one's environment independent of their level of participation. The administration of the measure involves a structured observational encounter between a researcher and a participant, i.e. a researcher observes and videotapes community mobility activities such as going to a grocery store or seeing a healthcare provider. Using a structured assessment approach, the researcher notes the frequency with which persons encountered environmental challenges in 8 different areas: (i) temporal; (ii) physical load; (iii) terrain; (iv) postural transitions; (v) distance; (vi) density; (vii) attentional demands; and (viii) ambient conditions. Though this approach provides the investigator with an independent assessment of environmental factors, the limitations are the protocol's cost and the time it takes to administer it. While having attractive features, it is not feasible to use the Shumway-Cook protocol in large-scale field studies where feasibility, study costs and participant burden are paramount.

Existing environmental instruments have several limitations for rehabilitation research. Although the Shumway-Cook's observational approach (17) is appealing if one is trying to assess specific aspects of the environment and correlate them with levels of daily life participation, it is impractical for large-scale studies. While the CHIEF approach is appealing because of its feasibility through the use of self-report, it relies on the individual's perception of the extent to which an environmental factor influences their level of participation which raises question about its validity (1). Our proposed approach draws from the attractive features of existing instruments while attempting to provide an independent, self-report assessment of a person's home and community environment distinct from their level of participation. We are unaware of any existing instrument designed to assess the environment in this fashion.

The overall goal of this study was to develop a prototype self-report measure of a person's home and community environments. We addressed the following questions: (i) Can adults with mobility impairments provide self-report information on specific aspects of their home and community environments? (ii) Can adults provide consistent information on their home and community environments over time?; and (iii) Do self-reports of factors in a person's home and community environment coincide with expected amounts in different types of community residences, preliminary evidence of the instrument's validity? We hypothesized that people who lived in private homes would report more obstacles in the home than those who lived in apartments, condominiums or multi-unit dwellings. We did not expect responses to the community items to vary across type of living situation. This article describes the development and testing of the Home and Community Environment instrument (HACE), presents preliminary data on its reliability and validity, and discusses some of the conceptual and theoretical implications for future environment research.

METHODS

Questionnaire development

The Medline database was used to identify articles pertaining to environmental assessment instruments. We contacted known researchers studying the environment-participation relationship to locate unpublished instruments they were willing to allow us to review. After evaluating existing conceptual frameworks and instruments, we determined the CHIEF most closely represented the conceptual approach we wanted to use to measure the environment since it assessed attitudes and support, services and assistance, physical and architectural, policies and work and school domains. Thus we used the conceptual domains of the CHIEF to identify important environmental elements to include in the HACE.

Having decided to include the domains of physical and architectural features, support and services, political and attitudinal aspects of home and community environments, we then decided how each domain needed to be assessed to allow people to characterize the extent to which various elements were present or absent in their home or community. For example, we characterized people's home environments by asking them how many steps were present at the main entrance or inside their main living area, whether a ramp, chairlift, elevator or railing was present. To characterize the community environment, we asked people to indicate the extent to which their community had factors such as uneven sidewalks or other walking areas or safe parks and walking areas.

The initial prototype HACE included 44 items that assessed physical, attitudinal and political aspects of people's home and community environments. Social supports were not included in our survey because existing measures capture this domain (27, 28).

- Nine items pertained to home mobility. Examples of these items included how many steps are at the main entrance of your home, is there a railing at the step, how many steps are there inside your main living area. Main living areas was defined as "the rooms in which people live, sleep and eat".
- Sixteen items pertained to physical characteristics of the local community; "local community" was defined as "the neighborhood in which you live." Five items pertained to characteristics about community buildings; 7 items pertained to characteristics about the neighborhood in which persons lived. Three items pertained to programs and services: "To what extent does your local community have government programs for persons who are limited in their daily activities such as 'Meals on Wheels' or elder services?" "To what extent does your local community have employment programs for people who are limited in their daily activities?" Response options were: "not at all"; "some"; "a lot"; and "don't know."
- Thirteen items pertained to mobility and communication devices. Examples of these items included manual wheelchair, electric wheelchair, walker, cane, dressing aids, communication aids, computer and access to the internet (response option was "yes" or "no").
- Five items pertained to transportation factors. These items included whether there was a car available ("yes" or "no"), whether the participant was able to drive ("yes" or "no"), the extent to which public transportation, accessible public transportation and disabled people's parking were available (response options included "a lot," "some," "not at all," and "don't know").
- To assess attitudes, we asked respondents whether people in their community or home (i) had negative attitudes toward persons with limitations in daily activities, and (ii) were willing to help persons with limitations in daily activities. Response options ranged from "strongly agree to strongly disagree."

Two experts examined whether the prototype HACE adequately captured the physical and architectural, support and services, political and attitudinal aspects of home and community environments, whether it adequately captured the degree to which these aspects were present in peoples' homes, communities and work environments and whether we were missing any crucial components of the home or community environment. The reviewers provided their qualitative assessment of the survey with suggestions for improvement. Final revisions were made based on the reviewers' feedback.

Each of the 44 items in the initial prototype was examined to determine whether the following criteria were met: (i) 20% or fewer respondents answered, "don't know" and (ii) Kappa statistics and percent agreement achieved at least moderate agreement. Eight items did not meet these criteria and were eliminated from the HACE, resulting in a 36-item instrument (Appendix A) that covered 6 conceptual domains: (i) home mobility; (ii) community mobility; (iii) basic mobility devices; (iv) communication devices; (v) transportation factors; and (vi) attitudes.

HACE scoring

The *home mobility* domain consists of 3 items that describe the main entrance to a person's home, the main living area and the area between the main entrance and the main living area. To characterize the main entrance to a person's home, a score is calculated that includes the number of steps at the main entrance, whether a ramp is present, whether a railing is present, or whether mechanical or human assistance is available to help open the door. Number of steps at the main entrance is scored as: 0 = no steps; 1 = 1 or 2 steps; 2 = several steps; or 3 = 10 or more steps. The entrance ramp item is scored as: 0 = no ramp, 1 = ramp present. If a ramp is present the step score of the front entrance was set to 0. If a railing is present at the entrance to the home 1 point is subtracted from the number of steps score. If the participant indicated that assistance was not present at the main door, the score on the computed stair variable was increased by 1 point. The score for this variable ranges from 0 to 4 obstacles. Variable scores describing obstacles from the main entrance to main living area and inside the main living area are created in the same manner. The 3 home mobility variables are summed to represent a total score ranging from 0 to 10 points, with higher scores indicating more obstacles for home mobility.

In the *community mobility* domain each item is scored to reflect the presence or absence of a factor and summed across the 5 items. Scores range from 0 to 5, with higher scores indicating more obstacles.

To compute *basic mobility devices* 9 items are scored to record the number of available mobility assistive technologies, ranging from 0 to 9 assistive devices. In similar fashion, a *communication devices* score consists of the sum of 4 communication items, with higher scores indicating more communication technologies available to the subject.

The *transportation* variable includes 2 items pertaining to driving, 2 items pertaining to public transportation and 1 pertaining to disabled people's parking. Scores range from 0 transportation opportunities available to 5, with higher scores indicating more transportation opportunities available.

To calculate an *attitudes* variable, responses for each of 4 attitudinal items are scored as 1 for the absence of a negative community attitude towards persons with limitations in daily activities. Scores are summed and range from 0 to 4 negative community attitudes toward persons with limitations present.

Sample selection and recruitment

We recruited study participants by telephone from community organizations (e.g. senior centers, assisted living centers and elderly apartment complexes) and outpatient rehabilitation centers in the Greater Boston area during 2002. Eligibility criteria included: 21 years of age or older, community-dwelling, English speaking and intact or minimal cognitive impairment as measured by the Short Portable Mental Status Questionnaire (SPMSQ) (29). In addition, participants had to report having difficulty "walking or moving around" or difficulty "communicating with people" and provide an affirmative response to the question: "Has a doctor told you that you have any of the following conditions: stroke, hip or lower extremity fracture, arthritis, chronic pain, polio, Parkinson's disease, multiple sclerosis, congestive heart failure, chronic obstructive pulmonary disease, or spinal cord injury. Informed written consent was obtained from all subjects; human subjects approval was obtained from Boston University and the collaborating medical centers.

Data collection

Trained data collectors administered the HACE to 62 persons. Twenty-four participants were randomly selected to repeat the HACE within 1–3 weeks to enable us to assess the HACE's test retest reliability. Subjects reported the following background data: date of birth, gender, marital status, ethnicity, level of education, type of residence and major diagnoses.

Statistical analyses

To address whether an item was amenable to self report, we calculated frequency distributions of responses on the total sample ($n = 62$) to ascertain whether respondents felt sufficiently knowledgeable to respond to questions asked about the specific characteristics of their home and community environments. Items that yielded 20% or more "did not know" responses for the characteristic being assessed were considered for elimination from the HACE. To address the HACE's test retest reliability, Kappa statistics and percent agreement were calculated ($n = 24$) to examine the degree to which respondents could consistently report on specific characteristics of their environment over time. The unweighted Kappa statistic was used for individual item analysis. We computed percent agreement in addition to the Kappa statistic since we had a small sample that would increase the likelihood of skewed distributions that would artificially deflate the Kappa estimate. To examine test retest reliability of each HACE scale, we examined the median for all items comprising a particular scale.

The Kruskal-Wallis tests were used to ascertain if the distribution of environmental factors differed by type of living situation, a preliminary test of the instrument's construct validity. To account for multiple comparisons, a Bonferroni adjustment was made ($p \leq 0.006$ considered significant).

RESULTS

Eighty-five percent of respondents were recruited from the community; 15% were recruited from a large outpatient rehabilitation facility (Table I). The mean age of the sample was 70 years (range 32–94 years); 60% were 65 years of age or older. The majority of persons in the sample were white and lived alone. Forty percent had completed at least a high school degree or equivalent. Thirty-one percent lived in a single family or multifamily home; 69% lived in a multi-unit complex dwelling.

Participants were capable of characterizing home mobility, mobility devices, communication devices, transportation and attitudes with less than 20% responding "don't know" to questions in these areas. However, characterizing community mobility was more challenging for participants and we eliminated 3 items pertaining to community policies and programs from the HACE because >20% were unable to answer the question. The items were: awareness of "a government program for people who were limited in their daily activities"; "employment programs for people who were limited in their daily activities"; and "policies or programs that made it harder for people who were limited in daily activities". We eliminated the following items due to low test retest reliability: "buildings with steps at main entrances"; "buildings with electronically activated doors"; "buildings with wide doorways in public bathrooms"; and "buildings with elevators or chair-lifts". We also eliminated the item pertaining to the accessibility of items in stores because it did not fit in any of our final conceptual categories for the HACE. In total, 8 items were eliminated from the initial 44-item instrument.

Table I. *Sample description*

Variable	
Age (mean (standard deviation)) (years)	70 (17)
Gender (female) (%)	84
Race (white) (%)	81
High school education or less (%)	40
Married (%)	12
Living alone (%)	74
Recruited from community sources (%)	85
Recruited from outpatient practices (%)	15
Residential status	
Single home (%)	18
Multifamily home (%)	13
Apartment or condominium (%)	56
Assisted living (%)	11
Other (%)	2

The median percent agreement of the 6 environmental domains ranged from 75% to 100% while the median kappa values ranged from 0.47 to 1.0 (Table II). The lowest agreement was obtained with the community mobility items. Percent agreement for individual items ranged from 58% to 100% (Table II). The item with the lowest percent agreement pertained to sidewalks with curb-cuts. The kappa statistics for individual items were lower than the percent agreement scores, which was expected because of the small sample size for the test retest analyses.

Table III presents the distribution of responses for HACE domains by type of residential location. As hypothesized, subjects who lived in private homes reported more home obstacles than those who lived in multi-unit dwellings. One hundred percent of the participants who lived in single or multi-family homes reported at least 1 obstacle at the main entrance to their home in comparison to 26% of participants living in multi-unit complex dwellings ($\chi^2 = 29.99$, df = 1, $p < 0.0001$). Similarly, 56% of persons living in single- or multi-family homes reported at least 1 mobility obstacle in their main living areas, in comparison to none of the participants who lived in multi-unit complex dwellings ($\chi^2 = 28.02$, df = 1, $p < 0.0001$). Persons living in multi-unit complex dwellings were more likely to report at least 2 mobility assistive devices available to them (88%) compared to subjects living in private dwellings (47%) ($\chi^2 = 11.89$, df = 1, $p < 0.0006$). As hypothesized, there were no differences between persons who lived in private homes vs multi-unit complexes with respect to the characterization of their local community's attitudes or its physical characteristics. Virtually all members of this sample reported at least 1 community mobility obstacle (94%) and half of the participants reported at least 1 negative attitude toward persons with mobility limitations. There were no differences by type of living situation in the distribution communication assistive devices or transportation opportunities (see Table III). The availability of devices was high, with 60% of participants reporting the presence of a cane or crutch, 69% having grab bars or a bench in the tub or shower, and 56% having a bedside commode, raised toilet seat, or grab bars near toilet. Ten percent had a manual wheelchair and 5% had an electric wheelchair or scooter. Communication devices were also common, with 29% of persons having a computer and 26% having access to the internet. Our final 36-item instrument contained 9 home mobility items, 5 community mobility items, 9 basic mobility devices, 4 communication devices, 5 transportation factors and 4 attitudinal items.

Table II. *Test retest reliability of Home and Community Scales*

Domain (# items)	Median percent agreement (range) (n = 24)	Median Kappa (range) (n = 24)
Home mobility (9)	*89% (71–100)*	*0.66 (0.28–1.0)*
Type of home	79%	0.66
Steps at the main entrance	92%	0.86
Railings at the main entrance	89%	0.73
Ramp at the main entrance	92%	0.59
Assistance to open door	79%	0.59
Steps inside the building	78%	0.56
Chairlift or elevator inside the building	100%	1.0
Steps inside main living area	100%	1.0
Chairlift inside main living area	71%	0.28
Community mobility (5)	*75% (58–92)*	*0.47 (0.20–0.64)*
Uneven sidewalks and other walking areas	92%	0.47
Parks easy to get to	92%	0.67
Safe parks and walking areas	75%	0.57
Places to sit and rest	71%	0.24
Curbs with curb-cuts	58%	0.20
Basic mobility devices (9)	*92% (75–100)*	*0.65 (0.45–1.0)*
Manual wheelchair	92%	0.47
Electric wheelchair or scooter	100%	1.0
Walker	92%	0.80
Cane	96%	0.91
Bedside commode	75%	0.50
Grab bars	92%	0.81
Reacher	79%	0.57
Dressing aides	92%	0.63
Eating aides	96%	0.65
Communication devices (4)	*94% (88–96)*	*0.79 (0.75–0.83)**
Communication aides	88%	0.06
Voice output aides	96%	0.00
Computer	92%	0.75
Internet access	96%	0.83
Transportation (5)	*100% (67–100)*	*1.0 (0.29–1.0)*
Car available	100%	1.0
Able to drive	100%	1.0
Public transportation	100%	1.0
Public transportation with adaptations	79%	0.41
Disabled people's parking	67%	0.29
Attitudes (4)	*88% (84–95)*	*0.62 (0.51–0.77)*
People in buildings with negative attitudes toward people with disabilities	84%	0.58
People in buildings willing to help people with disabilities	95%	0.77
People in community with negative attitudes toward people with disabilities	88%	0.65
People in community willing to help people with disabilities	88%	51

* Two kappa scores excluded because of low variability in data.

DISCUSSION

Over the past decade there has been a significant advancement of the conceptual and theoretical development of the person-environment interaction (1, 15, 19–24). The findings from this study contributes to this growing literature on the role of the environment in rehabilitation by providing preliminary evidence that the HACE is a promising self-report instrument that allows a person to describe discrete characteristics of his/her home and community environments. Data from this pilot study revealed that, for the most part, respondents were able to provide consistent information about their home and community. The final version of the HACE instrument primarily contains items that pertain to physical aspects of a person's home and their local community. People were most capable and highly consistent when describing their home, including the availability of assistive technology. People were capable of assessing their local neighborhood, although the test retest reliability of these items was generally lower than for items pertaining to their home. The HACE is short, taking, on average, 10 minutes to administer to this sample, making it feasible for use in large-scale rehabilitation outcome studies.

The HACE instrument allows people to characterize their home and community environment without requiring that a person identify how often they encounter various environmental factors or whether certain features of the environment (e.g. stairs) are difficult or problematic for them. Having described the environment, our approach allows the researcher to examine empirically the hypothesized association between discrete characteristics of a person's home and community environment with their actual level of daily life participation. What aspects of the physical environment restrict or facilitate participation and do these relations vary among persons with different disabilities (e.g. individuals with spinal cord injuries, multiple sclerosis, arthritis or children, elderly persons, or adults in the workforce)? Are changes in the environment necessary and sufficient to ensure greater participation or are other factors such as personal skills, resources, motivation and behaviours also needed? The impact of the environment on rehabilitation outcomes is clearly complex, yet understanding this relationship is crucial to the lives of persons with disabilities, the healthcare system and funding agencies. If environment factors are shown to restrict people's participation in life activities, policy can be implemented to change the environment, thereby allowing full participation in life roles. On the other hand, if environmental factors are not related to participation – at least among certain populations of persons with limitations in daily life activities – then funding resources could be allocated to developing effective interventions to guide people to successful and independent living within the context of their environment.

Although we show in this study that persons can characterize some aspects of their home and community environments with acceptable levels of test retest reliability, not all domains were successfully measured. In this study, characterizing physical features found in community buildings and reporting on the availability of policies and programs for persons with disability was problematic since many participants were unaware of these features of their environment. One potential explanation for this finding was that the HACE's description of community

Table III. *Home and Community Environmental factors by type of residence*

Variable	Total sample Percent (*n*) (*n* = 62)	Single or multi-family home Percent (*n*) (*n* = 19)	Multi-unit complex dwelling* Percent (*n*) (*n* = 43)	*p*
Home mobility				
1 or more obstacle at the main door	48 (30)	100 (19)	26 (11)	<0.001
1 or more obstacle from the main door to main living area	10 (6)	26 (5)	2 (1)	0.009
1 or more obstacle inside main living area barriers	16 (10)	56 (10)	0 (0)	<0.001
1 or more home mobility obstacle (summary score)	48 (30)	100 (19)	26 (11)	<0.001
Community mobility				
1 or more mobility obstacles	94 (58)	95 (18)	93 (40)	n.s.
Basic mobility devices				
2 or more devices	76 (47)	47 (9)	88 (38)	0.0006
Communication devices				
2 or more devices	27 (17)	47 (9)	19 (8)	0.02
Transportation factors				
2 or more opportunities for transportation	81 (58)	100 (19)	91 (39)	n.s.
Attitudes				
1 or more negative attitudes	50 (31)	37 (7)	56 (24)	n.s.

* Includes apartment buildings or condominium complexes, congregate housing or assisted living, nursing home or rest home, or other (excluding single or multi-family home).

buildings included a range of buildings typically found in the community, such as grocery stores, pharmacies or drug stores, libraries, town halls, shopping centers and restaurants. The range of buildings presented to a respondent may have been too broad, resulting in a vague and inconsistent response to the question. On the other hand, sample members may simply not be aware of physical features found in public buildings and thus unable to provide accurate self-report information. Likewise, assessing community programs, policies and services was problematic for this sample, suggesting that people might not be able to adequately self-report programs and policies for persons with limitations in daily life activities. This information may need to be obtained by alternative means. Our final version of HACE also eliminated 3 items pertaining to policies and programs for persons with disabilities because a high number of persons in our sample indicated they did not know about the program or service we were assessing or they did not know what we meant by the question. Our initial version of HACE purposely omitted items assessing social environments because several valid and reliable instruments are available to assess this domain of the environment. Thus our final prototype HACE instrument under-represents physical features found in community buildings, the availability of programs and policies for persons with disability, and social support available in a person's environment.

Our study revealed preliminary evidence of the HACE's construct validity. As hypothesized, the HACE did differentiate between aspects of the home environments of respondents who lived in their own homes versus those who lived within more complex, group housing environments. As we anticipated, the HACE revealed that a significantly larger proportion of persons living in single- or multi-family homes had more obstacles in their home environments when compared with those living in complex dwellings. Although promising, much more research is needed on the validity of the HACE.

Although the results of this study support the reliability and validity of the HACE, they are preliminary and need replication. The final version of the HACE presented in Appendix A includes the 36 items selected from the initial version that contained 44 items. It is possible that interaction, order, and carry over effects might lead people to respond differently to the items on the 36-item questionnaire than to those on the 44-item questionnaire.

The characteristics of our sample do limit the generalizability of our findings. The HACE instrument was tested among an older adult population with a variety of functional mobility limitations. The majority of persons in our sample were not working nor were they confined to a wheelchair. Persons in these populations may face different barriers and facilitators in the community. Additional research is needed to understand how the environment limits or facilitates involvement of the broad range of persons with disabilities.

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APPENDIX A. HOME AND COMMUNITY ENVIRONMENT INSTRUMENT (HACE)

Domain	Item (response options)
Home mobility	What type of home do you live in? (single family, multi-family, apartment building or condominium complex, congregate housing or assisted living, nursing/rest home, or other)
	How many steps are at the main entrance of your home? (none, one or two, several, 10 or more)
	Is there a railing at the steps? (yes or no)
	Is there a ramp at the main entrance? (yes or no)
	Does the door at the main entrance open electronically or is someone available to open the door? (yes or no)
	How many steps are there from the main entrance of your building to your main living areas? (none, one or two, several, 10 or more)
	How many steps are there inside your main living area? (none, one or two, several, 10 or more)
	Is there a chairlift or elevator inside your main living area? (yes or no)
	Is there a chairlift or elevator inside your building? (yes or no)
Community mobility	To what extent does your local community have:
	Uneven sidewalks or other walking areas?
	Parks and walking areas that are easy to get to and easy to use?
	Safe parks or walking areas?
	Places to sit and rest at bus stops, in parks, or in other places where people walk?
	Curbs with curb cuts
	(A lot; some; not at all; don't know)
Basic mobility devices	Do you have:
	Manual wheelchair
	Electric wheelchair or electric scooter
	Walker
	Cane or crutch
	Bedside commode, raised toilet seat or grab bars near toilet
	Grab bars or bench in tub or shower
	Reachers
	Dressing aids such as button adapters of zipper pulls
	Eating aids such as built-up silverware or kitchen aids such as cutting boards that hold food or utensils that are designed to be used with one hand
	(yes or no)
Communication devices	Do you have:
	Aids to help you communicate with people such as boards or papers with pictures or telephones with big dials and hearing devices
	Voice-output communication aids, such as voice generating computers
	A computer
	Access to the internet
	(yes or no)
Transportation factors	Do you have a car available to you at your home? (yes or no)
	Do you drive? (yes or no)
	To what extent does you local community have:
	Public transportation that is close to your home
	Public transportation with adaptations for people who are limited in their daily activities, such as buses that lower to the ground and chairlifts for wheelchairs
	Adequate disabled people's parking
	(A lot; some; not at all; don't know)
Attitudes	People in your building have negative attitudes toward persons with limitations in daily activities.
	People in your building are willing to help persons with limitations in daily activities.
	People in your community have negative attitudes toward persons with limitations in daily activities.
	People in your community are willing to help persons with limitations in daily activities.
	(Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree)