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Are features of the neighborhood environment associated with disability in older adults?

Daniel K. White, ScD,

Clinical Epidemiology Research and Training Unit, Boston University Medical Center, Boston, MA, 650 Albany St X 200, Boston, MA 02118, O:(617) 638-5180 F: (617) 638-5239

Alan M. Jette, PhD,

Health and Disability Research Institute, Boston University School of Public Health, Boston, MA

David T. Felson, MD,

Clinical Epidemiology Research and Training Unit, Boston University Medical Center, Boston, MA

Michael P. LaValley, PhD,

Department of Biostatistics, Boston University School of Public Health, Boston, MA

Cora E. Lewis, MD,

University of Alabama, Birmingham, AL

James C. Torner, PhD,

University of Iowa, Iowa City, IA

Michael C. Nevitt, PhD, and

University of California San Francisco, San Francisco, CA

Julie J. Keysor, PhD

Sargent College of Health and Rehabilitation Sciences, Boston University, Boston, MA

For the MOST Investigators

Daniel K. White: white.daniel@gmail.com

Abstract

Purpose—To explore the association of features of a person's neighborhood environment with disability in daily activities.

Method—We recruited 436 people age 65 years and over (mean 70.4 years (sd=3.9)) with functional limitations from the Multicenter Osteoarthritis Study (MOST). Features of the neighborhood environment were assessed using the Home and Community Environment (HACE) survey. The Late-Life Disability Instrument (LLDI) was used to assess disability in daily activities. We used logistic regression to examine the association of individual environmental features with disability.

Results—Older adults whose neighborhoods did not have parks and walking areas less frequently engaged in a regular fitness program (OR=0.4, 95%CI [0.2 0.7]), and in social activities (OR= 0.5, 95%CI [0.3 1.0]). Those whose neighborhoods had adequate handicap parking had 1.5 to 1.8 higher odds of engagement in several social and work role activities. The presence of public transportation was associated with 1.5 to 2.9 higher odds of not feeling limited in social, leisure, and work role activities, and instrumental activities of daily living.

Conclusion—Our exploratory study suggests that parks and walking areas, adequate handicap parking, and public transportation are associated with disability in older adults.

Keywords

Environment; Elderly

INTRODUCTION

Older adults frequently face restrictions in their personal or leisure role behaviors, such as taking care of the inside of the home or taking part in a regular fitness program. The Nagi disablement model terms these restrictions as disabilities, and provides a framework to examine the various determinants of disability[1,2]. Specifically, the Nagi model posits that disability emerges from underlying functional limitations, such as difficulty walking and climbing stairs, impairments, such as pain, and pathology, such as osteoarthritis[1,3].

Recent adaptations to the Nagi model have added the environment as an important determinant [2,4–6], and several cross-sectional studies support this notion finding a small but statistically significant association between a person's physical environment and disability[7,8]. We recently reported that older adults who lived in neighborhood environments with more barriers and fewer facilitators experienced more disability[9]. Similar associations have been reported for people with spinal cord injury[8], traumatic brain injury[10], and stroke[7].

Despite this evidence of a general link between a person's neighborhood environment and disability, it remains unclear how specific features facilitate or are barriers to an older person's involvement in daily activity. For instance, does the presence of curbs with curb cuts and handicap parking facilitate taking care of local errands and visiting family and friends? Moreover, does the presence of uneven sidewalks or unsafe parks hinder these same activities? Understanding which particular features of the neighborhood environment is a preliminary first step to guiding policymakers to effectively allocate resources at the community level to enhance the lives of older people and reduce disability.

The purpose of the present study was to explore the association of particular features of neighborhood environments with disability among older adults with existing functional limitations.

METHODS

Subjects were recruited from the Multicenter Osteoarthritis (MOST) study, a large multicenter prospective cohort study of community-dwelling persons who had or who were at high risk of developing symptomatic knee osteoarthritis (OA). MOST was designed to evaluate the effects of biomechanics, bone, and other anatomic, physiologic, and nutritional factors on the occurrence and progression of radiographic and symptomatic knee OA. 3026 persons in Alabama and Iowa were enrolled between May 2003 and March 2005. Subjects were defined as being at risk of developing knee OA based on known risk factors, including age, gender, previous knee injury or operation, and high body weight. Subjects were excluded if they had rheumatoid arthritis, ankylosing spondylitis, psoriatic arthritis, or Reiter's syndrome; had bilateral knee replacements or were considering having knee replacement surgery in the next year; had a history of cancer in the past three years; were unable to walk without the help of another person or walker; had problems with kidneys requiring hemodialysis or peritoneal dialysis; or were planning to move out of the area in the

next three years. A more detailed description of recruitment and sampling for MOST is published elsewhere[11].

The MOST-Knee Pain and Disability (MOST-KPAD) study, a sub-cohort study to MOST, is a study of environmental risk factors for disability in a cohort of older individuals with self-reported limitations in their physical function. Enrollment for MOST-KPAD occurred between February 2004 and April 2005. Eligibility criteria included 1) 65 years of age or greater and 2) report of any limitation in at least two of the following items from the Western Ontario McMaster Osteoarthritis (WOMAC) Physical Function subscale a) climbing stairs, b) rising from sitting, c) bending to the floor. Of the 537 eligible subjects, 479 (89%) gave their consent and were enrolled in MOST-KPAD, and 436 (81%) completed a structured 30-minute telephone interview 43 days on average after the MOST baseline visit. Subjects who consented to MOST-KPAD but did not participate were more likely to be African American ($p < .01$), but did not differ on age, sex, education, body mass index, comorbidity, functional level, or pain compared to those who consented and participated. Demographic information and covariates were collected from the MOST baseline visit. During the telephone interview, a research assistant collected environment information from the Home and Community Environment (HACE) instrument and disability information from the Late Life Disability Instrument (LLDI). These instruments were administered in random order. The MOST-KPAD study was approved by the Institutional Review Boards at the University of Alabama-Birmingham, the University of Iowa, and Boston University.

Outcome Measures

Disability was assessed with the LLDI[12], which evaluates disability for 16 socially defined life tasks within two dimensions, frequency and limitation. The frequency dimension ascertains how often people engage in daily activities; whereas the limitation dimension ascertains how capable people feel to perform daily activities. We computed scores ranging from 0–100 for each of the frequency and limitation dimensions, with higher scores representing less disability. The validity and test-retest reliability of the LLDI has been established in people over the age of 65[12,13].

For individual disability item analyses, each question of the LLDI was dichotomized to represent the presence or absence of disability across frequency and limitation dimensions. For the frequency dimension, subjects were asked to rate “How often you do the activity?” Responses of “very often” and “often” were classified as no disability, while responses of “once in a while”, “almost never”, and “never” were classified as having disability. For the limitation dimension, subjects were asked to rate “To what extent do you feel limited in doing the activity?” The response of “not at all” was classified as no disability, while responses of “a little”, “somewhat”, “a lot”, and “completely” were classified as having disability.

Features of the neighborhood environment were assessed with a modified version of the HACE instrument[14]. The HACE is a standardized, self-report instrument designed to assess barriers and facilitators in several discrete environmental domains. The modified version excluded items pertaining to assistive technologies for upper extremity functioning or communication. The construct validity and reliability of the HACE has been established in community dwelling adults with limitations in functional activities[14]. We examined the following features of the neighborhood environment from the HACE: 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; public transportation close to home; public transportation with adaptations for people who are limited in their daily activities; and adequate handicap parking. In addition, subjects were asked if they had a car available at home and if they had

the ability to drive. Response options for the HACE were “a lot”, “some”, “not at all”, and “don’t know”. Each item was calculated to reflect the presence or absence of an environmental facilitator or barrier. The response option of “don’t know” was classified as missing and not included in the analysis.

Covariates included knee pain, functional limitation, comorbidity, body mass index (BMI), age, gender, educational attainment, ethnicity, and study site. These factors were collected in the MOST study at baseline and were chosen because of existing scientific evidence that links these factors to disability[11,15–21]. We included study site (categorized as Alabama or Iowa) to account for variations in the environment and disability due to geographic location. We used the Western Ontario McMaster Osteoarthritis (WOMAC) index to assess knee pain and physical difficulty[22,23]. Maximal knee pain of either knee was used in the analyses. The modified Charlson comorbidity index was computed from self reported chronic conditions[24]. Body Mass Index (BMI) covariate was computed from standardized weight and height assessments and education was categorized high school diploma or less versus some college or beyond. Subjects reported ethnicity as Caucasian, African American, or other.

Statistical Analysis

We excluded individual environmental and disability items when at least 80% of the subjects reported the item present to ensure adequate variability within each item. We employed a two-step method to examine the association between the neighborhood environment and disability. For step one, we screened for environmental features that may be associated with total frequency and limitation LLDI scores in order to limit comparisons (defined as $p < 0.3$). We applied multiple regression with summary LLDI scores as dependent variables, and individual environmental items and covariates as independent variables. Individual environmental items that may be associated with summary LLDI scores were brought forth to step two of the analysis.

For step two, we used multiple logistic regression to examine associations between individual dichotomized LLDI items as dependent variables, and individual environmental items from the screening analysis and covariates as independent variables. Odds ratios and 95% confidence intervals are reported for environmental features reaching a $p < 0.05$ level of significance. SAS version 9.1 (SAS Institute, Inc., Cary, NC) was used for all analyses.

RESULTS

Of the 436 subjects a majority were female (69%), Caucasian (90%), and had some college education (65%) as seen in table 1. [Insert table 1 about here]

For neighborhood environments, over 80% of subjects reported the presence of ‘public transportation with adaptations for people who are limited in their daily activities’, ‘have a car available to you at your home’, and ‘able to drive’. The highest ‘do not know’ response for features of the neighborhood environment was 18% for ‘public transportation that is close to your home’ as seen in table 2. [Insert table 2 about here]

Over 80% of subjects reported no disability with ‘keeping in touch with others’, and ‘taking care of your own personal needs’ within both frequency and limitation disability dimensions, and ‘taking care of the inside of the home’, ‘taking care of household business and finances’, ‘taking care of your own health’, ‘taking care of local errands’, and ‘preparing meals for yourself’ within the limitation disability dimension as seen in table 3. [Insert table 3 about here]

The screening analysis (step one) showed that ‘uneven sidewalks or other walking areas’ and ‘no parks and walking areas’ had a chance association ($p < 0.30$) with more disability (lower summary disability scores), whereas ‘adequate handicap parking’ and ‘public transportation’ had a chance association with less disability (higher summary disability scores) as seen in table 4. Thus these environmental features were brought forward and examined in step two. [Insert table 4 about here]

Analyses between individual features of the neighborhood environment with specific areas of disability (step two) revealed that subjects with ‘no parks and walking areas’ reported less frequent engagement in a regular fitness program (OR = 0.4, 95%CI [0.2 0.7]), and taking part in social activities (OR = 0.5, 95%CI [0.3 1.0]) compared to those with neighborhood parks and walking areas. Subjects reporting adequate handicap parking reported more frequent engagement ‘visiting friends and family’ (OR=1.8, 95%CI [1.1 2.8]), ‘going out with others to public places’ (OR=1.8 95%CI [1.1 2.8]), ‘providing care and assistance to others’ (OR=1.5 95%CI [1.1 2.3]), and ‘working at a volunteer job’ (OR=1.6 95%CI [1.0 2.5]) compared to those without adequate handicap parking. Subjects reporting the presence of public transportation had about twice the odds of not feeling limited with visiting friends and family, taking care of the inside of the home, working at a volunteer job, taking part in active recreation, inviting people into the home for a meal, going out with others to public places, taking part in social activities, and preparing meals compared to those without neighborhood public transportation as seen in table 5.

DISCUSSION

Our study revealed that parks and walking areas, handicapped parking, and public transportation were important features of the neighborhood environment for older adults with existing functional limitations. Specifically, those who reported the absence of parks had more disability with social and recreational activities, while those who reported the presence of handicapped parking and public transportation had less disability with social, leisure, and work role activities.

Our study extends the findings of previous work by examining the link between particular features of the physical environment with disability. We adopted a definition of disability defined by the Nagi disablement model[1] elaborated by Verbrugge and Jette[2], which emphasizes disability encompasses not only difficulty with basic and instrumental activities of daily living, but also paid and unpaid role activities, social activities, and leisure activities[25]. While previous studies have found links between environmental features with levels of physical activity and walking outside of home, our study suggests these findings may also include instrumental activities of daily living, and social, leisure, and work role activities in older adults with self reported functional limitations. In addition, our exploratory findings support the notion that the allocation of environmental resources such as community parks, handicap parking, and public transportation may positively influence older adults engagement in social, leisure, and work roles.

This study supports a growing body of literature that suggests walking areas, adequate handicapped parking, and public transportation play an important role in recreational and social activity, as well as general physical activity. Previous studies have identified the presence of parks to be associated with more walking[26,27], recreational activity[28], and physical activity[29] in the general population. Handicapped parking was identified as an important environmental feature to the recovery of social roles and integration in a qualitative study of stroke survivors [30]. Lastly, cross-sectional studies have found public transportation to be associated with going outside of the home [31] and physical activity[27] in adults over the age of 50. These previous findings together with our study results

strengthen the notion that public parks, adequate handicapped parking, and public transportation have a role with disability in older adults.

Two specific environment-disability links emerged from our exploratory analysis. The first link was between parks and walking areas with recreational and social roles. Given that parks and walking areas are commonly utilized for fitness in society-at-large[26–29], our study also suggests this theme likely applies to older adults with functional limitations. The second link was between transportation facilitators and social and work roles. We found adequate handicapped parking to be associated with going out with others to public places and working at a volunteer job. This association seems reasonable and supports regulations for parking accessibility mandated by the American's with Disability Act of 1990.

We also found public transportation to be associated with a variety of social, recreational, and work roles. The interpretation of these findings is less clear given that over 98% of subjects drove and had a car available to them, and some of the activities associated with public transportation were specific to the inside the home, such as preparing meals. One possible explanation is that the presence of public transportation is a marker of an urban neighborhood environment. Recent literature suggests that older adults living in urban settings [32] and pedestrian friendly areas[33] are less likely to be disabled. Thus, the environment-disability association we report may be reflective of the urban quality of the neighborhood rather than presence of public transportation. Another explanation is that information bias may have occurred with study subjects when completing the HACE, a self report instrument. Study subjects may have been unaware of public transportation in the neighborhood environment and underestimated its presence. Lastly, these findings could be spurious given our study is exploratory in nature.

Our findings need to be interpreted with caution given the exploratory nature of our study. First, our study is cross-sectional in design and we cannot examine causality. Second, we used multiple statistic comparisons, which magnifies the possibility of a type I error. We did not adjust for multiple comparisons since this study is exploratory in nature, and we wanted to evaluate all possible disability-environment associations. Third, we acknowledge that the LLDI and HACE were not developed nor subsequently validated to examine the environment or disability, respectively, on an individual item basis, and using these instruments in this manner may result in unstable estimates. Fourth, the MOST cohort recruited subjects from two geographical areas within the United States, and is not representative of a national sample nor of a sample from other countries. Fifth, we measured features of the neighborhood in terms of the physical or built environment, though other environmental features can be related to specific items of disability. The International Classification of Functioning, Disability, and Health defines the environment consisting of a much broader collection of factors, including social attitudes, and legal and social structures[5]. Hence, many more specific environment-disability links likely exist which were beyond the scope of our study. Lastly, socioeconomic status may have still confounded our environment-disability findings, despite adjusting for educational attainment.

Despite these limitations, the present study provides an exploratory look at potential links between specific features of the neighborhood environment with older adults' disability in role activities. Our findings suggest that community parks and walking areas, adequate handicap parking, and public transportation could be critical features of neighborhood environments which are important with social, leisure, and work role activities in older adults. Public health strategies employed by city planning commissions and zoning boards may consider placement of these environmental resources to minimize disability in older adults if these findings are replicated in future study and are shown to be more potent than other environmental features not examined in this study, such as health facilities, gyms, or

bike lanes. Lastly, future research is needed to establish a causal link between features of the neighborhood environment and disability in older adults.

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Table 1

Demographics of sample (N=436)

Female [n (%)]	304 (70)
Age, years [mean (sd)]	70.4 (3.9)
Caucasian [n (%)]	393 (90)
Education, > some college [n (%)]	284 (65)
Body Mass Index [mean (sd)]	30.2 (5.3)
No comorbidities [n (%)]	270 (62)
WOMAC* Physical Function (0–68) [mean (sd)]	20.3 (10.6)
WOMAC Knee Pain (0–20) [mean (sd)]	6.0 (3.7)

* WOMAC= Western Ontario and McMaster's University Osteoarthritis Index

Table 2

Features of the neighborhood environment present in study subjects

	Present (% of 436)	Don't know (% of 436)
Uneven sidewalks or other walking areas	79	4
No parks and walking areas that are easy to get to and easy to use	12	2
No safe parks or walking areas	12	4
No places to sit and rest at bus stops, in parks, or in other places where people walk	21	8
No curbs with curb cuts	20	5
Public transportation that is close to your home	58	18
Public transportation with adaptations for people who are limited in their daily activities	92	1
Adequate handicap parking	45	5
Have a car available to you at your home	98	0
Able to Drive	96	0

Table 3

Percentage reporting no disability for individual disability items within frequency and limitation dimensions*

Late Life Disability Instrument Item	No disability (% of 436)	
	Frequency dimension	Limitation dimension
Keeping in touch with others	91.0	82.6
Visiting family and friends in their homes	67.2	66.3
Providing care to others	49.5	39.9
Taking care of the inside of the home	84.2	42.7
Working at a volunteer job	35.6	38.5
Taking part in active recreation	41.1	14.7
Taking care of household business and finances	86.0	78.7
Taking care of your own health	98.2	76.4
Traveling out of town	40.8	61.7
Taking part in a regular fitness program	46.1	31.4
Inviting people into your home for a meal	42.0	54.4
Going out with others to public places	62.2	72.3
Taking care of your own personal needs	100	90.2
Taking part in organized social activities	67.9	53.0
Taking care of local errands	94.5	71.3
Preparing meals for yourself	80.3	79.4

* Bold represents individuals items used for multiple regression analysis (<80% reporting no disability).

Table 4

Screening analysis for associations between individual features of the neighborhood environment and summary disability scores within frequency and limitation dimensions

	Summary disability scores			
	Frequency dimension		Limitation dimension	
	Parameter Estimate	p-value	Parameter Estimate	p-value
Uneven sidewalks or other walking areas	0.59	.45	−2.01	.20*
No parks and walking areas that are easy to get to and easy to use	−1.48	.21*	−2.37	.32
No safe parks or walking areas	−0.48	.67	−1.48	.51
No places to sit and rest at bus stops, in parks, or in other places where people walk	−0.04	.96	1.25	.49
No curbs with curb cuts	−0.24	.77	−0.13	.94
Public transportation that is close to your home	0.43	.59	3.13	.05*
Adequate handicap parking	1.41	.05*	1.10	.44

* p<0.30 : Environmental item has a chance association with disability; Adjusted for age, ethnicity, gender, education, body mass index, comorbidities, WOMAC knee pain and physical function, and site (Iowa or Alabama). Positive parameter estimates for environmental features represent association with less disability (higher summary disability scores), while negative estimates represent association with more disability (lower summary disability scores).

Table 5

Adjusted associations between individual features of the neighborhood environment and individual disability items reaching statistical significance*

Environmental Items [†]	Frequency dimension	Adjusted OR [‡] for no disability	95% Confidence Interval
No parks and walking areas that are easy to get to and easy to use	Taking part in a regular fitness program	0.4	[.2 .7]
	Taking part in organized social activities	0.5	[.3 1.0]
Adequate handicap parking	Visiting Friends and Family	1.8	[1.1 2.8]
	Going out with others to public places	1.8	[1.1 2.8]
	Providing care and assistance to others	1.5	[1.0 2.3]
	Working at a volunteer job	1.6	[1.0 2.5]
	Limitation dimension	Adjusted OR for no disability	95% Confidence Interval
Public transportation that is close to your home	Visiting friends and family	2.0	[1.2 3.4]
	Taking care of the inside of the home	1.9	[1.1 3.3]
	Working at a volunteer job	1.8	[1.1 3.1]
	Taking part in active recreation	2.9	[1.2 6.9]
	Inviting people into your home for a meal	2.1	[1.2 3.5]
	Going out with others to public places	2.0	[1.1 3.4]
	Taking part in organized social activities	2.0	[1.2 3.3]
	Preparing meals for yourself	2.5	[1.4 4.7]

* Adjusted for age, ethnicity, gender, education, body mass index, comorbidities, WOMAC knee pain and physical function, and site (Iowa or Alabama).

[†] Environmental items listed had at least a chance association ($p < 0.30$) with total summary disability scores.

[‡] Greater Odds Ratios (OR) represent higher likelihood of no disability. Adjusted for age, ethnicity, gender, education, body mass index, comorbidities, WOMAC knee pain and physical function, and site (Iowa or Alabama).