Predictors of ADL Disability in Culturally Diverse Older Adults

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ABSTRACT

Int J Exerc Sci 2(3) : 202-214, 2009. The purpose of this study was to utilize the disablement pathway model to examine the contribution of physical function, dyspnea, and pain to disability in activities-of-daily-living (ADL) in culturally diverse older adults. Participants were 51 older adults (age = 69.0 years ± 9.7; 76.5% African-American, 51.0% < high school education, 52.9% < $20,000 annual income) from an urban community center and an independent living housing facility for seniors. Participants completed the Functional Status Index (FSI), which provides ratings of need for assistance (FSIA) and pain (FSIP) with ADL, the Continuous Scale Physical Functional Performance 10-item Test (CS-PFP10), and an analog dyspnea scale. Hierarchical multiple regression analyses revealed that facility, physical function, pain, and dyspnea accounted for 50.5% of the variance in disability and that pain ($\beta = .43$, $p < .01$) and physical function ($\beta = -.39$, $p < .01$) were the only significant predictors. In the second model, facility, dyspnea, and pain explained 27.6% of the variance in physical function, and facility ($\beta = .39$, $p < .01$) and dyspnea ($\beta = -.26$, $p = .05$) were the only significant predictors. Based on the disablement pathway model, physical functional improvement and pain prevention and management should be targeted when designing culturally appropriate strategies for delaying disability and maintaining independent life.

KEY WORDS: Aging, health-related quality of life, longevity, exercise

INTRODUCTION

There are approximately 35 million Americans 65 years of age and older, and this number is expected to reach nearly 72 million by the year 2030 (16). Further, the number of individuals 85 years and older is expected to quadruple by 2050 (16). The elevated life expectancy and concomitant growth of the oldest-old cohort contributes to an escalating number of people living longer with chronic diseases and disabilities. According to the 2000 US Census, almost 42% of the general population of adults over 65 years of age live with at least one disability (38). Additionally, data from the U.S. Department of Health and Human Services

(36) indicate that the absolute number of older adults with disabilities has increased from 26.9 million in 1982 to 34.4 million in 2004.

Interestingly, the profile of the older population is becoming more diverse. The current distribution of African-Americans in the population of older adults is 8% and is projected to reach 10% by 2030; whereas, the number of non-Hispanic Caucasians is expected to decrease from 84% to 72% in the same time period (16). Furthermore, older minorities are more likely to live in poverty, have lower educational attainment, and experience higher rates of disability and functional limitation than older non-Hispanic Caucasians (16). The prevalence of disability in African-American persons is 19.8% and when compared with other races, African-Americans have the highest prevalence rate for severe disability (14%; 31). Additionally, African-Americans and people of lower socioeconomic status (SES) have greater risks for disability than Caucasians and individuals of higher SES (16).

As the population ages, the elevation in disability rates associated with aging becomes an important matter for research. The increased interest in the subject and consequent proliferation of studies in this field can sometimes confuse rather than clarify the matter as terminology is used indiscriminately with no guidance of a standard model. Accordingly, disability should be investigated within a solid theoretical framework to minimize conceptual inconsistencies. An example is the disablement pathway model proposed by Verbrugge and Jette (37), which was based on Nagi's original conceptual scheme of disability (26). The main pathway begins with pathology, and evolves to impairment, functional limitation, and ultimately disability.

Common impairments associated with aging include pain and dyspnea, which may threaten independence because they led to functional limitations. Research repeatedly demonstrates that pain contributes to lower physical functioning and increased chance of disability (18, 30, 24). Another impairment, dyspnea, is a feeling of difficult or labored breathing inappropriate to the level of effort produced (39) and is associated with reduced functioning among people over 65 years of age (3). Bestall and colleagues (3) observed that as the degree of breathlessness intensifies, the ability to perform ADL significantly decreases.

In turn, functional limitations may lead to disability in older adults. Objective measures of physical function are highly predictive of disability in previously non-disabled older persons (14, 27, 15). Judge and colleagues (21) statistically reviewed studies that included older adults with various levels of functioning in six different study sites nationwide and observed that a small decline in performance is associated with a higher prevalence of disability. Furthermore, Gill et al. (12) demonstrated that physical performance contributes to the risk of disability, regardless of other potential risk factors such as cognitive performance.

The disablement pathway model successfully predicts disability among Caucasians (22, 9, 28). Femia et al. (9) demonstrated the usefulness of the model in understanding disability among the oldest-old in Sweden. Lawrence and Jette (22) investigated the intermediary role of physical function in the disablement pathway model among a predominantly Caucasian and educated sample. Their results revealed that lower extremity function predicted onset of disability, and one of their suggestions for future research was the evaluation of race as a risk factor for disability.

Despite the high rates of disability among African-Americans and people of lower SES, there is a lack of systematic research on disability among culturally diverse persons (i.e., diverse according to race, education, income), and specifically, a lack of research using the disablement pathway model with this population. Disability can be caused by a myriad of factors; consequently, it is crucial to identify which factors are associated with increased risk of dependence in a heterogeneous sample of older adults. Therefore, the purpose of this study was to use the disablement pathway model (37) as a guiding framework to examine the contribution of physical function (i.e., functional limitation), pain (i.e., impairment), and dyspnea (i.e., impairment) to ADL disability (i.e., defined as a need for assistance) in culturally diverse older adults. It was hypothesized that physical function would mediate the relation between impairment and ADL disability in culturally diverse older adults.

METHOD

Participants

Eighty-three culturally diverse, independent-living older adults were recruited over a two-year period to participate in a larger physical activity intervention study through informational meetings and flyers at an urban community center and at an independent living housing facility for seniors. The older adults interested in the study were contacted by phone or face-to-face meetings at the centers to schedule an initial interview. Inclusion criteria for the intervention study consisted of (a) minimum age of 50 years, (b) participation in activities at an urban community center or residence at an independent living housing facility for seniors, and (c) consent to participate in the intervention study that was approved by the institutional review board of the Louisiana State University. Exclusion criteria for the intervention study were any conditions consistent with the American Heart Association Classes C and D (1). Class C includes individuals with moderate-to-high risk for cardiac complications during exercise and/or who are unable to self regulate activity or understand the recommended activity level, and class D encompasses individuals with unstable cardiovascular conditions.

Instruments

Descriptive Measures. The three following measures were used to collect descriptive information: (a) a *personal history questionnaire* obtained participants' age, sex, marital status, education level, annual income, race, and employment status; (b) the *health status questionnaire* (17) assessed participants' medical history and use of prescription medications; and (c) the *Mini-mental status examination (MMSE)* screened cognitive status (10). Classifications of cognitive status are (a) normal cognitive function = 27-30, (b) mild cognitive impairment = 21-26, (c) moderate cognitive impairment = 11-20, and (d) severe cognitive impairment = 0-10 (11). The MMSE has adequate content, predictive, and convergent validity (32).

Predictor and Outcome Measures. The three following measures were predictor and outcome measures in the hypotheses tests: (a) the *functional status index (FSI;* 19) measured self-reported need for assistance (FSIA), amount of pain (FSIP), and degree of difficulty (FSID) with the performance of basic and instrumental ADL. The construct and criterion validity of the FSI was established against objective measures of physical function (19, 20), and the test-retest reliability coefficients of the various test items are reported as being in the range of $r = .64$ to .82 (19, 20). The FSIA ($\alpha = .69$) was used in the analyses as the outcome measure of disability and the FSIP ($\alpha = .77$) was used as a measure of impairment; (b) the *continuous scale-physical functional performance 10-item test (CS-PFP10;* 4) assessed performance-based physical function. The CS-PFP10 requires the participant to perform a series of ADL based activities in a standard fashion. Each item is explained to the participant by trained test administrators who adhere to a standardized script. The time taken to complete the tasks, distance covered, and/or weight carried are recorded and converted to a set of continuous-scale scores. The test battery provides scores in the following five physical domains: upper body strength (e.g., pot carry), lower body strength (e.g., stair climb), upper body flexibility (e.g., reach), balance and coordination (e.g., floor sit), endurance (6-min walk), and a total CS-PFP score (5). The CS-PFP10 total score was used in the analyses as a measure of physical function. The test has been validated for use in older populations (5, 4), and the reproducibility of the CS-PFP10 scores and subscales are very good, with intraclass correlation coefficients in the range of $r = 0.79$ to 0.94; and (c) the *visual analog dyspnea scale (VAS)* measured dyspnea. Immediately upon completion of the CS-PFP10 participants were instructed to indicate their degree of breathlessness by marking along the 10cm horizontal line. Dyspnea was then expressed as a percent of the full VAS line length. The VAS has adequate reproducibility, with a coefficient of variation for the maximal scores of 6 ± 1%, which is similar to the variation in maximal Borg score (3 ± 1%). The VAS is strongly correlated with minute ventilation ($r = .98$) and the Borg scale ($r = .99$) in individuals with stable chronic obstructive pulmonary disease (25) and it is commonly used to quantify the sense of effort to breathe in patients with numerous disorders (2).

Protocol

Participant recruitment for the physical activity intervention study occurred on a continuous basis from February 2004 to February 2006. Once recruited, participants were asked to complete four pre-tests before beginning the intervention (8). Measures for this study were collected during two 60-min testing sessions that were part of the four pre-tests. The first testing session was a face-to-face interview in which participants from the local community center were interviewed at the community center and residents of the independent living housing facility were interviewed at their residence. During the first session, participants signed an informed consent document and then they responded to the personal history questionnaire, the health status questionnaire, and the MMSE. The FSI, CS-PFP10, and dyspnea scale were administered during a second testing session that was conducted at the local community center. Participants from the independent living housing facility were transported to the testing locale.

Statistical Analyses
Before conducting the analyses, tests of normality and univariate and multivariate outliers were performed. Descriptive statistics (frequencies, means, and standard deviations) were used to determine the sample characteristics. Two multivariate analyses of variance (MANOVA) were conducted to examine differences on the FSIA, CS-PFP10 total score, FSIP, dyspnea, and MMSE between the older adults from the two facilities, and to examine differences on the FSIA, CS-PFP10 total score, FSIP, and dyspnea based on MMSE scores. Pearson correlation was conducted to determine associations between the predictor and outcome variables. Finally, to analyze the hypothesis, hierarchical regression analyses with forced entry within each block were conducted to test the predictors of disability. The order and content of the blocks of predictors were based on the theoretical model (37). In the first model, disability (FSIA) was regressed on physical function (CS-PFP10 total score; Block 1) and dyspnea and pain (FSIP; Block 2). In the second model, physical function (CS-PFP10 total score) was regressed on dyspnea and pain (FSIP). If group differences were detected in the MANOVAs, partial correlations were used instead of Pearson correlations and facility and/or MMSE were included in the first block of the hierarchical regression analyses to control for any confounding effects. Statistical calculations were considered significant at alpha level of .05. SPSS 15.0 for Windows (SPSS Inc., Haverhill, MA) was used to conduct all analyses.

RESULTS

Eighty-three men and women 50 years of age and older consented to participate in a physical activity intervention study. Twenty-six of these participants had missing data on the predictor and outcome variables for this investigation. Incomplete data was the result of (a) participant relocation (n = 5), (b) voluntary withdrawal from the study for health (n = 2) or unidentified (n = 6) reasons, (c) participant's inability to complete one of the tests because of physical or visual impairment (n = 3), and (d) failure to collect one of the measures (n = 10).

Of the 57 participants with complete data for the predictor and outcome variables, six were identified as univariate and multivariate outliers and were excluded from the analyses. The final sample included 51 culturally diverse older adults (n = 33 from the urban community center and n = 18 from the independent living housing facility for seniors). Participants were between the ages of 50 and 93 (age = 69.0 years ±9.7), and had an average cognitive status of 24.8 ± 3.7. About three quarters of the participants were female (78.4%), 76.5% were African-American (n = 1 did not know race), approximately half had less than or equal to a high school education (51.0%), 52.9% reported an annual income of less than or equal to $20,000 ($n$ = 8 did not report or did not know income level), 76.5% were not

Table 1. Mean and Standard Deviations of the Disablement Pathway Model Constructs and Cognitive Status by Facility

	Full Sample		Community Center		Housing Facility	
	Mean	SD	Mean	SD	Mean	SD
FSIA†	21.65	4.79	20.36	0.78	24.00	1.06
CS-PFP10†	54.19	15.70	59.12	2.49	45.15	3.37
Dyspnea	0.30	0.24	0.29	0.04	0.32	0.06
FSIP	19.55	2.95	19.03	0.50	20.50	0.68
MMSE	24.76	3.68	24.61	3.82	25.06	3.49

†Significant group difference at $p < .05$.
Note. FSIA = functional status index-need for assistance; CS-PFP10 = Continuous Scale Physical Functional Performance 10-item Test; FSIP = functional status index-pain; MMSE = Mini-mental Status Examination.

married (i.e., single, divorced, widowed, living with partner), and 74.5% were not working (i.e., retired, unemployed). The most prevalent chronic medical conditions were cardiorespiratory (82.1%; e.g., asthma, emphysema, heart problems, high blood pressure, stroke), followed by orthopedic conditions (37.3 %; e.g., arthritis, back or neck problems), "other" health conditions (37.3%; e.g., cancer, diabetes), and neurological conditions (35.5%; e.g., eye or hearing problems). Participants reported using an average of 2.86 ± 2.10 prescription medications.

Kolmogrov-Smirnov (with Lilliefors significance correction) tests were used to analyze normality assumptions for the predictor and outcome variables. These analyses indicated that the data for dyspnea (p = .03), FSIA (p < .001), and FSIP (p < .001) were not normally distributed; however, the skewness and kurtosis values did not exceed the recommended criteria (7).

Two MANOVA were used to examine differences on FSIA, CS-PFP10 total score, FSIP, dyspnea, and MMSE between the older adults from the two facilities, and to examine differences on FSIA, CS-PFP10 total score, FSIP, and dyspnea on MMSE scores (scores $\geq$ 27 vs. scores < 27). Significant group differences were observed based on facility, Pillai's Trace = .23, F (5, 45) = 2.74, p < .05, η^2 = .23. Univariate analyses revealed that the groups were significantly different on the FSIA and CS-PFP10 total score with the group from the independent living housing facility reporting a greater need for

Table 2. Mean and Standard Deviations of the Disablement Pathway Model Constructs by MMSE scores

	Normal Cognitive Status (scores = 27-30)		Mild-Moderate Impairment (scores = 15-26)	
	Mean	SD	Mean	SD
FSIA	21.25	1.08	21.90	0.87
CS-PFP10	57.20	3.50	52.25	2.81
Dyspnea	0.29	0.05	0.31	0.04
FSIP	19.85	0.66	19.36	0.53

Note. FSIA = functional status index-need for assistance; CS-PFP10 = Continuous Scale Physical Functional Performance 10-item Test; FSIP = functional status index-pain.

Table 3. Partial Correlations of the Disablement Pathway Model Constructs

	FSIA	CS-PFP10	Dyspnea	FSIP
FSIA	-	-.48**	.27	.54**
CS-PFP10		-	-.32*	-.20
Dyspnea			-	.27

**p* < .05; ** *p*<.01.
Note. FSIA = functional status index-need for assistance; CS-PFP10 = Continuous Scale Physical Functional Performance 10-item Test; FSIP = functional status index-pain.

Table 4. Hierarchical Regression Analysis for Predicting Disability (FSIA)

	R^2	R^2_{change}	F (df)	p	β
Block 1	.13	.13	7.61 (1,50)	.01	
Facility				.01	-.37
Block 2	.33	.20	11.80 (2,50)	.00	
Facility				.24	-.16
CS-PFP10				.00	-.49
Block 3	.51	.18	11.75 (4,50)	.00	
Facility				.42	-.10
CS-PFP10				.00	-.39
Dyspnea				.78	.03
FSIP				.00	.43

Note. FSIA = functional status index-need for assistance; CS-PFP10 = Continuous Scale Physical Functional Performance 10-item Test; FSIP = functional status index-pain.

Table 5. Hierarchical Regression Analysis for Predicting Functional Limitation (CS-PFP10)

	R^2	R^2_{change}	F (df)	p	β
Block 1	.18	.18	11.07 (1,50)	.00	
Facility				.00	.43
Block 2	.28	.09	5.99 (3,50)	.00	
Facility				.00	.39
Dyspnea				.05	-.26
FSIP				.40	-.11

Note. CS-PFP10 = Continuous Scale Physical Functional Performance 10-item Test; FSIP = functional status index-pain.

assistance ($p < .05$) and performing worse on the CS-PFP10 than the group from the urban community center (Table 1). No group differences were observed for cognitive status ($p = .71$; Table 2). Because of the group differences for facility, facility was used as a covariate in the correlations (i.e., partial correlations) and regressions (i.e., included facility in first block of hierarchical regression analyses).

Significant associations were observed between FSIA (disability), CS-PFP10 (physical function), and FSIP (pain) when controlling for facility (Table 3). The strongest association was between the FSIA and FSIP, and the CS-PFP10 was also significantly correlated with the FSIA.

The first hierarchical regression analysis revealed that facility explained 13.4% of the variance in disability (FSIA; Block 1). When physical function (CS-PFP10 total score) was added to the model (Block 2), 33% of the variance in disability was explained and physical function was the only significant predictor (β = -.49, $p < .01$). The addition of pain (FSIP) and dyspnea (Block 3) resulted in 50.5% explained variance in disability (FSIA); however, only pain (β = .43, $p < .01$) and physical function (β = -.39, $p < .01$) were significant predictors of disability (Table 4).

In the second model, physical function was regressed on facility (Block 1) and it accounted for 18.4% of the variance in physical function (CS-PFP10 total score). The variance explained in physical function increased to 27.6% when pain and dyspnea were added to the analysis (Block 2), and facility (β = .39, $p < .01$) and dyspnea (β = -.26, $p = .05$) were significant predictors of physical function; table 5).

DISCUSSION

As life expectancy increases, optimizing the ability to perform ADL becomes increasingly important to a growing number of older adults who wish to live an active, independent life. Therefore, the primary purpose of this study was to investigate the contribution of physical function, dyspnea, and pain to ADL disability in a sample of culturally diverse older adults. In general, the findings support the premise that functional limitations and impairments predict ADL disability, thus providing support for the utility of the disablement pathway model to understand disability in culturally diverse older adults.

The study sample included 51 older adults between the ages of 50 and 93 (age = 69.0 years ±9.7; 78.4% female, 76.5% African-American, 51.0% ≤ high school, 52.9% ≤ $20,000 per year). In comparison to the general population as reported by the U.S. Census Bureau (34, 33), the sample included a higher percentage of African-Americans, females, individuals of lower income, and a similar percentage of participants with lower education level. Moreover, the sample can be considered more diverse than the population of Louisiana, which is approximately 31.7% African-Americans, 25.2% ≤ high school, and 19.2% below poverty (35).

Previous studies have examined the disablement pathway model in some detail (22, 9, 29, 28); however, there has been limited investigation utilizing a culturally diverse sample. Although these studies demonstrated the utility of the disablement pathway model, the demographic characteristics of the study sample justifies the purpose of examining the contribution of physical function, pain, and dyspnea to ADL disability in a more culturally diverse sample of older adults.

Disability was significantly associated with physical function and pain and these findings are consistent with previous reports (14, 30). However, unlike the other impairment of pain, dyspnea was not significantly associated with disability, only with physical function. The associations between physical function and disability, as well as the relationship between dyspnea and physical function were expected based on the main pathway of the disablement pathway model (impairment → functional limitation → disability). The significant association between pain and disability and the lack of a significant correlation between pain and physical function does not fit the disablement pathway model adequately and could be an indication of pain bypassing functional limitation in the pathway to ADL disability.

To further test the disablement pathway model, after controlling for facility, hierarchical regression analyses revealed that physical function and pain were the only significant predictors of self-reported disability. These findings are consistent with the disablement pathway model as functional limitation immediately precedes disability, thus explaining a large portion of the variance in disability. Impairments such as dyspnea and pain can also predict disability, but generally this prediction is indirect, through functional limitations. Therefore, physical function was regressed on pain and dyspnea on the second model. Dyspnea was the only significant predictor of physical function, partially supporting the disablement model. Thus, it appears that whereas dyspnea affects independent living through physical function, pain may influence disability directly, and not through functional limitation. This statement is corroborated by the first hierarchical regression in which pain was a significant predictor of disability when all variables were regressed on disability.

Another finding that needs to be addressed is that facility was a significant predictor of physical function. Although demographic and environmental differences between the participants at each facility were not examined, it is possible that the groups may have been different according to race, income, or an environmental factor. It cannot confidently be concluded that the disablement model did not hold up in this population when the group differences in this sample may have interfered with the ability to truly understand the relationship among all the variables. Future studies should further examine the relationship among these variables in culturally diverse older adults to determine whether it fits the disablement model with a large enough sample size to split the groups if necessary and also test demographic and environmental variables as predictors of functional limitation and disability.

Contrary to the hypotheses of the disablement pathway model, pain was a significant predictor of disability, but not of physical function. This result could suggest that when analyzing the model with this population, pain should be part of the functional limitation construct rather than impairment, particularly if the pain is widespread as it limits performance at the level of the whole organism. Because the instrument utilized in the present study does not differentiate between localized and whole body pain, the information necessary to reclassify pain as a functional limitation in the model is not available. However, it is also important to consider that the present sample did not report high levels of pain; therefore, their pain might not have been severe enough to affect their physical function. Future research should attempt to distinguish between localized and widespread pain, as well as utilize a more diverse population regarding pain as to better understand the role of pain in the disablement model.

On the basis of these findings and previous work demonstrating the impact of physical function and impairments on disability, it appears that treating functional limitations, pain, and to a lesser degree dyspnea among culturally diverse older adults could reduce the risk of ADL disability. Consequently, these results draw important practical implications by revealing physical function, pain, and dyspnea as potential targets for intervention.

Although this study adds to the knowledge base regarding the process of disability among culturally diverse older adults, it is not without limitations. One limitation of this study was the small sample size, which did not provide adequate power for the regression models with 3 and 4 predictors (13), and may have led to the lack of expected associations between physical function and impairments. Another limitation was selection bias because the participants were all volunteers and some were currently participating in structured physical activity programs at their respective facilities. Finally, the assessment tool utilized for cognitive function (MMSE) is influenced by educational levels and age (6), thus the MMSE scores in this sample may reflect the varied education levels of the participants rather than cognitive impairment. However, there were no differences on disability, physical function, pain, or dyspnea according to MMSE scores. Therefore, the inclusion of participants with various levels of cognitive status may not be a major limitation of this study.

Based on the potential influence of sedentary lifestyle and hypokinetic diseases and conditions on all elements of the disablement pathway, future research efforts should include a comparison of active and inactive culturally diverse older adults on the disablement constructs, as well as describing the results of physical activity interventions for this population. Additionally, a larger sample is crucial to increase statistical power and possibly reveal significant relations between the constructs of the disablement process model. Recruiting more men into these studies is also important to increase the generalizability of future findings. Mechanisms underlying the disability process are another intriguing area of research. Understanding how pathologies evolve into impairments, functional limitation, and ultimately disability, as well as knowing how intra and extra-individual factors act to accelerate or delay the disabling process can greatly improve prevention efforts. Lastly, utilizing measures of cognitive status that are not dependent on educational status may enhance the assessment of cognitive status in culturally diverse older adults.

In summary, physical function, pain, and to a lesser degree dyspnea, contribute to ADL disability in a sample of culturally diverse community-living older adults. The disablement pathway was a useful framework to understand ADL disability in this understudied population. Overall, the findings of this study support pain and functional limitation as the main predictors of disability. Consequently, physical function and pain are identified as potential sites for intervention strategies.

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