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Neighborhood Disadvantage and Life-Space Mobility are Associated with Incident Falls in Community-Dwelling Older Adults

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Abstract

OBJECTIVES: To determine the relationship between neighborhood-level socioeconomic disadvantage, life-space mobility and incident falls in community-dwelling older adults.

DESIGN: Prospective, observational cohort study with a baseline in-home assessment and 6-month telephone follow-up.

SETTING: Central Alabama, U.S.A.

PARTICIPANTS: One thousand community-dwelling adults age 65 years, recruited from a random sample of Medicare beneficiaries.

MEASUREMENTS: Neighborhood disadvantage was measured by a composite index derived from baseline neighborhood-level residential census tract socioeconomic variables. Data on individual-level socioeconomic characteristics, clinical variables and life-space collected at

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baseline were included as covariates in a multivariate model using generalized estimating equations to assess the association with incident falls in the six months after baseline.

RESULTS: Of the 940 participants who completed baseline and follow-up assessments, 126 (13%) reported one or more new falls in the six months after baseline. Neighborhood disadvantage (by increasing quartiles of disadvantage) demonstrated an independent non-linear association with incident falls after adjusting for confounders: The lowest quartile served as reference; 2nd quartile Odds Ratio 2.4 (95% CI 1.2–4.6); 3rd quartile OR 1.9 (1.0–3.7); 4th quartile OR 3.2 (1.7–6.0). Each 10-point decrement in life-space (OR 1.2, 95% CI 1.0–1.3) was associated with a higher risk of falls.

CONCLUSION: Greater neighborhood disadvantage was associated with a higher risk of falls. Life-space also contributes separately to fall risk. Community-dwelling older adults in disadvantaged neighborhoods, particularly those with limited mobility, may benefit from a more rigorous assessment of their fall risk by healthcare providers. Neighborhood level socioeconomic characteristics should also be an important consideration when identifying vulnerable populations that may benefit the most from fall prevention programs.

Keywords

Falls; neighborhood disadvantage; socioeconomic status; life-space

INTRODUCTION

One third of community-dwelling adults 65 years old fall each year.¹ Falls not only lead to loss of function and mobility,² but are also associated with over 2 million emergency department visits, over 20,000 fatalities and over \$30 billion in direct medical costs annually.³

A number of important risk factors have been identified in the literature, and an expert panel on falls prevention established eleven consensus fall risk factors: Muscle weakness, history of falls, gait deficit, balance deficit, use of assistive device, visual deficit, arthritis, Activities of Daily Living (ADL) impairment, depression, cognitive impairment and age >80 years.⁴ The physical neighborhood environment has also been identified as a risk factor in outdoor falls,^{5, 6} however, there is limited data on the impact of neighborhood characteristics exclusive of the physical environment on fall risk. Neighborhood level characteristics related to socioeconomic and health disparities contribute to *neighborhood disadvantage*, which has been associated with a higher risk of obesity,⁷ hypertension,⁸ cardiovascular disease,⁹ and disability,¹⁰ but has not been studied as a risk factor for falls. It is also unclear how socioeconomic disadvantage at the individual and neighborhood level impacts the role of known fall risk factors. An important confounder of neighborhood disadvantage is life-space mobility (“life-space”), which determines whether one’s social interactions extend beyond the confines of one’s neighborhood. Life-space is associated with several negative health outcomes including ADL impairment,¹¹ cognitive decline,¹² healthcare utilization,¹³ and mortality.¹⁴ Yet, its influence on the risk of falls has never been examined.

To address these gaps in knowledge, we investigated the role of (1) neighborhood disadvantage, using the Index of Objective Neighborhood Disadvantage (derived from poverty and female-headed household indices) and (2) life-space in community-dwelling older adults, as they relate to the risk of incident falls. Demonstrating an independent association between neighborhood disadvantage and falls may help identify particularly vulnerable individuals towards whom fall prevention strategies should be directed.

METHODS

Setting and Participants

The University of Alabama at Birmingham Study of Aging was designed to understand subject-specific factors predisposing older adults to mobility decline as well as racial differences in mobility changes associated with aging. Participants were a stratified random sample of community-dwelling Medicare beneficiaries, age ≥ 65 years living in central Alabama. Baseline in-home interviews were conducted for 1,000 participants between November 1999 and February 2001. Telephone follow-up interviews were conducted at 6-month intervals for up to 8.5 years. If participants were unable to complete follow-up assessments, designated contact persons were interviewed. The current analysis used data from 940 participants with complete data for baseline and first 6-month follow-up interviews. Persons were censored at time of a nursing home admission, death or loss to follow-up so that results would be relevant to community-dwelling older adults. The UAB Institutional Review Board approved the study protocol. Study methods have been described elsewhere.^{15–17}

Study variables

Neighborhood level covariates: Neighborhood Disadvantage—We geocoded each participant's address, linked their place of residence to 178 unique census tracts and applied the characteristics of each census tract using data from the 2000 US Census summary files as previously described.⁸ We were unable to geocode three participants' addresses, and therefore used the characteristics of their zip codes as proxies, accounting for two unique zip codes and resulting in a total of 180 unique census tracts or zip codes. We defined neighborhood disadvantage based on the Index of Objective Neighborhood Disadvantage (ONDI) developed by Ross, Mirowsky, and Pribesh,^{18, 19} and measured this variable at the census tract level where participants lived. The ONDI is a composite measure that combines the prevalence of poverty (determined from the number of households living below the poverty line in the year 2000) and the prevalence of female-headed households, defined as households with children under 18 years old and without an adult male member, in the census tract. The prevalence of poverty is a marker of economic disadvantage, and the prevalence of female-headed or single-mother households is a marker of social disadvantage. In keeping with the methods of Ross and colleagues,^{18, 19} we determined the ONDI for each individual by dividing the rates of poverty and single-mother households by 10 and assigning the mean of these two values as the ONDI. Thus, a one-unit increase in the ONDI represents a 10 percent increase in the prevalence of poverty or of single-mother households at the individual's census tract level. This method of defining neighborhood disadvantage and calculating the ONDI has been previously used with this cohort.^{8, 20} A prior comparison

of low, middle and high levels of neighborhood disadvantage by ONDI tertiles in this cohort showed that the mean number of years participants had lived at their current address did not differ across tertiles.⁸

Individual level covariates: Socio-demographic characteristics and life-space

—Self-reported data collected at the baseline interview included age, gender, race (Black/African-American or white), living alone, marital status, years of education, and annual income. The number of years of education was converted into a categorical variable (≤ 6 years, 7–11 years, 12 years, and ≥ 12 years). Income was defined as total combined family income before taxes for the last 12 months and measured quantitatively and qualitatively. Quantitatively, income was categorized based on income range, from a minimum of “less than \$5,000” to a maximum of “\$50,000 or more”. These categories were used to define poverty in this study, where we compared each participant’s income category against the 2000 Federal Poverty Guidelines and assigned poverty status to individuals below the poverty threshold of \$8,350 for persons living alone or \$11,250 for persons living with someone. Poverty was modeled as a dichotomous variable (below the 2000 Poverty Guideline threshold vs. above) in statistical models. Participants provided a subjective assessment of their income into one of four categories: “Not enough to make ends meet”; “enough to get by on”; “comfortable but permits no luxuries”; “allows you to do what you want”. In our multivariate analysis, income was modeled as “Not enough to make ends meet” vs. “enough to get by on” or better.

We selected life-space as the preferred measure of mobility. Unlike measures of mobility-related tasks (e.g., gait speed or lower extremity strength), life-space addresses functional mobility that combines one’s life activities (life) with the maximal geographical limits of one’s activities (space), thereby providing a true metric of community participation beyond strict physical mobility. The definition and validation of life-space as a measure of mobility have been previously described.^{15, 16} Life-space was measured at baseline and at each 6-month follow-up using the validated Life-space Assessment tool (LSA). Participants were asked: “During the past 4 weeks, have you: 1) been to other rooms in your home besides the room where you sleep; 2) been to an area outside your home such as your porch, deck, or patio; hallway of an apartment building; or garage; 3) been to places in your neighborhood other than your own yard or apartment building; 4) been to places outside your neighborhood, but within your town; and 5) been to places outside your town?” Participants were asked how frequently they attained each of the above five levels of activity and whether they required assistance from an assistive device or another person. A composite score was calculated based on life-space level, degree of independence in achieving each level, and the frequency of attaining each level. Scores ranged from 0 to 120 with higher scores representing greater mobility. We examined the association between 10-point differences in life-space scores and risk of falls. The 10-point difference has been previously found to be clinically meaningful.^{16, 21, 22} An example of a 10-point difference would be an older person who previously reported no assistance to go into the neighborhood daily and to town 1 to 3 times a week (e.g., 64 points) but who now requires a cane to go into town less than once a week (e.g., 54 points).

Individual level covariates: Fall risk factors—Our study focused on 11 consensus risk factors for falls identified by the aforementioned expert panel from the American Geriatrics Society, British Geriatrics Society and American Academy of Orthopaedic Surgeons on fall prevention.⁴ Data for these factors were collected at the baseline interview: (i) Muscle weakness by self-report, (ii) history of falls in past one year, (iii) gait deficit defined as gait speed <0.8 meters/second,²³ (iv) balance deficit by in-person exam, (v) use of assistive device by in-person assessment, (vi) visual deficit as determined by standardized visual acuity exam, (vii) history of arthritis by self-report, (viii) impairment in 1 area of ADL by self-report, (ix) depression based on the 15-item version²⁴ of the Geriatric Depression Scale (GDS)²⁵ and defined as a score of 6 or higher, (x) cognitive impairment based on the Mini-Mental State Examination (MMSE)²⁶ and defined as a score less than 24,²⁷ and (xi) age >80 years.

Outcome variable—The main outcome was one or more incident falls in the 6-month interval following baseline assessment, determined by self-report at the first 6-month telephone follow-up.

Statistical Analysis

We compared baseline sociodemographic characteristics and the prevalence of fall risk factors between participants who reported one or more falls and those who reported no falls at six months. We performed cross-sectional analyses to compare the prevalence of socio-demographic characteristics and the prevalence of consensus fall risk factors across increasing degrees of neighborhood disadvantage defined by quartiles of increasing ONDI scores. Pearson chi-square and t-tests were used to compare proportions and means, respectively. Generalized estimating equations (GEE) with a logit link function²⁸ were used to examine the significance and independent association of the ONDI with incident falls while accounting for correlation among individuals within the same census tract.²⁹ To ensure that any detected effects of neighborhood disadvantage were attributable to the neighborhood context and not characteristics inherent to the participants' individual socioeconomic disadvantage, we controlled for individual-level poverty status, adequacy of income and years of education, as well as risk factors for falls.^{7, 29} We performed univariate GEE analysis of (i) neighborhood disadvantage by ONDI score in quartiles, (ii) individual-level socioeconomic covariates, (iii) life-space, and (iv) the 11 consensus fall risk factors. For the multivariate analyses, we developed one model for the relationship between ONDI (in quartiles) and fall risk that included individual-level socioeconomic covariates, life-space, and consensus fall risk factors that met criteria as a confounder.³⁰ We developed a second multivariate to examine the relationship between life-space and fall risk using a similar approach. All statistical analyses were conducted using IBM SPSS statistics software version 22 (IBM Corporation, Somers, NY).

RESULTS

At enrollment, 308 (31%) of the 1,000 participants reported a history of falls in the 12 months prior to baseline. At the first 6-month follow-up, 940 completed the follow-up assessment and 126 (13%) reported one or more incident falls in the 6 months after baseline.

Participants who reported any incident fall were significantly older, reported more years of education and had a higher prevalence of consensus fall risk factors (Table 1).

The 1,000 participants were associated with 180 unique census tracts, which formed the basis of our neighborhood analyses. The geographic distribution of ONDI scores is shown in Supplemental Figure 1. In univariate analysis, greater neighborhood disadvantage (as measured by ONDI quartiles) was significantly associated with lower income and with fewer years of education. Mean age ($p=0.12$) and gender ($p=0.38$) did not vary across quartiles of the ONDI. Participants residing in the highest quartile of the ONDI were more likely to describe themselves as Black or African American and less likely to be married (Table 2). The prevalence of consensus fall risk factors was generally higher in participants at higher levels of neighborhood disadvantage. The notable exceptions were history of previous falls and age ≥ 80 years, which did not differ across ONDI quartiles (Table 2).

Life-space was inversely correlated with the ONDI (Pearson $R = -0.162$; $p < 0.001$) and the mean life-space of participants decreased across higher ONDI quartiles ($p < 0.001$). Individuals in the highest ONDI quartile were more likely to be homebound (16% vs. 6%, $p < 0.001$) when compared with individuals in the lowest quartile. The number of incident falls was substantially lower in the lowest quartile of neighborhood disadvantage compared to higher quartiles, although no consistent trend persisted across all quartiles. The number of falls (1 fall vs. >2 falls) did not differ ($p=0.13$) across neighborhood disadvantage quartiles (Supplemental Table 1).

In multivariate analysis using a GEE model, greater neighborhood disadvantage as defined by a continuous ONDI score was independently associated with higher risk of incident falls, even after adjusting for individual-level socioeconomic factors and fall risk factors (Odds Ratio 1.64, 95% Confidence Interval (CI) 1.20–2.24; $p=0.002$). Comparing individuals residing in a neighborhood in the highest quartile of neighborhood disadvantage to individuals residing in neighborhoods in the least disadvantaged quartile (Table 3), the OR was 3.20 (95% CI 1.71–5.97; $p < 0.001$). However, the relationship between ONDI quartiles and incident falls did not show a consistent trend across the middle quartiles (Table 3). Multivariate GEE analysis of life-space demonstrated an inverse relationship between life-space and incident falls, where every 10-point decrement in life-space was associated with 16% greater odds of incident falls, after adjusting for confounders for life-space (Table 4). In both neighborhood disadvantage and life-space models, black race was protective of falls.

DISCUSSION

Greater neighborhood disadvantage was independently associated with higher risk of incident falls in this cohort of community-dwelling older adults, even after adjusting for individual-level socioeconomic disadvantage, life-space and fall risk factors. To our knowledge, this is the first report demonstrating an independent association between neighborhood disadvantage and incident falls. This finding offers evidence in support of the important role of neighborhood disadvantage in health outcomes in older adults, adding to previous studies reporting that neighborhood characteristics, exclusive of the physical environment, was associated with higher risk of disability¹⁰ and disease.^{8, 9, 19} Although any

fall - even one without any injury - has previously been shown to cause a decline in life-space,¹⁷ a clear temporal link between life-space and the risk of future falls has not been previously examined. Our results suggest that life-space may be an important risk factor for falls. Although life-space overlaps with fall risk factors, it is nonetheless a critical variable for fall risk because it measures how much one is able to escape one's neighborhood, a measure that is not captured by the fall risk factors.

The odds of falls among residents of the most disadvantaged neighborhoods was greater than three times that of residents in least disadvantaged neighborhoods, underscoring the profound contribution of one's residential neighborhood to the risk of incident falls. The exact mechanism(s) through which neighborhood-level socioeconomic disadvantage might cause incident falls cannot be elucidated from our data. While an individual's income and education may influence the risk of falls,^{31, 32} the influence of socioeconomic characteristics of an individual's neighborhood on falls is unclear. A UK study found that social deprivation at the electoral ward level was associated with higher rates of hospital admissions for falls in adults 75 years, but did not study the actual incidence of falls.³³ Li and colleagues recently reported that neighborhood level SES was associated with both increased walking for daily tasks and increased outdoor falls,³⁴ raising the question of whether hazards in the physical neighborhood walking environment or socioeconomic disadvantages of the neighborhood were more responsible for the outdoor falls. Disadvantaged neighborhoods indeed have poorer pedestrian infrastructure, including incomplete or damaged sidewalks, which serve as disamenities that may increase the risk for falls.³⁵⁻³⁷ Poorer neighborhoods also often have lower quality parks and open spaces that present potential fall hazards and impede the maintenance of fitness and balance skills.³⁷⁻³⁹ In contrast to participants in Li's study, those in our study represent a more balanced biracial cohort (50% white) and have a greater representation of individuals with fewer years of education (73% high school graduate) than in Li's study (78% white; 34% high school graduate). Our findings therefore add to the literature by demonstrating the contribution of neighborhood disadvantage to fall risk among older adults in the community, but with findings that are more generalizable to a broader population across the racial and socioeconomic spectrum.

Lower life-space is also associated with risk of mortality in advanced age¹⁴ as well as a higher prevalence of heart disease, stroke, arthritis and eye disease.⁴⁰ Therefore, lower life-space may identify individuals at higher risk for falls due to medical rather than mechanical reasons. Life-space is a potential confounder for neighborhood disadvantage as individuals with greater life-space can have social interactions beyond the boundaries of their neighborhood. The lack of mobility also may confine the individuals geographically and prevent them from escaping economically and socially deprived environments.⁸ The inclusion of life-space in the multivariate model thus lends further validity to the independent detrimental impact of neighborhood level socioeconomic disadvantage. Unlike individual level fall risk factors that may lend themselves to individualized patient-oriented fall prevention strategies, the identification of neighborhood level risk factors requires a public health approach. Community-level interventions address the base levels of the Health Impact Pyramid and are likely to have the greatest potential impact, particularly because they are not dependent on factors such as access to medical services.⁴¹

We reported associations between neighborhood disadvantage and falls and life-space and falls using separate models with distinct sets of covariates to adjust for confounding. This avoided the epidemiological fallacy that can occur when results for two exposures of interest are reported from the same model but the exposures have different set of confounders.⁴²

Among the 11 consensus fall risk factors, only (i) muscle weakness, (ii) difficulty with balance, (iii) use of assistive device and (iv) ADL impairment met criteria for confounding³⁰ in the neighborhood disadvantage model. For the life-space model, only (i) muscle weakness and (ii) difficulty with balance were confounders. The use of assistive devices is incorporated in the calculation of life-space and the literature suggests that ADL impairment is a mediator rather than a confounder of life-space. Therefore, these two variables were excluded from the final model for the association between life-space and falls. Ultimately, the minimal set of adjusted variables that comprised the most parsimonious model for the association between neighborhood disadvantage and falls was not the same for life-space and falls.

The strengths of this study include the measurement of neighborhood disadvantage in a racially balanced, population-based sample of community-dwelling older adults which enhances the generalizability of our findings. The measurement of life-space in this cohort has been validated as a measure of mobility.¹⁵ We limited our outcome analysis to the first six months of the study in order to minimize potential changes in the socioeconomic environment over time within each census tract that would introduce misclassification related to the exposure variable (ONDI). While this restriction may also minimize the Hawthorn effect⁴³ where study participation could artificially impact the likelihood of falls, the true benefit of the shortened time lag is that it strengthens the temporal link between neighborhood characteristic and falls.

The limitations of this study include the constrained ability to examine a broader range of neighborhood factors that may be potential confounders at the neighborhood and individual levels. It is reasonable to expect that some of the characteristics measured at baseline may have changed over time, and therefore social circumstances or clinical conditions at baseline may not necessarily reflect those same characteristics at the end of the follow-up period. Falls were self-reported and may be under-reported due to poor recall. However, since we limited our analysis only to falls at the first follow-up encounter six months after baseline, it minimizes the temporal gap between baseline and outcome and therefore would minimize any threat of misclassification of the baseline characteristics at the time of outcome measurement. Another limitation is the potential loss of statistical power resulting from the clustering of individuals at the neighborhood level, although this should be minimal given the large number of neighborhoods and low mean number of subjects per neighborhood. We also recognized that life-space overlaps with many of the consensus fall risk factors.^{12, 15, 17} However, our sample size did not allow us to tease apart the separate contributions of life-space and each individual fall risk factors. In a larger model with ONDI, life-space and all 11 fall risk factors (not shown), life-space did not produce a significant association with falls, although ONDI and life-space demonstrated effects whose respective magnitude and direction were similar to those in the final models (Tables 3 and 4).

Our results underscore the adverse health effect of negative neighborhood characteristics and suggest the need to preferentially increase fall prevention efforts among residents of socioeconomically disadvantaged neighborhoods. They also suggest the potential importance of preserving life-space in older adults with regard to minimizing adverse health outcomes due to neighborhood characteristics, regardless of their clinical profile. Future studies should investigate the direct mechanism by which neighborhood characteristics increase the risk of falls or other health outcomes in older adults.

In conclusion, falls in older adults are a significant public health problem. Neighborhood level socioeconomic characteristics and individual life-space are both important risk factors that may help improve intervention programs aimed at reducing incident falls among community-dwelling older adults.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Comparison of Sociodemographic Characteristics and Consensus Fall Risk Factors between Individuals with and without 1 Incident Falls (N=940)

Table 1

	Fall within 6 months (N=126)	No Fall (N=814)	p
<i>Sociodemographic Characteristics</i>			
Age (mean ± SD)	77 ± 7.9	75 ± 6.5	0.002
Female gender	72 (57%)	405 (50%)	0.12
Black/African-American race	60 (48%)	410 (50%)	0.57
Married	52 (41%)	431 (53%)	0.15
Education (grade)			0.01
6 th or less	23 (18%)	168 (21%)	
7 th through 11 th	48 (38%)	224 (28%)	
12 th	17 (14%)	205 (25%)	
More than 12 th	38 (30%)	217 (27%)	
Below 2000 Poverty Guideline threshold	47 (37%)	276 (34%)	0.46
Income			0.49
“Not enough to make ends meet”	15 (12%)	65 (8%)	
“Enough to get by on”	45 (36%)	285 (35%)	
“Comfortable but permits no luxuries”	33 (26%)	225 (28%)	
“Allows you to do what you want”	33 (26%)	238 (29%)	
<i>Consensus Fall Risk Factors</i>			
Muscle weakness	77 (61%)	283 (35%)	<0.001
History of falls in past 1 year	75 (60%)	213 (26%)	<0.001
Gait deficit (gait speed <0.8 m/s)	95 (92%)	580 (79%)	0.001
Balance deficit	86 (68%)	372 (46%)	<0.001
Use of assistive device	67 (53%)	229 (28%)	<0.001
Visual deficit	32 (25%)	115 (14%)	0.001
History of arthritis	91 (72%)	524 (64%)	0.09
Impaired ADL (1 areas of dependence)	81 (64%)	282 (35%)	<0.001
Depression (GDS>5)	25 (20%)	67 (8%)	<0.001
Cognitive impairment (MMSE <24)	39 (31%)	236 (29%)	<0.001

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	Fall within 6 months (N=126)	No Fall (N=814)	p
Age over 80 years	39 (31%)	167 (21%)	0.008

SD: Standard deviation. ADL: Activities of Daily Living. GDS: Geriatric Depression Scale. MMSE: Mini Mental State Examination. P-value: The p-value is the calculated probability of obtaining the observed result when the null hypothesis is true. The p-values in this table were derived from a combination of Pearson chi-square and T tests.

Table 2

Comparison of Sociodemographic Characteristics, Incident Falls and Consensus Falls Risk Factors across Quartiles* of Neighborhood Disadvantage (N=940)

Sociodemographic characteristics	Lowest ONDI Quartile (N=240)	2 nd ONDI Quartile (N=242)	3 rd ONDI Quartile (N=216)	Highest ONDI Quartile (N=242)	P
Age in years (mean $\pm$ SD)	75 $\pm$ 6	75 $\pm$ 6	76 $\pm$ 7	76 $\pm$ 7	0.12
Female gender	120 (50%)	122 (50%)	120 (56%)	115 (48%)	0.38
Black/African-American race	40 (17%)	110 (45%)	138 (64%)	182 (75%)	<0.001
Married	158 (66%)	118 (49%)	94 (44%)	113 (47%)	<0.001
Education (grade)					<0.001
6 th or less	20 (8%)	46 (19%)	67 (31%)	58 (24%)	
7 th through 11 th	47 (20%)	74 (31%)	67 (31%)	84 (35%)	
12 th	62 (26%)	61 (25%)	46 (21%)	53 (22%)	
More than 12 th	111 (46%)	61 (25%)	36 (17%)	47 (19%)	
Below 2000 Poverty Guideline threshold	34 (14%)	77 (32%)	110 (51%)	102 (42%)	<0.001
Income					<0.001
“Not enough to make ends meet”	10 (4%)	22 (9%)	30 (14%)	18 (7%)	
“Enough to get by on”	48 (20%)	79 (33%)	100 (46%)	103 (43%)	
“Comfortable but permits no luxuries”	63 (26%)	75 (31%)	47 (22%)	73 (30%)	
“Allows you to do what you want”	118 (49%)	66 (27%)	39 (18%)	48 (20%)	
Life-space (mean $\pm$ SD)	70 $\pm$ 22	66 $\pm$ 26	59 $\pm$ 25	61 $\pm$ 25	<0.001
Muscle weakness	69 (29%)	96 (40%)	96 (44%)	99 (41%)	0.003
History of falls in past 1 year	65 (27%)	81 (33%)	77 (36%)	65 (27%)	0.089
Gait deficit (gait speed <0.8 m/s)	142 (63%)	174 (84%)	169 (89%)	190 (88%)	<0.001
Balance deficit	84 (35%)	125 (52%)	125 (58%)	124 (51%)	<0.001
Use of assistive device	49 (20%)	63 (26%)	94 (44%)	90 (37%)	<0.001
Visual deficit	37 (15%)	28 (12%)	46 (21%)	36 (15%)	0.039
History of arthritis	141 (59%)	157 (65%)	156 (72%)	161 (67%)	0.026
Impaired ADL (1 areas of dependence)	77 (32%)	100 (41%)	98 (45%)	88 (36%)	0.021
Depression (GDS>5)	14 (6%)	26 (11%)	30 (14%)	22 (9%)	0.033

Sociodemographic characteristics	Lowest ONDI Quartile (N=240)	2 nd ODI Quartile (N=242)	3 rd ONDI Quartile (N=216)	Highest ONDI Quartile (N=242)	p
Cognitive impairment (MMSE <24)	37 (15%)	67 (28%)	85 (39%)	86 (36%)	<0.001
Age over 80 years	49 (20%)	45 (19%)	55 (26%)	57 (24%)	0.28

* Higher quartiles indicate greater disadvantage.

ONDI: Objective Neighborhood Disadvantage Index. SD: Standard deviation. ADL: Activities of Daily Living. GDS: Geriatric Depression Scale. MMSE: Mini Mental State Examination. P-value: The p-value is the calculated probability of obtaining the observed result when the null hypothesis is true. The p-values in this table were derived from a combination of Pearson chi-square and T tests.

Table 3

Multivariate (Adjusted) Generalized Estimating Equation Regression Model on the Association between Neighborhood Socioeconomic Disadvantage and Incident Falls

Characteristic	Odds Ratio	95% Confidence Interval	p
Neighborhood Disadvantage [*] by quartiles			
Top quartile (greatest disadvantage)	3.20	1.71	5.97
3 rd quartile	1.92	1.00	3.71
2 nd quartile	2.38	1.23	4.63
Lowest quartile	Reference		
Black/African American race	0.53	0.35	0.80
Income just enough to get by	0.93	0.62	1.42
Education >12 th grade	1.66	0.83	3.32
12 th grade	0.62	0.34	1.12
7 th -11 th grade	1.39	0.88	2.20
< 7 th grade	Reference		
Below 2000 Poverty Guideline threshold	0.82	0.54	1.23
Life-space (10-point decrement)	1.11	0.97	1.27
Balance deficit	1.49	0.83	2.64
Use of assistive device	1.38	0.88	2.15
Impaired ADL (1 areas of dependence)	2.18	1.36	3.50

^{*}Neighborhood disadvantage is based on the Objective Neighborhood Disadvantage Index (ONDI) score.

Note: Variables in the table are adjusted for all other variables in the model.

P-value: The p-value is the calculated probability of obtaining the observed result when the null hypothesis is true. The p-values in this table were derived from generalized estimating equations.

Table 4

Multivariate (Adjusted) Generalized Estimating Equation Regression Model on the Association between Life-space Mobility and Incident Fall

Characteristic	Odds Ratio	95% Confidence Interval	p
Life-space (10-point decrement)	1.16	1.03	1.31
Neighborhood Disadvantage [*] by quartiles			
Top quartile (greatest disadvantage)	3.27	1.75	6.10
3 rd quartile	2.07	1.05	4.05
2 nd quartile	2.45	1.25	4.78
Lowest quartile	Reference		
Black/African American race	0.49	0.34	0.71
Income just enough to get by	0.98	0.64	1.51
Education >12 th grade	1.92	0.97	3.78
12 th grade	0.69	0.38	1.25
7 th -11 th grade	1.39	0.88	2.21
< 7 th grade	Reference		
Below 2000 Poverty Guideline threshold	0.84	0.55	1.28
Muscle weakness	2.16	1.39	3.33
Balance deficit	1.70	0.96	3.02

^{*} Neighborhood disadvantage is based on the Objective Neighborhood Disadvantage Index (ONDI) score.

Note: Variables in the table are adjusted for all other variables in the model.

P-value: The p-value is the calculated probability of obtaining the observed result when the null hypothesis is true. The p-values in this table were derived from generalized estimating equations.