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Home Accessibility, Living Circumstances, Stage of Activity Limitation, and Nursing Home Use

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Abstract

Objective—To explore the influence of physical home and social environments and disability patterns on nursing home (NH) use.

Design—Longitudinal cohort study. Self- or proxy-reported perception of home environmental barriers accessibility, 5 stages expressing the severity and pattern of activities of daily living (ADLs) limitations, and other characteristics at baseline were applied to predict NH use within 2 years or prior to death through logistic regression.

Setting—General community.

Participants—Population-based, community-dwelling individuals (N=7836; 70y) from the Second Longitudinal Study of Aging interviewed in 1994 with 2-year follow-up that was prospectively collected.

Interventions—Not applicable.

Main Outcome Measure—NH use within 2 years.

Results—Perceptions of home environmental barriers and living alone were both associated with approximately 40% increased odds of NH use after adjustment for other factors. Compared with those with no limitations at ADL stage 0, the odds of NH use peaked for those with severe limitations at ADL stage III (odds ratio [OR]=3.12; 95% confidence interval [CI], 2.20 – 4.41), then declined sharply for those with total limitations at ADL stage IV (OR=.96; 95% CI, .33–2.81). Sensitivity analyses for missing NH use showed similar results.

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Conclusions—Accessibility of home environment, living circumstance, and ADL stage represent potentially modifiable targets for rehabilitation interventions for decreasing NH use in the aging U.S. population.

Keywords

Activities of daily living; Nursing homes; Rehabilitation

Most elderly people fear nursing home (NH) admission.¹ According to some estimates, long-term care expenditures from all public and private sources could nearly quadruple by 2050 to approximately \$379 billion.² NH costs are a prime contributor to rapidly escalating U.S. health care expenditures. It is essential to identify alterable environmental, functional, medical, and living circumstances associated with NH use as people age.

A major European initiative found that in-home person-environment fit³ enhances autonomy among older people.⁴ While rehabilitation professionals generally acknowledge the importance of home accessibility, little, if any, empirical evidence links the presence of home environmental barriers to NH use. Conversely, the literature consistently identifies advanced age, women sex, being unmarried, living alone, cognitive impairment, previous stroke, diabetes, activities of daily living (ADLs) limitations, and previous NH use as associated with NH use.^{4–10}

We apply a biopsychosocial paradigm where health conditions are seen as combining with barriers in the physical and social environments to cause difficulties performing essential tasks.¹¹ Theoretically, ADL limitations can be altered by removing home environmental barriers. Perceptions of home environmental barriers suggest that individuals are not living in optimally fit home environments.

The influence of the home environment and living circumstances on institutionalization may vary depending on the patterns of ADL limitations experienced by an individual. An approach to measuring ADL stages, which describes patterns of difficulty, has been shown to distinguish groups according to perceptions of home environmental barriers, falls during the past year, and mortality risks.^{12–14} The relationship between environment, ADL stages, and NH use has not been tested.

Our objectives were to explore how the physical and social environments in which people live combine with their patterns of disability to influence NH use.¹¹ We hypothesized that individuals' perceptions of home environmental barriers, living alone, and ADL stage will have independent effects on NH use among community-dwelling people aged 70 years and older after reducing the effects of diagnoses and other important risk factors.^{6,8–10} We expected a positive association between higher stages of ADL limitation and greater likelihood of NH use, such that those at the highest stage would have the highest likelihood of NH use within a 2-year period. We intended to identify subpopulations of older adults whose unmet needs might be ameliorated in ways that help prevent or delay NH placement.

METHODS

This study was approved by the University of Pennsylvania Institutional Review Board.

Study Population

Data from the prospective 1994 Second Longitudinal Study of Aging (LSOA II),¹⁵ sampled to be representative of community-dwelling persons 70 years and older in the U.S., were combined with the Disability Supplement Followback Survey of the National Health

Interview Survey, which reinterviewed people with disabilities.^{16,17} The code book of questions and detailed interviewer instructions are available from the Centers for Disease Control and Prevention website.¹⁸ The baseline Longitudinal Study of Aging (LSOA) interview in 1994 was the baseline for our study. While the baseline interview was limited to people living in the community, wave II of the LSOA included people regardless of living location. Wave II followed the initial sample of individuals for approximately 2 years, providing follow-up data for our study. Close relatives were asked to provide information for participants who could not answer for themselves or who were deceased at the time of the follow-up interview. NH use and survival were the only information obtained at follow-up.

Outcome

NH use between baseline and wave II interviews was designated by admission either to an NH or convalescent home. We combined files within the LSOA II for persons who were still alive (referred to as survivor files) and for those who died (referred to as decedent files). Verification of the use, or non-use, of an NH was obtained from proxy respondents as recorded in the decedent files for participants who died. If a proxy did not report NH use in a completed decedent interview, we treated the participant as no NH use because our primary objective was to address NH use in the full population regardless of death. Those without a complete interview at wave II were excluded in the main analysis regardless of their vital status at wave II.

Participant Baseline Characteristics

Participants were grouped by sex, race (white, black, and other), and age ranges of 70 to 74, 75 to 79, 80 to 85, and greater than 85 years of age.

Not graduating from high school approximated limited income. Marital status was defined as not married versus married. Living circumstance (social environment) was reported as living alone versus living with others. History of NH use by the person prior to the baseline interview was also included in the analysis.

Respondents were asked the following questions about home architectural barriers: "Some residences have special features to assist persons who have physical impairments or health problems. Whether you use them or not, does your residence have any of these features?" Respondents indicated yes, no, or don't know according to the presence of: widened doorways, ramps, kitchen modifications, railings, easy open doors, accessible parking or drop-off sites, elevators or stair glides, alerting devices, or other special features. For all features not marked yes respondents were asked: "Which special features do you NEED to get around this home but do not have?" The dichotomous variable of perceived home environmental barriers was captured as 1 or more positive responses to the second question.

Chronic health conditions were based on respondents' reported doctors' diagnoses of stroke, coronary artery disease (heart attack, myocardial infarction, or angina), other heart disease, bronchitis or emphysema, asthma, diabetes, cancer, osteoporosis, hypertension, and arthritis. An indicator of cognitive impairment was established through proxy use applying standard criteria and answers obtained according to survey interviewer instructions. If, as observed by the interviewer, a proxy was required because of poor memory, senility, or confusion or Alzheimer's disease, this was taken to indicate the presence of cognitive impairment. Other reasons for proxy use, such as physical illness, were not counted as cognitive impairment.

ADL stages reflect the *International Classification of Functioning, Disability and Health* self-care chapter (table 1). Five stages ordered by increasing severity express typical functional hierarchies of loss and recovery.^{19–23} Each defines a discrete threshold at which

the person must be functioning for eating, toileting, dressing, transferring between a bed and chair, bathing, and walking.¹³ The person or proxy rates status on each ADL as no difficulty, some difficulty, a lot of difficulty, and unable. ADL stages were developed using methods described previously.^{13,24,25}

Analysis

The LSOA II uses a multistage sample design. To obtain the correct point and variance estimates, we took into account clustering, sample weights, and stratification in all analyses. Prevalence was calculated as weighted proportions. We reported unweighted sample sizes and weighted proportions.

We fit a series of logistic regression models and reported odds ratios (ORs) and the 95% confidence intervals (CIs) from all models. First, each predictor was included in a separate model for an unadjusted analysis.

Second, we included conditions shown in the literature to be strongly related to NH use (cognitive impairment or Alzheimer's disease, stroke, and diabetes) and sociodemographic characteristics (model I).^{6,8–10} Third, we replaced the diagnoses with ADL stages (model II). Fourth, we fit a model by adding living circumstance, previous NH use, diagnoses, and perceived home environmental barriers (model III) to determine the degree to which stage and perceived home environmental barriers remained independently associated with NH use. Because living alone and marital status are highly correlated, we restricted models to only include living alone.

Model performance was compared using the C statistic, a measure of predictive ability for logistic regression ranging from 0.5 (poor) to 1 (perfect).²⁶ A C statistic is also the area under the receiver operating curve and can be regarded as an index of discrimination such that it expresses concordance between observed and predictive outcomes. The C statistic was calculated using the original dataset, and the 95% CIs were calculated through 1000 bootstrap samples. The bootstrap method has been shown to better estimate internal validity compared with other approaches, such as split-sample and cross-validation.²⁷

To make certain that important predictive associations were not missed, after model III we performed a sensitivity analysis by entering all available explanatory variables into a model and then used backward selection to remove variables using the criteria of $P > .10$. Moreover, recognizing that reduced exposure time could influence findings among those who died before wave II and did not use NHs, we performed a second sensitivity analysis by repeating the models excluding those individuals. We also performed 2 additional sensitivity analyses to address missing NH data.²⁸ The first assumed that all these persons used, and the second assumed that all did not use an NH during the follow-up period. Concerned that perception of home environmental barriers might be a proxy for limited income (poverty), we included an additional sensitivity analysis forcing high school graduation into the final statistical model. An association was considered statistically significant at $P < .05$.

RESULTS

There were 9447 individuals 70 years and older interviewed at baseline. Of these persons, follow-up information could be obtained on 7998 (84.7%), of which 2338 (29.2%) were proxy interviews. For another 47 individuals, contact was achieved but information about NH use was missing. Covariates included in the final statistical model were missing for another 115 persons, leaving 7836 people in the primary analysis. There were 938 (11.7%) persons with decedent interviews. Of these individuals, 678 were excluded, who died and did not use NHs, leaving 7158 for the secondary sensitivity analysis. The only statistically

significant differences between persons with missing NH use information and those for whom information could be obtained was higher mortality in the former group (20% compared with 15% [$P<.001$] and higher proportions of black and other races [9% vs 7%, 7% vs 4%, respectively, $P<.001$], table presenting these data is not shown).

From the cohort of 7836 individuals, there were 707 persons (9%) who used NHs within 2 years of their baseline interview. The weighted proportions of men and women in the sample were 39.9 and 60.1, respectively. Details about this population and the proportions of persons who used NHs according to each variable are presented in table 2. The weighted proportion of people who used NHs increased progressively from 5.8% for persons at ADL stage 0 (no limitation) to 30.9% at ADL stage III (severe), and declined to 17.9% at ADL stage IV (complete limitation).

Table 3 presents ORs for all NH use models beginning with unadjustment and showing increasing adjustment through models I, II, and III. All hypothesized associations were statistically significant. ORs associated with each variable were adjusted for all other variables, shown in the fully adjusted model III. The OR associated with the perception of home environmental barriers versus no perception of home environmental barriers was 2.80 (95% CI, 2.15–3.66) before and 1.43 (95% CI, 1.05–1.96) after full adjustment. The OR associated with living alone versus not living alone was 1.83 (95% CI, 1.53–2.19) before and 1.42 (95% CI, 1.15–1.75) after adjustment. In the fully adjusted model, the OR (95% CI) of NH use was 1.56 (1.24–1.98), 2.17 (1.62–2.91), and 3.12 (2.20–4.41) for stages I, II, and III, respectively, compared with stage 0, but then declined to .96 (.33–2.81) for stage IV.

The C statistic for model III, the final model, was .779 (95% CI, .760–.798) compared with .747 (95% CI, .727–.768) for model I and .754 (95% CI, .734–.774) for model II.

Sensitivity Analyses

After entering all available predictors in our dataset in a model, then using backward selection to remove insignificant ones (ie, high school graduation), only the diagnoses that were previously hypothesized to be strongly associated were positively associated with risk of NH use. Associations with ADL stage and NH use were stronger after excluding those who died before wave II and did not use NHs. As in the primary analysis, ADL stage IV was not statistically significantly different from stage 0, suggesting robustness of this finding. Directions of association did not change for the key variables of interest including living alone, perceived home environmental barriers, or stage in the sensitivity analyses setting missing to NH use or no NH use. The effect sizes were reduced particularly when we assumed all those with missing NH use used NHs (rather than no use) (table 4). Finally, the effect sizes associated with perceptions of home environmental barriers did not change after forcing high school graduation into the final model.

DISCUSSION

Perceptions of home environmental barriers, living alone, and ADL stage were all independently associated with NH use. It is further noteworthy that older adults at ADL stage III, the group most likely to use NHs, were also the most likely to perceive home environmental barriers.¹³ It is reasonable that enhanced home accessibility will be most effective among those with partial ADL limitations when it is still possible to reduce functional difficulties through home modifications. Those completely unable to perform ADLs may either already have such modifications or would not find them helpful, because they can no longer perform self-care on their own. Living alone, a quality of the social living environment, likely approximated less direct access to care giving or strong social

networks.⁸ These findings combined with Liu and Lapane's²⁹ discovery that people aged 85 years and older who had home accessibility features compared with those who did not were less likely to decline in function over 2 years²⁹ support the importance of asking people about home accessibility and their social networks. Future efforts might explore strategies to enhance person-environment fit among older people according to each stage across the physical and social domains.

Findings provide new clinical insights about the risk of NH use among people at different stages of ADL limitation. People with greater limitation are logically at increased risk of NH admission because of increased care burden. Thus, the ordered associations between increasing severity and NH use from ADL stage 0 through ADL stage III was expected, but the sharp drop in NH use among those with complete limitations (ADL stage IV) was unexpected. We were concerned that the relatively lower likelihood of NH use might relate to people at ADL stage IV being more likely to die and thus having a more brief opportunity to use NHs compared with those who lived through the full 2-year period. Our sensitivity analysis refuted this interpretation, confirming that persons at ADL stage IV remained less likely to use NHs than those at ADL stage III, even after removing those persons whose early deaths would have reduced the period of opportunity for NH use. We also recognize that a substantial proportion of individuals at ADL stage IV may have already entered an NH at the time of the initial interview, and therefore were not captured in the LSOA community-dwelling sample. Thus, persons in the survey who were at ADL stage IV may represent a small select group who found ways to remain in the community, despite total dependence, because of strong family or community support. Some may have chosen to receive end of life care in their homes. It will be essential in guiding clinical practice and policy to identify those factors that enable this subgroup of persons with ADL stage IV to stay in the community.

People can be at higher stages of ADL limitation because of the functional manifestations of any combination of comorbidities and associated physical, sensory, or cognitive impairments. Consistent with earlier articles, previous stroke, diabetes, and intellectual impairment (poor memory, senility, confusion, or Alzheimer's disease) were independently associated with NH use.^{6,8-10} ADL stage was an independent predictor comparable in strength with these diagnoses. Attenuation of the effect of perceived home environmental barriers after adjustment for ADL stage suggests that as previously reported,^{4,29,30} the presence or absence of those features may influence an individual's ADLs.

State and federal governments are facing increasing budget constraints. Our results suggest that targeting available resources to people with moderately severe (but not necessarily complete) ADL limitations may be most effective in stemming future NH use. Further research should attempt to replicate these findings prospectively, determining the extent to which home environmental barrier removal might reduce NH use among those at particular stages.

Study Limitations

Our study has several limitations. The LSOA data are over a decade old. We applied these legacy data because they contain rich information on home environmental barriers and other factors important to understanding older adults with disabilities. Clearly, the long-term care environment and payment policies have evolved with the growth of assisted living programs, as well as the implementation of the prospective payment system for inpatient rehabilitation. This study should be replicated if more recent population-level data become available. While self-reported health and functional information may not be comparable with that obtained by health care professionals, such ratings appear valid and predictive of

health care resource use and various outcomes.^{31–33} The particular questions applied were standardized and extensively tested.³⁴

CONCLUSIONS

The environmental modifications included in this study primarily accommodate physical disabilities. ADL stages, by grouping older people with similar patterns of ADL limitation, might inform research and policy initiatives for home- and community-based interventions. ADL stages could operate as an easy screening tool for community workers, family, or rehabilitation teams to identify older adults in need of additional assessment of need for environmental support services or assisted living in their homes. At ADL stage I, bathing and walking difficulties might be reduced by bathroom equipment and first floor setups. At ADL stages II and III, environmental accommodations can be expected to be beneficial but insufficient. Because people can no longer perform some of the more difficult ADLs, they will need partial assisted living. At ADL stage IV, people will require total assisted living. Stage-specific strategies for those with cognitive or sensory impairments would differ.

The Institute of Medicine recently called for policies to improve dissemination of effective community-based interventions for helping people live well with chronic illness and physical disabilities.³⁵ Our findings of population-level associations between the perception of home environmental barriers, ADL stage, living alone, and NH use are salient, because these factors are sometimes modifiable at reasonable cost. Architectural barriers can be reduced. Social environments enhanced by community workers or volunteers providing regular visits to older adults and formal in-home therapy services, which include training on barrier reduction, can reduce declines in self-care and mortality.^{36,37} Future work should focus on the capacity of such interventions to reduce NH use.

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List of Abbreviations

ADLs	activities of daily living
CI	confidence interval
LSOA	Longitudinal Study of Aging
LSOA II	Second Longitudinal Study of Aging
NH	nursing home
OR	odds ratio

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Table 1

Self-Report Version of ADL Questions Used to Assign Stages: Circle Level of Difficulty for Scores *

Because of Health or Physical Problem, Do You Have Any Difficulty With the Following Activities?	Level of Difficulty Scores			
	No Difficulty	Some Difficulty	A Lot of Difficulty	Unable
Do you have any difficulty eating?	0	1	2	3
Do you have any difficulty toileting, including getting to the toilet?	0	1	2	3
Do you have any difficulty dressing?	0	1	2	3
Do you have any difficulty getting in and out of bed or chair (transferring)?	0	1	2	3
Do you have any difficulty bathing or showering?	0	1	2	3
Do you have difficulty walking?	0	1	2	3

NOTE. ADL stage threshold definitions. ADL stage 0: people have no difficulty performing any ADLs. ADL stage I: eating and toileting are not difficult. People have no more than some difficulty dressing and/or transferring, but may have a lot of difficulty bathing and/or walking. ADL stage II: eating is not difficult. People have up to a lot of difficulty toileting, dressing, and/or transferring. They may be unable to bathe and/or walk. ADL stage III: people can perform at least 1 ADL, but they do not achieve the threshold defined as necessary to be at ADL stage II. ADL stage IV: people are unable to do any of the 6 ADLs.

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* Answers can also be obtained by a close proxy when the person cannot answer for self.

Table 2

NH Use in a Cohort of 7836 Community-Dwelling Persons 70 Years and Older

Predictor Variables	Total Weighted Sample Size (N=7836)	Use NH		P*
		Yes (n=707 [9.1%])	No (n=7129 [90.9%])	
Sex				
Male	3090 (39.9)	215 (7.0)	2875 (93.0)	<.001
Female	4746 (60.1)	492 (10.5)	4254 (89.5)	
Race				
White	6774 (89.1)	631 (9.3)	6143 (90.7)	.230
Black	794 (7.3)	55 (7.1)	739 (92.9)	
Other	268 (3.6)	21 (7.6)	247 (92.4)	
Age, y				
70–74	3625 (46.9)	156 (4.5)	3469 (95.5)	<.001
75–79	2087 (26.7)	167 (7.9)	1920 (92.1)	
80–84	1325 (16.5)	174 (13.6)	1151 (86.4)	
85	799 (9.9)	210 (26.6)	589 (73.4)	
High school graduation				
No	3185 (39.5)	356 (11.5)	2829 (88.5)	<.001
Yes	4651 (60.5)	351 (7.5)	4300 (92.5)	
Marital status				
Not married	3623 (45.8)	430 (12.1)	3193 (87.9)	<.001
Married	4213 (54.2)	277 (6.5)	3936 (93.5)	
Lives alone				
No	5104 (65.2)	378 (7.2)	4726 (92.8)	<.001
Yes	2732 (34.8)	329 (12.5)	2403 (87.5)	
Previous NH use				
No	7628 (97.4)	616 (8.2)	7012 (91.8)	<.001
Yes	208 (2.6)	91 (43.4)	117 (56.6)	
Perception of home environmental barriers				
No	7346 (93.9)	612 (8.4)	6734 (91.6)	<.001
Yes	490 (6.1)	95 (20.4)	395 (79.6)	
Stroke				
No	7187 (91.8)	587 (8.2)	6600 (91.8)	<.001
Yes	649 (8.2)	120 (18.5)	529 (81.5)	
CAD				
No	6228 (79.5)	520 (8.4)	5708 (91.6)	<.001
Yes	1608 (20.5)	187 (11.8)	1421 (88.2)	
Other heart disease				
No	7268 (92.8)	643 (8.9)	6625 (91.1)	.050
Yes	568 (7.2)	64 (11.8)	504 (88.2)	
COPD				
No	7090 (90.2)	628 (8.9)	6462 (91.1)	.120

Predictor Variables	Total Weighted Sample Size (N=7836)	Use NH		P*
		Yes (n=707 [9.1%])	No (n=7129 [90.9%])	
Yes	746 (9.8)	79 (10.4)	667 (89.6)	
Asthma				
No	7372 (94.2)	663 (9.0)	6709 (91.0)	.720
Yes	464 (5.8)	44 (9.8)	420 (90.2)	
Diabetes				
No	6908 (88.4)	591 (8.5)	6317 (91.5)	<.001
Yes	928 (11.6)	116 (13.3)	812 (86.7)	
Cancer				
No	6483 (82.4)	569 (8.9)	5914 (91.1)	.240
Yes	1353 (17.6)	138 (9.9)	1215 (90.1)	
Osteoporosis				
No	7263 (92.3)	634 (8.8)	6629 (91.2)	.010
Yes	573 (7.7)	73 (12.0)	500 (88.0)	
Hypertension				
No	4357 (56.1)	385 (8.8)	3972 (91.2)	.400
Yes	3479 (43.9)	322 (9.4)	3157 (90.6)	
Arthritis				
No	4106 (52.2)	362 (8.9)	3744 (91.1)	.480
Yes	3730 (47.8)	345 (9.3)	3385 (90.7)	
Major psychiatric disorders				
No	7759 (99.0)	695 (9.0)	7064 (91.0)	.130
Yes	77 (1.0)	12 (13.7)	65 (86.3)	
Impaired cognition [†]				
No	7436 (95.1)	588 (8.0)	6848 (92.0)	<.001
Yes	400 (4.9)	119 (30.0)	281 (70.0)	
ADL limitation stages				
0 (no)	5643 (72.4)	327 (5.8)	5316 (94.2)	
I (mild)	1266 (16.0)	159 (12.6)	1107 (87.4)	
II (moderate)	554 (7.0)	115 (21.2)	439 (78.8)	<.001
III (severe)	334 (4.1)	99 (30.9)	235 (69.1)	
IV (complete)	39 (0.5)	7 (17.9)	32 (82.1)	

NOTE. Values are n (%) or as otherwise noted.

Abbreviations: CAD, coronary artery disease; COPD, chronic obstructive pulmonary disease.

* During the entire study period of 1997–1998 (chi-square test).

[†] Poor memory, senility, confusion, or Alzheimer's disease of such severity that the person was unable to answer interview questions and required a proxy respondent.

Table 3

Relationship Between Sociodemographics, Diagnostic Category, ADL Stages, and NH Use

Predictor Variables	Unadjusted OR (95% CI)	Model I AOR (95% CI)	Model II AOR (95% CI)	Model III AOR (95% CI)
Sex				
Male	1 (reference)	1 (reference)	1 (reference)	1 (reference)
Female	1.57 (1.33–1.85)	1.43 (1.21–1.70)	1.32 (1.11–1.56)	1.22 (1.02–1.46)
Race				
Black	1 (reference)	1 (reference)	1 (reference)	1 (reference)
White	1.34 (0.92–1.96)	1.58 (1.09–2.29)	1.6 (1.12–2.39)	1.68 (1.16–2.44)
Other	1.07 (0.57–2.01)	1.23 (0.63–2.43)	1.44 (0.75–2.75)	1.53 (0.80–2.95)
Age, y				
70–74	1 (reference)	1 (reference)	1 (reference)	1 (reference)
75–79	1.83 (1.45–2.31)	1.76 (1.40–2.22)	1.72 (1.36–2.17)	1.65 (1.30–2.09)
80–84	3.37 (2.68–4.23)	3.06 (2.43–3.86)	2.86 (2.26–3.62)	2.60 (2.03–3.33)
85	7.75 (6.16–9.76)	6.42 (5.03–8.19)	5.55 (4.35–7.08)	4.74 (3.67–6.13)
Lives alone				
Yes	1.83 (1.53–2.19)	NA	NA	1.42 (1.15–1.75)
No	1 (reference)	NA	NA	1 (reference)
Previous NH use				
Yes	8.60 (6.43–11.49)	NA	NA	3.79 (2.72–5.29)
No	1 (reference)	NA	NA	1 (reference)
Perception of home environmental barriers				
Yes	2.80 (2.15–3.66)	NA	NA	1.43 (1.05–1.96)
No	1 (reference)	NA	NA	1 (reference)
Stroke				
Yes	4.93 (3.95–6.17)	2.78 (2.11–3.68)	NA	2.07 (1.52–2.81)
No	1 (reference)	1 (reference)	NA	1 (reference)
Diabetes				
Yes	1.64 (1.30–2.06)	1.77 (1.37–2.28)	NA	1.60 (1.23–2.07)
No	1 (reference)	1 (reference)	NA	1 (reference)
Impaired cognition *				
Yes	2.52 (2.01–3.17)	2.00 (1.55–2.58)	NA	1.53 (1.17–2.00)
No	1 (reference)	1 (reference)	NA	1 (reference)
ADL limitation stages				
0 (no)	1 (reference)	NA	1 (reference)	1 (reference)
I (mild)	2.33 (1.87–2.89)	NA	1.90 (1.51–2.40)	1.56 (1.24–1.98)
II (moderate)	4.34 (3.36–5.61)	NA	3.08 (2.34–4.04)	2.17 (1.62–2.91)
III (severe)	7.22 (5.48–9.51)	NA	5.71 (4.21–7.75)	3.12 (2.20–4.41)
IV (complete)	3.52 (1.61–7.66)	NA	2.07 (0.81–5.31)	0.96 (0.33–2.81)
No. of observations	7836	7836	7836	7836
C statistic	NA	0.747 (0.727–0.768)	0.754 (0.734–0.774)	0.779 (0.760–0.798)

Abbreviation: AOR, adjusted odds ratio; NA, not applicable.

* Poor memory, senility, confusion, or Alzheimer's disease of sufficient severity that the person was unable to answer interview questions and needed an assistant or proxy respondent.

Table 4

Sensitivity Analysis

Predictor Variables	Complete Case Analysis	Missing Assigned Used NH	Missing Assigned No NH Use
Lives alone			
Yes	1.42 (1.15–1.75)	1.23 (1.08–1.40)	1.38 (1.12–1.69)
No	1 (reference)	1 (reference)	1 (reference)
Perception of home environmental barriers			
Yes	1.43 (1.05–1.96)	1.21 (0.97–1.52)	1.40 (1.04–1.88)
No	1 (reference)	1 (reference)	1 (reference)
ADL limitation stages			
0 (no limitations)	1 (reference)	1 (reference)	1 (reference)d
I (mild limitations)	1.56 (1.24–1.98)	1.20 (1.05–1.38)	1.56 (1.24–1.97)
II (moderate limitations)	2.17 (1.62–2.91)	1.46 (1.18–1.81)	2.06 (1.56–2.72)
III (severe limitations)	3.12 (2.20–4.41)	1.93 (1.50–2.49)	2.68 (1.94–3.71)
IV (complete limitations)	0.96 (0.33–2.81)	0.80 (0.40–1.61)	1.03 (0.37–2.83)