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## Individual and Environmental Determinants of Late-Life Community Disability for Persons Aging With Cardiovascular Disease

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### Abstract

**Objective:** The aim of the study was to estimate the prevalence of late-life community disability for adults 65 yrs and older with cardiovascular disease versus those without. This study also investigated the contributions of environmental and individual risk factors on late-life community disability for persons with cardiovascular disease.

**Design:** This is a secondary data analysis of the 2016 round of the National Health and Aging Trends Study. The study sample included community-dwelling Americans with cardiovascular disease ( $n = 1490$ ) and without ( $n = 4819$ ). Logistic regression was used to estimate associations between individual risk factors, environmental factors, and community disability for those with cardiovascular disease.

**Results:** Individuals with cardiovascular disease had a significantly higher prevalence of late-life community disability than those without (44.8% vs.29.0%). For persons with cardiovascular disease, lack of transportation, home modification, and needing assistance with mobility increased the odds of community disability. Younger age and lower comorbidity were associated with decreased odds of community disability. When accounting for environmental factors in multivariate analyses, sex, race, and education were not significantly associated with community disability.

**Conclusion:** Late-life community disability is highly prevalent for persons aging with cardiovascular disease. Intervention strategies to deter late-life community disablement should focus on improving access to transportation and improving the community environment in which older adults live.

### Keywords

Healthy Aging; Cardiovascular Disease; Environment; Social Participation

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Recent increases in life expectancy have increased the number of years that individuals live with chronic disease, such as cardiovascular disease (CVD). The prevalence of CVD among those 60 to 79 yrs is 69% and increases to 86% for those 80 yrs and older.<sup>1</sup> It is inevitable that this increase in the older adult population with accompanying chronic disease will pose significant concerns for society, because many chronic diseases are associated with more functional limitations and higher rates of disability. Disability in older adults reduces quality of life<sup>2</sup> and increases healthcare costs<sup>3</sup> and caregiver burden.<sup>4</sup> A better understanding of how prevalent chronic diseases such as CVD influence late-life disability is needed.

The disablement process<sup>5</sup> provides a conceptual framework to investigate disability related to chronic disease. Chronic conditions, such as CVD, cause impairments in cardiac and systemic vasculature, which can decrease an individual's aerobic capacity (body structure/system impairment). As a result, the individual may reduce physical activity and consequently experience decreased muscle strength and endurance. These impairments may then reduce the ability to perform simple mobility activities in the home (functional limitations). As functional limitations increase, the individual may experience disability. Disability is defined as the inability to perform activities that define an individual's role in society (e.g., having lunch with friends, volunteering, or working).

Disability is influenced by individual risk factors and environmental (extraindividual) factors.<sup>5</sup> Individual risk factors are characteristics (sociodemographic, lifestyle, and biologic) that are present before the onset of chronic conditions and can impact the disablement process.<sup>6</sup> Environmental factors include external supports such as receiving assistance from another person or using assistive devices and features of the physical environment (e.g., home modifications).<sup>6</sup> Therefore, environmental factors can either retard or promote participation in society for persons with functional limitations.

Previous studies have examined the contribution of various environmental factors on disability in aging. Social engagement, an individual's participation in social activities, has a protective effect against disability in late life,<sup>7</sup> whereas social support has produced conflicting findings. Whereas one study found that social support in late life decreased disability,<sup>8</sup> another found no effect on disability.<sup>7</sup> Having access to transportation<sup>9</sup> and trust in the surrounding neighborhood has been shown to decrease disability for older adults.<sup>8</sup> The role of home modification in the prevention of disability remains poorly understood.<sup>10,11</sup>

Contradictory findings related to environmental factors and late-life disability may stem from variation in the definition of disability used by the authors. Many studies defined disability as mobility disability or difficulty completing basic and/or instrumental activities of daily living. There has been a lack of research examining late-life disability related to participation in activities that are community based, such as socializing with friends and family or participating in organized social groups. This "community disability" may be more influenced by environmental factors than disability that is related to basic and instrumental activities of daily living. Moreover, there is a need to investigate community disability in late life to determine overall prevalence as well as to determine how prevalence is impacted by chronic disease.

Use of a bio-psycho-social approach that addresses individual and environmental factors may decrease the likelihood of disability and improve participation in late life for persons with chronic conditions. Therefore, the current study has two primary aims: (1) to estimate the current prevalence of community disability in persons aging with CVD vs. those aging without CVD in the United States and (2) to determine the relative contribution of environmental and individual risk factors on community disability in late life for persons with CVD.

## **METHODS**

### **Data Source**

This study used data from the 2016 round of the National Health and Aging Trends Study (NHATS), a nationally representative cohort study in the United States.<sup>12</sup> The NHATS is an annual structured in-home survey that follows individuals who are 65 yrs and older,<sup>13</sup> starting in 2011. It was designed for the study of late-life function and disability and includes a wide array of validated self-reported and physical performance measures of function.<sup>14,15</sup> Full information about the NHATS including survey sample design and validation of measures can be found at <http://www.nhatsdata.org>.

### **Inclusion Criteria**

Participants were included in this study if they were community dwelling and self-reported having “heart disease” or a “heart attack” in the health conditions segment of the NHATS.

### **Measures: Community Disability**

Investigators for the NHATS developed an innovative approach to measure disability related to participation restrictions in late life. Participants rated valued activities (a lot, somewhat, or not at all) and indicated inability to participate in valued activities due to health or functioning. Activities include the following: socializing in person with friends/family, attending religious services, participation in clubs/classes/other organized activities, going out for enjoyment, working, volunteering, and participating in a favorite activity.<sup>16</sup> For each of the seven activities, participants who reported valuing the activity and being unable to participate in the activity due to health/functioning in the previous month were categorized as having a participation restriction for that activity. A disability summary score was derived by summing the total number of participation restrictions present for each person. The disability summary score was then dichotomized for regression modeling. Participants who had one or more participation restrictions were considered to experience community disability.<sup>16</sup>

### **Measures: Environmental Factors**

Based on previous research, we hypothesized that the following environmental factors would impact community disability: social engagement,<sup>7</sup> social support,<sup>7,8</sup> transportation,<sup>9</sup> home modification,<sup>10,11</sup> and trust in neighborhood.<sup>8</sup> The use of assistive devices for mobility was also included in analyses as an environmental factor that may allow for continued participation in activities.<sup>16</sup> Social engagement was defined as living in a building that has a defined common or shared space designed for social activities. Social support was

characterized by the total number of individuals in a participant's household as well as need for physical assistance with mobility from another person. The total number of persons in the household was categorized: lives alone, lives with another person, and lives with two or more people. Assistance for mobility was dichotomized as "yes" if the participant reported needing physical assistance from another person for mobility in the previous month (otherwise "no"). Participants were considered to have transportation if they self-reported driving, had transportation provided by friends and/or family, used public transportation systems, or used of another mode of transportation (call a ride, shuttle, etc.). Home modifications were included as "yes" if individuals reported having stairs to enter *and* had a chair lift or elevator to enter the home. Use of assistive device was no or yes if a person reported use of cane, walker, wheelchair, or scooter in the previous month. Participants were determined to trust their neighborhood if they reported that people in their community could be trusted.

### Measures: Individual Risk Factors

We also examined the relative contribution of individual risk factors in addition to environmental factors on disability. Age,<sup>17</sup> sex,<sup>17,18</sup> education,<sup>18</sup> race,<sup>18,19</sup> income,<sup>19</sup> and comorbidity<sup>17,19</sup> have all been associated with late-life functional limitations and/or disability. Age was categorically defined as follows: 65–69, 70–74, 75–79, 80–84, and 85 yrs and older. Sex was defined as "male" and "female." Education was categorized as follows: "less than high school," "high school," and "some college or more." Race was defined as "white, non-Hispanic," "black, non-Hispanic," "Hispanic," and "others." Income was categorically defined by quartiles in the 2016 sample. Missing data for income were imputed by a variable created by the NHATS.<sup>20</sup> Comorbidity was defined categorized by number of chronic conditions: 0–3 and 4+.

### Statistical Analysis

We used appropriate weights and design variables in all analyses to maintain the national representativeness of the 2016 NHATS sample and to reflect the correlated nature of the data.<sup>21</sup> Demographic characteristics were calculated for the 2016 NHATS sample with CVD. Rao Scott  $\chi^2$  tests were used to examine differences in disability between those with CVD versus those without CVD for each valued activity (socializing, religious services, clubs, going out for enjoyment, working, volunteering, and favorite activity) and for the community disability summary measure.

We used logistic regression to estimate the associations in the form of odds ratios between environmental factors and risk factors on community disability (modeled as the probability of having at least one or more restrictions in participation in a valued activity) for individuals with CVD. All environmental factors and individual risk factors were first examined for collinearity. Backward selection was used to determine the final model. Nonsignificant variables were sequentially removed from the model if they were not significant ( $\alpha = 0.10$ ).<sup>22</sup> Predictor variables were identified as confounding if remaining model parameter estimates changed by 20% when the variable was removed during model selection.<sup>22</sup> The final model was adjusted for confounding predictors. Forward variable selection was then used to confirm the final model.

All analyses were conducted using SAS 9.4 (SAS Institute, Cary, NC). This investigation received exempt status from the Partners Healthcare Institutional Review Board. This study follows the STROBE guidelines for conducting and reporting results from observational studies (see Checklist, Supplemental Digital Content 1, <http://links.lww.com/PHM/A645>).

## RESULTS

Of the 6309 community-dwelling participants in the 2016 NHATS sample, 1490 participants self-reported having CVD. Those with CVD were predominantly white and more than half of the sample had four or more comorbidities (Table 1). A high proportion had transportation (72%), trusted their neighborhood (85%), and had social support (71%). A small proportion of participants with CVD had modifications to enter or leave their homes (17.3%), and 9.9% had a space to socialize where they lived. Many persons with CVD did not require physical assistance with mobility (94%) or use an assistive device (95%) in the previous month.

### Community Disability Prevalence

Significant differences in community disability were found between those with CVD and those without CVD (Table 2). Prevalence of community participation restrictions was nearly double for persons with CVD in socializing with friends/family, attending religious services, and volunteering. Persons with CVD reported higher rates of being unable to participate in their favorite activity (26.0% vs. 17.0%) and had a higher proportion of overall community disability (44.8% vs. 29.0%).

### Risk Factors

The final model of risk factors for community disability status in the 2016 NHATS for persons with CVD can be found in Table 3.

Income was identified as a confounder and was adjusted for in the final model. Three environmental factors were associated with increased odds of experiencing community disability: not having transportation (odds ratio [OR] = 1.95, 95% confidence interval [CI] = 1.36 to 2.80), having modification to enter the home (OR = 1.53, 95% CI = 1.03 to 2.24), and needing physical assistance with mobility from another person in the previous month (OR = 3.16, 95% CI = 1.57 to 6.37). As for individual risk factors, younger age and fewer comorbidities were also associated with decreased odds of community disability. Persons aged 70 to 84 yrs were less likely to have community disability compared with persons 85 yrs and older. Persons with three chronic conditions or fewer were less likely to than those with four chronic conditions or more to have community disability (OR = 0.48, 95% CI = 0.36, 0.63). Social support, having a social space where one lives, using an assistive device for mobility, sex, education, and race were not significantly associated with disability in this sample.

## DISCUSSION

Our findings reveal that persons aging with CVD experience significantly higher rates of community disability when compared with persons aging without CVD (44.8% vs. 29.0%),

respectively). Significant differences persisted between the two groups when examining individual participation restrictions separately. These results demonstrate that aging with CVD is associated with increased rates of late-life community disability. In addition, this study is the first to demonstrate that a combination of environmental and individual risk factors are associated with late-life community disability in a nationally representative sample of persons aging with CVD. Community disability was significantly associated with lack of transportation, modifications to enter the home, requiring physical assistance with mobility, age, and comorbidity. The activities used to delineate community disability (socializing with friends, volunteering, participating in clubs, etc.) in this study reflect social roles held by the NHATS participants in their respective communities. Therefore, screening older adults for social participation may identify potential late-life community disability.

Consistent with previous studies, the role of the physical environment outside of the home was found to be significantly associated with community disability in late life.<sup>9-11</sup> Persons who did not have access to transportation (private, public transit, or other transportation assistance) were 195% more likely to have community disability than persons with transportation. Previous work by Dickens et al.<sup>23</sup> has demonstrated that lack of transportation in late life can lead to social isolation. Social isolation due to lack of transportation may then exacerbate functional limitations and lead to increased likelihood of community disability.

Although persons with more severe functional limitations who rely on external supports (such as home modification or physical assistance with mobility tasks) were more likely to experience community disability, the independent use of assistive devices to perform mobility tasks was not associated with disability. This finding suggests that persons who only require the use assistive devices to accommodate for functional impairments may be able to navigate continued involvement in valued social activities. This finding is consistent with the work by Freedman et al.<sup>16</sup> indicating the important role of assistive device use in reducing functional limitations in late life. In addition, social support and social engagement were not found to be significantly associated with community disability. These findings may be due to how these characteristics were defined in the study. Living with one or more people may not be reflective of actual social support received, and our measure of social engagement was limited in scope.

When coupled with environmental factors, risk factors of sex, education, and race were not found to be significantly associated with community disability. These findings demonstrate that community disability may be more impacted by environmental factors, which serve to facilitate or deter participation. Many previous studies defined disability as difficulty or needing help with mobility, basic activities of daily living, and instrumental activities of daily living. These domains of disability identify individuals with severe functional limitations who are then more likely to be unable to participate in community activities. The disablement process, however, involves declining participation in a broad spectrum of life roles in a social context,<sup>5</sup> resulting from the accumulation or progression of functional limitations. This definition suggests that disability is experienced in a variety of domains, such as community disability, basic activities of daily living disability, and activities of daily living disability. Although previous work established that risk factors of sex, education, and



race were significantly associated with basic activities of daily living and activities of daily living disability,<sup>17-19</sup> the current study revealed no significant association between these risk factors and community disability when controlling for environmental factors. This implies that late-life community disablement for persons aging with CVD may be mitigated by environmental factors, which may be more amenable to intervention. Therefore, to improve community disability, intervention strategies should aim to improve access to transportation and provide support for participation in the communities in which older adults live.

### Limitations

This study is unable to provide causal links between risk factors, environmental factors, and disability status due to the cross-sectional, observational nature of the data. All data for this study were self-reported by the NHATS participants, including presence of CVD, self-reported as “heart disease” and “heart attack.” Therefore, the proportion of persons in the NHATS with CVD may be greater because of lack of information regarding the presence of other cardiac disorders (heart failure, valve disease, etc). This study was unable to account for severity of CVD-related symptoms (e.g., chest pain, shortness of breath). Thus, there may be differences in disability prevalence when examining disability stratified by CVD type and severity. In addition, disability status may be influenced by the type and severity of additional chronic conditions, which we were unable to account for. This study was underpowered to fully examine associations between race and disability and environmental factors. Future studies should examine the association between race and environmental factors related to community disability.

### Implications for Further Research

Investigation into environmental factors was limited to those variables measured in the NHATS. The impact of other environmental factors (e.g., access to buildings where activities take place, neighborhood walkability, etc.) requires further study. Future studies should further examine the contribution of risk factors and environmental factors on the development of community disability. Finally, further work should examine the impact of other extraindividual factors on disability status (e.g., rehabilitation intervention, medical care received for chronic conditions, etc.) to continue to develop the most comprehensive understanding of the disablement process.

## CONCLUSIONS

This study reveals that close to half of Americans 65 yrs and older who have CVD experience community disability, and this is significantly higher than Americans aging without CVD. Environmental factors including lack of transportation, modifications to enter the home, and needing assistance with mobility were significantly associated with experiencing late-life community disability. Individual risk factors traditionally associated with disability (sex, race, education) were not significantly associated with community disability when controlling for environmental factors. Therefore, community disability may be more influenced by environmental factors. Community disability emphasizes activities and participation in social roles with friends, family, and colleagues, which is vital to how an individual defines oneself, regardless of age. Thus, deterring community disability in older

adults may allow for continued participation in valued activities and social roles in late life, thereby improving quality of life in aging. Ultimately, intervention strategies to reduce late-life disability will require comprehensive approaches that target the many facets of the disablement process.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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**TABLE 1.**Demographic characteristics for individuals with CVD in the 2016 NHATS ( $n = 1490$ )

	<i>n</i>	%
Age, yr		
65–69	95	16.3
70–74	280	24.0
75–79	324	22.4
80–84	319	17.3
85+	472	20.0
Sex		
Male	666	48.1
Female	824	51.9
Education		
Less than high school	351	19.0
High school	396	26.8
Some college or higher	743	54.2
Race		
White	1080	80.1
Black	271	7.5
Hispanic	79	6.6
Other	60	5.8
Income		
<\$17,962	435	23.2
\$17,962–\$34,955	402	25.9
\$34,956–\$64,940	342	26.5
\$64,941	311	24.4
Comorbidity		
0–3	599	43.7
4+	891	56.3
Has transportation	965	71.7
Social support		
Lives alone	503	28.7
Lives with someone	681	50.3
Lives with 2	306	21.0
Trusts community	1251	85.0
Modification to enter home	285	17.3
Social space in building	177	9.9
Needed assistance with mobility	74	6.3
Used assistive device with mobility	63	5.1

**TABLE 2.**

Community disability comparisons in the 2016 NHATS

Participation Restriction in Valued Activities	NoCVD ( <i>n</i> = 4819)		CVD ( <i>n</i> = 1490)	
	<i>n</i>	%	<i>n</i>	%
Overall community disability <sup>a</sup>	1517	29.0	698	44.8
Socializing <sup>a</sup>	274	5.6	175	11.9
Attending religious services <sup>a</sup>	506	9.0	296	17.7
Going to organized club <sup>b</sup>	293	5.8	134	8.2
Going out for enjoyment <sup>a</sup>	288	5.8	139	9.0
Working <sup>a</sup>	289	5.5	131	8.1
Volunteering <sup>a</sup>	480	8.2	278	15.9
Participation in favorite activity <sup>a</sup>	860	17.0	390	26.0

<sup>a</sup>*p* < 0.001;<sup>b</sup>*p* < 0.05.

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**TABLE 3.**

Associations between environmental and individual risk factors on community disability for persons with CVD

	OR	95% CI
Environmental factors		
No transportation <sup>a</sup>	1.95	1.36–2.80
Modification to enter home (vs. none) <sup>b</sup>	1.53	1.04–2.24
Needs assistance with mobility <sup>c</sup>	3.16	1.57–6.37
Individual risk factors		
Age (vs. 85+ yrs), yr <sup>c</sup>		
65–69	0.65	0.36–1.19
70–74	0.55	0.38–0.80
75–79	0.56	0.39–0.81
80–84	0.69	0.48–0.99
Income (vs. <\$17,962)		
\$17,962–\$34,955	1.18	0.83–1.68
\$34,956–\$64,939	0.97	0.65–1.45
\$64,940	0.69	0.44–1.07
Comorbidity (vs. 4+) <sup>a</sup>		
0–3 conditions	0.48	0.36–0.63

<sup>a</sup>  $p < 0.0001$ ;

<sup>b</sup>  $p < 0.05$ ;

<sup>c</sup>  $p < 0.01$ .

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