ARTICLE | Annals of Internal Medicine

# Geriatric Conditions and Disability: The Health and Retirement Study

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**Background:** Geriatric conditions, such as incontinence and falling, are not part of the traditional disease model of medicine and may be overlooked in the care of older adults. The prevalence of geriatric conditions and their effect on health and disability in older adults has not been investigated in population-based samples.

**Objective:** To investigate the prevalence of geriatric conditions and their association with dependency in activities of daily living by using nationally representative data.

**Design:** Cross-sectional analysis.

**Setting:** Health and Retirement Study survey administered in 2000.

**Participants:** Adults age 65 years or older ($n$ = 11 093, representing 34.5 million older Americans) living in the community and in nursing homes.

**Measurements:** Geriatric conditions (cognitive impairment, falls, incontinence, low body mass index, dizziness, vision impairment, hearing impairment) and dependency in activities of daily living (bathing, dressing, eating, transferring, toileting).

**Results:** Of adults age 65 years or older, 49.9% had 1 or more geriatric conditions. Some conditions were as prevalent as common chronic diseases, such as heart disease and diabetes. The association between geriatric conditions and dependency in activities of daily living was strong and significant, even after adjustment for demographic characteristics and chronic diseases (adjusted risk ratio, 2.1 [95% CI, 1.9 to 2.4] for 1 geriatric condition, 3.6 [CI, 3.1 to 4.1] for 2 conditions, and 6.6 [CI, 5.6 to 7.6] for ≥3 conditions).

**Limitations:** The study was cross-sectional and based on self-reported data. Because measures were limited by the survey questions, important conditions, such as delirium and frailty, were not assessed. Survival biases may influence the estimates.

**Conclusions:** Geriatric conditions are similar in prevalence to chronic diseases in older adults and in some cases are as strongly associated with disability. The findings suggest that geriatric conditions, although not a target of current models of health care, are important to the health and function of older adults and should be addressed in their care.

*Ann Intern Med.* 2007;147:156-164. www.annals.org
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Geriatric conditions, such as incontinence and falling, fall outside the traditional disease model of clinical medicine and thus may be overlooked in the care of older adults (1). Yet, these conditions are a necessary focus for geriatricians in their management of patients. A recent American Geriatrics Society statement includes "expertise in the diagnosis and care" of geriatric conditions among its core attributes and competencies (2). Although certain geriatric conditions have been studied extensively, the aggregate effect of those conditions on health and disability in the older adult population has not been investigated.

One obstacle is the lack of consensus on the definition of a geriatric condition or geriatric syndrome (3–5). Citing an early edition of the Geriatrics Review Syllabus and drawing on other sources (6), Flacker (7) noted that geriatric syndromes are understood to have the following features: They occur in older, especially vulnerable, adults; are multifactorial in cause; are precipitated by a variety of acute insults; are typically episodic in nature; and are often followed by functional decline. This lack of consensus on the definitions leads to variation in what is considered a geriatric condition or geriatric syndrome (4, 5). For instance, there is consensus that cognitive impairment, falls, incontinence, and delirium are geriatric syndromes, but less agreement that malnutrition and neglect and abuse also qualify. In this paper, we use the term *geriatric condition* and include all conditions for which survey data were available. Use of the term *geriatric condition*, to indicate a collection of symptoms and signs common in older adults not necessarily related to a specific disease, avoids the ambiguity associated with the term *syndrome* (2).

We examined the association, both individually and in aggregate, between geriatric conditions and dependency in activities of daily living (ADLs) in older Americans. We used nationally representative data that include information on geriatric conditions, chronic diseases, disability, and demographic characteristics. We hypothesized that having 1 or more geriatric conditions is strongly associated with ADL dependency, independent of prevalent diseases.

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## METHODS

### Data

We obtained data from the 2000 wave of the Health and Retirement Study (HRS), a biennial longitudinal health interview survey of a cohort of adults age 50 years or older in the United States. Sponsored by the National In-

 

stitute on Aging and performed by the Institute for Social Research at the University of Michigan, the HRS is designed to study health transitions among older adults (8, 9).

Of the 19 580 HRS respondents interviewed in 2000, we identified 11 093 respondents age 65 years or older, who represented 34.5 million U.S. adults in this age group in that year. The HRS investigators interviewed sampled respondents and their spouses. When the eligible respondent could not be interviewed, often because of medical or cognitive problems, a proxy ($n = 1392$)—frequently the spouse ($n = 698$)—was enlisted to answer questions for that respondent.

The HRS was approved by the Behavioral Sciences Committee institutional review board at the University of Michigan. The data used for this analysis are publicly available and contain no unique identifiers, thus ensuring respondent anonymity.

## Variables and Their Measurement

### *Geriatric Conditions*

The 2000 wave assessed self-reported information on 7 geriatric conditions and their activity or severity. We used survey data on the following geriatric conditions in their active or severe forms: 1) falls resulting in injury; 2) incontinence requiring use of pads or other absorbent undergarments; 3) low body mass index (BMI) (<18.5 kg/m$^2$, based on self-reported height and weight); 4) dizziness (dizziness or lightheadedness as a persistent or troublesome problem); 5) vision impairment (fair or poor eyesight despite use of corrective lenses); 6) hearing impairment (fair or poor hearing despite use of hearing aids); and 7) cognitive impairment.

The HRS assesses for cognitive impairment by 1 of 2 means. For self-respondents, cognitive impairment is determined by using a performance-based measure—a modified version of the Telephone Interview for Cognitive Status, which is a validated cognitive screening instrument patterned on the Mini-Mental State Examination (10) and is specifically designed for population-based studies. We defined severe cognitive impairment as a score of 8 or less on the 35-point cognitive scale. This cut-point has previously been used by researchers because the proportion of people that it identifies as having serious cognitive impairment is consistent with other estimates of the prevalence of dementia (11–13). Detailed information on the cognitive measures that make up the modified Telephone Interview for Cognitive Status is available on the HRS Web site (http://hrsonline.isr.umich.edu/docs/userg/dr-006.pdf).

Respondents unable to complete the survey interview were assigned proxy respondents by a trained interviewer according to study protocol. Each proxy was asked to assess the respondent's memory. Respondents reported to have "fair" or "poor" memory were considered to have severe cognitive impairment (13).

***Context***

Geriatric conditions, such as incontinence and falling, are prevalent and associated with disability in older adults.

***Contribution***

Using national survey data, the authors found that almost half of older U.S. adults had geriatric conditions. Some were as prevalent as common conditions, such as heart disease. The authors confirmed a strong association between having a geriatric condition and dependency in activities of daily living.

***Caution***

Conditions and dependence were identified by self-report.

***Implications***

Geriatric conditions are often overlooked in older adults, but they are as common as other chronic diseases and are as strongly associated with disability.

*—The Editors*

### *Disability*

Of the traditional ADLs (14), we included bathing, dressing, eating, toileting, and transferring in our analysis but excluded continence, because we considered incontinence to be a geriatric condition. Our definition of ADL dependency required respondents to both have difficulty with and receive assistance for the task. "Difficulty" included the inability to perform the task because of a health or memory problem.

### *Chronic Diseases*

We considered the following diseases surveyed in the HRS to be chronic: heart disease, chronic lung disease, diabetes, cancer, musculoskeletal conditions, stroke, and psychiatric problems. Respondents reported whether a physician had diagnosed each disease. Questions about the diseases included those indicating their activity or severity (for example, receiving treatment). We limited each chronic disease to its active or severe form. Because our dependent variable was ADL dependency, we tried to avoid activity or severity constraints that were inherently functional in nature (15). For example, musculoskeletal conditions included arthritis requiring medication or other treatment and/or joint replacement in the past 2 years and/or hip fracture in the past 2 years. We limited stroke to persons who required medication for stroke (or its complications) or had remaining problems (such as weakness in arms or legs and difficulty speaking or swallowing).

### *Demographic Factors*

Demographic variables were age, sex, race (white, African American, other), marital status (married, unmarried), educational attainment, and net financial worth (total household assets minus current debt) (8).

*Table 1.* **Respondent Characteristics***

| Characteristic | Entire 2000 Survey Wave ($n$ = 11 093), *weighted* %† | Geriatric Conditions, *weighted* %† | | | | *P* Value‡ |
|---|---|---|---|---|---|---|
| | | 0 ($n$ = 5450) | 1 ($n$ = 3342) | 2 ($n$ = 1399) | ≥3 ($n$ = 902) | |
| **Overall prevalence** | | 50.1 | 30.4 | 12.4 | 7.1 | |
| **Age** | | | | | | <0.001 |
| 65–69 y | 27.1 | 32.9 | 24.9 | 18.8 | 10.1 | |
| 70–74 y | 25.1 | 29.4 | 23.4 | 18.5 | 13.9 | |
| 74–79 y | 21.5 | 21.0 | 22.7 | 22.0 | 18.8 | |
| ≥80 y | 26.3 | 16.7 | 29.1 | 40.8 | 57.3 | |
| **Sex** | | | | | | <0.001 |
| Male | 42.0 | 43.9 | 44.6 | 34.8 | 29.3 | |
| Female | 58.1 | 56.1 | 55.4 | 65.2 | 70.7 | |
| **Race** | | | | | | 0.005 |
| White | 88.4 | 88.7 | 89.6 | 86.1 | 84.6 | |
| African American | 8.7 | 8.4 | 7.5 | 10.6 | 12.2 | |
| Other | 3.0 | 2.9 | 2.9 | 3.4 | 3.2 | |
| **Marital status** | | | | | | <0.001 |
| Married | 54.9 | 60.1 | 54.6 | 44.6 | 37.7 | |
| Unmarried | 45.1 | 39.9 | 45.4 | 55.4 | 62.3 | |
| **Education** | | | | | | <0.001 |
| <12 y | 32.0 | 24.9 | 33.6 | 44.0 | 54.9 | |
| 12 y | 34.0 | 35.9 | 33.8 | 31.3 | 25.6 | |
| >12 y | 34.0 | 39.2 | 32.6 | 24.7 | 19.4 | |
| **Net financial worth** | | | | | | <0.001 |
| ≤$45 000 | 21.8 | 17.2 | 22.0 | 28.3 | 41.6 | |
| $45 001–$134 000 | 23.0 | 20.8 | 24.1 | 27.8 | 25.3 | |
| $134 001–$319 000 | 25.1 | 26.3 | 25.3 | 23.9 | 18.0 | |
| ≥$319 000 | 30.2 | 35.7 | 28.7 | 20.0 | 15.1 | |
| **Nursing home residence** | | | | | | <0.001 |
| No | 97.6 | 99.4 | 98.4 | 95.7 | 84.4 | |
| Yes | 2.4 | 0.6 | 1.6 | 4.3 | 15.6 | |
| **≥1 ADL dependencies** | | | | | | <0.001 |
| No | 90.6 | 97.4 | 91.9 | 80.6 | 55.0 | |
| Yes | 9.4 | 2.6 | 8.1 | 19.4 | 45.0 | |
| **Chronic disease** | | | | | | |
| Heart disease | 9.2 | 5.3 | 8.6 | 18.6 | 23.3 | <0.001 |
| Lung disease | 5.8 | 3.7 | 6.4 | 9.5 | 11.4 | <0.001 |
| Diabetes | 13.2 | 10.4 | 14.5 | 17.4 | 20.5 | <0.001 |
| Cancer | 4.8 | 4.5 | 5.1 | 5.6 | 4.6 | 0.36 |
| Musculoskeletal disorder | 29.7 | 24.2 | 30.4 | 39.3 | 49.4 | <0.001 |
| Stroke | 5.4 | 2.7 | 4.8 | 10.2 | 19.8 | <0.001 |
| Psychiatric disorder | 7.1 | 3.7 | 6.9 | 12.8 | 21.3 | <0.001 |

* ADL = activities of daily living.
† Weighted percentage derived by using the Health and Retirement Study (HRS) respondent population weights to adjust for the complex sampling design of the HRS.
‡ *P* values were derived from the chi-square test for association between the indicated variable and the number of geriatric conditions.

## Statistical Analysis

We used multivariate logistic regression modeling to examine the association between geriatric conditions (numbers of conditions/individual conditions) and the probability of having 1 or more ADL dependencies. Then, we sequentially introduced groups of variables into the model, first demographic variables and then chronic disease variables, because these are known to be associated with ADL dependencies. We used variance inflation factors to investigate and rule out multicollinearity among the independent variables. We obtained estimates of risk ratios from the logistic models. We then used bootstrapping to produce the CIs; we performed the bootstrapping by resampling at the primary sampling unit for the bootstrapping (16). The dependent variables for each model are: any ADL dependency (model 1) and each particular ADL dependency (models 2 to 6). The independent variables for each model are the 7 geriatric conditions. Each model con-

trolled for 6 demographic characteristics and the 7 chronic diseases.

Regression diagnostics performed on our initial unweighted models suggested that the logistic regression models were a reasonable fit for our data and that the models evaluating groups of geriatric conditions and groups of diseases showed the best fits. We systematically tested interactions between the independent variables. Those that were considered clinically significant were not statistically significant (for example, vision impairment and hearing impairment), and those that were statistically significant we did not consider to be clinically significant (for example, falls and lung disease). Therefore, we did not include these terms in the final model.

To adjust for the complex sample design of the HRS, the differential probability of selection, and nonresponse, all analyses were weighted and adjusted by using the Stata statistical package (release 8.0; Stata, College Station, Texas); thus, we could take advantage of the nationally representative data set to produce national population estimates.

### Role of the Funding Sources

This study was supported by grants from the John A. Hartford Foundation and the National Institute on Aging and by the Ann Arbor Veterans Affairs Geriatric Research, Education and Clinical Center. The funding sources had no role in the design, conduct, or analysis of the study or in the decision to submit the manuscript for publication.

## RESULTS

**Table 1** shows the proportion of survey respondents in each age stratum, weighted to be representative of adults age 65 years or older in the United States in 2000, and the proportion of respondents in each stratum by number of geriatric conditions. Compared with persons who had no geriatric conditions, those with increasing numbers of conditions were older, female, from a minority ethnic group, and unmarried and had less education and a lower net financial worth. **Appendix Table 1** (available at www.annals.org) shows the proportion of adults age 65 years or older with individual geriatric conditions. The prevalence rates of the individual conditions in the older adult population were similar to rates of chronic diseases. For example, the prevalence rates of injurious falls and urinary incontinence were 9.6% and 12.7%, respectively, compared with 9.2% for heart disease and 13.2% for diabetes.

**Table 2** shows the number of geriatric conditions by age group. The numbers of conditions increased markedly with advancing age. A similar analysis examining the prevalence of having 1, 2, 3, or 4 geriatric conditions across the age spectrum showed a slight decrease in prevalence of having 1 condition (from 27.9% at age 65 to 69 years to 26.4% at age ≥90 years) and an increase in prevalence of having 2 (8.6% to 25.1%), 3 (2.1% to 17.2%), and 4 conditions (0.5% to 11.4%).

**Table 2** also shows the weighted proportions of respondents with individual geriatric conditions by age. All conditions increased in prevalence with advancing age. For each condition, respondents age 80 years or older form a large proportion of those with a condition (data not shown). Thus, 55% of older adults with cognitive impairment were age 80 years or older, as were 44% of older adults with an injurious fall, 39% with incontinence, 52% with low BMI, 36% with dizziness, 48% with vision impairment, and 38% with hearing impairment.

**Table 3** shows how the individual geriatric conditions group together within individuals. For each condition, both the prevalence of each of the other 6 conditions (**Appendix Table 2**, available at www.annals.org) and the prevalence of multiple other conditions are shown. For each of the conditions (except hearing impairment), the prevalence

*Table 2.* **Respondents with a Geriatric Condition Who Have Other Geriatric Conditions, by Age***

| Variable | Proportion of Respondents (95% CI), *weighted* %† | | | | | |
|---|---|---|---|---|---|---|
| | 65–69 y (*n* = 3256) | 70–74 y (*n* = 2492) | 75–79 y (*n* = 2253) | 80–84 y (*n* = 1621) | 85–89 y (*n* = 967) | ≥90 y (*n* = 504) |
| Geriatric conditions | | | | | | |
| ≥1 | 39.2 (36.9–41.4) | 41.4 (39.0–43.8) | 51.0 (48.1–53.8) | 62.2 (59.1–65.1) | 73.0 (70.1–75.8) | 82.2 (78.2–85.6) |
| ≥2 | 11.2 (9.8–12.8) | 13.0 (11.5–14.7) | 18.9 (17.3–20.6) | 27.6 (25.3–30.0) | 37.9 (34.6–41.3) | 55.8 (51.7–59.7) |
| ≥3 | 2.6 (2.0–3.4) | 3.9 (3.0–5.1) | 6.2 (5.3–7.2) | 10.3 (8.7–12.0) | 17.8 (15.2–20.7) | 30.7 (26.2–35.6) |
| ≥4 | 0.5 (0.3–0.8) | 1.4 (0.9–2.0) | 1.9 (1.2–2.8) | 2.6 (1.9–3.6) | 8.0 (6.5–9.9) | 13.5 (10.3–17.5) |
| Individual geriatric conditions | | | | | | |
| Cognitive impairment | 3.4 (2.7–4.1) | 4.3 (3.5–5.4) | 6.0 (4.9–7.3) | 9.9 (8.5–11.5) | 18.1 (15.3–21.2) | 31.6 (28.0–35.5) |
| Injurious falls | 6.0 (5.1–7.0) | 7.2 (6.1–8.5) | 9.1 (7.9–10.4) | 13.0 (11.7–14.5) | 19.6 (16.6–22.9) | 21.9 (18.6–25.7) |
| Incontinence (use of pads) | 9.3 (8.4–10.2) | 10.0 (8.8–11.4) | 12.8 (11.4–14.3) | 15.3 (13.4–17.5) | 20.8 (18.1–23.8) | 26.7 (21.7–32.4) |
| Low BMI | 1.3 (0.9–1.9) | 1.5 (1.0–2.2) | 3.1 (2.2–4.5) | 3.6 (2.8–4.7) | 6.4 (4.9–8.3) | 12.0 (8.8–16.2) |
| Dizziness | 10.3 (9.2–11.6) | 10.6 (9.3–12.1) | 14.1 (12.4–16.1) | 16.7 (14.9–18.7) | 21.8 (19.2–24.7) | 17.9 (14.2–22.3) |
| Vision impairment | 4.6 (3.8–5.5) | 6.0 (5.0–7.2) | 6.5 (5.3–7.9) | 11.5 (9.7–13.7) | 16.9 (14.8–19.3) | 22.8 (18.3–28.0) |
| Hearing impairment | 18.8 (17.3–20.3) | 20.5 (18.6–22.5) | 26.9 (24.9–29.0) | 33.0 (30.5–35.6) | 36.6 (33.2–40.1) | 51.5 (46.7–56.3) |

* BMI = body mass index.
† Weighted percentage derived by using the Health and Retirement Study (HRS) respondent population weights to adjust for the complex sampling design of the HRS.

*Table 3.* **Respondents with an Index Geriatric Condition Who Have Other Geriatric Conditions***

| Condition | ≥1 Other Geriatric Conditions (95% CI), *weighted* %† | ≥2 Other Geriatric Conditions (95% CI), *weighted* %† | ≥3 Other Geriatric Conditions (95% CI), *weighted* %† |
|---|---|---|---|
| Cognitive impairment ($n$ = 1012) | 78.7 (75.5–81.6) | 46.3 (42.3–50.4) | 20.1 (17.1–23.4) |
| Injurious falls ($n$ = 1084) | 63.5 (60.0–66.8) | 32.9 (30.2–35.7) | 14.3 (11.8–17.3) |
| Incontinence (use of pads) ($n$ = 1439) | 60.2 (57.8–62.5) | 29.3 (26.7–32.0) | 12.7 (10.3–15.5) |
| Low BMI ($n$ = 334) | 63.1 (57.7–68.2) | 38.8 (32.4–45.8) | 22.5 (18.2–27.6) |
| Dizziness ($n$ = 1540) | 69.7 (66.9–72.5) | 31.2 (28.7–33.7) | 12.2 (9.9–15.0) |
| Vision impairment ($n$ = 973) | 74.5 (71.0–77.7) | 43.3 (39.5–47.3) | 19.8 (17.0–22.9) |
| Hearing impairment ($n$ = 2884) | 48.7 (46.6–50.9) | 20.4 (18.8–22.2) | 7.7 (6.4–9.3) |

* BMI = body mass index.
† Weighted percentage derived by using the Health and Retirement Study (HRS) respondent population weights to adjust for the complex sampling design of the HRS.

of having at least 1 other condition exceeded 60%. This grouping of conditions was greatest for cognitive impairment, low BMI, and vision impairment.

**Table 4** shows the association between geriatric conditions and dependency in at least 1 ADL. Although attenuated after adjustment for demographic characteristics and chronic diseases, risk ratios for ADL dependency remained large and highly significant. Risk ratios for conditions were similar to or greater than those for most chronic diseases. **Appendix Table 3** (available at www.annals.org) shows risk ratios for the association between demographic variables and ADL dependency.

We performed sensitivity analyses examining the roles of respondents with cognitive impairment and respondents who had proxies. Models excluding respondents with cognitive impairment (modification of model 3) yielded risk ratios for the geriatric conditions that were smaller but still similar to those for the chronic diseases and were highly significant: 1 condition, 1.9 (95% CI, 1.7 to 2.2); 2 conditions, 2.6 (CI, 2.2 to 3.1); and 3 or more conditions, 3.7 (CI, 3.0 to 4.3). Similar findings resulted from models that excluded proxy respondents (modification of model 3): 1 condition, 2.1 (CI, 1.8 to 2.4); 2 conditions, 3.0 (CI, 2.4 to 3.5); and 3 or more conditions, 4.5 (CI, 3.6 to 5.3).

**Table 5** shows the prevalence of and risk ratios for ADL dependency, by each geriatric condition. Risk ratios for the presence of ADL dependency are largest for cognitive impairment, incontinence, and vision impairment. Hearing impairment is not associated with ADL dependency.

## DISCUSSION

This cross-sectional study examined the prevalence of geriatric conditions (individually and in aggregate) among older adults and the association of geriatric conditions with ADL dependency. A systematic search of MEDLINE from January 1980 to April 2007, first using the terms *geriatric conditions* and *geriatric syndromes* and then using each of the 7 conditions in combination with *activities of daily living*, retrieved no studies of multiple geriatric conditions and ADL disability that used nationally representative data. Thus, to our knowledge, this is the first study to use such data to quantify the prevalence of geriatric conditions among older adults and to demonstrate that these conditions increase in frequency with age. Among older adults with a geriatric condition, the prevalence of ADL dependency was high. After adjustment for demographic characteristics and chronic diseases, the association of geriatric conditions with ADL dependency remained strong. Yet, the high prevalence of geriatric conditions and the strength of their association with ADL dependency demonstrate that these conditions go largely unrecognized in the current disease-based model of clinical care.

Because there is no consensus on the definition of a geriatric condition or what conditions that category includes, we studied all relevant conditions surveyed in the HRS. Although ours is only one set of possible conditions, they are among those most widely agreed upon. Nonetheless, key geriatric conditions are not included. Delirium and pressure sores are associated with acute illnesses and are not surveyed by the HRS. Frailty and failure to thrive have different potential definitions; one proposed model of frailty requires physical performance measures, which were unavailable in the 2000 wave (17, 18).

There is also no accepted standard for the definition and measurement of the individual geriatric conditions (and their severity) in the older adult population. Administrative claims data cannot be reliably used because geriatric conditions may not be recorded as the reason for a visit, leading to undercounting (19). Health interview surveys may not include questions on geriatric conditions. Here, the HRS is distinctive in that it contains expanded questions on most of the conditions and uses a performance-based measure to determine cognitive impairment.

The prevalence rates of the individual geriatric conditions in our study are generally consistent with those reported in the literature (20–34). For example, using data from the HRS, we found the prevalence of urinary incontinence requiring use of pads to be 12.7%. In comparison, in the Health, Aging, and Body Composition Study, Jackson and colleagues (25) found the prevalence of urinary incontinence and wearing protection among community-dwelling women age 70 to 79 years to be 12.3%. Using data from the National Health and Nutrition Examination

Survey, Anger and colleagues (23) found that the prevalence of daily incontinence varied from 12.2% in women 60 to 64 years of age to 20.9% in women 85 years of age or older. Previous research has demonstrated the comparability of chronic disease and disability prevalences in the HRS to those in other study populations (15, 35, 36).

Our search of the literature identified multiple studies of the associations between individual geriatric conditions and disability. Findings about these associations, however, depend to varying extents on the aims and contexts of the particular studies. We focused on the studies identified in our search that broadly addressed the geriatric population and that most closely examined ADL dependency as an outcome. Investigation of association with ADL dependency is most developed for cognitive impairment, for which different degrees of impairment have been examined and longitudinal associations and patterns of functional losses have been found (12, 37–42). The literature is more ambiguous for falls and incontinence; studies have found associations with dependency that are not necessarily causal (38, 43–45). Rather, the geriatric condition may be a marker for decline. In addition, falls are better associated with declines in physical performance measures rather than ADL tasks. Low BMI has been associated with eating dependency and with physical performance measures suggesting frailty (46, 47). Dizziness is not strongly associated with dependency (29). The association for vision impairment is strong, in contrast to hearing impairment (34, 48–53). Dual sensory impairment may or may not have additional disability beyond that of vision alone. Most studies that address the association of the individual conditions with dependency are done in the setting of multimorbidity or specific diseases. Our research adds to this literature by examining 7 geriatric conditions in the context of one another (as well as diseases) in a nationally representative population not limited to certain age groups or disease categories (54).

Although empirical research on geriatric conditions has tended to study them individually, there are ongoing efforts to link the conditions theoretically. Some have postulated an etiologic link through aging processes, through multiple physiologic disruptions, or through impairments in several domains that lead to a common pathway resulting in geriatric conditions (55). Inflammatory, endocrine, or metabolic dysregulation in multiple systems could lead to falls (17), weight loss (56), and dementia (57). Such hypotheses are related to current research in frailty, itself often considered a geriatric condition. Research seeks to define frailty—its empirical measurement remains unclear despite several useful models—and its role in health and aging, particularly as it relates to comorbid conditions and to other geriatric conditions (17, 18, 58–61).

Another important theoretical consideration is the location of geriatric conditions in the disablement process. Models of disability development and progression, such as the World Health Organization and Institute of Medicine models and their updates, have increased theoretical and practical understanding of physical impairments and dis-

*Table 4.* **Risk Ratios for Activities of Daily Living Dependency***

| Variable | Risk Ratio (95% CI)† | | | |
|---|---|---|---|---|
| | Model 1‡ | Model 2§ | Model 3‖ | Model 4¶ |
| **Number of geriatric conditions** | | | | |
| 1 | 3.0 (2.6–3.4) | 2.6 (2.3–3.0) | 2.2 (2.0–2.5) | 2.1 (1.9–2.4) |
| 2 | 7.3 (6.3–8.3) | 5.4 (4.7–6.2) | 3.9 (3.4–4.4) | 3.6 (3.1–4.1) |
| ≥3 | 16.9 (14.8–18.9) | 11.5 (9.9–13.0) | 7.5 (6.4–8.5) | 6.6 (5.6–7.6) |
| **Number of chronic diseases** | | | | |
| 1 | – | – | 1.9 (1.8–2.1) | – |
| 2 | – | – | 2.8 (2.6–3.1) | – |
| ≥3 | – | – | 4.0 (3.5–4.5) | – |
| **Type of chronic disease** | | | | |
| Heart disease | – | – | – | 1.2 (1.0–1.3) |
| Lung disease | – | – | – | 1.4 (1.3–1.6) |
| Diabetes | – | – | – | 1.3 (1.2–1.4) |
| Cancer | – | – | – | 1.0 (0.8–1.2) |
| Musculoskeletal disorder | – | – | – | 1.4 (1.3–1.5) |
| Stroke | – | – | – | 3.0 (2.7–3.3) |
| Psychiatric disorder | – | – | – | 1.5 (1.3–1.6) |

* ≥1 dependencies for activities of daily living.
† Risk ratios were weighted by using the Health and Retirement Study (HRS) respondent population weights to adjust for the complex sampling design of the HRS.
‡ Unadjusted.
§ Adjusted for 6 demographic characteristics.
‖ Adjusted for 6 demographic characteristics and numbers of chronic diseases.
¶ Adjusted for 6 demographic characteristics and 7 chronic diseases.

*Table 5.* **Relationship between Individual Geriatric Conditions and Activities of Daily Living Dependency***

| Geriatric Condition | Model 1: ≥1 ADL Dependencies | | Model 2: Bathing | | Model 3: Dressing | | Model 4: Eating | |
|---|---|---|---|---|---|---|---|---|
| | Prevalence, %† | Risk Ratio (95% CI)‡ | Prevalence, %† | Risk Ratio (95% CI)‡ | Prevalence, %† | Risk Ratio (95% CI)‡ | Prevalence, %† | Risk Ratio (95% CI)‡ |
| Cognitive impairment | 47.9 | 3.6 (3.3–3.9) | 41.0 | 4.4 (4.0–4.9) | 35.2 | 4.2 (3.8–4.5) | 23.5 | 6.1 (5.1–7.1) |
| Injurious falls | 21.7 | 1.2 (1.1–1.3) | 17.8 | 1.4 (1.3–1.5) | 15.4 | 1.3 (1.2–1.5) | 7.7 | 1.0 (0.9–1.2) |
| Incontinence (use of pads) | 26.2 | 1.9 (1.7–2.0) | 20.5 | 2.0 (1.8–2.2) | 19.2 | 2.3 (2.0–2.6) | 10.2 | 2.1 (1.8–2.4) |
| Low BMI | 27.7 | 1.5 (1.3–1.7) | 23.7 | 1.6 (1.3–1.9) | 16.1 | 1.2 (0.9–1.5) | 12.9 | 1.6 (1.3–1.9) |
| Dizziness | 21.0 | 1.2 (1.1–1.3) | 13.5 | 1.0 (0.9–1.1) | 13.8 | 1.2 (1.1–1.3) | 6.6 | 1.2 (1.0–1.3) |
| Vision impairment | 31.8 | 1.7 (1.6–1.9) | 24.1 | 1.7 (1.5–1.9) | 20.1 | 1.6 (1.5–1.8) | 13.7 | 2.2 (1.9–2.5) |
| Hearing impairment | 14.5 | 1.0 (1.0–1.1) | 10.4 | 1.0 (0.9–1.1) | 9.4 | 1.0 (0.9–1.1) | 4.8 | 0.9 (0.8–1.0) |

* Prevalences and risk ratios are weighted by using the Health and Retirement Study (HRS) respondent population weights to adjust for the complex sampling design of the HRS. ADL = activities of daily living; BMI = body mass index.
† Prevalence of dependency for each geriatric condition.
‡ Each model was adjusted for 7 geriatric conditions simultaneously, and for 6 demographic characteristics (age, sex, race, marital status, education, and net financial worth) and 7 chronic diseases (heart disease, lung disease, diabetes, cancer, musculoskeletal disorder, stroke, and psychiatric disorder).

ability (62). The well-known Institute of Medicine model (pathology → impairment → functional limitation → disability) has helped us understand how pathology (diseases) may sometimes be associated with physical limitation and sometimes not (63). Research has modified this model, demonstrating additional complexity, such as recovery and adaptation, as well as progression (64–70). However, geriatric conditions have not been clearly located within this model but rather appear to operate and interact at multiple points. Conditions may lead to ADL dependency (for example, cognitive impairment contributing to dependency in bathing and dressing), and ADL dependency may lead to geriatric conditions (for example, dependency in transferring contributing to injurious falls and functional urinary incontinence). Geriatric conditions may be considered impairments resulting from 1 or more diseases (such as cognitive impairment, incontinence, and vision impairment). To confuse matters further, disability itself has been called a geriatric syndrome (65).

A strength of our study is that it is based on a large, nationally representative survey (the HRS) that provides data on geriatric conditions in addition to ADL dependency and chronic diseases. The performance-based determination of cognitive ability freed us from relying on respondents' self-report of a dementia diagnosis when studying cognitive impairment. In addition, the HRS samples across the age range of older adults, including the oldest old, and it samples both community-dwelling and nursing facility respondents. Finally, the HRS is a biennial longitudinal survey that includes utilization and cost data, thereby allowing future studies that examine the cross-sectional and longitudinal association of geriatric conditions, ADL dependency, and chronic diseases with health, utilization, and cost outcomes.

Our study has limitations. First, the HRS is based on self-reported data. In particular, the activity and severity constraints developed for geriatric conditions (and chronic diseases) are based on self-reported data. Furthermore, the geriatric conditions (and chronic diseases) and activity and severity constraints chosen for this study are limited by the questions included in the HRS. For example, the HRS does not have data on delirium, and we used low BMI to indicate undernutrition, recognizing that malnutrition may exist with any BMI. In addition, survival bias may play a role in the age-related prevalence of the geriatric conditions, especially among the oldest old. Finally, this study was cross-sectional; further research is needed to examine geriatric conditions and their longitudinal association with disability.

This research has relevance to the ongoing care of older adults. Geriatric conditions present a challenge to the clinician because they are prevalent and are associated with disability but typically lack an underlying cause that may be cured. Yet, identifying and assessing geriatric conditions are clinically important because these conditions can be prevented or delayed (vision impairment [30]), managed (cognitive impairment [71], falls [22, 72, 73], incontinence [26, 74], vision impairment [31], hearing impairment [75]), and sometimes treated (low BMI [28], dizziness [29]), with resulting improvement in symptoms and decrease in disability. Caregivers need to be informed about conditions so that they can deal with their practicalities (urinary incontinence) and anticipate their long-term consequences (cognitive impairment). In addition, the presence of geriatric conditions has implications for how accompanying diseases and disability are to be treated or managed.

Geriatric conditions fall outside models that now govern much of health care. The disease management model is directed toward individuals with a single disease that dominates their health care utilization; this model is less able to address older adults whose health care use is related to multiple diseases, conditions, and disabilities that affect one another (15). The care management model is currently directed toward patients with multimorbidity and disability; conditions are not targeted. Most older adults with geriatric conditions live in the community and are not under the primary care of geriatricians. An approach to

*Table 5*—Continued

| Model 5: Transferring | | Model 6: Toileting | |
|---|---|---|---|
| Prevalence, %† | Risk Ratio (95% CI)‡ | Prevalence, %† | Risk Ratio (95% CI)‡ |
| 22.4 | 5.6 (4.6–6.6) | 21.2 | 7.8 (6.1–9.6) |
| 9.4 | 1.6 (1.4–1.8) | 7.8 | 1.4 (1.2–1.7) |
| 11.2 | 2.8 (2.4–3.2) | 9.8 | 2.9 (2.3–3.4) |
| 9.5 | 1.2 (0.9–1.4) | 10.2 | 1.4 (1.1–1.8) |
| 6.5 | 1.0 (0.9–1.2) | 4.8 | 0.9 (0.8–1.0) |
| 12.5 | 1.9 (1.6–2.2) | 10.2 | 1.7 (1.3–2.0) |
| 4.6 | 0.9 (0.8–1.0) | 4.1 | 0.9 (0.8–1.0) |

their care that includes the identification and management of geriatric conditions is needed.

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**Note:** An early version of this paper was presented at the 2004 Gerontological Society of America National Meeting in Washington, D.C.

**Acknowledgments:** The authors thank Tisha L. Moore for her assistance with manuscript preparation and development of the tables.

**Grant Support:** By a John A. Hartford Foundation pilot grant to Dr. Cigolle and a John A. Hartford Foundation grant to the Society of General Internal Medicine (2002–0013). Dr. Cigolle was supported by a National Research Service Award Institutional Training Grant (University of Michigan Institute of Gerontology) from the National Institute on Aging (5T32AG000114); by a Ruth L. Kirschstein National Research Service Award from the National Institute on Aging (1F32AG027649-01); and by the Ann Arbor Veterans Affairs Geriatric Research, Education and Clinical Center. Dr. Langa was supported by a Career Development Award from the National Institute on Aging (K08 AG19180) and a Paul Beeson Physician Faculty Scholars in Aging Research Award. Dr. Blaum was supported by the Ann Arbor Veterans Affairs Geriatric Research, Education and Clinical Center and a National Institute on Aging grant (R01:AG021493-01). The National Institute on Aging provided funding for the Health and Retirement Study (U01 AG09740), data from which were used in this study.

**Potential Financial Conflicts of Interest:** None disclosed.

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## *Appendix Table 1.* Respondent Characteristics, by Individual Geriatric Conditions*

| Characteristic | Cognitive Impairment (*n* = 1012) | Injurious Falls (*n* = 1084) | Incontinence (Use of Pads) (*n* = 1439) | Low BMI (*n* = 334) | Dizziness (*n* = 1540) | Vision Impairment (*n* = 973) | Hearing Impairment (*n* = 2884) |
|---|---|---|---|---|---|---|---|
| **Overall prevalence** | 7.3 | 9.6 | 12.7 | 2.9 | 13.4 | 8.0 | 25.7 |
| **Age** | | | | | | | |
| 65–69 y | 12.4 | 16.8 | 19.9 | 12.1 | 21.0 | 15.5 | 19.8 |
| 70–74 y | 14.9 | 18.7 | 19.9 | 12.8 | 20.0 | 18.7 | 20.0 |
| 74–79 y | 17.5 | 20.2 | 21.7 | 23.6 | 22.7 | 17.4 | 22.6 |
| ≥80 y | 55.2 | 44.3 | 38.6 | 51.5 | 36.3 | 48.4 | 37.6 |
| *P* value | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| **Sex** | | | | | | | |
| Male | 42.8 | 25.9 | 13.4 | 13.5 | 34.2 | 35.0 | 54.6 |
| Female | 57.2 | 74.1 | 86.6 | 86.5 | 65.8 | 65.0 | 45.4 |
| *P* value | 0.63 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| **Race** | | | | | | | |
| White | 76.1 | 91.0 | 91.2 | 87.0 | 85.4 | 81.9 | 89.3 |
| African American | 18.4 | 6.3 | 6.9 | 10.4 | 11.5 | 14.8 | 7.5 |
| Other | 5.5 | 2.7 | 1.9 | 2.6 | 3.1 | 3.3 | 3.1 |
| *P* value | <0.001 | 0.006 | 0.032 | 0.56 | <0.001 | <0.001 | 0.059 |
| **Married** | | | | | | | |
| Yes | 46.3 | 40.9 | 41.5 | 31.8 | 46.1 | 41.2 | 54.2 |
| No | 53.7 | 59.1 | 58.5 | 68.2 | 53.9 | 58.8 | 45.8 |
| *P* value | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.37 |
| **Education** | | | | | | | |
| <12 y | 60.4 | 36.3 | 31.7 | 38.9 | 48.2 | 54.8 | 41.6 |
| 12 y | 21.6 | 33.4 | 35.9 | 31.4 | 28.7 | 25.6 | 31.4 |
| >12 y | 18.0 | 30.3 | 32.4 | 29.8 | 23.1 | 19.6 | 27.0 |
| *P* value | <0.001 | 0.007 | 0.37 | 0.104 | <0.001 | <0.001 | <0.001 |
| **Net financial worth** | | | | | | | |
| ≤$45 000 | 39.7 | 27.4 | 25.5 | 33.1 | 34.3 | 40.9 | 24.9 |
| $45 001–$134 000 | 27.0 | 25.3 | 24.5 | 26.3 | 26.2 | 24.2 | 26.1 |
| $134 001–$319 000 | 19.4 | 23.6 | 25.0 | 22.2 | 21.5 | 18.4 | 23.4 |
| ≥$319 000 | 13.9 | 23.7 | 25.0 | 18.4 | 18.1 | 16.5 | 25.6 |
| *P* value | <0.001 | <0.001 | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| **Nursing home** | | | | | | | |
| No | 81.5 | 92.5 | 91.8 | 88.6 | 96.4 | 91.0 | 96.1 |
| Yes | 18.5 | 7.5 | 8.2 | 11.4 | 3.6 | 9.0 | 3.9 |
| *P* value | <0.001 | <0.001 | <0.001 | <0.001 | 0.002 | <0.001 | <0.001 |
| **≥1 ADL dependencies** | | | | | | | |
| No | 52.1 | 78.3 | 73.8 | 72.3 | 79.0 | 68.2 | 85.5 |
| Yes | 47.9 | 21.7 | 26.2 | 27.7 | 21.0 | 31.8 | 14.5 |
| *P* value | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| **Chronic disease** | | | | | | | |
| Heart disease | 17.4 | 15.0 | 15.0 | 11.8 | 22.4 | 18.7 | 14.4 |
| *P* value | <0.001 | <0.001 | <0.001 | 0.124 | <0.001 | <0.001 | <0.001 |
| Lung disease | 8.5 | 7.7 | 9.1 | 12.2 | 10.2 | 11.2 | 7.5 |
| *P* value | 0.001 | 0.020 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Diabetes | 15.5 | 18.2 | 17.2 | 5.6 | 20.0 | 24.1 | 15.2 |
| *P* value | 0.063 | <0.001 | <0.001 | 0.002 | <0.001 | <0.001 | 0.001 |
| Cancer | 4.2 | 4.2 | 6.3 | 4.7 | 5.8 | 4.2 | 5.0 |
| *P* value | 0.39 | 0.34 | 0.013 | 0.89 | 0.080 | 0.34 | 0.64 |
| Musculoskeletal disorder | 34.1 | 46.2 | 46.3 | 29.1 | 45.0 | 39.6 | 32.6 |
| *P* value | 0.009 | <0.001 | <0.001 | 0.81 | <0.001 | <0.001 | <0.001 |
| Stroke | 19.5 | 11.0 | 11.4 | 9.5 | 12.6 | 13.8 | 7.9 |
| *P* value | <0.001 | <0.001 | <0.001 | 0.002 | <0.001 | <0.001 | <0.001 |
| Psychiatric disorder | 16.0 | 13.3 | 14.8 | 12.5 | 16.5 | 16.3 | 9.2 |
| *P* value | <0.001 | <0.001 | <0.001 | 0.002 | <0.001 | <0.001 | <0.001 |

* Values are weighted percentages unless otherwise noted. Weighted percentages were derived by using the Health and Retirement Study (HRS) respondent population weights to adjust for the complex sampling design of the HRS. *P* values are derived from the chi-square test for association between the indicated variable and the individual geriatric condition. ADL = activities of daily living; BMI = body mass index.

*Appendix Table 2.* **Respondents with an Index Geriatric Condition Who Have Other Geriatric Conditions***

| | Cognitive Impairment | Injurious Falls | Incontinence (Use of Pads) | Low BMI | Dizziness | Vision Impairment | Hearing Impairment | ≥1 Other Geriatric Condition(s) | ≥2 Other Geriatric Conditions | ≥3 Other Geriatric Conditions |
|---|---|---|---|---|---|---|---|---|---|---|
| Cognitive impairment ($n$ = 1012) | – | 19.5 (16.8–22.6) | 26.7 (23.2–30.5) | 8.9 (6.9–11.6) | 25.6 (21.6–30.0) | 23.6 (20.8–26.7) | 48.1 (43.8–52.3) | 78.7 (75.5–81.6) | 46.3 (42.3–50.4) | 20.1 (17.1–23.4) |
| Injurious falls ($n$ = 1084) | 14.8 (12.5–17.6) | – | 25.4 (22.9–28.0) | 6.4 (5.0–8.1) | 24.1 (21.0–27.5) | 14.9 (12.5–17.7) | 31.2 (28.2–34.3) | 63.5 (60.0–66.8) | 32.9 (30.2–35.7) | 14.3 (11.8–17.3) |
| Incontinence (use of pads) ($n$ = 1439) | 15.4 (12.9–18.4) | 19.3 (17.0–21.9) | – | 4.0 (2.8–5.7) | 24.0 (21.3–26.9) | 14.0 (11.8–16.6) | 29.9 (27.5–32.5) | 60.2 (57.8–62.5) | 29.3 (26.7–32.0) | 12.7 (10.3–15.5) |
| Low BMI ($n$ = 334) | 22.9 (17.6–29.1) | 21.4 (17.4–26.1) | 17.9 (13.1–24.0) | – | 21.8 (18.0–26.1) | 19.0 (14.6–24.2) | 31.7 (26.4–37.5) | 63.1 (57.7–68.2) | 38.8 (32.4–45.8) | 22.5 (18.2–27.6) |
| Dizziness ($n$ = 1540) | 14.0 (11.6–16.9) | 17.4 (15.5–19.6) | 22.8 (20.4–25.3) | 4.7 (3.7–5.9) | – | 18.1 (15.8–20.5) | 40.4 (37.8–43.0) | 69.7 (66.9–72.5) | 31.2 (28.7–33.7) | 12.2 (9.9–15.0) |
| Vision impairment ($n$ = 973) | 21.6 (19.1–24.3) | 17.9 (15.1–21.1) | 22.2 (19.1–25.6) | 6.8 (5.0–9.1) | 30.1 (26.5–34.0) | – | 46.4 (43.5–49.4) | 74.5 (71.0–77.7) | 43.3 (39.5–47.3) | 19.8 (17.0–22.9) |
| Hearing impairment ($n$ = 2884) | 13.7 (12.0–15.6) | 11.7 (10.5–13.1) | 14.8 (13.5–16.1) | 3.5 (2.8–4.5) | 21.0 (19.2–23.0) | 14.5 (13.0–16.2) | – | 48.7 (46.6–50.9) | 20.4 (18.8–22.2) | 7.7 (6.4–9.3) |

* Values are weighted percentages (95% CIs) derived by using the Health and Retirement Study (HRS) respondent population weights to adjust for the complex sampling design of the HRS survey. BMI = body mass index.

## *Appendix Table 3.* Risk Ratios for Activities of Daily Living Dependency

| | Risk Ratio (95% CI)* | | | |
|---|---|---|---|---|
| | Model 1† | Model 2‡ | Model 3§ | Model 4‖ |
| **Number of geriatric conditions** | | | | |
| 1 | 3.0 (2.6–3.4) | 2.6 (2.3–3.0) | 2.2 (2.0–2.5) | 2.1 (1.9–2.4) |
| 2 | 7.3 (6.3–8.3) | 5.4 (4.7–6.2) | 3.9 (3.4–4.4) | 3.6 (3.1–4.1) |
| ≥3 | 16.9 (14.8–18.9) | 11.5 (9.9–13.0) | 7.5 (6.4–8.5) | 6.6 (5.6–7.6) |
| **Age** | | | | |
| 70–74 y | – | 1.1 (1.0–1.2) | 1.1 (0.9–1.2) | 1.1 (0.9–1.2) |
| 75–79 y | – | 1.2 (1.0–1.3) | 1.2 (1.0–1.3) | 1.2 (1.0–1.3) |
| ≥80 y | – | 2.0 (1.8–2.2) | 2.1 (1.9–2.3) | 2.1 (1.9–2.3) |
| **Female sex** | – | 1.2 (1.2–1.3) | 1.2 (1.1–1.3) | 1.2 (1.1–1.3) |
| **Race** | | | | |
| African American | – | 1.4 (1.3–1.5) | 1.4 (1.3–1.5) | 1.4 (1.3–1.5) |
| Other | – | 1.4 (1.2–1.7) | 1.4 (1.2–1.7) | 1.5 (1.2–1.7) |
| **Married** | – | 1.3 (1.2–1.4) | 1.3 (1.2–1.4) | 1.3 (1.2–1.4) |
| **Education** | | | | |
| 12 y | – | 0.9 (0.8–1.0) | 0.9 (0.8–1.0) | 0.9 (0.8–1.0) |
| ≥12 y | – | 1.0 (0.9–1.1) | 1.1 (0.9–1.2) | 1.1 (0.9–1.2) |
| **Net financial worth** | | | | |
| $45 001–$134 000 | – | 0.8 (0.7–0.9) | 0.8 (0.8–0.9) | 0.9 (0.8–0.9) |
| $134 001–$319 000 | – | 0.7 (0.6–0.8) | 0.8 (0.7–0.9) | 0.8 (0.7–0.9) |
| ≥$319 000 | – | 0.6 (0.5–0.6) | 0.6 (0.6–0.7) | 0.7 (0.6–0.7) |
| **Number of chronic diseases** | | | | |
| 1 | – | – | 1.9 (1.8-2.1) | – |
| 2 | – | – | 2.8 (2.6–3.1) | – |
| ≥3 | – | – | 4.0 (3.5–4.5) | – |
| **Type of chronic disease** | | | | |
| Heart disease | – | – | – | 1.2 (1.0–1.3) |
| Lung disease | – | – | – | 1.4 (1.3–1.6) |
| Diabetes | – | – | – | 1.3 (1.2–1.4) |
| Cancer | – | – | – | 1.0 (0.8–1.2) |
| Musculoskeletal disorder | – | – | – | 1.4 (1.3–1.5) |
| Stroke | – | – | – | 3.0 (2.7–3.3) |
| Psychiatric disorder | – | – | – | 1.5 (1.3–1.6) |

* Risk ratios are weighted by using the Health and Retirement Study (HRS) respondent population weights to adjust for the complex sampling design of the HRS.
† Unadjusted.
‡ Adjusted for 6 demographic characteristics.
§ Adjusted for 6 demographic characteristics and number of chronic diseases.
‖ Adjusted for 6 demographic characteristics and 7 chronic diseases.