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Symptom Burden among Community-Dwelling Older Adults in the United States

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Abstract

Objectives: To determine the prevalence and impact of common co-occurring symptoms among community-dwelling older adults in the United States.

Design: The National Health and Aging Trends Study is a nationally representative, prospective study with annual data collection between 2011–2017.

Setting: Community-based, in-person interviews (survey response rates: 71–96%).

Participants: 7,609 community-dwelling Medicare beneficiaries, aged ≥65 years.

Measurements: Symptoms assessed at baseline include pain, fatigue, breathing difficulty, sleeping difficulty, depressed mood, and anxiety. Total symptom count ranged from 0–6. Several outcomes were examined, including grip strength, gait speed, and overall lower-extremity function as well as incidence of recurrent falls (≥2 per year), hospitalization, disability, nursing home admission, and mortality.

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Author contributions: Dr. Patel had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. *Study concept and design*: Patel; *Acquisition, analysis, or interpretation of data*: All authors; *Drafting of manuscript*: Patel; *Critical revision of the article for important intellectual content*: All authors; *Statistical Analysis*: Patel and Guralnik.

Conflict of Interest: The authors declare no conflicts of interest related to the current study.

Impact Statement: We certify that this work is novel. The brief symptom assessment used in the current study identifies a high burden of symptoms and offers a valuable, patient-centered perspective on the health status of older adults in the United States.

Results: Prevalence of 0, 1, 2, 3, and ≥4 symptoms was 25.0%, 26.6%, 20.7%, 14.0%, and 13.6%, respectively. Symptom count increased with advancing age and was higher in women than in men. Pain and fatigue were the most common co-occurring symptoms. Higher symptom count was associated with decreased physical capacity. For example, participants with 1, 2, 3, and ≥4 symptoms had gait speeds that were 0.04, 0.06, 0.09, and 0.13 meters per second slower, respectively, than those with no symptoms, adjusting for specific diseases, total number of diseases, and other potential confounders (P<0.001). The risk of several adverse outcomes also increased with greater symptom count. For example, compared to those with no symptoms, the adjusted risk ratios for recurrent falls were 1.48 (95% confidence interval [CI]: 1.30–1.70), 1.54 (95% CI: 1.32–1.80), 1.90 (95% CI: 1.55–2.32), and 2.38 (95% CI: 2.00–2.83) for older adults with 1, 2, 3, and ≥4 symptoms, respectively.

Conclusions: Symptoms frequently co-occur among community-dwelling older adults and are strongly associated with increased risk of a range of adverse outcomes. Symptoms represent a potential treatment target for improving outcomes and should be systematically captured in health records.

Keywords

symptom burden; multimorbidity; falls; hospitalization; disability

INTRODUCTION

Symptoms are negative health-related experiences that are reported by patients but are not observable by clinicians. They account for the majority of outpatient visits[1] and are among the leading causes of disability.[2, 3] Although symptoms can be attributed directly to certain diseases (e.g., chest pain in acute myocardial infarction), they often have multiple causes (e.g., fatigue in patients with knee osteoarthritis, depression, and heart failure). In addition, symptoms frequently co-occur and can reinforce each other over time. For example, the co-occurrence of pain and depression ranges from 30–50%,[4] and several prospective studies have shown bidirectional relationships between pain, insomnia, fatigue, and emotional distress.[5–8] While treatment of an individual symptom can be complicated by co-occurrence of other symptoms (e.g., pain modifying the response to depression treatment[9]), interventions that improve overall symptom burden are associated with subsequent improvement in patient-reported functioning.[10,11] Taken together, optimal patient-centered care requires the assessment and management of multiple co-occurring symptoms.

The clinical significance of co-occurring symptoms has been demonstrated in specific patient populations (e.g., breast cancer),[12, 13] but less work has been done in the general older adult population. Prior studies have reported associations of symptom burden with worse physical functioning in cross-sectional analyses[14,15] and prospectively examined the risk of hospitalization and nursing home admission among older adults.[16–18] However, these previous studies were limited to clinic-based samples or specific geographic areas. Considering that older adults report symptoms as an underlying cause of disability[2] and rank symptom relief as a health care priority,[19] there is a need to characterize the burden of symptoms at a national level. Accordingly, the current study sought to determine the

prevalence and impact of common co-occurring symptoms among community-dwelling older adults in the United States.

METHODS

Study Design and Population

The National Health and Aging Trends Study (NHATS) is an ongoing, prospective cohort study designed to investigate trends in disability among older adults and is funded by the US National Institute on Aging.[20] A nationally representative sample of adults ages 65 and older was drawn from the Medicare enrollment file on September 30, 2010, and baseline interviews and assessments were conducted with 7,609 participants (538 were proxy-respondents) living in the community or in residential care settings between May and November 2011. The baseline response rate was 71%. Follow-up rates for data collected annually in 2012, 2013, 2014, 2015, 2016, and 2017 were 86%, 88%, 90%, 96%, 95%, and 95%, respectively.[20] Trained survey research staff conducted in-person interviews in the homes of study participants, including nursing homes during annual follow-up visits. Written informed consent was obtained from all study participants or their proxy-respondents, and the study protocol was approved by the Johns Hopkins University Institutional Review Board.

Measures

Symptoms—Several questions were used to assess symptoms during the baseline interview. For pain, fatigue, and breathing difficulty, participants were asked the following 3 questions with yes/no response options: “In the last month, have you been bothered by pain?”; “In the last month, did you have low energy or were you easily exhausted?”; and “In the last month, did you have any breathing problems, including shortness of breath or difficulty breathing?”. Two questions assessed frequency of sleep difficulty. Participants were considered to have sleep difficulty if they reported that “every night” or “most nights” in the last month that they (a) took 30 minutes or longer to fall asleep or (b) had trouble falling back to sleep after waking up early. Symptoms of depression and anxiety were assessed with the two-item Patient Health Questionnaire (PHQ-2) and two-item Generalized Anxiety Disorder scale (GAD-2), respectively.[21, 22] Total scores of ≥3 on the PHQ-2 and GAD-2 identified participants with depressed mood and anxiety, respectively.[21, 22] The total number of symptoms was computed for each participant (range: 0–6).

Outcomes—Several performance-based measures of physical capacity were assessed at baseline and at the annual follow-up visits. Grip strength was measured in kilograms (kg) by having participants squeeze a dynamometer as hard as they could. The maximum recorded strength from 2 trials was analyzed. Lower extremity function was assessed with the Short Physical Performance Battery (SPPB), which is a widely used summary measure that incorporates standing balance, gait speed, and ability to rise from a chair.[23, 24] The composite SPPB score ranges from 0–12 with higher values reflecting better lower extremity function. In addition, usual gait speed over a 3 meter course was examined in meters per second (m/s) as a separate variable given the salience of mobility in daily function and the direct impact that symptoms can have on walking.[25–27]

The incidence of several outcomes relevant to the older adult population was also examined. Participants were asked if they had fallen down in the last 12 months and, if so, had they fallen more than one time in the last 12 months (i.e., recurrent falls). Hospitalizations were also recorded annually by asking participants, "Have you had an overnight hospital stay within the last 12 months?" A series of questions asked whether study participants received assistance in the past month with getting out of bed (i.e., transferring), eating, getting cleaned up (bathing), using the toilet, and getting dressed. Those receiving assistance with any of these basic activities of daily living (ADLs) were considered disabled. Residence in a nursing home was determined through survey questions about housing type and services. For deceased participants, proxy respondents (usually a family member or caregiver) were asked about the sampled participant's last month of life, including their place of death (e.g., in a nursing home). Nursing home admission was defined as living in a nursing home at the time of a follow-up interview or at the time of death. Mortality was identified through follow-up contacts and interviews with proxy-respondents or residential care staff.

Other Variables—Age and sex were extracted from the Medicare enrollment file and confirmed during the baseline interview. Participants were asked to self-identify their race and ethnicity. Socioeconomic position was assessed in terms of the highest grade of education completed. A standard set of questions was used to determine smoking status (i.e., never, former, or current smoker). Physical activity was assessed with 2 questions that asked whether participants walked for exercise or spent time doing vigorous activities that increased their heart rate and breathing in the last month. Based on these questions, participants were classified into 1 of 3 levels: does not exercise, walks for exercise, and exercises vigorously. Body mass index (BMI) was calculated using measured height and weight. Chronic medical conditions were assessed by asking participants if a doctor has ever told them that they had any of the following: arthritis; osteoporosis; hip fracture; cancer; emphysema, asthma, or chronic bronchitis; myocardial infarction; heart disease/failure; diabetes; hypertension; stroke; or Alzheimer's disease/dementia. The total number of chronic medical conditions was computed for each participant (range: 0–11). Cognitive function was assessed with 3 tests of verbal recall and orientation that were summed into a composite score ranging from 0–24 with higher scores indicating better function.[20]

Data Analysis—The total number of symptoms was categorized into 0, 1, 2, 3, and ≥4. The prevalence of individual symptoms and total number of symptoms were estimated using analytic weights that account for unequal probabilities of selection into the NHATS sample, including adjustment for non-response. Variance estimates were calculated using a Taylor series linearization that incorporated the complex sampling design of NHATS.

Adjusted Wald statistics were used to determine differences in the percent distribution of symptom count across demographic and health characteristics. Linear regression was used to model the cross-sectional associations of symptom count with grip strength, gait speed, and SPPB scores at baseline. Two models were fitted for each outcome measure to adjust for potential confounding and to evaluate to what extent behavioral factors and medical conditions account for the effects of symptom burden beyond demographic factors alone; Model 1 adjusted for age, sex, race/ethnicity, education level, and proxy interview status,

and Model 2 further adjusted for smoking history, physical activity, BMI, individual medical conditions, and total number of medical conditions, and cognitive function. In addition to cross-sectional analyses, the onset (incidence) of muscle weakness (grip strength <16 kg in women and <26 kg in men),[28] slow gait speed (<0.6 m/s)[29], and poor lower extremity function (SPPB score <4)[23,24,30] were examined prospectively using clinically relevant cutpoints. General linear models with a binomial distribution and complementary log-log link function were used to examine the incidence of muscle weakness, slow gait speed, and poor lower extremity function as well as the incidence of recurrent falls, hospitalization, disability in basic ADLs, nursing home admission, and mortality. Only participants who did not have the outcome of interest at baseline were included in the time to event analyses (e.g., older adults reporting a history of falls at baseline were excluded from models examining the incidence of falls). In addition, two models were fitted for each incident outcome with the same set of covariates that were specified in the cross-sectional analyses. For incidence of muscle weakness, slow gait speed, and poor lower extremity function, a third model was fitted to further adjust for baseline level of physical performance. Finally, as a sensitivity analysis, we excluded participants who died within 2 years of the baseline assessment and reran all of the statistical models. All analyses were weighted and accounted for the complex sampling design. Data management and statistical analyses were performed with Stata SE version 15 (Stata Corp., College Station, Texas).

RESULTS

Three-fourths (75.0%) of community-dwelling older adults reported at least 1 of the 6 symptoms, and nearly half (48.3%) had 2 or more symptoms (Table 1). Notably, 13.6% (an estimated 4.8 million older adults in the U.S.) had 4 or more symptoms. Supplementary Figure S1 shows that the prevalence of individual symptoms was substantial, ranging from 12.6% for anxiety to 52.9% for pain. For each symptom, there was a high co-occurrence with the other symptoms. Pain and fatigue were the most prevalent co-occurring symptoms (31.7%, 11.2 million older adults; results not shown in tables), exceeding what would be expected from the prevalence of these symptoms individually. The most common triad of symptoms included pain, fatigue, and sleep difficulty (13.4%, 4.7 million older adults; results not shown in tables).

Table 2 shows that demographic and health characteristics varied according to symptom count at baseline. Symptom count generally increased with advancing age (see also Supplemental Table S1). Women were more likely to have more symptoms than men. Compared to white individuals, symptom counts were higher in black and Hispanic participants. Further, older adults with lower levels of education had higher symptom counts than those with higher education levels. Current smoking, obesity, and sedentary behavior were also associated with higher symptom counts. As expected, each of the chronic medical conditions as well as the total number of conditions were associated with greater number of symptoms. Cognitive function also decreased with higher symptom count. Finally, proxy respondents were more likely to report more symptoms than self-respondents.

Older adults with greater number of symptoms were weaker, slower, and had poorer lower extremity physical performance at baseline than those with fewer symptoms (Figure 1).

There was a graded association of total symptom count with each performance-based outcome, adjusting for demographic characteristics as well as when adjusting for specific chronic medical conditions, total number of conditions, and other health characteristics (Supplemental Table S2). Further, the risk of developing clinically significant muscle weakness, slow gait speed, and poor lower extremity function over time increased significantly with greater number of symptoms (Table 3). For example, among those with gait speeds ≥0.6 m/s at baseline, the risk of developing slow gait speed (<0.6 m/s) over time was 1.8 times higher in older adults with ≥4 symptoms compared to those who did not report any symptoms at baseline, adjusting for demographic and health characteristics and gait speed at baseline (Model 3, Table 3).

In addition to increased risk of poor physical performance over time, the incidence of recurrent falls, hospitalization, and disability in basic ADLs increased with greater symptom count (Table 4). Compared to older adults who did not report any symptoms, there was approximately a two-fold higher risk of falls, hospitalization, and disability among those with ≥4 symptoms (Model 2, Table 4). The risk of nursing home admission was also higher among those with greater symptom counts. Finally, there was a strong, graded relationship of symptom count with mortality.

In sensitivity analyses, excluding participants who died during the first 2 years of follow-up did not meaningfully change the associations of symptom count with the clinical and physical performance outcomes (see Supplemental Tables S3 and S4).

DISCUSSION

In this large, nationally representative study, there was a high burden of symptoms among community-dwelling older adults in the United States. Approximately half of older adults reported 2 or more of the 6 symptoms that we analyzed and over a quarter reported 3 or more symptoms. The impact of symptoms was substantial. Not only were older adults with multiple symptoms more functionally limited at baseline than those without symptoms, they also had greater risk for several major adverse outcomes over time, including slow gait speed, falls, hospitalizations, disability, and mortality. Importantly, the effects of having multiple symptoms on these outcomes were independent of disease burden and other health and demographic factors.

The current study findings are consistent with prior studies on symptoms in older adults that have examined cross-sectional associations with physical functioning as well as prospectively examined the risk of hospitalization and nursing home admission.[14–18] However, in contrast to previous studies with symptom counts ranging between 10 and 20,[14–18] the current study focused on 6 common physical and psychological symptoms. While other symptoms, such as self-reported weakness or balance problems, are collected in the NHATS and were used in previous studies, we chose not to include them because we planned to investigate mobility-related functional outcomes. In addition, the current study adjusted for a comprehensive set of demographic and health characteristics that are known to predict adverse outcomes in older adults.

The size and consistency of effects that symptom count had on a diverse set of outcomes is noteworthy. There was a graded, dose-response relationship of symptom count with each of the outcomes examined. Consistent with prior conceptual frameworks of disability in later life,[31,32] symptoms likely reflect multiple biopsychosocial processes and can have a more direct effect than diseases (pathology) on functional limitations and disability. For example, although concordance between knee pain and pathologic findings with imaging is variable,[33] knee pain often leads older adults to modify or reduce daily physical activities (i.e., a cognitive-behavioral response) that increases risk for functional decline.[34–37] Even when adjusting for specific individual chronic medical conditions and total number of conditions, symptom count remained a powerful predictor of slow gait speed (<0.6 m/s), poor overall lower extremity function (SPPB score<4), and disability in basic ADLs. It is well established that older adults with limited mobility and self-care ability are more vulnerable to other adverse outcomes, including falls, hospitalizations, and mortality.[23–26, 38, 39] Thus, symptom burden among older adults is potentially an important treatment target in the disablement process.

In view of the current study results as well as the findings from previous studies, greater effort is needed to evaluate whether improvements in symptom management can help prevent or delay functional decline among community-dwelling older adults. The set of symptoms examined herein should be ameliorable through routine physical activity. Indeed, symptom amelioration may be one of the mechanisms by which physical activity reduces adverse outcomes in older adults.[43–45] However, most physical activity intervention trials have not reported effects of exercise participation on the full range of symptoms that we have identified as prevalent and co-occurring. Greater attention to intervention effects on symptoms would be worthwhile as part of future physical activity research. Chronic disease self-management programs may also be valuable as they have some beneficial effects on cognitive aspects of symptom management.[46] In addition, palliative care approaches to symptom management that are used effectively in end of life care could potentially be applied in primary care settings,[40–42] although it is important to note that the sensitivity analyses demonstrate that the effects of co-occurring symptoms are not limited to the end of life period. Finally, systematic collection of symptoms and functional status indicators in electronic health records are needed to not only identify optimal treatment strategies through comparative effectiveness research,[47, 48] but also to prompt primary care providers to proactively elicit, manage, and monitor symptoms.

The current study has several strengths and limitations that should be considered when interpreting the results. First, case definitions of individual symptoms were based on 1–2 interview questions, reducing the specificity of symptom ascertainment than if more detailed symptom questionnaires were administered. However, the questionnaire items used in the NHATS have face-validity and previous studies have demonstrated the criterion-validity and screening properties of several of the questionnaire items.[21,22,27,49] Additionally, the NHATS symptom questions are generally similar to ones used in previous studies of symptom burden in older adults.[14–18] A second limitation is that symptom reports are subject to recall bias. Other study limitations include the absence of data on disease severity or on medications, which can cause symptoms through side-effects and polypharmacy might be an important unmeasured confounder. A clear strength of the study is that the findings are

generalizable to older, community-dwelling Medicare beneficiaries living in the 48 contiguous states. Further, the current study prospectively examined the risk for a variety of outcomes relevant to the geriatric population.

The brief assessment of symptom burden used in NHATS offers a valuable, patient-centered perspective on the health status of older adults. As the population ages and the prevalence of multiple chronic conditions increases,[50–53] the number and proportion of older adults with multiple chronic symptoms is likely to grow. While it is widely accepted that treating symptoms is important to improving quality of life at the end of life (i.e., palliative care), there is less appreciation for the potential predictive value of multiple, co-occurring symptoms in the general older adult population. In light of the current study, further multidisciplinary research on symptoms is needed to ultimately develop effective symptom management interventions.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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REFERENCES

1. Kroenke K Studying symptoms: sampling and measurement issues. Ann Intern Med. 2001;134:844–53. [PubMed: 11346320]
2. Leveille SG, Fried L, Guralnik JM. Disabling symptoms: what do older women report? J Gen Intern Med 2002;17:766–773. [PubMed: 12390552]
3. Vos T, Barber RM, Bell B, Bertozzi-Villa A, Biryukov S, Bolliger I et al. Global, regional, and national incidence, prevalence, and years lived with disability for 301 acute and chronic diseases and injuries in 188 countries, 1990–2013: A systematic analysis for the Global Burden of Disease Study 2013. The Lancet. 2015;386:743–800.
4. Bair MJ, Robinson RL, Katon W, Kroenke K. Depression and pain comorbidity: A literature review. Arch Intern Med 2003; 163: 2433–2445. [PubMed: 14609780]
5. Smith MT, Haythornthwaite JA. How do sleep disturbance and chronic pain inter-relate? Insights from the longitudinal and cognitive-behavioral clinical trials literature. Sleep Med Rev 2004;8:119–32. [PubMed: 15033151]
6. Kroenke K, Wu J, Bair MJ, Krebs EE, Damush TM, Tu W. Reciprocal relationship between pain and depression: A 12-month longitudinal analysis in primary care. J Pain 2011;12:964–973. [PubMed: 21680251]
7. Alvaro PK, Roberts RM, Harris JK. A systematic review assessing bidirectionality between sleep disturbances, anxiety, and depression. Sleep 2013;36:1059–68. [PubMed: 23814343]
8. Tang NK, McBeth J, Jordan KP, Blagojevic-Bucknall M, Croft P, Wilkie R. Impact of musculoskeletal pain on insomnia onset: a prospective cohort study. Rheumatology 2015;54:248–256. [PubMed: 25125589]

9. Bair MJ, Robinson RL, Eckert GJ, Stang PE, Croghan TW, Kroenke K. Impact of pain on depression treatment response in primary care. Psychosom Med 2004; 66:17–22. [PubMed: 14747633]
10. Kroenke K A practical and evidence-based approach to common symptoms: a narrative review. Ann Intern Med 2014;161:579–586. [PubMed: 25329205]
11. Davis LL, Kroenke K, Monahan P, Kean J, Stump TE. The SPADE symptom cluster in primary care patients with chronic pain. Clin J Pain 2016;32:388–93. [PubMed: 26295379]
12. Dodd MJ, Miaskowski C, Paul SM. Symptom clusters and their effect on the functional status of patients with cancer. Oncol Nurs Forum 2001; 28:465–470. [PubMed: 11338755]
13. Aktas A Cancer symptom clusters: current concepts and controversies. Curr Opin Support Palliat Care 2013;7:38–44. [PubMed: 23287418]
14. Whitson HE, Sanders LL, Pieper CF, Morey MC, Oddone EZ, Gold DT, Cohen HJ. Correlation between symptoms and function in older adults with comorbidity. J Am Geriatr Soc 2009;57(4): 676–82. [PubMed: 19392960]
15. Henchoz Y, Büla C, Guessous I, Rodondi N, Goy R, Demont M, Santos-Eggimann S. Chronic symptoms in a representative sample of community-dwelling older people. BMJ Open 2017;6:e014485.
16. Sha MC, Callahan CM, Counsell SR, Westmoreland GR, Stump TE, Kroenke K. Physical symptoms as a predictor of health care use and mortality among older adults. Am J Med 2005;118(3):301–306. [PubMed: 15745729]
17. Salanitro AH, Hovater M, Hearld KR, Roth DL, Sawyer P, Locher JL, Bodner E, Brown CJ, Allman RM, Ritchie CS. Symptom burden predicts hospitalization independent of comorbidity in community-dwelling older adults. J Am Geriatr Soc 2012;60(9):1632–7. [PubMed: 22985139]
18. Sheppard KD, Brown CJ, Hearld KR, Roth DL, Sawyer P, Locher JL, Allman RM, Ritchie CS. Symptom burden predicts nursing home admissions among older adults. J Pain Symptom Manage 2013;46(4):591–7. [PubMed: 23218806]
19. Fried TR, Tinetti ME, Iannone L, O'Leary JR, Towle V, Van Ness PH. Health outcome prioritization as a tool for decision making among older persons with multiple chronic conditions. Arch Intern Med 2011;171(20):1854–1856. [PubMed: 21949032]
20. Kasper JD, Freedman VA. National Health and Aging Trends Study User Guide: Rounds 1–7 Beta Release. Baltimore: Johns Hopkins University School of Public Health; 2018.
21. Kroenke K, Spitzer RL, Williams JB. The Patient Health Questionnaire-2: Validity of a two-item depression screener. Med Care 2003;41:1284–1292. [PubMed: 14583691]
22. Kroenke K, Spitzer RL, Williams JBW & Lowe B. 2009 An ultra-brief screening scale for anxiety and depression: The PHQ-4. Psychosomatics 50:613–621. [PubMed: 19996233]
23. Guralnik JM, Ferrucci L, Simonsick EM, Salive ME, Wallace RB. Lower-extremity function in persons over the age of 70 years as a predictor of subsequent disability. N Engl J Med 1995;332:556–561. [PubMed: 7838189]
24. Guralnik JM, Simonsick EM, Ferrucci L, Glynn RJ, Berkman LF, Blazer DG, Scherr PA, Wallace RB. A short physical performance battery assessing lower extremity function: association with self-reported disability and prediction of mortality and nursing home admission. J Gerontol 1994;49:M85–94. [PubMed: 8126356]
25. Studenski S, Perera S, Patel K, Rosano C, Faulkner K, Inzitari M, Brach J, Chandler J, Cawthon P, Barrett Conner E, Nevitt M, Visser M, Kritchevsky S, Bandinelli S, Harris T, Newman A, Cauley J, Ferrucci L, Guralnik J. Gait speed and survival in older adults. JAMA 2011;305(1):50–58. [PubMed: 21205966]
26. Perera S, Patel KV, Rosano C, Rubin SM, Satterfield S, Harris T, Ensrud K, Orwoll E, Lee CG, Chandler JM, Newman AB, Cauley JA, Guralnik JM, Ferrucci L, Studenski S. Gait speed predicts disability: A pooled analysis. J Gerontol A Biol Sci Med Sci 2016;71(1):63–71. [PubMed: 26297942]
27. Patel KV, Guralnik JM, Dansie EJ, Turk DC. Prevalence and impact of pain among older adults in the United States: Findings from the 2011 National Health and Aging Trends Study. Pain 2013;154: 2649–2657. [PubMed: 24287107]

28. Studenski SA, Peters KW, Alley DE, Cawthon PM, McLean RR, Harris TB, Ferrucci L, Guralnik JM, Fragala MS, Kenny AM, Kiel DP, Kritchevsky SB, Shardell MD, Dam TT, Vassileva MT. The FNIH sarcopenia project: rationale, study description, conference recommendations, and final estimates. J Gerontol A Biol Sci Med Sci 2014;69:547–58. [PubMed: 24737557]
29. Cummings SR, Studenski SA, Ferrucci L. A diagnosis of dismobility--giving mobility clinical visibility: a Mobility Working Group recommendation. JAMA 2014;311(20):2061–2. [PubMed: 24763978]
30. Guralnik JM, Ferrucci L, Pieper CF, Leveille SG, Markides KS, Ostir GV, Studenski S, Berkman LF, Wallace RB. Lower extremity function and subsequent disability: consistency across studies, predictive models, and value of gait speed alone compared with the short physical performance battery. J Gerontol A Biol Sci Med Sci 2000;55(4):M221–31. [PubMed: 10811152]
31. Nagi SZ. An epidemiology of disability among adults in the United States. Milbank Mem Fund Q Health Soc 1976; 54:439–467. [PubMed: 137366]
32. Verbrugge LM, Jette AM. The disablement process. Soc Sci Med 1994; 38:1–14. [PubMed: 8146699]
33. Bedson J, Croft PR. The discordance between clinical and radiographic knee osteoarthritis: a systematic search and summary of the literature. BMC Musculoskelet Dis. 2008;9(1):116.
34. Gignac MA, Cott C, Badley EM. Adaptation to disability: Applying selective optimization with compensation to the behaviors of older adults with osteoarthritis. Psychol Aging. 2002;17(3):520. [PubMed: 12243392]
35. Hawker GA, Stewart L, French MR, Cibere J, Jordan JM, March L, Suarez-Almazor M, Gooberman-Hill R. Understanding the pain experience in hip and knee osteoarthritis–an OARSI/OMERACT initiative. Osteoarthritis Cartilage. 2008;16(4):415–22. [PubMed: 18296075]
36. Weiss CO, Wolff JL, Egleston B, Seplaki CL, Fried LP. Incident preclinical mobility disability (PCMD) increases future risk of new difficulty walking and reduction in walking activity. Arch Gerontol Geriatr. 2012;54(3):e329–33. [PubMed: 21944428]
37. Mackichan F, Adamson J, Gooberman-Hill R. 'Living within your limits': activity restriction in older people experiencing chronic pain. Age Ageing. 2013;42(6):702–708. [PubMed: 23978405]
38. Branch LG, Jette AM. A prospective study of long-term care institutionalization among the aged. Am J Public Health 1982;72(12):1373–9. [PubMed: 6814269]
39. Nevitt MC, Cummings SR, Kidd S, Black D. Risk factors for recurrent nonsyncopal falls. A prospective study. JAMA 1989;261(18):2663–8. [PubMed: 2709546]
40. Temel JS, Greer JA, Muzikansky A, et al. Early palliative care for patients with metastatic non-small-cell lung cancer. N Engl J Med. 2010;363:733–742. [PubMed: 20818875]
41. Kamal AH, Currow DC, Ritchie CS, Bull J, Abernethy AP. Community-based palliative care: the natural evolution for palliative care delivery in the U.S. J Pain Symptom Manage. 2013;46(2):254–64. [PubMed: 23159685]
42. Quill TE, Abernethy AP. Generalist plus specialist palliative care — creating a more sustainable model. N Engl J Med. 2013;368:1173–1175 [PubMed: 23465068]
43. Wallace JI, Buchner DM, Grothaus L, Leveille S, Tyll L, LaCroix AZ, Wagner EH. Implementation and effectiveness of a community-based health promotion program for older adults. J Gerontol A Biol Sci Med Sci 1998;53(4):M301–M306. [PubMed: 18314570]
44. Ettinger WH, Jr, Burns R, Messier SP, Applegate W, Rejeski WJ, Morgan T, Shumaker S, Berry MJ, O'Toole M, Monu J, Craven T. A randomized trial comparing aerobic exercise and resistance exercise with a health education program in older adults with knee osteoarthritis: the Fitness Arthritis and Seniors Trial (FAST). JAMA 1997;277(1):25–31. [PubMed: 8980206]
45. Pahor M, Guralnik JM, Ambrosius WT, Blair S, Bonds DE, Church TS, Espeland MA, Fielding RA, Gill TM, Groessl EJ, King AC, Kritchevsky SB, Manini TM, McDermott MM, Miller ME, Newman AB, Rejeski WJ, Sink KM, Williamson JD. Effect of structured physical activity on prevention of major mobility disability in older adults: the LIFE Study randomized clinical trial. JAMA 2014;311(23):2387–96. [PubMed: 24866862]
46. Brady TJ, Murphy L, O'Colmain BJ, Beauchesne D, Daniels B, Greenberg M, House M, Chervin D. A meta-analysis of health status, health behaviors, and health care utilization outcomes of the Chronic Self-Management Program. Prev Chronic Dis 2013;10:120112. [PubMed: 23327828]

47. Ritchie CS. Symptom burden: In need of more attention and more evidence. JAMA Intern Med 2013;173(16):1541–1542. [PubMed: 23835609]

48. Maciejewski ML, Bayliss EA. Approaches to comparative effectiveness research in multimorbid populations. Med Care 2014;52 Suppl 3:S23–30.

49. Spira AP, Kaufmann CN, Kasper JD, Ohayon MM, Rebok GW, Skidmore E, Parisi JM, Reynolds CF, 3rd. Association between insomnia symptoms and functional status in U.S. older adults. J Gerontol B Psychol Sci Soc Sci 2014;69 Suppl 1:S35–41. [PubMed: 25342821]

50. Wu S, Green G. Projection of Chronic Illness Prevalence and Cost Inflation. Washington, DC: RAND; 2000.

51. Ward BW, Schiller JS. Prevalence of multiple chronic conditions among US adults: Estimates from the National Health Interview Survey, 2010. Prev Chronic Dis 2013;10:120203.

52. Salive ME. Multimorbidity in older adults. Epidemiol Rev. 2013;35:75–83. [PubMed: 23372025]

53. Tinetti ME, Fried TR, Boyd CM. Designing health care for the most common chronic condition–multimorbidity. JAMA 2012;307:2493–2494. [PubMed: 22797447]

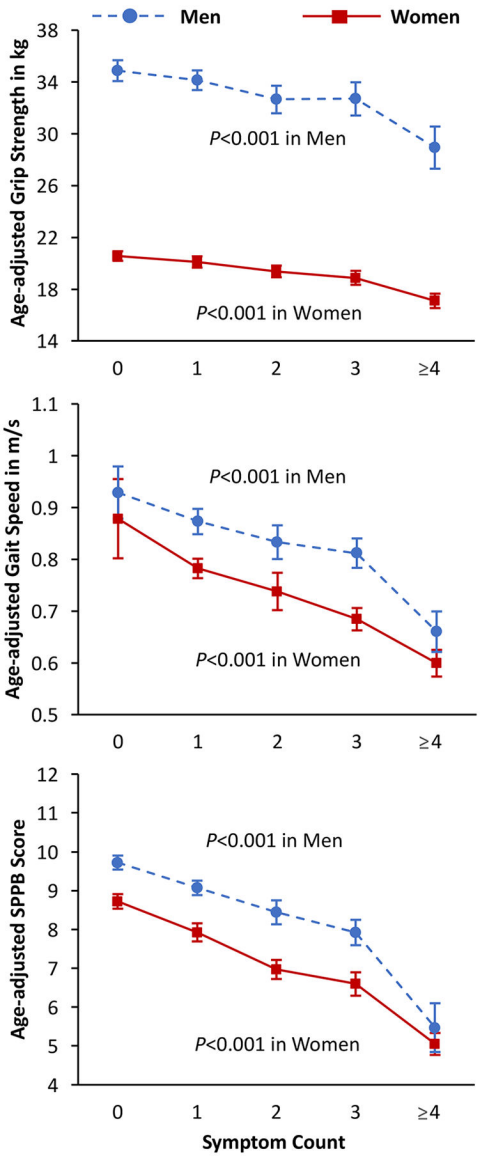

Figure 1.

Age-adjusted mean (and 95% CI bars) grip strength, gait speed, and SPPB score according to total number of symptoms in men and women 65 years and older: National Health and Aging Trends Study, 2011

Table 1.

Prevalence of symptoms in community-dwelling adults 65 years and older, United States: National Health and Aging Trends Study, 2011

Total No. of Symptoms	Unweighted No. of Observations, n	Weighted No. in the United States	% Prevalence (95% CI)
0	1,759	8,834,000	25.0 (23.8–26.2)
1	2,002	9,408,000	26.6 (25.5–27.8)
2	1,609	7,318,000	20.7 (19.4–22.1)
3	1,135	4,940,000	14.0 (13.1–14.9)
≥4	1,104	4,805,000	13.6 (12.6–14.7)

Table 2.

Distribution of baseline demographic and health characteristics according to the total number of symptoms among adults 65 years and older: National Health and Aging Trends Study, 2011

	Total Number of Symptoms					
Characteristic	**0**	**1**	**2**	**3**	**≥4**	***P* value**
Age in years, No. (%)						<0.001
65–69	382 (32.6)	366 (27.1)	279 (26.7)	182 (24.8)	200 (26.1)	
70–74	422 (27.1)	448 (26.4)	298 (23.1)	217 (23.8)	194 (22.2)	
75–79	353 (18.3)	405 (19.8)	315 (19.0)	222 (18.8)	218 (19.4)	
80–84	324 (12.7)	396 (14.6)	315 (15.1)	238 (16.2)	232 (16.3)	
85–89	171 (6.5)	219 (8.0)	231 (10.4)	172 (11.9)	160 (11.2)	
≥90	107 (2.8)	168 (4.1)	171 (5.7)	104 (4.5)	100 (4.9)	
Sex, No. (%)						<0.001
Women	866 (47.7)	1098 (52.9)	993 (61.5)	756 (65.3)	725 (63.8)	
Race/Ethnicity, No. (%)						0.013
White	1225 (82.5)	1375 (81.7)	1134 (83.3)	753 (80.9)	699 (76.8)	
Black	355 (7.2)	442 (8.4)	331 (7.7)	272 (9.3)	262 (9.3)	
Hispanic	95 (6.3)	110 (6.2)	84 (5.8)	63 (6.4)	102 (10.8)	
Other	57 (4.0)	60 (3.7)	43 (3.1)	31 (3.4)	28 (3.2)	
Education, No. (%)						<0.001
<9 years	161 (7.3)	237 (9.2)	187 (8.9)	172 (12.2)	232 (18.7)	
9–11 years	205 (9.2)	221 (8.6)	235 (12.3)	192 (14.1)	205 (16.5)	
High school graduate	445 (24.7)	528 (26.6)	472 (30.0)	311 (28.7)	313 (30.1)	
Some college/vocational	427 (25.5)	493 (26.8)	379 (26.1)	280 (28.2)	239 (24.6)	
College graduate	27 (17.1)	268 (14.8)	183 (12.4)	94 (10.1)	61 (6.1)	
Masters or higher degree	237 (16.1)	235 (14.0)	135 (10.2)	69 (6.7)	40 (4.0)	
Smoking history, No. (%)						0.044
Never smoked	898 (49.0)	1009 (48.9)	791 (47.1)	544 (45.3)	519 (43.8)	
Former smoker	730 (43.2)	857 (43.9)	699 (44.6)	497 (46.0)	464 (43.9)	
Current smoker	127 (7.8)	133 (7.2)	115 (8.3)	94 (8.8)	119 (12.3)	
Body mass index, No. (%)						<0.001
<18.5 kg/m^2	31 (1.5)	36 (1.6)	50 (2.5)	33 (2.2)	53 (4.7)	
18.5–24.9 kg/m^2	637 (36.1)	665 (32.3)	545 (32.5)	351 (30.5)	297 (26.1)	
25.0–29.9 kg/m^2	707 (43.6)	767 (40.6)	523 (34.6)	339 (31.9)	330 (32.2)	
≥30 kg/m^2	318 (18.8)	473 (25.6)	426 (30.4)	365 (35.4)	386 (37.0)	
Exercise, No. (%)						<0.001
Does not exercise	349 (16.7)	569 (24.7)	598 (33.1)	501 (40.5)	606 (53.0)	
Walks for exercise	558 (29.1)	660 (31.6)	537 (32.9)	354 (31.8)	301 (27.7)	
Exercises vigorously	852 (54.3)	770 (43.7)	473 (34.0)	280 (27.7)	197 (19.3)	
Arthritis, No. (%)	584 (32.5)	1007 (49.4)	979 (59.8)	819 (70.3)	859 (75.4)	<0.001
Osteoporosis, No. (%)	213 (12.8)	331 (17.2)	354 (23.2)	299 (26.8)	362 (35.9)	<0.001
Hip Fracture, No. (%)	49 (2.1)	72 (2.9)	97 (5.3)	73 (5.2)	88 (7.3)	<0.001

	Total Number of Symptoms					
Characteristic	**0**	**1**	**2**	**3**	**≥4**	***P* value**
Non-skin Cancer, No. (%)	263 (14.0)	316 (15.6)	297 (17.5)	211 (17.1)	218 (19.8)	<0.001
Pulmonary disease, No. (%)	80 (4.4)	183 (9.8)	251 (16.0)	261 (24.0)	379 (36.9)	<0.001
Heart disease/failure, No. (%)	152 (8.6)	269 (12.5)	311 (18.8)	293 (24.1)	386 (34.6)	<0.001
Myocardial Infarction, No. (%)	169 (8.7)	246 (10.8)	233 (14.6)	221 (17.1)	295 (26.4)	<0.001
Diabetes, No. (%)	313 (15.7)	459 (22.2)	404 (24.3)	328 (26.7)	421 (38.6)	<0.001
Hypertension, No. (%)	978 (52.2)	1310 (63.1)	1096 (65.3)	847 (72.4)	877 (76.4)	<0.001
Stroke, No. (%)	107 (4.9)	181 (7.8)	190 (10.1)	165 (12.7)	249 (21.0)	<0.001
Alzheimer's Disease, No. (%)	50 (1.9)	79 (3.0)	106 (4.6)	93 (5.7)	129 (10.2)	<0.001
Total No. Medical Conditions						<0.001
0	351 (21.6)	195 (10.6)	87 (6.3)	26 (2.7)	17 (1.7)	
1	510 (31.4)	415 (22.4)	268 (18.8)	119 (12.7)	54 (5.3)	
2	466 (25.1)	602 (30.2)	421 (26.4)	251 (22.9)	158 (15.5)	
3	275 (14.5)	458 (21.7)	414 (23.8)	302 (27.7)	250 (21.6)	
≥4	157 (7.4)	332 (15.2)	419 (24.7)	437 (34.0)	625 (55.8)	
Proxy Respondent, No. (%)	74 (3.3)	119 (4.5)	136 (6.2)	104 (6.7)	150 (11.8)	<0.001
Cognitive Score, Mean (SE)	12.2 (0.12)	11.7 (0.12)	11.2 (0.14)	11.2 (0.14)	9.8 (0.17)	<0.001

Table 3.

Longitudinal association of total number of symptoms at baseline with incidence of muscle weakness, gait speed <0.6 meters per second, and SPPB score <4 in community-dwelling adults 65 years and older, United States: National Health and Aging Trends Study, 2011–2017

	Number of Events (% Cumulative Incidence)	Model 1[a] Incidence Rate Ratio (95% CI)	Model 2[b] Incidence Rate Ratio (95% CI)	Model 3[c] Incidence Rate Ratio (95% CI)
Muscle weakness				
Total No. of Symptoms				
0	231 (15.0)	1.00	1.00	1.00
1	297 (19.5)	1.27 (1.02–1.58)	1.21 (0.98–1.50)	1.15 (0.95–1.41)
2	237 (22.9)	1.47 (1.18–1.85)	1.35 (1.08–1.69)	1.22 (0.99–1.49)
3	158 (23.8)	1.66 (1.34–2.06)	1.44 (1.14–1.82)	1.32 (1.04–1.69)
≥4	117 (25.1)	1.86 (1.34–2.58)	1.56 (1.10–2.21)	1.35 (1.02–1.78)
Gait speed < 0.6 m/s				
Total No. of Symptoms				
0	223 (12.9)	1.00	1.00	1.00
1	295 (17.9)	1.44 (1.15–1.80)	1.27 (0.98–1.64)	1.24 (0.96–1.59)
2	265 (24.2)	1.83 (1.47–2.28)	1.42 (1.11–1.82)	1.35 (1.05–1.73)
3	177 (25.7)	2.00 (1.53–2.61)	1.37 (1.04–1.82)	1.21 (0.92–1.60)
≥4	149 (34.3)	3.21 (2.55–4.03)	2.08 (1.59–2.72)	1.80 (1.39–2.34)
SPPB score < 4				
Total No. of Symptoms				
0	165 (8.8)	1.00	1.00	1.00
1	258 (13.0)	1.70 (1.33–2.19)	1.53 (1.18–1.97)	1.28 (1.00–1.63)
2	227 (16.8)	2.20 (1.70–2.85)	1.77 (1.34–2.32)	1.35 (1.04–1.75)
3	195 (23.4)	2.98 (2.27–3.90)	2.11 (1.62–2.75)	1.49 (1.18–1.88)
≥4	167 (28.8)	4.44 (3.38–5.82)	2.96 (2.16–4.06)	1.85 (1.37–2.51)

[a]Model 1 adjusted for age, sex, race/ethnicity, education level, and proxy response status

[b]Model 2 additionally adjusts for BMI, smoking history, exercise, arthritis, osteoporosis, hip fracture, non-skin cancer, pulmonary disease, heart disease/failure, myocardial infarction, diabetes, hypertension, stroke, dementia, total number of medical conditions, and cognitive function

[c]Model 3 additionally adjusts for the baseline level of physical performance for the item being tested (grip strength, gait speed, or SPPB)

Table 4.

Longitudinal association of total number of symptoms at baseline with incidence of recurrent falls, overnight hospitalization, disability in basic ADLs, nursing home admission, and mortality in community-dwelling adults 65 years and older, United States: National Health and Aging Trends Study, 2011–2017

	Number of Events (% Cumulative Incidence)	Model 1[a] Incidence Rate Ratio (95% CI)	Model 2[b] Incidence Rate Ratio (95% CI)
Recurrent falls (≥2 per year)			
Total No. of Symptoms			
0	442 (22.8)	1.00	1.00
1	664 (34.0)	1.56 (1.36–1.80)	1.48 (1.30–1.70)
2	604 (40.6)	1.76 (1.53–2.04)	1.54 (1.32–1.80)
3	425 (45.2)	2.22 (1.81–2.73)	1.90 (1.55–2.32)
≥4	397 (53.0)	3.12 (2.66–3.67)	2.38 (2.00–2.83)
Hospitalization			
Total No. of Symptoms			
0	472 (29.8)	1.00	1.00
1	627 (37.9)	1.50 (1.27–1.76)	1.39 (1.19–1.62)
2	535 (43.4)	1.67 (1.49–1.88)	1.46 (1.29–1.65)
3	376 (45.6)	2.09 (1.74–2.50)	1.68 (1.42–2.01)
≥4	293 (45.1)	2.67 (2.28–3.12)	1.99 (1.69–2.35)
Disability in basic ADLs			
Total No. of Symptoms			
0	306 (14.7)	1.00	1.00
1	481 (21.7)	1.48 (1.24–1.77)	1.40 (1.21–1.63)
2	419 (26.6)	1.77 (1.52–2.06)	1.46 (1.24–1.72)
3	356 (36.3)	2.42 (1.99–2.94)	1.85 (1.50–2.28)
≥4	286 (39.1)	3.20 (2.61–3.93)	2.20 (1.78–2.73)
Nursing home admission			
Total No. of Symptoms			
0	89 (3.5)	1.00	1.00
1	137 (5.1)	1.28 (0.83–1.98)	1.30 (0.80–2.10)
2	126 (6.5)	1.31 (0.87–1.99)	1.32 (0.84–2.05)
3	105 (7.4)	1.44 (0.94–2.20)	1.41 (0.84–2.37)
≥4	126 (10.3)	1.80 (1.24–2.59)	1.62 (1.04–2.54)
Mortality			
Total No. of Symptoms			
0	255 (10.3)	1.00	1.00
1	411 (16.2)	1.42 (1.21–1.66)	1.25 (1.09–1.44)
2	439 (20.9)	1.68 (1.40–2.03)	1.34 (1.12–1.60)
3	326 (24.5)	1.96 (1.65–2.34)	1.51 (1.29–1.76)
≥4	385 (30.7)	2.36 (1.94–2.87)	1.56 (1.30–1.86)

[a]Model 1 adjusted for age, sex, race/ethnicity, education level, and proxy response status

[b]Model 2 additionally adjusts for BMI, smoking history, exercise, arthritis, osteoporosis, hip fracture, non-skin cancer, pulmonary disease, heart disease/failure, myocardial infarction, diabetes, hypertension, stroke, dementia, total number of medical conditions, and cognitive function