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Impact of Sensory Impairments on Functional Disability in Adults With Arthritis

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Abstract

Introduction—Mobility is reduced in people with sensory impairments and those with arthritis. The joint impact of these conditions may be underappreciated. This study examines the associations between impairments in vision, hearing, and balance and functional ability in adults with versus without arthritis.

Methods—Using National Health and Nutrition Examination Survey data from 1999–2004, arthritis status, functional ability, and sensory impairments (vision, hearing, and balance) were assessed from self-reported responses by 6,654 individuals aged ≥50 years (mean age, 63.4 years; 46.3% male). Multivariable regression analyses, conducted in 2014, assessed the associations between sensory impairment and arthritis on functional ability and mobility.

Results—Among study participants, 41.8% reported having arthritis; of these, 27.1%, 44.9%, and 35.1% reported impaired vision, hearing, or balance, respectively. Having multiple sensory impairments was significantly associated with reduced functional ability in people with arthritis; individuals with three sensory impairments reported the highest levels of disability for all functional domains (compared with no impairment; lower extremity mobility, 80.2% vs 39.1%; general physical activities, 94.7% vs 75.9%; activities of daily living, 69.7% vs 27.2%; instrumental activities of daily living, 77.2% vs 37.4%; leisure and social activities, 66.3% vs 30.6%; impaired gait speed, 48.1% vs 16.3%; all $p < 0.001$). Importantly, visual deficits, in combination with arthritis, had the greatest impact on mobility, with odds of impaired mobility at least twice as high as for individuals without arthritis.

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Conclusions—Addressing sensory deficits, especially difficulties with vision, may improve functional ability, which may be particularly helpful for adults with arthritis.

Introduction

Sensory impairments (SIs), specifically deficits in vision, hearing, and balance, are common in old age, influencing health and quality of life.¹ SIs have been associated with other adverse chronic health conditions, as well as reduced physical function.¹⁻¹⁰ Individuals with functional disabilities suffer greater morbidity and utilize more healthcare services than individuals without disabilities.¹¹⁻¹³

As a leading cause of disability, arthritis is a chronic condition estimated to affect more than 50% of people aged 65 years or older in the U.S.,^{14,15} many of whom experience progressive and severe functional limitations.¹⁵⁻¹⁹ SI²⁻⁶ and arthritis¹⁵⁻¹⁹ have each been independently associated with increased functional disability and impaired mobility. Additionally, individuals with arthritis tend to exhibit greater SI than individuals without arthritis,²⁰⁻²² but there has been no study to address whether associations, if any, exist between specific sensory deficits and functional ability in people with arthritis.

The National Health and Nutrition Examination Survey (NHANES) provides an opportunity to investigate how common age-related conditions interact and impact on functional ability. Data from the 1999–2004 surveys were used to examine the impact of SIs (vision, hearing, and balance) on functional ability in adults with and without arthritis.

Methods

Study Design

The NHANES, conducted by the National Center for Health Statistics, CDC, utilizes a complex, stratified, multistage probability survey design to obtain a representative sample of the non-institutionalized, civilian population of the U.S. (www.cdc.gov/nchs/nhanes.htm). Adhering to the Tenets of the Helsinki Declaration, all study participants provided written informed consent. The survey includes household interviews, physical examinations, and laboratory specimen collection. Sample weights are used to generate population estimates that adjust for the differential selection resulting from oversampling of target groups (e.g., older adults, African Americans, and Hispanic Americans), lack of coverage, and non-response.

During the 1999–2004 surveys, 6,776 individuals aged ≥ 50 years participated in NHANES. Individuals who did not respond to questions about the presence of arthritis or vision, hearing, or balance impairments were excluded, leaving 6,654 participants for the current study.

Measures

Self-reported, doctor-diagnosed disease status was determined from responses to the question: Has a doctor or other health professional ever told you that you had arthritis? Use

of self-report for arthritis case definition has been previously validated for public health surveillance purposes.²³

To assess vision impairment, participants were asked to rate their vision with glasses or contact lenses, if any, as excellent, good, fair, poor, or very poor. Respondents were then classified as not impaired (excellent or good) or impaired (fair, poor, or very poor). For hearing impairment, participants were asked to describe their hearing without hearing aids as good, a little trouble, a lot of trouble, or deaf. Respondents were then classified as not impaired (good) or impaired (a little trouble or worse). Balance impairment was determined from the participant's response to the question: In the past 12 months, have you had dizziness, difficulty with balance, or difficulty with falling? Participants who gave affirmative responses were classified as having balance impairment; otherwise, they were classified as having no impairment.

Functional disability was evaluated using data from interviews and medical examinations. Participants were asked 19 questions designed to assess an individual's ability to perform routine functional tasks without the use of any special equipment.²⁴ For each task, the participant could respond *no difficulty*, *some difficulty*, *much difficulty*, or *unable to do*. The tasks were grouped into five functional domains based on published definitions^{13,25}: lower extremity mobility (walking 0.25 miles, walking up ten steps), general physical activities (stooping/crouching/kneeling, standing for 2 hours, sitting for 2 hours, standing up from an armless chair, reaching overhead, grasping/holding small objects, lifting or carrying 10 pounds), activities of daily living (eating, dressing, getting out of bed, walking between rooms on the same floor), instrumental activities of daily living (managing money, doing household chores, preparing meals), and leisure and social activities (going to movies/shopping/events, doing leisure activities at home, participating in social activities). Functional disability was defined as having any difficulty performing one or more tasks within a functional domain.^{13,25}

Participants were also asked to walk 20 feet at their usual pace while certified health technicians measured the time it took to complete the walk. Gait speed, calculated in m/second and categorized as normal (>0.8 m/second) or impaired (≤ 0.8 m/second), was only assessed during the 1999–2002 surveys, and was available from 3,902 participants, of whom 1,650 had arthritis.

Age, sex, race/ethnicity, education, smoking status, alcohol use, and medical history, collected from self-reported responses to questionnaires, were considered as possible confounding variables in multivariable analyses. Race/ethnicity was categorized as non-Hispanic white, non-Hispanic black, Mexican American, or other. Education was dichotomized as less than college (including high school graduate or less) or at least some college. Smoking status was categorized as never, former, or current smoker. Alcohol use was classified as never; past use (at least 12 drinks in their lifetime but none in the past year); current use, light (one drink per day or less, on average, in the past year); and current use, moderate/heavy (more than one drink per day, on average, in the past year). BMI was calculated as weight (kg) divided by height squared (m²), categorized as normal (<25 kg/m²), overweight (25–29 kg/m²), or obese (≥ 30 kg/m²) based on CDC criteria.²⁶ Blood

pressure was defined as the average of three systolic and diastolic measurements taken while seated. Hypertension was defined as a self-reported history of hypertension, use of antihypertensive medications, or blood pressure $\geq 140/90$ mmHg during the medical examination. Diabetes, congestive heart failure, and stroke (yes or no) were determined from self-reported responses to questions asking if a doctor or health professional ever told them that they had the condition. Peripheral neuropathy was categorized as none, mild, or severe based upon the number of insensate sites observed by certified health technicians during the medical examination.²⁷

Statistical Analysis

All analyses were conducted in 2014 using SAS, version 9.3, with PROC SURVEY and the Taylor series (linearization) method to estimate sample variance, following National Center for Health Statistics guidelines.²⁸⁻³⁰

Differences in participant characteristics and functional ability by arthritis status were compared using logistic regression models, adjusted for age and sex. Following determination of vision, hearing, and balance impairments, the number of impairments (ranging from no impairment to a maximum of three impairments) was calculated for each participant. Results were presented as weighted percentages with 95% CIs, ORs, and *p*-values. Interactions between SI and arthritis on functional ability were formally tested. Where noted, weighted percentages with 95% CIs have been age- and sex-standardized based on the 2000 U.S. Census population using sex and age (categorized as 50–59, 60–69, and ≥ 70 years) in order to reduce the impact of age and sex on estimates. Multivariable logistic regression models calculating odds of functional ability by SI for participants with arthritis compared with those without arthritis status were completed. Covariates, age, sex, race/ethnicity, education, smoking status, alcohol use, BMI, hypertension, diabetes, self-reported history of congestive heart failure or stroke, and hearing aid use, significant in either bivariate analyses for arthritis status or SI, were retained in all multivariable models. Two-sided tests at the 95% confidence level were employed.

Results

Among 6,654 individuals aged ≥ 50 years who participated in NHANES from 1999 to 2004, 41.8% self-reported having arthritis. Compared with people without arthritis, individuals with arthritis were more likely to be female (61.8% vs 47.9%, $p < 0.001$), older (mean age, 68.8 years vs 65.6 years; $p < 0.001$), non-Hispanic white or black, less educated, former smokers, alcohol users, and to have hypertension or diabetes, a self-reported history of congestive heart failure or stroke, a higher BMI, and vision, hearing, and balance impairments (Appendix Table 1). Impaired vision, hearing or balance was reported by 27.1%, 44.9%, and 35.1% of individuals with arthritis compared with 17.3%, 33.8%, and 20.6% without arthritis ($p < 0.001$ for each). Adults with arthritis were also significantly more likely to report difficulty completing tasks in each functional domain compared with adults without arthritis (general physical activities [with vs without arthritis], 84.0% vs 59.2%), lower extremity mobility (51.1% vs 30.3%), instrumental activities of daily living (50.1% vs

28.9%), activities of daily living (43.5% vs 21.7%), and leisure and social activities (39.8% vs 20.7%) ($p<0.001$ for each, Table 1).

Among individuals with arthritis, 36.9%, 23.1%, and 8.1% had one, two, or three SIs, respectively (Table 1). As the number of sensory deficits increased, participants reported greater difficulty in performing tasks in all functional domains, and adults with arthritis, compared with those without arthritis, expressed higher rates of difficulty for each level of SI (Table 1). In formal tests, the interaction between the number of SIs and arthritis status was statistically significant for all functional domains (p -interaction <0.001 , results not shown), and as a result, all subsequent analyses were stratified. When compared with people without arthritis but the same level of SI, individuals with arthritis exhibited higher odds of disability (Figure 1).

Impaired gait speed was also considerably more common in adults with arthritis compared with adults without arthritis (25.4% vs 15.2%, $p<0.001$) (Table 1). Gait speed impairment was significantly higher in adults with arthritis compared with adults with the same number of SIs but no arthritis (for one, two, or three impairments, respectively, 22.5%, 34.1%, and 48.1% with arthritis vs 14.2%, 21.7%, and 31.3% without arthritis). Additionally, though the number of SIs was associated with impaired gait speed in both adults with and without arthritis, the likelihood of impairment was greater in individuals with arthritis (Table 2). Among individuals with two or three SIs, individuals with arthritis had odds of impaired gait speed of 1.89 (95% CI=1.25, 2.83, $p=0.002$) and 2.10 (95% CI=1.08, 4.09, $p=0.030$), respectively, after multivariable adjustment, when compared with individuals without arthritis but with the same SIs (Figure 1). This was true for both men and women (data not shown).

For specific SIs, visual deficits, in combination with arthritis, had the greatest impact on gait speed (Table 3, Appendix Figure 1). Individuals with arthritis and vision impairment only, vision and hearing impairments, vision and balance impairments, or all three (vision, hearing, and balance) impairments exhibited odds of impaired gait speed at least twice as high as individuals without arthritis and the same impairments (all $p<0.05$). Among older adults whose only SI was hearing impairment, individuals with arthritis were also significantly more likely to experience reduced gait speed than those without arthritis ($p=0.019$); however, having balance impairment alone or balance and hearing impairments combined did not increase the odds of impaired gait speed in individuals with arthritis compared to those without arthritis.

Analyses utilizing hypertension or self-reported cancer status instead of self-reported arthritis were completed to determine whether the associations described above were specific to arthritis or applicable to any common chronic medical condition (Appendix Figure 2). Individuals with hypertension or cancer reported less SI than did participants with arthritis (37.6%, 36.8% and 32.0% had no SI, respectively), and given the same level of SI, individuals with hypertension or cancer were not consistently more likely to experience functional disability or impaired mobility than individuals without hypertension or cancer.

Discussion

Adults with arthritis were significantly more likely to report vision, hearing, and balance impairments than participants without arthritis in this representative sample of U.S. adults, even after adjustment for possible confounders. Though an increasing number of SIs was associated with decreased functional ability and impaired mobility overall, adults with arthritis and concomitant SIs had the greatest difficulty, specifically individuals with visual deficits.

Although the current study relies heavily on self-report without any data to validate clinically or detail the etiology of SIs, most adults have sufficient health literacy to self-report a limitation even if they cannot ascribe a definitive diagnosis,^{31,32} and the study results corroborate earlier research.²⁻¹⁰ In a longitudinal study of older adults,³ participants with vision impairment had significantly decreased mobility, defined by walking speed. Similarly, hearing impairment was independently associated with greater disability and functional limitations in older participants of NHANES.⁴ A study on knee extension strength and standing balance found that impairment was a predictor of severe walking disability and increased dependence.⁶ Crews and Campbell¹⁰ found that not only were individual sensory deficits associated with poorer physical function but there was also a graded pattern to reports of functional disability: Individuals with only hearing loss experienced a decline in health and activity levels whereas individuals with only vision impairment experienced even worse decline and the greatest reductions in health and functional abilities were found in individuals with concurrent vision and hearing impairments. The current study builds on these earlier findings by considering multiple SIs and demonstrating that adults with arthritis and at least one SI experience greater difficulties—worsening with increasing number of SIs—with functional tasks and mobility compared with those unimpaired or those without arthritis.

Disease traits typical in arthritis, including tissue inflammation and structural joint damage, are known to affect functional ability and mobility.^{16,17} In the U.S., more than one third of adults with arthritis aged 45 years or older reported no physical activity despite its known benefits to reduce pain and disability and improve general health.¹⁸ Yet, although there has been research on the relationships between individual SIs or arthritis, separately, with health or functional ability, to the authors' knowledge, there are no studies that have examined functional ability and mobility when arthritis and SIs present concomitantly. The current study examines this scenario, finding that higher numbers of SIs were present in older adults with arthritis and that the impact of an increasing number of SIs on disability was greater in people with arthritis compared with those without arthritis. Analyses utilizing hypertension or self-reported cancer instead of arthritis provided evidence demonstrating that the association between SI and functional impairment is not common to all chronic conditions. Therefore, this research broadens current understanding of the interaction between these age-related conditions and suggests that inquiring about SI, though potentially important for all adults, may be especially important for those with arthritis.

Visual deficits, alone and in combination with other SIs, were found to have the most significant impact on mobility, in spite of its lower prevalence. Because participants were

not asked to elaborate on what visual symptoms they experienced, it is not possible to expound on how visual difficulty was characterized. The reasons for the effects of arthritis with visual symptoms are also unknown but may be, at least in part, associated with inflammation, which is commonly seen in arthritis and increasingly recognized in other conditions.³³⁻³⁵ Another possibility is that arthritis with concomitant visual impairment reflects frailty,³⁶ which itself is associated with reduced physical activity and greater disability across multiple health domains, particularly cardiovascular disease.³⁷⁻³⁹ Although concomitant ocular disease is not noted to occur commonly in people with arthritis, those with inflammatory ocular diseases such as keratoconjunctivitis sicca (dry eye syndrome), scleritis, uveitis, and retinal vasculitis are frequently noted to have arthritis.⁴⁰⁻⁴⁵ Research characterizing these eye disorders in individuals with arthritis suggests that the presence of the rheumatic disease may predate the eye disorder,^{40,41} but that the severity of both conditions is greater when ocular disease and arthritis presented concurrently.⁴²⁻⁴⁵ To the authors' knowledge, there are no studies examining the concomitance of age-related eye diseases with arthritis, but there is growing recognition that common eye diseases, such as glaucoma and age-related macular degeneration, have an inflammatory component.^{46,47}

Balance impairment, in the absence of vision loss, was not more likely to be associated with impaired gait speed in participants with arthritis compared to those without arthritis. That is, though balance impairment, which included history of falls, negatively impacted on mobility, it was not particularly more detrimental in adults with arthritis. This may be partly due to an understanding and willingness of healthcare professionals to address issues related to impaired balance (e.g., structural damage to joints) as part of the management of the patient's arthritis.

Strengths of the current study include a large sample with a substantial number of cases of arthritis that allows for statistical analysis of small, but important, differences, a wide array of variables available to reduce potential confounding, and a study design that facilitates the generalizability of the results to the non-institutionalized, civilian U.S. population aged 50 years or older. Limitations include the use of self-report and inability to validate with any specific clinical diagnosis, lack of information on arthritis type, data on gait speed available for only two survey periods, and no data available on treatment for arthritis, SI, or functional ability.

Conclusions

Individuals with arthritis self-report more SIs than adults without arthritis (and also more SIs than those with hypertension or cancer). Additionally, SIs in people with arthritis are significantly more likely to be associated with reduced physical functioning compared with adults without arthritis. These results suggest it would be worthwhile to ask arthritis patients about any SIs and refer for evaluation those reporting symptoms. Conceptually, it seems reasonable to expect that addressing, for example, a visual impairment to improve sight would likely have some positive impact on physical ability and, likewise, improving hearing should increase socialization and also promote physical activity, which confers additional health benefits, likely including cardiovascular disease prevention. However, additional

research will be required to determine whether addressing SI, specifically in arthritis patients, has any positive effect on functional ability.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1.

AORs comparing functional domains for participants with versus without arthritis for each level of sensory impairment, NHANES 1999-2004.

Table 1

Percentage with Functional Disability by Arthritis Status and Number of Sensory Impairments, NHANES 1999-2004

	Lower-extremity mobility Weighted % (95% CI) ^b	General physical activity Weighted % (95% CI) ^b	Activities of daily living Weighted % (95% CI) ^b	Instrumental activities of daily living Weighted % (95% CI) ^b	Leisure and social activities Weighted % (95% CI) ^b	Impaired gait speed^a Weighted % (95% CI) ^b
No arthritis (N=3,749)	30.3 (26.9, 33.8)	59.2 (56.0, 62.4)	21.7 (19.3, 24.1)	28.9 (25.2, 32.5)	20.7 (17.6, 23.8)	15.2 (13.3, 17.1)
No sensory impairments (46.7%, N=1,589)	22.4 (16.9, 27.9)	46.5 (40.7, 52.2)	11.2 (7.1, 15.3)	22.6 (16.3, 28.9)	14.3 (9.0, 19.5)	10.5 (8.1, 13.0)
Any one sensory impairment (35.4%, N=1,354)	31.5 (26.3, 36.6)	58.5 (53.0, 64.0)	20.1 (15.4, 24.8)	26.5 (21.2, 31.9)	19.0 (14.3, 23.8)	14.2 (11.5, 17.0)
Any two sensory impairments (14.3%, N=629)	39.6 (30.8, 48.3)	79.0 (74.8, 83.1)	36.5 (29.2, 43.9)	39.7 (32.2, 47.1)	31.6 (24.6, 38.6)	21.7 (16.0, 27.5)
All three sensory impairments (3.6%, N=177)	59.6 (46.0, 73.1)	91.1 (86.4, 95.9)	50.5 (39.0, 62.0)	51.2 (41.1, 61.3)	41.3 (30.7, 52.0)	31.3 (24.6, 38.1)
Arthritis (N=2,905)	51.1 (46.2, 56.1)	84.0 (82.3, 85.7)	43.5 (40.0, 47.0)	50.1 (47.2, 53.0)	39.8 (36.3, 43.4)	25.4 (22.7, 28.1)
No sensory impairments (32.0%, N=836)	39.1 (31.0, 47.2)	75.9 (72.1, 79.6)	27.2 (20.3, 34.0)	37.4 (31.8, 43.1)	30.6 (23.6, 37.6)	16.3 (12.4, 20.2)
Any one sensory impairment (36.9%, N=1,101)	46.6 (38.4, 54.9)	84.4 (81.2, 87.6)	42.9 (38.2, 47.5)	47.7 (42.5, 53.0)	35.0 (28.9, 41.1)	22.5 (19.1, 25.9)
Any two sensory impairments (23.1%, N=696)	61.7 (55.3, 68.1)	88.6 (84.9, 92.3)	52.4 (46.1, 58.8)	58.0 (53.0, 63.0)	47.5 (41.2, 53.8)	34.1 (30.4, 37.8)
All three sensory impairments (8.1%, N=272)	80.2 (75.0, 85.5)	94.7 (92.0, 97.3)	69.7 (61.8, 77.6)	77.2 (71.1, 83.4)	66.3 (58.4, 74.2)	48.1 (36.5, 59.7)

NHANES, National Health and Nutrition Examination Survey; N, represents the exact number of participants in the survey.

^a Gait Speed 0.8 m/s; data only available through 2002.

^b Results are presented as age- and sex-adjusted weighted percentage (95% CI); standardization was based on the 2000 U.S. Census population using sex and age (categorized as 50-59, 60-69, and 70+ years).

Table 2

Multivariate Analyses of Functional Disability by Arthritis Status and Number of Sensory Impairments, NHANES 1999-2004

	Lower-extremity mobility OR (95% CI) ^b	General physical activity OR (95% CI) ^b	Activities of daily living OR (95% CI) ^b	Instrumental activities of daily living OR (95% CI) ^b	Leisure and social activities OR (95% CI) ^b	Impaired Gait Speed ^a OR (95% CI) ^b
No arthritis						
No sensory impairments	1 [reference]	1 [reference]	1 [reference]	1 [reference]	1 [reference]	1 [reference]
Any one sensory impairment	2.07 (1.61, 2.66) p<0.001	1.97 (1.49, 2.61) p<0.001	2.31 (1.57, 3.39) p<0.001	1.87 (1.23, 2.86) p=0.004	2.30 (1.53, 3.46) p<0.001	1.32 (0.96, 1.81) p=0.086
Any two sensory impairments	3.62 (2.49, 5.27) p<0.001	4.52 (3.21, 6.36) p<0.001	5.45 (3.70, 8.02) p<0.001	3.77 (2.54, 5.61) p<0.001	5.27 (3.43, 8.11) p<0.001	1.91 (1.30, 2.80) p<0.001
All three sensory impairments	8.72 (4.36, 17.43) p<0.001	15.19 (8.68, 26.60) p<0.001	9.48 (5.32, 16.88) p<0.001	6.59 (3.40, 12.80) p<0.001	7.53 (3.88, 14.65) p<0.001	3.06 (1.83, 5.10) p<0.001
Arthritis						
No sensory impairments	2.69 (2.01, 3.60) p<0.001	3.83 (2.90, 5.05) p<0.001	3.69 (2.46, 5.52) p<0.001	2.84 (1.86, 4.32) p<0.001	3.78 (2.39, 5.97) p<0.001	1.84 (1.19, 2.86) p=0.007
Any one sensory impairment	4.50 (3.20, 6.34) p<0.001	6.54 (4.86, 8.80) p<0.001	5.87 (4.26, 8.09) p<0.001	4.40 (3.16, 6.12) p<0.001	5.37 (3.69, 7.82) p<0.001	2.22 (1.56, 3.17) p<0.001
Any two sensory impairments	8.01 (5.53, 11.60) p<0.001	12.22 (8.41, 17.75) p<0.001	10.39 (6.98, 15.48) p<0.001	8.15 (5.46, 12.16) p<0.001	8.91 (5.93, 13.38) p<0.001	3.60 (2.56, 5.07) p<0.001
All three sensory impairments	14.81 (8.82, 24.87) p<0.001	26.05 (16.26, 41.73) p<0.001	21.55 (12.75, 36.43) p<0.001	17.05 (9.97, 29.14) p<0.001	20.78 (12.47, 34.62) p<0.001	5.07 (3.11, 8.27) p<0.001

Note: Boldface indicates statistical significance ($p<0.05$).

^a Gait Speed = 0.8 m/s; data only available through 2002.

^b Model comparing odds of functional disability by arthritis status and number of sensory impairment, adjusted for age, sex, race/ethnicity, education, smoking status, alcohol use, medical history (hypertension, diabetes mellitus, self-reported history of congestive heart failure, self-reported history of stroke), body mass index, and hearing aids use.

Table 3

Impaired Gait Speed by Sensory Impairment for Participants With and Without Arthritis, NHANES 1999-2002

Sensory impairments	Arthritis vs. No arthritis			
	No arthritis* (58.0%) Weighted % (95% CI) ^a	Arthritis* (42.0%) Weighted % (95% CI) ^a	OR (95% CI) ^b	p-value
No sensory impairment (N=1,619)	10.5 (8.1, 13.0)	16.3 (12.4, 20.2)	1.86 (1.18, 2.93)	0.007
Vision impairment only (N=422)	18.8 (12.5, 25.0)	31.6 (23.8, 39.4)	3.31 (1.65, 6.63)	<0.001
Hearing impairment only (N=788)	10.1 (6.8, 13.4)	16.7 (12.5, 20.9)	1.86 (1.11, 3.14)	0.019
Balance impairment only (N=360)	21.9 (15.3, 28.4)	26.9 (19.4, 34.3)	1.06 (0.55, 2.05)	0.865
Vision and hearing impairment (N=316)	21.1 (14.0, 28.3)	31.8 (25.3, 38.4)	2.32 (1.18, 4.53)	0.014
Vision and balance impairment (N=241)	18.2 (12.2, 24.1)	46.7 (37.8, 55.7)	5.63 (1.78, 17.83)	0.003
Hearing and balance impairment (N=324)	26.9 (16.7, 37.2)	29.6 (23.1, 36.0)	1.15 (0.61, 2.16)	0.674
Vision, hearing, and balance impairment (N=311)	31.3 (24.6, 38.1)	48.1 (36.5, 59.7)	2.10 (1.08, 4.09)	0.030

Impaired gait speed 0.8 m/s; data only available through 2002.

NHANES, National Health and Nutrition Examination Survey; N, represents the exact number of participants in the survey.

Note: Boldface indicates statistical significance ($p < 0.05$).

^a Results are presented as age- and sex-adjusted weighted percentages (95% CI); standardization was based on the 2000 U.S. census population using sex and age (categorized as 50-59, 60-69, and 70+ years).

^b Model comparing odds of impaired gait speed for participants with arthritis versus without arthritis, adjusted for age, sex, race/ethnicity, education, smoking status, alcohol use, medical history (hypertension, diabetes mellitus, self-reported history of congestive heart failure, self-reported history of stroke), BMI, and hearing aids use.