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Nationwide Prevalence of Self-Reported Serious Sensory Impairments and Their Associations with Self-Reported Cognitive and Functional Difficulties

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Purpose: To estimate the nationwide prevalence of self-reported serious vision impairment (SVI), serious hearing impairment (SHI), and serious dual sensory impairment (DSI; i.e., concomitant SVI and SHI) and to characterize their associations with self-reported cognitive, independent living, self-care, and ambulatory difficulties.

Design: The American Community Survey (ACS) is a nationwide cross-sectional survey administered by the United States Census Bureau.

Participants: The 2011−2015 ACS sample contains data on 7 210 535 individuals 45 years of age or older.

Methods: Descriptive statistics for each of the 4 mutually exclusive sensory impairment categories no sensory impairment (NSI), SVI, SHI, and serious DSI were calculated using the weighted sample. Adjusted odds ratios using several logistic regressions were calculated using the unweighted sample to measure the magnitude of associations between sensory impairment status and the outcome difficulties.

Main Outcome Measures: Self-reported cognitive, independent living, self-care, and ambulatory difficulty.

Results: Among individuals 45 years of age or older, the estimated nationwide prevalence of self-reported SVI alone is 2.8%, that of SHI alone is 6.0%, and that of serious DSI is 1.6%. The prevalence of each sensory impairment increases with age. A greater proportion of American Indians or Alaskan Natives experience SVI (4.8%), SHI (8.5%), and serious DSI (3.7%) than any other race or ethnic group ($P < 0.001$). Individuals reporting serious DSI are more likely to report cognitive impairment, independent living difficulty, self-care difficulty, and difficulty ambulating than individuals with NSI across all age groups (all $P < 0.001$). Furthermore, serious DSI is associated with greater cognitive and functional difficulties than SVI or SHI alone, and SVI alone has a greater association with cognitive and functional difficulties than SHI alone.

Conclusions: The nationwide prevalence of self-reported serious sensory impairment increases with age and is distributed unequally among different racial and ethnic groups. Any sensory impairment is associated with greater cognitive and functional difficulties than NSI. Additionally, serious DSI is associated with greater difficulties than SVI or SHI alone, and SVI alone is more serious than SHI alone in each of the 4 cognitive and functional difficulties. *Ophthalmology 2017;■:1−10 © 2017 by the American Academy of Ophthalmology*

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Numerous studies have investigated the impact of combined visual impairment (VI) and hearing impairment (HI)—dual sensory impairment (DSI)—and its association with various outcomes using cross-sectional and longitudinal study designs. Compared with VI or HI alone, DSI is associated with higher all-cause mortality,[1] more motor vehicle collisions,[2] worse depressive symptoms,[3,4] decreased physical and mental health−related quality of life,[5,6] increased risk of falling,[7] and greater difficulty with activities of daily living and instrumental activities of daily living.[8−10] Additionally, a number of longitudinal studies present evidence that VI, HI, and DSI are independent predictors of cognitive decline,[11−14] although 1 study reported negative results.[15]

The literature indicates that this poorer functioning among individuals with DSI compared with those with VI or HI alone is greater among the oldest individuals. This is particularly concerning because 1 in 9 adults older than 80 years in the United States has DSI.[16]

In this article, we report the prevalence of DSI in the recently released 5-year American Community Survey (ACS) 2011−2015 Public Use Microdata Sample (PUMS) and explore the associations between sensory impairments and cognitive functioning, physical functioning, and activities of daily living among Americans. The ACS, administered and maintained by the United States Census Bureau, is a self-report survey, the results of which are used to allocate

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more than $400 billion annually through more than 180 federal domestic assistance programs.[17] The ACS collects a wide range of demographic and social information on a large, representative national sample and asks about VI, HI, and other difficulties.[18] To our knowledge, an analysis of ACS data examining the relationship between sensory impairments and cognitive and functional difficulties has not yet been performed.

Methods

Data and Collection

The ACS is a cross-sectional survey using a complex survey design of millions of mostly noninstitutionalized United States inhabitants. Data collection is an ongoing process, with data aggregated yearly and over several years to provide information on households and individuals from practically every United States Census tract.[18] Data collection methodology and interview questions for the ACS have progressed and improved since the ACS's conception and pilot phase in the 1990s to its full-scale implementation in 2005, and it undergoes frequent improvements with successive iterations.

The United States Census Bureau currently mails 295 000 surveys to addresses randomly selected across the United States each month, to which households can respond either via paper or online. After 6 weeks and several reminders (also mailed), non-responses are followed-up by phone calls from operators at Census Bureau call centers, with numerous attempts made at varying times during the day. A sample of households unable to be reached by phone is selected for Census Bureau field representatives to conduct in-person visits with accompanying interviews. This overall process includes in-person visits to individuals living in group housing, such as nursing homes, college dormitories, and prisons.[18] Strengths of the ACS include an average response rate of 95.5% from 2011 through 2015,[19,20] achieved in part because in contrast to the academic or private settings, United States residents are legally obligated to respond to the survey; oversampling of minority groups; and techniques to handle nonsampling error (i.e., coverage error, nonresponse error, measurement error, and processing error).[18]

One challenge when compiling ACS data is that within a completed survey, an individual may have left some survey questions unanswered. The United States Census Bureau handles this in 2 ways. Assignment takes place when an answer from 1 question logically informs the answer to an unanswered question. For example, an individual may respond to a detailed question regarding their type of present employment, but neglect to respond to the initial question about employment status. The United States Census Bureau then replaces the missing response with an answer indicating the fact that the individual is currently employed.[18] The second method of handling unanswered questions is termed *allocation* and uses a statistical algorithm to replace a missing response with an answer from what can be conceptualized as an appropriate control from the ACS pool of responses, matched by geographic area, age, gender, socioeconomic status, educational attainment, and numerous other factors. In our analysis, we include all data and present a table displaying the proportion of the sample that had allocated responses to the questions about sensory impairment. Failing to account for the process of allocation may lead readers of this article to underestimate the uncertainty within the data.[18,21]

The ACS also uses proxy reporting, where 1 individual in the household typically completes the survey for themselves and for the others living in the household. This includes filling out responses to the cognitive and functional difficulty items. The individual may be a spouse, a child, other family member, a caregiver, a friend, or someone with some other relationship with the person for whom they are proxy reporting.[18] In our analysis of the 2011−2015 ACS PUMS, we report how many and what proportion of individuals reported on their own behalf versus those whose information was submitted to the United States Census Bureau via proxy reporting within each sensory impairment category.

Sample

While data collection is ongoing, the ACS data are compiled and organized into 1-, 3-, and 5-year PUMSs. For our study, we used the most recent 5-year PUMS containing data from individuals collected between 2011 and 2015 that was released on January 19, 2017. We then restricted the sample to those 45 years of age and older so we could analyze only adults with VI, HI, or DSI, understanding that we could not be certain whether the individuals' sensory impairment(s) developed in childhood or adulthood. The ACS includes a generalized weight variable to facilitate weighted estimates,[18] which were used to calculate descriptive statistics (i.e., Table 1) so as to characterize the true United States population more accurately.

Cognitive and Physical Functioning Questions

The ACS contains 6 questions that capture an individual's self-reported sensory, cognitive, and physical functioning and difficulty with activities of daily life and are included in Figure 1. Individuals who answered "yes" to the sensory impairment questions in Figure 1A were considered to have serious impairment in that domain, that is, serious VI (SVI) or serious HI (SHI). The responses to these questions were used to generate 4 mutually exclusive sensory impairment categories: individuals with no sensory impairment (NSI), those with SVI only, those with SHI only, and those with serious DSI. Figure 1B displays those ACS questions relating to difficulty in the domains of cognition, independent living, self-care, and ambulation, which were the outcome measures of interest in our study (Table 2).

Data Analysis

Descriptive statistics using the weighted sample were used to show the differences between the 4 mutually exclusive sensory impairment categories (NSI, SVI alone, SHI alone, and serious DSI) by demographic (Table 1 and Fig 2) and functional (Fig 3) characteristics. Using TIGER/Line shapefiles (https://www.census.gov/geo/maps-data/data/tiger-line.html) from the United States Census Bureau,[22] county-level maps of the United States (excluding Hawaii and Alaska) prevalence of self-reported SVI and SHI were created (Figs S4 and S5, available at www.aaojournal.org). The counties were ranked and shaded by quartile. These county-level prevalence estimates are only surrogates for the SVI alone and SHI alone categories described in this article because the county-level estimates, although based on the same 2011 though 2015 sample, are not available at the individual level. Thus, the SVI prevalence estimate includes individuals who have SVI alone and serious DSI, and the SHI prevalence estimate includes individuals who have SHI alone and serious DSI.

Multivariate logistic regression modeling was used in the unweighted sample to estimate the adjusted odds ratio (aOR) for difficulties by varying sensory impairments across 3 age strata: 45 to 64 years, 65 to 79 years, and 80 years and older. To evaluate how each sensory impairment status compared with NSI, we calculated aORs for the cognitive and functional outcomes among