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Section: Original Research

Article Title: Sedentary Time in U.S. Older Adults Associated With Disability in Activities of Daily Living Independent of Physical Activity

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Running Head: Sedentary time and disability in U.S. older adults

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ABSTRACT

Background: The harmful relationship of sedentary behavior to health may reflect an exchange of sedentary activity for moderate-vigorous activity or sedentary behavior may be a separate risk factor. We examined whether time spent in sedentary behavior is related to disability in activities of daily living (ADL), independent of time spent in moderate-vigorous activity in older adults. **Methods:** The nationally representative 2003-2005 National Health and Nutrition Examinations Surveys (NHANES) included 2286 adults aged 60 years and older with accelerometer-assessed physical activity. The association between ADL task disability and the daily percentage of sedentary time was evaluated by multiple logistic regression. **Results:** This sample spent almost 9 hours/day being sedentary during waking hours and 3.6% reported ADL disability. The odds of ADL disability were 46% greater (odds ratio 1.46, 95% confidence interval: 1.07, 1.98) for each daily hour spent in sedentary behavior, adjusted for moderate-vigorous activity, socioeconomic, and health factors. **Conclusion:** These U.S. national data show a strong relationship between greater time spent in sedentary behavior and the presence of ADL disability, independent of time spent in moderate or vigorous activity. These findings support programs encouraging older adults to decrease sedentary behavior regardless of their engagement in moderate or vigorous activity.

Key words: accelerometer, aging, sedentary behavior, activities of daily living

Over 56 million Americans have disability [1]. Medical spending among older adults is related more strongly to the presence of disability than remaining life expectancy [2, 3]. Disability increases the risk of hospitalization and institutionalization and is a major public policy concern [1, 4]. Disability crosses all age, gender, and race groups and is a major public health concern [5] .

Participation in moderate-vigorous intensity physical activity is a low cost measure to improve health outcomes and reduce disability [6]. Despite important publicized benefits of physical activity [7-12, 13] , U.S. adults primarily engage in sedentary behavior (<1.5 metabolic equivalents) [14]. A sedentary lifestyle is associated with a variety of poor health outcomes, including increased incidence for diabetes, cardiovascular disease, and mortality [15-17]. Clinically, a sedentary lifestyle leads to increased biomarkers associated with obesity, diabetes, and cardiovascular disease [18, 19].

The relationship between sedentary behavior and poor health outcomes may reflect an exchange of sedentary time for moderate-vigorous physical activity or sedentary behavior may be an independent risk factor. This distinction is important because even a large daily dose of moderate-vigorous activity may not be sufficient to offset the adverse effects of a sedentary lifestyle. Studies evaluating this relationship are sparse because documenting sedentary and moderate-vigorous activity requires systematic, objective assessment of all daily physical activity engaged in by an individual.

Our objective was to 1) use nationally representative data among adults 60 years and older to evaluate the relationship between time spent in sedentary activity (based

on objective accelerometer monitoring) and disability in activities of daily living (ADL), and 2) determine if this relationship was independent of time spent in moderate-vigorous activity. ADL disability in this age group is of particular importance given the current context of a demographically aging society and an increased prevalence of disability among older adults [20, 21]. Determining if sedentary behavior is related to ADL disability independent of time spent in moderate-vigorous activity could support public policy and public health programs that target the reduction of sedentary behavior independent of policy and programs promoting regular physical activity.

Methods

Study Population

The National Health and Examination Surveys (NHANES) are cross-sectional nationally representative probability samples of the non-institutionalized US population. Surveys consist of household interviews and a physical examination. Data analyzed (2012) were drawn from 2003-4 and 2005-6 NHANES cycles, which included objective monitoring of physical activity using accelerometers [22]. The National Center for Health Statistics Research Ethics Review Board approved the survey protocols; written informed consent was obtained for all subjects [23].

There were 14,631 people aged 6 years and older who participated in the NHANES accelerometer studies of whom 2,910 were aged 60 or older. An older adult population (age≥60) was examined due to the infrequency of ADL disability cases among younger adults. For analysis purposes the final sample was restricted to participants with 4 or more valid days of accelerometer monitoring[24] (n=2,311) and

whose weight and height were measured at the clinical examination, bringing the final sample to 2,286 older adults.

Outcome Measures

***Disability*.** NHANES collected disability task information on ADL limitations. Disability in ADL tasks adheres to the Institute of Medicine's disability classification[25], defined as the inability to carry out self-care tasks at the personal level (e.g., dressing). ADL limitations represent severe disabilities and threaten the ability of an individual to live independently. Each question pertaining to ADL disability-related tasks, participants were asked, "By yourself and without using any special equipment, how much difficulty do you have [with the particular task]"? Participants reported having no difficulty, some difficulty, much difficulty, unable to do, or do not do this activity. Participants were considered to have ADL disability if they reported much difficulty, inability or did not do one or more self-care tasks: getting in and out of bed, eating, dressing, or walking. Unfortunately NHANES did not ask about bathing or toileting, leading to a slightly lower prevalence of observed ADL disability in older individuals relative to other surveys [21]. The NHANES walking question assessed walking from room to room on the same floor. Because some ADL instruments use a more conservative walking assessment (e.g., walk across a room) we performed sensitivity analyses omitting the walking item for ascertainment of ADL disability; analytic results were similar.

Physical activity and sedentary behavior measurement. Physical activity was monitored using the ActiGraph AM-7164 accelerometer. The monitor was attached to a belt strapped around the waist. Participants were instructed to wear the monitor for seven consecutive days over their right hip and to remove the monitor before going to

bed and during showers or other water activities. The monitors were returned to the NHANES contractor to download data, and check the monitor calibration [24] The uniaxial accelerometer output is an activity count, which is the weighted sum of the number of accelerations over a minute, where weights are proportional to the magnitude of acceleration. A sedentary minute and a moderate-vigorous minute are analytically identified by activity counts/minute of <100 and ≥2020 respectively [24]. Non-wear time was defined as intervals of at least 60 consecutive minutes of 0 counts with allowance for up to 2 consecutive minutes of counts between 0 and 100. A valid day of monitoring was defined as 10 or more wear hours.[24] To provide reliable physical activity estimates, we restricted analyses to participants with at least four valid days of accelerometer monitoring [24]. This study examined the average daily sedentary time (hours) and the daily percentage of time registering as sedentary during wear hours These continuous variables were averaged across the monitoring days. For simplicity, the terms waking hours and wear hours are used interchangeably.

Covariates. Covariates included socioeconomic factors and health characteristics. Socioeconomic factors were: self-reported age, sex, race/ethnicity (assessed by self-report and categorized as Hispanic, non-Hispanic black compared with non-Hispanic white/other), education, household income, health insurance. Most participants held health insurance through Medicare; some additionally held Medicaid. Therefore, health insurance was coded as insured through Medicaid, insured not through Medicaid, and not insured. Ten health characteristics included current smoking, average daily moderate-vigorous activity hours, and the presence of 8 chronic conditions. Descriptive analyses coded moderate-vigorous activity as meeting versus

not meeting aerobic physical activity guidelines (≥ 2.5 moderate-vigorous hours/week acquired in bouts ≥ 10 minutes) [11]. Chronic conditions were ascertained by asking whether a physician had ever told them they had any of 7 conditions: arthritis, pulmonary disease (chronic bronchitis, emphysema), diabetes, cardiovascular disease (congestive heart failure, coronary heart disease, heart attack), cancer, hypertension, or stroke. An 8th condition, obesity, was identified from body mass index (BMI) calculated as measured weight in kilograms divided by measured height in meters squared value ≥30.

Statistical Analysis

All analyses employed SAS 9.2 Software to account for the complex survey design and incorporate sample weights. Per suggested best practice with NHANES accelerometer data[35], sample weights were recalculated from the NHANES clinical examination sample weights to analytically address missing interview information and/or "nonresponse" related to incomplete accelerometer monitoring. Reweighting was conducted within age (60-64 years, 65-69 years, 70-74 years, 75-79 years, 80-84 years, and 85+ years), race/ethnicity, and gender strata [24]. Statistical testing conducted at a nominal five percent alpha level used the resulting sample weights.

Univariate testing of the relationship of ADL disability to socioeconomic and health characteristics used the Rao-Scott adjustment to the Chi-Square test for sample survey data.[26] Tree diagrams were used to show the relationship between ADL disability and sedentary time adjusted for age, moderate-vigorous physical activity, and total wear time in a logistic regression model. Odds ratios are stratified by each level of the socioeconomic factors and health characteristics to assess consistency of the

relationship across multiple subgroups. The relationship between proportion of sedentary time and ADL disability was examined using multiple logistic regression models adjusted for socioeconomic factors and health characteristics including health behavior and chronic illness. Multiple regression models were also adjusted for NHANES cohort (2003-04 versus 2005-06). Sedentary time analyses additionally controlled for waking hours, to account for variability in daily monitoring time. An odds ratio (OR) with associated 95% confidence interval (CI) excluding one indicated statistical significance.

Results

Over a seven day period, the average accelerometer monitoring time during waking hours of the 2286 participants aged 60 years or older was 14.0 hours/day. Average time spent in sedentary behavior during waking hours was 8.9 hours/day (63.4% reported being sedentary at least 9 hours per day).

Table 1 describes the sample and their profile of reported ADL disability, the average daily hours spent in sedentary behavior, and the average percentage daily sedentary time of total waking hours. The majority of the sample were aged 60-79, women, white/Other race/ethnicity, had high school or less education, household income $\geq$20k, were insured (non-Medicaid), non-smokers and did not meet aerobic physical activity guidelines. About 12% reported no chronic conditions, while arthritis (52%) hypertension (58%) and obesity (30%) were the most common chronic conditions reported.

ADL disability (Table 1) was significantly related to older age, female gender, lower education levels, low income, Medicaid health insurance coverage, or the presence of any chronic illness. Low ADL disability rates among the uninsured group (2%) likely reflect the large proportion of this group under age 65 (80%, data not shown). Although none of these associations was significant, higher sedentary behavior (both hours and %) was related to older age, male gender, non-Hispanic white/other or non-Hispanic black race/ethnicity, higher educational levels, lower household income, health insurance via Medicaid, smoking, not meeting physical activity guidelines, and the presence of any chronic illness.

The relationship between the presence of ADL disability and sedentary behaviors is shown in Figures 1 and 2 tree diagrams. Figure 1 shows the odds ratio for ADL disability for each additional hour/day spent in sedentary behavior, controlling for age, average daily moderate-vigorous time, and daily waking hours. Overall the odds for ADL disability was more than 50% greater (OR=1.52, 95% CI: 1.10, 2.10) for every one hour increase in sedentary time, independent of time spent in moderate-vigorous activity. This tree diagram shows a relationship between greater sedentary time and more frequent ADL disability (odds ratio greater than unity) independent of moderate-vigorous activity, for every stratification level of the socioeconomic or health characteristics. For many subgroups (women, non-Hispanic black race/ethnicity, low or higher education, non-Medicaid insured, nonsmokers, cancer), more time spent in sedentary behavior was associated with significantly greater odds for the presence of ADL disability, despite the low statistical power from small sample sizes. For example if two women of the same age engaged in identical moderate-vigorous hours, but one

spent an additional hour each day being sedentary, the odds of ADL disability would significantly increase by 60% (OR=1.60, 95% CI: 1.09, 2.33). The consistent and positive relationship between more hours spent in sedentary behavior and ADL disability across almost all stratifications (with the exception of the non-insured group) indicates effect modification is unlikely.

The Figure 2 tree diagram displays a similar positive relationship between the average daily percentage of sedentary time and the odds for ADL disability, independent of time spent in moderate-vigorous activity and age. Subgroup relationships shown are similar to Figure 1.

To investigate if sedentary behavior is an independent risk factor, we examined sedentary behavior odds ratios for the presence of ADL disability in multiple logistic regression analyses first adjusted for socioeconomic factors and then additionally adjusted for health characteristics including moderate-vigorous activity. Table 2 displays adjusted odds ratio related to each hour/day spent in sedentary behavior. Model 1 shows increasing sedentary behavior by one hour/day significantly increased odds (OR=1.56, 95% CI: 1.15, 2.11) of ADL disability after adjusting for socioeconomic factors and controlling for wear time. The relationship remained significant after additional adjustment for health behaviors (Model 2) and chronic illnesses (Model 3 OR=1.46, 95% CI: 1.07, 1.98). Importantly, the length of time spent in sedentary behavior is a significant risk factor for ADL disability independent of the time spent in moderate-vigorous activity. In the final model, the only health characteristics significantly related to the presence of ADL disability were stroke (OR=2.29, 95% CI: 1.34, 3.92), arthritis (OR=2.22, 95% CI: 1.14, 4.35), and diabetes (OR=1.94, 95% CI:

1.07, 3.52). These findings are mirrored in Table 3, where the daily percentage of sedentary time was associated with ADL disability. After controlling for socioeconomic and health characteristics, a 10% increase in daily sedentary time significantly increased the odds (OR=1.70, 95% CI: 1.10, 2.60) of ADL disability.

To investigate if sedentary behavior may be a stronger risk factor for some population subgroups, we conducted sensitivity analyses adding interactions for sedentary behavior with demographic factors to the Table 2 and Table 3 models. Positive and significant interactions with older age (70 or older) and African American race indicate a stronger relationship between sedentary behavior and disability for those population groups.

Discussion

Despite the known benefits of physical activity to promote health, older adults on average spent almost two thirds of their waking time being sedentary. Analyses of these nationally representative NHANES data from US adults age 60 or older show the presence of ADL disability is related to greater daily hours and a greater daily percentage of time being sedentary. The odds of ADL disability increased by approximately 50% for each additional sedentary hour per day. This relationship held within subgroups of individuals with and without recognized risk factors for disability. Significant interactions of sedentary behavior with older age (age 70 or older) and African American race suggest sedentary behavior may be a particularly strong risk factor for those subgroups. Importantly, independent of time spent in moderate-vigorous activity, the presence of ADL disability was significantly associated with daily

sedentary hours (OR/hour =1.46, 95% CI: 1.07, 1.98) and the sedentary percentage of daily waking hours (OR/10% increase =1.70, 95% CI: 1.10, 2.75).

Sedentary behavior, such as sitting, is problematic and costly. A sedentary lifestyle has long been associated with premature mortality; recently this relationship was shown to be independent of moderate-vigorous activity [27]. As many as 5.3 million deaths worldwide are related to insufficient physical activity each year [28]. The increasing prevalence of sedentary lifestyles leads to increased healthcare costs [29]. Clinically, a sedentary lifestyle contributes to markers of poor health including poor 2-hour plasma glucose levels and suppressed skeletal muscle lipoprotein lipase.[15, 18, 30-33] Animal studies show sedentary behavior produces distinct biological effects from low activity levels, including alterations in the expression of genes regulating lipoprotein lipase, plasma triglyceride levels, and cholesterol metabolism [31]. It follows sedentary behavior may not only exacerbate health consequences from lack of sufficient physical activity, but it may contribute additional and independent harmful health consequences.

This study contributes substantially to the literature. To our knowledge, it is the first study which documents objectively measured time spent in sedentary behavior is related to the presence of ADL disability and this relationship is independent of time spent in moderate-vigorous activity. While prior studies showed greater self-reported physical activity is related to less disability, the role of sedentary behavior was not assessed [34, 35]. The strong demonstrated relationship between ADL disability and sedentary behavior suggests the importance of considering clinical, policy, and programmatic strategies to reduce sedentary behavior among older adults, particularly those with disabilities.

Moderate-vigorous activity was not significantly related to ADL disability when sedentary time was in the model. This finding indicates ADL disability is more strongly related to sedentary activity than moderate-vigorous activity. The independent relationship of sedentary time to ADL disability extends recent findings demonstrating objectively measured sedentary time, controlled for moderate-vigorous physical activity, was related to metabolic syndrome[27], depression[36], cancer[37], and mortality[17]. The present findings demonstrate sedentary behavior is a distinct concept from insufficient moderate-vigorous activity. The separate and independent relationship of sedentary behavior to disability is important because this establishes sedentary behavior as an additional modifiable risk factor to reduce disability, which threatens personal independence. Among some older adults reducing sedentary behavior may be a more attainable goal than increasing moderate-vigorous activity, particularly in persons with chronic illness, pain, and those with pre-existing disabilities.

While substantial research has evaluated interventions to increase physical activity among older adults, few studies focused on reducing sedentary time in this population [38]. A recent study showed promise in reducing sedentary time among older adults via a brief counseling strategy. Gardiner and colleagues[39] conducted a single face-to-face counseling session followed by a tailored mailing. This intervention significantly reduced sedentary time and increased the frequency of breaks in sedentary time per day. Due to the high burden of multiple chronic diseases and their association with both sedentary time and ADL disability among older adults reported here, counseling during medical encounters may be an excellent way to reach this population. However, Shuval and colleagues[40] found only 10% of older primary care patients

received counseling to reduce sedentary time (compared to 53% counseled to increase general physical activity) and none received a written plan. Interventions aimed at reducing sedentary time should target common sedentary behaviors reported by older adults such as talking on the phone, watching television, reading, and listening to the radio [41]. Sedentary social activities were especially prevalent among women, a subgroup which may warrant special attention [42]. This finding suggests one strategy may be to offer physical activity classes before or after social programs (book clubs, quilting groups, bingo, etc.). Replacing just 30 minutes per day of sedentary time with equal amounts of light activity has been associated with better physical health[43] suggesting there may be substantial benefit to small changes in sedentary time for older adults and future research in this area is critically needed.

Limitations

While an important strength of these data is the objective measurement of sedentary activity using accelerometers, it is recognized accelerometers are not sensitive to detect all activities such as cycling or upper body movement and accelerometers were not worn during water activities such as swimming. Limitations include the cross sectional study design, not capturing all ADLs and the fact causation cannot be inferred from these cross-sectional data. Future studies are needed which are longitudinal and address different types of disability (e.g., work disability).

Conclusions

In summary, this study based on a nationally representative sample demonstrates a strong relationship between sedentary behavior and ADL disability in

older adults, regardless of their participation in moderate-vigorous physical activity. These findings are evidence sedentary behavior is a separate disability risk factor as opposed to a mere synonym for inadequate physical activity. Programs to encourage reducing sedentary behavior as a means to improve health outcomes in addition to interventions to increase moderate-vigorous activity may expand the effectiveness of future public health initiatives to improve health outcomes.

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Figure 1. Adjusted odds ratio for disability in activities of daily living (ADL) per additional hour of average sedentary time, by socioeconomic and health characteristics, NHANES 2003-2006 (n=2286 adults). Odds ratio per daily sedentary hour adjusted for age, moderate-vigorous activity, and wear time

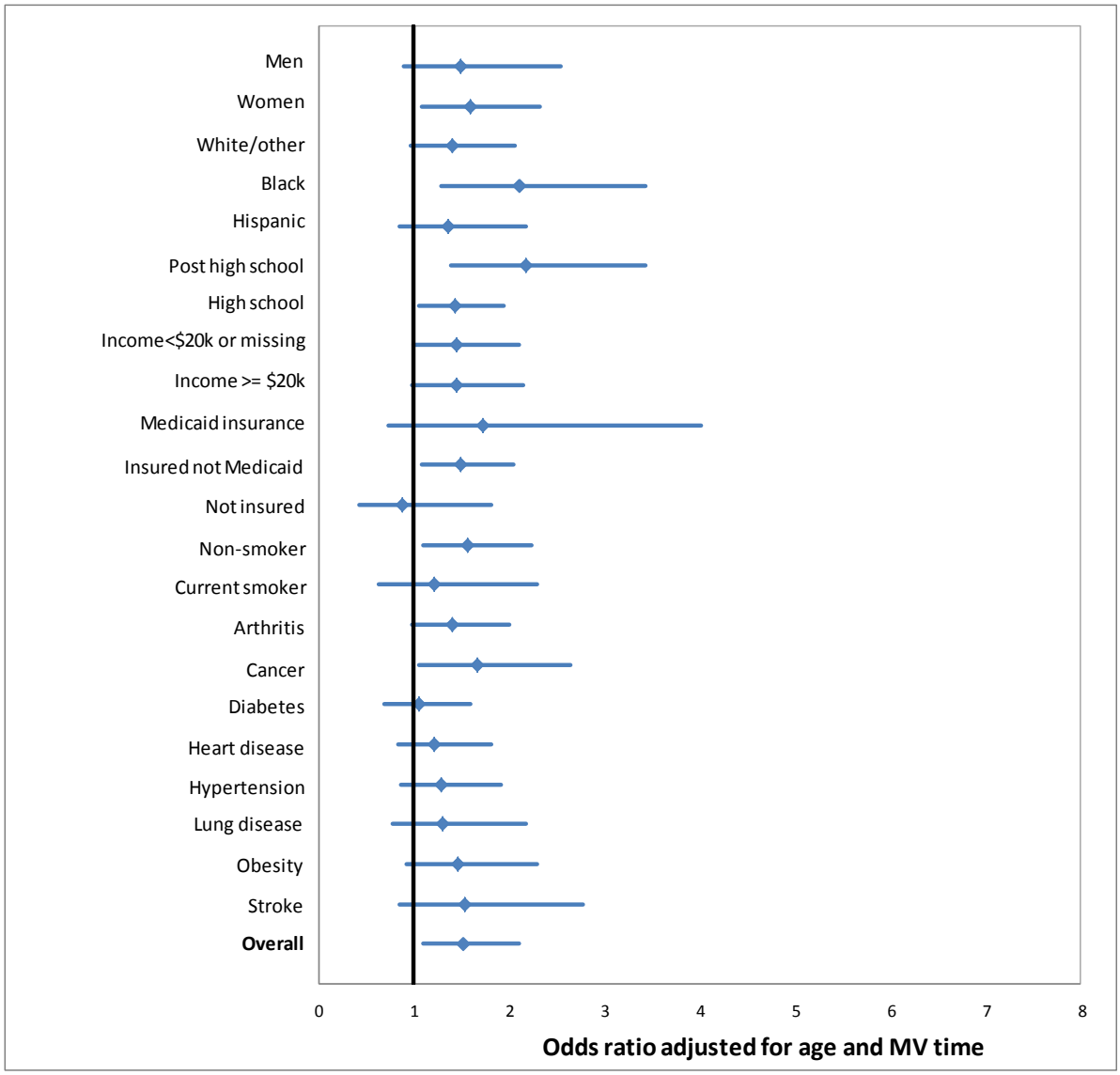

Figure 2. Adjusted odds ratio for disability in activities of daily living (ADL) additional 10% daily percentage sedentary time, by socioeconomic and health characteristics, NHANES 2003-2006 (n=2286 adults). Odds ratio per 10% daily time (i.e., 1-2 hours) spent in sedentary activities adjusted for age and moderate-vigorous activity.

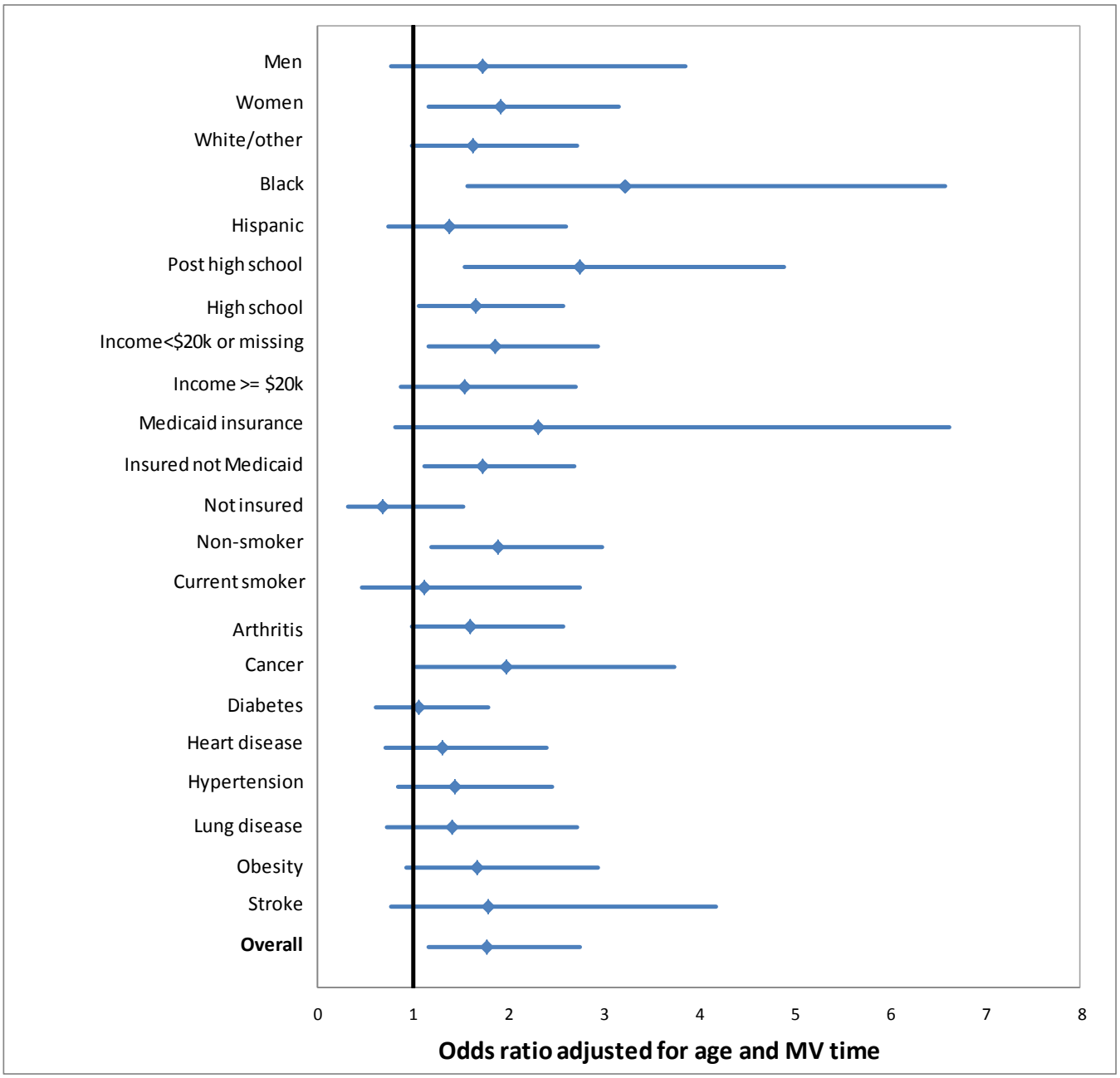

Table 1 Unadjusted Population Characteristics, by the Sample, ADL Disability and Sedentary Behavior, NHANES 2003-2006

				Sedentary Behaviors	
Population Characteristics	Sample n	Proportion of Population (%)	ADL disability (weighted %)	Average daily sedentary hours Weighted Mean (SD)	Average percentage daily sedentary time of total wear hours Weighted Mean (SD)
Overall	2286	100.0	4.5	8.9 (1.9)	63.4 (11.2)
6 Socioeconomic Factors					
Age 60-69	1038	47.3	2.8**	8.6 (1.8)	60.0 (10.4)
70-79	754	33.9	4.6	9.0 (1.8)	64.6 (10.6)
80+	494	18.8	8.6	9.6 (2.1)	69.7 (10.9)
Gender Men	1159	43.9	2.4**	9.1 (2.1)	64.2 (11.7)
Women	1127	56.1	6.1	8.7 (1.8)	62.7 (10.7)
Race/ethnicity					
Non-Hispanic White/Other	1450	86.2	4.2	8.9 (1.6)	63.6 (9.4)
Non-Hispanic Black	370	8.6	7.2	9.2 (3.2)	64.6 (16.6)
Hispanic	466	5.2	4.8	8.2 (4.1)	58.9 (23.7)
Education					
Post high school	863	45.4	2.6*	9.1 (1.7)	63.9 (9.4)
High school or less	1423	54.6	6.1	8.7 (2.1)	63.0 (12.6)
Household income					
>=$20k	1519	73.3	2.9 **	8.8 (1.8)	62.8 (10.4)
0-$20K/missing	767	26.8	8.6	9.0 (2.4)	65.0 (13.3)
Health Insurance					
Medicaid Insurance	148	4.5	12.1 **	9.2 (2.6)	65.3 (14.3)
Insured, not Medicaid	1988	91.5	4.3	8.9 (1.9)	63.5 (10.9)
Not Insured	150	4.0	2.0	8.3 (2.5)	58.9 (13.0)
10 Health Characteristics					
Health Behaviors					
Current smoker No	2002	88.7	6.2	8.9 (1.9)	63.3 (11.1)
Yes	284	11.3	4.3	9.2 (2.3)	64.5 (11.8)
Met physical activity guidelines[a] Yes	127	6.2	2.5	8.2 (1.5)	58.1 (9.3)
No	2159	93.8	4.6	8.9 (2.0)	63.8 (11.2)
8 Chronic Illnesses					
None	288	12.2	0.9 ##	8.6 (2.2)	59.5 (11.9)
Arthritis	1143	52.4	6.7 **	8.9 (1.8)	64.5 (11.1)
Cancer	447	22.5	6.6 *	9.1 (1.7)	65.5 (9.9)
Cardiovascular disease	419	19.0	7.9 **	9.4 (1.8)	68.0 (10.2)
Diabetes	429	16.2	9.4 **	9.3 (2.0)	67.5 (11.1)
Hypertension	1319	57.9	5.5 *	9.0 (1.8)	64.7 (10.9)
Obesity	710	30.1	5.0 **	9.1 (2.0)	65.7 (10.9)

				Sedentary Behaviors	
Population Characteristics	Sample n	Proportion of Population (%)	ADL disability (weighted %)	Average daily sedentary hours Weighted Mean (SD)	Average percentage daily sedentary time of total wear hours Weighted Mean (SD)
Pulmonary disease	237	11.6	8.7 *	9.2 (1.8)	66.0 (10.6)
Stroke	170	7.2	15.0 **	9.5 (2.0)	68.9 (11.6)

ADL = activity of daily living, defined as reporting much difficulty, inability or did not do any of 4 daily self-care tasks: getting in and out of bed, eating, dressing, or walking

*p-value≤.05 and **p-value≤.001 from Rao-Scott adjusted Chi-Square Test for survey data testing disability homogeneity among categories.

#Guideline for moderate-vigorous physical activity ≥ 150 minutes/week accumulated in bouts lasting 10 minutes or longer

Chi-square test for each chronic condition is compared to no chronic illness category

Table 2 Adjusted odds ratios for presence of ADL disability per additional hour of average daily sedentary time# among individuals 60 Years and Older (n=2286 persons)

Risk Factors	Model 1[a] OR (95% CI)	Model 2[b] OR (95% CI)	Model 3[c] OR (95% CI)
Sedentary Time (additional hour/day)#*	1.56 (1.15, 2.11)*	1.58 (1.17, 2.15)*	1.46 (1.07, 1.98)*
Health Behavior			
Current Smoker		1.33 (0.70, 2.54)	1.44 (0.77, 2.71)
Moderate-vigorous time (hour/day)		1.67 (0.25,10.90)	2.20(0.40,11.59)
Chronic Illness			
Arthritis			2.22 (1.14, 4.35)*
Cancer			1.46 (0.80, 2.65)
Cardiovascular disease			1.30 (0.90, 1.89)
Diabetes			1.94 (1.07, 3.52)*
Hypertension			1.09 (0.60, 1.99)
Obesity			0.68 (0.40, 1.16)
Pulmonary disease			1.76 (0.88, 3.55)
Stroke			2.29 (1.34, 3.92)*

a. All models use weighted data and adjust for wear time, NHANES cohort membership (2003-4 or 2005-6), and socioeconomic factors (age, gender, race/ethnicity, education, income, health insurance)

b. Model 2 adds smoking and MV physical activity to Model 1.

c. Model 3 adds chronic illnesses to Model 2

Adjusted odds ratio for presence of ADL disability per daily hour average sedentary activity

* 95% CI excludes 1 indicating statistically significant factor

Table 3 Adjusted odds ratios for presence of ADL disability per 10% average daily percentage sedentary time # among individuals 60 Years and Older (n=2286 persons

Risk Factors	Model 1[a] OR (95% CI)	Model 2[b] OR (95% CI)	Model 3[c] OR (95% CI)
Sedentary Percent#	1.87 (1.24, 2.82)*	1.91 (1.26, 2.89)*	1.70 (1.10, 2.60)*
Health Behavior			
Current Smoker		1.35 (0.71, 2.57)	1.45 (0.76, 2.75)
Moderate-vigorous activity (hour)		1.82 (0.30,10.52)	2.17 (0.43,11.80)
Chronic Illness			
Arthritis			2.19 (1.12, 4.28)*
Cancer			1.44 (0.77, 2.69)
Diabetes			1.92 (1.07, 3.44)*
Heart Disease			1.30 (0.90, 1.88)
Hypertension			1.08 (0.58, 2.01)
Lung			1.77 (0.89, 3.51)
Obesity			0.68 (0.40, 1.16)
Stroke			2.28 (1.35, 3.84)*

a. All models use weighted data and control for NHANES cohort membership (2003-4 or 2005-6) and socioeconomic factors (age, gender, race/ethnicity, education, income, health insurance)

b. Model 2 adds smoking and MV physical activity to Model 1.

c. Model 3 adds chronic illnesses to Model 2

Adjusted odds ratio per 10% daily time (i.e., 1-2 hours) spent in sedentary behavior during wear time

* 95% CI excludes 1 indicating statistically significant factor