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Association Between Insomnia Symptoms and Functional Status in U.S. Older Adults

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Objectives. We studied the association between insomnia symptoms and late-life functioning, including physical capacity, limitations in household activities, and participation in valued activities.

Methods. Participants were 6,050 adults independent in self-care activities from a representative sample of older Medicare beneficiaries. They completed objective measures of physical capacity and self-report measures of insomnia symptoms, help and difficulty with household activities, and participation in valued activities.

Results. After adjustment, insomnia symptoms were associated with a greater odds of receiving help or having difficulty with selected household activities (laundry, shopping), greater odds of help or difficulty with ≥1 household activity [1 symptom vs. 0, odds ratio (OR)=1.27, $p < .05$; 2 symptoms vs. 0, OR = 1.35, $p < .01$), and of restricted participation in specific valued activities (attending religious services, going out for enjoyment) and in ≥1 valued activity (1 symptom vs. 0, OR = 1.29, $p < .05$; 2 symptoms vs. 0, OR = 1.50, $p < .01$). There was no independent association between insomnia symptoms and physical capacity.

Discussion. Among older adults, insomnia symptoms are associated with a greater odds of limitation in household activities and of restricted participation in valued activities. Insomnia interventions may improve functioning and quality of life among elders.

Key Words: Function—Insomnia—Sleep—Valued activities.

INCREASINGLY, epidemiologic studies are linking insomnia to health outcomes that are prevalent among older adults. Insomnia symptoms are associated with an increased risk of depression (Ford & Kamerow, 1989) and acute myocardial infarction (Laugsand, Vatten, Platou, & Janszky, 2011), and when combined with reports of short sleep duration, they are associated with incident hypertension (Vozoris, 2013) and diabetes (Vgontzas et al., 2009). Insomnia symptoms have also been linked to a greater risk of mortality (Li et al., 2014). Among older adults, a growing number of studies demonstrate associations between insomnia-related variables and indices of disability. For example, insomnia symptoms have been linked to reports of limitations in activities of daily living (ADLs) and related behaviors in three large community-based samples of U.S. older adults (Foley et al., 1995), and insomnia symptoms and short sleep duration were associated with a greater risk of limitations in mobility among older women in a Finnish cohort (Stenholm et al., 2010). Also, when measured objectively by wrist actigraphy, both shorter sleep duration and spending a smaller proportion of time in bed asleep (i.e., poorer sleep efficiency) were associated with a greater risk of incident difficulty with household activities and with significant decline in grip strength in a sample of older women (Spira et al., 2012). These links are concerning because approximately half of older adults have insomnia complaints (Foley et al., 1995), and may therefore be at increased risk for disability. However, if insomnia contributes to functional decline, prevention or treatment of insomnia may prevent or reduce late-life disability. Studies in nationally representative samples are needed to clarify the extent to which poor sleep is associated with disability in U.S. older adults.

We examined the association between insomnia symptoms and disability in three areas: physical capacity, which underlies the ability to perform activities, and two key subdomains of activity—domestic household activities and

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participation in valued activities that contribute to quality of life. The National Health and Aging Trends Study (NHATS) framework (Freedman, 2009) characterizes capacity for mobility and upper/lower body movements as a foundation that affects ability to perform more complex tasks and activities. Sleep disturbance may act directly on physical capacity (Spira et al., 2012; Stenholm et al., 2010). The NHATS framework also distinguishes between activities that are essential to independent community living, such as household activities (IADLs; Lawton & Brody, 1969) and participation in productive, generative activities that contribute to quality of life, a distinction proposed in the WHO International Classification of Functioning, Disability and Health (World Health Association, 2001). To the extent that sleep problems are related to limitations in household activities, they potentially impair independence at older ages. The relationship of sleep problems to participation, on the other hand, has implications for quality of life beyond the basics of daily routine activities.

Using data from a nationally representative cohort of older Medicare beneficiaries, we investigated the association of insomnia symptoms with late-life disability in the subdomains described above. To investigate insomnia symptoms as a risk factor for disability that may limit independent functioning, we studied community-dwelling older adults not already dependent on help from others with basic self-care.

Methods

Participants

We studied participants in the National Health & Aging Trends Study (NHATS), a prospective, nationally representative study of Medicare beneficiaries aged ≥65 years funded by the National Institute on Aging (U01AG032947) and administered by the Johns Hopkins Bloomberg School of Public Health. Overall, 8,245 individuals participated in NHATS Round 1 (2011). We excluded 1,048 participants in residential care and 1,129 more dependent in eating, bathing, toileting, or dressing, leaving 6,068. Eighteen more were missing insomnia data, leaving a sample of 6,050. Of these, 5,882 (97.2%) were self-respondents; for the remaining 168 (2.8%), a proxy provided responses. Results were equivalent when analyzed without the 168 proxy respondents, so we retained their data for analyses.

Measures

Insomnia symptoms.—Two items measured insomnia symptoms over the prior month. One asked how frequently participants took >30 min to fall asleep; the other asked the frequency of difficulty returning to sleep when waking earlier than desired. Responses were on a five-point scale (1 = every night, 5 = never). We considered responses of "every," "most," or "some nights" to indicate an insomnia symptom; "rarely" or "never" indicated absence of a symptom. We summed the number of symptoms (range = 0–2).

Physical capacity.—Participants completed several performance-based measures, examined as in the Short Physical Performance Battery (SPPB), a widely used measure of lower-extremity functioning constructed from balance, walking, and chair stands (Guralnik, Ferrucci, Simonsick, Salive, & Wallace, 1995; Guralnik et al., 1994). The NHATS Expanded SPPB, created to obtain a broader distribution of scores, was normed on the NHATS sample (Kasper, Freedman, & Niefeld, 2012). For balance, participants completed five tests and were scored on level completed: side-by-side stand (feet side-by-side and together for 10 s); semi-tandem stand (instep of the heel of one foot touching the other foot's big toe for 10 s); full tandem stand (one foot directly in front of the other with heel touching big toe for 10 s); and stand on one leg with eyes open and again with eyes closed for 30 s. The walking test is timed on a 3-m course at a person's usual pace. The repeated chair stand is timed as a person rises five times as quickly as possible from a sitting position in a hard-backed chair with arms folded across the chest. Grip strength was measured in kg by hand dynamometer, and peak airflow was measured in liters/minute with a peak air flow meter. Each task was scored from 0 to 4; 0 indicated ineligibility for a task based on exclusion criteria (e.g., recent surgery) or no attempt of the task for safety concerns (Kasper et al., 2012). Scores of 1–4 were assigned based on quartile of performance (1 = lowest, 4 = highest), based on the weighted NHATS sample distribution. Expanded SPPB scores range from 0 to 12; higher scores indicate better physical capacity.

Household activities.—Participants were asked about doing laundry, shopping for groceries/personal items, preparing hot meals, handling finances, and managing medications. They reported whether they did each activity alone or with another person, reason for any help received (i.e., health or functional problems vs. other reasons), and degree of difficulty performing each task alone. Participants were coded as having a limitation if they reported doing a task with others for health or functional reasons or having any difficulty performing a task by themselves on a four-point scale (1 = none, 2 = a little, 3 = some, 4 = a lot). Small numbers of participants who provided a health/functioning-related reason for not doing a task alone but were missing data on whether they did the task themselves were coded as having limitation. For participants with complete data for all five activities, we created a binary variable indicating limitations in any household activity.

Participation in valued activities.—Participants were asked how important visiting with friends and family, attending religious services, participating in "clubs, classes, or other organized activities," and going out "for enjoyment" (other than for religious services) were to them. Response options were "very," "somewhat," and "not so important." They indicated whether health or functioning kept them from these activities in the past month. We considered activities rated "somewhat" or "very important" to be valued, and coded participants as having restricted participation if health or functioning kept them from the valued activity in the last month. For participants with complete data for all four activities, we created a binary variable indicating restricted participation in any valued activity.

Other measures.—Participants reported their age, race/ethnicity (coded as White, non-Hispanic; Black, non-Hispanic; other; or Hispanic), and education, which we coded as <high school, high school, and >high school. Participants reported whether a doctor had said they had a range of medical conditions. They also were asked whether they were "bothered by pain" in the last month (yes or no), and whether pain had limited their activities in this interval (yes or no). We used responses to create a three-level variable (no pain, pain without limitation, pain with limitation). Three participants reported pain but were missing the limitations variable; they were added to the pain without limitations group. Participants reported their weight and height; we calculated body mass index (BMI; kg/m^2) and categorized participants using standard cutoffs. Participants completed two-item measures of depressive (PHQ-2) and anxiety symptoms (GAD-2) (Kroenke, Spitzer, & Williams, 2003; Kroenke, Spitzer, Williams, & Lowe, 2009), a word-list memory test (Ofstedal, Fisher, & Herzog, 2005), and the Clock Drawing Test (Schretlen, Testa, & Pealson, 2010). They indicated how frequently they used "medication to help…[them]…sleep" over the prior month, using a five-point scale (1 = every night, 5 = never). We recoded responses as rarely or never; some nights; and most or every night.

Statistical Analyses

We computed descriptive statistics for participant characteristics and fit multivariable-adjusted regression models. The primary predictor was number of insomnia symptoms; outcomes were NHATS Expanded SPPB and individual performance test scores (linear regression), limitation (difficulty or help for health/functioning reasons) in household activities (logistic regression), and difficulty participating in valued activities (logistic regression). We fit two models for each outcome: Model I (adjusted for age, sex, race/ethnicity, and education); and Model II, which included Model I covariates and several additional variables that may confound the association between disturbed sleep and our outcomes (BMI category, depressive symptoms, anxiety symptoms, hypertension, diabetes, heart disease, heart attack, stroke, pulmonary disease, arthritis, osteoporosis, cancer, dementia/Alzheimer's disease, pain, delayed recall, Clock Drawing Test, frequency of sleep medication use). Survey weights were applied to produce nationally representative estimates; analyses accounted for clustering and stratification. Analyses were performed using Stata Version 12.1 (StataCorp, College Station, TX).

Results

Insomnia Symptoms

Demographic and other health characteristics are shown in Table 1. A total of 45.2% of older adults had 0 insomnia symptoms in the last month, 27.1% had 1 insomnia symptom (14.7% had difficulty falling asleep, 12.5% had trouble returning to sleep), and 27.7% had two insomnia symptoms. Number of insomnia symptoms was associated with age, sex, race/ethnicity, education, BMI, depressive symptoms, and anxiety symptoms. Persons with any medical conditions had more symptoms than those without, with the exception of cancer and dementia/ Alzheimer's disease (Table 1).

Physical Performance Tests

In Model I, compared to participants with 0 insomnia symptoms, those with 1 symptom had a 0.08-point lower balance score ($B = -0.08$, $p < .05$), and those with two symptoms had a 0.17-point lower balance score ($B = -0.17$, $p < .001$) (Table 2). These associations became non-significant after further adjustment (Model II). We observed a similar pattern for walking, chair stand, grip strength, and air flow tests, and for the NHATS Expanded SPPB.

Limitations in Household Activities

In Model I, compared to those with 0 insomnia symptoms, participants with one symptom had a greater odds of limitation in doing laundry, shopping, cooking, and managing medications, and in one or more of these tasks (Table 3). Those with two symptoms had an even higher odds of limitation in these activities, or in any activity, relative to those with 0 symptoms. They also had a greater odds of being limited in handling finances. In Model II, compared to those with 0 symptoms, participants with two symptoms had a 54% greater odds of being limited in doing laundry [odds ratio (OR) = 1.54, $p < .01$]. Compared to those with 0 insomnia symptoms, those with one symptom had a 25% greater odds of being limited in shopping for groceries or personal items (OR = 1.25, $p < .05$); those with two symptoms had a 26% greater odds (OR = 1.26, $p < 0.05$). Compared to participants with 0 insomnia symptoms, those with one symptom had a 27% greater odds of being limited in any of the household activities (OR = 1.27, $p < .05$);

Table 1. Participant Characteristics by Number of Insomnia Symptoms (mean ± *SE* or Row %)

	Number of insomnia symptoms				
	Entire sample (column % or mean ± *SE*)	0	1	2	
Total population unweighted *N*	100% (*N* = 6,050)	45.2% (*n* = 2,638)	27.1% (*n* = 1,624)	27.7% (*n* = 1,788)	*p* value
Age					0.004
65–69	30.9	47.2	28.0	24.8	
70–74	26.9	47.1	25.8	27.1	
75–79	19.3	44.8	26.5	28.7	
80–84	13.8	42.2	28.7	29.2	
85–89	6.8	38.0	27.1	34.8	
90+	2.3	40.3	26.6	33.2	
Sex					<0.001
Male	45.3	51.0	26.3	22.7	
Female	54.8	40.4	27.8	31.8	
Race/ethnicity					0.002
White, non-Hispanic	82.3	45.7	28.1	26.2	
Black, non-Hispanic	7.9	40.6	25.1	34.3	
Hispanic	6.3	43.9	22.0	34.2	
Other (Am Indian, Asian, Native HI)	3.6	46.0	22.1	31.9	
Education					<0.001
< High school	19.9	37.4	26.1	36.5	
High school graduate	27.3	40.5	28.5	31.1	
> High school	52.7	50.4	27.2	22.4	
BMI (kg/m^2)					0.005
<18.5	1.7	49.2	21.9	28.9	
≥18.5 to ≤24.9	31.8	43.4	27.9	28.7	
≥25 to ≤29.9	39.0	47.1	28.7	24.2	
≥30	27.6	44.3	25.2	30.6	
Depressive symptoms (PHQ-2)	0.80 ± 0.02	0.55 ± 0.02	0.80 ± 0.03	1.23 ± 0.05	<0.001
Anxiety symptoms (GAD-2)	0.80 ± 0.02	0.49 ± 0.02	0.81 ± 0.04	1.29 ± 0.05	<0.001
Medical conditions					
Hypertension	62.3	43.0	27.0	29.9	<0.001
Diabetes	21.9	39.9	27.5	32.6	<0.001
Heart disease	15.8	36.7	28.5	34.8	<0.001
Heart attack	12.9	39.8	26.9	33.4	<0.001
Stroke	7.8	39.9	26.8	33.3	0.005
Pulmonary disease	14.4	38.5	28.3	33.2	<0.001
Arthritis	51.1	40.0	27.8	32.2	<0.001
Osteoporosis	19.4	35.5	29.0	35.4	<0.001
Cancer	25.3	46.9	27.6	25.5	0.191
Dementia/AD	1.7	44.4	20.9	34.7	0.206
Pain					<0.001
Not bothered by pain	50.0	53.7	25.5	20.8	
Pain, does not limit activities	24.2	40.7	29.2	30.0	
Pain, limits activities	25.8	33.1	28.3	38.6	
Sleep medication use					<0.001
Rarely/never	79.7	50.4	26.2	23.4	
Some nights	6.7	17.2	33.7	49.1	
Most/every night	13.6	28.8	29.2	42.0	

Note. All percentages are weighted. *P* values account for complex sampling design. *SE* = standard error. AD = Alzheimer's disease.

those with two insomnia symptoms had a 35% greater odds (OR = 1.35, $p < .01$).

Participation in Valued Activities

In Model I, compared to participants with 0 insomnia symptoms, those with one symptom had a greater odds of having their health restrict visiting friends and family, attending religious services, participating in clubs or classes, and going out for enjoyment, and of a health restriction in one or more of these activities (Table 4). Those with two symptoms had an even greater odds of restricted participation. In Model II, many of these associations decreased and became non-significant. Nonetheless, compared to those with 0 insomnia symptoms, participants with two symptoms had a 55% greater odds of restrictions in attending religious services (OR = 1.55, $p < .05$) and a 62% greater odds of restrictions in going out for enjoyment (OR = 1.62, $p < .05$). In Model II, participants with

Table 2. Association Between Insomnia Symptoms and Physical Capacity Measured by Performance-Based Tests

Number of insomnia symptoms	Model I B	Model II B
	Balance	
0	Ref.	Ref.
1	−0.08*	−0.04
2	−0.17***	−0.01
	Walking	
0	Ref.	Ref.
1	−0.08	−0.02
2	−0.16***	0.02
	Chair Stands	
0	Ref.	Ref.
1	−0.11	-0.05
2	−0.27***	-0.06
	Average Grip	
0	Ref.	Ref.
1	−0.11**	-0.03
2	−0.19***	-0.01
	Average Peak Air Flow	
0	Ref.	Ref.
1	−0.06	−0.05
2	−0.14***	−0.07
	NHATS expanded SPPB Score	
0	Ref.	Ref.
1	−0.25*	−0.09
2	−0.56***	0.00

Note. For all performance measures, a higher score indicates better functioning. Model I (*N* ranges from 5,288 to 5,746) adjusted for age, sex, race/ethnicity, education; Model II (*N* ranges from 4,909 to 5,333) adjusted for Model I covariates + BMI category, depressive symptoms, anxiety symptoms, medical comorbidities (i.e., heart attack, heart disease, hypertension, arthritis, osteoporosis, diabetes, pulmonary disease, stroke, dementia/Alzheimer's disease, cancer), pain, delayed word recall, Clock Drawing Test score, frequency of sleep medication use. B = unstandardized regression coefficient.
*$p < .05$. **$p < .01$. ***$p < .001$.

Table 3. Association Between Insomnia Symptoms and Household Activity Limitations

Number of insomnia symptoms	% with limitation (weighted)	Model I OR	Model II OR
		Doing laundry	
0	5.2	Ref.	Ref.
1	8.6	1.56**	1.25
2	14.8	2.65***	1.54**
		Shopping	
0	9.7	Ref.	Ref.
1	14.5	1.46***	1.25*
2	21.6	2.09***	1.26*
		Preparing hot meals	
0	6.9	Ref.	Ref.
1	10.4	1.47**	1.18
2	15.0	1.93***	1.04
		Handling finances	
0	6.1	Ref.	Ref.
1	8.1	1.29	1.08
2	12.1	1.78***	1.03
		Managing medications	
0	7.9	Ref.	Ref.
1	10.8	1.45**	1.28
2	13.7	1.82***	1.26
		Limitation in any Activity	
0	21.3	Ref.	Ref.
1	29.6	1.48***	1.27*
2	39.5	2.14***	1.35**

Note. Disability includes difficulty when doing the activity oneself or receiving help with the activity for health or functioning reasons. Model I (*N* ranges from 5,402 to 5,975) adjusted for age, sex, race/ethnicity, education; Model II (*N* ranges from 4,958 to 5,464) adjusted for Model I covariates + BMI category, depressive symptoms, anxiety symptoms, medical comorbidities (i.e., heart attack, heart disease, hypertension, arthritis, osteoporosis, diabetes, pulmonary disease, stroke, dementia/Alzheimer's disease, cancer), pain, delayed word recall, Clock Drawing Test score, frequency of sleep medication use. OR = odds ratio.
*$p < .05$. **$p < .01$. ***$p < .001$.

1 symptom had a 29% greater odds (OR = 1.29, $p < .05$), and those with two symptoms had a 50% greater odds of restricted participation in one or more valued activities (OR = 1.50, $p < .01$).

Discussion

We studied the association between insomnia symptoms and several indicators of disability in a nationally representative sample of older community-resident persons not dependent in ADLs. In unadjusted models, a greater number of insomnia symptoms was associated with all of the functional indicators—reduced objectively measured physical capacity, and reports of limitations in performing household activities, and of restricted participation in valued activities. After adjusting for demographic and clinical characteristics, there was no association between insomnia symptoms and measures of physical capacity. For more complex tasks, however, results were different. Participants with insomnia symptoms had a greater odds of being limited in at least one household activity and in at least one valued activity. We also found associations between insomnia symptoms and limitations in specific household activities (doing laundry, shopping) and in specific valued activities (attending religious services, going out for enjoyment). Results suggest that, in the growing population of U.S. older adults, insomnia may be an important independent risk factor for increased disability in tasks important to independent community living and those related to high quality of life.

Our findings are consistent with and extend those from several prior studies. As described above, cross-sectional research has found associations between insomnia-related variables and impairment in ADLs and related activities (Foley et al., 1995), and in a U.S. sample of older women, shorter objectively measured sleep duration and lower sleep efficiency were associated with a greater odds of incident instrumental activity of daily living difficulty (Spira et al., 2012). On the other hand, we found no associations between insomnia symptoms and measures of physical capacity, suggesting

Table 4. Association Between Insomnia Symptoms and Health-Related Restrictions in Participation in Valued Activities

Number of insomnia symptoms	% with restrictions (weighted)	Model I OR	Model II OR
		Restricted in visiting with friends and family	
0	3.2	Ref.	Ref.
1	4.9	1.49*	1.15
2	8.0	2.19***	1.07
		Restricted in attending religious services	
0	6.1	Ref.	Ref.
1	10.0	1.56**	1.35
2	15.8	2.35***	1.55*
		Restricted in participating in clubs or classes	
0	4.8	Ref.	Ref.
1	7.0	1.47*	1.25
2	10.9	2.16***	1.18
		Restricted in going out for enjoyment	
0	3.1	Ref.	Ref.
1	4.7	1.51*	1.21
2	9.9	2.98***	1.62*
		Any health-related restrictions in valued activities	
0	18.0	Ref.	Ref.
1	26.5	1.59***	1.29*
2	41.8	2.70***	1.50**

Note. Valued activities are those reported as important by the participant. Health-related restrictions were based on a report that there was a time in the last month when health or functioning kept the person from engaging in the valued activity. Model I (*N* ranges from 2,895 to 5,270) adjusted for age, sex, race/ethnicity, education; Model II (*N* ranges from 2,689 to 4,860) adjusted for Model I covariates + BMI category, depressive symptoms, anxiety symptoms, medical comorbidities (i.e., heart attack, heart disease, hypertension, arthritis, osteoporosis, diabetes, pulmonary disease, stroke, dementia/Alzheimer's disease, cancer), pain, delayed word recall, Clock Drawing Test score, frequency of sleep medication use. OR = odds ratio.

*$p < .05$. **$p < .01$. ***$p < .001$.

that difficulty falling asleep or returning to sleep may not be linked to physical performance. While the absence of such a causal link might be welcome news for those with these sleep disturbances, findings from other studies regarding sleep variables and physical performance are mixed. A study in Italy linked reports of long sleep duration with declines in SPPB scores (Stenholm, Kronholm, Bandinelli, Guralnik, & Ferrucci, 2011), while actigraphic indices of shorter sleep duration, lower sleep efficiency, and greater time awake after sleep onset were associated with decline in grip strength in a sample of older U.S. women (Spira et al., 2012). Differences between our findings and those from other studies may be due to the different populations studied, sleep variables investigated (e.g., sleep duration vs. insomnia), and self-report versus objective sleep measurement.

That we observed associations between indices of poor sleep and household activity limitations in community-dwelling older Medicare beneficiaries from a nationally representative sample could have significant implications for quality of life and for health care expenditures. If there is a causal link between poor sleep and disability, the economic burdens placed by sleep on the health care system could be substantial, given the prevalence of sleep complaints among older adults (Foley et al., 1995) and the rapid growth of the U.S. population of older people. Documenting these relationships and estimating the economic burden associated with disturbed sleep among older adults seems an important next step.

Our findings raise questions regarding the mechanisms that might link insomnia symptoms to limitations in household activities and participation in valued activities. One possibility is that disturbed sleep leads to daytime sleepiness and fatigue, which may in turn promote functional problems, particularly in more complex tasks. Alternatively, insomnia may lead to depression or cognitive problems, which are themselves associated with disability. Prospective studies are needed to examine whether these factors mediate the link between insomnia, activities and participation, and future NHATS study waves will afford the opportunity to evaluate these and other potential mediators.

Our results may also help explain the association between insomnia and depression. Although studies have demonstrated that insomnia is a risk factor for subsequent depression (Ford & Kamerow, 1989), the mechanisms underlying this association remain unclear. We found that insomnia symptoms are associated with limitations in household activities and restriction of engagement in pleasurable, meaning-making activities. Because both disability and social and behavioral withdrawal may promote depression (Blazer, Hughes, & George, 1987; Cole & Dendukuri, 2003), insomnia-related activity limitations may partially mediate some of the association between insomnia and depression in older populations.

This study's strengths are a large and nationally representative sample of older Medicare beneficiaries, who comprise 96% of persons 65 and older in the United States (Montaquilla, Freedman, Edwards, & Kasper, 2012), and the inclusion of indicators of physical capacity as well as complex tasks of daily living and community participation. Its limitations include the current availability of only two questions about sleep parameters in NHATS, and the lack of objective measures of poor sleep, such as wrist actigraphy. The latter is important because estimates of sleep from objective measures may differ in unpredictable ways from those obtained by self-report (Van Den Berg et al., 2008). Similarly, caution is needed when interpreting results from self-report measures of household limitations, which may provide somewhat different results from other methods of assessment, such as direct observation of performance (Rogers et al., 2003). Further, this is a cross-sectional study,

so we cannot draw conclusions regarding whether poor sleep preceded and might therefore have contributed to our outcomes, or whether the reverse is true. As longitudinal data from NHATS become available, we will be able to prospectively examine these associations.

In sum, our findings suggest that insomnia symptoms are associated with a greater odds of limitations with complex community-living skills and of health-related restrictions in ability to engage in valued activities among persons who are not dependent in self-care activities. While the population burden of sleep disturbance among older adults makes the prospect of a causal link between poor sleep and disability worrisome, such a link may present an opportunity for prevention with the potential for widespread benefits to quality of life and possibly even savings to health care expenditures. Our findings in a national population sample add weight to the evidence supporting the initiation of intervention trials to improve sleep with the goal of preventing adverse late-life health outcomes.

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Conflict of Interest Statement

Dr. Reynolds reports receiving pharmaceutical support for NIH-sponsored research studies from Bristol-Myers Squibb, Forest, Pfizer, and Lilly. He has received an honorarium as a speaker from MedScape/WEB MD. He is the co-inventor (Licensed Intellectual Property) of Psychometric analysis of the Pittsburgh Sleep Quality Index (PSQI). The other authors report no conflicts.

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