Self-Reported Sleep Problems Prospectively Increase Risk of Disability: Findings from the Survey of Midlife Development in the United States

Elliot M. Friedman, PhD

OBJECTIVES: To determine whether subjective poor sleep prospectively increases functional limitations and incident disability in a national sample of adults living in the United States.

DESIGN: Prospective cohort.

SETTING: Longitudinal Survey of Midlife Development in the United States (MIDUS).

PARTICIPANTS: Young, middle-aged, and older men and women (aged 24–75) surveyed in 1995/96 (MIDUS 1) and followed up in 2004–06 (MIDUS 2). Complete data were available for 3,620 respondents.

MEASUREMENTS: Data were from telephone interviews and self-administered questionnaires. Participant reported chronic sleep problems within the prior month; functional limitations were assessed using the Functional Status Questionnaire. Demographic (age, sex, race), socioeconomic (educational attainment), health (chronic conditions, depression), and health behavior (obesity, smoking) covariates were assessed to reduce potential confounding.

RESULTS: Approximately 11% of the sample reported chronic sleep problems at both MIDUS waves. Average number of activity of daily living (ADL) and instrumental activity of daily living (IADL) limitations increased significantly between MIDUS 1 (ADL limitations: 0.06; IADL limitations: 0.95) and MIDUS 2 (ADL limitations: 0.15; IADL limitations: 1.6; $P < .001$). Adjusted regression models estimating change in ADL scores showed that chronic sleep problems at MIDUS 1 predicted significantly greater increases in ADL (incident rate ratio (IRR) = 1.55, $P < .001$) and IADL (IRR = 1.28, $P < .001$) limitations. In those with no functional limitations at baseline, logistic regression models showed that chronic sleep problems significantly increased the odds of incident ADL (odds ratio (OR) = 2.33, 95% confidence interval (CI) = 1.68–3.24, $P < .001$) and IADL (OR = 1.70, 95% CI = 1.21–2.42, $P = .002$) disability.

CONCLUSION: Reports of chronic sleep problems predicted greater risk of onset of and increases in functional limitations 9 to 10 years later. Poor sleep may be a robust and independent risk factor for disability in adults of all ages. **J Am Geriatr Soc 64:2235–2241, 2016.**

Key words: subjective sleep; activity of daily livings; MIDUS; disability

Disability rates in older adults have declined in recent years,[1,2] due principally to medical and technological advances and to broad improvements in socioeconomic indicators, including poverty and educational attainment.[3] Nonetheless, inability to perform activities of daily living (ADLs) remains common. Estimates from the National Health Interview Surveys and the National Long-Term Care Survey show that 15% to 20% of adults aged 65 and older have at least one functional limitation.[1,2] Further decreases in disability rates will largely rest on changes in lifestyle factors. Obesity[4] and physical inactivity,[5] for example, are robustly linked to greater risk of disability,[1,6] and rates of both are high in aging adults; these factors threaten to slow or stall the downward trend in disability rates. Another lifestyle factor—sleep—has received relatively little attention as a predictor of disability, despite well-documented links between sleep problems and a range of adverse health outcomes, including mortality.[7–10] This study examined the prospective associations between self-reported sleep problems and ADL dependence in a national sample of middle-aged and older adults living in the United States.

Two lines of research converge on sleep as a compelling focus for understanding disability risk. First, sleep quality tends to decline with age. Objective assessments show significant age-related declines in sleep duration, sleep efficiency, rapid eye movement, and Stage 3 and 4 sleep coupled with significant increases in sleep latency

From the Department of Human Development and Family Studies, Purdue University, West Lafayette, Indiana.

Address correspondence to Elliot M. Friedman, Department of Human Development and Family Studies, 1202 West State Street, West Lafayette, IN 47907. E-mail: efriedman@purdue.edu

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and Stage 1 and 2 sleep.[11] Subjective complaints of poor sleep also tend to increase with age.[12,13] Second, quantitative (e.g., number of hours slept per night) and qualitative (e.g., complaints of poor sleep) aspects of sleep are linked to morbidity and mortality in older adults.[7,8,14] Subjective reports of impaired sleep, for example, significantly increased the risk of subsequent heart attack, stroke, and cardiac mortality in older men and women with primary acute myocardial infarction from the Stockholm Heart Epidemiology Program.[14] A regional longitudinal study in Sweden found that sleep complaints at baseline predicted greater risk of coronary artery disease[15] and diabetes mellitus[16] in men 12 years later. Few studies have examined the prospective links between sleep complaints and disability. A recent study of 908 older Catholic clergy in the United States found that poor subjective sleep significantly increased risk of disability at follow-up 9.6 years later.[17]

The current study extends this earlier work by examining the prospective associations between sleep complaints and disability in a representative national sample of men and women in the United States: the Survey of Mid-Life Development in the United States (MIDUS).[18] It was hypothesized that subjective report of sleep problems would increase the risk of functional limitations and incident disability in those with no functional impairments at baseline. The MIDUS sample is community dwelling, making the results applicable to the general adult U.S. population. The broad age range of the MIDUS sample, spanning five decades from mid-20s to mid-70s, also makes it possible to determine whether the links between poor sleep and functional impairment are limited to older adults or extend to middle-aged and younger adults as well. Finally, although the main analyses in this study involve self-reported functional limitations, these are bolstered by supplemental analyses using objective assessments of functional status available for subsamples of MIDUS participants.

METHODS

Participants

Data are from the first two waves of MIDUS, a longitudinal study of the physical and mental health of middle-aged and older adults.[18] The first wave of data collection (MIDUS 1; N = 7,108) included a national probability sample of noninstitutionalized English-speaking adults living in the contiguous United States recruited using random digit dialing (n = 3,487), a sample of monozygotic and dizygotic twin pairs from a national twin registry (n = 1,914), oversamples from five metropolitan areas (n = 757), and siblings of individuals from the random digit dialing sample (n = 950). Respondents completed telephone interviews and self-administered questionnaires. A follow-up study was completed 9 to 10 years later (MIDUS 2). Mortality-adjusted retention from the original study was 75%. Complete data for the present analyses were available for 3,620 participants. The analytical sample had fewer female respondents, was better educated, and had fewer functional limitations at baseline than the full longitudinal sample; the samples were comparable on all other important variables. The institutional review board at the University of Wisconsin-Madison approved Collection of data for both waves of MIDUS and the institutional review board at Purdue University approved analyses for the current study.

Measures

Sleep complaints were assessed using a single questionnaire item: "In the past 12 months, have you experienced or been treated for chronic sleeping problems?" A dichotomous variable was used in all models. Information on ADLs and instrumental ADLs (IADLs) came from the Functional Status Questionnaire.[19] Respondents were asked how much their health limited their ability to perform a number of activities. ADL limitations were determined from two items: bathing or dressing oneself and walking one block. IADL limitations were determined from seven items: lifting or carrying groceries; climbing several flights of stairs; bending, kneeling, or stooping; walking more than a mile; walking several blocks; vigorous activities (e.g., running, lifting heavy objects); and moderate activities (e.g., bowling, vacuuming). Responses ranged from not at all (1) to a lot (4). To determine the number of activities for which respondents reported at least some degree of limitation, responses of some or a lot of limitation were scored as 1 and other responses as 0. Responses were then summed into separate scores for ADLs and IADLs with possible scores of 0 to 2 for ADLs and 0 to 7 for IADLs. Total scores at MIDUS 1 and MIDUS 2 were calculated and used to examine changes in number of functional limitations over time. Dichotomous variables for presence or absence of any limitations were also created for logistic regression models estimating incident functional limitations between MIDUS 1 and MIDUS 2.

A set of demographic, socioeconomic, health, and health behavior covariates was included in all models to reduce the likelihood of confounding. These included age, sex, race, and educational attainment (dummy coded variables for high school degree or GED, some college, and college degree or more).

To assess health, a variable for 12 chronic medical conditions was used in all analyses. Information on nine of these conditions came from participant responses to self-administered questionnaire items; participants were asked whether they had experienced or received treatment for chronic obstructive pulmonary disease (COPD), arthritis or other joint conditions, acquired immunodeficiency syndrome, hypertension, diabetes mellitus, tuberculosis, neurological disorders, stroke, or ulcer in the prior 12 months. Presence of heart problems and cancer were determined from single items in the telephone interview. Participants were asked whether they had had heart trouble suspected or confirmed by a doctor and whether they had ever had cancer. Possible scores ranged from 0 to 12.

Variables for obesity and smoking were included to control for health behaviors. Body mass index (BMI) was calculated from measurement of height and weight, and dummy coded variables for normal weight (BMI < 24.99 kg/m^2), overweight (BMI 25.00–29.99 kg/m^2) and obese (BMI ≥ 30.00 kg/m^2) were created. Smoking status was assessed using dummy-coded variables indicating nonsmoker, ex-smoker, and current smoker.

Finally, because depressed individuals are more likely to report poor sleep[20] and greater functional impairment,[21] likely depression was determined using the short form of the Composite International Diagnostic Interview (CIDI).[22] Respondents were scored as positive for depression if they indicated that they felt sad, blue, or depressed; that "The feeling of being sad, blue, or depressed lasted all day long or most of the day; and that they felt this way every day or almost every day. They were scored as positive for anhedonia if they reported a loss of interest in most things lasting all day long or most of the day and that this feeling was every day or almost every day. A dichotomous variable indicating likely clinical depression (positive scores for depression and anhedonia) was included in all models.

Statistical Analyses

Longitudinal increases in ADL limitations were estimated in separate Poisson regression models. Poisson modeling was appropriate because the outcome measures (number of limitations) were counts rather than continuous variables. Incident rate ratios (IRRs) comparing the rate of functional limitations in respondents with sleep problems with the rate in those without were determined; these are interpreted in a fashion similar to those of odds ratios. All models were adjusted for age, sex, race, educational attainment, and functional limitations at MIDUS 1. To control for the possible influences of coincident illness, obesity, and depressive symptoms on functional abilities, MIDUS 2 measures of number of chronic medical conditions, smoking status, BMI, and depression were included in all models. Poisson models used data from the full longitudinal sample.

Binary logistic regression models were used to estimate the odds of incident ADL and IADL disability between MIDUS 1 and MIDUS 2, adjusted for covariates. In these models, the analytical samples were limited to respondents with no functional limitations at MIDUS 1 (n = 3,244 for ADLs, n = 1,329 for IADLs). Models were estimated using Stata version 13.0 (Stata Corp., College Station, TX).

Given age-related changes in sleep complaints and disability risk and to determine whether the associations between sleep and ADL limitations varied with age, additional analyses were conducted that included interaction terms for sleep problems and age as predictors of longitudinal changes in ADLs and incident ADL impairments.

Clustered robust standard errors were applied to account for familial relatedness among the twins and siblings in the sample. A threshold for statistical significance was set at alpha = .05 in all models.

RESULTS

Descriptive statistics for the full analytical sample are shown in Table 1. Sociodemographic characteristics are from MIDUS 1. Mean age was 46.5, slightly more than half the sample was female, 6.3% were nonwhite, and 35.9% had a 4-year college degree or more. Data on other variables were from MIDUS 1 and MIDUS 2. Between the two data collection points, the average number of ADL (MIDUS 1 = 0.06; MIDUS 2 = 0.15; $t(3,619) = -12.2$, $P < .001$) and IADL (MIDUS 1 = 0.95; MIDUS 2 = 1.61; $t(3,619) = -20.2$, $P < .001$) limitations rose significantly, whereas the fraction of the sample reporting sleep problems did not change significantly (MIDUS 1 = 11.3; MIDUS 2 = 10.7; $\chi^2 = 0.91$, $P = .33$). Of those who reported sleep problems at MIDUS 1, 38.9% continued to report sleep problems at MIDUS 2 (data not shown). The proportion of people who met criteria for depression on the CIDI-SF declined significantly between MIDUS 1 (12.0%) and MIDUS 2 (10.1%; $\chi^2 = 10.32$, $P = .001$), and the average number of chronic conditions increased significantly between MIDUS 1 and MIDUS 2 ($t(3,619) = 28.89$, $P < .001$).

Table 1. Descriptive Statistics for Longitudinal Sample (N = 3,620)

Variable	MIDUS 1 (1995–96)	MIDUS 2 (2004–06)
Age, mean ± SD (range)	46.5 ± 12.5 (20–75)	
Female, %	55.2	
Nonwhite, %	6.3	
Educational attainment, %		
High school or GED	35.0	
Some college	29.1	
College or more	35.9	
ADLs		
Number of limitations, mean ± SD (range)	0.06 ± 0.3 (0–2)	0.15 ± 0.4 (0–2)
≥1 ADLs, %	5.0	12.2
IADLs		
Number of limitations, mean ± SD (range)	0.95 ± 1.8 (0–7)	1.61 ± 2.2 (0–7)
≥1 IADLs, %	35.5	48.9
Composite International Diagnostic Interview–Short Form depression, %	12.0	10.1
Number of chronic conditions, mean±SD (range)	0.8 ± 1.1 (0–8)	1.4 ± 1.5 (0–10)
Body mass index, kg/m^2, %		
<25.00 (normal)	41.4	32.3
25.00–29.99 (overweight)	37.6	39.4
≥30.00 (obese)	21.0	28.3
Smoking status, %		
Current	25.2	19.5
Former	40.7	48.9
Never	34.1	31.6
Sleep problems, %	11.3	10.7

MIDUS = Longitudinal Survey of Midlife Development in the United States; SD = standard deviation.

Poisson regression models were used to estimate the increase in ADL and IADL limitations associated with reporting poor sleep at MIDUS 1 adjusted for MIDUS 1 sociodemographic characteristics and initial levels of functional limitations and MIDUS 2 health, health behavior, and depression. As shown in Table 2, reporting chronic sleep problems at MIDUS 1 was associated with significantly greater rates of ADL and IADL limitations. Respondents who reported chronic sleep problems in the prior year showed a 55% greater increase in ADL limitations

Table 2. Activity of Daily Living (ADL) and Instrumental ADL (IADL) Limitations in Longitudinal Survey of Midlife Development in the United States (MIDUS) 2 Regressed on MIDUS 1 Sleep Problems, Functional Limitations, and Covariates (N = 3,620)

Variable	IRR (95% Confidence Interval)	
	ADLs	IADLs
Age	1.03 (1.02–1.04)[c]	1.02 (1.02–1.03)[c]
Sex (female=1)	1.30 (1.08–1.56)[c]	1.29 (0.07–0.15)[c]
Race (nonwhite=1)	0.88 (0.64–1.21)	0.85 (0.76–0.94)[b]
Educational attainment (reference ≥college)		
High school or GED	1.90 (1.50–2.41)[c]	1.30 (1.22–1.39)[c]
Some college	1.42 (1.10–1.85)[b]	1.10 (1.02–1.18)[a]
ADLs at Wave 1	1.88 (1.62–2.19)[c]	1.16 (1.14–1.17)[c]
Chronic conditions (MIDUS 2)	1.30 (1.24–1.37)[c]	1.17 (1.15–1.19)[c]
Body mass index, kg/m^2 (MIDUS 2) (reference <25.00 (normal weight))		
25.00–29.99 (overweight)	1.13 (0.89–1.44)	1.12 (1.04–1.20)[b]
≥30 (obese)	1.80 (1.42–2.28)[c]	1.52 (1.42–1.63)[c]
Composite International Diagnostic Interview–Short Form depression (MIDUS 2)	1.42 (1.12–1.79)[b]	1.19 (1.10–1.28)[c]
Smoking status (MIDUS 2) (reference never)		
Former	1.26 (1.04–1.53)[a]	1.11 (1.05–1.18)[c]
Current	1.52 (1.19–1.94)[b]	1.41 (1.31–1.52)[c]
Sleep problems (MIDUS 1)	1.55 (1.26–1.90)[c]	1.28 (1.20–1.37)[c]

Estimates were from Poisson regression models; incident rate ratios (IRRs) are shown for ease of interpretation.
$P <$ [a].05, [b].01, [c].001.

Table 3. Logistic Regression Models Predicting Functional Limitations at Longitudinal Survey of Midlife Development in the United States (MIDUS) 2

Variable	Odds Ratio (95% Confidence Interval)	
	ADLs, n = 3,244	IADLs, n = 1,329
Age	1.04 (1.03–1.05)[c]	1.04 (1.03–1.05)[c]
Sex (female=1)	1.73 (1.32–2.27)[c]	1.49 (1.22–1.82)[c]
Race (nonwhite=1)	0.82 (0.46–1.46)	0.90 (0.61–1.35)
Educational attainment (reference ≥college)		
High school or GED	2.29 (1.64–2.46)[c]	1.39 (1.10–1.76)[b]
Some college	1.55 (1.09–2.22)[a]	1.21 (0.96–1.53)
Chronic conditions (MIDUS 2)	1.54 (1.40–1.69)[c]	1.40 (1.29–1.52)[c]
Body mass index, kg/m^2 (MIDUS 2) (reference <25.00 (normal weight))		
25.00–29.99 (overweight)	1.42 (1.01–1.99)[a]	1.38 (1.11–1.73)[b]
≥30.00 (obese)	2.81 (1.99–3.97)[c]	2.32 (1.78–3.02)[c]
Depression (MIDUS 2)	1.42 (0.97–2.08)[d]	1.82 (1.30–2.57)[b]
Smoking status (MIDUS 2) (reference never)		
Former	1.55 (1.17–2.06)[b]	1.01 (0.82–1.25)
Current	2.14 (1.49–3.08)[c]	2.26 (1.69–3.01)[c]
Sleep problems (MIDUS 1)	2.33 (1.68–3.24)[c]	1.70 (1.21–2.42)[b]

Activity of daily living (ADL) and instrumental ADL (IADL) limitations were estimated in separate models. Only cases with no limitations at MIDUS 1 were included.
$P <$ [a].05, [b].01, [c].001; [d]P = .07.

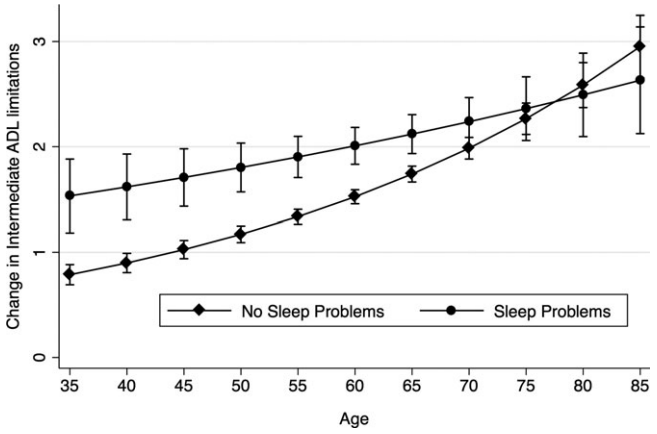

Figure 1. Interaction between age and sleep problems predicting longitudinal change in instrumental activities of daily living (IADLs). Sleep problems were more likely to produce greater increases in IADL limitations in younger and middle-aged (<65) than older adults.

($P < .001$) and a 28% greater increase in IADL limitations ($P < .001$) than did those without sleep complaints. Independent of sleep, greater risk of increases in functional impairments over time was also associated with older age, being female, being white (IADLs only), not having completed a 4-year college degree or more, more chronic medical conditions, obesity, higher CIDI depression scale score, and smoking currently or in the past.

The likelihood of incident disability between MIDUS 1 and MIDUS 2 was estimated using logistic regression models; analytical samples were limited to respondents without ADL limitations at MIDUS 1. As shown in Table 3, respondents who reported chronic sleep problems at MIDUS 1 were more than twice as likely to develop ADL limitations ($P < .001$) and 70% more likely to develop IADL limitations ($P = .002$) than those with no sleep complaints. Age, being female, low educational attainment, being overweight or obese, more chronic conditions, depression, and smoking were all associated with likelihood of incident functional limitations at MIDUS 2.

Analyses that included interaction terms between age and sleep problems showed that age significantly moderated the association between MIDUS 1 sleep problems and longitudinal increases in IADL limitations. Specifically, the rate of increases in limitations in younger and middle-aged adults (e.g., 45 years old) who reported sleep problems (increase of 2.13 limitations) was double that of peers with no sleep complaints (1.04 increase) (interaction effect: IRR = 0.98, $P < .001$) (Figure 1). Age did not moderate the association between sleep problems and change in ADL limitations.

Analytical Refinements

These results were probed in four ways to exclude potential alternative explanations of the observed associations.

First, 39% of the full analytical sample reported chronic sleep problems at MIDUS 1 and MIDUS 2. It is

possible that coincident poor sleep and functional limitations at MIDUS 2 accounted for the observed longitudinal associations with sleep complaints. To test this possibility, all regression models were reestimated with an additional adjustment for sleep complaints at MIDUS 2. Inclusion of MIDUS 2 sleep complaints slightly reduced the coefficients for MIDUS 1 sleep complaints, but the associations remained robust ($P < .001$ in ADL and IADL models). In the logistic regression models, the likelihood that someone with chronic sleep problems would develop ADL limitations at MIDUS 2 declined from 133% of that of someone without sleep complaints to 78%, but the effect remained statistically significant ($P = .001$). For IADL limitations, the odds declined from 79% to 69% ($P = .05$). In all of these analyses, the coefficients and odds ratios associated with sleep problems at MIDUS 1 were consistently larger than those associated with sleep problems at MIDUS 2 (data not shown).

Second, because sleep complaints were assessed using a single item that was subjective and global in nature, these responses were compared with scores on a widely used measure of sleep quality, the Pittsburgh Sleep Quality Index[23] (PSQI; this measure was used in a subsample of MIDUS 2 respondents (n = 1,063), so it was unavailable for longitudinal analyses). The PSQI is a 24-item scale assessing seven sleep components: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, daytime dysfunction. Respondents who reported sleep problems at MIDUS 2 had significantly higher PSQI mean scores (9.47 vs 5.47, $t(997) = 153.81$, $P < .001$) than those without sleep problems, indicating significantly poorer sleep quality.

Third, use of sleep medication in the context of sleep complaints may contribute to functional limitations. The only variable available at MIDUS 1 referred to the use of sedatives without a doctor's prescription; 105 MIDUS 1 respondents (2.3% of the sample) reported taking such medication, and inclusion of this variable in longitudinal models did not affect the relationship between MIDUS 1 sleep problems and MIDUS 2 functional limitations (data not shown). MIDUS 2 data, in contrast, included a specific question about the use of sleeping pills as part of the PSQI. To gauge the cross-sectional association between sleep medication use and ADLs at MIDUS 2, numbers of ADL and IADL limitations (separate models) were regressed on the seven individual PSQI components, adjusted for age, sex, race, and education. The results showed that only sleep disturbance (assessing trouble sleeping) and daytime dysfunction (assessing sleepiness during waking hours) were associated with ADL limitations ($P < .001$ for both); use of sleep medication was not independently associated with ADLs or IADLs (data not shown).

Finally, sleep problems and functional limitations were assessed using self-report measures, raising the possibility that unobserved subjective factors may underlie both sets of ratings. To probe this, an objective measure of functional status—a 50-foot timed walk—and potential longitudinal effects of sleep complaints were examined; walk time was measured in a subsample of MIDUS 2 respondents (n = 1,063). Linear regression models predicting walk time adjusted for sociodemographic, health, and health behavior covariates showed that, on average, respondents who reported chronic sleep problems at MIDUS 1 took more than 1 second longer to walk 50 feet than those who slept better (15.4 seconds vs 14.2 seconds; $P = .02$); this association remained significant after adjusting for sleep problems at MIDUS 2 ($P = .02$).

DISCUSSION

The prospect of disability is a significant concern in aging adults, and as the population ages, better understanding of the causes of disability is increasingly important for individual health and quality of life, as well as for the creation of policies designed to improve overall population health. These analyses focused on subjectively poor sleep as a potential risk factor for disability. Reports of chronic sleep problems were associated with greater ADL and IADL limitations and with significantly greater odds of developing functional limitations at follow-up. In the case of ADL limitations, reporting poor sleep more than doubled the risk of incident disability. These associations were observed after accounting for a set of established disability risk factors, including older age, low educational attainment, chronic medical conditions, obesity, depression, and smoking. Moreover, with the exception of increases in IADL limitations between MIDUS 1 and MIDUS 2, the relationship between sleep problems and disability did not vary with age (and for IADLs, differences based on sleep problems were more evident in younger and middle-aged adults than older adults). Collectively, these results suggest that poor subjective sleep is a robust and independent risk factor for functional limitations and that this risk is not limited to later life.

Impaired or insufficient sleep has been linked to a variety of diseases and associated risk factors. Population-based studies have consistently shown that routine sleep duration that is shorter or longer than the optimal amount (typically 7 hours a night) predicts greater risk of mortality.[8–10,24] Objectively assessed poor sleep quality, often associated with disruptions due to sleep-disordered breathing, increases the risk of hypertension, diabetes mellitus, cardiovascular disease, stroke, disability, and mortality.[25–28] Subjective sleep ratings have also been linked to a range of adverse health outcomes, including diabetes mellitus, cardiovascular disease, and cardiac mortality.[14–16] In spite of these associations, few studies have focused on disability risk associated with poor sleep, and fewer still have involved representative population samples. Regional studies in Italy[29] and China[30] have linked poor subjective sleep quality to greater risk of disability, and a recent study in the United States reported greater risk of incident disability in members of the clergy who reported sleep problems.[17] The current study of a larger, community-based, nationally representative sample with a broader age range adds robust support to the conclusion that poor sleep is an independent risk factor for disability in older adults.

Poor sleep may lead to impaired function by way of a number of paths. Physical activity, for example, is protective against functional decline in older men and women. Subjective reports of poor sleep are linked to fatigue[31] that is often sufficient to limit daily activities in older adults.[32] Physical activity in adults who sleep poorly may thus be

reduced to levels that increase risk of functional limitations. Poor sleep is also linked to dysregulation of diverse physiological systems. For example, studies using objective and subjective assessments show that naturally occurring poor sleep is associated with higher circulating levels of inflammatory proteins.[33–37] In parallel experimental studies, sleep restriction reliably produced high levels of acute and chronic inflammation.[38–41] Inflammation in turn is linked prospectively with greater risk of disability,[42] and experimental studies highlight a role for inflammatory proteins in the loss of muscle tissue that can result in sarcopenia[43,44] and associated functional limitations. Poor sleep has also been shown to increase risk of obesity prospectively,[36,45,46] and obesity increases risk of disability.[6] There are thus multiple behavioral and physiological routes by which sleep may be linked to subsequent disability risk, although specific mechanisms have yet to be elucidated.

This study has several important limitations. Principally, MIDUS respondents reported sleep problems and functional limitations rather than them being assessed using objective measures. This leaves open the possibility that one or more unmeasured variables that capture a common subjective dimension explain their associations. A number of observations from the current study make this possibility less likely. In the subsample of respondents who completed an objective assessment of functional status—the timed walk—those who reported sleep problems 9 to 10 years earlier were significantly slower, independent of current sleep problems. Moreover, many MIDUS 1 respondents who reported no functional limitations claimed sleep problems, suggesting some independence of these measures, and those who reported sleep problems were twice as likely to develop substantial limitations in the intervening years. Finally, those who reported sleep problems had an average score on the PSQI, a widely used measure of sleep and sleep pathology, that was almost double that of people who reported none. All of these observations increase confidence that the observed links between sleep problems and functional status are not spurious. In addition, subjective reports of poor sleep often do not match the results of objective sleep assessments.[13,47,48] Nonetheless, subjective complaints of poor sleep are meaningfully linked to health outcomes independently of objectively determined sleep patterns,[49] the implication being that subjective and objective assessments capture unique aspects of sleep that are both important for understanding how sleep affects health.

Against these limitations are substantial strengths, including a large, nationally representative sample, a large time difference between the waves of data collections for assessing long-term change, and the availability of data with which to control for confounding and to probe for alternative explanations. The current results suggest that subjective reports of poor sleep significantly increase disability risk independently of demographic characteristics, socioeconomic status, health, or health behavior and that such risk extends to middle-aged men and women as well as older adults. These results add to a growing literature citing the importance of sleep to good health and the resulting need for effective ways to promote good sleep in the general population.[50]

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