

Correlates of Sleep Complaints in Adults: The ARIC Study

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Study Objectives: We investigated the prevalence and correlates of sleep complaints in a large well-characterized population.

Design: The Atherosclerosis Risk in Communities Study is a prospective population-based study of cardiovascular disease. Using this well-characterized cohort, we undertook a cross-sectional epidemiologic analysis of correlates of 3 sleep complaints that are commonly included in insomnia definitions. We hypothesized that different sleep complaints included under the rubric of “insomnia” would have different correlates. Using multivariate regression analysis we predicted the likelihood of endorsing the symptoms of difficulty falling asleep, difficulty staying asleep, and nonrestorative sleep by age, sex, alcohol intake, smoking, diabetes, heart disease, menopausal status, hypnotic use, hypertension, depression, education level, income, body mass index, respiratory symptoms, and pulmonary function.

Setting: North American communities.

Participants: 13,563 participants aged 47 to 69 years

Interventions: None.

Measurements and Results: The prevalences of sleep complaints were

22%, 39%, and 35% for difficulty falling asleep, difficulty staying asleep, and nonrestorative sleep, respectively. In contrast to previous reports, we found that Black race was associated with reduced risk of sleep complaints. We also found that increasing age was associated with difficulty staying asleep but not with difficulty falling asleep or nonrestorative sleep. Medical illness, depression, lower socioeconomic status, and unhealthy behaviors were associated with increased risk of sleep complaints, which varied by risk factor.

Conclusions: In a well-characterized population-based study, specific sleep complaints have differing covariates. It is likely that difficulty falling asleep and difficulty staying asleep have different causes and outcomes. Sleep difficulties do not appear to be associated with black race per se.

Keywords: Insomnia, sleep continuity disturbance, lifestyle, sleep maintenance, nonrestorative sleep, ethnicity, gender, aging, cigarette smoking, alcohol

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Sleep complaints and disorders are increasingly recognized and reported by patients to physicians.¹⁻³ Insomnia is the most commonly reported sleep complaint.⁴ The National Institutes of Health Working Group on Insomnia defines insomnia as *difficulty falling asleep, difficulty maintaining sleep, waking up too early in the morning, and/or nonrestorative sleep.*⁴ That report further notes that daytime consequences, such as fatigue, lack of energy,

difficulty concentrating, and irritability are “often” present and estimates that 30% to 40% of American adults report some level of insomnia within a given year.

The current American Psychiatric Association *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV) also includes complaints of difficulty initiating or maintaining sleep and/or nonrestorative sleep as symptoms of insomnia.⁵ The DSM-IV estimates that about one third of the general population presents at least 1 of these symptoms. The revised *International Classification of Sleep Disorders* (ICSD-R) also includes these symptoms,⁶ and both the DSM-IV and the ICSD-R require associated daytime impairment that is believed to be the consequence of the sleep disturbance. Most recently, the American Academy of Sleep Medicine Work Group for the Research Diagnostic Criteria for insomnia has published new research diagnostic criteria for insomnia, stressing that an insomnia disorder must include a daytime impairment (a wide and nonspecific array of these consequences is listed) but can include problems either with sleep onset or with sleep maintenance.⁷ The research diagnostic criteria for insomnia include subcategories such as “psychophysiologic” and “associated with a mental disorder,” although the diagnostic criteria do not reliably separate these groups.⁸ That document reviews published reports of insomnia definitions and prevalence and notes, “Although there has been general agreement that insomnia per se is a symptom and not necessarily an independent sleep disorder, there has been great variability in how this ‘symptom’ has been defined in the literature.” This echoes a similar conclusion reached by Ohayon, who points out that our understanding of the

Disclosure Statement

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prevalence and consequences of insomnia is impeded by lack of uniform diagnostic criteria and studies of well-defined populations.⁹ In short, “insomnia” has been so variously and loosely described in past epidemiologic studies that we do not have a good understanding of the prevalence and outcomes of its various components.

The Atherosclerosis Risk in Communities Study is a prospective population-based study of cardiovascular disease. The subjects are well described, and the data collected include information about sleep complaints. We undertook analysis of the Atherosclerosis Risk in Communities data to characterize the predictors and correlates of sleep complaints that are commonly included in insomnia definitions. Our hypothesis was that different sleep complaints included under the rubric of “insomnia” would have different predictors and correlates. Our aim was to describe the predictors of disturbed sleep, not necessarily insomnia disorders.

METHODS

Participants

The Atherosclerosis Risk in Communities study is a prospective study of the natural history and etiology of atherosclerotic disease and of cardiovascular disease event rates and is described in detail elsewhere.¹⁰ The study population is a probability sample of men and women aged 44 to 66 years (at the baseline examination) from 4 United States communities: Forsyth County, NC (Winston-Salem); Jackson, MS; Washington County, MD (Hagerstown); and suburbs of Minneapolis, MN. Baseline examinations, tests, and interviews were conducted during 1987 to 1989, and participants subsequently were contacted on an annual basis. Survivors were invited to take part in 3 follow-up data collections at intervals of approximately 3 years. In this analysis, we used data from the second visit conducted between 1990 and 1992 for establishment of behavioral and sociodemographic variables. The study objectives, design, sampling scheme, and cohort examination procedures have been described previously.¹⁰

Variable Measurement and Definitions

Most measurements reported here were collected at the second Atherosclerosis Risk in Communities examination (1990-1992). Three sleep complaints were available as part of the Maastricht questionnaire: Do you often have trouble falling asleep? Do you wake up repeatedly during the night? Do you ever wake up with a feeling of exhaustion and fatigue?¹¹

Education level was categorized as less than high school, completion of high school, or more than high school. Respondents with positive responses to “Have you ever smoked cigarettes?” and “Do you now smoke cigarettes?” were classified as “ever smokers” and “current smokers,” respectively. Current intake of beer, wine, and liquor was summarized as grams of ethanol per week. We defined a subject as having a respiratory symptom (used to characterize pulmonary status) if he or she responded positively to any of the following questions: Do you usually have a cough?, Do you usually bring up phlegm from your chest?, Does your chest ever sound wheezy or whistling apart from colds?, Do you have to walk slower than people of your age on the level because of breathlessness? and Are you too breathless to leave the house or breathless on dressing or undressing? Cardiac disease was considered present if the subject self-reported a myocardial

infarction, had a hospitalization for a myocardial infarction, or had evidence on the electrocardiogram of a myocardial infarction. Depression was assessed by use of the Maastricht Questionnaire, which correlates with the Hospital Anxiety and Depression Scale.¹² The 14 depressive symptoms from the Maastricht Questionnaire were used to define depression; a positive response on 4 or more items was considered indicative of depression for this analysis. Body mass index was calculated as weight divided by height squared (kg/m^2). Using a modification of the criteria developed by the Global Initiative for Chronic Obstructive Lung Disease (GOLD),¹³ subjects were classified according to their GOLD stages of pulmonary disease based on pulmonary function testing: GOLD stage 3 or 4 (forced expiratory volume in 1 second/forced vital capacity [FEV_1/FVC] < 0.70 and FEV_1 < 50% predicted), GOLD stage 2 (FEV_1/FVC < 0.70 and $\text{FEV}_1 \geq 50\%$ to < 80% predicted), GOLD Stage 1 (FEV_1/FVC < 0.70 and $\text{FEV}_1 \geq 80\%$), restricted ($\text{FEV}_1/\text{FVC} \geq 0.70$ and FVC < 80% predicted), GOLD stage 0 (presence of respiratory symptoms in the absence of any lung function abnormality), and no lung disease.¹³ Systolic and diastolic fifth-phase blood pressures were measured 3 times using a random 0 sphygmomanometer in the right arm in seated participants. The mean of the last 2 measurements was used in analyses. Hypertension was defined as a systolic blood pressure of > 160 mmHg or diastolic > 95 or the use of antihypertensives. Diabetes was defined as a fasting glucose of > 126 mg/dL, a non-fasting glucose > 200 mg/dL, or a self-reported history of or treatment for diabetes. Use of hypnotics and other medications was assessed by means of standardized questionnaire.

Analysis

All analyses were conducted with SAS version 8.2¹⁴ and SPSS version 10.¹⁵ The prevalence of each sleep complaint by age, sex, race, smoking status, alcohol ingestion, respiratory symptoms, education level, income level, depression inventory, body mass index, diabetes, hypertension, heart disease, menopausal status, pulmonary function (GOLD class), and use of hypnotics was included in the adjusted logistic regression models and the models were evaluated for interactions.

RESULTS

Data were available from 13,564 participants from the Atherosclerosis Risk in Communities study (Table 1). Two thousand nine hundred fourteen (21.5%) endorsed difficulty falling asleep, and 5173 (38.5%) endorsed waking up repeatedly. Of those participants who endorsed difficulty falling asleep, a majority (74%) also had problems with waking up repeatedly. Waking up exhausted was the most frequently endorsed symptom in this cohort reported by 35%.

Several interesting factors emerged among the demographic factors. Increasing age was associated with an increased awakening at night in a dose-dependent way. However, compared with the youngest individuals in this cohort, older participants were no more likely to endorse difficulty initiating or maintaining sleep and were less likely to report waking up feeling fatigued (Table 2). As has been consistently reported in the literature, women were more likely than men to endorse all 3 sleep complaints. Postmenopausal state was associated with increased problems falling asleep but not with staying asleep or with waking up fatigued. Those subjects who described themselves as Black were

Table 1—Demographics and Sleep Complaints of the Study Population.

	No. (%)	DFA, %	SCD, %	NRS, %		No. (%)	DFA, %	SCD, %	NRS, %
Age Category, y					Cardiac Disease				
45-49	1477 (10.9)	18.6	32.8	41.0	Yes	1700 (12.5)	31.8	52.1	46.9
50-54	3670 (27.1)	20.4	35.4	37.1	No	11863 (87.5)	20.0	36.1	33.3
55-59	3515 (25.9)	21.3	37.3	36.4	Lung Function*				
60-64	3181 (23.5)	22.4	41.0	30.8	GOLD 3 or 4	285 (2.1)	23.5	46.0	42.5
65-69	1720 (12.7)	25.1	44.9	30.2	GOLD 2	1400 (10.3)	22.4	36.9	34.2
Sex					GOLD 1	1313 (9.7)	17.4	35.7	29.9
Female	7482 (55.2)	27.8	42.1	42.1	GOLD 0	1439 (10.6)	32.8	50.4	48.0
Male	6081 (44.8)	13.8	33.3	26.3	Restricted	1697 (12.5)	26.3	44.3	40.5
Menopausal Status					Normal	7429 (54.8)	18.4	34.5	31.7
Premenopausal	774 (5.7)	16.4	34.6	41.9	Hypertension				
Perimenopausal	644 (4.8)	20.1	36.8	43.8	Yes	4806 (35.4)	24.6	42.8	36.1
Postmenopausal, natural	4115 (30.3)	29.8	43.6	39.5	No	8757 (64.6)	19.7	35.6	34.4
Postmenopausal, surgical	1239 (9.1)	30.8	44.6	45.9	Smoking Status				
Unknown	695 (5.1)	29.9	41.6	49.4	Current Smoker	3345 (24.7)	24.1	34.5	38.0
Race					Former Smoker	5112 (37.7)	18.3	39.7	31.1
Black	3213 (23.7)	24.7	39.2	39.7	Never Smoker	5106 (37.7)	23.0	39.0	36.9
White	10350 (76.3)	20.5	37.8	33.5	Alcohol Intake				
Education, years					Heavy	675 (5.0)	14.8	40.4	30.5
< 12	2906 (21.4)	31.6	46.9	38.3	Moderate	3936 (29.0)	18.2	35.3	31.1
12	4474 (33.0)	23.3	40.5	36.8	Light	3095 (22.8)	19.5	35.2	34.9
> 12	6183 (45.6)	15.5	32.3	32.1	Former Drinker	2817 (20.8)	24.6	43.8	36.8
Annual family income, \$					Never Drinker	3040 (22.4)	26.4	40.0	39.4
Unknown	769 (5.7)	22.2	38.9	35.6	Diabetes				
<16,000	2489 (19.1)	31.2	46.6	41.6	Yes	1992 (14.7)	27.2	46.4	38.2
16,000-49,999	6886 (50.8)	21.1	38.3	34.8	No	11571 (85.3)	20.5	36.7	34.4
≥50,000	3319 (24.5)	14.4	31.0	30.0	Hypnotic Use				
Body mass index, kg/m ²					Barbiturates	44 (0.3)	29.6	34.1	31.8
< 20	399 (2.9)	25.3	35.3	44.6	Antihistamines	104 (0.8)	51.9	59.6	45.2
20-24	3833 (28.3)	21.1	35.9	33.3	Benzodiazepines	148 (1.1)	68.9	65.5	58.8
25-29	5417 (39.9)	19.2	36.4	32.9	None	13267 (97.8)	20.2	37.7	34.7
≥ 30	3914 (28.9)	24.5	43.1	38.6	Total	13563	21.5	38.1	35.0
Depression									
Yes	4084 (30.1)	38.1	56.5	61.4					
No	9479 (69.9)	14.3	30.2	23.6					

The number of subjects in this analysis, stratified by age, sex, menopausal status, race, education level, income, body mass index, depression, presence of cardiac disease, lung function status, presence of hypertension, smoking status, alcohol intake, diabetes, and hypnotic use, and the proportion in each stratum reporting difficulty falling asleep, sleep continuity disturbance, and nonrestorative sleep. From the Atherosclerosis Risk in Communities Study. DFA refers to difficulty falling asleep; SCD, Sleep continuity disturbance; NRS, nonrestorative sleep.

*GOLD stage 3 or 4 ($FEV_1/FVC < 0.70$ and $FEV_1 < 50\%$ predicted), GOLD stage 2 ($FEV_1/FVC < 0.70$ and $FEV_1 \geq 50$ to $< 80\%$ predicted), GOLD Stage 1 ($FEV_1/FVC < 0.70$ and $FEV_1 \geq 80\%$), restricted ($FEV_1/FVC \geq 0.70$ and $FVC < 80\%$ predicted), GOLD stage 0 (presence of respiratory symptoms in the absence of any lung function abnormality), and no lung disease.

less likely to report problems with sleep onset and continuity than were Whites.

Those who reported incomes below \$50,000 and less than high school education were more likely to endorse trouble falling asleep and staying asleep but not nonrestorative sleep. In fact, those with less than high school education were less likely to wake up feeling unrefreshed.

Body mass index did not appear to be associated with sleep complaints, except for waking up fatigued in those who were underweight. On the other hand, those with diabetes were more likely to complain of having trouble falling asleep and staying asleep. In fact, medical and psychiatric illnesses were strongly associated with endorsement of sleep complaints. Depression was consistently and strongly associated with all 3 sleep complaints, as was heart disease. The association between pulmonary function and symptoms and sleep complaints was strongest for those reporting waking exhausted. Severe airflow obstruction, restrictive pulmonary physiology, and pulmonary symptoms with nor-

mal pulmonary function tests all predicted waking exhausted. Pulmonary symptoms, even in the absence of pulmonary-function abnormality, were associated with all 3 sleep complaints.

Former alcohol drinkers seemed to be the worst sleepers, endorsing difficulty with sleep onset and maintenance. Heavy and moderate drinkers were more likely to report waking up at night. Cigarette smokers had more trouble with sleep onset but actually reported fewer problems with sleep maintenance.

As expected, those taking any kind of sleeping pill had sleep complaints. The associations between hypnotic use and sleep complaints were strongest for the benzodiazepines.

DISCUSSION

This study has several strengths, including the large well-characterized population and the specificity of the sleep complaints surveyed. We have opted to assess the predictors and correlates of specific sleep complaints, rather than addressing the more problematic issue of insomnia. Waking up exhausted was reported by

Table 2—Odds Ratios and Confidence Intervals for Sleep Complaints

	No. (%)	Odds Ratios (confidence intervals)		
		DFA	SCD	NRS
Age Category, y				
45-49	1477 (10.9)	1.0	1.0	1.0
50-54	3670 (27.1)	1.0 (0.9, 1.3)	1.1 (0.9, 1.1)	0.8 (0.7, 0.96)*
55-59	3515 (25.9)	0.9 (0.7, 1.1)	1.1 (0.9, 1.3)	0.8 (0.7, 0.9)*
60-64	3181 (23.5)	0.9 (0.8, 1.1)	1.2 (1.1, 1.4)*	0.6 (0.5, 0.7)*
65-69	1720 (12.7)	1.0 (0.8, 1.2)	1.4 (1.2, 1.6)*	0.6 (0.5, 0.7)*
Sex				
Female	7482 (55.2)	1.0	1.0	1.0
Male	6081 (44.8)	0.8 (0.6, 0.98)*	0.8 (0.7, 0.9)*	0.6 (0.5, 0.7)*
Menopausal Status				
Premenopausal	774 (5.7)	1.0	1.0	1.0
Perimenopausal	644 (4.8)	1.1 (0.9, 1.5)	1.0 (0.8, 1.2)	1.0 (0.8, 1.3)
Postmenopausal, natural	4115 (30.3)	1.7 (1.4, 2.2)*	1.1 (0.9, 1.3)	0.9 (0.8, 1.1)
Postmenopausal, surgical	1239 (9.1)	1.8 (1.4, 2.2)*	1.1 (0.9, 1.4)	1.1 (0.9, 1.4)
Unknown	695 (5.1)	1.6 (1.3, 2.1)*	1.1 (0.9, 1.3)	1.1 (0.9, 1.4)
Race				
Black	3213 (23.7)	0.8 (0.7, 0.9)*	0.8 (0.7, 0.9)*	1.0 (0.9, 1.1)
White	10350 (76.3)	1.0	1.0	1.0
Education, years				
< 12	2906 (21.4)	1.7 (1.5, 1.9)*	1.3 (1.2, 1.5)*	0.9 (0.8, 0.95)*
12	4474 (33.0)	1.3 (1.1, 1.4)*	1.2 (1.1, 1.3)*	1.0 (0.9, 1.1)
> 12	6183 (45.6)	1.0	1.0	1.0
Annual family income, \$				
Unknown	769 (5.7)	1.1 (0.9, 1.4)	1.2 (0.97, 1.4)	1.0 (0.9, 1.2)
<16,000	2589 (19.1)	1.3 (1.1, 1.5)*	1.2 (1.1, 1.4)*	1.1 (0.9, 1.2)
16,00-49,999	6886 (50.8)	1.2 (1.04, 1.3)*	1.2 (1.05, 1.3)*	1.1 (1.01, 1.2)*
≥ 50,000	3319 (24.5)	1.0	1.0	1.0
Body mass index, mg/m ²				
< 20	399 (2.9)	1.0 (0.8, 1.3)	0.9 (0.7, 1.1)	1.4 (1.1, 1.8)*
20-24	3833 (28.3)	1.0	1.0	1.0
25-29	5417 (39.9)	0.8 (0.8, 1.00)	1.0 (0.9, 1.1)	1.0 (0.9, 1.1)
≥ 30	3914 (28.9)	0.9 (0.8, 1.01)	1.1 (0.96, 1.2)	1.0 (0.9, 1.1)
Depression				
Yes	4084 (30.1)	2.8 (2.5, 3.0)*	2.6 (2.4, 2.8)*	4.7 (4.3, 5.1)*
No	9479 (69.9)	1.0	1.0	1.0
Cardiac Disease				
Yes	1700 (12.5)	1.5 (1.4, 1.8)*	1.6 (1.4, 1.7)*	1.6 (1.4, 1.8)*
No	11863 (87.5)	1.0	1.0	1.0
Lung Function				
GOLD 3 or 4†	285 (2.1)	0.9 (0.7, 1.3)	1.3 (1.00, 1.7)	1.5 (1.1, 1.9)*
GOLD 2	1400 (10.3)	1.1 (0.9, 1.3)	1.0 (0.9, 1.1)	1.1 (0.96, 1.3)
GOLD 1	1313 (9.7)	1.0 (0.8, 1.1)	1.1 (0.9, 1.2)	1.0 (0.9, 1.2)
GOLD 0	1439 (10.6)	1.6 (1.4, 1.8)*	1.5 (1.4, 1.7)*	1.5 (1.4, 1.3)*
Restricted	1697 (12.5)	1.1 (0.98, 1.3)	1.2 (1.1, 1.4)*	1.2 (1.1, 1.4)*
Normal	7429 (54.8)	1.0	1.0	1.0
Hypertension				
Yes	4806 (35.4)	1.1 (1.00, 1.2)	1.1 (1.03, 1.2)*	1.0 (0.9, 1.1)
No	8757 (64.6)	1.0	1.0	1.0
Smoking Status				
Current Smoker	3345 (24.7)	1.2 (1.04, 1.3)*	0.8 (0.7, 0.9)	1.0 (0.9, 1.2)
Former smoker	5112 (37.7)	0.9 (0.8, 0.96)*	1.0 (0.9, 1.1)	0.9 (0.8, 1.01)
Never smoker	5106 (37.7)	1.0	1.0	1.0
Alcohol Intake				
Heavy	675 (5.0)	1.0 (0.8, 1.3)	1.6 (1.3, 1.9)*	1.1 (0.9, 1.3)
Moderate	3936 (29.0)	1.2 (1.02, 1.3)*	1.2 (1.1, 1.3)*	1.0 (0.9, 1.1)
Light	3095 (22.8)	1.0	1.0	1.0
Former drinker	2817 (20.8)	1.2 (1.03, 1.4)*	1.2 (1.1, 1.4)*	1.0 (0.9, 1.2)
Never drinker	3040 (22.4)	1.2 (1.00, 1.3)	1.0 (0.9, 1.1)	1.1 (0.95, 1.2)
Diabetes				
Yes	1992 (14.7)	1.2 (1.02, 1.3)*	1.2 (1.1, 1.3)*	1.0 (0.9, 1.1)
No	11571 (85.3)	1.0	1.0	1.0
Hypnotic Use				
Barbiturates	44 (0.3)	1.4 (0.7, 2.8)	0.7 (0.4, 1.4)	0.8 (0.4, 1.6)
Antihistamines	104 (0.8)	4.4 (2.9, 6.7)*	2.4 (1.6, 3.6)*	1.5 (0.98, 2.3)
Benzodiazepines	148 (1.1)	8.2 (5.5, 12.3)*	2.6 (1.8, 3.7)*	2.3 (1.6, 3.2)*
None	13267 (97.8)	1.0	1.0	1.0
Total	13,563			

Results of logistic regression model predicting sleep complaints, controlling for age, sex, menopausal status, race, education level, income, body mass index, depression, presence of cardiac disease, lung function status, presence of hypertension, smoking status, alcohol intake, diabetes, and hypnotic use. DFA refers to difficulty falling asleep; SCD, sleep continuity disturbance; NRS, nonrestorative sleep.

* $p < .05$

†GOLD stage 3 or 4 (forced expiratory volume in 1 second/forced vital capacity [FEV₁/FVC] < 0.70 and FEV₁ < 50% predicted), GOLD stage 2 (FEV₁/FVC < 0.70 and FEV₁ ≥ 50% to < 80% predicted), GOLD Stage 1 (FEV₁/FVC < 0.70 and FEV₁ ≥ 80%), restricted (FEV₁/FVC ≥ 0.70 and FVC < 80% predicted), GOLD stage 0 (presence of respiratory symptoms in the absence of any lung function abnormality), and no lung disease.¹³

35% of the subjects in this cohort. While this complaint is frequently included in definitions of insomnia, it is important to remember that nonrestorative sleep has many medical and psychiatric causes as well. Waking up repeatedly was reported by 38%, and difficulty going to sleep was reported by 22%. These numbers correlate reasonably well with prevalence estimates of insomnia reported previously,^{4,5,7,16} though most reports do not break insomnia into its components of each of the 3 or 4 possible complaints, nor do they include frequency and duration criteria. In this cohort, difficulty falling asleep was only half as prevalent as was waking up exhausted.

The relationship between sleep complaints and aging in this cohort is complex. The raw prevalence rates for all 3 sleep complaints increase with age but, after multivariate analysis, only waking up repeatedly remains significantly higher in the older participants. In fact, after controlling for the covariates, the older people in this group were less likely to report waking up exhausted. Many past surveys have reported increased sleep complaints with aging.¹⁶⁻²¹ Our study, which controlled for medical illnesses, income, and lifestyle, suggests that it is not age per se that results in increasing sleep complaints but, rather, the increased burden of medical illness. This confirms findings by others.^{9,22,23} It is also important to note the rather narrow age range of our participants: from 45 to 69 years. However, this does include the “watershed” years of middle age; we did not see increased reports of sleep complaints in the study participants over this age range.

We were also surprised to find that Black people reported fewer sleep complaints than did White people, controlling for all other variables, including education and income. Although the raw percentages of sleep complaints among Black people were higher than those of Whites, in the multivariate models the Black-White differences change, suggesting that other factors (such as education, income, or comorbidity) are more influential. These findings conflict with those of Foley et al,²⁴ who found that Black women were more likely than White women or than men to endorse difficulty staying asleep or difficulty falling asleep. These investigators were able to control for physical and mental health but not for socioeconomic status. A report of correlates of sleepiness in the Cardiovascular Health Study²⁵ noted that elderly Black men were less likely to report frequent nocturnal awakenings than other racial groups.

Lower income and educational attainment, on the other hand, predicted sleep complaints, controlling for other variables. Insomnia has been reported to be higher in those with lower incomes and lower education,^{16,26} but these have not been consistent findings, particularly in studies that have used multivariate analyses.⁹ Our finding of increased sleep complaints in those with lower education and income, controlling for other covariates, may partly address a concern expressed by Ohayon, “The use of an index that takes into account age, education, household income, and size of the household would give a better indication about the importance of poverty in insomnia.”⁹

As has been previously and consistently reported, we found that women were more likely than men to report all sleep complaints.^{9,16,19,21} In fact, the female predilection to insomnia complaints begins with menarche.²⁷ While women are more likely to be diagnosed with insomnia than are men at all ages, the differential in rates of sleep complaints between men and women increases with age.²⁸ Some of this difference may be attributable to changes occurring with menopause. For example, Maertens et al²⁹

reported that “insomnia complaints” (derived from a questionnaire) are increased in both perimenopausal and postmenopausal women compared with premenopausal women. Our study confirmed that postmenopausal women, whether by natural or surgical means, were more likely to complain of trouble falling asleep but not of staying asleep. This replicates the work of Young et al.³⁰ It is important to note that sleep complaints may not always accurately reflect sleep quality. In fact, Young concluded “Although perimenopausal and postmenopausal women were less satisfied with their sleep, relative to premenopausal women, menopause was not a strong predictor of specific sleep-disorder symptoms. Symptoms and signs of sleep abnormalities in midlife women should not be attributed primarily to menopause before ruling out underlying sleep disorders.”³⁰

Depression was the most consistent and robust predictor of endorsement of all sleep complaints. This is a consistent finding in the literature,^{9,20} and is not surprising considering that sleep complaints are often considered part of the definition of depression.^{5,7,9} We also confirmed the previously reported associations between several medical illnesses and sleep complaints. Of particular interest is the consistent relationship between Stage 0 GOLD status (cough and or dyspnea with normal pulmonary function) with all 3 sleep complaints. Klink and Quan have previously reported that respiratory complaints are associated with sleep complaints.³¹

Several behavioral factors were associated with sleep complaints. Cigarette smokers were more likely to report difficulty with sleep onset than were nonsmokers or never-smokers. Cigarette smoking has previously been reported to be a risk factor for sleep complaints.^{32,33} In a carefully done study, Riedel et al³⁴ recently reported that light smoking, but not heavier smoking, is associated with increased reports of chronic insomnia and less sleep time. Unfortunately, we do not know which component of insomnia was increased in the smokers. Associations between cigarette smoking and other sleep disorders, including sleep-disordered breathing^{35,36} and restless legs syndrome^{37,38} have also been reported, though the findings are not consistent.³⁹ Since both restless legs syndrome and sleep-disordered breathing can interfere with sleep onset, it is possible that some of the difference for this variance results from differing definitions or criteria for insomnia and unrecognized coexisting sleep disorders.

Acute and chronic alcohol use, as well as abstinence, are well known to disturb sleep.⁴⁰ In this study, even moderate drinking was associated with an increased risk of waking up repeatedly (but not other sleep complaints). However, light drinkers appeared to be least likely to endorse sleep complaints, and former drinkers most likely. We speculate that former drinkers may be abstinent alcoholics, a population known to have chronic sleep disruption.⁴⁰ This finding is somewhat at variance with the findings of Crum et al,⁴¹ who reported, “Individuals with persistent alcohol dependence have greater odds of insomnia than those whose alcohol dependence remits” in a report of follow-up of 248 individuals with chronic alcohol dependence. While the study of Crum et al controlled for important confounders, insomnia was not precisely defined.

These findings may help the clinician evaluate patients with sleep complaints. For example, aging or Black people are not necessarily predisposed to sleep complaints on the basis of demographics and may need investigation of medical or psychiatric causes. Smokers can be told that cigarette smoking may interfere with their ability to fall asleep. When controlling for other vari-

ables, postmenopausal women are likely to report difficulty falling asleep; those who report difficulty staying asleep may have other problems.

Fatigue is an extremely common and nonspecific complaint, endorsed by nearly half of these participants. While it is associated with cardiopulmonary disease, it predicts depression more robustly than the other sleep complaints that we evaluated.

This large population-based study of a well-defined cohort confirmed several previously established correlates of sleep complaints, including female sex, age, depression, socioeconomic status, and burden of medical illness. We are unable to confirm associations between age, race, and sleep complaints. In this study, each of these 3 complaints was associated with different correlates. It is likely that "insomnia" is a heterogeneous condition, with a variety of predisposing factors and likely outcomes. More work needs to be done to determine if there are differences in patient outcomes by type of complaint, eg, difficulty with going to sleep versus difficulty staying asleep.

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