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## Association of Insufficient Sleep With Respiratory Infection Among Adults in the United States

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Sleep is increasingly recognized as an important determinant of health and well-being. Approximately 50 million to 70 million Americans have either a sleep disorder or habitually insufficient sleep.<sup>1</sup> How insufficient sleep ultimately affects disease risk remains unclear. Experimental evidence demonstrates that sleep loss can adversely affect components of the immune system critical to host resistance to infectious illness. Furthermore, short sleep duration and sleep disturbances prospectively predict increased susceptibility to upper respiratory infection after an experimental viral challenge.<sup>2,3</sup> Despite this evidence and the common belief that risk of infectious illness increases during periods of insufficient sleep, to our knowledge this has not been investigated at the population level. We examined associations between self-reported measures of sleep and the probability of occurrence of colds and infections, including influenza, pneumonia, and ear infections, in a nationally representative sample of adults.

### Methods

Participants were 22 726 Americans (mean [SE] age, 46.2 [0.3] years) enrolled in the 2005 to 2012 National Health and Nutrition Examination Surveys (NHANES), an ongoing, multistage survey administered by the National Center for Health Statistics. The need for institutional review board approval was waived by the University of California– San Francisco Institutional Review Board because this study was a secondary analysis of deidentified data. Participants reported their typical weekday sleep duration in hours, whether a physician had ever diagnosed a sleep disorder in them, and if they had ever told a

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**Author Contributions:** Drs Prather and Leung had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

*Study concept and design:* Prather.

*Acquisition, analysis, or interpretation of data:* Both authors.

*Drafting of the manuscript:* Prather.

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physician that they had trouble sleeping. Participants also reported on whether they had a head or chest cold (yes or no) or an infection, including influenza, pneumonia, or an ear infection (yes or no) in the past 30 days. To account for possible confounding, analyses were adjusted for age, sex, race/ethnicity, highest educational attainment, household income, marital status, smoking status, physical activity, body mass index (BMI), and survey year. Multivariable logistic regression models were used to examine associations between sleep and odds of a cold or other infection. All analyses incorporated weights from the mobile examination center recalculated to reflect the probability of a visitor to the examination center being sampled during the study period.

## Results

Among the study participants, 13.6% reported sleeping for 5 hours or less per night, 23.0% reported sleeping for 6 hours, 56.3% for 7 to 8 hours, and 7.1% for 9 hours or more. A diagnosis of a sleep disorder had been made in 7.1% of the participants, and 25.0% reported having told a physician that they had trouble sleeping. Compared with participants who slept for 7 to 8 hours, short sleepers (< 5 hours) were more likely to report a head or chest cold (odds ratio [OR], 1.28; 95% CI, 1.10–1.48) and infection (OR, 1.82; 95% CI, 1.42–2.34) in the past 30 days according to results of a multivariable logistic regression analysis that adjusted for age and sex (Table). No such associations were observed among those who slept 6 and 9 or more hours. Similarly, adults who reported ever having had a diagnosed sleep disorder or disclosing trouble sleeping to a physician were also more likely to report a head or chest cold (sleep disorder: OR, 1.30; 95% CI, 1.09–1.54; trouble sleeping: OR, 1.29; 95% CI, 1.15–1.45) and infection (sleep disorder: OR, 2.15; 95% CI, 1.63–2.83; trouble sleeping: OR, 1.73; 95% CI, 1.45–2.06). Similar associations were observed in multivariable logistic regression analysis that adjusted for our additional covariates (Table).

## Discussion

In a nationally representative sample of adults, self-reported short sleep duration, a physician's diagnosis of a sleep disorder, and reported trouble with sleeping was associated with a greater likelihood of a cold or infection or both in the past 30 days. This is consistent with the findings in experimental studies using viral-challenge paradigms<sup>2,3</sup> and a prospective analysis linking both short and long sleep duration with increased risk of pneumonia.<sup>4</sup> The cross-sectional nature of the data in our study precludes any causal inferences, and the bidirectional relationship between sleep and the immune system is well established.<sup>5</sup> However, the absence of an association between long sleep and illness increases our confidence that sleep contributes to susceptibility to infectious illness rather than vice versa. This finding adds to the growing scientific literature linking sleep with physical health. It may be time that sleep assessments become more commonplace in medical settings, as sleep may serve as yet another vital sign for health.<sup>6</sup>

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Table

## Self-reported Sleep and Rates of Colds and Infections

Characteristic	Incidence of Head or Chest Colds or of Infections, No. (Weighted %)	Model 1, OR (95% CI) <sup>a</sup>	P Value	Model 2, OR (95% CI) <sup>b</sup>	P Value
<b>Head or Chest Colds</b>					
Sleep duration, h					
5	624 (19.0)	1.28 (1.10–1.48)	.001	1.17 (1.01–1.35)	.04
6	828 (16.1)	1.04 (0.94–1.16)	.43	1.02 (0.91–1.14)	.75
7–8	1779 (15.5)	1 [Reference]		1 [Reference]	
9	253 (15.7)	1.03 (0.89–1.20)	.69	0.97 (0.83–1.14)	.73
Sleep disorder					
Yes	307 (18.9)	1.30 (1.09–1.54)	.003	1.18 (0.99–1.42)	.06
No	3186 (15.9)	1 [Reference]		1 [Reference]	
Sleep disturbance					
Yes	924 (18.3)	1.29 (1.15–1.45)	<.001	1.27 (1.13–1.42)	<.001
No	2571 (15.4)	1 [Reference]		1 [Reference]	
<b>Infections<sup>c</sup></b>					
Sleep duration, h					
5	188 (5.9)	1.82 (1.42–2.34)	<.001	1.51 (1.18–1.93)	.001
6	193 (3.4)	1.05 (0.82–1.34)	.71	0.97 (0.76–1.25)	.82
7–8	407 (3.3)	1 [Reference]		1 [Reference]	
9	63 (2.9)	0.93 (0.73–1.19)	.58	0.83 (0.65–1.06)	.14
Sleep disorder					
Yes	113 (7.0)	2.15 (1.63–2.83)	<.001	1.88 (1.39–2.53)	<.001
No	741 (3.4)	1 [Reference]		1 [Reference]	
Sleep disturbance					
Yes	281 (5.3)	1.73 (1.45–2.06)	<.001	1.67 (1.38–2.03)	<.001
No	576 (3.1)	1 [Reference]		1 [Reference]	

<sup>a</sup>Model 1 includes adjustment for age and sex.<sup>b</sup>Model 2 includes adjustment for age, sex, race/ethnicity, educational attainment, household income, marital status, smoking status, physical activity, body mass index, and survey year.

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Infections include influenza, pneumonia, and ear infection.

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