

# Mortality Risk Associated with Sleeping Patterns Among Adults

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**Summary:** The mortality risk associated with different sleeping patterns was assessed by use of the 1965 Human Population Laboratory survey of a random sample of 6928 adults in Alameda County, CA and a subsequent 9-year mortality follow-up. The analysis indicates that mortality rates from ischemic heart disease, cancer, stroke, and all causes combined were lowest for individuals sleeping 7 or 8 h per night. Men sleeping 6 h or less or 9 h or more had 1.7 times the total age-adjusted death rate of men sleeping 7 or 8 h per night. The comparable relative risk for women was 1.6. The association between sleeping patterns and all causes of mortality was found to be independent of self-reported trouble sleeping and self-reported physical health status at the time of the 1965 survey. Simultaneous adjustment for age, sex, race, socioeconomic status, physical health status, smoking history, physical inactivity, alcohol consumption, weight status, use of health services, social networks, and life satisfaction reduced the relative mortality risk associated with sleeping patterns to 1.3 ( $p \leq 0.04$ ). **Key Words:** Mortality—Population studies—Sleep.

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The mortality risk associated with different sleeping patterns has received relatively little attention. The two major sources of information on this topic are the prospective study, described herein, initiated in 1965 by the Human Population Laboratory in Alameda, CA, and a nationwide prospective study initiated by the American Cancer Society in 1959-1960 (1-3). In the last and most detailed report of sleeping habits from that series, analyses indicate that men 30 years or older who usually slept under 4 h per night were 2.8 times as likely to die within 6 years as those who slept 7 or 8 h, whereas those who slept over 10 h were 1.8 times as likely to die. Comparable ratios for women were 1.5 and 1.8. These differences remained statistically significant when controlled for age and a history of illness (heart disease, high blood pressure, diabetes and/or stroke). Analyses also indicated that extremely long or short nightly sleep was associated with mortality from heart disease, stroke, cancer, and suicide.

The Human Population Laboratory has previously reported that sleeping 7 or 8 hours

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per night was cross-sectionally associated with good physical health status in both men and women (4) and prospectively associated with reduced 6- and 9-year mortality risks from all causes (5,6). In addition a multivariate analysis demonstrated that sleeping patterns were associated with mortality risk from all causes when controlled for age, sex, physical health status, and a number of other social and behavioral factors (7).

This report presents in more detail the 9-year mortality risk associated with sleeping patterns in adults between the ages of 30 and 69 years in the Alameda County study, while considering various possible confounders of the relationship. Data are presented separately for men and women and for specific causes of death, as well as death from all causes.

## METHODS

In 1965 the Human Population Laboratory of the California State Department of Health Services surveyed a random sample of Alameda County residents (8). An extensive questionnaire, returned by 86% of those contacted, included information on number of hours usually slept, sleep problems, age, sex, and physical health status. The present analysis is restricted to 2222 men and 2491 women between 30 and 69 years of age in 1965.

Mortality data were collected for the 9-year period 1965 to 1974 for 97% of those responding to the 1965 survey. To obtain death certificates for those who had died within the state, a computer-matching file was created with the California Death Registry (9). Out-of-state death clearance information was obtained for those respondents who moved out of state during this period. Through these methods death certificates were obtained for 210 men and 159 women aged 30–69 years in 1965. An extensive follow-up survey in 1974 located all but 149 persons, or 3% of the present sample. Since those lost to follow-up did not differ markedly in health status as determined in the 1965 survey, their death rate is probably similar to that of the whole sample. The collection of mortality data, therefore, seems fairly complete and unbiased.

Cause-specific mortality rates were calculated for men and women by the number of hours they reported sleeping per night. Significant differences were tested using the chi-square statistic. Age-adjusted death rates were calculated by the indirect method and significant differences tested by the Mantel-Haenszel (10) summary chi-square statistic. Relative mortality risks were calculated using the above rates to compare those reporting sleeping 6 h or less or 9 h or more per night with those reporting 7 or 8 h per night.

A multiple logistic analysis (11) was used to assess the relative mortality risk associated with sleeping patterns, while controlling for several other risk factors. The mortality risk ( $R$ ) for  $k$  risk factors ( $x_1, x_2, \dots, x_k$ ) is represented by the equation

$$R = \frac{1}{1 + e^{-(B_0 + B_1 x_1 + \dots + B_k x_k)}}$$

The logistic coefficients ( $B_0, B_1, \dots, B_k$ ) are estimated by the method of maximum likelihood. Approximate relative risk per unit change in the level of risk factor,  $x_i$ , is  $e^{B_i x_i}$ .

# RESULTS

Nearly 78% of both men and women reported sleeping 7 or 8 h per night, with 16% reporting 6 h or less and 7% reporting 9 h or more. The distribution of sleeping hours among men changed little with age, while more women reported sleeping 6 h or less and fewer reported sleeping 7 or 8 h at older ages.

Age and sex-specific mortality rates from all causes are presented in Table 1, grouped according to reported number of hours slept per night. For both men and women, those sleeping 7 or 8 h per night had the lowest death rates at almost every age. After adjusting for age differences, men sleeping 6 h or less or 9 h or more per night had 1.7 times the death rate of men sleeping 7 or 8 hours per night. The comparable relative risk for women was 1.6.

Age-adjusted mortality rates are presented in Table 2, by both number of hours slept per night and reported trouble sleeping. Both men and women sleeping 7 or 8 h per night had the lowest mortality rates, whether they reported often, sometimes, or never having trouble sleeping. Overall, persons reporting never having trouble sleeping had the lowest mortality rates, although this was not always the case.

Table 3 assesses whether the number of hours a person sleeps per night predicts mortality, independent of health status. With only two exceptions, men and women sleeping 7 or 8 h per night had the lowest mortality rates.

A multivariate analysis of the mortality risk associated with sleeping patterns is presented in Table 4. Persons sleeping 6 h or less or 9 or more per night had 1.3 times the death rate of persons sleeping 7 or 8 h per night. Their death rate over the 9-year period was 30% higher. This difference was statistically significant ( $p = 0.04$ ) when controlling for differences in age, sex, health status and other social and behavioral factors.

TABLE 1. Age-specific and age-adjusted mortality rates per 100 by number of hours slept per night: Men and women aged 30–69 years, Alameda County, CA, 1965–1974

Age	Number of hours slept per night			Total
	≤6	7,8	≥9	
Men				
30–49	7.9 (227)	2.8 (1093)	3.8 (78)	3.7 (1398)
50–59	22.7 (75)	11.4 (394)	19.4 (31)	13.6 (500)
60–69	32.0 (50)	26.7 (251)	— <sup>a</sup> (23)	27.8 (324)
Age-adjusted <sup>b</sup>	14.8 (352)	8.2 (1738)	11.1 (132)	9.4 (2222)
Women				
30–49	5.3 (209)	2.8 (1209)	2.6 (114)	3.1 (1532)
50–59	10.3 (97)	7.0 (426)	10.0 (50)	7.8 (573)
60–69	22.5 (80)	14.1 (270)	27.8 (36)	17.1 (386)
Age-adjusted <sup>c</sup>	9.0 (386)	5.6 (1905)	8.5 (200)	6.4 (2491)

Values indicate the percentage who died during the period; the number of individuals is given in parentheses.

<sup>a</sup> Rates not calculated for cells with 30 or fewer individuals.

<sup>b</sup> Significant difference in age-adjusted death rates by sleeping patterns, based on Mantel-Haenzsel (10) chi-square statistic:  $p \leq 0.001$ .

<sup>c</sup> Significant difference in age-adjusted death rates by sleeping patterns, based on Mantel-Haenzsel (10) chi-square statistic:  $p \leq 0.01$ .

**TABLE 2.** Age-adjusted mortality rates per 100 by number of hours slept per night and reported trouble sleeping: Men and women aged 30–69 years, Alameda County, CA, 1965–1974

Reported trouble sleeping	Number of hours slept per night			Total
	≤6	7,8	≥9	
<b>Men</b>				
Often	19.0 (78)	9.0 (53)	— <sup>a</sup> (2)	15.7 (133)
Sometimes	11.3 (132)	9.0 (629)	— (29)	9.3 (790)
Never	15.5 (142)	7.6 (1053)	11.5 (101)	8.7 (1296)
Total	14.8 (352)	8.2 (1735)	11.2 (132)	9.4 (2219)
<b>Women</b>				
Often	8.9 (132)	3.4 (108)	— (9)	6.9 (249)
Sometimes	8.8 (155)	6.1 (882)	10.6 (80)	7.0 (1117)
Never	9.7 (99)	5.2 (912)	6.6 (111)	5.8 (1122)
Total	9.0 (386)	5.6 (1902)	8.4 (200)	6.4 (2488)

Values are the percentage who died during the period; the number of individuals is given in parentheses.

<sup>a</sup> Rates not calculated for cells with 30 or fewer individuals.

Finally, Table 5 demonstrates that men and women sleeping 7 or 8 h per night generally had lower death rates from ischemic heart disease, cancer, and stroke. The exceptions are ischemic heart disease mortality in women and other causes in men, where individuals sleeping 9 h or more had the lowest rates. The aforementioned differences were not always statistically significant, possibly because of small sample sizes.

## DISCUSSION

The foregoing analyses indicate that in this population mortality rates were lowest for individuals sleeping 7 or 8 h per night, whether considering ischemic heart disease,

**TABLE 3.** Age-adjusted mortality rates per 100 by number of hours slept per night and physical health status: Men and women aged 30–69 years, Alameda County, CA, 1965–1974

Physical health status	Number of hours slept per night			Total
	≤6	7,8	≥9	
<b>Men</b>				
Disability	24.9 (44)	21.0 (100)	— <sup>a</sup> (18)	22.6 (162)
Chronic condition	13.4 (137)	7.9 (592)	3.5 (45)	10.2 (774)
Symptoms	11.1 (88)	6.7 (423)	15.2 (34)	8.0 (545)
No health problem	11.1 (83)	6.1 (623)	6.7 (35)	6.6 (741)
Total	14.8 (352)	8.2 (1738)	11.1 (132)	9.4 (2222)
<b>Women</b>				
Disability	14.7 (80)	12.0 (178)	21.4 (32)	13.8 (290)
Chronic condition	6.9 (162)	5.4 (630)	6.5 (72)	5.8 (864)
Symptoms	5.3 (101)	3.9 (598)	0.0 (49)	3.8 (748)
No health problem	7.5 (43)	4.1 (499)	7.4 (47)	4.7 (589)
Total	9.0 (386)	5.6 (1905)	8.5 (200)	6.4 (2491)

Values are the percentage who died during the period; the number of individuals is given in parentheses.

<sup>a</sup> Rates not calculated for cells with 30 or fewer individuals.

**TABLE 4.** *Nine-year mortality risk of sleeping patterns: A multiple logistic analysis of men and women aged 30–69 years, Alameda County, CA, 1965–1974*

Variable (high/low category)	Approximate relative risk		
	Logistic coefficient	Relative risk <sup>a</sup>	Significance probability
Sleeping patterns ( $\leq 6$ or $\geq 9/7$ or 8 h)	0.2699	1.3	0.04
Potential confounders			
Age (69/30)	0.0838	26.3	0.00
Sex (male/female)	0.5476	1.7	<0.001
Physical health status (disabled/healthy)	1.1148	3.0	<0.001
Smoking history (ever/never)	0.6243	1.9	<0.001
Physical inactivity (inactive/active)	0.3037	1.4	0.02
Alcohol consumption (high/low)	0.4083	1.5	0.01
Social networks (few/many)	0.2460	2.1	<0.001

There was no significant ( $p > 0.05$ ) independent increase in risk due to: race, socioeconomic status, weight state, use of health services, or life satisfaction.

<sup>a</sup> Approximate relative mortality risk (odds ratio) for high compared with low risk category.

cancer, stroke, or all causes combined. Men sleeping 6 h or less or 9 h or more had 1.7 times the total age-adjusted death rate of men sleeping 7 or 8 h per night, a 70% higher death rate over the 9-year period. The comparable relative risk for women was 1.6.

The number of hours a person sleeps may reflect the amount of sleep he or she needs or is able to get, for example, owing to work schedules or trouble sleeping. The latter may in turn reflect ill health and an increased likelihood of death. However, the association between sleeping patterns and all-cause mortality was found to be independent of self-reported trouble sleeping. Both men and women sleeping 7 or 8 h per night had the lowest mortality rates, whether they reported often, sometimes, or never having trouble sleeping. Accounting for ill health directly also failed to eliminate the

**TABLE 5.** *Cause-specific mortality rates per 100 by number of hours slept per night: Men and women aged 30–69 years, Alameda County, CA, 1965–1974*

Cause of death	Number of deaths	Number of hours slept per night			Total
		≤6	7,8	≥9	
Men					
All causes <sup>a</sup>	210	14.5	8.2	12.1	9.5
Ischemic heart disease	80	4.3	3.3	5.3	3.6
Cancer	40	2.8	1.5	3.0	1.8
Stroke	25	1.7	0.9	2.3	1.1
Other <sup>b</sup>	65	5.7	2.5	1.5	2.9
Women					
All causes <sup>a</sup>	159	10.1	5.4	9.0	6.4
Ischemic heart disease	39	3.6	3.3	2.0	1.6
Cancer	43	2.8	1.5	2.0	1.7
Stroke	25	1.0	0.9	2.0	1.0
Other <sup>b</sup>	52	2.6	1.9	3.0	2.1

<sup>a,b</sup> Significant difference in death rates by sleeping patterns, based on chi-square statistic: *a*,  $p \leq 0.001$ ; *b*,  $p \leq 0.01$ .

association between sleeping patterns and mortality. Men and women sleeping 7 or 8 h per night generally had the lowest mortality rates, independently of their having reported disabilities, chronic conditions, or other symptoms of ill health at the time of the 1965 survey.

Other factors that might account for the association of sleeping patterns and mortality include other health practices (i.e., smoking) and social networks (i.e., marriage) that are associated with mortality (6,12). For example, if individuals who sleep 6 h or less per night are more likely to smoke cigarettes, their death rates will be higher, perhaps solely owing to their smoking. A multivariate analysis including these variables lowered the relative risk of mortality associated with sleeping. However, after adjustment, individuals sleeping 6 h or less or 9 h or more still had 1.3 times the 9-year death rate of persons sleeping 7 or 8 hours per night, a 30% higher death rate.

These analyses indicate that sleeping patterns are associated with mortality risk and that this relationship is not entirely due to reported trouble sleeping, ill health, age, sex, or any of a number of other risk factors considered. Further research should explore why this relationship remains—i.e., some associated factor not yet considered or the actual experience of sleep. It would also be useful to differentiate between those individuals who sleep as much as they feel they need or want, and those whose sleeping patterns are dictated by other factors in their life style.

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