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Over 8 Hours of Sleep – Marker of Increased Mortality in Mediterranean Population: Follow-up Population Study

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Aim. To investigate night and total sleep duration in relation to all-cause, cardiovascular, and non-cardiovascular mortality, controlling for recognized predictors of mortality in a population where the practice of siesta is common.

Methods. Our community-based sample included 1,842 residents (1,001 women) of a West Jerusalem neighborhood, aged 50 years and over. The study was conducted in the 1985-87 period, with a response rate of 85%. The participants were followed-up for 9-11 years. At the beginning of the study, the participants were asked at what time they usually fell asleep at night and awoke in the morning, and the average duration of their daytime nap if they slept during the day. Cox survival analysis was used to predict time to death for all-cause, cardiovascular, and non-cardiovascular mortality.

Results. The overall number of deaths was 403 (205 women), which included 170 deaths from cardiovascular causes (93 women). Men who reported long total sleep duration (>8h) had a substantially elevated risk of all-cause mortality (adjusted hazard ratio, 2.1; 95% confidence interval [CI], 1.2-3.7), and a stronger association with cardiovascular mortality (hazard ratio, 2.9; 95% CI, 1.2-7.1). The population attributable risk associated with more than 8 h of sleep was 12% (95% CI, 4-21%) for total mortality and 17% (95% CI, 4-33%) for cardiovascular causes of death. There was no significant association in women, although those who slept 6-8 h seemed to have the lowest risk.

Conclusions. Duration of sleep is an important risk marker of mortality also in populations that practice afternoon siesta.

Key words: *cardiovascular diseases; circadian rhythm; epidemiology; Mediterranean region; mortality; sleep*

People are often concerned with quality and duration of their sleep, as a reflection of their well-being. There is some evidence that prolonged sleep is associated with higher morbidity and mortality (1-8). Large prospective studies conducted in the USA documented an optimal survival of men and women who slept 7 h per night and excess mortality associated with sleep duration of 8 h or more (1-4). Excess mortality associated with longer sleep has also been observed in smaller studies in the USA (5), UK (6), and Japan (7). Longer sleep (>8 h) has also been associated with excess risk of coronary heart disease and stroke among American men and women (8). There is, obviously, rather consistent evidence that duration of sleep may be an independent risk marker for morbidity and mortality in populations that traditionally do not practice taking afternoon naps.

Yet little is known about mortality associated with sleep patterns in Mediterranean countries that engage in the time-honored practice of siesta. In such countries, it has been argued that short afternoon naps that healthy adults usually take might be beneficial as a stress-alleviating mechanism (9,10). The effects of a short daytime nap have also been linked to an increase in alertness and may compensate for restricted night sleep (11). However, research results on the possible health effects of siesta are conflicting (9,10,12,13).

Therefore, the same total sleep duration (sleep per 24 hours) might have different health implications in individuals who practice afternoon naps and those who do not.

We investigated night sleep and total sleep duration in relation to all-cause and cardiovascular mortality in middle-aged and elderly men and women in a West Jerusalem community, where the practice of siesta is common. The population had been followed up for 9-11 years.

Participants and Methods

Study Population

The third round of the Kiryat Yovel Community Health Study took place between 1985 and 1987 (14-16). All residents 50 years of age or older, first identified by a household census of

3,434 dwelling units, were invited to participate in the study. The response rate was 96%. A total of 1,948 men and women gave informed consent and agreed to participate (85% response rate) (14-16). The study population was ethnically heterogeneous, consisting mainly of people who immigrated in 1950s and 1960s from the Central and Eastern Europe, North Africa, and Middle East, as well as those born in Israel. Age and sex distribution was similar in both nonrespondents and respondents (14). The study was approved by the Hadassah Institutional Review Board.

Data Collection

Data were collected via a structured questionnaire and physical examination, which included measurement of blood pressure, weight, height, and drawing of blood in the non-fasting state (14-16). In a 10-year mortality follow-up undertaken by linkage of the study population with the National Population Registry, 453 deaths were identified. The underlying cause of death, coded by the Central Bureau of Statistics using the International Classification of Diseases 9th revision, was available for 424 of deaths (17); information for 29 deaths was unavailable. We classified cause-specific mortality as cardiovascular disease mortality (International Classification of Diseases 9th revision codes 390-458) and non-cardiovascular disease mortality (all other codes).

Variables

Sleep. Participants were asked at what time they usually fell asleep at night and awoke in the morning. This enabled us to calculate night sleep duration. Subjects were also asked about their daytime sleep ("Do you usually sleep during the day?") and the average duration of their daytime nap. Total sleep duration was calculated for each participant. In the analysis, night and total sleep duration were coded as <6h, 6-8h, >8h, based on previous studies (5,8).

Out of 841 men (97%) and 1,001 women (93%) who provided data on their sleep habits, 403 (198 men and 205 women) died during the follow-up. This included 170 cardiovascular deaths, 77 in men and 93 in women.

Covariates. The analysis included data on age, sex, social class (based on occupation), country of origin, educational level, cigarette smoking, alcohol consumption, physical activity, self-appraised health status, activities of daily living, an abbreviated version of the Cornell Medical Index (18), the demoralization scale (19,20), pre-existing self-reported chronic conditions (diabetes, coronary heart disease, and stroke), congestive heart failure obtained by interview, blood pressure, body mass index, serum glucose, creatinine, albumin, total cholesterol, HDL-cholesterol, thiocyanate, and total plasma homocysteine. The methods have been described elsewhere (14-17).

Data Analysis

Sex-specific age-stratified Kaplan-Meier survival analysis of night sleep and total sleep duration was performed. Adjustment for age was performed with the log rank method.

Cox survival analysis was used to predict time to death for all-cause, cardiovascular, and non-cardiovascular mortality, separately for men and women, by introducing night and total sleep duration as categorical terms. The assumption of proportional hazards, tested by inspecting log-minus-log survival plots and by the introduction of time-dependent covariates, was not found to be violated. Initial models included only age and night or total sleep duration. Subsequently, all covariates were added to the models and removed in a backward stepwise procedure if their p-value exceeded 0.10. Age-adjusted and multivariable-adjusted hazard ratios were calculated as well as their 95% confidence intervals (CI).

Adjustment for multiple covariates that reflect health status at baseline may nevertheless be inadequate. To further reduce possible residual confounding effects of ill-health at baseline, the Cox analyses were repeated after exclusion of deaths that occurred in the first 2 and 5 years of follow-up.

Interactions with age were tested by the introduction of product terms of age (either continuous or categorical) and sleep duration.

Nominal p-values were presented, and correction for multiple comparisons was not made.

The Statistical Package for Social Sciences (SPSS version 10.0; SPSS Inc., Chicago, IL, USA) was used for all statistical analyses.

Results

Characteristics of Study Population

The study population was ethnically heterogeneous with respect to country of origin, social class, and education (Table 1), as well as their health-relevant behavior (alcohol intake is particularly low in the Israeli population), self-appraised health status, selected chronic conditions, physical measures and clinical chemistry, and functional status. The median age was 64 (interquartile range, 56.5-72.0) years for men and 63 (interquartile range, 56.0-70.0) for women.

Sleep Duration

Total sleep duration of less than 6 h was reported by 15% of men and 15% of women, whereas 22% of

Table 1. Baseline characteristics of the study population consisting of 1,842 residents of a West Jerusalem neighborhood*

Variables†	Men	Women
Categorical variables (No, %)		
Origin:		
Asia	153 (18)*	187 (19)*
Africa	156 (19)	193 (19)
Europe/America	319 (38)	401 (40)
Israel	213 (25)	220 (22)
total	841 (100)	1,001 (100)
Social class:		
white collar	486 (58)	571 (57)
blue collar	355 (42)	430 (43)
total	841 (100)	1,001 (100)
Education:		
0-8 years	289 (34)	481 (48)
9-11 years	166 (20)	176 (18)
>12 years	386 (46)	336 (34)
total	841 (100)	993 (100)
Smoking:		
never	274 (33)	688 (69)
past	347 (42)	162 (16)
current	213 (25)	147 (15)
total	834 (100)	997 (100)
Alcohol consumption:		
never	426 (51)	790 (81)
<1-2drinks/week	254 (31)	152 (16)
>3-4drinks/week	151 (18)	31 (3)
total	831 (100)	973 (100)
Self-appraised physical activity:		
not active/low activity	160 (20)	122 (13)
intermediate	315 (38)	414 (43)
active/very active	348 (42)	428 (44)
total	823 (100)	964 (100)
Self-appraised poor health:	285 (34)	479 (48)
high blood pressure	116 (14)	128 (13)
prevalence of diabetes	111 (13)	141 (14)
history of CHD	146 (17)	102 (10)
history of stroke	30 (4)	44 (4)
restriction in ADL	33 (4)	43 (4)
Congestive heart failure:		
absent	472 (56)	484 (49)
suspected	291 (35)	343 (34)
positive	74 (9)	167 (17)
total	837 (100)	994 (100)
Continuous variables (mean±SD):		
BMI (kg/m^2)	26.5±3.6	28.1±4.9
cholesterol level (mmol/dL)	5.55±1.11	6.29±1.19
HDL cholesterol (mg/dL)	42.4±13.4	54.1±15.8
creatinine (mol/L)	97.0±22.1	77.7±18.9
thiocyanate (mol/L)	33.4±34.6	28.6±29.3
homocysteine (μmol/L)	13.2±7.7	11.6±5.3
glucose (mol/dL)	5.90±2.70	6.08±2.80
serum albumin (g/L)	44.2±2.6	44.0±2.6
systolic blood pressure (mm Hg)	132.3±20.7	133.5±22.5
diastolic blood pressure (mm Hg)	79.0±11.6	76.6±10.9

*Abbreviations: CHD – chronic heart disease; ADL – activities of daily living; BMJ – body mass index; HDL – high density lipoprotein.
†Discrepancies in totals are due to missing values.

Table 2. Baseline distribution of night and total sleep duration according to sex and age-group in the study population consisting of 1,842 residents of a West Jerusalem neighborhood

Sleep duration	Number of subjects (No.) and number of deaths (D) in age-group (years)							
	50-64		65-74		>75		total	
	No. (%)	D (%)	No. (%)	D (%)	No. (%)	D (%)	No. (%)	D (%)
Men (n=841)								
Night sleep:								
<6h	93 (21)	9 (21)	62 (25)	12 (18)	30 (20)	15 (17)	185 (22)	36 (18)
6-8h	321 (72)	32 (74)	144 (59)	36 (55)	87 (59)	50 (56)	552 (66)	118 (60)
>8h	33 (7)	2 (5)	40 (16)	18 (27)	31 (21)	24 (27)	104 (12)	44 (22)
total	447 (100)	43 (100)	246 (100)	66 (100)	148 (100)	89 (100)	841 (100)	198 (100)
Total sleep:								
<6h	75 (17)	8 (19)	36 (15)	7 (11)	17 (12)	7 (8)	128 (15)	22 (11)
6-8h	312 (70)	29 (67)	143 (58)	29 (44)	71 (48)	39 (44)	526 (63)	97 (49)
>8h	60 (13)	6 (14)	67 (27)	30 (45)	60 (40)	43 (48)	187 (22)	79 (40)
total	447 (100)	43 (100)	246 (100)	66 (100)	148 (100)	89 (100)	841 (100)	198 (100)
Women (n=1,001)								
Night sleep:								
<6h	96 (17)	7 (15)	54 (20)	17 (20)	29 (19)	17 (22)	179 (18)	41 (20)
6-8h	392 (68)	30 (65)	163 (60)	44 (53)	69 (45)	31 (41)	624 (62)	105 (51)
>8h	87 (15)	9 (20)	56 (20)	22 (27)	55 (36)	28 (37)	198 (20)	59 (29)
total	575 (100)	46 (100)	273 (100)	83 (100)	153 (100)	76 (100)	1,001 (100)	205 (100)
Total sleep:								
<6h	76 (13)	6 (13)	41 (15)	15 (19)	22 (14)	14 (18)	140 (15)	35 (17)
6-8h	381 (66)	28 (61)	149 (55)	38 (46)	62 (41)	28 (37)	592 (58)	94 (46)
>8h	118 (21)	12 (26)	83 (30)	30 (35)	69 (45)	34 (45)	269 (27)	76 (37)
total	575 (100)	46 (100)	273 (100)	83 (100)	153 (100)	76 (100)	1,001 (100)	205 (100)

men and 27% of women reported to sleep more than 8 h a day (Table 2). Long night sleep duration was reported by 12% of men and 20% of women. The total sleep duration increased with age in both sexes, being higher in women across all age groups. Forty percent of men and 35% of women reported taking a nap during the day. Long siestas (2 h or more) were more prevalent among men than among women (12% vs 7%, respectively).

Association of Sleep Duration with Covariates

Longer sleep duration was associated with numerous risk factors or risk markers for mortality (Table 3). North African origin and lower education level were associated with significantly longer sleep in both sexes ($p<0.014$ for ethnic differences, and $p<0.02$ for educational differences). Lower social class was associated with longer sleep duration in women only ($p<0.030$). Although obesity, cigarette smoking, and alcohol consumption were not significantly associated with sleep variables in either sex, serum high density lipoprotein (HDL) cholesterol showed an inverse relation to sleep duration in both sexes ($p<0.031$ for total sleep duration). Men, but not women, with poor self-appraised health, diabetes, congestive heart failure, or past stroke slept significantly longer.

Association of Sleep Duration with Mortality

Kaplan-Meier survival curves for all-cause and cause-specific mortality by night and total sleep duration were calculated separately for men and women (data not shown). In both sexes, the crude survival probabilities for all-cause, cardiovascular disease, and non-cardiovascular disease mortality were the lowest among those reporting long sleep duration ($p<0.020$ for all outcomes in both sexes). Upon adjustment for age, there were no significant differences for any outcome for night and total sleep duration in women, whereas in men an association persisted for all-cause and cardiovascular disease mortality. The association of night and total sleep duration with all-cause and cardiovascular disease mortality was seen in men aged 65 years or more, but not in younger men.

Age-adjusted hazard ratios obtained from Cox regression models for all-cause, cardiovascular disease, and non-cardiovascular disease mortality were calculated separately for men and women (Table 4). In women, there were no significant associations between sleep duration and any outcome, although those who slept 6-8 h a day seemed to have the lowest risk. Long duration of night sleep (>8h) in men was positively associated with all-cause mortality (hazard ratio, 1.9; 95% CI, 1.2-2.9). Long total sleep duration in men was associated with the highest hazard for all-cause mortality (hazard ratio, 1.8; 95% CI, 1.1-2.9), and for cardiovascular disease mortality (hazard ratio, 2.1; 95% CI, 1.0-4.4). There was no significant difference in mortality between men with a sleep duration of <6h and those with sleep duration of 6-8 h. In women, there was a trend towards an association of short sleep (<6h) with increased mortality.

Multivariate adjustment in women did not affect the results. Among men, the multivariate hazard ratios were either unaltered or accentuated, compared with the age adjustment (hazard ratio for all-cause mortality, 2.1; 95% CI, 1.2-3.7; hazard ratio for cardiovascular disease mortality, 2.9; 95% CI, 1.2-7.1, for the comparison of >8h with <6h total sleep).

Since bedtime itself might be important, the analysis was repeated by introducing time-to-bed at night data for each participant (data not shown). There was no observable effect of bedtime on estimates of hazard ratios in either sex.

Poor health before death could be a confounding factor in the sleep-mortality association. However, exclusion of deaths in the first 2 and 5 years of follow-up did not substantially affect the results in either sex (data not shown).

Table 3. Association of sleep duration with socio-demographic factors and pre-existing conditions according to sex, in the study population consisting of 1,842 residents of a West Jerusalem neighborhood, with age-adjusted results from binary logistic regression

	Men (n=841)				Women (n=1,001)			
	long night sleep duration (>8h)*		long total sleep duration (>8h)[†]		long night sleep duration (>8h)*		long total sleep duration (>8h)[†]	
Variable[‡]	OR	p (df)[§]	OR	p (df)	OR	p (df)[‡]	OR	p (df)
Education:		0.011 (2)		0.020 (2)		0.011 (2)		0.020 (2)
0-8 years	2.50	0.013	1.61	0.014	3.36	0.013	1.45	0.013
9-11 years	2.20	0.023	1.64	0.063	2.10	0.032	1.10	0.102
>12 years	1.00	-	1.00	-	1.00	-	1.00	-
Low social class	1.15	0.53	1.23	0.401	1.60	0.012	1.83	0.030
Origin:		0.012 (3)		0.014 (3)		0.011 (3)		0.012 (3)
Asia	1.30	0.473	0.91	0.750	2.21	0.014	1.45	0.144
Africa	3.02	0.014	2.09	0.013	3.47	0.012	2.23	0.013
Europe/America	0.74	0.361	0.69	0.152	1.60	0.094	1.30	0.241
Israel	1.00	-	1.00	-	1.00	-	1.00	-
Obesity (BMI>30)	0.80	0.53	1.10	0.724	1.20	0.402	1.39	0.104
Smoking:		0.223 (3)		0.193 (2)		0.101 (2)		0.232 (2)
never	1.00	-	1.00	-	1.00	-	1.00	-
past	1.22	0.454	1.08	0.704	0.46	0.401	0.72	0.121
current	1.67	0.082	1.50	0.082	0.98	0.190	1.10	0.674
Alcohol consumption:		0.510 (2)		0.644 (2)		0.370 (2)		0.532 (2)
never	1.00	-	1.00	-	1.00	-	1.00	-
<1-2 drinks/week	1.15	0.704	1.06	0.822	0.80	0.262	0.79	0.594
>3-4 drinks/week	1.30	0.271	1.21	0.353	0.56	0.420	0.80	0.312
Poor health	1.62	0.030	1.83	<0.001	1.12	0.501	1.01	0.971
CHD	0.93	0.782	1.05	0.813	0.76	0.324	0.98	0.923
Stroke	2.37	0.062	2.69	0.010	0.75	0.49	1.14	0.704
CHF:		0.013 (2)		<0.001 (2)		0.673 (2)		0.530 (2)
absent	1.00	-	1.00	-	1.00	-	1.00	-
suspected	1.44	0.131	1.57	0.021	0.93	0.703	0.96	0.784
positive	2.77	0.012	2.71	<0.001	1.15	0.532	1.21	0.352
Diabetes	1.96	0.012	1.83	0.011	1.14	0.554	1.36	0.121
Hypertension (SBP>165 and/or DBP<95 mm Hg)	1.15	0.604	1.20	0.553	0.90	0.351	0.95	0.204
High cholesterol (>6.5 mmol/dL)	0.75	0.190	1.06	0.744	0.67	0.154	0.76	0.152
Low HDL-cholesterol (<35 mg/dL)	1.49	0.093	1.52	0.031	1.50	0.160	1.61	0.013
High blood glucose (>6.7 mmol/L)	1.94	0.014	1.86	<0.001	0.98	0.941	1.24	0.301
High creatinine (>130 mol/L)	0.65	0.351	0.92	0.803	0.58	0.504	1.04	0.950

*Odds ratios (OR) relative to night sleep duration <8h.
[†]Odds ratios (OR) relative to total sleep duration <8h.
[‡]Abbreviations: BMI – body mass index; CHD – coronary heart disease; CHF – congestive heart failure; SBP – systolic blood pressure; DBP – diastolic blood pressure; HDL – high density lipoprotein.
[§]Overall p-value; df – degrees of freedom.

The sex difference in the sleep-mortality association was nominally significant for the association of total sleep duration with all-cause mortality (p=0.011).

Adjustment for siesta (yes/no) did not alter the association of total or night sleep duration with mortality in men. Although the mortality association seemed stronger in those who took a siesta (multivariable adjusted hazard ratio, 2.2; 95% CI, 1.1-4.3), a test for interaction was not statistically significant (p>0.300).

In men, the population-attributable risk associated with more than 8 h of total sleep was 11.7% (95% CI, 4.2-20.9%) for all-cause mortality, and 16.5% (95% CI, 4.2-32.6%) for cardiovascular disease mortality.

Discussion

The principal finding of our study, conducted in a Mediterranean population where siesta is a time-honored practice, was the positive association of long total sleep duration with mortality in men. Daytime napping did not attenuate this association, which was non-significantly stronger in those who took a siesta. The fraction of mortality in the population attributable to (or associated with) sleep duration of >8h was substantial. The association of prolonged sleep with mortality in men is consistent with previous large studies conducted in the USA, where afternoon sleep is not a traditional practice and where long sleep was associated with higher all-cause and specific-cause mortality in both sexes after controlling for socio-demographic variables, known risk factors, and chronic conditions (2,4,5). A large prospective epidemiological study conducted in the USA in the 1960s (which included about 800,000 men and women aged 40-79 years upon enrollment, with a 6-year mortality follow-up), reported that the lowest death rates from both coronary heart disease and stroke were found in subjects who said that they usually slept about 7 h per night (29). By far, the highest rates were found among those who usually slept over 9 h per night (2). In a recently published prospective study that enrolled 1.1 million US men and women, the optimal survival was reported for those who slept 7 h per night (4). Participants who reported sleeping 8 h or more experienced significantly increased mortality hazard, as did those who slept 6 h or less. The increased risk exceeded 15% for those reporting more than 8.5 h of sleep or less than 3.5-4.5 h (4).

In our study, there was no statistically different risk of all-cause or cardiovascular disease mortality between those sleeping <6 h and those sleeping 6-8

Table 4. Association of night sleep and total sleep duration in men and women, with all-cause, cardiovascular (CVD) and non-cardiovascular mortality and multivariable-adjusted hazard ratios (HR) from Cox models

	Age-adjusted									Multivariable-adjusted*								
	all-cause mortality			CVD mortality			non-CVD mortality			all-cause mortality			CVD mortality			non-CVD mortality		
Sleep duration	HR	95% CI[†]	p (df)[‡]	HR	95% CI	p (df)	HR	95% CI	p (df)	HR	95% CI	p (df)	HR	95% CI	p (df)	HR	95% CI	p (df)
Men		(n=841)			(n=826)			(n=826)			(n=760)			(n=750)			(n=750)	
Night:			0.021 (2)			0.281 (2)			0.132 (2)			0.030 (2)			0.271 (2)			0.130 (2)
<6h	1.00	-	-	1.00	-	-	1.00	-	-	1.00	-	-	1.00	-	-	1.00	-	-
6-8h	1.21	0.83-1.76	0.310	1.14	0.64-2.04	0.664	1.40	0.83-2.36	0.201	1.25	0.83-1.87	0.282	1.35	0.71-2.58	0.362	1.38	0.79-2.42	0.264
>8h	1.86	1.19-2.91	0.012	1.72	0.84-3.51	0.143	1.92	1.03-3.59	0.040	1.91	1.16-3.13	0.014	1.91	0.86-4.23	0.113	2.02	1.01-4.03	0.052
Total:			0.011 (2)			0.013 (2)			0.164 (2)			0.012 (2)			0.020 (2)			0.183 (2)
<6h	1.00	-	-	1.00	-	-	1.00	-	-	1.00	-	-	1.00	-	-	1.00	-	-
6-8h	1.03	0.65-1.64	0.893	0.92	0.44-1.92	0.831	1.24	0.65-2.37	0.513	1.41	0.83-2.39	0.201	1.57	0.65-3.78	0.324	1.54	0.75-3.15	0.244
>8h	1.81	1.12-2.93	0.020	2.07	0.98-4.37	0.051	1.75	0.89-3.46	0.112	2.13	1.23-3.71	0.013	2.86	1.15-7.13	0.024	2.02	0.94-4.35	0.071
Women		(n=1,001)			(n=987)			(n=987)			(n=915)			(n=910)			(n=910)	
Night:			0.464 (2)			0.752 (2)			0.833 (2)			0.201 (2)			0.672 (2)			0.474 (2)
<6h	1.00	-	-	1.00	-	-	1.00	-	-	1.00	-	-	1.00	-	-	1.00	-	-
6-8h	0.82	0.57-1.17	0.273	0.85	0.49-1.45	0.540	0.86	0.51-1.45	0.570	0.80	0.54-1.17	0.250	0.83	0.47-1.45	0.511	0.81	0.46-1.43	0.460
>8h	0.95	0.63-1.42	0.792	0.99	0.54-1.81	0.961	0.94	0.52-1.70	0.841	1.08	0.70-1.66	0.743	1.02	0.54-1.93	0.963	1.10	0.58-2.07	0.773
Total:			0.131 (2)			0.294 (2)			0.532 (2)			0.092 (2)			0.250 (2)			0.491 (2)
<6h	1.00	-	-	1.00	-	-	1.00	-	-	1.00	-	-	1.00	-	-	1.00	-	-
6-8h	0.68	0.46-1.01	0.060	0.68	0.38-1.23	0.203	0.73	0.41-1.28	0.274	0.64	0.42-0.97	0.044	0.61	0.33-1.12	0.114	0.69	0.37-1.29	0.250
>8h	0.84	0.56-1.27	0.424	0.93	0.50-1.71	0.811	0.82	0.45-1.48	0.503	0.80	0.51-1.24	0.313	0.79	0.42-1.48	0.461	0.82	0.43-1.57	0.553

*The following variables were included in a backward stepwise procedure with a p-value >0.10 as an exclusion criterium: age, social class (based on occupation), country of origin, educational level, self-appraised health status, activities of daily living, the Cornell Medical Index, a demoralization scale, reported pre-existing chronic conditions (diabetes, coronary heart disease [CHD], stroke), congestive heart failure, cigarette smoking, alcohol consumption, physical activity, blood pressure, body mass index (BMI), serum levels of glucose, thiocyanate, creatinine, albumin, total cholesterol and HDL-cholesterol, plasma homocysteine as well as siesta and its duration. 81 men and 86 women with missing values for covariates were excluded from the analysis. Twenty-nine deaths (15 men and 14 women) with unavailable information were excluded from cause-specific mortality analyses. The final model in men included: age, self-appraised health, activities of daily living, CHD, alcohol consumption, systolic blood pressure, homocysteine and glucose. Models with night sleep duration were also adjusted for siesta and its duration. The final model in women included: age, diabetes, congestive heart failure, BMI (linear and quadratic terms), systolic blood pressure, and albumin. Models with night sleep duration were also adjusted for siesta and its duration.
†Confidence interval.
‡Overall p-value; df – degrees of freedom.

h. In Alameda County, California, higher overall and cardiovascular disease mortality was reported among those who slept 6 h or less, compared with those sleeping 7 or 8 h per day (5). Since the number of cardiovascular disease deaths in our study was modest, the power to detect differences between the <6 h and 6-8 h groups was limited, especially for cardiovascular disease.

In our study, the association of longer sleep duration with mortality in men persisted after controlling for an array of socio-demographic variables, known risk factors, psycho-behavioral measures, and chronic conditions. It also persisted after excluding deaths in the first 2 or 5 years of follow-up. Although the statistical significance decreased because of the reduction in the number of events, the strength of the association was largely maintained. Adjustment for a wide selection of covariates and exclusion of early deaths was designed to minimize the confounding effect of pre-existing conditions on the association between sleep and mortality. These analyses reduced but did not eliminate the possibility that pre-existing conditions were important determinants in our findings.

It has been convincingly argued that the adverse outcomes associated with long sleep duration may be the result of specific sleep disorders (21). Individuals may sleep longer because some component of their sleep is disturbed, resulting in more prolonged sleep. A common speculation on the nature of this alteration has often focused on respiratory dysfunction in sleep, usually called sleep apnea (22). Sleep apnea, an age-related male-predominant condition, has been related to cardiovascular risk (22). Snoring, obesity, and daytime napping have been reported as key symptoms of sleep apnea (22). We did not have data on snoring, but we did have data on daytime napping (siesta) and obesity. We found no association between night sleep or total sleep duration and obesity; neither did we find night or total sleep duration to be associated with daytime sleep (siesta). However, in our study, the association of longer sleep with mortality seemed largely restricted to men who reported daytime napping, which raises the possibility that unhealthy somnolence may play a role. The fact that siesta was not associated with shorter night sleep in our population also suggests that siesta, particularly of long duration, may be a marker of somnolence rather than a compensation for restricted night sleep.

On the other hand, longer sleep duration might represent a modifiable lifestyle or behavioral risk factor the same as food intake, smoking, alcohol consumption, or exercise (23-25). Yet, the mechanisms of the association between sleep duration, viewed in this context, and mortality need further investigation.

In our study, the less educated, lower social class, and those of North African origin reported to sleep longer. This is consistent with a report from the UK, where long sleep was associated with manual social classes (6). It is also consistent with the findings from the NHANES 1 study, where those with 12 years or more of education were less likely (odds ratio, 0.6; 95% CI, 0.5-0.8) than those with less than 12 years of education to report a long sleep duration (>8 h) (8). In our study, sleep duration did not differ between groups defined by overweight, cigarette smoking, or high cholesterol level, which is consistent with the findings from the NHANES 1 study (8). In our study, long sleep among men was associated with chronic conditions (diabetes and congestive heart failure), which was also reported in the UK (6).

Although we did not find a significant association of night or total sleep duration with mortality in women, the upper bounds of the confidence limits do not exclude an association, and there was a hint of lower risk for all three outcomes in the 6-8 h sleep group. Test for interactions in our study revealed a modifying effect of sex on the association between total sleep and all-cause mortality. However, it is not clear what other reasons but chance could account for different association in women vs men. Very large prospective studies did not report sex differences in the association of sleep duration with mortality (2,4).

In conclusion, our findings indicate that long sleep duration is an important risk marker for mortality in middle-aged and elderly men in a population with a high prevalence of siesta, and that this association was not attenuated in those taking a siesta. Whether longer total sleep (>8 h) duration is also associated with mortality in other Mediterranean populations that engage in the practice of siesta remains to be determined. The evidence suggest that there is no overall benefit and possibly a health cost in sleeping longer than 8 hours a day, irrespective of whether it is restricted to night sleep or includes also daytime napping. It does seem that simple and readily acquired information on sleep duration can provide useful clues to the general health status of middle-aged and elderly people.

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