

eTable 1. Characteristics of Women in the Sister Study at Baseline (2003 to 2009) Stratified by Race/Ethnicity

Baseline characteristics	White	Black	Hispanic
No. of participants (%)	29 720 (88.7)	2151 (6.4)	1626 (4.9)
Sociodemographic			
Mean age, years	54.3 ± 8.8	51.2 ± 7.9	51.2 ± 8.7
Age <54 years	14 735 (49.6)	1376 (64.0)	1036 (63.7)
Age ≥54 years	14 985 (50.4)	775 (36.0)	560 (36.3)
Marital status			
Single/never married	1348 (4.5)	309 (14.4)	117 (7.2)
Married/living as married	23 557 (79.3)	1161 (54.0)	1153 (70.9)
Separated/widowed/divorced	4813 (16.2)	679 (31.6)	356 (21.9)
Educational attainment			
≤high school	3971 (13.4)	178 (8.3)	338 (20.8)
>high school	25 746 (86.6)	1973 (91.7)	1288 (79.2)
Annual household income ^a	43.7 ± 27.1	42.2 ± 28.3	30.7 ± 25.1
Unemployed (yes)	9053 (30.8)	393 (18.4)	542 (33.6)
Work hours			
<20 hours/week	10 796 (36.7)	443 (20.8)	626 (38.8)
≥20 hours/week	18 608 (63.3)	1687 (79.2)	987 (61.2)
Health behaviors			
Smoker status			
Never	16 582 (55.8)	1465 (68.1)	1146 (70.5)
Former	10 769 (36.2)	492 (22.9)	362 (22.3)
Current	2365 (8.0)	194 (9.0)	117 (7.2)
Alcohol consumption			
Current/former	28 909 (97.3)	2034 (94.6)	1475 (90.8)
Binge drinking ^b	5840 (19.7)	201 (9.3)	277 (17.1)
Physical activity, MET hours/week	16.1 ± 18.9	12.8 ± 17.7	11.6 ± 16.9
Healthy Eating Index score ^c	72.2 ± 9.5	70.8 ± 9.5	70.2 ± 10.0
Ever use of sleep medication, melatonin, or antihistamines (yes)	10 042 (34.1)	592 (29.3)	515 (32.7)
Antidepressant use			
Never/no baseline depression	24 050 (81.0)	1880 (87.4)	1318 (81.1)
Former	1949 (6.6)	136 (6.3)	150 (9.2)
Current	3694 (12.4)	135 (6.3)	158 (9.7)
Clinical characteristic			
BMI, kg/m ²	26.2 ± 5.4	29.7 ± 6.4	27.3 ± 5.3
Underweight: <18.5	469 (1.6)	13 (0.6)	14 (0.9)
Normal: 18.5 to 24.9	14 160 (47.7)	497 (23.1)	596 (36.7)
Overweight: 25 to 29.9	9175 (30.9)	754 (35.1)	611 (37.6)
Obese: ≥30	5905 (19.9)	886 (41.2)	405 (24.9)
Waist-to-hip ratio	0.79 ± 0.08	0.82 ± 0.08	0.81 ± 0.07
Menopausal status			
Premenopausal	11 640 (39.2)	1099 (51.2)	798 (49.1)
Postmenopausal	18 073 (60.8)	1047 (48.8)	826 (50.9)
Systolic BP, mm Hg	111.1 ± 12.2	114.9 ± 12.2	110.5 ± 11.7
Diastolic BP, mm Hg	70.6 ± 8.2	73.2 ± 8.4	70.4 ± 8.1
Cardiovascular disease	5646 (19.9)	409 (19.3)	242 (15.3)

Hypercholesterolemia	7929 (27.0)	521 (24.3)	493 (30.4)
Diabetes	644 (2.2)	105 (4.9)	85 (5.3)
Clinical depression	5960 (22.5)	312 (15.4)	347 (23.1)
Sleep characteristics			
Sleep duration	7.2 ± 1.0	6.5 ± 1.2	6.9 ± 1.2
≤5 hours	1405 (4.7)	396 (18.6)	164 (10.1)
>5 to <7 hours	6016 (20.3)	734 (34.4)	403 (24.9)
7 to 9 hours	21 973 (74.0)	990 (46.4)	1034 (64.0)
>9 hours	282 (1.0)	15 (0.7)	16 (1.0)
Inconsistent weekly sleep patterns ^d	3820 (12.9)	438 (20.4)	329 (20.3)
Sleep debt ≥2 hours ^e	6640 (22.7)	680 (33.1)	499 (31.6)
Napping ≥3 times/week	2551 (8.6)	245 (11.4)	184 (11.3)
Insomnia symptoms ^f	7106 (23.9)	686 (32.0)	540 (33.3)
Difficulty falling asleep ^g	4373 (14.7)	572 (26.6)	436 (26.9)
Difficulty staying asleep ^h	3801 (12.8)	228 (10.6)	209 (12.9)
Insomnia symptoms and short sleep	2809 (9.6)	447 (21.1)	272 (17.0)
Cumulative sleep score ⁱ	0.95 ± 1.11	1.52 ± 1.24	1.33 ± 1.24
0	13 417 (45.4)	502 (23.7)	508 (31.6)
1	8622 (29.1)	661 (31.2)	468 (29.1)
2	4440 (15.0)	507 (23.9)	349 (21.7)
3	2010 (6.8)	285 (13.4)	176 (10.9)
4	995 (3.4)	142 (6.7)	96 (6.0)
5	103 (0.4)	25 (1.2)	13 (0.8)

Values are no. of participants (%) or mean ± standard deviation unless stated otherwise. No., number; MET, metabolic equivalent of task; BMI, body mass index; BP, Blood pressure.

^a Annual income scaled to 1000 US Dollars.

^b Binge drinking: ≥4 per sitting.

^c Healthy Eating Index scores range from 0-100 with higher scores indicating a healthier diet.

^d Inconsistent weekly sleep patterns (yes vs. no) were defined as participants reporting inconsistent wake-up times and bedtimes from week-to-week during the prior 6 weeks.

^e Sleep debt was defined as the difference in sleep hours between the nights with the longest and shortest sleep durations and was dichotomized at ≥2 hours.

^f Insomnia defined as difficulty falling asleep or difficulty staying asleep.

^g Difficulty falling asleep defined as taking ≥30 minutes to fall asleep.

^h Difficulty staying asleep defined as waking up 3 or more times per night at least 3 nights per week.

ⁱ Cumulative sleep score is the summation of the following symptoms of poor sleep: short sleep or long sleep, inconsistent weekly sleep patterns, sleep debt ≥2 hours, napping ≥3 times per week, and insomnia.

eTable 2: Hazard Ratios for Sleep Duration and Hypertension Risk in US Women by Age Group among Premenopausal and Postmenopausal Women, the Sister Study (March 2003 - September 2018) ^a

	Age <54 years		Age ≥54 years		P for interaction
	No. with event/ person-years	HR (95% CI) ^b	No. with event/ person-years	HR (95% CI)	
Sleep duration, Premenopausal					0.7484
≤5 hours	153/5457	1.10 (0.92, 1.32)	9/363	0.58 (0.25, 1.37)	
>5 to <7	534/24 664	1.10 (0.99, 1.22)	36/1253	1.06 (0.70, 1.60)	
7 to <9 hours	1548/90 646	1.00	113/4665	1.00	
≥9 hours	30/977	1.36 (0.92, 2.00)	0/27	n/a	
Sleep duration, Postmenopausal					0.3560
≤5 hours	92/3201	1.12 (0.88, 1.42)	227/7261	1.01 (0.87, 1.16)	
>5 to <7	239/9388	1.08 (0.92, 1.27)	802/28 206	0.98 (0.90, 1.07)	
7 to <9 hours	553/26 962	1.00	2735/99 138	1.00	
≥9 hours	7/213	1.49 (0.70, 3.17)	45/1323	1.12 (0.83, 1.52)	
Inconsistent weekly sleep patterns, Premenopausal					0.8880
No	1999/108 840	1.00	135/5501	1.00	
Yes	268/12 782	0.95 (0.83, 1.09)	23/807	0.92 (0.56, 1.52)	
Inconsistent weekly sleep patterns, Postmenopausal					0.2304
No	749/34 732	1.00	3184/115 360	1.00	
Yes	143/5059	1.10 (0.90, 1.33)	632/20 702	0.96 (0.87, 1.05)	
Sleep debt ≥2 hours, Premenopausal					0.7909
No	1572/88 398	1.00	110/4645	1.00	
Yes	651/31 998	1.06 (0.95, 1.17)	46/1579	1.23 (0.81, 1.88)	
Sleep debt ≥2 hours, Postmenopausal					0.2238
No	614/29 347	1.00	2976/107 477	1.00	
Yes	251/9716	1.07 (0.89, 1.27)	777/26 453	1.03 (0.92, 1.15)	
Napping ≥3 times/ week, Premenopausal					0.0433
No	2072/113 735	1.00	137/5875	1.00	
Yes	196/8158	1.10 (0.94, 1.28)	21/434	1.82 (1.12, 2.95)	
Napping ≥3 times/ week, Postmenopausal					0.0199
No	800/36 772	1.00	3409/122 255	1.00	
Yes	94/3071	1.19 (0.95, 1.50)	412/13 931	0.90 (0.81, 1.01)	
Insomnia symptoms, Premenopausal					0.6234
No	1666/97 521	1.00	113/4953	1.00	
Yes	602/24 300	1.22 (1.10, 1.35)	45/1345	1.36 (0.93, 1.98)	
Insomnia symptoms, Postmenopausal					0.1112
No	595/28 588	1.00	2780/100 615	1.00	
Yes	296/11 192	1.11 (0.96, 1.29)	1033/35 331	1.01 (0.93, 1.09)	

Difficulty falling asleep, Premenopausal					0.1950
No	1852/105 731	1.00	128/5562	1.00	
Yes	417/16 118	1.18 (1.05, 1.32)	30/736	1.67 (1.07, 2.61)	
Difficulty falling asleep, Postmenopausal					0.0541
No	685/32 727	1.00	3146/114 134	1.00	
Yes	207/7037	1.18 (1.00, 1.40)	669/21 791	1.02 (0.94, 1.12)	
Difficulty staying asleep, Premenopausal					0.6985
No	1985/110 665	1.00	136/5558	1.00	
Yes	283/11 168	1.27 (1.11, 1.44)	22/750	1.14 (0.70, 1.85)	
Difficulty staying asleep, Postmenopausal					0.2444
No	740/33 797	1.00	3269/116 882	1.00	
Yes	152/6017	1.13 (0.94, 1.35)	547/19 178	1.02 (0.93, 1.12)	
Short sleep and insomnia symptoms, Premenopausal					0.4012
No	1944/110 696	1.00	141/5720	1.00	
Yes	290/9984	1.30 (1.14, 1.48)	17/551	0.96 (0.53, 1.75)	
Short sleep and insomnia symptoms, Postmenopausal					0.0205
No	723/34 298	1.00	3331/120 268	1.00	
Yes	158/5180	1.22 (1.02, 1.47)	424/14 061	1.01 (0.90, 1.12)	
Cumulative sleep score, Premenopausal		1.05 (1.01, 1.09) ^c		1.10 (0.95, 1.27) ^d	0.5825
Cumulative sleep score, Postmenopausal		1.07 (1.00, 1.13) ^e		0.98 (0.96, 1.01) ^f	0.0031

HR, hazard ratio; CI, confidence interval

^a All models adjusted for age, race/ethnicity, marital status, income level, employment status, educational attainment, smoking status, alcohol use, binge drinking, physical activity, Healthy Eating Index, BMI, waist-to-hip ratio, diabetes, antidepressant use, and inconsistent weekly sleep patterns (for sleep debt analyses only).

^b Bolded estimates and p-values are significant at the 0.05 significance level.

^c Number of events/person-years for all values of the cumulative sleep score for premenopausal participants age <54 years: Score of 0 = 909 events/57 122 person-years; 1 = 676/34 750; 2 = 372/18 126; 3 = 189/7943; 4 = 97/3043; 5 = 17/389.

^d Number of events/person-years for all values of the cumulative sleep score for premenopausal participants age ≥54 years: Score of 0 = 53 events/2833 person-years; 1 = 54/1929; 2 = 31/868; 3 = 15/444; 4 = 4/210; 5 = 1/2.

^e Number of events/person-years for all values of the cumulative sleep score for postmenopausal participants age <54 years: Score of 0 = 292 events/15 845 person-years; 1 = 265/12 311; 2 = 187/6626; 3 = 83/3065; 4 = 52/1575; 5 = 7/216.

^f Number of events/person-years for all values of the cumulative sleep score for postmenopausal participants age ≥54 years: Score of 0 = 1606 events/59 698 person-years; 1 = 1117/39 061; 2 = 599/21 154; 3 = 284/9841; 4 = 168/5247; 5 = 20/472.

eTable 3: Hazard Ratios for Multiple Sleep Dimensions and Hypertension Risk by Sleep Medication, Melatonin, and Antihistamine Use in the Sister Study (March 2003 - September 2018) ^a

Sleep dimensions	Sleep medication, melatonin, or antihistamine use				P for interaction
	Never (N=21 862)		Ever (N=11 149)		
	No. with event/ person-years	HR (95% CI) ^b	No. with event/ person-years	HR (95% CI)	
Sleep duration					0.0061
≤5 hours	266/8583	1.14 (1.00, 1.31)	209/7408	0.93 (0.80, 1.09)	
>5 to <7 hours	963/41 222	0.97 (0.90, 1.05)	624/21 323	1.13 (1.03, 1.24)	
7 to <9 hours	3188/150 424	1.00	1692/68 589	1.00	
>9 hours	43/1422	1.18 (0.86, 1.60)	39/1104	1.22 (0.87, 1.70)	
Inconsistent weekly sleep patterns					0.2569
No	3915/179 249	1.00	2070/82 113	1.00	
Yes	549/22 334	0.92 (0.84, 1.01)	501/16 428	1.00 (0.90, 1.12)	
Sleep debt ≥2 hours					0.8051
No	3402/155 942	1.00	1807/71 485	1.00	
Yes	1020/44 016	1.07 (0.98, 1.16)	671/24 615	1.03 (0.92, 1.16)	
Napping ≥3 times/ week					0.2412
No	4043/185 573	1.00	2286/89 739	1.00	
Yes	423/16 300	0.96 (0.87, 1.07)	290/8939	1.08 (0.94, 1.23)	
Insomnia symptoms					0.0833
No	3473/164 957	1.00	1600/63 879	1.00	
Yes	988/36 693	1.12 1.04, 1.20)	971/34 656	1.02 (0.94, 1.11)	
Difficulty falling asleep					0.0418
No	3853/180 406	1.00	1872/74 587	1.00	
Yes	610/21 279	1.15 (1.05, 1.26)	701/23 906	1.01 (0.92, 1.11)	
Difficulty staying asleep					0.7782
No	3947/181 937	1.00	2095/81 709	1.00	
Yes	516/19 834	1.08 (0.98, 1.18)	477/16 860	1.11 (1.00, 1.23)	
Insomnia symptoms and short sleep					0.9010
No	3983/185 219	1.00	2064/82 454	1.00	
Yes	428/14 756	1.10 (0.99, 1.22)	455/14 692	1.12 (1.01, 1.25)	
Cumulative poor sleep score		1.01 (0.98, 1.04) ^c		1.02 (0.99, 1.06) ^d	0.6948

CI=confidence interval

^a All models adjusted for age, race/ethnicity, marital status, income level, employment status, educational attainment, smoking status, alcohol use, binge drinking, physical activity, Healthy Eating Index score, BMI, waist-to-hip ratio, diabetes, antidepressant use, and inconsistent weekly sleep patterns (for sleep debt analyses only).

^b Bolded estimates and p-values are significant at the 0.05 significance level.

^c Number of events/person-years for all values of the cumulative poor sleep score for participants without sleep medication or melatonin use: Score of 0 = 1969 events/98 272 person-years; 1 = 1338/57 225; 2 = 683/28 445; 3 = 301/11 966; 4 = 134/4610; 5 = 24/557.

^d Number of events/person-years for all values of the cumulative poor sleep score for participants with sleep medication or melatonin use: Score of 0 = 852 events/35 906 person-years; 1 = 746/29 717; 2 = 17 664; 3 = 255/8934; 4 = 185/5354; 5 = 21/508.

eTable 4: Hazard Ratios for Multiple Sleep Dimensions and Hypertension Risk in the Sister Study (March 2003 - September 2018), excluding those with blood pressure \geq 130/80 mm Hg at baseline or reporting medication use for high blood pressure at baseline, N=25,400

Sleep dimensions	Number of events/ person-years	Model 1: Adjusted for demographics ^a		Model 2: Adjusted for demographics and lifestyle ^b		Model 3: Fully adjusted ^c	
		HR (95% CI) ^d	P value	HR (95% CI)	P value	HR (95% CI)	P value
Sleep duration							0.420
≤5 hours	252/12 423	1.09 (0.95, 1.24)		1.03 (0.90, 1.18)		1.00 (0.87, 1.15)	
>5 to <7 hours	902/50 319	1.05 (0.98, 1.14)		1.03 (0.95, 1.12)		1.02 (0.94, 1.11)	
7 to <9 hours	2860/178 654	1.00		1.00		1.00	
>9 hours	48/1914	1.51 (1.13, 2.02)	0.019	1.40 (1.04, 1.88)	0.139	1.28 (0.95, 1.71)	
Inconsistent weekly sleep patterns							0.913
No	3467/213 437	1.00		1.00		1.00	
Yes	600/29 818	1.12 (1.03, 1.23)	0.012	1.07 (0.97, 1.17)	0.177	1.01 (0.92, 1.10)	
Sleep debt \geq 2 hours							0.106
No	3009/185 437	1.00		1.00		1.00	
Yes	984/54 756	1.15 (1.05, 1.26)	0.002	1.11 (1.01, 1.21)	0.027	1.08 (0.98, 1.18)	
Napping \geq 3 times/week							0.447
No	3662/224 195	1.00		1.00		1.00	
Yes	409/19 426	1.14 (1.02, 1.27)	0.016	1.11 (1.00, 1.24)	0.052	1.04 (0.94, 1.16)	
Insomnia symptoms							0.042
No	2974/187 321	1.00		1.00		1.00	
Yes	1093/56 046	1.15 (1.07, 1.23)	<0.001	1.10 (1.03, 1.19)	0.008	1.08 (1.00, 1.16)	
Difficulty falling asleep							0.023
No	3337/207 990	1.00		1.00		1.00	
Yes	733/35 390	1.19 (1.09, 1.29)	<0.001	1.14 (1.04, 1.24)	0.003	1.10 (1.01, 1.20)	
Difficulty staying asleep							0.038
No	3504/214 715	1.00		1.00		1.00	
Yes	563/28 762	1.15 (1.05, 1.26)	0.003	1.11 (1.01, 1.22)	0.028	1.10 (1.01, 1.21)	
Insomnia symptoms and short sleep							0.089
No	3524/217 926	1.00		1.00		1.00	
Yes	484/23 175	1.15 (1.04, 1.27)	0.007	1.11 (1.00, 1.22)	0.049	1.09 (0.99, 1.21)	
Cumulative poor sleep score ^e		1.07 (1.04, 1.10)	<0.001	1.05 (1.02, 1.08)	0.001	1.02 (1.00, 1.05)	0.094

HR=hazard ratio; CI=confidence interval

^a Model 1: Demographic factors (age, race/ethnicity, marital status, income level, employment status, and educational attainment) and inconsistent weekly sleep patterns (for sleep debt analyses only).

^b Model 2: Model 1 + smoking status, alcohol use, binge drinking, physical activity, and health eating index score.

^c Model 3: Model 2 + comorbidities (BMI, waist-to-hip ratio, and diabetes) and antidepressant use.

^d Bolded estimates and p-values are significant at the 0.05 significance level.

^e Number of events/person-years for all values of the cumulative poor sleep score: Score of 0 = 1664 events/110 981 person-years; 1 = 1188/70 292; 2 = 690/36 923; 3 = 306/16 179; 4 = 178/7472; 5 = 23/731.