

Supplemental Material

Table S1. MESA Sleep participant characteristics by categories of sleep timing regularity (N=2032)

	Sleep Timing Regularity				
	<i>(Nightly within- Person Standard Deviations)</i>				
	Overall	≤ 30 mins n=420	31 – 60 mins n=713	61 – 90 mins n=443	>90 mins n=456
Demographics					
Female sex, n (%)	1090 (53.6)	219 (52.1)	402 (56.4)	237 (53.5)	232 (50.9)
Race-ethnicity, n (%)					
White	770 (37.9)	217 (51.7)	282 (39.6)	145 (32.7)	126 (27.6)
Chinese-American	226 (11.1)	34 (8.1)	84 (11.8)	58 (13.1)	50 (11.0)
Black, African-American	561 (27.6)	66 (15.7)	176 (24.7)	140 (31.6)	179 (39.3)
Hispanic	475 (23.4)	103 (24.5)	171 (24.0)	100 (22.6)	101 (22.1)
Education, n (%)					
< HS grad	613 (30.2)	129 (30.7)	229 (32.1)	124 (28.0)	131 (28.7)
Some college	615 (30.3)	118 (28.1)	206 (28.9)	135 (30.5)	156 (34.2)
College graduate plus	800 (39.4)	173 (41.2)	277 (38.8)	182 (41.1)	168 (36.8)
Avg. Yearly Income*					
<\$20,000	383 (18.8)	73 (17.4)	118 (16.5)	92 (20.8)	100 (21.9)
\$20,000 - <\$50,000	502 (24.7)	102 (24.3)	192 (26.9)	104 (23.5)	104 (22.8)
\geq \$50,000	1086 (53.4)	233 (55.5)	379 (53.2)	242 (54.6)	232 (50.9)
Work Schedule, n (%)					
No Work	1148 (56.5)	266 (63.3)	404 (56.7)	228 (51.5)	250 (54.8)
Day shift	617 (30.4)	115 (27.4)	229 (32.1)	150 (33.9)	123 (27.0)
Other shift	246 (12.1)	37 (8.8)	72 (10.1)	60 (13.5)	77 (16.9)
Lifestyle characteristics					
Current Smoker, n (%)*	142 (7.0)	16 (3.8)	42 (5.9)	32 (7.2)	52 (11.4)
Current Alcohol Consumer, n (%)*	881 (43.4)	181 (43.1)	316 (44.3)	200 (45.1)	184 (40.4)
MVPA, MET mins/week*	5380 \pm 6220	4760 \pm 4230	5600 \pm 6200	5790 \pm 8230	5190 \pm 5440
BMI, kg/m ² *	28.8 \pm 5.6	28.2 \pm 5.2	28.7 \pm 5.5	28.7 \pm 5.4	29.6 \pm 6.0
Cardiovascular risk factors					
Systolic blood pressure, mm Hg*	123.0 \pm 20.0	124.0 \pm 20.2	121.0 \pm 18.4	124.0 \pm 18.9	125.0 \pm 22.9
Diastolic blood pressure, mm Hg*	68.3 \pm 9.8	66.9 \pm 9.7	67.3 \pm 9.4	69.6 \pm 9.3	70.0 \pm 10.7
Anti-hypertensive medication use, n (%)	1090 (53.6)	224 (53.3)	367 (51.5)	239 (54.0)	260 (57.0)
Statin medication use, n (%)	775 (38.1)	182 (43.3)	252 (35.3)	166 (37.5)	175 (38.4)
LDL-C, mg/dL*	106.0 \pm 32.4	102.0 \pm 30.6	109.0 \pm 32.4	108.0 \pm 32.4	105.0 \pm 33.7

HDL-C, mg/dL*	55.6 ± 16.5	54.9 ± 14.9	56.5 ± 16.6	56.4 ± 17.9	54.2 ± 16.1
Prevalent diabetes, n (%)*	397 (19.5)	64 (15.2)	121 (17.0)	86 (19.4)	126 (27.6)
Severe obstructive sleep apnea, n (%)*	386 (19.0)	67 (16.0)	120 (16.8)	91 (20.5)	108 (23.7)
Average sleep fragmentation	20.2 ± 7.0	18.9 ± 6.6	19.8 ± 6.9	21.0 ± 7.1	21.1 ± 7.1

Data presented as mean ± SD unless specified; HS: high school; MVPA: moderate to vigorous intensity physical activity; BMI: Body Mass Index; LDL-C: low density lipoprotein cholesterol; HDL-C: high density lipoprotein cholesterol.

Table S2. Sleep duration regularity and associations with subclinical markers of CVD excluding participants with prevalent Cardiovascular Disease: The MESA Sleep Study (2010-2013)

		Sleep Duration Regularity (Nightly within- Person Standard Deviations)			
		≤60 mins	61 – 90 mins	91 – 120 mins	>120 mins
		Prevalence Ratio (95% Confidence Interval)			
Coronary Artery Calcium (>0)					
Model 3	(reference)	1.06 (0.98, 1.16)	1.03 (0.94, 1.13)	1.07 (0.98, 1.18)	
<i>Model 3 - prevalent CVD</i>	(reference)	1.07 (0.98, 1.17)	1.02 (0.92, 1.12)	1.07 (0.97, 1.18)	
Coronary Artery Calcium (>300)					
Model 3	(reference)	1.26 (0.99, 1.59)	1.32 (1.05, 1.67)	1.33 (1.03, 1.71)	
<i>Model 3 - prevalent CVD</i>	(reference)	1.12 (1.01, 1.24)	1.06 (0.95, 1.19)	1.13 (1.01, 1.26)	
Carotid plaque					
Model 3	(reference)	1.10 (1.01, 1.20)	1.09 (0.99, 1.20)	1.09 (0.99, 1.21)	
<i>Model 3 - prevalent CVD</i>	(reference)	1.09 (1.00, 1.20)	1.09 (0.99, 1.21)	1.08 (0.97, 1.20)	
Carotid-IMT (>0.9)					
Model 3	(reference)	0.99 (0.83, 1.18)	0.99 (0.83, 1.18)	1.03 (0.85, 1.25)	
<i>Model 3 - prevalent CVD</i>	(reference)	0.98 (0.82, 1.18)	0.94 (0.78, 1.14)	1.06 (0.87, 1.29)	
Ankle Brachial Index (<0.9)					
Model 3	(reference)	1.50 (0.86, 2.59)	1.62 (0.98, 2.70)	1.75 (1.03, 2.95)	
<i>Model 3 - prevalent CVD</i>	(reference)	1.12 (0.62, 2.04)	1.51 (0.90, 2.54)	1.63 (0.95, 2.78)	

CAC n=1431; Carotid plaque n=1464; Carotid-IMT n=1415; ABI n=1839; Model 1: age, sex, race/ethnicity, site; Model 2: M1+ education, income, work schedule, smoking status, alcohol consumption, physical activity, and BMI; Model 3: M2 + systolic blood pressure, diastolic blood pressure, anti-hypertension medication use, statin medication use, LDL-C, HDL-C, prevalent diabetes

Table S3. Sleep duration regularity and associations with subclinical markers of CVD excluding participants with severe obstructive sleep apnea (OSA): The MESA Sleep Study (2010-2013)

		Sleep Duration Regularity (Nightly within- Person Standard Deviations)			
		≤60 mins	61 – 90 mins	91 – 120 mins	>120 mins
		Prevalence Ratio (95% Confidence Interval)			
Coronary Artery Calcium (>0)					
Model 3	(reference)	1.06 (0.98, 1.16)	1.03 (0.94, 1.13)	1.07 (0.98, 1.18)	
<i>Model 3 – severe OSA</i>	(reference)	1.07 (0.97, 1.19)	1.08 (0.97, 1.20)	1.14 (1.02, 1.27)	
Coronary Artery Calcium (>300)					
Model 3	(reference)	1.26 (0.99, 1.59)	1.32 (1.05, 1.67)	1.33 (1.03, 1.71)	
<i>Model 3 – severe OSA</i>	(reference)	1.13 (1.01, 1.26)	1.18 (1.05, 1.32)	1.18 (1.04, 1.34)	
Carotid plaque					
Model 3	(reference)	1.10 (1.01, 1.20)	1.09 (0.99, 1.20)	1.09 (0.99, 1.21)	
<i>Model 3 – severe OSA</i>	(reference)	1.12 (1.02, 1.24)	1.14 (1.03, 1.26)	1.09 (0.97, 1.22)	
Carotid-IMT (>0.9)					
Model 3	(reference)	0.99 (0.83, 1.18)	0.99 (0.83, 1.18)	1.03 (0.85, 1.25)	
<i>Model 3 – severe OSA</i>	(reference)	1.01 (0.83, 1.22)	1.00 (0.82, 1.22)	1.03 (0.82, 1.29)	
Ankle Brachial Index (<0.9)					
Model 3	(reference)	1.50 (0.86, 2.59)	1.62 (0.98, 2.70)	1.75 (1.03, 2.95)	
<i>Model 3 – severe OSA</i>	(reference)	1.68 (0.92, 3.07)	1.67 (0.93, 3.02)	1.83 (0.98, 3.42)	

CAC n=1235; Carotid plaque n=1272; Carotid-IMT n=1233; ABI n=1565; Model 1: age, sex, race/ethnicity, site; Model 2: M1+ education, income, work schedule, smoking status, alcohol consumption, physical activity, and BMI; Model 3: M2 + systolic blood pressure, diastolic blood pressure, anti-hypertension medication use, statin medication use, LDL-C, HDL-C, prevalent diabetes; OSA: Obstructive Sleep Apnea

Table S4. Sleep duration regularity and associations with subclinical markers of CVD with additional adjustment for season of actigraphy collection: The MESA Sleep Study (2010-2013)

		Sleep Duration Regularity (Nightly within- Person Standard Deviations)			
		≤60 mins	61 – 90 mins	91 – 120 mins	>120 mins
		Prevalence Ratio (95% Confidence Interval)			
Coronary Artery Calcium (>0)					
Model 3	(reference)	1.06 (0.98, 1.16)	1.03 (0.94, 1.13)	1.07 (0.98, 1.18)	
<i>Model 3 + season</i>	(reference)	1.06 (0.97, 1.16)	1.03 (0.94, 1.13)	1.07 (0.98, 1.18)	
Coronary Artery Calcium (>300)					
Model 3	(reference)	1.26 (0.99, 1.59)	1.32 (1.05, 1.67)	1.33 (1.03, 1.71)	
<i>Model 3 + season</i>	(reference)	1.10 (1.00, 1.22)	1.10 (0.99, 1.22)	1.14 (1.02, 1.26)	
Carotid plaque					
Model 3	(reference)	1.10 (1.01, 1.20)	1.09 (0.99, 1.20)	1.09 (0.99, 1.21)	
<i>Model 3 + season</i>	(reference)	1.10 (1.01, 1.20)	1.09 (0.99, 1.20)	1.09 (0.99, 1.21)	
Carotid-IMT (>0.9)					
Model 3	(reference)	0.99 (0.83, 1.18)	0.99 (0.83, 1.18)	1.03 (0.85, 1.25)	
<i>Model 3 + season</i>	(reference)	1.00 (0.84, 1.19)	0.99 (0.83, 1.19)	1.04 (0.86, 1.26)	
Ankle Brachial Index (<0.9)					
Model 3	(reference)	1.50 (0.86, 2.59)	1.62 (0.98, 2.70)	1.75 (1.03, 2.95)	
<i>Model 3 + season</i>	(reference)	1.47 (0.85, 2.55)	1.61 (0.97, 2.66)	1.72 (1.02, 2.92)	

CAC n=1549; Carotid plaque n=1588; Carotid-IMT n=1535; ABI n=1989; Model 1: age, sex, race/ethnicity, site; Model 2: M1+ education, income, work schedule, smoking status, alcohol consumption, physical activity, and BMI; Model 3: M2 + systolic blood pressure, diastolic blood pressure, anti-hypertension medication use, statin medication use, LDL-C, HDL-C, prevalent diabetes

Table S5. Weekday sleep duration regularity and associations with subclinical markers of CVD: The MESA Sleep Study (2010-2013)

Weekday Sleep Duration Regularity (Nightly within- Person Standard Deviations)				
	≤60 mins	61 – 90 mins	91 – 120 mins	>120 mins
Prevalence Ratio (95% Confidence Interval)				
Coronary Artery Calcium (>0)				
<i>n</i> (%)	363 (65.5)	273 (65.5)	211 (66.1)	180 (69.5)
Model 1	(reference)	1.03 (0.94, 1.18)	1.00 (0.91, 1.11)	1.05 (0.96, 1.15)
Model 2	(reference)	1.02 (0.94, 1.17)	1.00 (0.90, 1.11)	1.02 (0.93, 1.12)
Model 3	(reference)	1.02 (0.94, 1.11)	0.99 (0.89, 1.09)	1.01 (0.92, 1.11)
Coronary Artery Calcium (>300)				
<i>n</i> (%)	113 (20.4)	84 (20.1)	78 (24.4)	67 (25.9)
Model 1	(reference)	1.03 (0.94, 1.14)	1.02 (0.91, 1.14)	1.12 (1.01, 1.25)
Model 2	(reference)	1.03 (0.94, 1.14)	1.01 (0.90, 1.13)	1.10 (0.99, 1.23)
Model 3	(reference)	1.05 (0.95, 1.15)	1.01 (0.90, 1.13)	1.08 (0.97, 1.20)
Carotid plaque				
<i>n</i> (%)	356 (64.1)	289 (67.5)	230 (69.3)	192 (70.3)
Model 1	(reference)	1.04 (0.95, 1.14)	1.15 (1.05, 1.26)	1.12 (1.02, 1.23)
Model 2	(reference)	1.04 (0.95, 1.14)	1.14 (1.04, 1.25)	1.10 (1.01, 1.21)
Model 3	(reference)	1.04 (0.95, 1.14)	1.13 (1.03, 1.24)	1.09 (0.99, 1.20)
Carotid-IMT (>0.9)				
<i>n</i> (%)	183 (34.1)	133 (32.2)	119 (36.6)	98 (37.5)
Model 1	(reference)	1.16 (0.94, 1.32)	1.03 (0.86, 1.24)	1.10 (0.92, 1.31)
Model 2	(reference)	1.10 (0.94, 1.31)	0.99 (0.82, 1.20)	1.08 (0.90, 1.30)
Model 3	(reference)	1.08 (0.92, 1.28)	0.95 (0.78, 1.16)	1.07 (0.89, 1.29)
Ankle Brachial Index (<0.9)				
<i>n</i> (%)	24 (3.5)	26 (4.8)	28 (6.8)	25 (7.3)
Model 1	(reference)	1.45 (0.87, 2.42)	1.69 (1.02, 2.81)	1.88 (1.13, 3.12)
Model 2	(reference)	1.45 (0.86, 2.45)	1.61 (0.97, 2.66)	1.87 (1.12, 3.10)
Model 3	(reference)	1.41 (0.83, 2.38)	1.59 (0.95, 2.66)	1.70 (1.01, 2.85)

CAC n=1549; Carotid plaque n=1588; Carotid-IMT n=1535; ABI n=1989; Model 1: age, sex, race/ethnicity, site; Model 2: M1+ education, income, work schedule, smoking status, alcohol consumption, physical activity, and BMI; Model 3: M2 + systolic blood pressure, diastolic blood pressure, anti-hypertension medication use, statin medication use, LDL-C, HDL-C, prevalent diabetes