

Supplementary Tables

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Table S1. Oxidative balance score assignment scheme.

OBS components	Property	Male			Female		
		0	1	2	0	1	2
Dietary OBS components							
Dietary fiber (g/d)	A	≤13.20	13.20-20.80	>20.80	≤11.30	11.30-17.30	>17.30
Carotene (RE/d)	A	≤53.58	53.58-176.81	>176.81	≤57.60	57.60-198.53	>198.53
Riboflavin (mg/d)	A	≤1.80	1.80-2.64	>2.64	≤1.40	1.40-2.02	>2.02
Niacin (mg/d)	A	≤22.93	22.93-32.73	>32.73	≤16.29	16.29-23.49	>23.49
Vitamin B6 (mg/d)	A	≤1.74	1.74-2.59	>2.59	≤1.29	1.29-1.89	>1.89
Total folate (mcg/d)	A	≤328.33	328.33-495	>495.00	≤257.39	257.39-385.50	>385.50
Vitamin B12 (mcg/d)	A	≤3.66	3.66-4.40	>4.40	≤2.56	2.56-4.50	>4.50
Vitamin C (mg/d)	A	≤43.23	43.23-104.13	>104.13	≤41.45	41.45-90.35	>90.35
Vitamin E (ATE) (mg/d)	A	≤6.02	6.02-9.57	>9.57	≤5.03	5.03-7.98	>7.98
Calcium (mg/d)	A	≤751.00	751.00-1130.50	>1130.50	≤610.67	610.67-921.50	>921.50
Magnesium (mg/d)	A	≤262.33	262.33-366.50	>366.50	≤211.00	211.00-293.00	>293.00
Zinc (mg/d)	A	≤10.00	10.00-14.65	>14.65	≤7.24	7.24-10.54	>10.54
Copper (mg/d)	A	≤1.08	1.08-1.53	>1.53	≤0.88	0.88-1.25	>1.25
Selenium (mcg/d)	A	≤102.60	102.6-145.48	>145.48	≤74.77	74.77-105.73	>105.73
Total fat (g/d)	P	≤70.92	70.92-104.62	>104.62	≤53.03	53.03-77.44	>77.44
Iron (mg/d)	P	≤12.72	12.72-18.74	>18.74	≤9.79	9.79-14.12	>14.12
Lifestyle OBS components							
Physical activity	A	Low	Moderate	High	Low	Moderate	High
Alcohol (g/d)	P	≥30	0-30	None	≥15	0-15	None
Obesity	P	Obesity	Overweight	Normal	Obesity	Overweight	Normal

<i>Smoking status</i>	P	Current smoker	Former smoker	Never smoker	Current smoker	Former smoker	Never smoker
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OBS – oxidative balance score, A – antioxidant; P – prooxidant, RE – retinol equivalent, ATE – alpha-tocopherol equivalent, MET – metabolic equivalent.

Table S2. Characteristics of non-weighted study participants according to sleep patterns, NHANES 2005 to 2018 (n = 10, 212).

Characteristics	Healthy sleep (n = 4334)	Intermediate sleep (n = 3628)	Poor sleep (n = 2250)	P value
Age (years)				< 0.05**
20-40	1751(41.99)	1388(39.45)	789(36.05)	
41-60	1429(37.58)	1321(40.24)	909(44.06)	
61-80	1154(20.43)	919(20.30)	552(19.90)	
Gender				0.01*
Female	2009(47.62)	1706(48.73)	1196(53.68)	
Male	2325(52.38)	1922(51.27)	1054(46.32)	
Race				< 0.05***
Non-Hispanic White	1954(72.39)	1588(71.22)	1085(73.22)	
Non-Hispanic Black	731(7.58)	903(11.63)	527(11.02)	
Mexican American	797(8.26)	505(6.26)	251(4.93)	
Others	852(11.77)	632(10.89)	387(10.83)	
BMI				< 0.05***
Normal	1358(33.40)	985(29.69)	513(24.56)	
Overweight	1508(33.49)	1201(33.17)	674(29.73)	
Obesity	1468(33.11)	1442(37.14)	1063(45.71)	
Education levels				< 0.05***
Less than high school	839(11.43)	658(10.86)	421(10.90)	
High school diploma	927(20.52)	891(24.42)	555(27.86)	
More than high school	2568(68.05)	2079(64.73)	1274(61.23)	
Marriage status				< 0.05***
Married	768(17.03)	678(17.17)	441(18.80)	

<i>Separated</i>	664(12.90)	695(15.74)	538(20.22)	
<i>Never married</i>	2902(70.07)	2255(67.08)	1271(60.97)	
Family income				< 0.05***
< US\$25 000	747(11.04)	691(12.38)	593(18.59)	
US\$25 000-54 999	1704(34.15)	1426(33.30)	833(32.33)	
US\$55 000-99 999	1217(33.56)	1022(34.45)	546(30.82)	
≥ US\$100 000	666(21.25)	489(19.88)	278(18.25)	
Family PIR				< 0.05***
< 1.3	992(14.01)	898(15.75)	721(21.22)	
1.3-3.5	1674(34.39)	1449(35.51)	805(33.92)	
≥ 3.5	1668(51.60)	1281(48.74)	724(44.86)	
Alcohol drinking status				0.01*
<i>Never</i>	575(15.71)	501(16.49)	294(16.05)	
<i>Moderate</i>	918(23.50)	667(19.16)	401(19.65)	
<i>Heavy</i>	2841(60.79)	2460(64.35)	1555(64.30)	
Smoking status				< 0.05***
<i>Never</i>	2572(59.53)	1981(55.54)	1020(43.62)	
<i>Current</i>	724(16.08)	773(19.08)	631(27.64)	
<i>Former</i>	1038(24.40)	874(25.38)	599(28.74)	
Physical activity				0.01*
<i>Low</i>	1649(36.59)	1342(36.25)	810(34.49)	
<i>Moderate</i>	1332(32.47)	1050(30.80)	621(28.58)	
<i>High</i>	1353(30.94)	1236(32.95)	819(36.93)	
Hypertension (yes, %)	1477(29.73)	1434(34.48)	1078(43.03)	< 0.05***
Hyperlipidemia (yes, %)	2861(65.02)	2465(68.02)	1597(70.35)	< 0.05**
Diabetes (yes, %)	596(9.75)	528(9.96)	474(17.42)	< 0.05***

Depression (yes, %)	101(1.64)	221(4.90)	431(17.72)	< 0.05***
Congestive heart failure (yes, %)	49(0.65)	85(1.60)	98(2.54)	< 0.05***
Coronary heart disease (yes, %)	117(2.31)	99(2.45)	100(3.90)	0.01*
Angina (yes, %)	48(0.69)	65(1.56)	82(3.08)	< 0.05***
Heart attack (yes, %)	92(1.71)	105(1.91)	118(4.29)	< 0.05***
Stroke (yes, %)	71(1.07)	96(1.80)	105(3.25)	< 0.05***
CVD (yes, %)	242(4.25)	288(6.08)	291(9.71)	
OBS				< 0.05***
<i>Quartile 1</i>	996(19.40)	992(22.98)	705(29.20)	
<i>Quartile 2</i>	1095(24.84)	911(24.63)	574(25.01)	
<i>Quartile 3</i>	1246(30.03)	965(28.50)	538(25.33)	
<i>Quartile 4</i>	997(25.73)	760(23.89)	433(20.45)	

Data were expressed as percentage (frequency%). BMI – body mass index, PIR – poverty-income ratio, CVD – cardiovascular disease, OBS – oxidative balance score. *P*-value: *, < 0.05; **, < 0.01; ***, < 0.001.

Table S3. Characteristics of non-weighted study participants according to OBS, NHANES 2005 to 2018 (n = 10212).

Characteristics	Quartile 1 (n = 2560)	Quartile 2 (n = 2588)	Quartile 3 (n = 2766)	Quartile 4 (n = 2298)	P value
Age (years)					0.10
20-40	931(39.88)	955(38.17)	1084(40.47)	958(40.51)	
41-60	893(38.74)	909(38.86)	1008(40.30)	849(41.60)	
61-80	736(21.38)	724(22.97)	674(19.22)	491(17.89)	
Gender					0.44
Female	1188(48.49)	1255(51.04)	1338(49.54)	1130(48.19)	
Male	1372(51.51)	1333(48.96)	1428(50.46)	1168(51.81)	
Race					< 0.05***
Non-Hispanic White	1038(67.50)	1116(70.22)	1347(74.60)	1126(75.21)	
Non-Hispanic Black	743(14.82)	587(10.87)	492(7.95)	339(6.47)	
Mexican American	352(6.84)	391(7.02)	407(6.21)	403(7.34)	
Others	427(10.84)	494(11.90)	520(11.25)	430(10.99)	
BMI					< 0.05***
Normal	531(22.47)	692(29.46)	795(29.53)	838(38.09)	
Overweight	812(31.06)	887(33.22)	956(33.84)	728(31.67)	
Obesity	1217(46.47)	1009(37.32)	1015(36.63)	732(30.24)	
Education levels					< 0.05***
Less than high school	648(16.25)	517(11.59)	421(8.89)	332(8.83)	
High school diploma	732(31.23)	599(24.40)	599(21.52)	443(18.35)	
More than high school	1180(52.52)	1472(64.01)	1746(69.59)	1523(72.82)	
Marriage status					< 0.05***
Never married	530(21.25)	457(15.96)	463(15.74)	437(17.73)	
Separated	595(19.08)	481(16.09)	477(14.87)	344(12.64)	

<i>Married</i>	1435(59.67)	1650(67.95)	1826(69.39)	1517(69.64)	
Family income					< 0.05***
< US\$25 000	699(19.62)	489(12.78)	464(10.91)	379(10.68)	
US\$25 000-54 999	1031(36.41)	1059(35.78)	1044(32.01)	829(30.31)	
US\$55 000-99 999	586(28.34)	692(32.51)	829(35.56)	678(35.59)	
≥ US\$100 000	244(15.64)	348(18.94)	429(21.52)	412(23.43)	
Family PIR					< 0.05***
< 1.3	1017(38.33)	1049(36.35)	1019(32.58)	843(32.37)	
1.3-3.5	867(23.48)	648(16.37)	614(13.71)	482(12.74)	
≥ 3.5	676(38.19)	891(47.28)	1133(53.71)	973(54.89)	
Alcohol drinking status					< 0.05**
<i>Never</i>	348(15.10)	340(18.30)	393(15.95)	289(14.81)	
<i>Moderate</i>	450(18.20)	484(19.21)	584(24.32)	468(21.80)	
<i>Heavy</i>	1762(66.70)	1764(62.49)	1789(59.73)	1541(63.39)	
Smoking status					< 0.05***
<i>Never</i>	1101(42.22)	1427(53.58)	1584(56.43)	1461(64.15)	
<i>Current</i>	824(32.74)	518(19.87)	485(15.98)	301(12.63)	
<i>Former</i>	635(25.05)	643(26.55)	697(27.59)	536(23.22)	
Physical activity					< 0.05***
<i>Low</i>	1017(37.97)	895(33.50)	871(31.36)	631(26.65)	
<i>Moderate</i>	779(31.34)	881(35.43)	977(36.92)	762(35.51)	
<i>High</i>	764(30.68)	812(31.06)	918(31.72)	905(37.84)	
Hypertension (yes, %)	1162(38.92)	1039(36.23)	996(32.30)	792(30.90)	< 0.05***
Diabetes (yes, %)	495(13.76)	447(13.28)	389(10.52)	267(9.00)	< 0.05***
Depression (yes, %)	278(11.23)	174(5.54)	177(5.33)	124(4.05)	< 0.05***
Hyperlipidemia (yes, %)	1814(70.09)	1792(69.15)	1865(66.37)	1452(63.99)	< 0.05**

Congestive heart failure (yes, %)	103(2.58)	54(1.28)	41(1.16)	34(0.78)	< 0.05***
Coronary heart disease (yes, %)	107(3.51)	89(3.23)	67(2.15)	53(2.16)	0.04*
Angina (yes, %)	64(2.04)	58(1.72)	40(1.15)	33(1.31)	0.23
Heart attack (yes, %)	119(3.04)	84(2.78)	60(1.96)	52(1.78)	0.06
Stroke (yes, %)	108(2.86)	71(2.15)	54(1.33)	39(1.13)	< 0.05**
CVD (yes, %)	303(8.84)	222(7.03)	165(4.67)	131(4.48)	< 0.05***
Trouble sleeping (yes, %)	720(30.80)	674(29.57)	628(24.82)	580(27.50)	< 0.05***
Sleepy (yes, %)	573(24.75)	518(21.32)	560(20.89)	511(22.71)	0.05*
Sleep duration					< 0.05***
<i>Normal</i>	1410(57.55)	1637(66.86)	1800(69.05)	1529(70.14)	
<i>Short sleep</i>	962(35.07)	809(28.40)	822(26.43)	674(26.55)	
<i>Long sleep</i>	188(7.38)	142(4.74)	144(4.52)	95(3.32)	
Sleep patterns					< 0.05***
<i>Healthy sleep</i>	945(36.59)	1122(42.35)	1258(46.50)	1009(44.10)	
<i>Intermediate sleep</i>	950(35.93)	894(34.78)	968(34.25)	816(36.37)	
<i>Poor sleep</i>	665(27.49)	572(22.87)	540(19.25)	473(19.54)	

Data were expressed as percentage (frequency%). BMI – body mass index, PIR – poverty-income ratio, CVD – cardiovascular disease, OBS – oxidative balance score. *P*-value: *, < 0.05; **, < 0.01; ***, < 0.001.

Table S4. Weighted odds ratios with 95% confidence intervals for the associations between sleep patterns and specific CVD risk.

Characteristics	Angina OR (95% CI)	Congestive heart failure OR (95% CI)	Coronary heart disease OR (95% CI)	Heart attack OR (95% CI)	Stroke OR (95% CI)
Sleep patterns *					
<i>Healthy sleep</i>	Reference	Reference	Reference	Reference	Reference
<i>Intermediate sleep</i>	2.16(1.33, 3.50)	2.27(1.41, 3.64)	1.05(0.64, 1.72)	1.03(0.63, 1.69)	1.43(0.92, 2.21)
<i>Poor sleep</i>	3.18(1.93, 5.23)	2.68(1.66, 4.32)	1.43(0.93, 2.19)	1.94(1.16, 3.24)	1.93(1.19, 3.13)
Trouble sleeping *					
<i>No</i>	Reference	Reference	Reference	Reference	Reference
<i>Yes</i>	1.72(1.15, 2.56)	1.93(1.35, 2.77)	1.21(0.84, 1.75)	1.55(1.05, 2.31)	1.74(1.18, 2.58)
Sleepy *					
<i>No</i>	Reference	Reference	Reference	Reference	Reference
<i>Yes</i>	1.76(1.11, 2.79)	1.74(1.12, 2.70)	1.03(0.75, 1.43)	1.16(0.84, 1.59)	1.53(1.03, 2.28)
Sleep duration *					
<i>Normal</i>	Reference	Reference	Reference	Reference	Reference
<i>Short sleep duration</i>	1.94(1.28, 2.95)	1.44(1.00, 2.08)	1.21(0.87, 1.69)	1.63(1.08, 2.48)	1.38(0.96, 2.00)
<i>Long sleep duration</i>	2.48(1.09, 5.64)	1.83(0.98, 3.44)	1.70(0.69, 4.21)	1.56(0.61, 4.03)	1.26(0.65, 2.45)

OR – odds ratio, CI – confidence interval, CVD – cardiovascular disease, BMI – body mass index, PIR – poverty income ratio.

* Adjusted for age categories, gender, education, race, marital, PIR, alcohol drinking status, smoking status, BMI categories, physical activity, diabetes, hypertension, hyperlipidemia, and depression.

Table S5. Weighted odds ratios with 95% confidence intervals for the associations between combined sleep patterns with OBS and specific CVD risk.

Characteristics	Angina OR (95% CI)	Congestive heart failure OR (95% CI)	Coronary heart disease OR (95% CI)	Heart attack OR (95% CI)	Stroke OR (95% CI)
Sleep patterns and OBS *					
<i>Healthy sleep and antioxidative OBS</i>	Reference	Reference	Reference	Reference	Reference
<i>Healthy sleep and pro-oxidative OBS</i>	1.91(0.67, 5.45)	2.89(0.88, 9.46)	1.83(0.79, 4.24)	2.06(1.01, 4.23)	1.25(0.62, 2.48)
<i>Unhealthy sleep and antioxidative OBS</i>	3.77(1.80, 7.89)	4.77(1.62,14.04)	1.65(0.76, 3.61)	2.47(1.10, 5.56)	1.43(0.79, 2.58)
<i>Unhealthy sleep and pro-oxidative OBS</i>	4.04(1.71, 9.55)	5.17(1.73,15.49)	1.86(0.91, 3.80)	2.52(1.14, 5.56)	2.20(1.25, 3.87)

OR – odds ratio, CI – confidence interval, CVD – cardiovascular disease, OBS – oxidative balance score.

Unhealthy sleep is combined intermediate sleep with poor sleep patterns. Quartile 1 and quartile 2 OBS were considered as the pro-oxidative group, while quartile 3 and quartile 4 OBS were considered as the antioxidative OBS group.

* Adjusted for age category, gender, education, race, marital, family income-to-poverty ratio, diabetes, hypertension, hyperlipidemia, and depression.