

1 **Supplementary Materials**

2 **Joint Association of Sleep and Physical Activity with Central**
3 **Obesity in Chinese Adults**

4 Supplementary Figure S1. Overview of participant selection procedure in the
5 current study.

6 Supplementary Figure S2. Subgroup analyses of sleep duration and physical activity
7 with waist circumference and central obesity.

8 Supplementary Table S1. Basic characteristics of participants included and excluded.

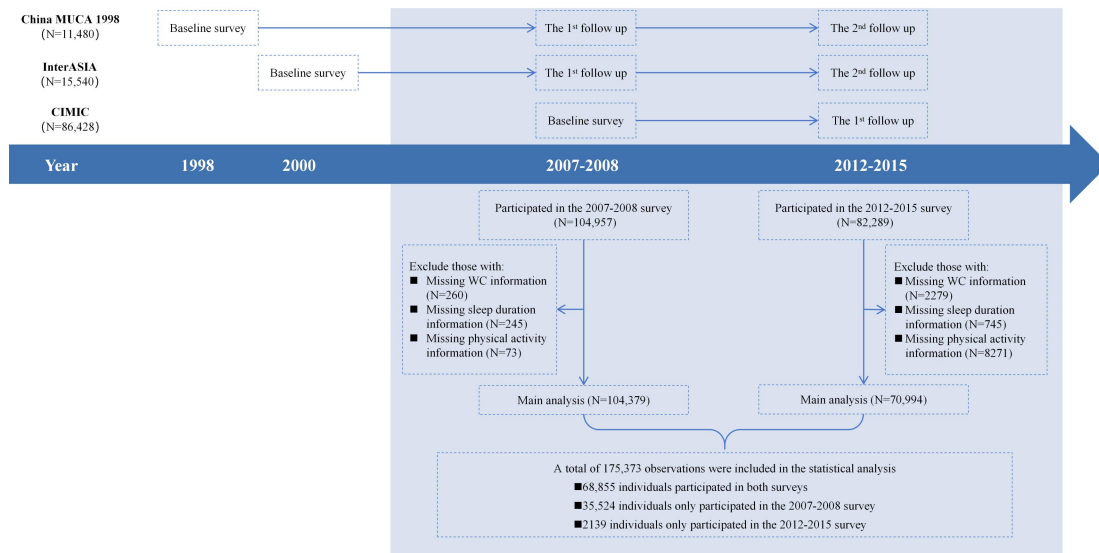
9 Supplementary Table S2. The basic characteristics of participants classified by
10 central obesity statuses.

11 Supplementary Table S3. Association of physical activity with waist circumference
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15 size and 95% confidence interval).

16 Supplementary Table S5. The joint association of sleep duration and physical activity
17 with waist circumference and central obesity after excluding individuals with
18 diabetes, cardiovascular diseases, and malignant tumors (effect size and 95%
19 confidence interval).

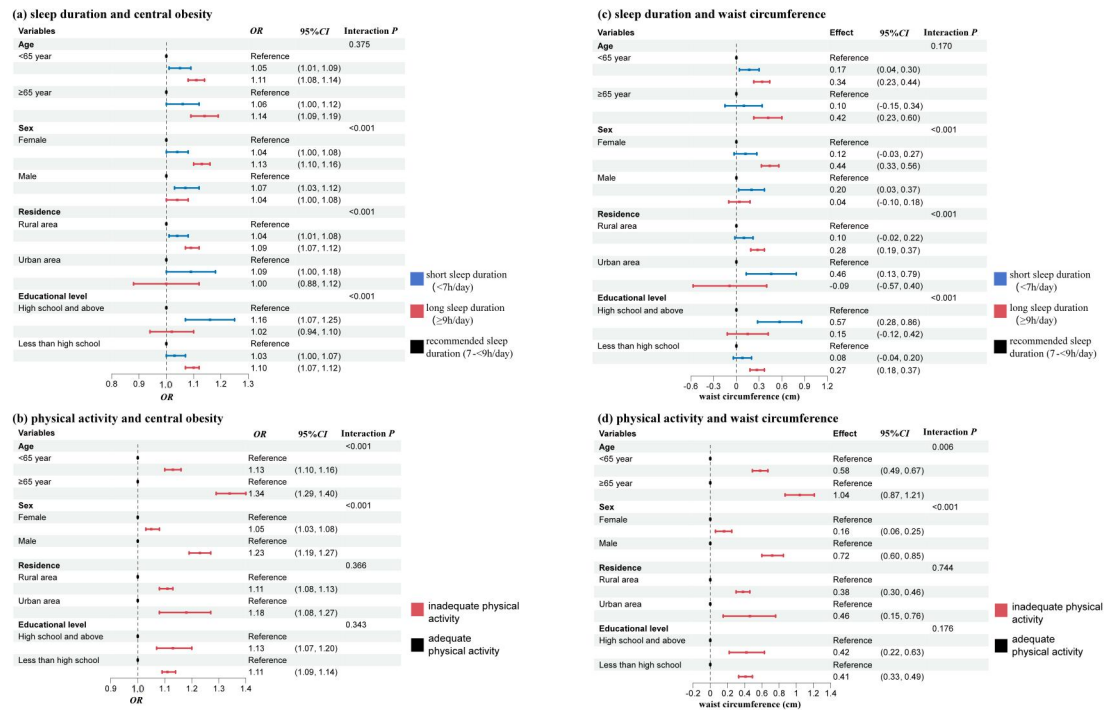
Sleep and physical activity with central obesity



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21 **Supplementary Figure S1.** Overview of participant selection procedure in the
 22 current study. ChinaMUCA: China Multi-Centre Collaborative Study of
 23 Cardiovascular Epidemiology; CIMIC: Community Intervention of Metabolic
 24 Syndrome in China and Chinese Family Health Study; InterASIA: International
 25 Collaborative Study of Cardiovascular Disease in Asia; WC, waist circumference.

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27 **Supplementary Figure S2.** Subgroup analyses of sleep duration and physical activity
28 with waist circumference and central obesity. All models were adjusted for age, sex,
29 cohort, residence, educational level, healthy diet, smoking status, drinking status,
30 and adequate physical activity (or sleep duration). *P* for interaction were derived
31 from multiplicative interaction terms. *CI*: confidence interval; *OR*: odds ratio.

Supplementary Table S1. Basic characteristics of participants included and excluded

Variables	The 2007-2008 survey			The 2012-2015 survey		
	Overall (<i>N</i> = 104,957)	Included in the analysis (<i>N</i> = 104,379)	Excluded from the analysis (<i>N</i> = 578)	Overall (<i>N</i> = 82,289)	Included in the analysis (<i>N</i> = 70,994)	Excluded from the analysis (<i>N</i> = 11,295)
Age, year	52.7 ± 12.5	52.7 ± 12.5	51.0 ± 16.1	58.6 ± 12.0	59.4 ± 11.5	53.1 ± 13.1
Male, <i>N</i> (%)	41,764 (39.8)	41,476 (39.7)	288 (49.8)	31,782 (38.6)	27,237 (38.4)	4,545 (40.2)
Urban resident, <i>N</i> (%)	7,911 (7.5)	7,820 (7.5)	91 (15.7)	5,218 (6.3)	4,437 (6.3)	781 (6.9)
High school and above, <i>N</i> (%)	14,590 (13.9)	14,437 (13.8)	153 (26.5)	9,603 (11.7)	7,915 (11.1)	1,688 (14.9)
Smoker, <i>N</i> (%)	25,726 (24.5)	25,540 (24.5)	186 (32.1)	18,087 (22.0)	15,337 (21.6)	2,750 (24.3)
Drinker, <i>N</i> (%)	21,780 (20.8)	21,638 (20.7)	142 (24.5)	12,669 (15.4)	10,950 (15.4)	1,719 (15.2)
Adequate physical activity, <i>N</i> (%)	69,117 (65.9)	68,852 (66.0)	265 (45.8)	46,292 (56.3)	44,723 (63.0)	1,569 (13.9)
Healthy diet, <i>N</i> (%)	71,678 (68.3)	71,374 (68.4)	304 (52.5)	55,106 (67.0)	48,309 (68.0)	6,797 (60.2)
Diabetes, <i>N</i> (%)	6,812 (6.5)	6,779 (6.5)	33 (5.7)	8,191 (10.0)	7,378 (10.4)	813 (7.2)
BMI, kg/m ²	23.8 ± 3.6	23.9 ± 3.6	23.3 ± 3.6	24.5 ± 3.6	24.6 ± 3.6	23.8 ± 3.4
WC, cm	81.4 ± 10.2	81.5 ± 10.2	79.9 ± 10.4	82.4 ± 9.8	82.7 ± 9.8	80.0 ± 9.7
SBP, mmHg	130.3 ± 21.6	130.3 ± 21.6	127.5 ± 21.8	132.2 ± 18.3	132.7 ± 18.2	128.3 ± 18.3

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DBP, mmHg	79.4 ± 11.9	79.4 ± 11.9	78.1 ± 11.6	79.5 ± 10.3	79.8 ± 10.3	76.4 ± 10.4
TC, mg/dL	174.3 ± 35.6	174.3 ± 35.5	169.0 ± 40.0	185.0 ± 38.3	185.1 ± 38.3	184.4 ± 38.7
TG, mg/dL	144.9 ± 106.9	144.9 ± 107.0	137.3 ± 101.3	139.8 ± 98.2	138.9 ± 96.2	145.6 ± 110.2
HDL-C, mg/dL	51.3 ± 12.8	51.3 ± 12.8	50.3 ± 13.4	54.1 ± 18.4	54.3 ± 18.6	53.0 ± 16.6
LDL-C, mg/dL	95.6 ± 28.8	95.6 ± 28.8	93.1 ± 30.5	104.3 ± 34.0	104.2 ± 33.4	104.9 ± 37.8
Glucose, mg/dL	92.3 ± 27.6	92.3 ± 27.6	94.2 ± 30.1	98.7 ± 28.7	98.8 ± 29.4	97.6 ± 23.9
Sleep duration, h/day	8.0 ± 1.3	8.0 ± 1.3	7.6 ± 1.5	7.8 ± 1.3	7.9 ± 1.3	7.6 ± 1.2
Sleep duration, N (%)						
Short (< 7 h/day)	12,060 (11.5)	11,712 (11.2)	348 (60.2)	12,686 (15.4)	9,722 (13.7)	2,964 (26.2)
Recommended (7 –< 9 h/day)	69,842 (66.5)	69,660 (66.7)	182 (31.5)	54,673 (66.4)	47,556 (67.0)	7,117 (63.0)
Long (≥ 9 h/day)	23,055 (22.0)	23,007 (22.0)	48 (8.3)	14,930 (18.1)	13,716 (19.3)	1,214 (10.8)

Note. Data are presented as mean ± standard deviation or frequency (percentage). Adequate physical activity was defined as engaging in at least 150 minutes of moderate to vigorous physical activity per week. BMI, body mass index; DBP, diastolic blood pressure; HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; SBP, systolic blood pressure; TC, total cholesterol; TG, triglyceride; WC, waist circumference.

Supplementary Table S2. The basic characteristics of participants classified by central obesity statuses

Variables	Central obesity (<i>N</i> = 54,405)	Non-obesity (<i>N</i> = 120,968)
Age, year	57.0 ± 11.1	54.7 ± 13.1
Male, <i>N</i> (%)	18,172 (33.4)	50,541 (41.8)
Urban resident, <i>N</i> (%)	4,323 (7.9)	7,934 (6.6)
High school and above, <i>N</i> (%)	6,560 (12.1)	15,792 (13.1)
Smoker, <i>N</i> (%)	10,609 (19.6)	30,268 (25.1)
Drinker, <i>N</i> (%)	9,383 (17.3)	23,205 (19.3)
Adequate physical activity, <i>N</i> (%)	32,867 (60.4)	80,708 (66.7)
Healthy diet, <i>N</i> (%)	36,956 (67.9)	82,727 (68.4)
Diabetes, <i>N</i> (%)	7,168 (13.2)	6,989 (5.8)
BMI, kg/m ²	27.4 ± 3.0	22.7 ± 2.8
WC, cm	93.4 ± 6.2	76.8 ± 6.7
SBP, mmHg	137.2 ± 20.6	128.6 ± 19.6
DBP, mmHg	83.4 ± 11.2	77.9 ± 10.9
TC, mg/dL	184.6 ± 37.3	175.7 ± 36.6
TG, mg/dL	174.6 ± 123.8	127.8 ± 87.9
HDL-C, mg/dL	49.1 ± 14.5	54.0 ± 15.5
LDL-C, mg/dL	103.2 ± 31.1	97.1 ± 30.7
Glucose, mg/dL	100.6 ± 32.8	92.2 ± 25.8
Sleep duration, h/day	8.0 ± 1.3	7.9 ± 1.2
Sleep duration, <i>N</i> (%)		
Short (< 7 h/day)	6,810 (12.5)	14,298 (11.8)
Recommended (7 –< 9 h/day)	35,000 (64.5)	82,216 (68.1)
Long (≥ 9 h/day)	12,471 (23.0)	24,252 (20.1)

Note. Data are presented as mean ± standard deviation or frequency (percentage). Adequate physical activity was defined as engaging in at least 150 minutes of moderate-to-vigorous physical activity per week. BMI, body mass index; DBP, diastolic blood pressure; HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; SBP, systolic blood pressure; TC, total cholesterol; TG, triglyceride; WC, waist circumference.

45 **Supplementary Table S3.** Association of physical activity with waist circumference and central obesity (effect size and 95% confidence interval)

Outcomes	Model 1	Model 2	Model 3
Waist circumference (cm)			
Inadequate physical activity (MVPA < 150 min/week)	Reference	Reference	Reference
Adequate physical activity (MVPA ≥ 150 min/week)	-0.43 (-0.50, -0.35)	-0.39 (-0.47, -0.32)	-0.39 (-0.47, -0.32)
Central obesity (odds ratio)			
Inadequate physical activity (MVPA < 150 min/week)	Reference	Reference	Reference
Adequate physical activity (MVPA ≥ 150 min/week)	0.90 (0.88, 0.91)	0.90 (0.88, 0.92)	0.90 (0.88, 0.91)

46 **Note.** Model 1: adjusted for age, sex, and cohort; Model 2: Model 1 + residence and educational level; Model 3: Model 2 + healthy diet,
 47 smoking status, drinking status, and sleep duration. MVPA: moderate-vigorous physical activity.

48 **Supplementary Table S4.** Subgroup analyses and sensitivity analyses of sleep
 49 duration and physical activity with waist circumference and central obesity (effect
 50 size and 95% confidence interval)

Subgroups	Sleep duration			Physical activity	
	Recommended (7 –< 9 h/day)	Short (< 7 h/day)	Long (≥ 9 h/day)	Adequate	Inadequate
Waist circumference (cm)					
Age					
< 65 year	Reference	0.17 (0.04, 0.30)	0.34 (0.23, 0.44)	Reference	0.58 (0.49, 0.67)
≥ 65 year	Reference	0.10 (-0.15, 0.34)	0.42 (0.23, 0.60)	Reference	1.04 (0.87, 1.21)
<i>P</i> for interaction	0.170			0.006	
Sex					
Male	Reference	0.20 (0.03, 0.37)	0.04 (-0.10, 0.18)	Reference	0.72 (0.60, 0.85)
Female	Reference	0.12 (-0.03, 0.27)	0.44 (0.33, 0.56)	Reference	0.16 (0.06, 0.25)
<i>P</i> for interaction	< 0.001			< 0.001	
Residence					
Urban area	Reference	0.46 (0.13, 0.79)	-0.09 (-0.57, 0.40)	Reference	0.46 (0.15, 0.76)
Rural area	Reference	0.10 (-0.02, 0.22)	0.28 (0.19, 0.37)	Reference	0.38 (0.30, 0.46)
<i>P</i> for interaction	< 0.001			0.744	
Educational level					
High school and above	Reference	0.57 (0.28, 0.86)	0.15 (-0.12, 0.42)	Reference	0.42 (0.22, 0.63)
Less than high school	Reference	0.08 (-0.04, 0.20)	0.27 (0.18, 0.37)	Reference	0.41 (0.33, 0.49)
<i>P</i> for interaction	< 0.001			0.176	
Sensitivity analyses					
Excluding patients with diabetes	Reference	0.17 (0.05, 0.29)	0.21 (0.12, 0.31)	Reference	0.34 (0.26, 0.42)
Excluding patients with cardiovascular disease	Reference	0.13 (0.02, 0.25)	0.28 (0.19, 0.37)	Reference	0.33 (0.25, 0.41)
Excluding patients with malignant tumors	Reference	0.16 (0.05, 0.28)	0.27 (0.18, 0.35)	Reference	0.40 (0.32, 0.48)

Central obesity (Odds ratio)					
Age					
< 65 year	Reference	1.05 (1.01, 1.09)	1.11 (1.08, 1.14)	Reference	1.13 (1.10, 1.16)
≥ 65 year	Reference	1.06 (1.00, 1.12)	1.14 (1.09, 1.19)	Reference	1.34 (1.29, 1.40)
<i>P</i> for interaction	0.375			< 0.001	
Sex					
Male	Reference	1.07 (1.03, 1.12)	1.04 (1.00, 1.08)	Reference	1.23 (1.19, 1.27)
Female	Reference	1.04 (1.00, 1.08)	1.13 (1.10, 1.16)	Reference	1.05 (1.03, 1.08)
<i>P</i> for interaction	< 0.001			< 0.001	
Residence					
Urban area	Reference	1.09 (1.00, 1.18)	1.00 (0.88, 1.12)	Reference	1.18 (1.08, 1.27)
Rural area	Reference	1.04 (1.01, 1.08)	1.09 (1.07, 1.12)	Reference	1.11 (1.08, 1.13)
<i>P</i> for interaction	< 0.001			0.366	
Educational level					
High school and above	Reference	1.16 (1.07, 1.25)	1.02 (0.94, 1.10)	Reference	1.13 (1.07, 1.20)
Less than high school	Reference	1.03 (1.00, 1.07)	1.10 (1.07, 1.12)	Reference	1.11 (1.09, 1.14)
<i>P</i> for interaction	< 0.001			0.343	
Sensitivity analyses					
Excluding patients with diabetes	Reference	1.06 (1.03, 1.09)	1.08 (1.05, 1.10)	Reference	1.10 (1.08, 1.13)
Excluding patients with cardiovascular disease	Reference	1.04 (1.01, 1.07)	1.09 (1.07, 1.12)	Reference	1.10 (1.07, 1.12)
Excluding patients with malignant tumors	Reference	1.05 (1.02, 1.08)	1.09 (1.07, 1.12)	Reference	1.12 (1.10, 1.14)

51 **Note.** All models were adjusted for age, sex, cohort, residence, educational
52 level, healthy diet, smoking status, drinking status, and adequate physical activity
53 (or sleep duration). *P* for interaction were derived from multiplicative interaction
54 terms.

55 **Supplementary Table S5.** The joint association of sleep duration and physical activity with waist circumference and central obesity after
 56 excluding individuals with diabetes, cardiovascular diseases, and malignant tumors (effect size and 95% confidence interval)

Physical activity	Waist circumference (cm)			Central obesity (odds ratio)		
	Recommended sleep duration	Short sleep duration	Long sleep duration	Recommended sleep duration	Short sleep duration	Long sleep duration
Excluding patients with diabetes						
Adequate	Reference	-0.07 (-0.22, 0.07)	0.28 (0.17, 0.39)	Reference	1.01 (0.97, 1.05)	1.08 (1.05, 1.11)
Inadequate	0.31 (0.21, 0.40)	0.87 (0.68, 1.05)	0.41 (0.26, 0.55)	1.09 (1.06, 1.12)	1.23 (1.18, 1.29)	1.16 (1.12, 1.21)
Excluding patients with cardiovascular disease						
Adequate	Reference	-0.11 (-0.26, 0.03)	0.38 (0.27, 0.49)	Reference	1.00 (0.96, 1.03)	1.11 (1.08, 1.14)
Inadequate	0.31 (0.22, 0.41)	0.85 (0.67, 1.04)	0.41 (0.26, 0.55)	1.09 (1.06, 1.12)	1.21 (1.16, 1.27)	1.17 (1.12, 1.21)
Excluding patients with malignant tumors						
Adequate	Reference	-0.08 (-0.22, 0.07)	0.34 (0.23, 0.44)	Reference	1.00 (0.97, 1.04)	1.10 (1.07, 1.13)
Inadequate	0.37 (0.28, 0.46)	0.90 (0.73, 1.08)	0.52 (0.38, 0.66)	1.11 (1.08, 1.13)	1.24 (1.19, 1.29)	1.20 (1.16, 1.24)

57 **Note.** Individuals with recommended sleep duration (7 –< 9 h/day) and adequate physical activity were used as the reference. Adequate
 58 physical activity was defined as engaging in at least 150 minutes of moderate-to-vigorous physical activity per week. All models were adjusted
 59 for age, sex, cohort, residence, educational level, healthy diet, smoking status, and drinking status.