Self-Reported Long Total Sleep Duration Is Associated With Metabolic Syndrome

The Guangzhou Biobank Cohort Study

Teresa Arora, bsc[1,2]
Chao Qiang Jiang, md[3]
G. Neil Thomas, phd[4]
Kin-bong Hubert Lam, phd[5]
Wei Sen Zhang, md, phd[3]
Kar Keung Cheng, mbbs, phd[4]
Tai Hing Lam, md[6]
Shahrad Taheri, mbbs, phd[1,2]

OBJECTIVE—To examine the association between total sleep duration and the prevalence of metabolic syndrome (MetSyn) in older Chinese.

RESEARCH DESIGN AND METHODS—Cross-sectional analysis of baseline data from the Guangzhou Biobank Cohort Study (GBCS) was performed. Participants (n = 29,333) were aged ≥50 years. Risk of MetSyn and its components were identified for self-reported total sleep duration.

RESULTS—Participants reporting long (≥9 h) and short (<6 h) total sleep duration had increased odds ratio (OR) of 1.18 (95% CI 1.07–1.30) and 1.14 (1.05–1.24) for the presence of MetSyn, respectively. The relationship remained in long sleepers (OR 1.21 [1.10–1.34]) but diminished in short sleepers (0.97 [0.88–1.06]) after full adjustment.

CONCLUSIONS—Long sleep duration was associated with greater risk of MetSyn in older Chinese. Confirmation through longitudinal studies is needed. The mechanisms mediating the link between long sleep duration and MetSyn require further investigation.

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Factors contributing to metabolic syndrome (MetSyn) (1) pathogenesis are poorly understood. Sleep duration has been suggested as a potential risk factor for MetSyn and/or its components, but the few studies that examine the relationship between sleep duration and MetSyn report heterogeneous findings (2–5). We examined the association between total self-reported sleep duration and prevalence of MetSyn in older Chinese from the Guangzhou Biobank Cohort Study (GBCS).

RESEARCH DESIGN AND METHODS

The Guangzhou Medical Association Ethics Committee approved the GBCS, described previously (6). GBCS participants (n = 30,519) underwent, after written consent, a half-day assessment, including structured interview and physical examination.

Sleep habits

A nurse-led interview included questions on total sleep duration (including daytime naps) in a 24-h period. Total sleep duration was categorized into <6 h, 6 to <7 h, 7 to <8 h, 8 to <9 h, and ≥9 h. Data were collected on snoring (yes/no/don't know), current hypnotic use (yes/no), insomnia (taking >30 min to initiate sleep, yes/no), and daytime sleepiness (yes/no).

MetSyn

MetSyn was defined according to the consensus statement (1). MetSyn was assessed after an overnight fast. Mean blood pressure was calculated from the last two of three consecutive readings. Height, weight, and waist circumference were measured.

Other measures

Self-reported information included age, sex, smoking (never/ever), and alcohol consumption (never/ever). Physical activity was assessed using the previously validated International Physical Activity Questionnaire (short version) (7) (inactive/minimally active/active). Educational level (primary or below/secondary/tertiary or above) was proxy for socioeconomic status.

Self-reported physician-diagnosed mental illness (yes/no) was obtained. Health status was assessed objectively (hospital admission in previous 6 months) and subjectively (four-scale rating: very good/good/poor/very poor; dichotomized into good/poor). Participants reported on cancer (any type, yes/no) and/or past/present physician-diagnosed cardiovascular disease (yes/no).

All analyses used SPSS software (version 15.0). Logistic regression analyses were conducted to determine risk of MetSyn and its components by sleep duration categories.

RESULTS—Of the total sample, 29,333 (21,239 women and 8,094 men) had complete information on all variables of interest and were included for analyses. Participants' age ranged from 50 to 96 years; men were slightly older (63.9 ± 6.7 years [mean ± SD]) than women (60.6 ± 7.1 years).

Total sleep duration of <6 h ("short" sleepers) was reported by 13.5% of participants, while 8.8% reported sleep duration of ≥9 h ("long" sleepers). Study population characteristics according to

From the [1]Birmingham and Black Country National Institute for Health Research Collaborations for Leadership in Applied Health Research and Care, University of Birmingham, Birmingham, U.K.; the [2]School of Clinical and Experimental Medicine, College of Medical and Dental Sciences, University of Birmingham and Heartlands Biomedical Research Centre, Birmingham, U.K.; the [3]Guangzhou Number 12 People's Hospital, Guangzhou, China; the [4]Department of Public Health, Epidemiology and Biostatistics, University of Birmingham, Birmingham, U.K.; the [5]Institute of Occupational and Environmental Medicine, University of Birmingham, Birmingham, U.K.; and the [6]School of Public Health, The University of Hong Kong, Hong Kong.
Corresponding author: G. Neil Thomas, gneilthomas@yahoo.co.uk.
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A list of the members of the Guangzhou Biobank Cohort Study can be found in the APPENDIX.

sleep duration are shown in Supplementary Table 1.

Table 1 shows a statistically significant association between MetSyn and longer sleep duration of from 8 to <9 h (odds ratio [OR] 1.16 [95% CI 1.08–1.25]) and ≥9 h (1.21 [1.10–1.34]) after adjustment. Risks for raised triglycerides and central obesity were significantly increased in long sleepers: OR 1.13 (1.02–1.24) and 1.12 (1.01–1.23), respectively. Associations between other components and longest sleep (≥9 h) were small and nonsignificant.

A higher proportion of those who reported poor health had MetSyn (31.9%) compared with those reporting good health (27.1%; $\chi^2 = 48.45$, $P < 0.001$), raising the possibility that poor health was responsible for the observed association. Therefore, a "healthy" subsample was identified, excluding those with hospital admission 6 months prior to study participation, past/present cancer and/or cardiovascular disease, physical inactivity, and poor self-rated health. In this healthy subsample, the association between MetSyn and long sleep remained, although the adjusted OR was slightly attenuated (1.19 [95% CI 1.06–1.34]) (Supplementary Table 2). Likewise, ORs across all MetSyn components remained similar across sleep duration categories.

As sleep duration declined with age (data not shown), the analysis was repeated stratifying by age (median split) (Supplementary Table 3). Middle-aged participants (50–61 years) with longest sleep duration (≥9 h) had an increased risk of MetSyn, impaired fasting glucose (IFG), and central obesity with ORs of 1.33 (95% CI 1.16–1.52), 1.17 (1.03–1.32), and 1.25 (1.09–1.42), respectively. Older participants (>61 years) with the longest sleep had increased odds of raised triglycerides (OR 1.18 [1.02–1.37]).

CONCLUSIONS—Our results demonstrate that self-reported long sleep duration is independently associated with a small, increased risk for MetSyn. Adjusted stratified age analysis revealed middle-aged participants with long sleep had increased risk of IFG and central obesity, while older participants were at increased risk of elevated triglycerides. There were nonstatistically significant associations between various components and long sleep after adjustment, except for raised triglycerides and central obesity in the total sample (which were statistically significant). Unlike previous studies, after adjustment, short sleep was unrelated to

Table 1—*Prevalence and ORs for the presence of MetSyn and its associated components according to total sleep duration*

Total sleep duration (h)	*n* (%)	Model 1	Model 2	Model 3	*n* (%)	Model 1	Model 2	Model 3
	MetSyn				Reduced HDL cholesterol			
<6	1,142 (28.8)	1.14* (1.05–1.24)	0.98 (0.90–1.06)	0.97 (0.88–1.06)	634 (16.0)	0.95 (0.86–1.05)	0.90 (0.82–1.00)	0.88* (0.79–0.99)
6 to <7	2,020 (28.2)	1.10* (1.03–1.18)	1.02 (0.95–1.09)	1.00 (0.93–1.08)	1,152 (16.1)	0.96 (0.88–1.04)	0.93 (0.86–1.01)	0.93 (0.85–1.01)
7 to <8	2,303 (26.2)	1.00	1.00	1.00	1,467 (16.7)	1.00	1.00	1.00
8 to <9	1,995 (28.8)	1.14* (1.06–1.22)	1.16* (1.08–1.25)	1.16* (1.08–1.25)	1,233 (17.8)	1.08 (0.99–1.17)	1.09* (1.01–1.19)	1.07 (0.98–1.17)
≥9	762 (29.6)	1.18* (1.07–1.30)	1.22* (1.11–1.35)	1.21* (1.10–1.34)	454 (17.7)	1.07 (0.95–1.20)	1.10 (0.98–1.23)	1.05 (0.93–1.18)
	Elevated blood pressure				IFG			
<6	2,216 (55.9)	1.15* (1.06–1.24)	0.96 (0.89–1.04)	0.93 (0.85–1.01)	1,623 (41.0)	1.18* (1.09–1.27)	1.07 (0.99–1.16)	1.06 (0.99–1.16)
6 to <7	3,969 (55.4)	1.12* (1.06–1.20)	1.02 (0.96–1.09)	1.00 (0.93–1.07)	2,808 (39.2)	1.10* (1.03–1.17)	1.04 (0.97–1.11)	1.01 (0.95–1.08)
7 to <8	4,609 (52.5)	1.00	1.00	1.00	3,253 (37.1)	1.00	1.00	1.00
8 to <9	3,720 (53.8)	1.05 (0.99–1.12)	1.04 (0.98–1.11)	1.02 (0.95–1.09)	2,737 (39.6)	1.11* (1.04–1.19)	1.11* (1.04–1.19)	1.08* (1.01–1.16)
≥9	1,448 (56.3)	1.16* (1.07–1.27)	1.14* (1.04–1.25)	1.08 (0.98–1.19)	1,042 (40.5)	1.16* (1.06–1.27)	1.14* (1.05–1.25)	1.08 (0.98–1.19)
	Elevated triglycerides				Central obesity			
<6	1,331 (33.6)	0.99 (0.92–1.07)	0.97 (0.90–1.05)	0.92 (0.84–1.00)	1,479 (37.3)	1.20* (1.11–1.30)	1.01 (0.93–1.10)	1.02 (0.94–1.11)
6 to <7	2,337 (32.6)	0.95 (0.89–1.01)	0.94 (0.88–1.00)	0.90* (0.84–0.97)	2,599 (36.3)	1.15* (1.08–1.23)	1.06 (0.99–1.13)	1.04 (0.98–1.12)
7 to <8	2,966 (33.8)	1.00	1.00	1.00	2,905 (33.1)	1.00	1.00	1.00
8 to <9	2,499 (36.1)	1.11* (1.04–1.18)	1.11* (1.04–1.19)	1.08* (1.01–1.16)	2,309 (33.4)	1.01 (0.95–1.08)	1.05 (0.98–1.12)	1.04 (0.97–1.12)
≥9	960 (37.3)	1.17 (1.06–1.28)	1.18* (1.08–1.29)	1.13* (1.02–1.24)	888 (34.5)	1.07 (0.97–1.17)	1.15* (1.05–1.27)	1.12* (1.01–1.23)

Data are ORs (95% CI) unless otherwise indicated. Participants are 29,333 Chinese adults aged ≥50 years from the GBCS, 2003–2008. Model 1 was unadjusted; model 2 was adjusted for age and sex; and model 3 was additionally adjusted for education, smoking, physical activity, diagnosed mental illness, insomnia, use of hypnotics, daytime sleepiness, alcohol consumption, snoring, and as appropriate, mean systolic blood pressure, glucose, total cholesterol, and triglycerides. *$P < 0.05$.

MetSyn and its components (2,8,9), possibly because of relationships diminishing with age (10).

Studies of sleep duration and MetSyn have produced inconsistent findings (2–5). Our study is in line with those indicating that long sleep is a potential risk factor for MetSyn (3,4) and supports a link between long sleep and increased IFG risk (9,11). Obstructive sleep apnea (OSA) may be responsible for the association (12). Although OSA diagnosis was unavailable, adjustment for snoring and daytime sleepiness—features of OSA—did not alter the relationship between long sleep and IFG. Longer sleep could be associated with circadian and/or hormonal alterations promoting insulin resistance. Conversely, chronic inflammation accompanying obesity may increase sleep duration as a result of metabolic and sleep-inducing effects of proinflammatory cytokines.

Some have reported a U-shaped association between sleep duration and adiposity (8). We confirmed the relationship between central obesity and long sleep duration only. Long sleepers have less waking time to undertake physical activity, which may contribute to this association. We controlled for physician-diagnosed mental illness; depression, previously linked to long sleep and obesity, is therefore unlikely to be responsible for the relationship.

In agreement with a recent study reporting an OR of 1.45 (95% CI 1.00–2.11) for elevated triglycerides in long sleepers (13), we found an independent relationship between long sleep and elevated triglycerides in the total sample, with older participants driving this observation.

Sleep duration and quality decline with age, while disease prevalence increases. To address the possibility of long sleep being a consequence of ill health, we repeated analyses in a healthy subsample. The relationships between sleep and MetSyn and most of its components remained after adjustment.

We report an association between long sleep and higher MetSyn prevalence in older Chinese. Prospective and mechanistic studies are needed to assess this further. With emerging obesity, MetSyn, and diabetes epidemics associated with rapid socioeconomic transition, particularly in Asia, if long sleep were shown to increase MetSyn risk, our findings would have important public health implications.

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