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Original Article

Sleep duration and abnormal serum lipids: the China Health and Nutrition Survey

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ABSTRACT

Objective: To examine the associations between sleep duration and total cholesterol (TC), triglyceride (TG), low density lipoprotein cholesterol (LDL-C), high density lipoprotein cholesterol (HDL-C), apolipoprotein B (ApoB), apolipoprotein A1 (ApoA1), and lipoprotein (a) [Lp(a)].
Methods: The present study analyzed 8574 adults from the China Health and Nutrition Survey (2009). Sleep duration was classified into ⩽6, 7, 8, 9, and ⩾10 h. Age, education, occupation, current smoking, current drinking, physical activity, body mass index, hypertension, and diabetes were adjusted as confounders in gender-stratified multiple logistic regression models.
Results: Compared with women reporting 8 h sleep duration, the odds ratios (ORs) and 95% confidence intervals (CIs) of high TC for those with ⩽6, 7, 9, and ⩾10 h were 1.65 (1.32–2.06), 1.19 (1.00–1.43), 1.11 (0.89–1.39), and 1.27 (1.02–1.60) after adjusting for confounders. Likewise, the ORs (95% CIs) of high LDL-C were 1.71 (1.28–2.29), 1.36 (1.05–1.76), 1.04 (0.74–1.46), and 1.09 (0.78–1.53), whereas those of high ApoB were 1.80 (1.34–2.42), 1.15 (0.88–1.52), 0.95 (0.66–1.35), and 1.00 (0.70–1.43) for women with ⩽6, 7, 9, and ⩾10 h sleep duration, respectively. These associations were not statistically significant in men.
Conclusions: Both shorter and longer sleep durations were associated with higher risks of abnormal serum lipid profiles in women but not in men.

1. Introduction

Shorter sleep duration has been increasingly reported to be associated with higher risks of hypertension [1], diabetes [2], psychological disorders [3], and cardiovascular disease mortality [4]. Recently, a study reported that short sleep duration was associated with dyslipidemia in an American adolescent population [5]. However, the result was not consistent with findings from a Chinese population-based study in Taiwan [6], which stated that short sleep duration was unrelated to a high level of triglyceride (TG) or to a low level of high density lipoprotein cholesterol (HDL-C). Additionally, a U-shaped association between sleep duration and metabolic disorders was described in two studies [7,8], both of which argued that shorter or longer sleep duration might be risk factors for abnormal serum lipid levels. However, a study in Norway did not reveal such a relationship between sleep duration and total cholesterol (TC), HDL-C, or TG [9].

Apolipoprotein B (ApoB), apolipoprotein A1 (ApoA1), and lipoprotein (a) [Lp(a)] are also normally measured as serum lipid markers in clinical practice. However, to the best of our knowledge, studies regarding the associations between sleep duration and ApoB, ApoA1, or Lp(a) are scarce. The aim of this study was to investigate the prevalence of abnormal serum lipids [TC, TG, LDL-C, HDL-C, ApoA1, ApoB, and Lp(a)] and their associations with sleep duration using data from the China Health and Nutrition Survey (CHNS) [10], which offered a unique opportunity to explore their relationships and to improve our understanding of sleep and lipids in health.

2. Methods

2.1. Study subjects

The China Health and Nutrition Survey (CHNS) [11] was initiated in 1989, with the aim to understand changes in health status using a follow-up interval of two or three years. The CHNS selected individuals from 228 communities and was designed to represent 56% of China's population from nine provinces including Liaoning, Shandong, Heilongjiang, Henan, Jiangsu, Hubei, Hunan, Guizhou,

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and Guangxi. A multi-stage, random cluster sampling design was used to draw study samples. This survey was approved by the institutional review committees of the University of North Carolina at Chapel Hill, the National Institute of Nutrition and Food Safety, the Chinese Center for Disease Control and Prevention, and the China–Japan Friendship Hospital, Ministry of Health. All participants provided written informed consent. Details about the study design were reported elsewhere [11].

In the 2009 wave of the CHNS, blood samples were collected and assessed for the first time. In all, 10,242 individuals aged ⩾7 years provided fasting blood and anthropometric measures. In the present study, we excluded those who had missing values of blood sample tests or sleep duration ($n = 853$) and those who were aged <18 years ($n = 815$). Altogether, 8574 adults were included in the analysis.

2.2. Measurements of abnormal serum lipid and sleep duration

Blood samples were collected by venipuncture after an overnight fast. Plasma and serum samples were then frozen, and stored at −86 °C for laboratory analysis. All samples were analyzed in a national central laboratory in Beijing (medical laboratory accreditation certificate ISO 15189:2007) with strict quality control. TC, HDL-C and LDL-C were measured using the glycerol–phosphate oxidase method, and the polyethylene glycol (PEG)-modified enzyme method, respectively, by determiner regents (Kyowa Medex Co., Ltd, Tokyo, Japan). TG was measured using the glycerol–phosphate oxidase method and the PEG-modified enzyme method, by determiner regents (Kyowa Medex Co., Ltd, Tokyo, Japan). ApoB and ApoA1 were assessed using the immunoturbidimetric method, by determiner regents (Randox Laboratories, Ltd, UK). Lp(a) was assessed using the immunoturbidimetric method, by determiner regents (Denka Seiken Co., Ltd, Japan). All lipid measures were on the Hitachi 7600 automated analyzer (Hitachi, Inc., Tokyo, Japan).

Abnormal TC was defined as TC >5.18 mmol/L, abnormal TG was defined as TG >1.70 mmol/L, abnormal LDL-C was defined as LDL-C >3.37 mmol/L, and abnormal HDL-C was defined as HDL-C <1.04 mmol/L. Dyslipidemia was defined by any of the levels of TC, TG, LDL-C and HDL-C being abnormal, in accordance with the Chinese Guidelines on Prevention and Treatment of Dyslipidemia in Adults [12]. Sleep duration was self-reported and categorized into five groups: ⩽6, 7, 8, 9, and ⩾10 h.

2.3. Potential confounders

Blood pressure (BP) was defined by the mean of three measurements after a 10 min seated rest, using standard mercury sphygmomanometers with regular adult cuffs. Hypertension was defined by BP ⩾140/90 mmHg or currently taking anti-hypertension medicines. Diabetes was defined as fasting glucose ⩾126 mg/dL or taking diabetes medication. Body mass index (BMI, kg/m^2), current smoking status, current drinking status, and physical activity were also considered as potential confounders.

Table 1
Characteristics of the male study subjects from the China Health and Nutrition Survey 2009.

Variables	⩽6 h ($n = 386$)	7 h ($n = 761$)	8 h ($n = 1902$)	9 h ($n = 479$)	⩾10 h ($n = 452$)	*P*
Age (years)	56.3 ± 13.6	51.7 ± 13.6	49.1 ± 13.9	50.2 ± 16.4	53.1 ± 18.3	<0.001
BMI (kg/m^2)	23.31 ± 3.64	23.63 ± 3.57	23.39 ± 3.51	23.19 ± 3.50	22.86 ± 3.54	0.007
TC (mmol/L)	4.87 ± 1.07	4.90 ± 1.03	4.82 ± 1.01	4.77 ± 1.03	4.70 ± 1.00	0.008
TG (mmol/L)	1.79 ± 1.44	1.84 ± 1.24	1.83 ± 1.24	1.72 ± 1.20	1.79 ± 1.15	0.791
LDL-C (mmol/L)	2.95 ± 1.00	2.99 ± 0.96	2.92 ± 0.99	2.92 ± 0.96	2.80 ± 1.03	0.021
HDL-C (mmol/L)	1.42 ± 0.37	1.38 ± 0.56	1.40 ± 0.48	1.35 ± 0.39	1.38 ± 0.41	0.289
ApoB (g/L)	0.94 ± 0.29	0.93 ± 0.27	0.90 ± 0.27	0.89 ± 0.27	0.87 ± 0.27	<0.001
ApoA1 (g/L)	1.18 ± 0.34	1.13 ± 0.45	1.14 ± 0.37	1.12 ± 0.33	1.12 ± 0.34	0.267
Lp(a) (g/L)	13.98 ± 26.22	14.59 ± 19.99	13.97 ± 26.9	14.12 ± 21.63	15.1 ± 21.56	0.564
Education						<0.001
<10 years	279 (72.2)	508 (66.7)	1328 (69.8)	359 (74.9)	365 (80.7)	
10–12 years	75 (19.5)	177 (23.3)	434 (22.8)	97 (20.3)	71 (15.8)	
⩾12 years	32 (8.3)	76 (10.0)	141 (7.4)	23 (4.8)	16 (3.5)	
Occupation						<0.001
No job	75 (19.5)	148 (19.4)	348 (18.3)	104 (21.7)	129 (28.5)	
Blue collar	189 (48.9)	393 (51.6)	1103 (58.0)	266 (55.6)	234 (51.8)	
Retired	74 (19.3)	112 (14.7)	204 (10.7)	70 (14.7)	65 (14.4)	
White collar	47 (12.3)	109 (14.3)	247 (13.0)	38 (8.0)	24 (5.3)	
Current smoking						0.147
No	135 (35.0)	292 (38.4)	747 (39.3)	202 (42.2)	161 (35.6)	
Yes	251 (65.0)	469 (61.6)	1155 (60.7)	277 (57.8)	291 (64.4)	
Current drinking						0.008
No	143 (37.0)	279 (36.7)	758 (39.9)	210 (43.8)	206 (45.6)	
Yes	243 (63.0)	482 (63.3)	1144 (60.1)	269 (56.2)	246 (54.4)	
Physical activity						0.043
Not regular	345 (89.4)	653 (85.8)	1689 (88.8)	432 (90.2)	411 (90.9)	
Regular	41 (10.6)	108 (14.2)	213 (11.2)	47 (9.8)	41 (9.1)	
Hypertension						<0.001
No	237 (62.0)	545 (72.2)	1380 (73.5)	344 (72.7)	292 (65.3)	
Yes	145 (38.0)	210 (27.8)	498 (26.5)	129 (27.3)	155 (34.7)	
Diabetes						0.902
No	348 (90.2)	691 (91.0)	1733 (91.3)	432 (90.6)	406 (90.0)	
Yes	38 (9.8)	68 (9.0)	166 (8.7)	45 (9.4)	45 (10.0)	

BMI, body mass index; TC, total cholesterol; TG, triglyceride; LDL-C, low density lipoprotein cholesterol; HDL-C, high density lipoprotein cholesterol; ApoB, apolipoprotein B; ApoA1, apolipoprotein A1; Lp(a), lipoprotein (a).