**Sleep duration and patterns in Chinese patients with diabetes:
a meta-analysis of comparative studies and epidemiological
surveys**

Running title: Sleep Duration in diabetes

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Conflict of interest

We declare that the authors have no competing interests.

Abstract

PURPOSE: A meta-analysis on sleep duration and patterns in patients with diabetes in China.

DESIGN AND METHODS: Two investigators independently carried out a systematic literature search in both international and Chinese databases.

FINDINGS: 47 studies with 98,911 patients were included. The pooled mean sleep duration was 7.15 hours/day in patients with diabetes and 7.49 hours/day in healthy controls. The estimated percentage of short sleep duration of <6 hours/day was 23.0% in patients with diabetes and 12.3% in healthy controls, while the proportion of short sleep duration of

< 7 hours/day was 38.0% in patients with diabetes and 14.1% in healthy controls.

PRACTICE IMPLICATIONS: Short sleep duration was common in Chinese patients with diabetes.

Key words: Sleep duration, sleep pattern, diabetes, meta-analysis, China

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INTRODUCTION

Diabetes is a common chronic disease (Guariguata et al., 2014) which is associated with severe complications, personal suffering and heavy treatment cost (Shaw, Sicree, & Zimmet, 2010). In 2000, the International Diabetes Federation (IDF) estimated around 180 million people suffered with diabetes worldwide (Lefebvre, 2002). However, the figure has reached 285 million in 2010, and project to increase to 439 million in 2030 (Shaw et al., 2010).

While sleep duration of 7-8 hours/day (h/d) is considered healthy (Hirshkowitz et al., 2015), both long and short sleep have been associated with chronic physical diseases and psychiatric disorders (S. Wang, Wu, et al., 2017). For example, a U-shaped association between all-cause mortality and sleep duration was previously reported (Ferrie et al., 2007; Heslop, Smith, Metcalfe, Macleod, & Hart, 2002). Clarifying the sleep patterns in specific physical diseases may help understand the relationship between increased mortality and unhealthy sleep duration.

Sleep problems could lead to the activation of hypothalamo-pituitary-adrenal (HPA) axis, which is significantly associated with diabetes (Balbo, Leproult, & Van Cauter, 2010; Spiegel, Tasali, Leproult, & Van Cauter, 2009). In addition, sleep problems could decrease insulin sensitivity and increase hyperglycemia which could result in diabetes. Moreover, poor sleep could lead to release of more glucocorticoids, increased glucose production and reduced hyperglycemia control (Buckley & Schatzberg, 2005; Knutson, Ryden, Mander, & Van Cauter, 2006). Some researchers have even found that sleep duration less than 6 h/d or more than 9 h/d could increase the risk of diabetes (Lou et al., 2015; Mallon, Broman, & Hetta, 2005).

Accumulating evidence indicated that socioeconomic and cultural factors can significantly influence sleep problems and sleep duration (Bin, Marshall, & Glozier, 2012; W. Sun et al., 2015; Xiang et al., 2009). However, there are inconsistent findings regarding sleep patterns and diabetes in China. To date, we could not locate published meta-analysis of sleep duration and patterns in patients with diabetes in China. Therefore, we conducted this meta-analysis of sleep duration in patients with diabetes in China.

METHODS

Literature search and entry criteria

Figure 1 shows that systematic literature search. Literatures were independently searched by two authors (FW and LL) in Wan Fang, Chinese biomedical literature service system, SinoMed, China National Knowledge Infrastructure, PsycINFO, PubMed, EMBASE from inception date of the databases to June 1st 2017 with the following search terms:

('China' OR 'Chinese') AND ('insomnia' OR 'sleep disturbance' OR 'sleep problem' OR 'sleep disorder' OR 'sleep quality' OR 'sleep symptom' OR 'sleep time' OR 'sleep duration' OR 'sleep habit' OR 'sleep pattern') AND ('diabetes mellitus' OR 'diabetes' OR 'mellitus') AND ('case-control study' OR 'cross-sectional study' 'rate' OR OR 'epidemiology' OR 'cohort study' OR 'prevalence' OR 'observational study'). The two authors also manually searched the reference lists of relevant reviews to avoid missing additional studies.

The entry criteria included: 1) case-control or cohort studies (baseline data were extracted in the latter) carried out in Chinese populations; 2) diabetes diagnosed according to international diagnostic criteria, such as the second World Health Organization (WHO) Expert Committee on Diabetes (Alberti & Zimmet, 1998); 3) sleep duration was reported as the percentage of long (>8 or >9 h/d) and/or short (<6, or <7 h/d) and/or as mean±standard deviation (SD) based on the local recommendation in China; 4) full texts available in Chinese or English. Reviews and case reports were excluded. Surveys conducted in special populations (e.g., pregnant, people with major psychological and severe medical conditions) and those that used convenience sampling or did not report sampling process were excluded.

Studies selection and data extraction

Titles and abstracts of relevant literatures were independently screened by the two authors (FW and IHC), followed by reading the full texts according to the entry criteria after removing the duplicates. A third reviewer (LL) was involved if there were any uncertainties in the process.

The relevant data were extracted by the same two authors, such as title, the first author, publication year, study site, survey year, sampling method, sample size, and sleep duration. If different cut-offs of sleep duration were used in different arms, we analyzed each arm separately.

Quality assessment

The study quality was independently assessed by two authors (WF and LL) with an 8-item quality assessment scale (Boyle, 1998), with the total score ranging from 0 to 8. The total score of 0-3 was considered as 'low quality', 4-6 as 'moderate quality' and 7-8 as 'high quality'.

Statistics

Data analyses were performed by the Comprehensive Meta-Analysis software V 2.0. The pooled results were estimated using the random-effects model (Higgins, Thompson, Deeks, & Altman, 2003). Heterogeneity across studies was evaluated by the I^2 statistic, with $I^2 > 50\%$ being rating as high heterogeneity. In case of high heterogeneity, sources of high heterogeneity were explored by subgroup and sensitivity analyses. Funnel plots were used to test publication bias. Two-sided test was conducted with the significance level of 0.05.

RESULT

Study characteristics

Altogether, 2,924 articles were identified and finally, 47 eligible studies (15 in English and 32 in Chinese) with 98,911 patients were analyzed (Figure 1). The sample size ranged from 36 to 56,032. The data of

sleeping <6 h/d was reported in 23 studies, <7 h/d were in 6 studies, >8 h/d were in 9 studies, and >9 h/d were in 10 studies (Table 1).

Assessment of study quality

The mean score of quality assessment was 5, ranging between 1 and 7 (Table 1); 6 studies were rated as 'high quality' (12.8%), 37 studies as 'moderate quality' (78.7%) and 4 studies as 'low quality' (8.5%).

Supplemental Figure 1a presents the funnel plot of the 23 studies which reported short sleep (<6 h/d). The Egger's test ($t=3.21$, 95%CI: 5.7-26.6, $P=0.004$) revealed publication bias. Similarly, publication bias was found in the 10 studies which reported long sleep (>9 hours/d) ($t=2.98$, 95% CI: -17.9, -2.2, $P=0.02$; Supplemental Figure 1b).

Sleep duration in patients with diabetes and health controls

Figure 2 shows that the mean sleep duration was 7.15 h/d (95% CI: 6.91–7.39 h/d). In contrast, the mean sleep duration was 7.49 h/d (95% CI: 7.48–7.50 h/d) in healthy controls.

The proportions of short and long sleep duration in patients with diabetes and healthy controls were showed in Tables 2a and 2b. The estimated proportion of short sleep duration of <6 h/d was 23.0% (95% CI: 15.4%–32.9%) in patients with diabetes and 12.3% (95% CI: 9.4%–15.9%) in healthy controls, while the proportion of short sleep duration of <7 h/d was 38.0% (95% CI: 24.4%–53.8%) in patients with diabetes and 14.1% (95% CI: 4.6%–35.6%) in healthy controls. In contrast, the proportion of long sleep duration of >8 h/d was 28.4% (95% CI: 17.3%–43.1%) in patients with diabetes and 18.7% (95% CI: 9.9%–32.6%) in healthy controls, while the proportion of long sleep

duration of >9 h/d was 8.6% (95% CI: 5.5%–13.3%) in patients with diabetes and 5.0% (95% CI: 1.3%–16.9%) in healthy controls (Table 2). No publication bias was found in the 11 studies with data on sleep duration ($t=2.19$, 95%CI: -21.5-0.37, $P=0.06$; Supplemental Figure 1c).

Subgroup analyses

Mean sleep duration

The mean sleep duration in studies with a sample size ≤ 771 was 6.78 h/d (95% CI: 6.49-7.07 h/d), which is significantly shorter than 7.57 h/d (95% CI: 6.4-7.95) in those with a sample size > 771 . The mean sleep duration in studies conducted between 2004 and 2009 was 6.9 h/d (95% CI: 6.62-7.17), while the figure was 7.59 h/d (95% CI: 7.23-7.95) in those conducted between 2010 and 2015 ($p<0.05$) (Table 3A).

Short sleep (<6 hours/day)

The proportion of short sleep was 43.6% (95% CI: 30.6-57.5) in hospital and 12.6% (95% CI: 8.1-19.0) in community samples ($p<0.01$). In addition, the proportion of short sleep duration was significantly associated with sample size (35.1%, 95% CI: 22.6-50.1 in studies with a sample size ≤ 729 vs. 13.6%, 95% CI: 7.7-23.0 in studies with a sample size > 729 ; $p<0.01$) and publication language (29.4%, 95% CI: 19.7-41.5 in Chinese versus 13.8%, 95% CI: 7.2-24.7 in English; $p=0.04$) (Table 3B).

Long sleep (> 9 hours/day)

The proportion of long sleep (> 9 h/d) was not significantly associated with study site, sample size, area, survey year and publication language (all p values > 0.05) (Table 3C).

Sensitivity analyses

The primary results did not change significantly after removing each study individually.

DISCUSSION

This is the first comprehensive meta-analysis of epidemiological surveys to explore the sleep patterns in Chinese patients with diabetes. This meta-analysis found that the pooled sleep duration was 7.15 h/d in patients with diabetes and 7.49 h/d.

Sleep problems are common in diabetes and are associated with a number of negative outcomes (Luyster & Dunbar-Jacob, 2011). In this meta-analysis the mean sleep duration was 7.15 h/d in the whole sample with diabetes and 7.28 h/d in those older than 56 years. These were shorter than the figure in Chinese healthy controls (7.49 h/d) old people in general population (7.50 h/d) reported in a recent meta-analysis (Lu et al., 2017). In addition, patients with diabetes had more frequent short and long sleep than healthy controls. Patients with diabetes often suffer from obesity, obstructive sleep apnea, depression, and experience thirst, hunger, and excessive urination at night (Mander, Colecchia, Spiegel, & Van Cauter, 2001), all of which could lead to poor sleep quality and duration (Lee, Ng, & Chin, 2017; X. Liu & Zhou, 2002).

In this meta-analysis the proportion of short sleep (<6 h/d) in hospital was significantly higher than in the community. Hospitalized patients with diabetes are clinically unstable with physical comorbidities, which could lead to short sleep (S. Wang, Li, et al., 2017). In addition, the hospital environment may affect sleep; for example, around 39% of patients with diabetes complained that other patients or caregivers often disrupt their sleep (Chuanqiao, 2006). In this meta-analysis, short sleep was positively associated with a small sample size. Given that no obvious external factors are involved in smaller studies, we assume that the results of smaller studies may be relatively unstable. Furthermore, the proportion of short sleep duration in the Chinese language studies was significantly higher than in the English language studies. We have no explanation for this discrepancy and this finding needs to be confirmed in future studies.

The mean sleep duration was shorter in studies conducted between 2004 and 2009 than between 2010 and 2015; this trend was consistent with previous findings (Ruihua Liu et al., 2017). The discrepancy across study periods may be related to different measures of sleep duration. Moreover, increased awareness on sleep problems and growing number of sleep clinics in Chinese general hospitals may partly contribute to the increase in sleep duration in patients with diabetes over time.

In China, economic status is better in eastern and northern regions than in central region. Therefore, we examined the association between sleep duration and regions as defined by the Chinese economic zone. (Lu et al., 2017) As expected, we found patients with diabetes in central region reported shorter sleep duration than in other areas, supporting

the view that sleep duration and patterns are associated with cultural, economic and environmental factors (Cappuccio, D'Elia, Strazzullo, & Miller, 2010; Lu et al., 2017).

Several limitations should be acknowledged in this study. First, most epidemiological surveys on sleep duration and patterns in patients with diabetes in China did not include healthy controls. Second, different criteria and cut-off of short/long sleep duration were used across studies. Third, heterogeneity was still present despite conducting subgroup analyses; it should be noted that heterogeneity is usually difficult to avoid in observational studies (Patsopoulos, Evangelou, & Ioannidis, 2008). In order to reduce heterogeneity, both subgroup and sensitivity analyses were performed. Finally, some factors related to sleep duration, such as Body Mass Index (BMI), socioeconomic factors and sleep hygiene, were not recorded in most studies, therefore their relationships with sleep duration could not be examined.

In summary, this meta-analysis found short sleep duration is common in Chinese patients with diabetes. Considering its potential negative health effects, health professionals should pay more attention to sleep patterns in patients with diabetes.

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Figures

Figure 1. Identification of studies included in the meta-analysis

Figure 2. Forest plot of the mean sleep duration

Table 1 Characteristic of the included studies

N o.	Study area	First author	Ref.	Language	Publication year	Study area	Survey year	Mean age (years)	Sampling method	Sample size	Proportion of Males (%)	Type of Diabetes	Quality assessment
1	h	Chao et al.	(Chao et al., 2011)	English	2011	Taiwan	2006-2007	52.0 ± 11.3	C	180	67.80 %	2	6
2	c	Kong et al.	(Kong et al., 2017)	English	2017	Hong Kong	2010-2014	53.9+ -8.7	C	3508	59.04 %	2	7
3	c	Lam et al.	(Lam et al., 2010)	English	2010	Guangzhou	2003-2006	NA	CL	4261	NR	2	6
4	c	Lin	(Lin, 2015)	English	2015	Taiwan	2005-2008	43.2± 12.4,	S.R	1533	47.81 %	2	6
5	c	Liu et al.	(R. Liu et al., 201	English	2017	Henan	NR	35-74	CL	1306	NR	2	5

			7)										
6	c	Lou et al.	(Lou et al., 2012)	English	2012	Xuzhou	2008	48.6±13.2	S,R	954	43.40%	2	4
7	h	Meng	(Meng, 2016b)	English	2016	Tianjin	2013-2016	NA	C	1220	50.82%	2	5
8	c	Qiu et al.	(Qiu et al., 2017)	English	2017	Jilin	NR	55.6±10.2	S,R,C	1956	49.69%	2	5
9	c	Song et al.	(Q. Song, Liu, Zhou, Wang, & Wu, 2016)	English	2016	Hebei	2006-2009	51.0±10.3	NR	4899	80.69%	2	6
10	c	Sun et al.	(K. Sun et al., 2016)	English	2016	Guangzhou	2011	56.0 ± 8.0	CL	1435	32.96%	2	7

1 1	c	Tang et al.	(Tang et al., 2014)	English	2014	Xuzhou	2012	52.2±16.2	S	634	49.80%	2	4
1 2	h	Wang et al.	(S. Wang, Fu, et al., 2017)	English	2017	Guangzhou	NR	28.5 ± 3.2	C	62	0	2	5
1 3	c	Wang et al.	(T. Wang et al., 2015)	English	2015	Mainland China	2011-2012	NA	CL	56032	38.38%	2	5
1 4	c	Wu et al.	(H. B. Wu et al., 2017)	English	2017	Zhejiang	2004-2008	30-79	CL	2914	33.39%	2	6
1 5	h	Ren et al.	(G. Q. Ren & Li, 2010)	Chinese	2010	Shanxi	2008-2009	50-60	NR	50	NR	2	3

16	c	Liu	(B. Liu, 2015)	Chinese	2015	Hubei	2013	62.6±7.2	CL	1123	44.60%	2	7
17	h	Zhuo	(Zhuo, 2014)	Chinese	2014	Fujian	2011-2014	56.5±0.8	C	2057	59.94%	2	3
18	h	Wu	(D. N. Wu, 2012)	Chinese	2012	Liaoning	2010-2011	60.9±7.9	C	348	44.83%	2	5
19	h	Wu	(X. J. Wu, Yu, & Zhou, 2012)	Chinese	2012	Xuzhou	2010-2011	60.3+11.4	C	222	46.40%	2	6
20	h	Wu et al.	(Z. H. Wu & Xu, 2011)	Chinese	2011	NR	2009-2010	59.7±13.5	C	104	63.46%	2	5
21	c	Wu	(H. M. Wu, 2011)	Chinese	2013	Xuzhou	2011-2012	55.8+13.0	S	729	42.73%	2	6

			3)										
2 2	h	Meng	(Meng, 2016a)	China	2016	Tianjin	NR	57.4± 10.2	C	551	54.99 %	2	6
2 3	h	Song	(Song, 2007)	China	2007	Henan	2004- 2015	60.3+ -15.6	C	200	57.50 %	2	4
2 4	c	Zhang et al.	(Peng, Zhang, Lou, Chang, Zhang, & Chen, 2014)	China	2015	Xuzhou	2013	58.5± 14.3	C	771	40.99 %	2	4
2 5	c	Zhang et al.	(Liang et al., 2012)	China	2012	Xuzhou	2008	NR	C	1060	NR	2	5
2 6	h	Zhu et al.	(Yan, Y.)	China	2016	Jiangsu	2014- 2015	56.4± 25.7	C	365	58.63 %	2	5

			Zhu , Yan g, & Lou , 201 6)										
2 7	c	Li et al.	(J. Q. Li, Hon g, Lia ng, Wan g, & Xu, 201 1)	Chine se	2011	Nanjing	2004	58.0± 12.3	C	76	44.70 %	2	5
2 8	h	Yang et al.	(Ya ng, Zhu , & Lou , 201 5)	Chine se	2015	Nanjing	2013- 2014	55.4± 11.6	C	290	53.45 %	2	5
2 9	h	Wang et al.	(H. J. Wan g, Pi, Yan g, & Li, 201	Chine se	2016	Hunan	2014- 2015	NR	C	72	50.00 %	2	3

			6)										
30	c	Hao	(Hao, 2013)	Chinese	2013	Beijing	NR	40-93	CI	4565	75.18%	2	6
31	c	Chen et al.	(Chen, Zhao, Zhou, Shu, & HU, 2015)	Chinese	2015	Nanchang	2013	NR	C	202	44.06%	2	5
32	c	Gao et al.	(Gao, Li, Wu, Wang, & Zhao, 2014)	Chinese	2014	Hebei	2010	NR	CL	3084	82.81%	2	5
33	h	Huang et al.	(Huang & Huang, 2010)	Chinese	2010	NR	2009	78	C	100	79.00%	NR	4

34	h	Zhu et al.	(B. Q. Zhu, Li, Wang, & Yu, 2014)	English	2014	Xi'an	2013-2014	57.2±11.2	C,S	220	66.00%	2	7
35	c	Yu et al.	(Yu, Zhao, & Shao, 2016)	Chinese	2016	Shanghai	2015	59.1±5.0	R,CL	81	46.91%	2	4
36	h	Chang et al.	(Chang, Li, & Gao, 2005)	Chinese	2005	Shandong	2001-2005	60-84	C	220	72.73%	NR	4
37	c	Peng	(Peng, 2008)	Chinese	2008	Hunan	2006-2007	60.2	C	36	52.78%	2	1
38	c	Wang et al.	(X. Z. Wang, Li, Zhao	Chinese	2015	Hebei	2013	57.1	C, R	525	60.60%	2	6

			u, Wan g, & Yan g, 201 5)										
3 9	h	Tian et al.	(Tia n & Che n, 201 3)	Chine se	2013	Jiangsu	2011- 2012	61.8 ± 12.9	R	60	51.67 %	2	6
4 0	c	Gu et al.	(Gu & Wan g, 201 5)	Chine se	2015	Shangha i	2014	58.9 ± 8.4	R	300	54.67 %	2	5
4 1	c	Wei et al.	(We i, Tao, Le, & Xia, 201 5)	Chine se	2015	Shangha i	2014	68.8± 9.3	R,Cl	372	38.44 %	2	7
4 2	c	Ren et al.	(H. Z. Ren , Cha ng, Sha n, &	Chine se	2015	Tianjin	2011- 2014	66.2± 6.2	CL	428	100.0 0%	2	5

			Yan g, 201 5)										
4 3	c	Ren et al.	(H. Z. Ren , Cha ng, Zhe ng, Xu, & Yan g, 201 6)	Chine se	2016	Tianjin	2011- 2014	66.2± 6.2	CL	536	0	2	5
4 4	h	Liu et al.	(J. Liu & Liu, 200 8)	Chine se	2008	Shandon g	2006- 2007	72	C	122	56.56 %	2	5
4 5	h	Liu	(Y. X. Liu, 201 2)	Chine se	2012	Shangha i	2011- 2012	30-90	S,R	283	51.24 %	2	7
4 6	c	Li et al.	(Z. Q. Li & Wu, 201	Chine se	2012	Liaoning	2009- 2011	60. 9±7. 9	C	348	NR	2	5

			2)										
4 7	h	You et al.	(Yo u & Jian g, 201 4)	Chine se	2014	Chongqi ng	2012	53.7 ± 7.6	C	200	44.50 %	NR	5

C: community; h, hospital; NR: Not Report; C: consecutive; CI: cluster; R: random; Ref.: reference; S: stratified sample method;

Table 2a. Proportion of sleep duration with different cut-off values in diabetes group

Cut-off of sleep duration (Number of studies)	Proportion (%)	95% CI (%)		Events	Sample size	I^2 (%)	P	Publication bias (Egger's Text)
<6 hours/day (23)	23.0	15.4	32.9	7524	84595	99.7	<0.001	0.004
<7 hours/day (6)	37.4	26.9	49.2	1754	5178	98.8	<0.001	0.811
>8 hours/day (9)	28.4	17.3	43.1	280	8808	99.4	<0.001	0.030
>9 hours/day (10)	8.6	5.5	13.3	13413	72139	99.3	<0.001	0.018

Table 2b. Proportion of sleep duration with different cut-off values in healthy control group

Cut-off of sleep duration (Number of studies)	Proportion (%)	95% CI (%)		Events	Sample size	I^2 (%)	P	Publication bias (Egger's Text)
<6 hours/day (10)	12.3	9.4	15.9	17623	124413	99.6	<0.001	0.549
<7 hours/day (2)	14.1	4.6	35.6	14756	73207	99.9	<0.001	-
>8 hours/day (8)	18.7	9.9	32.6	26963	119739	99.9	<0.001	0.714
>9 hours/day (3)	5.0	1.3	16.9	2588	75386	99.9	<0.001	0.964

Table 3A Subgroup analyses of sleep duration.

Subgroups	Categories		Mean	SE	95%CI	Sample size	I^2 (%)	P	Q (P)
	(Number of studies)								
Age groups (years)	≤ 56 (5)		7.00	0.19	6.63 7.37	10170	99.2	<0.001	1.15(0.28)
	>56 (6)		7.28	0.14	6.88 7.42	5349	98.7	<0.001	
Study site	Hospital (4)		6.54	0.19	6.16 6.91	695	92.0	<0.001	0.59(0.44)
	Community (5)		7.69	0.17	7.36 8.01	13215	99.4	<0.001	

Sample size	≤771 (6)	6.78	0.15	6.49	7.07	1542	97.1	<0.001	13.39(<0.05)
	>771 (5)	7.57	0.40	6.40	7.95	13977	99.3	<0.001	
Area	East (5)	7.29	0.20	6.72	7.93	9025	96.9	<0.001	4.39(0.22)
	Middle (2)	7.32	0.31	6.33	7.21	1173	99.5	<0.001	
	West (1)	6.31	0.45	5.43	7.19	100	-	-	
	Taiwan/Hong Kong (3)	7.08	0.25	6.59	7.57	5221	99.4	<0.001	
Survey time	2004-2009 (7)	6.90	0.14	6.62	7.17	9752	98.6	<0.001	8.88(<0.05)
	2010-2015 (4)	7.59	0.18	7.23	7.95	5767	98.4	<0.001	
Publication language	Chinese (6)	7.09	0.18	6.75	7.43	2485	99.0	<0.001	0.25(0.62)
	English (5)	7.22	0.19	6.85	7.59	13034	99.1	<0.001	

Table 3B. Subgroup analyses of short sleep (**<6 hours/day**).

Subgroups	Categories	Proportion (%)	95%CI		Events	Sample size	I^2 (%)	P	Q (P)
	(Number of studies)			(%)					
Study site	Hospital (10)	43.6	30.6	57.5	1951	5021	96.6	0.37	19.63(<0.01)
	Community (13)	12.6	8.1	19.0	5650	79574	99.6	<0.001	

Sample size	≤729 (12)	35.1	22.6	50.1	1189	3531	96.8	0.05	7.40(<0.01)
	>729 (11)	13.6	7.7	23.0	6412	81064	99.8	<0.001	
Area	East (17)	19.8	12.3	30.4	7148	80481	99.7	<0.001	5.26(0.07)
	Middle (4)	50.1	23.4	76.7	224	426	81.8	0.99	
	Taiwan/Hong Kong (2)	12.1	2.6	42.1	229	3688	99.0	0.02	
Survey time	≤ 2010 (11)	23.8	13.0	39.7	2206	13869	99.0	0.002	0.03(0.86)
	>2010 (12)	22.2	12.3	36.7	5395	70726	99.8	0.001	
Publication language	Chinese (15)	29.4	19.7	41.5	2975	14254	99.0	0.001	4.39(0.04)
	English (8)	13.8	7.2	24.7	4626	70341	99.8	<0.001	

Table 3C Subgroup analyses of long sleep (>9 hours/day).

Study site	Hospital (2)	3.5	1.3	9.6	47	1400	-	<0.001	3.76(0.05)
	Community (8)	10.5	6.6	16.3	13366	70739	99.4	<0.001	
Sample size	≤1377 (5)	8.6	4.4	16.1	175	2026	97.7	<0.001	0.001(0.98)
	>1377(5)	8.7	4.6	15.8	13238	70113	99.6	<0.001	
Area	East (7)	9.2	5.4	15.4	162	1713	99.5	<0.001	0.31(0.86)

	Middle (1)	8.7	1.9	31.6	18	202	-	0.004	
	Taiwan/Hong Kong (2)	6.7	2.3	18.0	13233	70224	85.0	<0.001	
Survey time	≤ 2010(6)	7.9	4.7	13.1	720	10120	98.4	<0.001	0.3(0.58)
	>2010(4)	9.9	5.3	17.6	12693	62019	99.2	<0.001	
Publication language	Chinese (5)	9.5	4.5	19.1	12630	8275	98.7	<0.001	0.15(0.70)
	English (5)	7.8	3.6	15.8	783	63864	99.5	<0.001

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