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Linking knowledge with attitude: Public knowledge and attitude towards sleep disturbances and dementia

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ABSTRACT

Objectives: Sleep disturbances increase the risk of dementia. The aim of this study was to investigate the proportions of and factors associated with the knowledge that sleep disturbances are a risk factor for dementia, as well as attitudes towards improving sleep quality and obtaining knowledge about dementia.

Design and setting: A cross-sectional, web-based questionnaire was conducted between May and October, 2019.

Participants: All participants provided informed consent were able to respond to the survey, and 3329 eligible samples were included.

Primary outcomes: Knowledge that sleep disturbances increase risk factor for dementia, as well as attitudes towards improving sleep quality and obtaining knowledge about dementia.

Results: 3329 eligible samples were included, among which 72.57% could correctly recognize sleep disturbances as a risk factor for dementia. In total, 92.97% of participants were willing to take at least one measure to improve sleep quality, and the percentages who would adopt these measures are described as follows: 78.73% would lead a regular life, 67.88% would engage in strengthening exercise, 28.84% would obtain psychotherapy, and 19.41% would take medication. The knowledge that sleep disturbances increase the risk of dementia was the only factor that was associated with the willingness of participants to improve sleep quality and all four categories of measures. Almost all participants (95.25%) were willing to take at least one measure to learn knowledge about dementia. Participants who were female, had contact with dementia, and regarded sleep disturbances as increasing the risk of dementia displayed a higher willingness to obtain knowledge about dementia and all categories of measures.

Conclusions: The findings link the knowledge that a lack of quality sleep increases the risk of dementia with attitudes towards improving sleep quality and obtaining knowledge about dementia, which further indicates the necessity of disseminating knowledge about sleep disturbances and dementia.

Keywords: public knowledge; sleep disturbances; dementia; sleep medications

Strengths and limitations of this study

- In this cross-sectional study, nearly three fourths participants could correctly recognize sleep disturbances as a risk factor for dementia.
- Almost all of the participants were willing to take at least one measure to improve sleep quality, and learn knowledge about dementia.
- The knowledge that sleep disturbances increase the risk of dementia was the only factor that was associated with the willingness of participants to improve sleep quality and all four categories of measures, implicating the necessity of disseminating knowledge about sleep disturbances and dementia
- Limitations included online survey, as well as self-reported sleep disturbances and mental health problems.

1. INTRODUCTION

Sleep disturbances are common and significant health problems. The prevalence of sleep disturbances varies with age, with sleep apnoea, insomnia, and restless leg syndrome being most common.[1-3] Sleep disturbances largely affect the endocrine, immunity, and cardiovascular systems and increase the risk of obesity,[4] diabetes,[4-6] cardiovascular diseases,[5 7 8] and cancer.[9] A growing body of evidence implies that disturbed sleep contributes to impairments in cognitive performance, including mild cognitive impairment and dementia.[10-12] Medicines for sleep disturbances might be related to adverse effects, such as cognitive impairment and possibly dementia,[13 14] although the causal association between benzodiazepine use and dementia remains controversial.[15] Based on the findings, modifying sleep disturbance might be a management priority for preventing or delaying the progression of dementia.[16]

Sleep disturbance as a risk factor for dementia has been identified, and whether it has been adequately disseminated and recognized among the general public remains unclear. Attitude does predict behaviour,[17] and public attitudes towards improving sleep disturbances and obtaining knowledge may guide and shape people's behaviour for regulating sleep disturbances and help reduce the risk of dementia. Consequently, it is important to prompt the general public's attitudes towards improving sleep quality and obtaining knowledge about dementia. However, to the best of our knowledge, no existing studies have investigated public knowledge of and attitudes towards sleep disturbances and dementia.

The aim of this study was to investigate the status of and factors associated with the knowledge that sleep disturbances are a risk factor for dementia. Moreover, we intended to explore the proportions and factors associated with public attitudes towards improving sleep quality and obtaining knowledge about dementia.

2. MATERIALS AND METHODS

2.1 Study design and participants

A cross-sectional, web-based study was conducted between May 27, 2019, and October 6, 2019. A self-designed survey was disseminated through WeChat, a social media outlet widely used in China. The detailed survey process was introduced in our previous paper.[18] A total of 3436 participants submitted the questionnaire, and a total of 3329 questionnaires with full available data were analysed. The whole process followed STROBE guidelines.

2.2 Questionnaire content

The questionnaire was written in Chinese and the items used in this study could be briefly categorized into following parts: (1) basic sociodemographic information, including sex, age, education level, type of job, income, type of residence, and whether the respondent had contact with anyone who lived with dementia; (2) sleep-related factors, such as shift work, sleep duration in the past one month, self-reported sleep quality in the past one month, and self-reported diagnosis of sleep disturbances, neurological or psychiatric disorders; (3) knowledge about sleep disturbances and risk of dementia, with the question "Do you think poor sleep will increase the risk of dementia?"; and perception of sleep medicine and risk of dementia, with the question "Do you think taking sleeping pills will increase the risk of dementia?"; (4) attitudes towards improving sleep quality if they were troubled with sleep disturbances, with a multiple-choice question "If you have sleep disturbances, what kind of methods would you like to take to improve your sleep quality?" The questions had the following response options: regular

lifestyle/strengthening exercise/psychotherapy/medication/others (please fill in)/not willing; and willingness to take a drug that could improve sleep quality and reduce the risk of/or prevent dementia; and (5) attitudes towards obtaining knowledge about dementia, with the following multiple-choice question "What kind of ways do you like to obtain knowledge about dementia?" The questions had the following response options: television and Internet (e.g., WeChat, Weibo, online video, etc.)/books, magazines or newspaper/lecture on medication, or doctor consultation service/others (please fill in)/not willing. Detailed information is listed in the Supplementary Data in a previous study (https://bmcpublichealth.biomedcentral.com/articles/10.1186/s12889-020-09665-7).

2.3 Statistical analysis

Descriptive statistics were used to present demographic data. The proportion of participants with the knowledge that sleep disturbances increase the risk of dementia was calculated and reported as the percentages of cases in different sociodemographic populations. To explore factors potentially associated with knowledge that sleep disturbances increase the risk of dementia, multiple logistic regression analyses were performed, and adjusted odds ratios (AORs) and 95% confidential intervals (CIs) are presented. Similar to the aforementioned statistical analysis, factors associated with participants' attitudes towards ameliorating sleep disturbances, willingness to take medicines that could improve sleep quality and dementia, and knowledge about dementia were explored using multiple logistic regression analyses, with AORs and 95% CIs presented. Two-sided Wald tests were conducted to determine whether the ORs in the regression models were statistically significant. The level of significance was set to $P < 0.05$. All the statistical analyses were performed using SPSS statistical

software version 22 (IBM Corp).

3. RESULTS

3.1 Characteristics of participants

Data from a total of 3329 eligible samples were included in the final analysis, for a participation rate of 96.89% (3329 of 3426 participants). Of the total sample, approximately one-fifth of the participants performed shift work. Most participants (64.73%) reported that they had 6 to 8 hours sleep per night in the past month, some participants (29.31%) had fewer than 6 hours sleep per night, and a small number of participants (5.95%) reported that they had over 8 hours sleep duration per night. A total of 2057 participants (61.79%) had self-reported very good or pretty good sleep quality in the past month, while 1272 participants (38.21%) had self-reported very bad or pretty bad sleep quality in the past month. In addition, 845 participants (25.38%) reported that they had at least one diagnosis of sleep disturbances or neurological or psychiatric disorders. Additional demographic and sleep-related characteristics are presented in Table 1.

Table 1. Proportions and factors associated with the knowledge that sleep disturbances increase the risk of dementia.

	Total number	Sleep disturbances		
		%	AOR	95% CI
Overall	3329	72.57		
Sex				
Men	1150	68.78	1	
Women	2179	74.58	1.47*	1.24-1.75
Age (years)				
< 40	1840	81.41	1	
40-65	1383	62.98	0.36*	0.39-0.56
≥ 65	106	44.34	0.35*	0.22-0.56
Education level (years)				
Primary school or illiteracy (≤ 6)	57	50.88	1	
Middle or high school (6-12)	614	57.82	1.33	0.75-2.35
College or university (12-16)	1667	74.09	1.92*	1.07-3.46
Postgraduate (≥ 16)	991	80.42	2.45*	1.32-4.53
Type of job				
Nonmanual	2574	76.53	1	
Manual	403	67.49	0.86	0.65-1.13
Retired	352	49.43	0.55*	0.41-0.74
Income groups (yuan/month)				

0-2000	362	71.55	1	
2000-5000	975	69.13	0.95	0.71-1.27
5000-10000	1229	74.78	0.99	0.74-1.33
> 10000	763	73.92	0.90	0.65-1.25
Type of residence				
City	2887	73.71	1	
Town	289	65.40	0.83	0.62-1.09
Rural area	153	64.71	0.86	0.58-1.26
Dementia contact				
Yes	1100	75.91	1	
No	1669	70.28	0.65*	0.54-0.78
Unclear	560	72.86	0.83	0.65-1.06
Shift work				
Yes	753	83.13	1	
No	2576	69.49	0.57*	0.46-0.71
Sleep duration in the past one month (hours)				
6-8	2155	73.97	1	
< 6	976	70.49	1.07	0.88-1.30
> 8	198	67.68	0.71*	0.51-0.99
Self-reported sleep quality in the past one month				
Very good/Pretty good	2057	71.71	1	
Very bad/Pretty bad	1272	73.98	1.00	0.83-1.20
Self-reported diagnosis of sleep disturbances, neurological or psychiatric disorders				
At least one	845	74.44	1	
None	2484	71.94	0.76*	0.62-0.92

3.2 Proportion and factors associated with the knowledge that sleep disturbances increased the risk of dementia

The proportion of participants who could correctly recognize sleep disturbances as a risk factor for dementia among the total sample was 72.57%. Additional details on the proportion of participants with the knowledge that sleep disturbances increase the risk of dementia in different populations are presented in Table 1.

The relationship between sociodemographic or sleep-related factors and knowledge of sleep disturbances for dementia were assessed using multiple logistic regression analysis. In the multivariable analysis, being female, being younger than 40 years, having a high educational level, having a nonmanual job, and having contact with dementia were associated with being more likely to realize the roles that sleep disturbances play in the risk of dementia, while participants with different types of residence or incomes had no significant differences in understanding sleep disturbances as a risk factor for dementia.

Participants who did not perform shift work (AOR = 0.57, 95% CI = 0.46-0.71) were less aware that sleep disturbances increase the risk of dementia compared with those who performed shift work. Compared with those with average sleep duration (6-8 hours), participants with longer sleep duration (> 8 hours: AOR = 0.71, 95% CI = 0.51-0.99) exhibited worse understanding of the relationship between sleep disturbances and dementia, while short sleepers (< 6 hours) did not show worse understanding of this relationship. In addition, respondents who had no self-reported diagnosis of sleep disturbances or neurological or psychiatric disorders (AOR = 0.76, 95% CI = 0.62-0.92) demonstrated less understanding of sleep disturbances in the risk of dementia. Participants with different sleep qualities did not show significant differences in understanding sleep disturbances as a risk factor for dementia. The detailed results of the multivariable analysis are shown in Table 1.

3.3 Proportion and factors associated with participants who were willing to take measures to improve sleep quality

Almost all participants (92.97%) were willing to take at least one measure to improve sleep quality if they were diagnosed with sleep disturbances, while 1.74% and 5.30% of participants showed a negative attitude towards improving sleep quality if they were diagnosed with sleep disturbances. The percentages of participants who were willing to take measures to improve sleep quality were as follows: 78.73% would t lead a regular life, 67.88% would engage in strengthening exercises, 28.84% would undergo psychotherapy, and 19.41% would take medication.

Factors associated with participants' willingness to take measures to improve sleep quality were further explored and are presented in Table 2. A strong association was explored between knowledge that sleep disturbances increase the risk of dementia

and willingness to improve sleep quality (AOR = 0.22, 95% CI = 0.13-0.38). Compared with participants who thought sleep disturbances increased the risk of dementia, participants who did not regard sleep disturbances as increasing the risk of dementia or who remained unclear about it displayed less willingness of all categories of four measures, including taking regular life (AOR = 0.52, 95% CI = 0.36-0.73, vs AOR = 0.79, 95% CI = 0.63-0.99), strengthening exercise (AOR = 0.45, 95% CI = 0.33-0.63, vs AOR = 0.77, 95% CI = 0.63-0.94), going for psychotherapy (AOR = 0.57, 95% CI = 0.37-0.86, vs AOR = 0.75, 95% CI = 0.60-0.94), and taking medication (AOR = 0.53, 95% CI = 0.34-0.83, vs AOR = 0.70, 95% CI = 0.54-0.89) to improve sleep quality. In addition, individuals who did not consider sleep medicine to increase the risk of dementia displayed a lower willingness to improve sleep quality than those who regarded sleep medicine as a risk factor for dementia (AOR = 0.56, 95% CI = 0.32-0.98). Other demographic or sleep-related factors were not associated with participants' willingness to ameliorate sleep disturbances.

Table 2. Factors associated with the attitudes of participants towards taking measures to improve sleep disturbances.

	Willingness to improve sleep quality		Regular life		Strengthened exercise		Psychotherapy		Medication	
	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI
Sex (ref: male)	1.19	0.80-1.78	1.02	0.85-1.24	0.91	0.77-1.08	1.62*	1.36-1.92	1.21	0.99-1.47
Age (ref: < 40 years)										
40-65 years	0.95	0.61-1.49	0.51*	0.42-0.63	1.00	0.83-1.20	0.87	0.72-1.04	1.36*	1.10-1.67
≥ 65 years	1.55	0.56-4.32	0.96	0.57-1.63	0.70	0.44-1.12	0.59	0.31-1.12	1.68	0.98-2.90
Education level (ref: primary school or illiteracy ≤ 6)										
Middle or high school (6-12)	0.79	0.26-2.42	1.58	0.89-2.80	1.05	0.60-1.84	2.07	0.85-5.07	1.77	0.72-4.34
College or university (12-16)	1.34	0.41-4.32	2.62*	1.44-4.74	1.87*	1.06-3.32	3.02*	1.23-7.41	2.16	0.87-5.35
Postgraduate (≥ 16)	2.32	0.64-8.37	2.62*	1.40-4.91	2.49*	1.37-4.53	3.06*	1.23-7.62	1.99	0.79-5.02
Type of job (ref: nonmanual)										
Manual	1.02	0.57-1.84	0.70*	0.52-0.93	0.87	0.67-1.13	0.77	0.58-1.03	0.90	0.65-1.24
Retired	0.57	0.31-1.02	0.71*	0.52-0.96	0.76	0.57-1.02	0.50*	0.35-0.72	0.97	0.69-1.38
Income groups (ref: 0-2000 yuan/month)										
2000-5000 yuan/month	0.88	0.49-1.59	1.08	0.80-1.47	0.84	0.64-1.10	0.94	0.70-1.25	0.96	0.69-1.33
5000-10000 yuan/month	1.30	0.68-2.48	1.18	0.86-1.62	1.02	0.77-1.33	1.15	0.87-1.53	1.05	0.76-1.45
> 10000 yuan/month	1.05	0.51-2.16	1.03	0.73-1.45	1.07	0.79-1.45	1.05	0.77-1.43	1.19	0.84-1.69
Type of residence (ref: city)										

Town	0.77	0.44-1.35	0.81	0.60-1.10	0.77*	0.58-1.00	0.73	0.54-1.00	0.85	0.60-1.20
Rural area	0.88	0.40-1.92	1.14	0.75-1.74	0.88	0.61-1.27	1.31	0.87-1.96	1.19	0.75-1.89
Dementia contact (ref: yes)										
No	1.15	0.74-1.78	1.09	0.89-1.33	0.83*	0.69-0.98	0.80*	0.67-0.96	0.88	0.72-1.08
Unclear	0.71	0.43-1.18	0.97	0.75-1.26	0.78*	0.62-0.98	0.89	0.70-1.12	1.03	0.79-1.34
Shift work (ref: yes)	0.79	0.48-1.31	0.67*	0.53-0.85	1.02	0.84-1.23	0.82*	0.68-0.98	0.77*	0.62-0.95
Sleep duration in the past one month (ref: 6-8 hours)										
< 6	0.91	0.60-1.39	0.78*	0.64-0.96	0.82*	0.69-0.99	1.21	1.00-1.45	1.10	0.89-1.36
> 8	0.80	0.37-1.73	0.60*	0.42-0.86	0.98	0.71-1.37	1.12	0.80-1.56	1.03	0.70-1.53
Self-reported sleep quality in the past one month (ref: very good/pretty good)	0.65*	0.43-0.97	0.80*	0.66-0.97	0.76*	0.65-0.90	1.01	0.85-1.20	0.96	0.79-1.17
Self-reported diagnosed sleep disturbances, neurological or psychiatric disorders (ref: at least one)	1.00	0.66-1.52	1.47*	1.21-1.79	0.98	0.82-1.17	0.57*	0.47-0.68	0.46*	0.38-0.57
Do you think sleep disturbances increase risk of dementia? (ref: yes)										
No	0.22*	0.13-0.38	0.52*	0.36-0.73	0.45*	0.33-0.63	0.57*	0.37-0.86	0.53*	0.34-0.83
Unclear	0.89	0.55-1.46	0.79*	0.63-0.99	0.77*	0.63-0.94	0.75*	0.60-0.94	0.70*	0.54-0.89
Do you think sleep medicine increase risk of dementia? (ref: yes)										
No	0.56*	0.32-0.98	0.64*	0.48-0.85	0.82	0.64-1.07	1.12	0.87-1.45	2.76*	2.11-3.61
Unclear	0.75	0.48-1.16	0.85	0.69-1.04	0.86	0.72-1.03	0.97	0.81-1.16	1.49*	1.21-1.83

A significant association was explored between sex and going for psychotherapy. Compared with younger individuals (aged < 40 years), middle-aged participants (aged 40–65 years) displayed unwillingness to lead a regular life and more willingness to take medicine if they were troubled with sleep disturbances, while the old adults (aged ≥ 65 years) had no significant difference compared with younger individuals. Participants with a high educational level were more prone to take regular life, strengthen exercise, and go for psychotherapy but not take medicines. Compared with nonmanual workers, manual workers were less willing to lead a regular lifestyle, and retired participants were less willing to either lead a regular lifestyle or undergo psychotherapy. Respondents who were never in contact with patients with dementia were less likely to choose strengthened exercise or going for psychotherapy to improve sleep quality than respondents who had contact with patients with dementia. Participants' willingness to take measures to improve sleep quality was not influenced by income or type of residence.

Participants who engaged in shift work had a lower desire to lead a regular lifestyle (AOR = 0.67, 95% CI = 0.53-0.85), go for psychotherapy (AOR = 0.82, 95% CI = 0.68-0.98) or take medicines (AOR = 0.77, 95% CI = 0.62-0.95) than those who did not perform shift work. Compared with participants with average sleep duration (6-8 hours), short sleepers (< 6 hours) displayed unwillingness to improve sleep quality by taking regular life (AOR = 0.78, 95% CI = 0.64-0.96) or strengthening exercise (AOR = 0.82, 95% CI = 0.69-0.99), while long sleepers (> 8 hours) showed unwillingness to improve sleep quality by taking regular life (AOR = 0.60, 95% CI = 0.42-0.86). In addition, associations were identified between sleep quality and participants' willingness to improve sleep quality (AOR = 0.65, 95% CI = 0.43-0.97). Specifically, respondents with poor sleep quality exhibited less willingness to improve sleep quality by leading a regular lifestyle (AOR = 0.80, 95% CI = 0.66-0.97) or strengthening exercise (AOR = 0.76, 95% CI = 0.65-0.90). Compared with those who were self-reported diagnosed with at least one sleep disturbance or neurological or psychiatric disorder, those participants with none of these diseases showed a greater willingness to lead a regular lifestyle (AOR = 1.47, 95% CI = 1.21-1.79) but less willingness to go for psychotherapy (AOR = 0.57, 95% CI = 0.47-0.68) or take medicines (AOR = 0.46, 95% CI = 0.38-0.57). Participants who did not regard sleep medicine as an increased risk of dementia or remained unclear about it displayed more willingness to take medication (AOR = 2.76, 95% CI = 2.11-3.61, vs AOR = 1.49, 95% CI = 1.21-1.83) to improve sleep quality.

Factors associated with participants' willingness to take medicines that could improve sleep quality and reduce the risk of dementia were also explored. In the multivariable analysis, being female, having contact with dementia, performing shift work, reporting good sleep quality, and reporting a diagnosis of sleep disturbances

and neurological or psychiatric disorders were found to be associated with more willingness to take medicines if the medicines could improve sleep quality and reduce the risk of dementia. In addition, participants who did not think sleep disturbances increase the risk of dementia or remained unclear about it displayed less willingness to take medicines (AOR = 0.45, 95% CI = 0.32-0.63, vs AOR = 0.69, 95% CI = 0.57-0.85) compared with participants who regard sleep disturbances as a risk factor for dementia. Participants who did not regard sleep medicine as increasing the risk of dementia demonstrated at least twice the willingness to take medicines that simultaneously relieved sleep disturbances and dementia (AOR = 2.23, 95% CI = 1.67-3.00). The detailed results of the multivariable analysis are shown in Supplementary Table 1.

3.4 Proportions and factors associated with participants who were willing to take measures to obtain knowledge about dementia

Almost all participants (95.25%) were willing to take at least one measure to learn dementia knowledge, while very few participants (4.75%) showed they were unwilling to learn dementia knowledge. The percentages of participants who were willing to take various measures to obtain knowledge about dementia were as follows: 80.35% for television and the Internet, 59.14% for books, magazines or newspapers, and 52.81% for lectures on medication or doctor consultation services.

Factors associated with participants who were willing to take measures to obtain knowledge about dementia are presented in Table 3. Participants who were female, had contact with dementia, and thought sleep disturbances increase risk of dementia displayed a higher willingness to obtain knowledge about dementia and all categories of measurements including television and Internet, books, magazines or

newspaper, as well as lecture on medication, or doctor consultation service. Moreover, education level, income, and type of residence also influenced participants' willingness to obtain dementia knowledge.

Table 3. Factors associated with the willingness of participants to obtain knowledge about dementia.

	Television and Internet		Books, magazines or newspaper		Lecture on medication, or doctor consultation service		Willingness to obtain knowledge about dementia	
	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI
Sex (ref: male)	1.42*	1.18-1.72	1.48*	1.27-1.73	1.63*	1.40-1.90	2.19*	1.55-3.09
Age (ref: < 40 years)								
40-65 years	0.81*	0.65-0.99	1.55*	1.30-1.84	1.17	0.99-1.39	1.38	0.93-2.06
≥ 65 years	0.62	0.37-1.03	1.15	0.71-1.84	0.78	0.48-1.27	0.83	0.34-2.02
Education level (ref: primary school or illiteracy ≤ 6)								
Middle or high school (6-12)	1.97*	1.12-3.47	2.62*	1.38-4.97	0.88	0.50-1.56	1.95	0.81-4.66
College or university (12-16)	3.38*	1.89-6.07	4.75*	2.48-9.09	1.45	0.81-2.58	2.43	0.97-6.10
Postgraduate (≥ 16)	3.41*	1.84-6.31	4.54*	2.33-8.83	1.60	0.88-2.90	3.12*	1.16-8.40
Type of job (ref: nonmanual)								
Manual	0.72*	0.54-0.96	0.93	0.72-1.20	0.98	0.76-1.26	1.34	0.76-2.33
Retired	0.69*	0.50-0.95	0.65*	0.49-0.86	0.86	0.65-1.15	0.85	0.43-1.68
Income groups (ref: 0-2000 yuan/month)								
2000-5000 yuan/month	1.24	0.92-1.67	1.03	0.80-1.33	1.13	0.88-1.46	1.80*	1.09-2.98
5000-10000 yuan/month	1.47*	1.08-2.00	1.15	0.89-1.48	1.48*	1.15-1.91	2.02*	1.20-3.40
> 10000 yuan/month	1.07	0.77-1.50	0.97	0.73-1.28	1.16	0.88-1.54	1.39	0.80-2.41
Type of residence (ref: city)								
Town	0.83	0.61-1.23	0.94	0.73-1.23	0.97	0.74-1.26	0.59*	0.36-0.98
Rural area	0.83	0.66-1.05	0.78	0.54-1.13	1.28	0.89-1.84	0.48*	0.26-0.87
Dementia contact (ref: yes)								
No	0.80*	0.65-0.99	0.72*	0.61-0.85	0.62*	0.52-0.73	0.49*	0.32-0.76
Unclear	0.79	0.60-1.03	0.66*	0.53-0.82	0.60*	0.49-0.75	0.52*	0.30-0.88
Shift work (ref: yes)	0.83	0.66-1.05	0.62*	0.52-0.75	0.56*	0.47-0.68	0.79	0.50-1.23
Sleep duration in the past one month (ref: 6-8 hours)								
< 6	0.89	0.72-1.09	0.93	0.78-1.11	1.09	0.92-1.30	0.89	0.60-1.30
> 8	0.91	0.63-1.34	0.93	0.68-1.26	1.01	0.75-1.37	0.84	0.43-1.64
Self-reported sleep quality in the past one month (ref: very good/pretty good)	0.94	0.77-1.15	0.82*	0.69-0.96	0.80*	0.68-0.94	0.78	0.54-1.11
Self-reported diagnosed sleep disturbances, neurological or psychiatric disorders (ref: at least one)	1.02	0.83-1.26	0.90	0.76-1.07	0.92	0.78-1.09	1.14	0.79-1.65
Do you think sleep disturbances increase risk of dementia? (ref: yes)								
No	0.44*	0.31-0.62	0.71*	0.51-0.98	0.74	0.53-1.03	0.32*	0.19-0.54
Unclear	0.68*	0.54-0.85	0.83	0.68-1.00	0.70*	0.58-0.84	0.79	0.51-1.22
Do you think sleep medicine increase risk of dementia? (ref: yes)								
No	1.09	0.79-1.48	0.90	0.71-1.15	1.00	0.78-1.27	0.99	0.57-1.70
Unclear	0.98	0.80-1.21	0.97	0.82-1.15	0.97	0.82-1.14	0.96	0.65-1.42

Compared with younger individuals (aged < 40 years), middle-aged participants (aged 40–65 years) were more willing to obtain knowledge about dementia by books, magazines or newspapers but not television and the Internet, while the older adults (aged ≥ 65 years) were not significantly different from younger individuals. Participants with a high educational level were more prone to utilize television and the Internet as well as books, magazines or newspapers to obtain knowledge about dementia than participants with an education level of primary school or illiteracy. When compared to nonmanual workers, both manual workers and retired workers were less willing to obtain dementia knowledge by television or the Internet. Compared with participants with incomes of 0-2000 yuan/month, those with incomes of 5000-10000 yuan/month were more willing to obtain knowledge about dementia by television and the Internet, as well as lectures on medication or doctor consultation services. The measures to obtain knowledge about dementia were not influenced by type of residence.

Participants who performed shift work were less willing to obtain knowledge about dementia by books, magazines or newspapers (AOR = 0.67, 95% CI = 0.53-0.85), as well as lectures on medication or doctor consultation services (AOR = 0.56, 95% CI = 0.47-0.68), compared with those who did not perform shift work. When compared with participants with good sleep quality, those with poor sleep quality exhibited less willingness to obtain knowledge about dementia by books, magazines or newspapers (AOR = 0.82, 95% CI = 0.69-0.96), as well as lectures on medication or doctor consultation services (AOR = 0.80, 95% CI = 0.68-0.94). Participants' willingness to take measures to obtain knowledge about dementia was not influenced by sleep duration or self-reported diagnosis with sleep disturbances or neurological or psychiatric disorders.

Compared with participants who thought sleep disturbances increased the risk of dementia, participants who did not regard sleep disturbances as increasing the risk of dementia exhibited less willingness to obtain knowledge about dementia by television and the Internet (AOR = 0.44, 95% CI = 0.31-0.62), as well as books, magazines or newspapers (AOR = 0.71, 95% CI = 0.51-0.98), while participants who were not clear about the relationship between sleep disturbances and the risk of dementia were less willing to obtain knowledge about dementia by television and the Internet (AOR = 0.68, 95% CI = 0.54-0.85), as well as lectures on medication or doctor consultation services (AOR = 0.70, 95% CI = 0.58-0.84). Participants' willingness to take measures to obtain knowledge about dementia was not influenced by participants' perception of sleep medicines and risk of dementia.

4. DISCUSSION

Overall, approximately three-fourths of the general public could recognize sleep disturbances as a risk factor for dementia. Almost all the participants had a positive attitude towards improving sleep quality as well as obtaining knowledge about dementia. Knowledge that sleep disturbances increase the risk of dementia was the only factor that could independently influence participants' willingness to improve sleep quality and obtain knowledge about dementia. In addition, factors including sleep quality and knowledge that sleep medicine and risk of dementia would largely affect participants' desire to alleviate sleep disturbances, and factors such as gender and whether they had dementia contact, would also influence attitudes towards all categories of measures of obtaining knowledge about dementia. These findings show the current status of the public awareness of sleep disturbances and dementia and help population-targeted health education.

Sleep disturbances as a risk factor for dementia have been widely identified;[10 11] however, it remains unclear whether they have been adequately disseminated and recognized among the general public. A meta-analysis suggested that most studies focused on factors such as mental health, physical activity, hypertension, smoking, and air pollution in the risk of dementia.[19] To the best of our knowledge, this study was the first to investigate public knowledge of sleep disturbances and the risk of dementia. Currently, 72.57% of participants could correctly recognize sleep disturbances as a risk factor for dementia, which was higher than the proportion of the knowledge that alcohol or smoking are risk factors of dementia but lower than the rate of the knowledge that a negative effect increases the risk of dementia in our previous findings.[18] Several sociodemographic characteristics, including female sex, young age, high level of education, and having contact with patients with dementia, were associated with a better understanding of sleep disturbances as a risk for dementia, which is partially consistent with previous surveys conducted in China.[20 21] In addition, sleep-related factors such as shift work, sleep duration, and previous diagnosis of psychiatric disorders were independently associated with knowledge that sleep disturbances increase the risk of dementia. The findings suggested the need to develop different approaches for populations with different sleep-related statuses to disseminate knowledge about dementia.

Almost all participants were willing to take at least one measure to improve sleep quality and obtain knowledge about dementia. Among all four measures in the questionnaire, taking regular life and strengthening exercise were chosen by most participants, while going for psychotherapy or taking medication was accepted by only a small portion of participants, with proportions of 29% and 19%, respectively. The general public had a high willingness to improve sleep quality if they were

diagnosed with sleep disturbance; however, medical refusal seemed to exist in the general public. Several reasons were postulated to explain the poor medication adherence, including concerns about the side effects, high financial burden and inadequate health literacy.[22 23] Therefore, more measures should be implemented to help the public correct the misunderstanding of medical therapy.

Several factors were found to be associated with the willingness of participants to improve sleep quality, with only the participants who knew that sleep disturbances increase the risk of dementia demonstrating a higher willingness to take all measures to improve sleep quality and obtain knowledge about dementia. The results suggest that knowledge of sleep disturbance plays a vital role in attitudes towards relieving sleep disturbances as well as obtaining knowledge about dementia, which is similar to findings that link knowledge with attitudes.[24] In addition, perception of sleep pills and risk of dementia also influenced individuals' attitudes towards improving sleep quality, especially taking medicines. Although the relationship between sleep medicines and the risk of dementia remains ambiguous, sleep medicines are also advocated when individuals are diagnosed with sleep disturbances. The current findings implicate that more effort should be paid to disseminating knowledge of dementia and related risk factors.

Participants with self-reported good sleep quality displayed more willingness to improve sleep quality when confronted with sleep problems, which suggests that more advocacy about improving sleep quality should be disseminated in participants with poor sleep quality. In addition, participants who were female and had contact with dementia also showed a better attitude towards obtaining dementia knowledge. These findings suggested the need to develop different approaches for different epidemiological and sleep-stratified populations to promote their willingness to

improve sleep quality as well as obtain dementia knowledge.

The strengths of this study lie in providing the status of knowledge of sleep disturbances in the risk of dementia and attitudes towards improving sleep quality as well as obtaining knowledge about dementia among the general public. Moreover, the link between knowledge that sleep disturbance increases the risk of dementia and positive attitudes towards improving sleep quality as well as obtaining knowledge about dementia further indicates the necessity of disseminating health knowledge. However, the study also has several limitations. First, this survey was an online survey, and we used a convenience sampling method. This online study was conducted among Internet users who were young and highly educated; thus, the representativeness of the sample might be limited. Second, sleep disturbances and mental disorders were based on the respondents' self-reports rather than clinical diagnoses. Third, other information, such as the types of sleep disturbances and detailed occupations, was not collected in this study.

5.CONCLUSION

The present survey demonstrated that most of the public could recognize sleep disturbance as a risk factor for dementia and exhibited a positive attitude towards improving sleep quality as well as obtaining knowledge about dementia. Moreover, the findings imply a link between knowledge and attitudes, which suggests the importance of disseminating more knowledge about sleep disturbances and dementia to achieve dementia prevention in the future.

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Contributors
YZ and LS developed the proposal and designed the protocol, JQ and LL were

involved in revising the proposal and design. YZ, LS, JD, QW, SS and ZL were involved in data collection, and analysis. YZ and LS drafted the manuscript. LS, YB JS and LL revised the analysis and helped in the preparation of the manuscript. All the authors have read and approved the final version of the manuscript.

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Competing interests
All authors have no conflicts of interest to disclose.

Patient and public involvement
Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication
Not required.

Ethics approval
The study procedure was reviewed and approved by the Peking University Sixth Hospital natural and computational science research and community service reviewers, and the approval number was 2020-4-9-1. Informed consent was received online before the respondents began the questionnaire. All participants were informed that they have the right not to participate in the study, and only those who provided informed consent were able to respond to the survey. Teenagers aged between 8 and 18 were approved by the ethics committee to voluntarily participate in the study without parental consent. All information obtained in the study was kept confidential.

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Data are available on reasonable request.

Supplemental material
This content has been supplied by the author(s).

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Tables

Table 1. Proportions and factors associated with the knowledge that sleep disturbances increase the risk of dementia.

Table 2. Factors associated with the attitudes of participants towards taking measures to improve sleep disturbances.

Table 3. Factors associated with the willingness of participants to obtain knowledge about dementia.

Supplementary data

Supplementary Table 1. Factors associated with the willingness of participants to take medicines that could improve sleep quality and reduce the risk of dementia.

Supplementary Table 1. Factors associated with the willingness of participants to take medicines that could improve sleep quality and reduce the risk of dementia.

	AOR	95% CI
Sex		
Men	1	
Women	1.20*	1.02-1.41
Age (years)		
< 40	1	
40-65	1.00	0.83-1.19
≥ 65	0.78	0.48-1.26
Education level (years)		
Primary school or illiteracy (≤ 6)	1	
Middle or high school (6-12)	0.87	0.49-1.57
College or university (12-16)	1.05	0.58-1.89
Postgraduate (≥ 16)	1.05	0.57-1.94
Type of job		
Nonmanual	1	
Manual	0.86	0.67-1.12
Retired	1.03	0.76-1.39
Income groups (yuan/month)		
0-2000	1	
2000-5000	0.91	0.69-1.20
5000-10000	0.93	0.71-1.23
> 10000	0.87	0.65-1.17
Type of residence		
City	1	
Town	1.02	0.78-1.35
Rural area	0.81	0.56-1.17
Dementia contact		
Yes	1	
No	0.74*	0.62-0.88
Unclear	0.75*	0.60-0.94
Shift work		
Yes	1	
No	0.65*	0.54-0.80
Sleep duration in the past one month (hours)		
6-8	1	
< 6	0.97	0.81-1.16
> 8	1.03	0.74-1.42
Self-reported sleep quality in the past one month		
Very good/Pretty good	1	
Very bad/Pretty bad	0.78*	0.66-0.93

Self-reported diagnosis of sleep disturbances, neurological or psychiatric disorders		
At least one	1	
None	0.62*	0.51-0.74
Do you think sleep disturbances increase risk of dementia?		
Yes	1	
No	0.45*	0.32-0.63
Unclear	0.69*	0.57-0.85
Do you think sleep medicine increase risk of dementia?		
Yes	1	
No	2.23*	1.67-3.00
Unclear	1.11	0.93-1.32

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Check
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	Page 1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	Page 2-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Page 5
Objectives	3	State specific objectives, including any prespecified hypotheses	Page 6
Methods			
Study design	4	Present key elements of study design early in the paper	Page 6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Page 6
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	Page 6
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case	N.A.
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Page 7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Page 7
Bias	9	Describe any efforts to address potential sources of bias	N.A.
Study size	10	Explain how the study size was arrived at	Page 6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Page 6-7
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	Page 7-8
		(*b*) Describe any methods used to examine subgroups and interactions	Page 8
		(*c*) Explain how missing data were addressed	Page 8
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy	Page 7-8
		(*e*) Describe any sensitivity analyses	NA.

Continued on next page

Results			**Check**
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Page 8
		(b) Give reasons for non-participation at each stage	Page 8
		(c) Consider use of a flow diagram	N.A.
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Page 8-9 Table 1
		(b) Indicate number of participants with missing data for each variable of interest	Page 8-9
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	N.A.
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time	N.A.
		Case-control study—Report numbers in each exposure category, or summary measures of exposure	N.A.
		Cross-sectional study—Report numbers of outcome events or summary measures	Page 8-9
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Page 9-16
		(*b*) Report category boundaries when continuous variables were categorized	Page 9-16
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Page 9-16
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N.A.
Discussion			
Key results	18	Summarise key results with reference to study objectives	Page 16-19
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Page 19
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Page 20
Generalisability	21	Discuss the generalisability (external validity) of the study results	Page 20
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Page 20

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at

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Linking knowledge with attitude: a cross-sectional study of public knowledge and attitude towards sleep disturbances and dementia

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Linking knowledge with attitude: A cross-sectional study of public knowledge and attitude towards sleep disturbances and dementia

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ABSTRACT

Objectives: Sleep disturbances increase the risk of dementia; however, there is insufficient information regarding this. We aimed to investigate public knowledge on the relationship between sleep disturbances and dementia, as well as attitudes towards improving sleep quality and obtaining knowledge on dementia.

Design and setting: A cross-sectional web-based questionnaire was administered between May and October 2019.

Participants: All participants provided informed consent and were able to respond to the survey.

Primary outcomes: Factors associated with the knowledge that sleep disturbances are risk factors for dementia and proportions of individuals with this knowledge; attitudes towards improving sleep quality and obtaining knowledge about dementia.

Results: Of the 3,329 eligible samples, 72.57% correctly recognised that sleep disturbances increased the risk of dementia. In total, 92.97% of participants were willing to take at least one measure to improve sleep quality, and the percentages of those adopting these measures are as follows: 78.73% would lead a regular life, 67.88% would engage in strengthening exercise, 28.84% would undergo psychotherapy, and 19.41% would take medication. The awareness regarding sleep disturbances increasing the risk of dementia was the only factor associated with the willingness to improve sleep quality in all four categories of measures. Almost all participants (95.25%) were willing to take at least one measure to acquire knowledge about dementia, with the following participants displaying higher willingness to obtain knowledge about dementia: female, had contact with dementia, and considered sleep disturbances to increase the risk of dementia.

Conclusions: Our findings indicate an association between people's knowledge and attitudes, suggesting the importance of disseminating knowledge about sleep disturbances and dementia to achieve dementia prevention in future.

Keywords: public knowledge; sleep disturbances; dementia; sleep medications

Strengths and limitations of this study

- In this cross-sectional study, nearly three-fourths of the participants correctly recognised sleep disturbance as a risk factor for dementia.
- Almost all participants were willing to take at least one measure to improve sleep quality and obtain knowledge about dementia.
- The knowledge that sleep disturbances increase the risk of dementia was the only factor associated with the willingness to improve sleep quality in all four categories of measures, indicating the necessity of disseminating knowledge about sleep disturbances and dementia.
- Limitations include online surveys, self-designed questionnaires, self-reported sleep disturbances, and mental health problems.

1. INTRODUCTION

Sleep disturbance is a common and significant health problem. The prevalence of sleep disturbances varies with age, with sleep apnoea, insomnia, and restless legs syndrome being the most common.[1-3] Sleep disturbances largely affect the endocrine, immune, and cardiovascular systems and increase the risk of obesity,[4] diabetes,[4-6] cardiovascular diseases,[5 7 8] and cancer.[9] A growing body of evidence implies that disturbed sleep contributes to impairments in cognitive performance, including mild cognitive impairment and dementia.[10-12] Medicines for sleep disturbances are related to adverse effects, such as cognitive impairment and possibly dementia,[13 14] although the causal association between benzodiazepine use and dementia remains controversial.[15] Thus, preventing sleep disturbance could prevent or delay the progression of dementia.[16]

Sleep disturbance is a risk factor for dementia, but its dissemination and recognition among the general public remains unclear. Attitudes predict behaviour,[17] and attitude towards improving sleep disturbances and obtaining knowledge may guide and shape people's behaviour for regulating sleep disturbances and reducing the risk of dementia. Consequently, it is important to prompt the general public's attitude towards improving sleep quality and obtaining knowledge about dementia. However, to the best of our knowledge, no existing studies have investigated people's knowledge and their attitudes towards sleep disturbances and dementia.

We aimed to investigate factors associated with the knowledge that sleep disturbances are risk factors for dementia and dissemination of this knowledge among the general public. Moreover, we intended to explore the factors associated with public attitudes towards improving sleep quality and obtaining knowledge about dementia.

2. MATERIALS AND METHODS

2.1 Study design and participants

This cross-sectional, web-based study was conducted between 27 May 2019 and 6 October 2019. A self-designed survey was disseminated through WeChat, a social media outlet that is widely used in China. Participation in the study was voluntary, and the information collected was anonymous. All the participants met the following criteria: (1) WeChat users; (2) voluntary to participate in the survey; and (3) provided informed consent. The detailed survey process was introduced in our previous paper.[18] In total, 3,436 participants submitted the questionnaire, and 3,329 questionnaires with full available data were analysed. The whole process followed STROBE guidelines.

2.2 Questionnaire content

The questionnaire was written in Chinese and the items used in this study could be briefly categorised as follows: (1) basic sociodemographic information, including sex, age, education levels, type of job, income, type of residence, and whether the respondent had contact with anyone who lived with dementia; (2) sleep-related factors, such as shift work, sleep duration in the past 1 month, self-reported sleep quality in the past 1 month, and self-reported diagnosis of sleep disturbances, neurological or psychiatric disorders; (3) knowledge about sleep disturbances and risk of dementia, investigated using the question "Do you think poor sleep will increase the risk of dementia?" and perception of sleep medicine and risk of dementia, investigated using the question, "Do you think taking sleeping pills will increase the risk of dementia?"; (4) attitudes towards improving sleep quality in case of sleep disturbances, with a multiple-choice question "If you have sleep disturbances, what

kind of methods would you use to improve your sleep quality?" The questions had the following response options: regular lifestyle/strengthening exercise/psychotherapy/medication/others (please fill in)/not willing; and willingness to take a drug to improve sleep quality and reduce the risk of/or prevent dementia; and (5) attitudes towards obtaining knowledge about dementia, with the following multiple-choice question "How do you obtain knowledge about dementia?" The questions had the following response options: television and Internet (e.g. WeChat, Weibo, online video)/books, magazines or newspaper/lecture on medication, or doctor consultation service/others (please fill in)/unwillingness. Detailed information is listed in the Supplementary Data of a previous study (https://bmcpublichealth.biomedcentral.com/articles/10.1186/s12889-020-09665-7).

2.3 Statistical analysis

Descriptive statistics were used to present demographic data. The proportion of participants with the knowledge that sleep disturbances increase the risk of dementia was calculated and reported as the percentage of cases in different sociodemographic populations. χ^2 tests were used to compare the differences between groups. To explore factors potentially associated with the knowledge that sleep disturbances increase the risk of dementia, multiple logistic regression analyses were performed, and adjusted odds ratios (AORs) and 95% confidential intervals (CIs) were presented. Like the aforementioned statistical analysis, factors associated with participants' attitudes towards ameliorating sleep disturbances, willingness to take medicines to improve sleep quality and dementia, and knowledge about dementia were explored using multiple logistic regression analyses, with AORs and 95% CIs presented. Two-sided Wald tests were performed to determine whether the ORs in the regression

models were statistically significant. The level of significance was set at $P < 0.05$. All statistical analyses were performed using SPSS statistical software version 22 (IBM Corp).

2.4 Patient and Public Involvement statement

Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

3. RESULTS

3.1 Characteristics of participants

Table 1 presents participants' characteristics. Data from 3,329 eligible samples were included in the final analysis, with a participation rate of 96.89% (3,329 of 3,426 participants). The average age was 39.23 ± 12.50 years, ranging from 15 to 97 years. Regarding sleep-related characteristics, the majority of the participants had no shift work (77.38%), 6 to 8 hours of sleep per night in the past month (64.73%), self-reported very good or good sleep quality in the past month (61.79%), and no diagnosis of sleep disturbances or neurological or psychiatric disorders (74.62%).

In total, 72.57%. of participants correctly recognised sleep disturbances as risk factors for dementia. The proportions of participants who recognised that sleep disturbances increase the risk of dementia stratified by demographic and sleep-related characteristics were significant as follows: sex, age, education levels, type of job, income levels, type of residence, contact with dementia, shift work, and sleep duration.

Table 1. Proportions of participants recognizing that sleep disturbances increase the risk of dementia stratified by demographic and sleep-related characteristics.

	Total number	Participants who recognize sleep disturbances as risk factors for dementia (No., %)	Participants who did not recognize sleep disturbances as risk factors for dementia (No., %)	*P* value

Overall	3329	2416 (72.57)	913 (27.43)	
Sex				< 0.001
Men	1150	791 (68.78)	359 (31.22)	
Women	2179	1625 (74.58)	554 (25.42)	
Age (years)				< 0.001
< 40	1840	1498 (81.41)	342 (18.59)	
40-65	1383	871 (62.98)	512 (37.02)	
≥ 65	106	47 (44.34)	59 (55.66)	
Education level (years)				< 0.001
Primary school or illiteracy (≤ 6)	57	29 (50.88)	28 (49.12)	
Middle or high school (6–12)	614	355 (57.82)	259 (42.18)	
College or university (12–16)	1667	1235 (74.09)	432 (25.91)	
Postgraduate (≥ 16)	991	797 (80.42)	194 (19.58)	
Type of job				< 0.001
Nonmanual	2574	1970 (76.53)	604 (23.47)	
Manual	403	272 (67.49)	131 (32.51)	
Retired	352	174 (49.43)	178 (50.57)	
Income groups (yuan/month)				0.021
0–2000	362	259 (71.55)	103 (28.45)	
2000–5000	975	674 (69.13)	301 (30.87)	
5000–10000	1229	919 (74.78)	310 (25.22)	
> 10000	763	564 (73.92)	199 (26.08)	
Type of residence				0.001
City	2887	2128 (73.71)	759 (26.29)	
Town	289	189 (65.40)	100 (34.60)	
Rural area	153	99 (64.71)	54 (35.29)	
Dementia contact				0.005
Yes	1100	835 (75.91)	265 (24.09)	
No	1669	1173 (70.28)	496 (29.72)	
Unclear	560	408 (72.86)	152 (27.14)	
Shift work				< 0.001
Yes	753	626 (83.13)	127 (16.87)	
No	2576	1790 (69.49)	786 (30.51)	
Sleep duration in the past one month (hours)				0.037
6–8	2155	1594 (73.97)	561 (26.03)	
< 6	976	688 (70.49)	288 (29.51)	
> 8	198	134 (67.68)	64 (32.32)	
Self-reported sleep quality in the past one month				0.153
Very good/Pretty good	2057	1475 (71.71)	582 (28.29)	
Very bad/Pretty bad	1272	941 (73.98)	331 (26.02)	
Self-reported diagnosis of sleep disturbances, neurological or psychiatric disorders				0.160
At least one	845	629 (74.44)	216 (25.56)	
None	2484	1787 (71.94)	697 (28.06)	

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3.2 Factors associated with the knowledge that sleep disturbances increased the risk of dementia

Table 2 presents the factors associated with knowledge that sleep disturbances increase the risk of dementia. In the multivariate analysis, female sex, less than 40 years of age, high educational levels, non-manual job, and contact with dementia were associated with more likelihood of recognising that sleep disturbances are risk factors of dementia; participants with different residences or income levels had no significant differences in understanding sleep disturbances as a risk factor for dementia.

Participants who did not perform shift work (AOR = 0.57, 95% CI = 0.46–0.71) were less aware that sleep disturbances increased the risk of dementia compared with those who performed shift work. Compared with individuals with average sleep duration (6–8 hours), participants with longer sleep duration (> 8 hours: AOR = 0.71, 95% CI = 0.51–0.99) exhibited worse understanding of the relationship between sleep disturbances and dementia, while short sleepers (< 6 hours) had a better understanding of this relationship. Additionally, respondents without self-reported diagnosis of sleep disturbances or neurological or psychiatric disorders (AOR = 0.76, 95% CI = 0.62–0.92) demonstrated less understanding of sleep disturbances with the risk of dementia. Sleep quality did not significantly affect the understanding of sleep disturbances with the risk of dementia.

Table 2. Factors associated with the knowledge that sleep disturbances increase the risk of dementia.

Factors	AOR	95% CI	*P* value
Sex			< 0.001
Men	1		
Women	1.47*	1.24–1.75	
Age (years)			< 0.001
< 40	1		
40-65	0.46*	0.39–0.56	
≥ 65	0.35*	0.22–0.56	
Education level (years)			< 0.001
Primary school or illiteracy (≤ 6)	1		

Middle or high school (6–12)	1.33	0.75–2.35	
College or university (12–16)	1.92*	1.07–3.46	
Postgraduate (≥ 16)	2.45*	1.32–4.53	
Type of job			< 0.001
Nonmanual	1		
Manual	0.86	0.65–1.13	
Retired	0.55*	0.41–0.74	
Income groups (yuan/month)			0.858
0–2000	1		
2000–5000	0.95	0.71–1.27	
5000–10000	0.99	0.74–1.33	
> 10000	0.90	0.65–1.25	
Type of residence			0.348
City	1		
Town	0.83	0.62–1.09	
Rural area	0.86	0.58–1.26	
Dementia contact			< 0.001
Yes	1		
No	0.65*	0.54–0.78	
Unclear	0.83	0.65–1.06	
Shift work			< 0.001
Yes	1		
No	0.57*	0.46–0.71	
Sleep duration in the past one month (hours)			0.082
6-8	1		
< 6	1.07	0.88–1.30	
> 8	0.71*	0.51–0.99	
Self-reported sleep quality in the past one month			0.999
Very good/Pretty good	1		
Very bad/Pretty bad	1.00	0.83–1.20	
Self-reported diagnosis of sleep disturbances, neurological or psychiatric disorders			0.005
At least one	1		
None	0.76*	0.62–0.92	

3.3 Proportion and factors associated with participants willing to take measures to improve sleep quality

Almost all participants (92.97%) were willing to take at least one measure to improve sleep quality if they were diagnosed with sleep disturbances, whereas 1.74% and 5.30% of participants showed a negative attitude towards improving sleep quality if they were diagnosed with sleep disturbances. The participants' measures to improve

sleep quality were as follows: 78.73% would lead a regular life, 67.88% would engage in strengthening exercises, 28.84% would undergo psychotherapy, and 19.41% would take medication.

Factors associated with participants' willingness to take measures to improve sleep quality were further explored and presented in Table 3. A strong association was found between knowledge that sleep disturbances increase the risk of dementia and willingness to improve sleep quality (AOR = 0.22, 95% CI = 0.13–0.38). Compared with participants who believed that sleep disturbances increased the risk of dementia, those who did not regard sleep disturbances to increase the risk of dementia or who remained uncertain displayed less willingness regarding all four measures, including adopting a regular lifestyle (AOR = 0.52, 95% CI = 0.36–0.73, vs. AOR = 0.79, 95% CI = 0.63–0.99), performing strengthening exercise (AOR = 0.45, 95% CI = 0.33–0.63, vs AOR = 0.77, 95% CI = 0.63–0.94), going for psychotherapy (AOR = 0.57, 95% CI = 0.37–0.86, vs AOR = 0.75, 95% CI = 0.60–0.94), and taking medication (AOR = 0.53, 95% CI = 0.34–0.83, vs AOR = 0.70, 95% CI = 0.54–0.89) to improve sleep quality. Additionally, individuals who did not consider sleep medicine to increase the risk of dementia displayed a lower willingness to improve sleep quality than those who regarded sleep medicine as a risk factor for dementia (AOR = 0.56, 95% CI = 0.32–0.98). Other demographic or sleep-related factors were not significantly associated with participants' willingness to ameliorate sleep disturbances in all four measures.

Table 3. Factors associated with participants' attitudes for taking measures to improve sleep disturbances.

Factors	Willingness to improve sleep quality		Regular life		Strengthened exercise		Psychotherapy		Medication	
	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI
Sex (ref: male)	1.19	0.80–1.78	1.02	0.85–1.24	0.91	0.77–1.08	1.62*	1.36–1.92	1.21	0.99–1.47
Age (ref: < 40 years)										
40—65 years	0.95	0.61–1.49	0.51*	0.42–0.63	1.00	0.83–1.20	0.87	0.72–1.04	1.36*	1.10–1.67

≥ 65 years	1.55	0.56–4.32	0.96	0.57–1.63	0.70	0.44–1.12	0.59	0.31–1.12	1.68	0.98–2.90
Education level (ref: primary school or illiteracy ≤ 6)										
Middle or high school (6—12)	0.79	0.26–2.42	1.58	0.89–2.80	1.05	0.60–1.84	2.07	0.85–5.07	1.77	0.72–4.34
College or university (12—16)	1.34	0.41–4.32	2.62*	1.44–4.74	1.87*	1.06–3.32	3.02*	1.23–7.41	2.16	0.87–5.35
Postgraduate (≥ 16)	2.32	0.64–8.37	2.62*	1.40–4.91	2.49*	1.37–4.53	3.06*	1.23–7.62	1.99	0.79–5.02
Type of job (ref: nonmanual)										
Manual	1.02	0.57–1.84	0.70*	0.52–0.93	0.87	0.67–1.13	0.77	0.58–1.03	0.90	0.65–1.24
Retired	0.57	0.31–1.02	0.71*	0.52–0.96	0.76	0.57–1.02	0.50*	0.35–0.72	0.97	0.69–1.38
Income groups (ref: 0—2000 yuan/month)										
2000—5000 yuan/month	0.88	0.49–1.59	1.08	0.80–1.47	0.84	0.64–1.10	0.94	0.70–1.25	0.96	0.69–1.33
5000—10000 yuan/month	1.30	0.68–2.48	1.18	0.86–1.62	1.02	0.77–1.33	1.15	0.87–1.53	1.05	0.76–1.45
> 10000 yuan/month	1.05	0.51–2.16	1.03	0.73–1.45	1.07	0.79–1.45	1.05	0.77–1.43	1.19	0.84–1.69
Type of residence (ref: city)										
Town	0.77	0.44–1.35	0.81	0.60–1.10	0.77*	0.58–1.00	0.73	0.54–1.00	0.85	0.60–1.20
Rural area	0.88	0.40–1.92	1.14	0.75–1.74	0.88	0.61–1.27	1.31	0.87–1.96	1.19	0.75–1.89
Dementia contact (ref: yes)										
No	1.15	0.74–1.78	1.09	0.89–1.33	0.83*	0.69–0.98	0.80*	0.67–0.96	0.88	0.72–1.08
Unclear	0.71	0.43–1.18	0.97	0.75–1.26	0.78*	0.62–0.98	0.89	0.70–1.12	1.03	0.79–1.34
Shift work (ref: yes)	0.79	0.48–1.31	0.67*	0.53–0.85	1.02	0.84–1.23	0.82*	0.68–0.98	0.77*	0.62–0.95
Sleep duration in the past one month (ref: 6–8 hours)										
< 6	0.91	0.60-1.39	0.78*	0.64-0.96	0.82*	0.69-0.99	1.21	1.00-1.45	1.10	0.89-1.36
> 8	0.80	0.37-1.73	0.60*	0.42-0.86	0.98	0.71-1.37	1.12	0.80-1.56	1.03	0.70-1.53
Self-reported sleep quality in the past one month (ref: very good/pretty good)	0.65*	0.43-0.97	0.80*	0.66-0.97	0.76*	0.65-0.90	1.01	0.85-1.20	0.96	0.79-1.17
Self-reported diagnosed sleep disturbances, neurological or psychiatric disorders (ref: at least one)	1.00	0.66-1.52	1.47*	1.21-1.79	0.98	0.82-1.17	0.57*	0.47-0.68	0.46*	0.38-0.57
Do you think sleep disturbances increase risk of dementia? (ref: yes)										
No	0.22*	0.13-0.38	0.52*	0.36-0.73	0.45*	0.33-0.63	0.57*	0.37-0.86	0.53*	0.34-0.83
Unclear	0.89	0.55-1.46	0.79*	0.63-0.99	0.77*	0.63-0.94	0.75*	0.60-0.94	0.70*	0.54-0.89
Do you think sleep medicine increase risk of dementia? (ref: yes)										
No	0.56*	0.32–0.98	0.64*	0.48–0.85	0.82	0.64–1.07	1.12	0.87–1.45	2.76*	2.11–3.61
Unclear	0.75	0.48–1.16	0.85	0.69–1.04	0.86	0.72–1.03	0.97	0.81–1.16	1.49*	1.21–1.83

Factors associated with the participants' willingness to take medicines that could improve sleep quality and reduce the risk of dementia were also explored. Participants who did not regard sleep medicine to increase the risk of dementia demonstrated at least twice the willingness to take medicines that simultaneously relieved sleep disturbances and dementia (AOR = 2.23, 95% CI = 1.67–3.00). The detailed results of the multivariate analysis are shown in Supplementary Table 1.

3.4 Proportions and factors associated with participants who were willing to take measures to obtain knowledge about dementia

Almost all participants (95.25%) were willing to take at least one measure to increase their knowledge on dementia, while very few (4.75%) were unwilling to learn about dementia. The percentages of participants who were willing to undertake measures to obtain knowledge about dementia were as follows: 80.35% through television and the Internet, 59.14% through books, magazines, or newspapers, and 52.81% through lectures on medication or doctor consultation services.

The factors associated with participants' willingness to take measures to obtain knowledge about dementia are presented in Table 4. Female participants had contact with dementia and displayed a higher willingness to obtain knowledge about dementia in all categories of measures. Compared with participants who considered sleep disturbances to increase the risk of dementia, participants who did not consider this exhibited less willingness to obtain knowledge about dementia through television and the Internet (AOR = 0.44, 95% CI = 0.31–0.62), as well as books, magazines, or newspapers (AOR = 0.71, 95% CI = 0.51–0.98). Participants who were not clear about the relationship between sleep disturbances and the risk of dementia were less willing to obtain knowledge about dementia on television and the Internet (AOR = 0.68, 95% CI = 0.54–0.85), as well as lectures on medication or doctor consultation services (AOR = 0.70, 95% CI = 0.58–0.84). Participants' willingness to take measures to obtain knowledge about dementia was not influenced by their perception of sleep medicines and the risk of dementia.

Table 4. Factors associated with the willingness of participants to obtain knowledge about dementia.

Factors	Television and Internet		Books, magazines or newspaper		Lecture on medication, or doctor consultation service		Willingness to obtain knowledge about dementia	
	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI

Sex (ref: male)	1.42*	1.18–1.72	1.48*	1.27–1.73	1.63*	1.40–1.90	2.19*	1.55–3.09
Age (ref: < 40 years)								
40–65 years	0.81*	0.65–0.99	1.55*	1.30–1.84	1.17	0.99–1.39	1.38	0.93–2.06
≥ 65 years	0.62	0.37–1.03	1.15	0.71–1.84	0.78	0.48–1.27	0.83	0.34–2.02
Education level (ref: primary school or illiteracy ≤ 6)								
Middle or high school (6–12)	1.97*	1.12–3.47	2.62*	1.38–4.97	0.88	0.50–1.56	1.95	0.81–4.66
College or university (12–16)	3.38*	1.89–6.07	4.75*	2.48–9.09	1.45	0.81–2.58	2.43	0.97–6.10
Postgraduate (≥ 16)	3.41*	1.84–6.31	4.54*	2.33–8.83	1.60	0.88–2.90	3.12*	1.16–8.40
Type of job (ref: nonmanual)								
Manual	0.72*	0.54–0.96	0.93	0.72–1.20	0.98	0.76–1.26	1.34	0.76–2.33
Retired	0.69*	0.50–0.95	0.65*	0.49–0.86	0.86	0.65–1.15	0.85	0.43–1.68
Income groups (ref: 0–2000 yuan/month)								
2000–5000 yuan/month	1.24	0.92–1.67	1.03	0.80–1.33	1.13	0.88–1.46	1.80*	1.09–2.98
5000–10000 yuan/month	1.47*	1.08–2.00	1.15	0.89–1.48	1.48*	1.15–1.91	2.02*	1.20–3.40
> 10000 yuan/month	1.07	0.77–1.50	0.97	0.73–1.28	1.16	0.88–1.54	1.39	0.80–2.41
Type of residence (ref: city)								
Town	0.83	0.61–1.23	0.94	0.73–1.23	0.97	0.74–1.26	0.59*	0.36–0.98
Rural area	0.83	0.66–1.05	0.78	0.54–1.13	1.28	0.89–1.84	0.48*	0.26–0.87
Dementia contact (ref: yes)								
No	0.80*	0.65–0.99	0.72*	0.61–0.85	0.62*	0.52–0.73	0.49*	0.32–0.76
Unclear	0.79	0.60–1.03	0.66*	0.53–0.82	0.60*	0.49–0.75	0.52*	0.30–0.88
Shift work (ref: yes)	0.83	0.66–1.05	0.62*	0.52–0.75	0.56*	0.47–0.68	0.79	0.50–1.23
Sleep duration in the past one month (ref: 6–8 hours)								
< 6	0.89	0.72–1.09	0.93	0.78–1.11	1.09	0.92–1.30	0.89	0.60–1.30
> 8	0.91	0.63–1.34	0.93	0.68–1.26	1.01	0.75–1.37	0.84	0.43–1.64
Self-reported sleep quality in the past one month (ref: very good/pretty good)	0.94	0.77–1.15	0.82*	0.69–0.96	0.80*	0.68–0.94	0.78	0.54–1.11
Self-reported diagnosed sleep disturbances, neurological or psychiatric disorders (ref: at least one)	1.02	0.83–1.26	0.90	0.76–1.07	0.92	0.78–1.09	1.14	0.79–1.65
Do you think sleep disturbances increase risk of dementia? (ref: yes)								
No	0.44*	0.31–0.62	0.71*	0.51–0.98	0.74	0.53–1.03	0.32*	0.19–0.54
Unclear	0.68*	0.54–0.85	0.83	0.68–1.00	0.70*	0.58–0.84	0.79	0.51–1.22
Do you think sleep medicine increase risk of dementia? (ref: yes)								
No	1.09	0.79–1.48	0.90	0.71–1.15	1.00	0.78–1.27	0.99	0.57–1.70
Unclear	0.98	0.80–1.21	0.97	0.82–1.15	0.97	0.82–1.14	0.96	0.65–1.42

4. DISCUSSION

Overall, approximately three-fourths of the general population recognises sleep disturbances as risk factors for dementia. Almost all participants had a positive attitude towards improving sleep quality and obtaining knowledge about dementia. The awareness regarding sleep disturbances increasing the risk of dementia was the

only factor that could independently influence participants' willingness to improve their sleep quality and obtain knowledge about dementia. Additionally, factors such as sleep quality and knowledge that sleep medicine and risk of dementia would largely affect participants' desire to alleviate sleep disturbances; factors including sex and dementia contact would also influence attitudes towards all categories of measures of obtaining knowledge about dementia. The findings reveal the current status of public awareness of sleep disturbances and dementia and could aid population-targeted health education.

Sleep disturbances are widely identified as risk factors for dementia;[10 11] however, it remains unclear whether they have been adequately disseminated and recognised by the general public. A meta-analysis suggested that most studies focused on factors such as mental health, physical activity, hypertension, smoking, and air pollution to increase the risk of dementia.[19] To the best of our knowledge, this study is the first to investigate public awareness of sleep disturbances and the risk of dementia. Currently, 72.57% of participants correctly recognise sleep disturbance as a risk factor for dementia; lesser proportion of participants consider alcohol or smoking as risk factors for dementia.[18] Several sociodemographic characteristics, including female sex, young age, high education levels, and contact with patients with dementia, were associated with a better understanding of sleep disturbance as a risk factor for dementia, which is partially consistent with previous surveys conducted in China.[20 21] Additionally, sleep-related factors such as shift work, sleep duration, and previous diagnosis of psychiatric disorders were independently associated with knowledge that sleep disturbances increase the risk of dementia. These findings suggest the need to develop different approaches for populations with different sleep-related statuses to disseminate knowledge about dementia.

Almost all participants were willing to practice at least one measure to improve their sleep quality and to obtain knowledge about dementia. Among the four measures in the questionnaire, leading a regular life and performing strengthening exercises were chosen by most participants, while undergoing psychotherapy or medication was accepted by only a small portion of participants (29% and 19%, respectively). The general public had a high willingness to improve their sleep quality if they were diagnosed with sleep disturbances; however, medical refusal was also observed in the general public. The poor medication adherence could be because of concerns about side effects, high financial burden, and inadequate health literacy.[22 23] Therefore, more measures should be implemented to improve the public understanding of medical therapy.

Several factors are associated with the willingness to improve sleep quality, comprising only the participants who knew that sleep disturbances increased the risk of dementia; they demonstrated a higher willingness to practice all measures to improve sleep quality and obtain knowledge about dementia. The results suggest that knowledge of sleep disturbance plays a vital role in people's attitudes towards relieving sleep disturbances as well as obtaining knowledge about dementia, which is similar to findings that link knowledge with attitudes.[24] Additionally, perception of sleep pills and risk of dementia also influence people's attitudes towards improving sleep quality, especially taking medicines. Although the relationship between sleep medicines and the risk of dementia remains ambiguous, sleep medicines are advocated when individuals are diagnosed with sleep disturbances. The current findings suggest that more efforts are required to disseminate knowledge about dementia and the related risk factors.

Participants with self-reported good sleep quality displayed more willingness to

improve sleep quality when they faced sleep-related problems, which suggests that more information for improving sleep quality should be disseminated among participants with poor sleep quality. Additionally, female participants who had contact with dementia also showed better attitudes towards obtaining knowledge on dementia. Thus, different approaches are required for different epidemiological and sleep-stratified populations to promote their willingness to improve sleep quality and obtain knowledge on dementia.

This study provided information regarding the public knowledge on sleep disturbances and the risk of dementia, attitudes towards improving sleep quality, and willingness to obtain knowledge on dementia. There was an association between awareness that sleep disturbances increase the risk of dementia and positive attitudes towards improving sleep quality as well as obtaining knowledge about dementia; thus, disseminating dementia knowledge is required among the general public. This study had several limitations. First, this was an online survey, and we used a convenience sampling method. This online study was conducted among Internet users who were young and highly educated; thus, the study sample may be limited. Second, the questionnaires were self-designed and not sufficiently validated. Third, sleep disturbances and mental disorders were based on the respondents' self-reports rather than clinical diagnoses. Finally, additional information, such as types of sleep disturbances and occupations, was not included in this study.

5. CONCLUSION

We demonstrated that most people recognised sleep disturbance as a risk factor for dementia and exhibited a positive attitude towards improving sleep quality as well as obtaining knowledge about dementia. Moreover, our findings indicate an

association between people's knowledge and attitudes, suggesting the importance of disseminating knowledge about sleep disturbances and dementia to achieve dementia prevention in future.

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Contributors
YZ and LS developed the proposal and designed the protocol, JQ and LL were involved in revising the proposal and design. YZ, LS, JD, QW, SS and ZL were involved in data collection, and analysis. YZ and LS drafted the manuscript. LS, YB JS and LL revised the analysis and helped in the preparation of the manuscript. All the authors have read and approved the final version of the manuscript.

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Disclaimer
The funding organizations had no role in the design or conduct of the study; collection, management, analysis and interpretation of the data; preparation, review or approval of the manuscript; and decision to submit the manuscript for publication.

Competing interests
All authors have no conflicts of interest to disclose.

Patient consent for publication
Not required.

Ethics approval
The study procedure was reviewed and approved by the Peking University Sixth Hospital natural and computational science research and community service reviewers, and the approval number was 2020-4-9-1. Informed consent was received online before the respondents began the questionnaire. All participants were informed that they have the right not to participate in the study, and only those who provided informed consent were able to respond to the survey. Teenagers aged between 8 and 18 were approved by the ethics committee to voluntarily participate in the study without parental consent. All information obtained in the study was kept confidential.

Provenance and peer review

Not commissioned; externally peer reviewed.

Data availability statement

Data are available on reasonable request.

Supplemental material

This content has been supplied by the author(s).

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Tables

Table 1. Proportions of participants who recognize the knowledge that sleep disturbances increase the risk of dementia stratified by demographic and sleep-related characteristics.

Table 2. Factors associated with the knowledge that sleep disturbances increase the risk of dementia.

Table 3. Factors associated with the attitudes of participants towards taking measures to improve sleep disturbances.

Table 4. Factors associated with the willingness of participants to obtain knowledge about dementia.

Supplementary data

Supplementary Table 1. Factors associated with the willingness of participants to take medicines that could improve sleep quality and reduce the risk of dementia.

Supplementary Table 1. Factors associated with the willingness of participants to take medicines that could improve sleep quality and reduce the risk of dementia.

	AOR	95% CI
Sex		
Men	1	
Women	1.20*	1.02-1.41
Age (years)		
< 40	1	
40-65	1.00	0.83-1.19
≥ 65	0.78	0.48-1.26
Education level (years)		
Primary school or illiteracy (≤ 6)	1	
Middle or high school (6-12)	0.87	0.49-1.57
College or university (12-16)	1.05	0.58-1.89
Postgraduate (≥ 16)	1.05	0.57-1.94
Type of job		
Nonmanual	1	
Manual	0.86	0.67-1.12
Retired	1.03	0.76-1.39
Income groups (yuan/month)		
0-2000	1	
2000-5000	0.91	0.69-1.20
5000-10000	0.93	0.71-1.23
> 10000	0.87	0.65-1.17
Type of residence		
City	1	
Town	1.02	0.78-1.35
Rural area	0.81	0.56-1.17
Dementia contact		
Yes	1	
No	0.74*	0.62-0.88
Unclear	0.75*	0.60-0.94
Shift work		
Yes	1	
No	0.65*	0.54-0.80
Sleep duration in the past one month (hours)		
6-8	1	
< 6	0.97	0.81-1.16
> 8	1.03	0.74-1.42
Self-reported sleep quality in the past one month		
Very good/Pretty good	1	
Very bad/Pretty bad	0.78*	0.66-0.93

Self-reported diagnosis of sleep disturbances, neurological or psychiatric disorders		
At least one	1	
None	0.62*	0.51-0.74
Do you think sleep disturbances increase risk of dementia?		
Yes	1	
No	0.45*	0.32-0.63
Unclear	0.69*	0.57-0.85
Do you think sleep medicine increase risk of dementia?		
Yes	1	
No	2.23*	1.67-3.00
Unclear	1.11	0.93-1.32

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Check
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	Page 1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	Page 2-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Page 5
Objectives	3	State specific objectives, including any prespecified hypotheses	Page 6
Methods			
Study design	4	Present key elements of study design early in the paper	Page 6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Page 6
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	Page 6
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case	N.A.
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Page 7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Page 7
Bias	9	Describe any efforts to address potential sources of bias	N.A.
Study size	10	Explain how the study size was arrived at	Page 6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Page 6-7
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	Page 7-8
		(*b*) Describe any methods used to examine subgroups and interactions	Page 8
		(*c*) Explain how missing data were addressed	Page 8
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy	Page 7-8
		(*e*) Describe any sensitivity analyses	NA.

Continued on next page

Results			**Check**
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Page 8
		(b) Give reasons for non-participation at each stage	Page 8
		(c) Consider use of a flow diagram	N.A.
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Page 8-9 Table 1
		(b) Indicate number of participants with missing data for each variable of interest	Page 8-9
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	N.A.
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time	N.A.
		Case-control study—Report numbers in each exposure category, or summary measures of exposure	N.A.
		Cross-sectional study—Report numbers of outcome events or summary measures	Page 8-9
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Page 9-16
		(*b*) Report category boundaries when continuous variables were categorized	Page 9-16
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Page 9-16
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N.A.
Discussion			
Key results	18	Summarise key results with reference to study objectives	Page 16-19
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Page 19
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Page 20
Generalisability	21	Discuss the generalisability (external validity) of the study results	Page 20
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Page 20

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at

http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.