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Can sleep disturbance influence changes in mental health status? Longitudinal research evidence from ageing studies in England and Japan.

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Abstract

Background: Little is known about the role of sleep disturbance in relation to changes in depressive states. We used data obtained from the participants aged 65 and over in the English Longitudinal Study of Ageing (ELSA, waves 4 and 5, N=3108) and the Japan Gerontological Evaluation Study (JAGES, 2010 and 2013 sweeps, N=7527) to examine whether sleep disturbance is longitudinally associated with older adults' patterns of depressive states.

Methods: We created four patterns of depressive states (non-case, recovered, onset, repeatedly depressive) by combining responses to the measures (scoring four or more on seven items from the Center for Epidemiological Studies Depression Scale for the ELSA participants and scoring 5 or more for the Geriatric Depression Scale-15 for the JAGES participants) obtained at the baseline and follow-up. Sleep disturbance was assessed through responses to three questions on sleep problems. Age, sex, partnership status, household equivalised income, alcohol and cigarette use, and physical function were treated as confounders in this study. Additionally, information on sleep medication was available in JAGES and was included in the statistical models.

Results: More ELSA participants were non-depressive cases and reported no sleep disturbances compared with the JAGES participants. Findings from multinomial logistic regression analysis showed that more sleep disturbance was associated with the onset group in ELSA (RRR=2.37, 95%CI=1.44-3.90) and JAGES (RRR=2.41, 95%CI=1.79-3.25) as well as the recovery (RRR=3.42, 95%CI=1.98-5.90, RRR=2.71, 95%CI=1.95-3.75) and repeatedly depressed group (RRR=7.24, 95%CI=3.91-13.40, RRR=5.16, 95%CI=3.82-6.98).

Conclusions: Findings suggest that the association between sleep disturbance and depression in older adults is complex.

Key words: Sleep; depressive states; cross-national comparisons; ELSA; JAGES

1.Introduction

Sleep and mental disorders are closely related [1]. Around 50% of older adults experience a disrupted sleep cycle, manifested by trouble with falling or staying asleep [2]. Sleep disturbance has been reported to be associated with depression among older adults both cross-sectionally [3, 4] and longitudinally [5]. A reported longitudinal link between sleep disturbance and onset of depression among non-depressive older adults [6] suggests sleep disturbance is a major risk factor for depression.

To date, research evidence on the link between lower levels of sleep disturbance and an improvement in depressive disorders has been limited to small studies among military personnel [7, 8]. Moreover, those who reported poor sleep did not show significant changes in their mental health. Longitudinal research using population-based studies of older adults that link sleep quality to changes in depressive states could provide new knowledge that will contribute to our understanding of healthy ageing, as sleep disturbance has been associated with cognitive functioning, especially among those who are depressed [9].

Using panel data collected from older adults in England and Japan, our study addresses these questions:

1. Is disturbed sleep associated with worsening mental health among older adults free from depression?

2. Is disturbed sleep associated with a lower probability of recovery from depression among depressed older adults?

To our knowledge, we are the first to examine the associations between sleep disturbance and patterns of depressive states, particularly onset and recovery across two countries. Finding similar associations between two developed countries that are culturally different would offer empirical support to our hypothesis that sleep disturbance adversely influences changes in mental health.

2.Material and methods

2.1 Study participants

We used the secondary longitudinal datasets collected from older adults who are independently living in England (English Longitudinal Study of Ageing, ELSA) or Japan (Japan Gerontological Evaluation Study, JAGES). The ELSA study population, aged 50 and over, was drawn from the Health Survey for England that annually assesses the general health of the adult population in England [10]. The ELSA study uses the multi-stage clustering sampling method in order to obtain a representative sample of the non-institutionalised population of older adults. Since the commencement of data collection in 2002, ELSA participants have been followed every two years for the investigation of socio-economic, physical, psychological, cognitive, and biological aspects of the ageing process. Respondents are interviewed in person, or by proxy, with their biomarkers collected by nurses every 4 years. There were 3 108 ELSA participants aged 65 and above with data from both waves 4 (N=11 050) and 5 (N=10 274). This was to achieve proximity of the sample between the ELSA and JAGES participants based on the sampled age group and the years of data collection.

JAGES is an ongoing ageing panel study, investigating factors associated with physical and psychological function decline among older adults aged 65 and over living in Japan [11]. During 2010 and 2011, over 110 000 participants across 31 municipalities in Japan were targeted to establish the baseline data, while about 195 000 older adults aged 65 across 30 municipalities were targeted for the subsequent data collection in 2013 [12]. The combined longitudinal data include participants from 24 municipalities[13], and the Ethics Committee on Research of Human Subjects at Nihon Fukushi University (No. 10–05) approved the project.

A random sampling method was used for the municipalities with a population of over 5000 (n=14) while all eligible older adults were targeted for the rest of the municipalities (n=10) [13]. Unlike ELSA, all data were collected via a postal survey. We used available cases of 7527 which contain all the information from the longitudinal datasets (N=62 438) of the 2010 (N=102 869) and 2013 (N=131 246) sweeps. The main reason for the large drop in sample size from the longitudinal datasets is because sleep questions were addressed to only one in five participants.

2.2 Outcome

We derived four patterns of depressive states by combining participants' responses to a questionnaire to assess possible depression which was administered at the baseline and the subsequent sweep. Those patterns are non-case (=no cases at either sweep), recovered (=was depressed at the baseline only), onset (=was depressed at the follow-up only), and repeatedly depressed (=depressed at both sweeps).

ELSA employs a widely accepted cut-off point of 4 or above in eight items of the Center for Epidemiology Depression Scale (CES-D) to identify possible depressive cases [14]. We adopted the approach taken by Jaussent et al. [6] in omitting the item addressing restless sleep, but keeping the same cut-off point. The distribution of possible cases was not significantly different, despite the omission.

JAGES uses the 15 items from the Geriatric Depressive Scale (GDS-15), translated into Japanese [13]. A cut-off point of 5 or above has been used to identify possible depressive cases in the Japanese version based on a report on high sensitivity and specificity [15].

2.3 Explanatory variable

Sleep disturbance was measured using three questions on frequency (=none, once a week, 1-2 times in a week, or 3 or more times a week) of symptoms related to insomnia occurring during the past month. Questions concerning difficulties in falling asleep and feeling disturbed upon waking up were similar in the two studies. In JAGES, the question about disturbed sleep patterns includes experiences occurring during the night or early morning while the question in the ELSA addressed only night-time sleep disruption. Previously sleep disturbance was assessed by taking a total score [16] or the highest quartile of the total score [17]. As stated previously, the sleep disturbance questions are slightly different. To overcome this shortcoming, we focused on experiences of non-sleep disturbance and created the measure by summing the numbers of the 'zero' response to all three questions and reverse ordered as, with 0 being least disturbed and 3 being most disturbed.

2.4 Covariates

Previous studies on sleep disturbance and depression have included covariates such as age, sex, income, partnership status, physical function indicated by Activities of Daily Living (ADL), and current drinking or smoking status[18]. These are plausibly the key confounders of the association between sleep disturbance and depression. In ELSA, participants aged 90 and over (2.7% of the sample) were grouped together to minimise the risk of disclosing their identity. We tabulated both samples in a 5-year band, creating a six-level category. Household equivalised income was deciled and added to the model. Use of sleep medication could also be a confounder [1, 18]. In JAGES, participants were asked about the use of sleep medication, which we also included as a covariate in the regression models.

2.5 Analysis

Multinomial logistic regression was used to assess longitudinal associations between sleep disturbance and patterned depressive states using Stata version 14SE [19]. All estimates were adjusted for age and sex first and for the confounders in the full model.

We noted the differences in the research design between datasets, especially the sampling approaches in ELSA and JAGES; therefore, we decided to assess the estimates separately, focusing on the direction of the associations between exposures and outcomes in these countries. A longitudinal weight was applied to account for survey non-response for ELSA. JAGES do not require survey weights as the data are representative of areas. We further examined the possibility that responses from rural areas in JAGES might be clustered because all eligible participants in selected rural areas were asked to join the study. However, our preliminary analyses showed that there were no differences in results between correcting the standard errors for potential clustered responses in each study area and not correcting for them (results not shown).

3. Results

3.1 Descriptive findings

Table 1 shows that the majority of the ELSA or JAGES participants were not depressed (75% for ELSA, 66% for JAGES) at either data collection point (=non-case). However, more Japanese participants were depressed at one point or repeatedly. Most of the participants were aged between 65 and 74, married, non-smokers and had no problems with ADLs. There were fewer men (45%) in ELSA while the gender distribution was nearly equal in JAGES (52%). Additionally, fewer ELSA participants reported that they had not consumed alcohol (14%), compared to JAGES participants (59%). Around 20% of JAGES participants were taking sleep medication. With regard to sleep disturbance, reporting no sleep disturbance was least common in both countries (15% for ELSA, 12% for JAGES). More Japanese participants (45%) than English participants (22%) were in the category of the most disturbed sleep.

(Table 1 about here)

3.2 Main results

Adjusted for sex and age, results from multinomial logistic regression showed more sleep disturbance was longitudinally and positively associated with all patterns of depression in reference to the non-case group across the two countries (Table 2). Sleep disturbance was longitudinally and positively associated with the repeatedly depressed group in a dose-response manner in both countries. Sleep disturbance was also associated with the onset group in a similar manner, but less steeply, especially among the JAGES participants. These longitudinal associations remained significant even when fully adjusting for income, ADL, smoking and drinking, and taking sleep medication (JAGES only). The hypothesised longitudinal association between sleep disturbance and the onset of the depressive state was supported, apart from respondents who reported one symptom of sleep disturbance. Respondents who reported the most disturbed sleep were more likely to report the onset of a depressive state in ELSA (RRR=2.37, 95%CI =1.44-3.90) and JAGES (RRR=2.41, 95%CI =1.79-3.25).

Sleep disturbance was also associated with recovery from depressive states in both countries. Respondents with the most disturbed sleep were also more likely to recover from a depressive state in ELSA (RRR=3.42, 95%CI= 1.98-5.90) and JAGES (RRR= 2.71, 95%CI =1.95-3.75). A post-hoc Wald test showed that the onset and recovery from depressive states were distinctively different from each other in both ELSA (χ^2=25.37, df=13, p<0.021) and JAGES (χ^2=29.12, df=14, p<0.010).

(Table 2 about here)

3.3 Post-hoc analysis

The estimates displayed in Table 2 were converted into probabilities of each depressive pattern by the levels of sleep disturbance (Table 3). This clearly shows that the probability of being a non-depressive case decreases considerably from low to high sleep disturbance. Conversely, the probability of being in a repeated depressive case increases around 4 times

from zero to high sleep disturbance. The onset of depressive states in both countries was associated with higher sleep disturbance, as was recovery from depressive states.

(Table 3 about here)

4. Discussion

Sleep disturbance and depressive symptoms have been found to be closely correlated [1, 20]. In our study, we found that greater sleep disturbance was positively associated with longitudinal patterns of depressive states in both countries, independent of sex, age and other confounders. We hypothesised that sleep disturbance would be positively associated with the repeatedly depressive group as well as the onset of depression group. However, we did not expect to find a similar association with the recovery group as well.

In our study, the GDS-15 scale used in JAGES is a validated scale to indicate possible depressive caseness among older adults, while selected items from CES-D used in ELSA have been empirically supported to capture the features of depressive symptoms. We think these instruments are reliable in examining the assumed associations. Moreover, the posthoc test result supports that onset and recovery from depressive states were different from each other in both ELSA and JAGES.

The brains of depressed individuals may work differently in relation to sleep compared to those of non-depressed individuals [21]. Although the mental health of our study participants was not clinically assessed, our findings on probabilities of each depressive state by sleep disturbance provide additional evidence of the benefits of experiencing good sleep being protective against repeated depressive states. It is possible that sleep disturbance may persist even after recovery from depressive symptoms. Based on their findings of positive associations between sleep disturbance and remitted depression as well as with current depression, van Mill et al. [22] suggested that those who remitted from depression could still be suffering from sleep disturbance. In addition, sleep disturbance is likely to be cross-

sectionally associated with depressive states, as well as longitudinally associated with depression. So the association of sleep disturbance with recovery could reflect the positive baseline cross-sectional association between sleep disturbance and depressive states. Older adults who recover from depressive states are likely to have had disturbed sleep that was associated with their earlier levels of depression.

JAGES is a large study, targeting healthy older adults aged 65 and over across various municipalities in Japan. The JAGEs study sample is representative of areas, but not representative of the nation, unlike ELSA. We did not focus on comparing the prevalence of sleep disturbance or depressive symptoms between ELSA and JAGES because measurements for sleep disturbance and depressive symptoms were not the same. Due to this measurement issue, we did not pool the data in order to empirically examine differences in the effect size between the two studies.

The scope of our study is limited to assessing the direction of the longitudinal associations between sleep disturbance and depressive patterns across two studies. To do this, covariates that are possibly contributing to both sleep disturbance and depressive patterns were included in the model to control those effects. Conditioning for the same covariates, we are confident that the longitudinal association between sleep disturbance and depressive patterns across the studies was similar. In addition, as suggested by De Martinis and Winokur [23], we included sleep medication as a covariate in our study model, which was measured in JAGES. Given similar results across two studies, the longitudinal link between sleep disturbance and the patterns of depressive states is unlikely to be found by chance alone.

Staner [20] discussed whether the relationship between sleep and depression was comorbid or causal. Our findings show distinct patterns of associations between sleep disturbance and depressive states, supporting a comorbid relationship as well as the possibility of sleep disturbance could be a precedent to a depressive state. Possible bidirectional associations

between sleep and depression [20, 24] and co-occurring anxiety disorders with depressive disorders [25] are likely to complicate the role of sleep in recovery from depressive symptoms. Future studies using repeated measures on sleep and depression may be able to reveal the complex associations between sleep disturbance and depressive symptoms and possibly distinguish between factors related to the onset of depression and recovery groups.

5. Conclusions

Our findings suggest that sleep disturbance is implicated in the onset of, recovery from and repeated depressive symptoms. The longitudinal mechanisms between sleep disturbance and depressive symptoms appear to be complex. Among older adults, good sleep is likely to prevent the occurrence and recurrence of depressive symptoms.

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Table 1. Descriptive characteristics of the participants by depressive patterns presented separately by the English Longitudinal Study of Ageing (ELSA) and the Japanese Gerontological Evaluation Study (JAGES)

	Non-case	Recovery	Onset	Repeated	All
ELSA (%)[a]	2155.79(74.59)	241.60(8.36)	248.03(8.58)	244.86(8.47)	3108
Sleep disturbance (%)[a]					
0 (least disturbed)	17.29	10.41	10.35	5.92	15.16
1	37.73	21.24	25.60	18.90	33.72
2	28.49	30.76	39.19	26.67	29.44
3 (most disturbed)	16.48	37.59	24.85	48.51	21.68
Men (%) [a]	49.53	30.00	37.86	31.12	45.34
Age (%) [a]					
65-69	32.95	28.46	27.51	23.21	31.28
70-74	29.40	26.83	24.79	24.48	28.38
75-79	19.10	18.88	19.84	18.85	19.12
80-84	11.17	14.57	16.10	18.41	12.49
85 and over	7.37	11.26	11.76	15.04	8.72
Partnered (%) [a]	67.07	45.65	59.15	38.98	62.22
ADL difficulties (%) [a]	9.78	22.47	17.79	35.76	13.72
Non-smokers (%) [a]	92.39	81.45	86.65	81.15	90.02
Non-drinkers (%) [a]	11.59	21.72	18.18	23.45	14.01
Income (decile) [a]					
1	6.39	7.77	8.24	11.58	7.10
2	12.27	19.42	15.14	11.72	13.07
3	12.56	17.56	12.70	14.50	13.15
4	12.67	12.04	16.33	13.19	12.97
5	11.11	17.26	9.69	17.43	12.04
6	10.24	8.34	12.77	10.87	10.35
7	9.96	6.72	9.41	10.20	9.66
8	9.59	6.88	8.66	4.35	8.84
9	9.19	2.35	3.40	3.35	7.62
10 (Most affluent)	6.02	1.60	3.65	2.80	5.18
JAGES (%)	5000(66.43)	577(7.67)	696(9.25)	1254(16.66)	7527
Sleep disturbance (%)					
0 (Least disturbed)	14.34	7.80	8.05	4.15	11.56
1	21.98	11.96	15.37	11.32	18.83
2	25.00	21.66	23.13	22.65	24.18
3 (Most disturbed)	38.68	58.58	53.45	61.88	45.44
Men (%)	51.54	53.90	54.31	50.96	51.88
Age (%)					
65-70	38.64	40.21	30.17	35.17	37.40
71-74	30.98	30.51	32.90	32.46	31.37
75-79	18.94	18.02	22.27	20.10	19.37
80-84	8.92	7.97	10.49	9.41	9.07
85-89	2.28	3.29	2.87	2.39	2.43
90 and over	0.24	0.00	1.29	0.48	0.36
Partnered (%)	79.18	76.26	75.00	70.26	77.08
ADL difficulties (%)	0.46	0.69	0.29	2.23	0.76
Non-smokers (%)	89.72	87.87	85.92	85.73	88.56
Non-drinkers (%)	57.62	62.56	59.63	65.07	59.43
Taking sleeping pills (%)	14.50	23.05	22.27	28.95	18.28
Income (decile)					

1 (Least affluent)	6.58	10.92	7.47	15.23	8.44
2	8.90	11.61	10.92	13.88	10.12
3	7.00	10.40	9.77	12.28	8.40
4	9.50	13.52	13.51	14.59	11.03
5	9.22	9.19	10.63	9.01	9.31
6	7.48	6.76	8.62	7.58	7.55
7	14.52	11.96	10.78	11.40	13.46
8	12.92	9.53	9.48	7.26	11.40
9	11.40	8.67	9.48	4.86	9.92
10 (Most affluent)	12.48	7.45	9.34	3.91	10.38

Abbreviations: ADL, Activities of Daily Living

[a]Weighted figures

Table 2. Multinomial logistic regression results (RRR with 95%CI) presented separately by the English Longitudinal Study of Ageing (ELSA) and the Japanese Gerontological Evaluation Study (JAGES)

	Non-case (ref)	Recovery		Onset		Repeated	
		Adjusted for Sex, Age	Fully Adjusted[a]	Adjusted Sex, Age	Fully Adjusted[a]	Adjusted for Sex, Age	Fully Adjusted
ELSA (N=3108)							
Sleep disturbance							
0 (=Least disturbed: Ref)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1	1.00	0.98 (0.56-1.67)	0.99 (0.57-1.72)	1.16 (0.72-1.89)	1.16 (0.72-1.88)	1.54 (0.82-2.91)	1.49 (0.78-2.83)
2	1.00	1.77 (1.06-2.97)	1.78 (1.04-3.04)	2.31 (1.45-3.69)	2.31 (1.45-3.68)	2.80 (1.51-5.19)	2.60 (1.39-4.88)
3 (=most disturbed)	1.00	3.56 (2.11-6.00)	3.42 (1.98-5.90)	2.47 (1.51-4.05)	2.37 (1.44-3.90)	8.50 (4.67-15.48)	7.24 (3.91-13.40)
JAGES(N=7527)							
Sleep disturbance							
0 (=Least disturbed: Ref)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1	1.00	0.99 (0.67-1.45)	1.03 (0.69-1.52)	1.24 (0.88-1.74)	1.25 (0.89-1.76)	1.78 (1.27-2.47)	1.87 (1.34-2.63)
2	1.00	1.59 (1.11-2.27)	1.62 (1.13-2.31)	1.65 (1.20-2.26)	1.66 (1.20-2.29)	3.16 (2.30-4.27)	3.22 (2.34-4.41)
3 (=most disturbed)	1.00	2.82 (2.04-3.90)	2.71 (1.95-3.75)	2.50 (1.86-3.36)	2.41 (1.79-3.25)	5.57 (4.15-7.47)	5.16 (3.82-6.98)

Abbreviations: RRR, Relative Related Ratio; CI, Confidence Interval

[a] Adjusted for sex, age, income, partnership status, physical functioning (ADL) and current drinking and smoking status. For JAGES, use of sleep medication was additionally included.

Notes: Estimates for ELSA are weighted.

Table 3. Probability [a] of each depressive pattern with 95% CI by sleep disturbance presented separately by the English Longitudinal Study of Ageing (ELSA) and the Japanese Gerontological Evaluation Study (JAGES)

	Non-case	Recovered	Onset	Repeated
ELSA (N=3108)				
Sleep disturbance				
0	0.84 (0.80-0.88)	0.06 (0.03-0.09)	0.06 (0.04-0.08)	0.04 (0.02-0.06)
1	0.82 (0.80-0.85)	0.06 (0.04-0.07)	0.07 (0.05-0.08)	0.05 (0.04-0.07)
2	0.72 (0.69-0.75)	0.09 (0.07-0.11)	0.11 (0.09-0.14)	0.08 (0.06-0.09)
3	0.61 (0.57-0.65)	0.13 (0.10-0.16)	0.10 (0.07-0.12)	0.16 (0.13-0.19)
JAGES (N=7527)				
Sleep disturbance				
0	0.81 (0.79-0.84)	0.05 (0.04-0.07)	0.07 (0.05-0.08)	0.06 (0.05-0.08)
1	0.76 (0.74-0.79)	0.05 (0.04-0.06)	0.08 (0.06- 0.09)	0.11 (0.09-0.13)
2	0.68 (0.66-0.70)	0.07 (0.06- 0.08)	0.09 (0.08- 0.10)	0.16 (0.15-0.18)
3	0.58 (0.56-0.60)	0.10 (0.09-0.11)	0.11 (0.10- 0.12)	0.21 (0.20-0.23)

[a] Estimates are based on the fully adjusted model.

Highlights

- Large ageing studies from England and Japan that are culturally different, but with similar sleep measures were used.
- Poorer sleep was longitudinally associated with the recovered depressive state.
- Poorer sleep was also associated with the onset and repeatedly depressive state.
- The benefit of good sleep is likely to be limited to those who are free from depressive symptoms.