



Associations of Self-Consciousness with Insomnia Symptoms

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Objective: Insomnia is a very common health problem that are getting more attention. Self-consciousness is one of the factors related to anxiety or rumination that affect insomnia symptoms. However, the number of studies regarding self-consciousness and insomnia is scarce. The objective of study is to evaluate effects of self-consciousness on insomnia symptoms. **Methods:** A total of 90 healthy adults (mean age 28 years, 58% female) were enrolled to the study. Pittsburgh Sleep Quality Index (PSQI) and Insomnia Severity Index (ISI) were used to define poor sleepers (PSQI score 8 or higher, or ISI score 8 or higher). Objective sleep parameters were obtained through actigraphy device, and subjective sleep parameters were obtained through sleep diaries concordantly. Self-consciousness scale was used to evaluate three domains of self-consciousness including public self-consciousness, private self-consciousness, and social anxiety. Binary regression analysis and multiple logistic regression analysis were conducted to find correlation between self-consciousness and insomnia symptoms. **Results:** Among three self-consciousness domains, only social anxiety showed significant correlation to poor sleepers [odds ratio (OR)=1.091, $p=0.046$]. Social anxiety was also significantly correlated with both PSQI score 8 or higher ($B=0.091$, $p=0.002$) and ISI score 8 or higher ($B=0.087$, $p=0.047$). Private self-consciousness was negatively associated with ISI score 8 or higher ($B=-0.202$, $p=0.043$). **Conclusion:** High social anxiety had a significant correlation to poor sleep. The result of this study implies high self-consciousness with emotional distress could affect insomnia symptoms.

Key Words: Insomnia; Sleep; Self-consciousness; Social anxiety; Actigraphy; Sleep diary

Received: March 6, 2021 **Revised:** March 9, 2021 **Accepted:** March 10, 2021

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INTRODUCTION

Insomnia is a common health problem that have recently been getting more attention. According to a 2017 Korean Gallup survey on 1004 Korean adults, 34 percent of people reported that they did not sleep well recently [1], and World Health Organization Study on Global Ageing and Adult Health claimed that 150 million of adults from 8 countries have sleep problem in 2007, and the numbers are expected to be increased more than 260 million in 2030 [2]. Insomnia symptoms including initiating or maintaining sleep, short sleep duration, and poor sleep quality are known to have correlation with cardiovascular disease risk, overall mortality, poor psychiatric condition, or daytime functioning including cognitive performance [3-8].

Self-consciousness, which is defined as one of the adaptive per-

sonality processes that are the object of one's consciousness which accompanies the natural disposition of, is one of the factors related to anxiety or rumination that affect insomnia symptoms [9-11]. Self-consciousness is generally considered to have two dimensions; public and private aspects of self-consciousness [12]. Public self-consciousness is outward directions of one's thought, while private self-consciousness is inward directions of one's thought. Social anxiety, discomfort in the presence of others, is a reaction to self-focused attention which also have theoretical implications for the nature of self-consciousness [12]. In the aspects of self-consciousness, social anxiety is considered as an enfoldment of public self-consciousness [13]. Self-consciousness is related to insomnia because people with insomnia are generally have self-consciousness about their sleep [10], yet the number of studies regarding self-consciousness and insomnia are scarce.

Some researchers reported the association between sleep problems and counterfactual emotions that included self-consciousness, such as social anxiety, regret, guilt, and shame [14-16]. However, there is still a lack of research on the effects of self-consciousness on insomnia.

In this study, we tried to find correlation between self-consciousness and insomnia symptoms. We hypothesized that self-consciousness would have negative effect on insomnia symptoms. We measured objective and subjective sleep parameters of the participants, and performed analysis to find the effects of self-consciousness on insomnia.

METHODS

Study population

Target population was healthy adults aged more than 19 years. We recruited participants through advertisements posted at Severance Hospital and Yonsei University College of Medicine. Exclusion criteria were as below; current or previous major psychiatric disorder (e.g., schizophrenia or related psychotic disorder, bipolar disorder, major depressive disorder, and anxiety disorder), substance use disorder (except for nicotine), uncontrolled medical condition, and regular use of sleeping medication. All of the participants had given explanation of the research purposes and procedure beforehand, and provided written consent voluntarily. The study was approved by the Institutional Review Board of Severance Hospital, Yonsei University Health System (no: 4-2017-0893 and 4-2016-0570).

Baseline measurement

Baseline characteristics including sex, age, job status (regular worker, part-time job, housemaker, student, or inoccupation), education level (years), presence of current psychiatric disorder, and other medical condition were obtained through face-to-face interview. Presence of psychiatric disorder was evaluated using the Structured clinical interview for DSM-5 (SCID-5) [17].

For measuring baseline sleep status, Pittsburgh Sleep Quality Index (PSQI) and Insomnia Severity Index (ISI) were used. PSQI is a self-rated questionnaire that assesses sleep quality and disturbances during past month [18]. It consists of 7 components including subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction based on experience within 1 month of patients' experience. Each component scored from 0 point to 3 point, and the sum of scores for these seven components yields one global score for PSQI. Higher PSQI score implies worse sleep status. Cut-off score of PSQI is generally considered as 5, which implies poor sleep quality [18,19], while others suggest a cut-off score of 8 is more suitable depending on the sample characteristics [20,21]. ISI is a 7-item self-report questionnaire evaluating below items; severity of sleep-onset, sleep maintenance, early morning awakening problems, satisfaction with current sleep pattern, interference with daily functioning, noticeability of im-

pairment attributed to the sleep problem, and level of distress caused by sleep problem [22]. Each of these items is rated on a five-point Likert scale ('0' not at all, '4'=extremely) based on experience within two weeks. High scores indicating greater insomnia severity. Cut-off score of ISI is 8, which suggesting sub-threshold insomnia [23]. In this study, if the participants' PSQI score was 8 or higher regardless of ISI score, or ISI score was 8 or higher regardless of PSQI score, all were defined as poor sleepers. If participants have both PSQI score lower than 8 and ISI score lower than 8, they were defined as good sleepers.

Study design

After their initial meeting with researchers, participants were asked to continuously wear the actigraphy device (ActiGraph GT3X+, ActiGraph, Pensacola, FL, USA) on their non-dominant wrist for 14 days, and to write sleep diary during same periods. If they did not wear actigraphy or write sleep diary for more than 7 days, they were excluded from the study. After the experiment, the participants were asked to conduct a survey on self-consciousness through e-mail.

Actigraphy was used to gather information of objective sleep parameters including objective sleep onset latency (SOL), objective total sleep time (TST), objective time in bed (TIB), and objective wake after sleep onset (WASO). Objective sleep efficiency was defined as ratio of objective TST per objective TIB. Actigraphy detects participants' movement as activity counts in every 60 second (1 epoch). All epochs were scored as either sleep or wake status by comparing the calculated total activity counts to awake threshold value based on Cole-Kripke algorithm [24]. If the total activity counts were less than or equal to the wake threshold value, the epoch was scored as sleep. ActiLife software (version 6.13.3, ActiGraph) was used to assess and analyze data from actigraphy.

International consensus format of sleep diary was used to measure subjective sleep parameters to assess subjective SOL, subjective TST, subjective TIB, subjective WASO, subjective sleep quality, consumption of alcohol, and number and time of naps [25]. Subjective sleep efficiency was defined as ratio of subjective TST per subjective TIB. We encouraged participants to complete the diary immediately upon awakening each morning to minimize errors.

Self-consciousness scale (SCS) was used to evaluate self-consciousness of participants [26]. It is self-rated questionnaire consisted with 23 questions assessing three domains of self-consciousness; private self-consciousness (nine items, e.g., "I'm always trying to figure myself out."), public self-consciousness (seven items, e.g., "I'm concerned about the way I present myself."), and social anxiety (six items, e.g., "I have trouble working when someone is watching me.") [13]. The private self-consciousness means one's concern with attending to their inner thoughts and feelings. The public self-consciousness is defined by a general awareness of the self as a social object that has an effect on others. The third domain, social anxiety, is defined by a discomfort in the presence of others. Higher score indicates higher self-consciousness.

Statistical analyses

A total of 106 individuals were enrolled to the study. Data from 16 participants were excluded from analysis for the following reasons; consent withdrawal (n=1), without use of actigraphy for more than 7 days (n=1), without use of sleep diary for more than 7 days (n=2), incompleteness of self-questionnaire (n=12). Therefore, data from a total of 90 people were used for the analysis.

To evaluate the effects of self-consciousness on insomnia symptoms, we performed independent sample t-test, binary regression analysis, and multiple logistic regression analysis. Independent sample t-tests were used to compare differences between poor sleepers (PSQI \geq 8 or ISI \geq 8) and good sleepers (PSQI $<$ 8 and ISI $<$ 8) including demographic factors, subjective and objective sleep parameters, and self-consciousness. Binary regression analysis was conducted to evaluate the effects of factors, including self-consciousness, on poor sleepers. Multiple logistic regression analysis was used to evaluate the effects of factors on each insomnia scale. The presence of multicollinearity among variables in regression model was examined by variance inflation factor, and no

factors were found to have multicollinearity problem. Statistical significance was set at $p < 0.05$. All analyses were performed by using statistical package for social science 23 for windows version (IBM Corp., Armonk, NY, USA) [27].

RESULTS

Participants characteristics

A total of 90 participant including poor sleepers (n=30) and good sleepers (n=60) were included in the study. Demographic and clinical characteristics of the 90 study participants (aged 20 to 61 years) are shown in Table 1. Subjective sleep quality was worse in poor sleepers than in good sleepers ($p < 0.001$). There was a tendency of less subjective TST in poor sleepers than in good sleepers ($p = 0.050$), whereas other sleep parameters including objective sleep parameters measured by actigraphy were not significantly different between two groups. Among the three domains of self-consciousness, only social anxiety was significantly higher in poor sleepers than in good sleepers ($p = 0.010$).

Table 1. Characteristics of study participants

Characteristic	Total (n=90)	Poor sleepers ^a (n=30)	Good sleepers ^b (n=60)	p
Age (yr)	28.73 \pm 8.53	29.30 \pm 6.73	28.45 \pm 9.336	0.658
Sex, female	53 (58.9)	21 (70)	32 (53.3)	0.130
Weight (kg)	63.04 \pm 12.52	63.89 \pm 14.50	62.61 \pm 11.491	0.653
Education (yr)	16.43 \pm 2.26	17.03 \pm 1.99	16.14 \pm 2.345	0.080
Current job status	84	28 (33.3)	56 (66.7)	0.109
Regular worker	33 (39.3)	14 (50)	19 (33.93)	
Part-time job	1 (1.2)	1 (3.57)	0	
Housemaker	2 (2.4)	1 (3.57)	1 (1.79)	
Student	47 (56.0)	11 (39.29)	36 (64.29)	
Inoccupation	1 (1.2)	1 (3.57)	0	
Total nap time (min)	21.44 \pm 20.42	20.87 \pm 18.36	21.73 \pm 21.510	0.850
Amount of drinks (g)	3.33 \pm 5.65	3.36 \pm 5.55	3.31 \pm 5.75	0.966
Subjective SOL (min)	13.06 \pm 11.05	12.84 \pm 11.475	13.17 \pm 10.94	0.894
Subjective TST (min)	407.38 \pm 56.30	390.99 \pm 49.08	415.58 \pm 58.25	0.050
Subjective TIB (min)	467.78 \pm 76.20	448.22 \pm 72.99	477.56 \pm 76.47	0.085
Subjective WASO (min)	4.58 \pm 4.69	6.04 \pm 5.68	3.84 \pm 3.97	0.064
Subjective SE (%)	87.61 \pm 6.58	87.81 \pm 6.26	87.51 \pm 6.78	0.839
Subjective sleep quality ^c	6.74 \pm 1.56	5.98 \pm 1.47	7.13 \pm 1.48	<0.001 [†]
Objective SOL (min)	1.27 \pm 0.76	1.21 \pm 0.78	1.30 \pm 0.76	0.586
Objective TST (min)	386.39 \pm 60.37	378.12 \pm 48.49	390.53 \pm 65.49	0.314
Objective TIB (min)	446.60 \pm 61.77	437.20 \pm 54.60	451.30 \pm 64.98	0.310
Objective WASO (min)	58.93 \pm 18.76	57.87 \pm 21.06	59.46 \pm 17.66	0.707
Objective SE (%)	86.35 \pm 4.44	86.53 \pm 4.50	86.27 \pm 4.45	0.790
PSQI (score)	6.07 \pm 2.55	8.77 \pm 1.78	4.72 \pm 1.65	<0.001 [†]
ISI (score)	5.12 \pm 3.57	8.83 \pm 3.19	3.27 \pm 1.93	<0.001 [†]
Private self-consciousness ^d	32.58 \pm 5.24	32.77 \pm 5.17	32.48 \pm 5.32	0.811
Public self-consciousness ^d	22.22 \pm 5.09	22.87 \pm 4.49	21.90 \pm 5.38	0.399
Social anxiety ^d	38.01 \pm 15.17	43.23 \pm 11.440	35.40 \pm 16.196	0.010 [*]

Values are expressed as mean \pm SD for continuous variables and as n (%) for categorical variables. Subjective sleep parameters are measured by using sleep diary. Objective sleep parameters are measured by using actigraphy. ^{*} $p < 0.05$, [†] $p < 0.01$. ^aParticipants with PSQI \geq 8 or ISI \geq 8. ^bParticipants with PSQI $<$ 8 and ISI $<$ 8. ^cMeasured on a Likert scale, range from 1 to 10. ^dMeasured by Self-consciousness scale. SOL: sleep onset latency, TST: total sleep time, TIB: time in bed, WASO: wake after sleep onset, SE: sleep efficiency, PSQI, Pittsburgh Sleep Quality Index, ISI: Insomnia Severity Index

Association between self-consciousness and poor sleep

Higher social anxiety was significantly associated with poor sleepers in binary regression analysis [odds ratio (OR)=1.091, $p=0.046$] (Table 2). As shown in Table 3, we found that only social anxiety had significant effect on the poor sleepers with PSQI score of 8 or higher in multiple regression analysis ($B=0.091$, $p=0.002$). On the other hand, both private self-consciousness and social anxiety showed significant effects on the poor sleepers with the ISI score of 8 or higher ($B=-0.202$, $p=0.043$, $B=0.087$, $p=0.047$, respectively).

DISCUSSION

In this study, we aimed to investigate the effects of self-conscious-

ness on insomnia symptoms. Social anxiety was higher in poor sleepers than in good sleepers, while other self-consciousness domains showed no significant difference between the two groups. Among the three self-consciousness domains, only social anxiety showed significant correlation with poor sleepers. In multiple regression analysis for each insomnia scale, social anxiety was significantly associated with poor sleepers with both high PSQI and ISI score, while private self-consciousness was negatively correlated with poor sleepers with high ISI score.

The most notable result of our study is that social anxiety among the three self-consciousness domains was found to have significant correlation with insomnia symptoms. The association of insomnia symptoms with social anxiety could be explained by that emotional distress and hyperarousal caused by high self-con-

Table 2. Association of factors including self-consciousness with poor sleepers^a

Variables	B	p	OR (95% CI)
Age (yr)	-0.081	0.156	0.922 (0.824–1.031)
Sex, female	1.172	0.183	3.227 (0.575–18.096)
Weight (kg)	0.052	0.123	1.504 (0.986–1.126)
Education (yr)	0.171	0.344	1.186 (0.833–1.689)
Current job status			
Regular worker	Reference		
Part-time job	20.613	1.000	895768629.60 (0.000–)
Housemaker	-19.286	1.000	0.000 (0.000–)
Student	-0.961	0.277	0.383 (0.068–2.165)
Inoccupation	19.883	1.000	431398599.63 (0.000–)
Total nap time (min)	-0.008	0.566	0.992 (0.964–1.021)
Amount of drinks (g)	0.052	0.399	1.054 (0.933–1.190)
Private self-consciousness ^b	-0.131	0.107	0.877 (0.748–1.029)
Public self-consciousness ^b	0.028	0.660	1.029 (0.907–1.167)
Social anxiety ^b	0.087	0.046*	1.091 (1.001–1.189)

* $p<0.05$. ^aParticipants with $PSQI \geq 8$ or $ISI \geq 8$. ^bMeasured by self-consciousness scale. B: regression coefficient, OR: odds ratio, CI: confidence interval, PSQI: Pittsburgh Sleep Quality Index, ISI: Insomnia Severity Index

Table 3. Association of factors including self-consciousness with insomnia scales

	PSQI ^a			ISI ^b		
	B	SE	p	B	SE	p
Age (yr)	-0.083	0.048	0.086	-0.107	0.073	0.148
Sex, female	1.658	0.756	0.032*	1.708	1.157	0.145
Weight (kg)	0.055	0.028	0.053	0.021	0.043	0.624
Education (yr)	0.165	0.165	0.321	0.136	0.253	0.594
Current job status						
Regular worker	Reference			Reference		
Part-time job	1.618	2.266	0.478	0.188	3.258	0.954
Housemaker	1.604	2.492	0.522	-0.211	3.492	0.942
Student	-0.421	0.831	0.614	-0.092	1.199	0.958
Inoccupation	0.540	2.316	0.816	4.594	3.330	0.173
Total nap time (min)	0.006	0.013	0.657	0.003	0.020	0.893
Amount of drinks (g)	0.090	0.053	0.094	0.104	0.077	0.181
Private self-consciousness ^c	-0.098	0.064	0.130	-0.202	0.098	0.043*
Public self-consciousness ^c	-0.046	0.058	0.424	-0.032	0.088	0.723
Social anxiety ^c	0.091	0.028	0.002†	0.087	0.043	0.047*

* $p<0.05$, † $p<0.01$. ^a $PSQI \geq 8$. ^b $ISI \geq 8$. ^cMeasured by self-consciousness scale. B: regression coefficient, SE: standard error, PSQI: Pittsburgh Sleep Quality Index, ISI: Insomnia Severity Index

sciousness. Emotional distress, perpetuating worry, and physiological hyperarousal could produce insomnia symptoms [28,29]. Previous literatures reported that high level of self-consciousness contribute to hyperarousal [30,31]. However, we should note that self-consciousness is not always associated with psychopathological status, as highly self-conscious individuals are aware of their attitudes which could lead to self-regulation and psychological well-being [32,33]. The reason of only social anxiety showed significant correlation to poor sleepers might be because social anxiety is the domain with the highest correlation to emotional distress and psychiatric symptoms including depression, anxiety, and interpersonal sensitivity among three self-consciousness domains [34]. We can assume that high self-consciousness with emotional distress could be related to worry or hyperarousal which could affect insomnia symptoms.

Private self-consciousness showed negative association with poor sleepers only with high ISI. We could assume this is because private self-consciousness is more likely to be associated with beneficial mental effect than other domains of self-consciousness. A previous study reported that private self-consciousness did not have association with various measures of anxiety, while public self-consciousness did [35]. There are also studies about beneficial mental effect of private self-consciousness including tolerance to stress, relaxation, and daily well-being [36,37]. Yet, it is difficult to confirm if there is a beneficial effect of private self-consciousness to insomnia symptoms solely based on the result of this study. In this study, private self-consciousness showed a significant correlation only with ISI score of 8 or high, not with PSQI score or poor sleepers. Further study about relationship between self-consciousness and insomnia is needed to verify this.

What should be noted here is that no significant difference in the objective sleep parameters was found between the poor sleepers and the good sleepers. This is because we recruited healthy population for this study. Poor sleepers in this study was defined as high PSQI or ISI score among healthy population. The most significantly different sleep parameter between poor sleepers and good sleepers was subjective sleep quality, which could explain high PSQI or ISI score of participants even without disturbance of other sleep parameters.

There are several limitations of this study. First, the survey on self-consciousness was performed after the end of experiment. Since sleep parameters and SCS are not measured at the same time, it might be difficult to confirm the effects of self-consciousness on insomnia symptoms. However, self-consciousness is an adaptive personality processes of individuals that is expected to be not easily changed. Previous study on self-consciousness reported SCS showed year-to-year stability [38]. Thus, we could assume that self-consciousness of the participants constantly remained during the experiment periods. Second, number of sample size was small. It is possible that small number of sample size could lead to the bias of sample characteristics.

This is the first study to evaluate the effects of self-consciousness on insomnia symptoms. We found the correlation between

high anxiety and poor sleep. The result of this study indicates that high self-consciousness with emotional distress could affect insomnia symptoms.

Acknowledgments

This study was funded by the Basic Science Research Program through the National Research Foundation of Korea (NRF); the Ministry of Science, ICT & Future Planning, Republic of Korea (grant number: 2017R1A2B3008214 to Eun Lee); and the Intelligence Information Expansion Support System for Private Organizations supervised by the National IT Industry Promotion Agency (grant number: A0602-19-1020 to Eun Lee).

Conflicts of Interest

The authors have no potential conflicts of interest to disclose.

Author Contributions

Conceptualization: all authors. Data curation: all authors. Formal analysis: Min Su Kim, Eun Lee, Kyung Mee Park, Investigation: Min Su Kim, Eun Lee, Kyung Mee Park. Methodology: Min Su Kim, Eun Lee, Kyung Mee Park. Project administration: all authors. Resources: all authors. Software: Min Su Kim, Hye Yoon Park, Eunchong Seo, Eun Lee. Supervision: Eun Lee, Suk Kyoan An, Kyung Mee Park. Validation: Min Su Kim, Eun Lee, Kyung Mee Park. Visualization: Min Su Kim, Eun Lee, Kyung Mee Park. Writing—original draft: Min Su Kim, Kyung Mee Park. Writing—review & editing: all authors.

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