



# Insomnia during coronavirus disease 2019 pandemic in Korea: a National sleep survey

Ji-Ye Jeon<sup>1</sup> · Keun Tae Kim<sup>2</sup> · Seo-Yong Lee<sup>3,4</sup> · Yong Won Cho<sup>2</sup>  on behalf of the Sleep Epidemiology Committee of the Korean Sleep Research Society

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## Abstract

Coronavirus disease 2019 (COVID-19) pandemic has caused widespread increase in stress and affected sleep quality and quantity, with up to 30% prevalence of sleep disorders being reported after the declaration of the pandemic. This study aimed to assess perceived changes due to the pandemic in the prevalence of insomnia and excessive daytime sleepiness (EDS) in Korea, and identify the associated factors. An online survey was conducted among 4000 participants (2035 men and 1965 women) aged 20–69 years enrolled using stratified multistage random sampling according to age, sex, and residential area, between January, 2021 and February, 2022. The questionnaire included various items, such as socio-demographics, Insomnia Severity Index, and Epworth Sleepiness Scale (ESS). Insomnia was defined as difficulty falling asleep and difficulty maintaining sleep more than twice a week. EDS was classified as an ESS score  $\geq 11$ . Insomnia was reported by 32.9% ( $n = 1316$ ) of the participants (37.3% among women and 28.6% among men). Multivariate logistic regression revealed that insomnia was associated with female sex [odds ratio (OR) = 1.526, 95% confidence interval (CI) = 1.297–1.796], night workers (OR 1.561, 95% CI 1.160–2.101), and being unmarried (OR 1.256, 95% CI 1.007–1.566). EDS was reported by 12.8% ( $n = 510$ ) of the participants (14.7% among men and 10.7% among women). EDS was associated with male sex (OR 1.333, 95% CI 1.062–1.674), and being employed (OR 1.292, 95% CI 1.017–1.641). During the COVID-19 pandemic, the prevalence of insomnia increased in Korea, while there was no significant change in EDS compared with pre-pandemic evidence.

**Keywords** COVID-19 · Daytime sleepiness · Epidemiology · Insomnia · Sleep disturbance

## Introduction

Sleep disturbances, especially insomnia and daytime sleepiness, are common among adults; they are associated with various physical disorders and accidents [1, 2]. The prevalence of insomnia in adults in Western countries reportedly ranges from 10 to 30% [3, 4]. In Korea, a nationwide

telephone survey demonstrated an insomnia, which was defined as either experiencing difficulty falling asleep or returning to sleep after waking in the night more than twice a week, prevalence of 22.8% in individuals aged 20–69 years in 2009. Meanwhile, a face-to-face interview that used the Insomnia Severity Index (ISI) and defined insomnia as a score of 11 or higher, reported a prevalence of 10.8% among adults aged 19–69 years in 2012 [5, 6]. Furthermore, the prevalence of excessive daytime sleepiness (EDS) was 12.2% in individuals aged 40–69 years living in Ansan, Korea; habitual snoring or sleep-related problems reportedly increased the risk of EDS [7].

Coronavirus disease 2019 (COVID-19) that causes respiratory syndrome, has resulted in a pandemic with widespread increase in stress [8]. The pandemic phenomena has influenced sleep, and efforts to prevent the spread of the virus have disheveled our daily lives. These factors may affect sleep patterns, resulting in serious physical and mental health problems. Since the pandemic is a complex,

✉ Yong Won Cho  
neurocho@gmail.com

<sup>1</sup> Department of Neurology, School of Medicine, Kyungpook National University Chilgok Hospital, Daegu, South Korea

<sup>2</sup> Department of Neurology, Keimyung University Dongsan Medical Center, Daegu, Korea

<sup>3</sup> Department of Neurology, School of Medicine, Kangwon National University, Chuncheon, Korea

<sup>4</sup> Interdisciplinary Graduate Program in Medical Bigdata Convergence, Kangwon National University, Chuncheon, Korea

multifaceted situation, it is necessary to investigate the potential changes in sleep patterns and how these patterns relate to the psychological response to the pandemic.

Early COVID-19 studies in Asia and Europe reported sleep disorders in up to one-third of the studied populations [9, 10]. In Korea, sleep surveys among medical staff at COVID-19 base hospitals have been conducted and reported that medical staff who worked in COVID-19 response teams had high levels of depression and anxiety and poor sleep quality; this was more severe in nurses than doctors [11]. However, sleep studies among the public have not been conducted yet in Korea. The present study aimed to assess perceived changes due to the pandemic in the prevalence of insomnia and EDS in the general public, and identify the factors associated with sleep changes during the outbreak.

## Methods

### Participants and survey procedure

This study used the data from National Sleep Survey of South Korea 2022, a nationwide population based survey on sleep disturbances and public awareness. An online survey using a structured questionnaire was conducted from January, 2021 to February, 2022. A representative sample of 4,000 participants aged between 21 and 69 years were constituted using a stratified multistage random sampling method. The sample was established based on population of residence (capital and five Korean provinces), sex, age (five levels: 20–29, 30–39, 40–49, 50–59, and 60–69 years), marital status, employment, working patterns, and monthly income. This survey was conducted by Embrain Public company on behalf of Epidemiology Committee of the Korean Sleep Research Society. This study was approved by the Institutional Review Board of the Dongsan Medical Center (IRB No. 2021–12-063). All participants provided written informed consent.

### Measures

This study used a structured web-based questionnaire consisting of the following nine sections: demographics and health habits, health status associated with COVID-19, Internet/social media use, current sleep pattern, subjective sleep parameters, awareness of sleep disorders, sleep apnea syndrome and insomnia treatment, STOP questionnaire, modified Insomnia Severity Index (ISI), Epworth Sleepiness Scale (ESS), and simple questions regarding restless legs syndrome. The outcome of interest was insomnia and EDS, measured using the modified ISI and ESS questionnaires in this study. The ISI includes seven items that evaluate difficulty falling asleep, difficulty staying asleep, problems

waking up too early, satisfaction with current sleep pattern, interference with daily functions, noticeability of impairment attributed to sleep problems, and distress caused by the sleep problem [12]. We modified the answers for the first three questions (about the severity of the symptoms) to 1: < once a week; 2: once a week; 3: 2–4 times per week; 4: 5–6 times per week; and 5: daily. Criteria for insomnia was having difficulty falling asleep and difficulty maintaining sleep twice or more in a week. An ISI score  $\geq 15$  was considered as moderate to severe insomnia. The ESS consists of questions on eight different sleep-related activities and situations to assess the likelihood of falling asleep or falling asleep in each situation [13]. An ESS score  $\geq 11$  was classified as EDS.

### Statistical analysis

The prevalence was calculated by dividing the number of cases by the total population. We analyzed the data using the chi-square test for categorical data. Logistic regression analysis was used to compute the relative risk of sociodemographic factors associated with insomnia and EDS symptoms. All reported  $p$  values are two-tailed, and  $p < 0.05$  was considered statistically significant. All statistical analyses were performed using IBM SPSS statistics version 23.0 for Windows (IBM Corp., Armonk, NY, USA).

## Results

### Study population

The 4,000 participants comprised 2,035 (50.9%) men and 1,965 (49.1%) women, with 717 (17.9%), 717 (17.9%), 874 (21.8%), 924 (23.1%) and 768 (19.2%) of the participants aged 20–29, 30–39, 40–49, 50–59, and 60–69 years, respectively.

The residential areas were Seoul (19.2%), Gyeonggi/Gangwon (35.3%), Daejeon/Chungcheong (10.5%), Daegu/Gyeongbuk (9.5%), Busan/Gyeongnam (15%), and Gwangju/Jeonla/Jeju provinces (10.6%). Among the participants, 58.8% were married, 35.9% were unmarried, and 5.6% were divorced/widowed. Employed participants comprised 71.3%, while 28.7% were unemployed. Of those employed, 90.5% were daytime workers, 7.2% were shift workers, and 2.3% were night workers. The percentages of the participants with monthly incomes of < 1600, 1600–2399, 2400–3199, 3200–3999, 4000–4799, 4800–5599, and > 5600 United States dollar (USD) were 12.9%, 16.7%, 17.1%, 15.6%, 11.9%, 8.9%, and 16.9%, respectively (Table 1). The sex, age, economic status, and place-of-residence distributions of the study participants were representative of the general Korean adult population.

## Prevalence of insomnia and associated characteristics

Of the 4,000 participants, 32.9% ( $n = 1316$ ) complained of insomnia; the prevalence was significantly higher in women than in men (37.3% versus 28.6%,  $p < 0.001$ ), across all age groups. Among men, the prevalence was the highest in those aged 20–29 years, while among women, it was in those aged 30–39 years, and showed a decreasing tendency with age ( $p < 0.001$ ) (Table 1 and Fig. 1). Difficulty initiating sleep, occurring more than twice a week, was reported by 25.6% of the participants (30.3% among women and 21.0% among men), with showing highest prevalence in their twenties (27.8% in men and 38.9% in women). Difficulty maintaining sleep occurred more than twice a week in 22.7% of the participants (25.1% among women and 20.3% among men). Among women, those in their thirties had the highest prevalence (29.7%), while among men, those in their sixties had the highest prevalence (24.0%) (Fig. 2). Moderate to severe insomnia was reported by 12.9% of the participants (13.9% among women and 11.9% among men). Among men, 20–29 years age group had the highest prevalence (16.2%), whereas among women, 60–69 years age group had the highest prevalence (13.6%) (Fig. 3).

The prevalence of insomnia decreased significantly with age ( $p < 0.001$ ), peaking at 37.9% at 20–29 years of age, and was higher among unmarried individuals (38.1%,  $p < 0.001$ ). Additionally, night workers (39.4,  $p = 0.013$ ) and those with low monthly income ( $p = 0.030$ ) showed significantly higher of insomnia compared with others; interestingly, it did not differ with the place of residence and employment status. Sleep latency and total sleep time were also showed significant correlation (Table 1).

Multivariate logistic regression revealed that the prevalence of insomnia was associated with being female (OR 1.526,  $p < 0.001$ ), unmarried (OR 1.256,  $p = 0.043$ ), night workers (OR 1.561,  $p = 0.003$ ), smoking (OR 1.267,  $p = 0.04$ ) (Table 2).

Additionally, 87 (6.6%) of the 1,316 participants with insomnia symptoms (2.2% of total participants) were currently being treated for insomnia. Further, Internet/social media was analyzed. High prevalence of Internet/social media use was characteristic of the younger age group, and 80% of the 4000 participants answered that watching digital media or TV before going to sleep interfered with sleep.

## Prevalence of EDS

Among the 4000 participants, 510 (12.8%) complained of EDS, with higher prevalence in men (14.7%) than in women (10.7%,  $p < 0.001$ ). Among both men and women, those in their thirties showed the highest EDS (15.3% and 20.0%) (Fig. 4). The prevalence of EDS decreased

significantly with age ( $p < 0.001$ ), peaking at 17.7% in individuals aged 30–39 years. Unmarried (16.0%,  $p < 0.001$ ) and employed (13.8%,  $p = 0.011$ ) individuals and those with lower income ( $p = 0.013$ ) showed significantly higher EDS. However, it did not differ with the place of residence or working pattern. Additionally, alcohol consumption showed a significant correlation with EDS (33.5%,  $p < 0.001$ ), sleep latency and total sleep time during weekday also had significant relationships (Table 1). Multivariate logistic regression revealed that the prevalence of EDS was negatively associated with 50–59 (OR 0.604,  $p = 0.007$ ) and 60–69 (OR 0.672,  $p = 0.047$ ) years age groups, and positively associated with male sex (OR 1.333,  $p = 0.013$ ) and being employed (OR 1.292,  $p = 0.036$ ) (Table 3).

## Discussion

COVID-19 pandemic has caused significant psychological, social, and medical issues. To our knowledge, this study is the first to investigate sleep disturbances during the COVID-19 pandemic in the Korean general population.

The findings suggest that one in three adults (32.9%) has insomnia; difficulty initiating and maintaining sleep at least two nights per week occurred in 25.6% and 22.7% of the participants, respectively. Compared with previous findings in Korea in 2009 (22.8%) [5], overall insomnia increased by one and half times with COVID-19, and difficulty initiating sleep and maintaining sleep dramatically increased by three and two times, respectively.

Similar tendency for the increase could be seen in other countries. In an online survey in the Greek population during the COVID-19 pandemic, 37.6% of the participants scored above the cut-off for insomnia [10]. According to a study which conducted self-design questions related to the COVID-19 outbreak of 1563 participants in China, 36.1% participants had insomnia symptoms according to the Insomnia Severity Index (ISI) (total score  $\geq 8$ ) [14], also the prevalence rate of insomnia was consistent with 37% in Hong Kong during severe acute respiratory syndrome (SARS) epidemic [15]. Additionally, a systematic review and meta-analysis estimated insomnia prevalence during COVID-19 to be 38.9% [16], which is high compared to the prevalence of 10–30% before the pandemic [3, 4]. These results showed interesting aspects of the pandemic related to sleep health. Stress levels increased during the outbreak of the virus due to concerns about health, financial consequences, social life, and changes in daily living. Reduced physical fatigue, increased sunlight exposure, and increased use of electronic devices can also negatively affect sleep health.

The prevalence of insomnia increased more steeply in women, compared with a previous epidemiologic study in

**Table 1** Participant characteristics and prevalence of insomnia and excessive daytime sleepiness

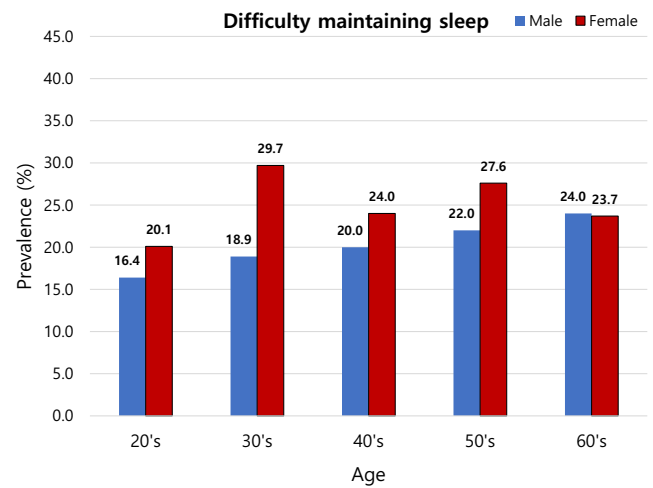
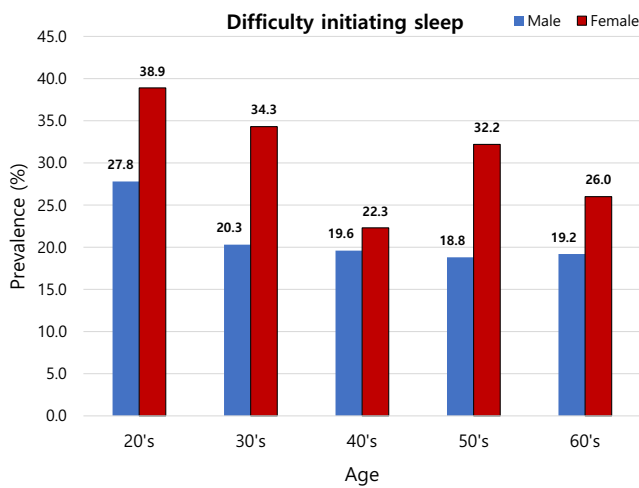
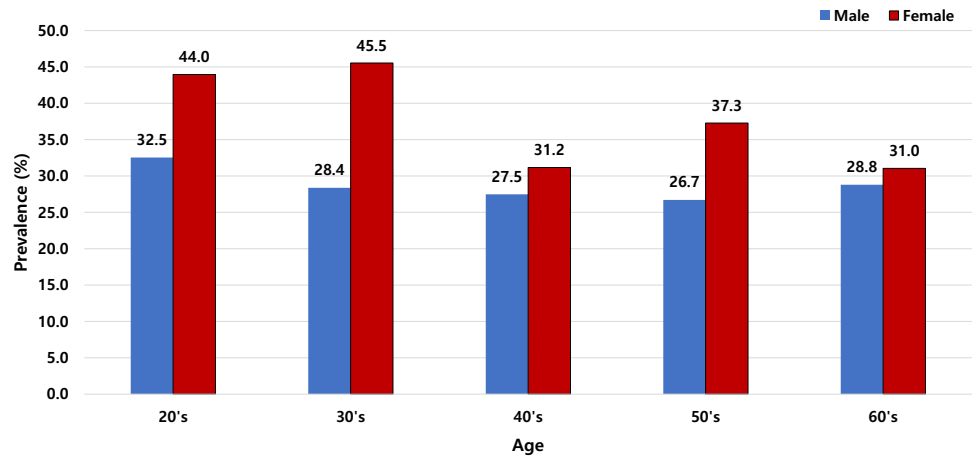
Characteristics	Insomnia	Excessive daytime sleepiness	Total participants
Total	1,316 (32.9)	510 (12.8)	4000 (100)
Sex <sup>*,†</sup>			
Male	583 (28.6)	300 (14.7)	2035 (50.9)
Female	733 (37.3)	210 (10.7)	1965 (49.1)
Age <sup>*,†</sup> (years)			
20–29	272 (37.9)	114 (15.9)	717 (17.9)
30–39	263 (36.7)	127 (17.7)	717 (17.9)
40–49	256 (29.3)	107 (12.2)	874 (21.8)
50–59	295 (31.9)	86 (9.3)	924 (23.1)
60–69	230 (29.9)	76 (9.9)	768 (19.2)
Place of residence			
Seoul	286 (37.3)	117 (15.3)	766 (19.2)
Gyeonggi/Gangwon	479 (33.9)	174 (12.2)	1423 (35.3)
Daejeon/Chungcheong	132 (31.5)	55 (13.1)	419 (10.5)
Daegu/Gyeongbuk	116 (30.5)	35 (9.2)	380 (9.5)
Busan/Gyeongnam	181 (30.3)	73 (12.2)	598 (15)
Gwangju/Jeolla/Jeju	122 (28.8)	56 (13.2)	424 (10.6)
Marital status <sup>*,†</sup>			
Married	690 (29.5)	262 (11.2)	2338 (58.5)
Unmarried	548 (38.1)	230 (16.0)	1437 (35.9)
Divorced/Widowed	78 (34.7)	18 (8.0)	225 (5.6)
Employment status <sup>†</sup>			
Employed	921 (32.3)	388 (13.6)	2852 (71.3)
Unemployed	395 (34.4)	122 (10.6)	1148 (28.7)
Working pattern <sup>*</sup>			
Day work	812 (31.5)	356 (13.8)	2581 (90.5)
Shift work	83 (40.5)	26 (12.7)	205 (7.2)
Night work	26 (39.4)	6 (9.1)	66 (2.3)
Monthly income (USD) <sup>*,†</sup>			
< 1600	198 (38.3)	65 (12.6)	517 (12.9)
1600–2399	250 (37.4)	105 (15.7)	669 (16.7)
2400–3199	218 (31.9)	93 (13.6)	683 (17.1)
3200–3999	184 (29.6)	75 (12.0)	622 (15.6)
4000–4799	147 (30.8)	61 (12.8)	477 (11.9)
4800–5599	112 (31.5)	21 (5.9)	355 (8.9)
> 5600	207 (30.6)	90 (13.3)	677 (16.9)
Alcohol consumption <sup>†</sup>	903 (33.5)	367 (13.6)	2694 (67.4)
Smoking	298 (36.3)	131 (16.0)	821 (20.5)
Weekday			
Sleep latency (minutes) <sup>*,†</sup>	44.7 ± 32.6	33.7 ± 30.4	30.6 ± 26.6
Total sleep time (minutes) <sup>*,†</sup>	384 ± 89	388 ± 86	397 ± 78
Weekend			
Sleep latency (minutes) <sup>*,†</sup>	49.0 ± 34.2	37.1 ± 31.7	34.2 ± 29.1
Total sleep time (minutes) <sup>*</sup>	448 ± 102	460 ± 105	457 ± 90

Data are presented as number (%)

USD United States dollar

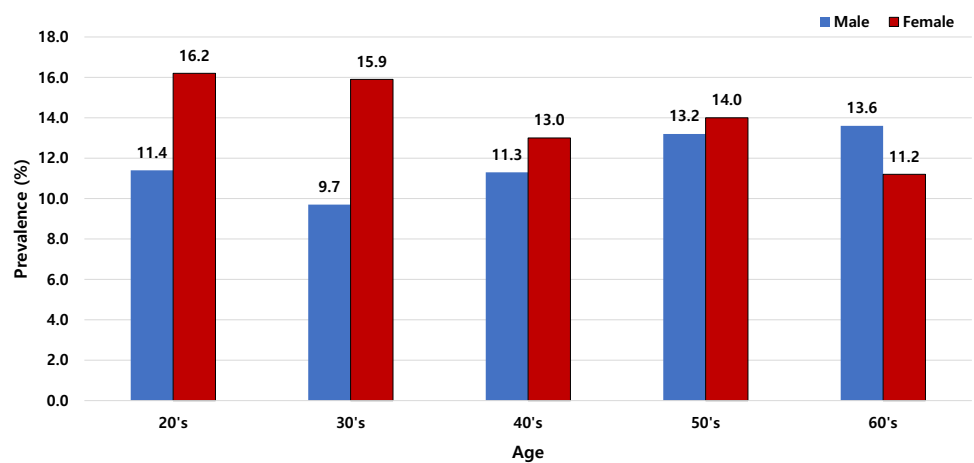
\* $p < 0.05$  for insomnia, † $p < 0.05$  for excessive daytime sleepiness

**Fig. 1** Prevalence of insomnia in the Korean population according to age



**Fig. 2** Prevalence of difficulty initiating sleep and difficulty maintaining sleep according to age

**Fig. 3** Prevalence of moderate to severe insomnia. Insomnia severity index (ISI) score  $\geq 15$  indicates moderate to severe insomnia



Korea [5]; additionally, women were found more vulnerable to depression, stressful incidents, post-traumatic stress, and psychological distress including anxiety [17, 18].

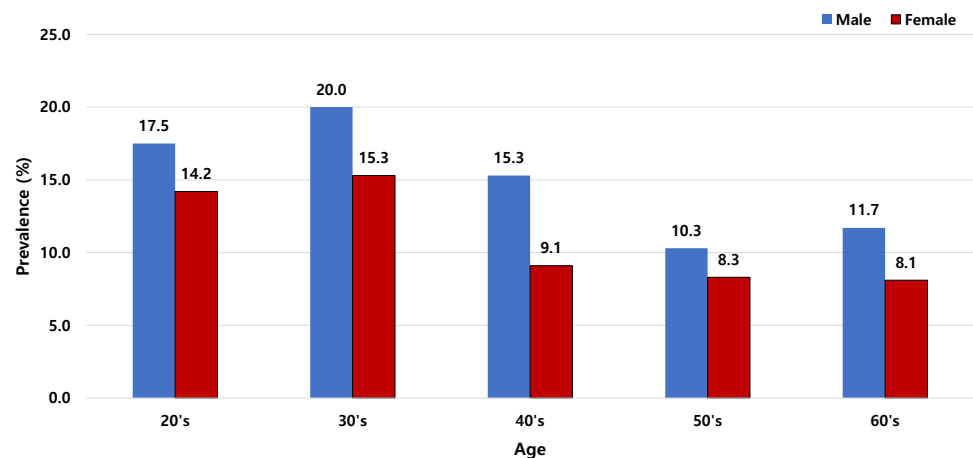
In addition, previous studies showed that the prevalence of insomnia increased with age [5], but in our study, it was confirmed that the prevalence of insomnia was high in

**Table 2** Factors associated with insomnia: results of multivariate analysis

	B	OR	95% CI	P
Sex (reference: male)				
Female*	0.423	1.526	1.297–1.796	<0.001
Age (years) (reference: 20–29)				
30–39	0.046	1.047	0.765–1.433	0.773
40–49	0.059	1.061	0.829–1.358	0.638
50–59	–0.185	0.831	0.659–1.049	0.119
60–69	–0.030	0.971	0.748–1.259	0.822
Marital status (reference: married)				
Unmarried*	0.228	1.256	1.007–1.566	0.043
Divorced/widowed	–0.032	0.968	0.678–1.382	0.859
Working pattern (reference: day work)				
Shift work	0.322	1.380	0.829–2.299	0.216
Night work*	0.445	1.561	1.160–2.101	0.003
Monthly income (USD; reference: < 1600)				
< 1600	0.011	1.011	0.726–1.409	0.946
1600–2399	–0.199	0.820	0.583–1.154	0.254
2400–3199	–0.298	0.742	0.523–1.053	0.095
3200–3999	–0.239	0.788	0.545–1.138	0.203
4000–4799	–0.123	0.884	0.601–1.301	0.532
4800–5599	–0.261	0.770	0.547–1.083	0.133
Alcohol consumption (reference: non-alcoholics)	–0.276	0.759	0.555–1.037	0.083
Smoking (reference: non-smoker)*	0.237	1.267	1.011–1.587	0.04

CI confidence interval, OR odds ratio, USD United States dollar

\* $p < 0.05$

**Fig. 4** Prevalence of excessive daytime sleepiness. Epworth sleepiness scale (ESS) score  $\geq 11$  indicates excessive daytime sleepiness

people in their 20s and 30s. The authors assessed the reason for the high prevalence of insomnia among young people. First, the increase in telecommuting due to the pandemic may have caused insomnia due to reduced physical activity during the day. Second, it may be caused by economic difficulties due to job insecurity due to the pandemic. Lastly, the tendency to go to bed late due to excessive use of smartphones in bed may be the cause.

Interestingly, although 32.9% of the participants complained of insomnia, only 87 (6.6%) of the 1,316 participants with insomnia symptoms (2.2% of overall participants) were currently being treated for insomnia. Few studies have assessed the treatment rate of insomnia worldwide. According to a study using health insurance review and assessment service data in 2011, sedatives were prescribed to 1.5% of the general population [19]; therefore, on comparing with

**Table 3** Factors associated with excessive daytime sleepiness: results of multivariate analysis

	B	OR	95% CI	P
Sex (reference: male)				
Male*	0.288	1.333	1.062–1.674	0.013
Age (years) (reference: 20–29)				
30–39	0.109	1.115	0.820–1.515	0.488
40–49	– 0.259	0.772	0.550–1.084	0.134
50–59*	– 0.505	0.604	0.418–0.871	0.007
60–69*	– 0.397	0.672	0.454–0.995	0.047
Marital status (reference: unmarried)				
Married	– 0.113	0.893	0.686–1.163	0.403
Divorced/widowed	– 0.441	0.643	0.373–1.109	0.112
Employment status (reference: unemployed)				
Employed*	0.256	1.292	1.017–1.641	0.036
Monthly income(USD; reference: < 1600)				
1600–2399	0.149	1.160	0.822–0.1639	0.398
2400–3199	0.029	1.029	0.721–0.1470	0.873
3200–3999	– 0.079	0.924	0.635–1.345	0.681
4000–4799	– 0.022	0.978	0.657–1.456	0.912
4800–5599	– 0.811	0.444	0.261–0.756	0.003
1600–2399	0.029	1.030	0.713–0.713	0.875
Alcohol consumption (reference: non-alcoholics)	– 0.299	0.741	0.481–1.142	0.175
Smoking (reference: non-smoker)	0.105	1.111	0.829–1.489	0.48

CI confidence interval, OR odds ratio, USD United States dollar

\* $p < 0.05$

the increased prevalence after the pandemic, the treatment rate is still estimated to be low.

Treatment for insomnia includes sleep hygiene education, pharmacological treatments, and cognitive behavioral therapy. The reason why participants with symptoms of insomnia did not receive treatment could be attributed to several factors. First, the guidelines for social distancing during the COVID-19 pandemic made it difficult to access medical care. Second, there was a fear of transmitting COVID-19 when visiting medical facilities. Third, the actual pandemic led to unemployment, which may have reduced the perceived need for treating insomnia, and lastly, the high prevalence of insomnia among young people may have led to a less serious perception of its risks and a lack of awareness of the need for treatment.

According to our results, the prevalence of insomnia and EDS is higher in younger age groups. These results are contrary to those of previous studies and may be interpreted as a special phenomenon related to the pandemic. There are several possible reasons why EDS is highly observed among young age groups. First, it is the increase in telecommuting due to the pandemic has led to an increase in daytime sleepiness, multivariate analysis suggests that the employed group is more likely to EDS compared to the unemployed group. Second, the decrease in outdoor activities due to social distancing measures among young people, prolonged indoor living, and increased mobile phone usage may lead

to an increase in insomnia, which in turn could cause an increase in EDS the following day. The prevalence of EDS in Korea is 12.8%, and significantly higher in men (14.7%) than in women. These findings are consistent with previous studies in Korea and other countries [6, 20, 21]. Unlike insomnia, EDS was not significantly affected by the COVID-19 pandemic; previous studies have shown that EDS was predominantly affected by habitual snoring or sleep related problems [22].

The strengths of our study include the recruitment of a representative sample with a broad age range, and the use of validated questionnaires. However our study had several limitations. First, the diagnosis of insomnia did not conform to all of the diagnostic criteria for insomnia given in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition. However, the two predominant components of insomnia, difficulty in initiating sleep and difficulty in maintaining sleep, were considered. Second, not all symptoms associated with insomnia, such as depression, anxiety, and memory impairment, were surveyed. Third, even if the study is representative of the Korean population considering most factors, due to the preference for healthy older adults in online surveys, the prevalence of insomnia and EDS may have been slightly lower compared to other studies. Additionally, young individuals who use more harmful media may have had a higher motivation to participate.

In conclusion, research on insomnia and EDS during the pandemic is scarce. Our study demonstrated an increased prevalence of insomnia during the COVID-19 pandemic. Women in their twenties and thirties, unmarried individuals, night workers, and those with low monthly incomes were more susceptible to insomnia. These findings may contribute to the management of insomnia during the COVID-19 pandemic in Asian populations. As insomnia is known to have adverse health effects, the aforementioned aspects need to be considered from a public health perspective.

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## Declarations

**Conflict of interest** This is not an industry supported study. None of the authors have potential conflicts of interest to be disclosed. All authors have seen and approved the manuscript.

**Ethics approval** This study was approved by the Institutional Review Board of the Dongsan Medical Center (IRB No. 2021-12-063). All participants provided written informed consent.

**Research involving human and animal participants** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by any of the authors.

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