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Does risk of obstructive sleep apnea have interaction with chronic facial pain?

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Abstract (J Korean Assoc Oral Maxillofac Surg 2022;48:277-283)

Objectives: The main purpose of the present study was to investigate the associations between the risk of obstructive sleep apnea (OSA) and chronic orofacial pain in a nationally representative sample of the Korean population.

Materials and Methods: Data from the 8th wave Korean national health and nutrition examination survey, which was conducted from 2019 to 2020 were analyzed. This study included 5,780 Koreans (2,503 males, 3,277 females) over 40 years of age. The presence of subjective chronic facial pain lasting more than 3 months was evaluated based on a self-reported questionnaire. The risk of OSA was determined using the STOP-BANG questionnaire. Data related to anthropometric and sociodemographic factors; diagnostic history of hypertension, depression, and OSA; level of health-related quality of life and stress awareness; health-related behaviors, including smoking and alcohol drinking; and sleep duration were collected. The participants were classified into two groups according to the presence of chronic facial pain.

Results: The level of health-related quality of life and stress awareness showed significant differences between the two groups. The sleep duration on weekends also presented significant differences. No significant differences were observed in the presence of snoring and observed apnea, while participants with chronic facial pain showed significantly higher levels of tiredness between the groups. The risk of OSA evaluated by STOP-BANG questionnaire showed significant differences between groups; however, the risk of OSA seemed to be higher in participants without chronic facial pain.

Conclusion: The participants with chronic facial pain demonstrated decreased sleep duration, lower health-related quality of life, and increased stress and tiredness. Even though, the role of OSA in the development of chronic facial pain was inconclusive from the study, it is possible that ethnicity play a role in relationship between OSA and chronic facial pain.

Key words: Obstructive sleep apnea, Sleep, Insomnia, Pain

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I. Introduction

Obstructive sleep apnea (OSA), the most prevalent chronic sleep-related breathing disorder is characterized by an intermittent or complete collapse of the upper airway during sleep with a reduction and/or cessation of airflow[1]. OSA has been associated with diverse comorbidities such as cognitive impairment, attention deficit, cardiovascular diseases, depression, and an increased risk of all-cause mortality[2-5]. Therefore, early diagnosis and prompt management of OSA are essential for reducing the risk of complications and their sequalae. Overnight full-channel polysomnography (PSG) has been considered the gold standard for diagnosing OSA[6]. However, PSG requires a special sleep laboratory equipped with diverse monitoring devices, and the interpretation of PSG data requires trained personnel. Therefore, applying PSG to all patients with suspected OSA is difficult in routine clinics and developing screening tools or questionnaires utilizing the clinical features of suspected OSA patients is necessary for the easy and early detection of OSA. Several questionnaires have been developed such as the Berlin and STOP-BANG questionnaires.

The STOP-BANG questionnaire, a widely used screening tool for OSA comprises four questions to assess snoring, tiredness, observed apnea, and blood pressure and four

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questions to evaluate OSA-related factors including obesity, age, neck circumference, and gender[7]. Owing to its concise and user-friendly format, it has been one of the most popular screening tools for OSA and also shows higher diagnostic sensitivity than the Berlin questionnaires in Korean populations[8].

The bi-directional relationship between chronic pain disorders and OSA has been proposed in several reports, previously[9-12]. However, sparse high-quality evidence has attempted to reveal the associations between OSA and chronic orofacial pain. The increased prevalence ratio of the likelihood of OSA in patients with temporomandibular disorders (TMDs) compared to those in normal controls has been detected in several cross-sectional studies[13-15]. According to a cross-sectional study, 36% of patients with TMDs seemed to have insomnia, and over 28% of patients with TMD appeared to have OSA[15]. On the other hand, 51% of suspected OSA patients showed signs and symptoms of TMD compared to controls[14]. A long-term cohort study proposed that OSA would be a risk factor for the occurrence of first onset TMD[16]. Majorities of studies were performed in the United States and no study has ever conducted in Asian populations with a community-based study design.

The Korea National Health and Nutrition Examination Survey (KNHANES) performed by the Korean Center for Disease Control and Prevention which annually monitors the sociodemographic features, nutritional status, and general, psychological, and oral health status of the South Korean population includes a relatively large number of samples. The KNHANES data could provide valid and meaningful results owing to large number of samples from the authorized institution. Hence, the main purpose of the present study was to investigate the associations between the risk of OSA and chronic orofacial pain in a nationally representative sample of the Korean population.

II. Materials and Methods

1. Participants

This study used the data obtained from the 8th wave, 2019-2020 KNHANES, a nationally representative survey conducted by the Korean Center for Disease Control and Prevention. This study enrolled 5,780 Korean adults (2,503 males, 3,277 females; mean age 62.0±12.0 years; age range, 40-80 years) over 40 years of age. Because STOP-BANG was only to be conducted with participants over 40 years of age, according to the definition, participants over 40 years of age were included in the analysis. A stratified, multistage, and clustered probability approach was applied to enroll a representative sample from the population. The survey comprise a nutritional survey, individual interviews, and a health examination survey. Data were obtained through household interviews from direct standardized physical examinations. Trained interviewers performed the interviews using structured questionnaires.

The participants were classified into two groups according to the presence of chronic facial pain and/or tenderness lasting more than 3 months, which was determined by a self-administered questionnaire. Subjective facial pain and/or tenderness was classified as follows: no discomfort; or a problem.

Written informed consents were obtained from all participants following approval from the Institutional Review Board of the Korean Center for Disease Control and Prevention. The ethical approval of this research protocol was exempt by the Institutional Review Board of Ajou University Hospital (No. AJOUIRB-EX-2022-373).

2. Anthropometric assessment

All participants wore uniform light gowns without shoes, and trained examiners assessed their weight (kg) and height (cm). Body mass index (BMI) was determined. The circumferences of the waist (cm) and neck (cm) were also assessed by trained staff.

3. Sociodemographic factors and health-related behaviors

Data related to sociodemographic factors, such as household income and educational level; diagnostic history of hypertension, depression, and OSA; level of health-related quality of life; and awareness of stress; health-related behaviors including smoking and alcohol drinking; and sleep duration during weekdays and weekends were assessed by self-administered questionnaires from the 2019-2020 KNHANES. The degree of household income was adjusted for the number of household members and divided into the following four different quartiles; <25% (the lowest quartile), 25%-49%, 50%-74%, and 75%-100% (the highest quartile). The education level was also divided into four levels based on the Korean education system: below elementary, middle school, high school, and over college education.

The degree of health-related quality of life was assessed

using the Euro-Quality of Life-5 Dimension index (EQ-5D) score, which comprises five aspects, including mobility, self-care, usual activities, pain or discomfort, and anxiety or depression. The levels of stress awareness were divided into following four groups; very high, high, moderate, and low.

Cigarette smoking was categorized into the following three groups: nonsmokers, smokers who have smoked at least five packs in their entire lives, and smokers who currently smoke and have smoked over five packs in their entire lives. Alcohol drinking was classified into the following two groups; none or light drinker (0-3 days/month) and moderate to heavy drinker (>4 days/month).

4. STOP-BANG and duration of sleep

The STOP-BANG comprises eight items by scoring 1 point each, including snoring, tiredness, observed stopping breathing, blood pressure, BMI, age (>50 years), neck circumference (>17 inches for males, >16 inches for females), and sex (male). Of the total of 8 points, 0-3 points were classified as a low-risk group, 4-5 points as a moderate-risk group, and over 6 points were as a high-risk group. Sleep duration during weekdays and weekends and diagnostic history of OSA were assessed using self-administered questionnaires from the 2019-2020 KNHANES.

5. Statistical analysis

Statistical analysis was performed using IBM SPSS Statistics (ver. 25; IBM, Armonk, NY, USA).

All statistical analyses were conducted using a complicated design including stratification, clustering and weighting. Sample weights were constructed for sample participants to represent the Korean population by accounting for the complex survey design, survey nonresponse, and stratification (according to geographic area, sex, and age). All values were considered significant when $P<0.05$.

Rao-Scott chi-square and independent *t*-tests were used to compare the differences in the anthropometric measurement; sociodemographic factors; diagnostic history of hypertension, depression, and OSA; levels of health-related quality of life; awareness of stress, and health-related behaviors for categorical and continuous variables, respectively according to the presence of chronic facial pain and/or tenderness lasting more than 3 months.

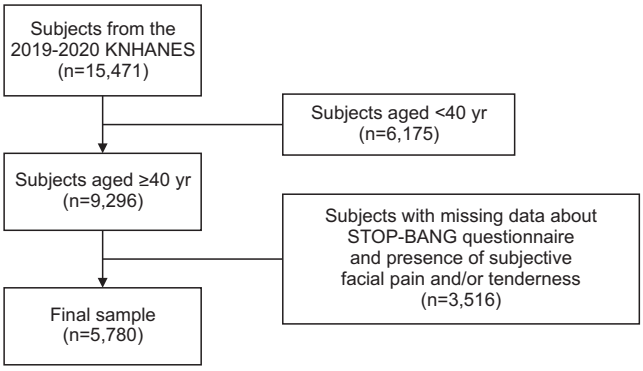

Fig. 1. Flow diagram of the study enrollment. (KNHANES: Korea National Health and Nutrition Examination Survey)
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III. Results

In total 15,471 participants were enrolled in the 8th wave 2019-2020 KNHANES. After excluding subjects who were less than 40 years old and had missing data about the STOP-BANG questionnaire and the presence of subjective facial pain and/or tenderness, a total of 5,780 participants were finally included in the analysis.(Fig. 1) Among them, only 32 patients answered that they had chronic facial pain.

No statistically significant differences were detected in sex distribution, circumference of waist and neck, BMI, levels of household income and education, presence of a diagnostic history of hypertension and depression, and alcohol consumption habits according to the presence of chronic facial pain. On the other hand, the level of health-related quality of life ($P<0.001$), smoking status ($P=0.004$), and level of stress awareness ($P<0.001$) showed significant differences between the two groups.(Table 1)

The duration of sleep on weekends ($P=0.045$) showed significant differences between the two groups; however, the duration of sleep during weekdays showed no significant difference. No participants with chronic facial pain had ever been diagnosed with OSA and the risk of OSA showed significant differences between the groups. However, the risk of OSA seemed to be higher in participants without chronic facial pain ($P<0.001$). No significant differences in snoring and observed apnea were detected between the groups, while participants with chronic facial pain showed significantly higher levels of tiredness ($P=0.002$).(Table 2) Hence, the participants with chronic facial pain did not demonstrated an increased risk of OSA, but decreased sleep time and level of health-related quality of life and an increased level of stress awareness and subjective tiredness were observed in the par-

Table 1. The demographic characteristics of the subjects according to masticatory difficulty

Variable	Total	Facial pain and/or pressure				*P*-value
		No		Yes		
		n	% (95% CI) or mean±SE	n	% (95% CI) or mean±SE	
Age	5,780					0.240
>50 yr		4,448	73.9 (72.4-75.3)	20	0.4 (0.2-0.6)	
≤50 yr		1,300	24.0 (22.6-25.5)	12	39.5 (22.3-59.7)	
Sex (male/female)	5,780					0.978
Male		2,491	43.4 (41.9-44.9)	12	41.6 (24.0-61.6)	
Female		3,257	56.6 (55.1-58.1)	20	58.4 (38.4-76.0)	
Waist circumference[1] (cm)	5,768	5,736	85.7±0.2	32	85.7±1.7	0.724
Neck circumference (cm)	5,754					0.605
>17 inch for males, >16 inch for females		53	0.9 (0.7-1.2)	0	0	
≤17 inch for males, ≤16 inch for females		5,669	99.1 (98.8-99.3)	32	100.0 (100.0-100.0)	
BMI	5,719					0.752
BMI >35 kg/m^2		30	0.4 (0.3-0.7)	0	0	
BMI ≤35 kg/m^2		5,657	99.6 (99.3-99.7)	32	100.0 (100.0-100.0)	
Household income	5,762					0.521
<25%		1,256	17.2 (16.1-18.3)	8	23.8 (10.8-44.7)	
25%-49%		1,439	23.6 (22.4-25.0)	6	21.3 (8.6-43.9)	
50%-74%		1,470	28.0 (26.7-29.4)	5	17.0 (6.6-37.2)	
≥75%		1,565	31.2 (29.7-32.7)	13	37.9 (21.4-57.8)	
Education	5,727					0.613
≤Primary school		1,338	17.9 (16.9-18.9)	8	17.4 (7.9-33.9)	
Middle school		723	10.8 (9.9-11.7)	2	7.0 (1.2-30.8)	
High school		1,876	35.4 (34.0-36.9)	12	47.2 (28.4-66.9)	
≥College or higher		1,758	35.9 (34.5-37.4)	10	28.4 (15.1-47.0)	
Hypertension	5,783					0.056
Yes		1,937	29.8 (28.5-31.2)	9	24.6 (12.0-43.9)	
No		3,814	70.2 (68.8-71.5)	23	75.4 (56.1-88.0)	
Depression	5,780					0.085
Yes		321	4.8 (4.2-5.4)	5	13.0 (5.0-30.1)	
No		5,427	95.2 (94.6-95.8)	27	87.0 (69.9-95.0)	
EQ-5D index[1]	5,780	5,748	0.990±0.001	32	1.000±0.001	<0.001**
Awareness of stress	5,776					<0.001**
Very high		215	3.7 (3.2-4.4)	6	25..9 (11.8-47.6)	
High		1,118	20.2 (19.0-21.5)	10	37.3 (19.9-58.6)	
Moderate		3,409	60.8 (59.3-62.2)	12	27.6 (14.7-45.9)	
Low		1,002	15.2 (14.2-16.2)	4	9.2 (3.0-25.3)	
Smoking status	5,778					0.004*
Never of former		3,466	98.2 (97.6-98.7)	17	0.4 (0.3-0.7)	
≤5 packs		87	1.7 (1.3-2.1)	0	0	
≥5 packs		2,193	41.5 (40.0-43.0)	15	59.6 (40.6-76.1)	
Alcohol consumption	5,778					0.253
None or light		827	11.6 (10.7-12.5)	4	5.2 (1.6-15.8)	
Moderate or heavy		4,919	88.4 (87.5-89.3)	28	94.8 (84.2-98.4)	

(BMI: body mass index, EQ-5D: Euro-Quality of Life-5 Dimension, %: weighted percentage by column, CI: confidential interval, SE: standard error)

*P<0.05, **P<0.001.

[1]Data obtained from independent t-test.

Data obtained from Rao-Scott chi-square test.

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ticipants with chronic facial pain.

IV. Discussion

Previous studies have highlighted the bi-directional relationship between OSA and chronic facial pain conditions, particularly painful TMD[13-16]. A long-term cohort study suggested OSA as a risk factor for TMD, and other cross-sectional studies suggested an increased prevalence of OSA in patients with TMD. There has been only one community-based study[16] and majorities of the study on this topic were hospital-based studies[12-15]. No community-based studies targeting Asian populations have ever been attempted. Therefore, the aim of the present study was to reveal the relationship between OSA and chronic facial pain in the Korean population using data from the 8th wave, 2019-2020 KNHANES.

Table 2. Sleep duration and risk of obstructive sleep apnea (OSA)

Variable	Total	Facial pain and/or pressure				*P*-value
		No		Yes		
		n	% (95% CI) or mean±SE	n	% (95% CI) or mean±SE	
Average sleep duration during weekdays (hr)[1]	5,780	5,748	6.63±0.06	32	6.10±0.27	0.074
Average sleep duration during weekends (hr)[1]	5,780	5,748	7.14±0.06	32	6.44±0.33	0.045*
Diagnosis of OSA	5,780					0.021*
Yes		32	0.6 (0.4-0.9)	0	0	
No		5,716	99.4 (99.1-99.6)	32	100.0 (100.0-100.0)	
STOP-BANG	5,701					<0.001**
Low risk		3,513	62.8 (61.3-64.3)	26	82.0 (64.0-92.1)	
Moderate risk		1,932	33.3 (31.9-34.8)	6	18.0 (7.9-36.0)	
High risk		224	100.0 (100.0-100.0)	0	0	
Snoring	5,780					0.618
Yes		1,097	20.2 (18.9-21.6)	7	26.2 (12.2-47.7)	
No		4,651	79.8 (78.4-81.1)	25	73.8 (52.3-87.8)	
Tiredness	5,780					0.002*
Yes		1,719	30.0 (28.6-31.5)	17	59.1 (39.7-76.0)	
No		4,029	70.0 (68.5-71.4)	15	40.9 (24.0-60.3)	
Observed apnea	5,780					0.405
Yes		491	9.5 (8.6-10.6)	6	17.3 (7.2-36.1)	
No		5,257	90.5 (89.4-91.4)	26	82.7 (63.9-92.8)	

(%: weighted percentage by column, CI: confidential interval, SE: standard error)
*P<0.05, **P<0.001.
[1]Data obtained from independent t-test.
Data obtained from Rao-Scott chi-square test.
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Even though, previous reports suggested potential relationships between OSA and orofacial pain[10,12-16], their associations could not be confirmed in this study. This study could not deduce the exact relationship between orofacial pain and OSA because, facial pain evaluation was just conducted by self-administered questionnaire, not with valid diagnostic criteria. However, the results from this study could provide important meaning to clinicians and researchers in the Asian population interested in pain modulating mechanisms. It can be postulated that the ethnic differences may play a role in the relationship between OSA and chronic orofacial pain modulation mechanisms.

The aforementioned results demonstrated that participants with chronic facial pain had shorter sleep durations, particularly during weekends than those without chronic facial pain. Because, sleep during weekdays could be influenced by diverse factors, including work, school and so on, sleep duration during weekends would be more valid factors to determine quality of the sleep. The association between insomnia and facial pain has been demonstrated, previously[15-19]. Patients with both TMD and insomnia with objective short sleep duration endorsed higher self-reported pain severity and functional limitation of the jaw[17] and the prevalence of primary insomnia was higher in patients with myofascial TMD compared to that in controls[15]. Reducing total sleep time could affect pain severity and morning pain expectancy[18]. Moreover, an eight-year cohort study suggested that primary sleep disorder could be an important independent risk factor for the initiation and maintenance of TMD[19], and treatment of underlying insomnia could result in improved chronic orofacial pain[20]. Hence, sleep deprivation may interact with the perception of chronic facial pain; however, the role of OSA in the development of chronic facial pain could not be assumed from this study.

The results from this study presented that participants with chronic facial pain presented higher levels of tiredness and stress. Even though, daytime tiredness is a well-known sign of OSA, the relationship between daytime tiredness and the risk of OSA could not be derived from the present study. Chronic fatigue is considered as one of the most common comorbidities of orofacial pain disorders[21-23]. Greater fatigue appears to be related to a higher level of pain-related interference and could worsen pain outcomes in patients with chronic painful TMD[22]. The above results may support this phenomenon that a higher prevalence of fatigue and tiredness would have interactions with chronic facial pain conditions, but their interactions with OSA seems obscure.

To the best of our knowledge, this study is the first attempt to reveal the association between chronic facial pain and OSA in community-based Korean populations with a large sample

size. However, the present study has several limitations. First of all, no valid and widespread diagnostic criteria for chronic facial pain evaluation were applied such as Research Diagnostic Criteria for TMD or Diagnostic Criteria for TMD. The significance of the results would inevitably be compromised owing to lack of information about the objective evaluation of facial pain. Secondly, due to the retrospective cross-sectional study design, the causal relationships between OSA and chronic facial pain could not be derived. Finally, compared to the prevalence rate of facial pain or TMD from previous reports, a small number of participants with chronic facial pain seemed to be included in this study[24,25]. Further long-term cohort studies with valid diagnostic criteria for OSA and chronic facial pain are required.

V. Conclusion

The participants with chronic facial pain demonstrated decreased sleep time and health-related quality of life and increased levels of stress and tiredness. However, the relationships between OSA and development and maintenance of chronic orofacial pain seemed to be inconclusive and the role of ethnicity should be considered in this topic.

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Authors' Contributions

J.H.K. and J.K.L. participated in conception and design of the study. J.H.K. analysis the data and performed statistical analysis. J.H.K. and J.K.L. wrote the manuscript. J.H.K. and J.K.L. edited and finally approved the manuscript. All authors approved the final version of the manuscript.

Ethics Approval and Consent to Participate

The ethical approval of this research protocol was exempt by the Institutional Review Board of Ajou University Hospital (No. AJOUIRB-EX-2022-373). Written informed consents were obtained from all participants following approval from the Institutional Review Board of the Korean Center for Disease Control and Prevention.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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