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Original Article

# Association between Sasang constitutional types with obesity factors and sleep quality

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ABSTRACT

*Background:* The purpose of this study was to investigate differences in obesity factors according to Sasang constitutional types and quality of sleep among Korean female college students.

*Methods:* Surveys using Sasang-types questionnaires(QSCCII) and quality of sleep questionnaires(PSQI; Pittsburgh Sleep Quality Index) were conducted with 339 Korean female college students. Additionally, obesity factors, including weight, fat mass, fat percent, abdominal fat percent, body mass index (BMI) and obesity rates were measured. All data analyses were performed using one-way ANOVA and two-way ANOVA.

*Results:* The interaction between Sasang types and quality of sleep was presented in the quality of sleep status, subjective quality of sleep (domain 1), sleep duration (domain 3) and sleep disturbance (domain 5). Variables with interaction effects had significant differences in terms of obesity factors between groups with different quality of sleep according to the Sasang types. Moreover, significant differences in obesity factors between different Sasang types according to the quality of sleep were also observed.

*Conclusion:* This study characterized the reduction effect of improvement in quality of sleep on the fat mass of So-Yang type individuals and obesity factors in Tae-Eum type individuals. The results of this study will be used in improving sleep quality according to the Sasang types.



## 1. Introduction

The importance of sleep is emphasized as a health factor along with exercise habits and eating habits.[1] Sleep is a basic need that plays an important role in human recovery from fatigue.[2] Sleep recharges physical and mental health and has a positive effect on daily life.[3] Moreover, Song IB[4] suggests that sleep is an indicator for managing constitutional diseases, in addition to perspiration, digestion, urination and defecation. The average sleeping time among Koreans is 7 hours, 49 minutes, 33 minutes shorter than that of OECD countries.[5] According to The 2017 Korean Study Of Women's Health

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Related Issues[6] published by the Korea Centers for Disease Control and Prevention (KCDC) of the Ministry of Health and Welfare, Korean women sleep an average of 6.9 hours a day, significantly shorter than other nations'. And the Pittsburgh Sleep Quality Index (PSQI) revealed that 43.7% of respondents had poor sleep quality. Moreover, Korean adolescents (range, 14–17 years old) do not get enough sleep (average of 6.8 hours a day). Sleep shortages in students have been shown to have adverse effects on academic performances by reducing concentration and causing fatigue.[7,8] Hence, some of the schools' starting times have been delayed to 9 AM to ensure students' right to sufficient sleep and overall health.[9] According to the Analysis of Korea's Health Insurance Claims Database by the National Health Insurance Service (NHIS),[10] 414,000 patients received medical care covered by the NHIS due to sleep disorders in 2014, 59.5% were women and 14,423 (3.48%) were female college students in their 20s. Dealing with sleeping problems is important during college since this is the time when an individual' acquires lifestyle habits. Furthermore, 71% of college students have been found to experience a sense of sleep dissatisfaction.[11]

In the 2017 Korean Study of Women's Health Related Issues, in addition to environmentally hazardous substances and environmental pollution, sleep deprivation and obesity have been identified as health-threatening factors subjectively perceived by women.[6] Moreover, previous studies have shown that reduced sleep quality is associated with the incidence of metabolic syndromes,[12–15] and reduction in sleep time is related to increases in obesity,[16–18] In Korea, morbidly obese patients with a BMI of 30 $kg/m^2$ or higher have increased rapidly (approximately 70% from 1998 to 2015). Experts have stated that Korea has become a society with acquired obesity at superfast rates, being a country with one of the fastest growing obesity rate.[19] The number of obese adult women is higher than that of obese adult men, increasing from 69 million in 1975 to 309 million in 2016.[20] The NHIS published The 2017 Obesity White Paper[21] to raise national awareness of (i) the seriousness of obesity as a health condition, (ii) obesity prevention, and (iii) devices designed to support obesity management. Obesity causes cardiovascular disease, hypertension and diabetes.[22] According to the 2017 Obesity White Paper,[21] the risk of hypertension doubles in obese individuals and is 2.7–2.9 times higher in morbidly obese individuals. The risk of diabetes is 2.5–2.6 times higher in obese individuals and increases 4–4.8 times in morbidly obese individuals.[21] Moreover, the annual health care cost of obesity surged to 4.4 trillion won in 2013, a 2.6-fold increase compared with 2005. Medical spending for obesity was highest among obesity, drinking and smoking-related causes (a 2.2-fold higher cost).[21] Therefore, obesity is being recognized as a serious health-threatening problem and not just an appearance issue.[22]

In Korea, there has been a growing interest in health promotion through prevention rather than illness treatment. Sasang typology has drawn attention considering the individuality and diversity among humans.[23] Sasang typology classifies human beings into four Sasang types, namely, Tae-Yang type, Tae-Eum type, So-Yang type and So-Eum type based on personality traits and strengths and weaknesses in functions of the internal organs. Since Sasang types vary in physical, physiological and psychological traits, Sasang typology suggests different causes and diagnosis is of illnesses and regimens for each type.[24]

In previous studies on Sasang typology and obesity, the Tae-Eum type accounted for a large proportion of the people in all obesity factors.[25–28] In contrast, according to a study by Bok-hee You,[29] these Sasang type individuals had a higher body fat percentage and BMI, while a study by Han Chae et al[30–35] reported a high BMI. A study by You-sun Go[36–38]has revealed that Tae-Eum type individuals are prone to obesity because of a large amount of distributed body fat mass. The Tae-Eum type accounts for 70% of patients with adiposity.[39,40] Therefore, many studies have concluded that obesity is found mostly in Tae-eum,[26,27,36–42] and that the amount of weight loss is at its highest when staying on a diet.[39]

In studies on Sasang type individuals and sleep, there was a correlation between sleep regimens and health status according to the Sasang types[43], and there was also a difference in the degree of health status according to the Sasang types and sleeping duration.[44] Of all Tae-Eum type respondents with insufficient amounts of sleep, 55.6% were suffering from insomnia.[45] Eum (So-Eum and Tae-Eum) type individuals have a longer period of sleep and have more dreams while sleeping.[46,47] On the contrary, So-Yang type individuals tend to sleep for shorter durations and dream less,[48] are prone to have sleep deprivation, and sleep disturbance is a major factor that causes fatigue.[49]

Several studies have been conducted out to investigate Sasang types, quality of sleep and obesity factors. You-sun Ko[36] conducted a study on obesity, physical fitness and bone density, and reported that significant differences were found regarding obesity according to the Sasang types and sleep duration. Likewise, only a few studies have been conducted to explore the relationship between sleep and obesity factors according to the Sasang types, and only a single domain such as sleep duration was measured.

In the light of these previous findings, it is anticipated that there are differences in obesity factors according to Sasang types and sleep domains.

Therefore, this study aimed to identify differences in obesity factors according to Sasang types and sleep domains by assessing the Questionnaire for the Sasang typology Classification II (QSCCII), obesity factors, and sleep domains of the Pittsburgh Sleep Quality Index (PSQI).

## 2. Methods

### 2.1. *Subjects*

Study subjects included 339 women out of 488 Korean female college students who responded to the QSCC II and PSQI questionnaires, the remaining subjects were excluded for not completing the questionnaires or measuring obesity properly. All participants were fully informed of the research purposes and consented to participate in the present study. The survey was conducted with the QSCC II and PSQI using self-administration method, wherein obesity factors were evaluated by study investigators. The subjects were classified as follows: So-Yang (112), So-Eum (168) and Tae-Eum (59) type

Table 1 – General Characteristics of Subjects

| Factors | So-Yang ($n = 112$) | So-Eum ($n = 168$) | Tae-Eum ($n = 59$) | Total ($n = 339$) | F-value | Post hoc |
|---|---|---|---|---|---|---|
| Age (year) | 21.57 (.21) | 21.50 (.14) | 21.38 (.20) | 21.50 (.10) | .197 | |
| Height (cm) | 161.58 (.42) | 160.83 (.39) | 162.58 (.73) | 161.39 (.27) | 2.807 | |
| Weight (kg) | 52.21 (.37) | 51.16 (.44) | 61.11 (.97) | 53.24 (.36) | 71.660** | TE > SY > SE |

Data are presented as means (SE). **$p < 0.01$.

students. Since no Tae-Yang type students were found, this type was excluded.

This study was performed with a non-invasive measurement method via simple contact of measurement instrument without any changes in the physical status of the subjects. This study does not include the subjects' personal information.

### 2.2. Study tools and methods

#### 2.2.1. Categorization of Sasang types

Sasang types were categorized using the Questionnaire for Sasang typology Classification II (QSCC II). The QSCC II is a Sasang typology diagnosis program for PC developed by Sun Ho Kim and the Department of Sasang typology at Kyung Hee University Medical Center. Through standardization and validation studies, the diagnostic accuracy rate of the QSCC II was reported as 70.08%,[50,51] and this instrument is widely used for the diagnosis of Sasang types with recognized objectivity. The QSCC II consists of 121 items assessing physical, mental and pathological traits. For Sasang typology classification, respondents were asked to complete a self-administered questionnaire. Answers to the survey questions were analyzed with Win QSCC II version software (SordMedicom & sord OMS, Seoul, Korea).

#### 2.2.2. Quality of sleep measurements

Quality of sleep was measured using the Pittsburgh Sleep Quality Index (PSQI) developed by Buysse et al[52] and translated by Jung-hee Yun in Korean.[53] The PSQI assesses subjective sleep disturbance over a month. The PSQI is an 18-item questionnaire composed of 7 domains: subjective quality of sleep, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of sleeping pills, and daytime disturbance. Each item is scored on a 3-point scale from 0 to 3. Total scores are calculated by summing up the items from the 7 domains, giving a score range of 0–21. The quality of sleep status was based on the 5 points scale suggested by Buysse et al,[52] scores below 5 were defined as good quality of sleep and above 5 were defined as bad quality of sleep. Assessing the reliability of the PSQI, Cronbach's $\alpha$ was 0.83.[52] On the basis of a total sum of 5 points as a standard score, total scores of 5 or below were classified as the good-quality of sleep group and total scores of 6 or above were classified as the bad-quality of sleep group. Of the 338 subjects, the quality of sleep status was classified as good in 105 and bad in 233. Quality of sleep status and 7 domains were used as independent variables.

#### 2.2.3. Measurement of obesity factors

Obesity factors were measured using bioelectrical impedance (BEI) and a body composition analyzer (InBody 720, Biospace, Korea), including weight (kg), fat mass (kg), fat percent (%), abdominal fat percent (%), BMI (kg/m$^2$), and obesity rate (%). On an empty stomach, subjects who dressed lightly stepped on the footpads after wetting both hands and foot soles with electrolyte tissue. After entering age, sex and height, obesity factors were measured by holding the electrodes with both hands and stretching the arms to about 15°.

### 2.3. Data analysis

One-way ANOVA was used to compare the different general characteristics among Sasang types. The interaction effect of Sasang types and quality of sleep on obesity factors were verified with Two-way ANOVA, while variables with interaction effect were tested using One-way ANOVA. Differences in obesity factors among different qualities of sleep according to the Sasang types and among Sasang types according to the quality of sleep were verified. A post-hoc test for one-way ANOVA was conducted using the Scheffe test, and differences were considered statistically significant at $p < 0.05$ and $p < 0.01$.

## 3. Results

The interaction effect of Sasang types and sleep was shown in the quality of sleep status, subjective quality of sleep, sleep duration, and sleep disturbance. Variables with interaction effect were verified to test differences in the obesity factors among different qualities of sleep according to the Sasang types and among Sasang types in terms of quality of sleep.

### 3.1. General characteristics of subjects

Table 1 shows the mean age, height and weight of subjects according to their Sasang type. The mean age was 21 years, mean height was 161.39 cm, and mean weight was 53.24 kg. According to the results of the post-hoc analysis, age and height show no significant difference among Sasang types ($p > 0.05$). On the contrary, the weight of Tae-Eum individuals was significantly higher than that of So-Yang and So-Eum individuals ($p < 0.01$).

### 3.2. Differences in obesity factors according to Sasang types and quality of sleep status

Table 2 shows differences in obesity factors according to the Sasang types and quality of sleep status. The interaction effect of Sasang types and quality of sleep status was found in weight fat mass and percent of abdominal fat ($p < 0.05$).

Differences in obesity factors between two groups with different quality of sleep status according to the Sasang types are as follows. The fat mass of the So-Yang type individuals, and the weight, fat mass of the Tae-Eum type individuals were

Table 2 – Differences in Obesity Factors According to Sasang Types and Quality of Sleep Status

| Obesity factors | Sasang types | Quality of sleep status | | | Post-hoc | Interaction effect (F) |
|---|---|---|---|---|---|---|
| | | Good (n = 105) | Bad (n = 233) | F | | |
| Weight(kg) | So-Yang | 51.75 (.52) | 52.48 (.51) | .890 | | Sasang types × quality of sleep status 3.60* |
| | So-Eum | 50.85 (.75) | 51.29 (.54) | .207 | | Sasang types 34.63** |
| | Tae-Eum | 56.56 (2.03) | 62.30 (1.07) | 6.003* | Bad > good | Quality of sleep status 9.06** |
| | F | 6.501** | 62.210** | | | |
| Fat mass (kg) | So-Yang | 13.72 (.37) | 14.93 (.34) | 5.280* | Bad > good | Sasang types × quality of sleep status 4.28* |
| | So-Eum | 13.65 (.49) | 14.16 (.31) | .769 | | Sasang types 26.53** |
| | Tae-Eum | 16.25 (1.04) | 20.34 (.62) | 9.282** | Bad > good | Quality of sleep status 17.54** |
| | F | 3.559* | 55.290** | | | |
| Abdominal fat percent (%) | So-Yang | .81 (.00) | .81 (.00) | 1.821 | | Sasang types × quality of sleep status 3.76* |
| | So-Eum | .80 (.00) | .80 (.00) | .479 | | Sasang types 13.70** |
| | Tae-Eum | .82 (.01) | .85 (.00) | 3.399 | | Quality of sleep status 5.63* |
| | F | 1.153 | 32.692** | | | |

Data are presented as means (SE). *$p < 0.05$. **$p < 0.01$.

significantly higher in the bad-quality sleep group than in the good-quality sleep group ($p < .05$).

Differences in obesity factors among Sasang types according to the quality of sleep status are as follows. The weight ($p < 0.01$) and fat mass ($p < 0.05$) of the good-quality sleep group, and the weight ($p < 0.01$), fat mass ($p < 0.01$) and abdominal fat percent ($p < 0.01$) of the bad-quality sleep group were the highest in Tae-Eum type individuals.

### 3.3. *Differences in obesity factors according to Sasang types and subjective quality of sleep (domain 1)*

Table 3 represents differences in obesity factors according to the Sasang types and subjective quality of sleep. The interaction effect of Sasang types and subjective quality of sleep was found in fat mass ($p < 0.05$), abdominal fat percent ($p < 0.01$), BMI ($p < 0.01$) and obesity ($p < 0.01$).

Differences in obesity factors among subjective quality of sleep measures according to the Sasang types are as follows. In Tae-Eum type individuals, abdominal fat percent ($p < 0.01$), BMI ($p < 0.05$) and obesity ($p < 0.05$) were highest when the subjective quality of sleep was very bad.

Differences in obesity factors among Sasang types according to the subjective quality of sleep are as follows. Tae-Eum type individuals had the highest fat mass ($p < 0.05$), BMI ($p < 0.01$) and Obesity ($p < 0.01$) rate when subjective quality of sleep was good; and the highest fat mass ($p < 0.01$), abdominal fat mass ($p < 0.01$), BMI ($p < 0.01$) and obesity ($p < 0.01$) rate when subjective quality of sleep was bad; and the highest fat mass ($p < 0.01$), abdominal fat mass ($p < 0.01$), BMI ($p < 0.01$) and Obesity ($p < 0.01$) rate when subjective quality of sleep was very bad.

### 3.4. *Differences in obesity factors according to Sasang types and sleep duration (domain 3)*

Table 4 represents differences in obesity factors according to the Sasang types and sleep duration. The interaction effect of Sasang types and sleep duration was found in fat mass ($p < 0.05$), abdominal fat percent ($p < 0.01$), BMI ($p < 0.05$) and obesity ($p < 0.05$).

Differences in obesity factors over sleep duration and according to the Sasang types are as follows. In Tae-Eum type individuals, fat mass, abdominal fat percent, BMI and obesity were highest when sleep duration was less than 5 hours ($p < 0.05$).

Differences in obesity factors among Sasang types according to sleep duration are as follows. Tae-Eum type individuals had the highest BMI and obesity ($p < 0.05$) rate at a sleep duration of more than 7 hours; the highest fat mass, BMI and obesity ($p < 0.01$) rate at a sleep duration of 6–7 hours; the highest fat mass, abdominal fat percent, BMI and obesity ($p < 0.01$) rate at a sleep duration of 5–6 hours; and the highest fat mass, abdominal fat percent, BMI and obesity ($p < 0.01$) rate at a sleep duration of less than 5 hours.

### 3.5. *Differences in obesity factors according to Sasang types and sleep disturbance (domain 5)*

Table 5 shows differences in obesity factors according to the Sasang types and sleep disturbance. The interaction effect of Sasang types and sleep disturbance was found in weight ($p < 0.01$), fat mass ($p < 0.05$), fat percent ($p < 0.05$), abdominal fat percent ($p < 0.05$), BMI ($p < 0.01$) and obesity rate ($p < 0.05$).

Differences in obesity factors with sleep disturbances according to the Sasang types are as follows. The fat mass of So-Yang type individuals and the abdominal fat percent of Tae-Eum type individuals were significantly high in the order of total scores between 10–18 points, 1–9 and 0 ($p < 0.05$).

Differences in obesity factors among Sasang types according to sleep disturbances are as follows. Tae-Eum type individuals had the highest fat mass ($p < 0.05$), BMI ($p < 0.01$), and obesity ($p < 0.01$), rate when sleep disturbance was scored 0; and the highest weight, fat mass, fat percent, abdominal fat mass, BMI, obesity ($p < 0.01$) rate when sleep disturbance scores ranged between 1 and 9; and the highest weight ($p < 0.01$), fat mass ($p < 0.01$), fat percent ($p < 0.01$), abdominal

Table 3 – Differences in Obesity Factors According to Sasang Types and Subjective Quality of Sleep Measures

| Obesity factors | Sasang types | Subjective quality of sleep | | | | Post-hoc | Interaction effect (F) |
|---|---|---|---|---|---|---|---|
| | | Good (1) (n = 42) | Bad (2) (n = 213) | Very bad (3) (n = 76) | F | | |
| Fat mass (kg) | So-Yang | 14.62 (.64) | 14.19 (.35) | 14.67 (.45) | .375 | | Sasang types × Subjective quality of sleep 3.09* |
| | So-Eum | 14.01 (.76) | 14.30 (.33) | 13.23 (.50) | 1.339 | | Sasang types 41.07** |
| | Tae-Eum | 17.61 (1.37) | 18.98 (.60) | 21.74 (1.53) | 2.979 | | Subjective quality of sleep 1.61 |
| | F | 3.755* | 29.131** | 30.658** | | | |
| Abdominal fat percent (%) | So-Yang | .81 (.00) | .81 (.00) | .82(.00) | .603 | | Sasang types × subjective quality of sleep 5.89** |
| | So-Eum | .81 (.00) | .80 (.00) | .80(.00) | 1.250 | | Sasang types 28.06** |
| | Tae-Eum | .84 (.01) | .83 (.00) | .88(.01) | 6.068** | 3 > 1 > 2 | Subjective quality of sleep 6.44** |
| | F | 1.776 | 10.678** | 26.021** | | | |
| BMI (kg/m$^2$) | So-Yang | 20.54 (.52) | 19.94 (.18) | 19.96(.34) | .875 | | Sasang types × subjective quality of sleep 4.22** |
| | So-Eum | 19.68 (.32) | 19.87 (.19) | 19.50(.30) | .528 | | Sasang types 55.35** |
| | Tae-Eum | 22.65 (.73) | 22.85 (.36) | 25.28(1.12) | 4.152* | 3 > 2 > 1 | Subjective quality of sleep 2.80 |
| | F | 7.251** | 35.420** | 30.939** | | | |
| Obesity (%) | So-Yang | 95.40 (1.58) | 93.96 (.88) | 94.00(1.71) | .258 | | Sasang types × subjective quality of sleep 3.94** |
| | So-Eum | 92.88 (1.57) | 93.45 (.91) | 91.78(1.42) | .463 | | Sasang types 56.07** |
| | Tae-Eum | 106.50 (3.62) | 107.41 (1.68) | 118.64(5.19) | 4.133* | 3 > 2 > 1 | Subjective quality of sleep 2.82 |
| | F | 9.792** | 34.605** | 30.239** | | | |

Data are presented as means (SE). *$p < 0.05$. **$p < 0.01$.

fat mass ($p < 0.01$), BMI ($p < 0.05$), obesity ($p < 0.05$) rate when sleep disturbance scores ranged between 10 and 18.

## 4. Discussion

This study evaluated the sleep domains of the QSCC II and PSQI to identify differences in obesity factors according to Sasang constitution types and sleep quality. The interaction effect of Sasang types and sleep was shown in the quality of sleep status, subjective quality of sleep (domain 1), sleep duration (domain 3), and sleep disturbance (domain 5). Variables with interaction effects were verified to test differences in obesity factors among different measures of sleep quality according to Sasang types and among Sasang types in terms of quality of sleep.

First, differences were found among obesity factors according to Sasang types and quality of sleep status. The fat mass of So-Yang type individuals and the weight and fat mass of Tae-Eum type individuals were higher in the bad-quality sleep group than in the good-quality sleep group. In light of these findings, bad sleep quality contributed to a high fat mass in So-Yang type individuals and increased risk of obesity factors in Tae-Eum type individuals. Excluding previous findings showing that insufficient and inappropriate quality of sleep[54] may lead to increases in fat intake, body weight[14] and body fat,[55] bad sleep quality is associated with obesity factors. According to previous studies on sleep status, So-Yang type individuals are more likely to suffer from sleep difficulties and sleep for shorter durations than other Sasang types.[48] Moreover, this type has a long sleep latency,[56] is most prone to sleep deprivation and in who sleep disturbance is a major cause for fatigue.[49] Tae-Eum type individuals are more prone to insomnia due to insufficient sleep duration[45] and tend to sleep for longer durations by dreaming more.[46,47] In addition, this type experiences frequent body movements during sleep, more severe snoring[57] and frequent obstructive sleep apnea syndrome.[58] These previous findings revealed that the quality of sleep status is poor in So-Yang and Tae-Eum type individuals. Therefore, improvement of sleep quality is expected to reduce fat mass and obesity in So-Yang and Tae-Eum type individuals, respectively. The weight and fat mass of the good-quality sleep group, and the weight, fat mass and abdominal fat percent of the bad-quality sleep group were highest in Tae-Eum type individuals. This outcome seems related with previous findings demonstrating that Tae-Eum type individuals are the most obese.[26,27,36–42] Thus, improvement in quality of sleep status is expected to reduce obesity factors of Tae-Eum type individuals.

Second, there were differences in obesity factors according to Sasang types and subjective quality of sleep (domain 1). In Tae-Eum type individuals, the poorer the subjective quality of sleep, the higher the percentage of abdominal fat, BMI and obesity rate. Therefore, improvement in subjective quality of sleep is thought to lower obesity factors of Tae-Eum type

Table 4 – Differences in Obesity Factors According to Sasang Types and Sleep Duration

| Obesity factors | Sasang types | Sleep duration (hours) | | | | | Post-hoc | Interaction effect (*F*) |
|---|---|---|---|---|---|---|---|---|
| | | ≥7 h (0) (*n* = 48) | ≥6–<7 h (1) (*n* = 99) | ≥5–<6 h (2) (*n* = 119) | <5 h (3) (*n* = 71) | *F* | | |
| Fat mass (kg) | So-Yang | 14.00 (.65) | 14.16 (.39) | 14.82 (.54) | 14.52 (.48) | .511 | | Sasang types × sleep duration 2.77* |
| | So-Eum | 14.36 (.79) | 14.09 (.46) | 14.07 (.44) | 13.51 (.59) | .327 | | Sasang types 44.05** |
| | Tae-Eum | 17.72 (1.17) | 17.65 (1.03) | 19.64 (.62) | 22.47 (1.53) | 3.824* | 3 > 2>0 > 1 | Sleep duration 2.91* |
| | *F* | 2.525 | 8.798** | 24.223** | 30.403** | | | |
| Abdominal fat percent (%) | So-Yang | .82 (.00) | .81 (.00) | .81 (.00) | .82 (.00) | .916 | | Sasang types × sleep duration 3.29** |
| | So-Eum | .81 (.00) | .81 (.00) | .80 (.00) | .80 (.00) | 1.420 | | Sasang types 26.10** |
| | Tae-Eum | .84 (.01) | .82 (.00) | .85 (.00) | .87 (.01) | 3.039* | 3 > 2>0 > 1 | Sleep duration 3.72* |
| | *F* | 2.455 | 1.211 | 18.598** | 16.341** | | | |
| BMI (kg/m$^2$) | So-Yang | 19.91 (.37) | 19.95 (.31) | 20.03 (.29) | 20.19 (.29) | .142 | | Sasang types × Sleep duration 2.42* |
| | So-Eum | 19.70 (.34) | 19.70 (.26) | 19.64 (.26) | 20.04 (.31) | .324 | | Sasang types 52.09** |
| | Tae-Eum | 21.90 (.71) | 22.18 (.54) | 23.85 (.66) | 25.16 (.79) | 3.599* | 3 > 2 > 1 > 0 | Sleep duration 5.01** |
| | *F* | 3.669* | 11.673** | 30.275** | 36.381** | | | |
| Obesity (%) | So-Yang | 93.85 (1.81) | 93.32 (1.13) | 94.28 (1.39) | 95.25 (1.40) | .335 | | Sasang types × sleep duration 2.38* |
| | So-Eum | 92.73 (1.62) | 92.85 (1.24) | 92.38 (1.26) | 94.18 (1.50) | .288 | | Sasang types 53.22** |
| | Tae-Eum | 103.40 (3.04) | 104.16 (2.62) | 112.17 (3.16) | 118.00 (3.34) | 3.567* | 3 > 2 > 1 > 0 | Sleep duration 5.18** |
| | *F* | 3.845* | 12.544** | 29.822** | 37.174** | | | |

Data are presented as means (SE). **$p < 0.05$. **$p < 0.01$.

Table 5 – Differences in Obesity Factors According to Sasang Types and Sleep Disturbance

| Obesity factors | Sasang types | Sleep disturbance | | | | | Post-hoc | Interaction effect (*F*) |
|---|---|---|---|---|---|---|---|---|
| | | 0 point (0) ($n = 52$) | 1–9 point (1) ($n = 263$) | 10–18 point (2) ($n = 17$) | 19–27 point (3) ($n = 1$) | *F* | | |
| Weight (kg) | So-Yang | 51.57(.70) | 52.32(.45) | 53.20 (1.78) | – | .472 | | Sasang types × sleep disturbance 3.48** |
| | So-Eum | 53.06(1.36) | 51.05(.48) | 49.25 (2.34) | – | 1.015 | | Sasang types 21.04** |
| | Tae-Eum | 56.19(1.72) | 62.37(1.19) | 61.19 (.30) | – | 3.170 | | Sleep disturbance 1.15 |
| | *F* | 2.669 | 67.078** | 8.038** | | | | |
| Fat mass (kg) | So-Yang | 13.62 (.40) | 14.45 (.30) | 17.18 (1.46) | – | 4.477* | 2 > 1 > 0 | Sasang types × sleep disturbance 2.78* |
| | So-Eum | 13.91 (.73) | 14.14 (.29) | 12.51 (1.01) | – | .778 | | Sasang types 20.30** |
| | Tae-Eum | 16.65 (.90) | 20.16 (.70) | 20.07 (1.58) | – | 2.997 | | Sleep disturbance 3.24* |
| | *F* | 4.457* | 52.287** | 6.891** | | | | |
| Fat percent (%) | So-Yang | 26.35 (.67) | 27.45 (.41) | 29.51 (1.06) | – | 1.952 | | Sasang types × Sleep disturbance 3.39* |
| | So-Eum | 26.61 (1.12) | 27.44 (.39) | 22.31 (2.27) | – | 2.470 | | Sasang types 19.46** |
| | Tae-Eum | 29.56 (1.05) | 31.81 (.62) | 35.55 (3.56) | – | 3.061 | | Sleep disturbance 1.73 |
| | *F* | 2.325 | 18.621** | 8.568** | | | | |
| Abdominal fat percent (%) | So-Yang | .81 (.00) | .81 (.00) | .83 (.00) | – | 1.384 | | Sasang types × sleep disturbance 2.90* |
| | So-Eum | .80 (.00) | .80 (.00) | .79 (.01) | – | .564 | | Sasang types 18.17** |
| | Tae-Eum | .81 (.01) | .85 (.00) | .89 (.03) | – | 3.433* | 2 > 1 > 0 | Sleep disturbance 3.30* |
| | *F* | 1.020 | 27.869** | 8.062** | | | | |
| BMI (kg/m$^2$) | So-Yang | 19.63 (.23) | 20.11(.19) | 20.61 (.89) | – | 1.013 | | Sasang types × sleep disturbance 3.46** |
| | So-Eum | 20.07 (.41) | 19.79(.16) | 18.57 (.74) | – | 2.035 | | Sasang types 36.54** |
| | Tae-Eum | 21.83 (.54) | 23.67(.39) | 25.72 (3.33) | – | 3.128 | | Sleep disturbance 2.93* |
| | *F* | 6.575** | 64.769** | 4.776* | | | | |
| Obesity (%) | So-Yang | 92.35(1.13) | 94.54(.83) | 96.71 (4.10) | – | 1.052 | | Sasang types × sleep disturbance 3.36* |
| | So-Eum | 94.41 (2.05) | 93.12(.76) | 87.66 (3.53) | – | 2.031 | | Sasang types 37.08** |
| | Tae-Eum | 102.81 (2.48) | 111.20(1.81) | 120.75 (16.17) | – | 3.064 | | Sleep disturbance 3.02* |
| | *F* | 6.386** | 67.080** | 4.473* | | | | |

Data are presented as means (SE). *$p < 0.05$. **$p < 0.01$.

individuals. When the subjective quality of sleep was good, fat mass, BMI and obesity rate were highest in Tae-Eum type individuals. When the subjective quality of sleep was bad or very bad, fat mass, abdominal fat percent, BMI and obesity rate were highest in Tae-Eum type individuals. Therefore, Tae-Eum type individuals were identified to be the most obese with respect to subjective quality of sleep. Moreover, excluding previous findings that Tae-Eum type individuals showed a high level of sleep satisfaction,[59] and Eum (So-Eum and Tae-Eum) type individuals with good sleep accounted for a large percentage,[47] there is an association between subjective quality of sleep and Tae-Eum type individuals. Thus, improving subjective quality of sleep is anticipated to be crucial in reducing obesity risks in Tae-Eum type individuals.

Third, differences were observed in obesity factors according to the Sasang types and sleep duration (domain 3). In Tae-Eum type students with a sleep duration of less than 5 hours, fat mass, abdominal fat percent, BMI and obesity rate were high. Thus, the obesity factors of Tae-Eum type individuals increase when sleep duration is less than 5 hours. This outcome aligns with the results of a study by You-sun Ko[36] who found that Tae-Eum type individuals who sleep less than 5 hours are more prone to risk of obesity due to an increased BMI. These outcomes indicate that obesity factors of Tae-Eum type individuals are associated with sleep duration considering Sasang types. Moreover, previous studies demonstrate a relationship between sleep duration and obesity regardless of Sasang types; women with a sleep duration of less than 5 hours have a higher prevalence of obesity,[60] a higher risk of metabolic syndromes[18] and a higher incidence of obesity, diabetes and hypertension.[61] Thus, to reduce obesity rates in Tae-Eum type individuals, a sleep duration of more than 7 hours per day is assumed to be essential.

Tae-Eum type individuals had the highest BMI and obesity at a sleep duration of more than 7 hours; the highest fat mass, BMI and obesity rate at a sleep duration of 6–7 hours; the highest fat mass, abdominal fat percent, BMI and obesity rate at a sleep duration of 5–6 hours; and the highest fat mass, abdominal fat percent, BMI and obesity rate at a sleep duration of less than 5 hours. Therefore, Tae-Eum type individuals are found to be the most obese type regardless of sleep duration. In addition, the effect of obesity reduction can be expected when Tae-Eum type individuals experience a sleep duration of more than 7 hours per day.

Fourth, there were differences in obesity factors according to Sasang types and sleep disturbance (domain 5). The fat mass of So-Yang type individuals and the abdominal fat percent of Tae-Eum type individuals were 10–18 points higher. Thus, the higher the sleep disturbance scores, the more the obesity factors for So-Yang and Tae-Eum type individuals. Among sub-items of sleep disturbance (domain 5) of the PSQI, 'Unable to fall asleep within 30 minutes' and 'Feel too hot' seem to influence an easy increase of energy[62] and sleep disturbance in So-Yang type individuals with a long sleep latency.[56] Moreover, sub-items, 'Have a feeling of uncomfortable breathing', 'Have a bad cough or heavy snoring' and 'Have a nightmare' are thought to affect sleep disturbance of Tae-Eum type individuals having frequent obstructive sleep apnea syndrome,[58] severe snoring,[57] and lots of dreams while sleeping.[46,47] Therefore, the outcome implies that sleep disturbance needs to be addressed in order to reduce the obesity rate of So-Yang and Tae-Eum type individuals. With a sleep disturbance score of 0 points, fat mass, BMI and obesity rate were the highest in Tae-Eum type individuals. With score ranges from 1 to 9 and from 10 to 18 points, all obesity factors were highest in Tae-Eum type individuals. These outcomes demonstrated that the most obese Tae-Eum type individuals are influenced by obesity factors in all groups with sleep disturbance. Therefore, the effect of obesity reduction can be expected when Tae-Eum type individuals experience less sleep disturbances.

This study confirmed differences in obesity factors according to Sasang types and sleep domains in female college students. In particular, poor sleep quality was attributable to high fat mass in So-Yang type individuals and high risk of obesity factors in Tae-Eum type individuals. There are several limitations to this study, partly because studies on the association of obesity factors with Sasang types and sleep using the PSQI index are few. Until now, studies on the relationship of obesity factors to sleep according to the Sasang types have only assessed a single domain (e.g., sleep duration). However, this study was meaningful in that explored a variety of sleep domains using the PSQI index. Thus, improvement in the quality of sleep had a reduction effect on fat mass in So-Yang type individuals and obesity factors among Tae-Eum type individuals. In this study, no participants were Tae-Yang type and thus it was excluded from the study. However, it is considered that the result of Tae-Yang type individuals is similar to that of So-Yang type individuals when considering the similarity of characteristics between these two types of individuals.[63,64]

Therefore, additional studies are warranted to enhance reliability of the present study taking different ages and gender into account, and further studies on sleep improvement need to be performed using a variety of sleep measurement tools.

In conclusion, sleep habits are among the factors influencing health, in addition to exercise, lifestyle and dietary habits. For this reason, this study examined differences in obesity factors according to Sasang constitution types and various sleep domains among 339 Korean female college students using QSCC II and PSQI.

The study findings are given as follows:

i poor sleep quality was associated with high fat mass in So-Yang type individuals.
ii poor sleep quality contributed to greater risk of obesity factors in Tae-Eum type individuals.

Therefore, this study confirmed that, the quality of sleep in female college students in different Sasang groups has an impact on obesity factors differently.

Thus, improvement in the quality of sleep is expected to have a reduction effect on fat mass in So-Yang type individuals and obesity factors in Tae-Eum type individuals.

In addition, the results of this study will be used to improve sleep quality depending on the Sasang types.

## Conflict of interest

The authors declare no conflict of interest.

## References


1. Kim TY, You BH, Ko YS. A study on physical fitness according to the Sasang constitution and the subjective sleep quality. In: *Pursuit of Evidence-Based Sport and Exercise Science*.; 2013:297 [In Korean, English Abstract].
2. Smyth C. The Pittsburgh Sleep Quality Index (PSQI). *J Geronotol Nurs* 1999;25:10–1.
3. Foreman MD, Wykle M. Nursing standard of protocol: sleep disturbance in elderly patient. *Geriatr Nurs* 1995;16:238–43.
4. Song IB. Clinical study on control of wind stroke in Sasang. *J Sasang Constitut Med* 1996;8:117–30.
5. http://media.daum.net/life/living/tips/newsview?newsId=20150208101808893.
6. Ministry of Health and Welfare Korea Centers for Disease Control. *Korean study of women's health related issues*.; 2017:2–6.
7. Kim JK, Song HS. The relation of circadian sleep phase preference to sleep habits, psychological adjustment and academic performance in college students. *Korean J Health Psychol* 2007;12:631–48 [In Korean, English Abstract].
8. Wolfson AR, Carskadon MA. Sleep schedules and daytime functioning in adolescents. *Child Dev* 1998;69:875–87.
9. http://www.tbs.seoul.kr/news/bunya.do?method=daum_html2&typ_800=R&seq_800=10069520.
10. National Health Insurance Service(NHIS). *The analysis of Korea's National Health Insurance claims database*; 2015:1–2.
11. Hicks RA, Fernandez C, Pellegrini RJ. Striking changes in the sleep satisfaction of unversity students over the last two decades. *Percept Motor Skills* 2001;93:660.
12. Wolk R, Somers VK. Sleep and the metabolic syndrome. *Exp Physiol Jan* 2007;92:67–78.
13. Gruber A, Horwood F, Sithole J, Ali NJ, Idris I. Obstructive sleep apnoea is independently associated with the metabolic syndrome but not insulin resistance state. *Cardiovasc Diabetol* 2006;5:22.
14. Han AR. *The association between sleep and metabolic syndrome*. Seoul, Korea: Graduate School, Yonsei University; 2007 [In Korean, English Abstract].
15. Lee JY. *The relationship between sleep quality and metabolic syndrome*. Seoul, Korea: Graduate School, Korea University; 2008 [In Korean, English Abstract].
16. Yaggi HK, Araujo AB, McKinlay JB. Sleep duration as a risk factor for the development of type 2 diabetes. *Diabetes Care* 2006;29:657–61.
17. Ayas NT, White DP, Manson JE, Stampfer MJ, Speizer FE, Malhotra A, et al. A prospective study of sleep duration and coronary heart disease in women. *Arch Intern Med* 2003;163:205–9.
18. Suh EK. *The relationship of sleep duration and obesity and the metabolic syndrome in Korean adults*. Seoul Korea: Graduate School, Ewha Women's University; 2009 [In Korean English Abstract].
19. http://news.chosun.com/site/data/html_dir/2018/01/01/2018010100142.html.
20. WHO. *Tenfold increase in childhood and adolescent obesity in four decades: new study by imperial College London and WHO*; 2017.
21. National Health Insurance. *The 2017 Obesity White Paper*; 2018:1–157.
22. Lee BS. *My constitution use manual*. Seoul, Korea; 2013.
23. Kim JW. The Study on the investigation of oriental medical therapy (oriental medical therapy by symptoms and signs and Sasang Constitutional medicine) and the each effect of oriental medicine, occidental medicine and both joint control. *J Sasang Constitut Med* 1998;10:351–429 [In Korean, English Abstract].
24. Ko BH, Koo DM, Kim KY, Kim DR, Kim IH, Kim JY, et al. *Sasang medicine*. Seoul, Korea; 1997.
25. Won DW. *Analysis of interaction effect between Sasang constitution and dance experience for obesity, bone quality index and depression of female college students*. Seoul, Korea: Education Graduate School, Sookmyung Women's University; 2011 [In Korean, English Abstract].
26. Kim TY. *Difference of the physical fitness and obesity according to the quality of sleep and Sasang constitution*. Seoul, Korea: Graduate School, Sookmyung Women's University; 2013 [In Korean, English Abstract].
27. Kang HY, Lee JD, Kim KH. Health habits and obesity according to Sasang constitution among female college students in Korea. *J Sport Leisure Stud* 2011;43:739–48.
28. Moon SH, Sin SH, Kim HJ, Kim JY. A relationship of the obesity composition analysis by Sasang constitution. *J Orient Rehab Med* 2002;12:1–10.
29. You BH. *Mediation model comparison of physical fitness on obesity and depression according to the Sasang constitution*. Seoul, Korea: Graduate School, Sookmyung Women's University; 2012 [In Korean, English Abstract].
30. Chae H, Lee SJ, Park SH, Jang ES, Lee SW. Validation of Sasang personality questionnaire (SPQ) with positive and negative affection schedule and body mass index. *J Sasang Constit Med* 2012;24:39–46 [In Korean, English Abstract].
31. Seo EH, Choi AR, Ha JH, Che H, Kim PJ, Goo DM. A study on the physical and psychological characteristics in Sasang constitution medicine. *J Sasang Constit Med* 2009;21:48–62 [In Korean, English Abstract].
32. Jang ES, Lee SJ, Park SH, Lee SW, Joo JC, Chae H. Clinical validation of the Sasang personality questionnaire. *J Orient Neuropsyc* 2012;23:23–32 [In Korean, English Abstract].
33. Che H, Lyoo IK, Lee SJ, Cho S, Bae H, Hong M, et al. An alternative way to individualized medicine: psychological and physical traits of Sasang typology. *J Altern Med* 2003;9:519–28.
34. Lee MS, Sohn KW, Kim YH, Hwang MW, Kwon YK, Bae NY, et al. Digestive system-related pathophysiological symptoms of Sasang-typology: systematic review. *J Integr Med Res* 2013;2:39–48.
35. Chae H, Kwon YK. Best-fit index for describing physical perspectives in Sasang typology. *J Integr Med Res* 2015;4:20–8.
36. Ko YS. Research on physique, bone density, obesity, body composition, and physical strength to sleep duration by Sasang constitution. *Korean J Growth Dev* 2010;18:271–8 [In Korean, English Abstract].
37. Ko YS. The discriminant analysis about the Sasang constitution on physical fitness. *Korean J Measure Eval Phys Educ Sport Sci* 2007;9:15–26 [In Korean, English Abstract].
38. Ko YS. *The discriminant analysis of Sasang constitutions through the body compositions and the factorof physical fitness*. Seoul, Korea: Graduate School, Sookmyung Women's University; 2003 [In Korean, English Abstract].
39. Kim DL, Beck TH. Clinical study on correlation of obesity and Sasang constitution. *J Sasang Constitut Med* 1996;8:319–35 [In Korean English Abstract].
40. Kim KJ, Kim DL. Experimental study on constitutional composition of serum lipid. *J Sasang Constitut Med* 1993;5:139–44 [In Korean, English Abstract].
41. Oh WJ. *Relationship between Sasang constitutions and health physical fitness and exercise eating habits in female college students*. Seoul, Korea: Graduate School, Sookmyung Women's University; 2011 [In Korean, English Abstract].
42. Ko YS. Comparison of model and path between fat-free, bone density, and muscular strength of Sasang constitution (Taeum & Soeum types). *Korean J Measure Eval Phys Educ Sport Sci* 2011;13:57–66 [The Korean, English Abstract].

43. Hyun MY. *Yangseng (養生: traditional oriental health promotion) and health status according to Sasang constitution of university student*. Jeonjul Jeonbuk, Korea: Graduate School, Woosuk University; 2004 [In Korean, English Abstract].
44. Beok YH, Kim HS, Lee SW, Kim SH, Ryu JH, Jang ES. Association between health practices and health state according to Sasang constitution. Korean Institute of Oriental Medicine. *Korean JOrient Physiol Pathol* 2009;23:1521–8 [In Korean, English Abstract].
45. Lee JY. *The Study of health and nutrition by Sasang Constitution in the rural elderly*. Daegu Kyungbuk, Korea: Graduate School of Education, Daegu Haany University; 2008 [In Korean, English Abstract].
46. Kim SH, Lee SY. *A study of the recognition and Syndromes of a dream in Oriental and Western medicine*. vol. 3. Dept. of Pathology, College of Oriental Medicine, Daejeon University; 1995:271–86 [In Korean, English Abstract].
47. Kim JJ, Lee YS, Park SS. A clinical study of sleeping, stool, urine according to Taeyangsoyangin (Yangin) and Taeumsoeumin (Eumin). *J Sasang Constitut Med* 2005;17:82–90.
48. Kim JJ, Lee YS, Park SS. A clinical study on the ordinary sleeping patterns of Soyangin. *J Orient Neuropsych* 2005;16:65–72.
49. Kim K. *Characteristics of fatigue in sasang constitution by analyzing questionnaire and medical devices data*. Igsan, Jeonbuk, Korea: Graduate School, Wonkwang University; 2013 [In Korean, English Abstract].
50. Kim SH, Ko BH, Song IB. A study on the standardization of QSCCII (Questionnaire for the Sasang Constitution Classification II). *J Korean Orient Med Soc* 1996;17:337–93 [In Korean, English Abstract].
51. Lee JC. *The validation study of the questionnaire for Sasang constitution classification (the 2nd edition revised in 1955) – in the field of profile analysis*. Seoul, Korea: Graduate School, Kyung Hee University; 1996 [In Korean, English Abstract].
52. Buysse DJ, Berman SR, Kuper DJ, Monk TH, Reynolds CF. The Pittsburgh Sleep Quality Index: new instrument for psychiatric and research. *Psychiat Res* 1989;28:193–213.
53. Youn JH. *A study on IBS and stress perceived by college women and their dietary habit and sleeping quality*. Seoul, Korea: Graduate School, Ewha Women's University; 2005 [In Korean, English Abstract].
54. Weiss A, Xu F, Storfer-Isser A, Thomas A, Ievers-Landis CE, Redline S. The association of sleep duration with adolescents' fat and carbohydrate consumption. *Sleep* 2010;33:1201–9.
55. Gangwisch JE, Malaspina D, Boden-Albala B, Heymsfield SB. Inadequate sleep as a risk factor for obesity: analyses of the NHANES I. *Sleep* 2005;28:1289–96.
56. Lee JH, Koh BH, Master thesis *The study on the ordinary symptoms based on Sasang constitution*; 2007:1–69.
57. Choi JY, Choi JR, Lee YS, Park SS. A study on the clinical features of ordinary sleeping patterns based on the Sasang constitution, using the logistic regression. *J Korean Orient Med* 2004;25:171–9.
58. Lee SK, Yoon DW, Yi H, Lee SW, Kim JY, Shin C. Tae-eum type as an independent risk factor for obstructive sleep apnea. *Evid-Based Complement Altern Med* 2003:1–7.
59. Sok SH, Kim KB. A comparative study on sleep state, satisfaction of sleep, and life satisfaction of korean elderly living with family by Sasangin constitution. *J Korean Psychiatr Ment Health Nurs Acad Soc* 2009;18:341–50.
60. Patel SR, Ayas NT, Molborta MR, White DP, Schemhammer ES, Speizer FE, et al. A prospective study of sleep duration and mortality risk in women. *Sleep* 2004;27:440–4.
61. Park SE, Kim HM, Kim DH, Kim J, Cha BS, Kim DJ. The association between sleep duration and general and abdominal obesity in Koreans: data from the Korean National Health and Nutrition Examination Survey, 2001 and 2005. *Obesity (Silver Spring)* 2009;17:767–71.
62. Lee HB, Han YR, Han SY, Kim YI, Son KW, Lee MS, et al. Systematic review on the Sasang type-specific pathophysiological symptoms of sleep. *J Orient Neuropsych* 2015;26:337–48.
63. Lee SJ, Park SH, Cloninger CR, Kim YH, Hwang M, Chae H. Biopsychological traits of Sasang typology based on Sasang personality questionnaire and body mass index. *BMC Complem Altern Med* 2014;14:1–10.
64. Jang ES, Do JH, Jang JS, Ku BC, Yoo JH, Choi HS, et al. The characteristics of Taeyangin on body shape, face, voice and temperament. *J Sasang Constitut Med* 2013;25:145–57.