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Relationship Between Daily Meal Frequency and Subjective Sleep Quality or Daytime Sleepiness in Japanese Medical Students

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SUMMARY

OBJECTIVE：The objective of the present study was to investigate subjective sleep factors and daily meal frequency in Japanese medical students.

METHODS：In a cross-sectional study design, a total of 360 medical students (215 men and 145 women) aged 18-28 years participated. The participants answered self-rated questionnaires regarding sleep quality using the Pittsburgh Sleep Quality Index (PSQI) and daytime sleepiness using the Epworth Sleepiness Scale (ESS), and daily meal frequency. The questionnaires were distributed and collected by medical students who assisted in this part of the study.

RESULTS：Bedtime and waking time for men was significantly later than those for women (p = 0.029, p < 0.001, respectively). ESS score among women was significantly greater than that among men (p = 0.001) and the proportion of women with excessive daytime sleepiness (EDS) was significantly higher than that among men (p = 0.027). In the multiple regression analysis including factors of daily meal frequency, age, sex, year of study and each subjective sleep related parameter, daily meal frequency was the only significant factor in the model for PSQI global score.

CONCLUSION：We found that there was a gender difference in sleep patterns and daytime sleepiness among medical students. Furthermore, better sleep quality was found among those who ate meals 3 times daily or more compared to that among with those who habitually skipped meals. These findings provide evidence that not skipping meals promotes health by getting better sleep.

Key Words：Sleep quality, Pittsburgh sleep quality index, Daytime sleepiness, Epworth sleepiness scale, Dietary behavior

INTRODUCTION

Getting proper rest and sleep in order to refresh the mind and body is essential for health, and promotes a full life along with a well-balanced diet and moderate physical activity[1]. Recently young adults frequently show several lifestyle problems including poor eating habits[2], even though they are in the process of establishing lifestyle habits that they will continue in the future. While the association of having unhealthy lifestyle, including irregular eating habit, and sleep loss among Japanese general population has been reported[3]. The sleep loss was indicated by subjective insufficient sleep and short sleep duration, those were con-

Table 1   Contents of the questionnaire in the present study

Name：_____   Your age（years）：_____   Your sex：Male/Female   Today's date：_____

The Epworth Sleepiness Scale[7]

How likely are you to doze off or fall asleep in the following situations, in contrast to feeling just tired？This refers to your usual way of life in recent times. Even if you have not done some of these things recently try to work out how they would have affected you. Use the following scale to chose the most appropriate number for each situation：

0＝would never doze
1＝slight chance of dozing
2＝moderate chance of dozing
3＝high chance of dozing

Situation	Chance of dozing
Sitting and reading	_____
Watching TV	_____
Sitting, inactive in a public place（e.g. a theater or a meeting）	_____
As a passenger in a car for an hour without break	_____
Lying down to rest in the afternoon when circumstances permit	_____
Sitting and talking to someone	_____
Sitting quietly after a lunch without alcohol	_____
In a car, while stopped for a few minutes in the traffic	_____

The Pittsburgh Sleep Quality Index[4]

The following questions relate to your usual sleep habits during the past month only. Your answers should indicate the most accurate reply for the majority of days and nights in the past month.
Please answer all questions

1. During the past month, when have you usually gone to bed at night？
                                        USUAL MED TIME   _____
2. During the past month, how long（in minutes）has it usually take you to fall asleep each night？
                                        NUMBER OF MINUTES   _____
3. During the past month, when have you usually gotten up in the morning？
                                        USUAL GETTING UP TIME   _____
4. During the past month, how many hours of actual sleep did you get at night？
   （This may be different than the number of hours you spend in bed.）
                                        HOURS OF SLEEP PER NIGHT   _____

Continued

firmed by asking subjects whether they always get sufficient sleep that they need and how many hours in average they sleep at night[3]. However, not much is available on the relationship between lifestyle factors and sleep quality assessed by the Pittsburgh Sleep Quality Index（PSQI）[4~6] or daytime sleepiness by the Epworth Sleepiness Scale（ESS）[7] in young adults. It is important to clarify the associations by these measurements, which have been confirmed the validation and used as general measurements.

The present study was targeted for medical stu-

dents for several reasons. First, we tried to clarify the sleep problem in the medical students at present for prevention of sleep problems in the future. The previous study among men who had graduated medical school showed that insomnia in young adults is indicative of a greater risk of subsequent clinical depression[8]. Second, relationships between sleep restriction and weight gain[9], diabetes[9] or hypertension[10] risk has been shown to date. It is important for them to care for sleep in both the medical treatment and their lifestyle. If medical students, who will be medical doc-

Table 1 Continued

For each remaining questions, check the one best response. Please answer all questions.

5. During the past month, how often have you had trouble sleeping because you...

（a）Cannot get to sleep within 30 minutes

Not during the past month/Less than once a week/Once or twice a week/Three or more times a week

（b）Wake up in the middle of the night or early morning

Not during the past month/Less than once a week/Once or twice a week/Three or more times a week

（c）Have to get up to use the bathroom

Not during the past month/Less than once a week/Once or twice a week/Three or more times a week

（d）Cannot breathe comfortably

Not during the past month/Less than once a week/Once or twice a week/Three or more times a week

（e）Cough or snore loudly

Not during the past month/Less than once a week/Once or twice a week/Three or more times a week

（f）Feel too cold

Not during the past month/Less than once a week/Once or twice a week/Three or more times a week

（g）Feel too hot

Not during the past month/Less than once a week/Once or twice a week/Three or more times a week

（h）Had bad dreams

Not during the past month/Less than once a week/Once or twice a week/Three or more times a week

（i）Have pain

Not during the past month/Less than once a week/Once or twice a week/Three or more times a week

（j）Other reason（s）, please describe _____

Not during the past month/Less than once a week/Once or twice a week/Three or more times a week

6. During the past month, how would you rate your sleep quality overall ?

Very good/Fairy good/Fairly bad/Very bad

7. During the past month, how often have you taken medicine（prescribed or "over the counter"）to help you sleep ?

Not during the past month/Less than once a week/Once or twice a week/Three or more times a week

8. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity ?

Not during the past month/Less than once a week/Once or twice a week/Three or more times a week

9. During the past month, how much of a problem has it been for you to keep enough enthusiasm to get things done?

No problem at all/Only a very slight problem/Somewhat of a problem/A very big problem

Additional items

How many meal times per day do you have ?

Once/Twice/Three times/Four times or over

Are you participating some club activities at the university ?

Yes/No

tors in the future, continue to engage in unhealthy lifestyle including having sleep problem, they are less likely to encourage healthy lifestyle behavior in their patients and patients are less likely to listen to them if they do talk about it[11]. Thus, it is necessary to raise recognition of the importance of sleep among medical students.

Previous studies have shown the association between changes in circulating leptin and ghrelin and change in sleep length[12~14], and the relationship between sleep and eating behavior, including self-reported hunger and appetite[13] and food intake[15]. In this study, we conducted the additional survey of daily meal frequency that was one of the simple methods for dietary behaviors, to confirm the associations with subjective sleep related parameters in Japanese medical students.

METHODS

Study design and participants

In this cross-sectional study, participants were recruited from 634 medical students attending Dokkyo Medical University in October 2003. A total of 409 medical students participated in the survey (64.5%). Of these, we selected 360 participants who provided complete answers to the questionnaire (56.8%). All participants were informed of the intention of this study. We interpreted that they gave informed consent by answering and returning the questionnaire. Ethical approval of the study protocol was not obtained because the ethical committee system did not exist at that time.

Procedures and measurements

Questionnaires were distributed and collected by medical students who assisted in this part of the study. The participants answered self-rated questionnaires regarding sleep related measures, daily meal frequency and participation in club activities at the university (Table 1). Sleep quality was assessed by the Pittsburgh Sleep Quality Index (PSQI)[4] Japanese version[16,17].

The PSQI was an 18-item questionnaire that produces a global sleep quality score that ranges from 0 to 21, derived from 7 components (sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbance, hypnotics medication use and daytime dysfunction)[4]. Poor sleepers were defined as those with a PSQI score of 6 or greater[4].

Daytime sleepiness by the Epworth Sleepiness Scale (ESS)[7] Japanese version[18]. The ESS was a 8-item questionnaire in which the patient rates the likelihood of dozing during typical daytime activities on a scale of 0-3[7]. Excessive daytime sleepiness (EDS) was defined by an ESS score of 11 or greater[18].

Statistical analysis

We examined gender differences and divided the participants into two groups by daily meal frequency, the group who ate meals 3 times or more daily and the group who ate 2 times or less daily. The results are shown as mean (SD) and as a percentage in the categorical variables. The distributions of continuous variables were analyzed by Kolmogorov-Smirnov test. The differences were examined by Student's t test or Mann-Whitney U test as appropriate. Differences in categorical variables were examined by Chi-squared test.

To explore the most influential factor for PSQI global score and ESS score, we included age, sex, year of study, daily meal frequency and each subjective sleep related parameter in a multiple regression analysis. The factor of participation in club activities was not included in the analysis, because upper year of study was significantly correlated with non-participation in club activities (Spearman r=0.349, p<0.001).

In all tests, a value of p<0.05 on two-tailed test was considered significant. All analyses were performed using SPSS 15.0J for Windows (SPSS Inc., Tokyo, Japan).

RESULTS

Characteristics of participating medical students

The average age was significantly higher in men than that in women (p=0.005) (Table 2). Bedtime and waking time for men was significantly later than those for women (p=0.029, p<0.001, respectively). Score of sleep disturbance in PSQI was significantly higher in women than that in men (p=0.049). ESS score among women was significantly greater than that among men (p=0.001) and the proportion of women with EDS was significantly higher than that among men (p=0.027). There was no significant difference in the proportion of those who ate meals 2 times daily or less between men and women.

Association of sleep parameters and daily meal frequencies

In both men and women, waking time of the group who ate meals 2 times daily or less was significantly later than that of the group who ate meals 3 times daily or more (p=0.002, p=0.001, respectively) (Table 3). Only in men, bedtime in the group who ate meals 2 times daily or less was significantly later than that in the group who ate meals 3 times daily or more (p<0.001). In women, the PSQI global score in the group who ate meals 2 times daily or less was significantly higher than that in the group who ate meals 3 times daily or more (p=0.029). Regarding the 7 component scores of PSQI, there were significant differences in

Table 2 The characteristics of participating medical students

	Total	Men	Women	P-value[a]
Number of participants, n	360	215	145	
Age, years, mean（SD）	22.1（2.2）	22.4（2.2）	21.8（2.3）	0.005
Year of study, %				
1	14.2	11.6	17.9	0.374[b]
2	28.9	31.6	24.8	
3	12.2	10.7	14.5	
4	17.8	19.1	15.9	
5	17.5	17.7	17.2	
6	9.4	9.3	9.7	
Sleep pattern, mean（SD）				
Bedtime, hh：mm（min）	1：14（90）	1：21（44）	1：03（62）	0.029
Waking time, hh：mm（min）	8：00（75）	8：08（86）	7：47（53）	＜0.001
Reported sleep duration at night,（hours）	6.5（1.2）	6.5（1.3）	6.4（1.1）	0.665
PSQI, score, mean（SD）				
Global score	5.5（2.5）	5.4（2.6）	5.6（2.4）	0.442
Sleep quality	1.2（0.8）	1.2（0.8）	1.2（0.7）	0.695
Sleep latency	0.9（0.9）	0.9（0.9）	0.9（0.9）	0.692
Sleep duration	1.3（0.9）	1.3（0.9）	1.4（0.9）	0.643
Sleep efficiency	0.2（0.5）	0.2（0.6）	0.1（0.4）	0.328
Sleep disturbance	0.7（0.5）	0.6（0.5）	0.7（0.5）	0.049
Hypnotics medication	0.0（0.2）	0.0（0.3）	0.0（0.1）	0.982
Daytime dysfunction	1.3（0.9）	1.2（0.9）	1.4（0.9）	0.108
Poor sleeper[c], %	46.9	47.4	46.2	0.818[b]
ESS				
ESS score, mean（SD）	7.4（3.4）	6.9（3.4）	8.1（3.3）	0.001
EDS[d], %	15.6	12.1	20.7	0.027[b]
Daily meal frequency ≦ 2 times, %	36.7	39.1	33.1	0.249[b]
Club activity participant, %	76.9	79.5	73.1	0.155[b]

Abbreviation：PSQI, Pittsburgh quality of sleep index；ESS, Epworth sleepiness scale；EDS, Excessive daytime sleepiness.

a. Unless otherwise specified, p value was determined by Mann-Whitney U test.

b. P value was determined by Chi-square test.

c. Poor sleepers were defined as those with PSQI global score of 6 or greater.

d. EDS was defined as ESS score of 11 or greater.

sleep latency for women, sleep duration and hypnotics medication for men.

As shown in Table 4, the multiple regression analysis including factors of daily meal frequency, age, sex, year of study and each subjective sleep parameter showed that daily meal frequency was the only significant factor in the model for PSQI global score not for ESS score, and sex difference was the only significant factor in the model for ESS score.

DISCUSSION

The results of the present study suggest that medical students with higher PSQI global score tended to eat meals 2 times daily or less. To our knowledge, this is the first report showing a relationship between habitually skipping meals and subjective sleep quality in medical students.

Considering our findings that a later pattern of going to bed and waking up tended to be found in the group who ate meals 2 times daily, it may be appropriate to

Table 3   Comparison of the characteristics between the two groups devided by daily meal frequency

	Men			Women		
	Daily meal frequency		P-value[a]	Daily meal frequency		P-value[a]
	≥3 times	≤2 times		≥3 times	≤2 times	
Number of participants, n	131	84		97	48	
Age, years, mean (SD)	22.3 (2.3)	22.7 (2.0)	0.187	22.0 (2.3)	21.5 (2.3)	0.185
Year of study, %						
1	13	9.5	0.182[b]	16.5	20.8	0.044[b]
2	33.6	28.6		24.7	25.0	
3	13	7.1		9.3	25.0	
4	13.7	27.4		17.5	12.5	
5	17.6	17.9		22.7	6.3	
6	9.2	9.5		9.3	10.4	
Sleep pattern, mean (SD)						
Bedtime, hh : mm (min)	0 : 59 (73)	1 : 55 (133)	<0.001	0 : 55 (50)	1 : 18 (72)	0.068
Waking time, hh : mm (min)	7 : 52 (57)	8 : 31 (114)	0.002	7 : 37 (42)	8 : 10 (66)	0.001
Reported sleep duration at night, (hours)	6.6 (1.2)	6.3 (1.3)	0.052	6.5 (1.1)	6.4 (1.0)	0.586
PSQI, score, mean (SD)						
Global score	5.1 (2.3)	5.9 (3.0)	0.081	5.3 (2.4)	6.3 (2.2)	0.029
Sleep quality	1.1 (0.7)	1.3 (0.9)	0.093	1.1 (0.7)	1.3 (0.7)	0.105
Sleep latency	0.8 (0.7)	1.0 (1.0)	0.465	0.8 (0.9)	1.2 (1.0)	0.009
Sleep duration	1.2 (0.8)	1.5 (0.9)	0.048	1.3 (0.9)	1.4 (0.8)	0.493
Sleep efficiency	0.1 (0.4)	0.3 (0.7)	0.341	0.1 (0.4)	0.2 (0.5)	0.407
Sleep disturbance	0.6 (0.5)	0.6 (0.5)	0.994	0.8 (0.5)	0.7 (0.5)	0.603
Hypnotics medication	0.0 (0.0)	0.1 (0.4)	0.030	0.0 (0.1)	0.0 (0.0)	0.318
Daytime dysfunction	1.2 (0.9)	1.2 (0.9)	0.935	1.3 (0.9)	1.5 (0.9)	0.199
Poor sleeper[c], %	45.0	51.2	0.378[b]	42.3	54.2	0.176[b]
ESS						
ESS score, mean (SD)	7.1 (3.5)	6.5 (3.3)	0.229	7.9 (2.9)	8.4 (3.8)	0.461
EDS[d], %	13.7	9.5	0.355[b]	15.5	31.3	0.027[b]

Abbreviation : PSQI, Pittsburgh quality of sleep index ; ESS, Epworth sleepiness scale ; EDS, Excessive daytime sleepiness.

a. Unless otherwise specified, p value was determined by Mann-Whitney U test.

b. P value was determined by Chi-square test.

c. Poor sleepers were defined as those with PSQI global score of 6 or greater.

d. EDS was defined as ESS score of 11 or greater.

consider that the skipped meal might be breakfast. A later sleep pattern may reflect a delay in an individual's internal biological clock relative to the schedule required by their daily activities[19]. Eating breakfast is considered one of the factors that regulate an individual's internal biological clock in relation to circadian rhythm[20].

The present study also showed gender differences in sleep parameters : women went to bed and got up earlier and showed a higher level of daytime sleepiness than men. These results are congruent with several previous studies[21,22]. Tsai et al. also showed the women had longer sleep latency, more awakenings and poor sleep quality than in men among college students[21]. In addition Oginska et al. reported that women showed a greater need of sleep, and more fatigue and mood than in men among adolescents, university students and young employees[22]. Moreover, in our study, there was a significant relationship between the frequency of daily meals and the proportion of those with EDS in women. Based on these data, it is speculated that lifestyle factors including dietary pattern have a greater impact on the sleep parameters of women than those of men in young adults.

Table 4 Multiple regression analysis of subjevtive sleep related parameters （N＝360）

	PSQI global score		ESS score	
	β^{a}	P-value	β^{a}	P-value
Dairy meal frequency[b]	0.169	0.001	−0.032	0.549
Sex[c]	0.038	0.483	0.156	0.003
Year of study	−0.053	0.479	−0.075	0.311
Age	0.005	0.946	−0.027	0.720
PSQI global score	—	—	0.084	0.112
ESS score	0.085	0.112	—	—
R^{2d}	0.040		0.045	

Abbreviation：PSQI, Pittsburgh quality of sleep index；ESS, Epworth sleepiness scale.

a. Standardized regression coefficients.

b. Daily meal frequency was categorized "3 times daily or more＝1" and "2 times daily or less＝2".

c. Men＝1, women＝2.

d. Coefficient of determination.

The factor of year of study was not a significantly influential factor for the PSQI global score and the ESS score in this study, though we assumed initially that the subjects in upper grades had more irregularity in their lifestyle and consequent sleep related problems than the subjects in lower grades for each schedule on curriculum. Considering the findings, there was the possibility that other factors on their schedule became confounding factors.

Our study includes several limitations. First, the method of food intake evaluation examined only the meal frequency and the validity and reproducibility of this method were not confirmed. The possibility that timing of eating[20], energy intake of food intake[15] and nutrient intake from that influenced our findings can not be denied. Thus, it must be considered that our results are based on estimated frequency of meal that the participants recognized. Second, our study design was cross-sectional and the presence of a causal relationship between meal skipping habit and subjective sleep factors remains unknown. It is likely that eating regular meals 3 times daily including breakfast affects sleep quality and also that a pleasant awakening after a good sleep impacts the consumption of regular meals 3 times daily. Third, we could not deny the possibility of confounding factors may have affected the results；physical activity[23], smoking status[5], menstrual cycle[24], academic performance[25], health status and other lifestyle habits[3]. In addition, eating habits of students might be affected by whether they receive meal or not[26]. The conclusions of this study should be generalized to Japanese medical students with caution because of possible bias, and further research is needed in order to generalize the findings of this study.

In conclusion, we found that there was a gender difference in sleep patterns and daytime sleepiness among medical students. Furthermore, better sleep quality was found among those who ate meals 3 times daily or more compared to that among with those who habitually skipped meals. These findings provide evidence that not skipping meals promotes health by getting better sleep.

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