



Original Article

Association of problem behavior with sleep problems and gastroesophageal reflux symptoms

Katsuyoshi Sakaguchi,¹ Takakazu Yagi,² Aya Maeda,¹ Kunihiro Nagayama,¹ Sawako Uehara,¹ Yoko Saito-Sakoguchi,¹ Kyoko Kanematsu¹ and Shouichi Miyawaki¹

¹Department of Orthodontics, Field of Developmental Medicine, Health Research Course, Graduate School of Medical and Dental Sciences and ²Department of Orthodontics, Kagoshima University Hospital, Kagoshima University, Kagoshima, Japan

Abstract **Background:** There are few large-scale epidemiologic studies examining the associations between sleep problems, gastroesophageal reflux disease (GERD) symptoms, lifestyle and food habits and problem behaviors (PB) in adolescents. The aim of this study was to evaluate the associations among these factors in Japanese adolescents.

Methods: A cross-sectional survey of 1840 junior high school students was carried out using questionnaires. The subjects were classified into PB or normal behavior (NB) groups using the Pediatric Symptom Checklist (PSC). The scores of the sleep-related factors, sleep bruxism, lifestyle and food habits, and GERD symptoms were compared. Logistic regression analysis was used to determine the factors related to PB.

Results: Mean subject age was 13.3 ± 1.8 years. The PB group had significantly longer sleep latency and higher GERD symptom score ($P < 0.001$). Furthermore, the PB group was significantly more likely to experience absence of the mother at dinner time, skip breakfast, and have <30 min of conversation among family at dinner time. The PB group had significantly higher frequencies of sleep bruxism, difficulty falling asleep within 30 min, nightmares, feeling of low sleep quality, daytime somnolence, and daytime lack of motivation. Feelings of low sleep quality had the strongest association with PB, with an adjusted odds ratio of 12.88 (95% confidence interval: 8.99–18.46).

Conclusions: PB in adolescents are associated with sleep problems, including sleep bruxism, as well as lifestyle and food habits and GERD symptoms.

Key words behavioral symptom, gastroesophageal reflux disease, psychology, sleep bruxism, sleep problem.

Psychological problems are known to be common among adolescents. Epidemiologic studies have demonstrated high prevalence rates of psychological problems in US adolescents.¹ In Japan, the prevalence of psychological problems in adolescents is increasing, and has been associated with problem behaviors (PB).² For example, in 2009, the Ministry of Education, Culture, Sports, Science and Technology of Japan issued a press release detailing a rise in severe PB in recent years, with incidents of juvenile violence and bullying. Additionally, concurrent PB such as school performance, school absenteeism, risk-taking behavior, injury, and impaired social functioning in children are associated with sleep problems.^{3,4} In particular, sleep bruxism in children is associated with an increased incidence of attention-behavior problems, which may be associated with higher arousal.⁵

Furthermore, sleep bruxism is significantly associated with chronic stress.⁶ Some reviews reported an association between emotional state and sleep, and that the association would be bidirectional.^{7,8}

Gastroesophageal reflux disease (GERD) impairs daytime and nocturnal functioning. In the USA, at least 20% of adults experience heartburn once a week.⁹ According to the American Gastroenterological Association, 79% of adult respondents in a survey reported experiencing heartburn at night, and the majority reported that night-time heartburn resulted in sleeping difficulties and impaired daytime functioning.¹⁰ Past research suggested that sleep quality is related to the severity of reflux during sleep, and adult patients with night-time heartburn and sleep complaints have greater acid contact times.¹¹ That study also noted that poor sleep occurred on the following day after esophageal acid exposure.

To date, the literature focusing on the prevalence and symptoms of GERD in adolescents is scarce. Based on questionnaire reports in the USA, the prevalence of symptoms of heartburn and acid regurgitation in children is 1.8–8.2%.¹² In the UK, the incidence of GERD in children is 0.84 per 1000 persons/year.¹³ Prevalence and symptom complexes vary according to geography

Correspondence: Shouichi Miyawaki, DDS PhD, Department of Orthodontics, Field of Developmental Medicine, Health Research Course, Graduate School of Medical and Dental Sciences, Kagoshima University, Kagoshima 890-8544, Japan. Email: miyawaki@dent.kagoshima-u.ac.jp

Received 29 January 2013; revised 29 July 2013; accepted 2 August 2013.

and patient perception.¹⁴ Therefore, there are few longitudinal reports evaluating GERD symptoms in children or adolescents. Some studies, however, suggest that GERD symptoms in childhood persist, and that these children are likely to experience GERD symptoms into adulthood.^{15,16} Given this situation, it is important to investigate GERD symptoms among adolescents, given that it may be useful for the future prevention and/or treatment of GERD symptoms in adults. In addition, it has been reported that GERD symptoms may result in anxiety and depression.^{14,17} In other words, there is a possibility that GERD symptoms may affect PB through psychological instability due to the anxiety or depression.

Considering the aforementioned associations of PB with sleep problems and sleep bruxism,^{3–8} the association between GERD symptoms and sleep problems,^{10,11} and the association between PB and GERD symptoms,^{14,17} these relationships are assumed to have associations with adolescents' psychological wellbeing. Additionally, recent studies have reported an association between sleep bruxism and gastroesophageal reflux in adults.^{18,19} Regarding this association, it was reported that PB are associated with bruxism, but that bruxism was not associated with GERD.⁵ Meanwhile, a noteworthy experimental study found that rhythmic masticatory muscle activity (RMMA) episodes including sleep bruxism were induced by esophageal acidification.²⁰ That study suggested that acid in the esophagus due to the gastroesophageal reflux possibly provokes sleep bruxism in order to wash out the acid. Also, sleep bruxism is considered to be one of the factors of sleep problems.²¹ Thus, we hypothesized that PB has associations with sleep problems and bruxism, and GERD symptoms in adolescents. The aims of the present study were (i) to collect epidemiologic data on Japanese adolescents; and (ii) to investigate the relationships of PB with sleep problems and bruxism, and GERD symptoms.

Methods

Participants

The study protocol was approved by the Ethics Committee of Kagoshima University. Approval from the Regional Committee of Education in Kagoshima prefecture in Japan was also obtained. This study was carried out from September to October 2009 in 11 public junior high schools located in the Kagoshima prefecture in Japan. A total of 1840 junior high school students aged 12–15 years and their parents agreed to participate in this study.

Procedure and questionnaires

Information regarding the survey was provided to the principal and school teachers of each school, and their consent to cooperate with this study was obtained. Each information package consisted of a cover letter, a questionnaire, and an envelope to return the questionnaire. The questionnaire was distributed to participants through their schools and returned in a sealed envelope. PB, sleep patterns, lifestyle and food habits, and GERD symptoms that were most common during the past week were investigated

using questionnaires as described in the following sections. Also, basic demographic information such as age, grade, and gender were collected.

Problem behavior

The Pediatric Symptoms Checklist (PSC) was used to assess PB. The PSC is a 35-item questionnaire examining children's emotional and PB according to parents' impressions of their children's psychosocial functioning.²² The PSC has been widely used and evaluated nationally. The Japanese edition of the PSC was used, with a cut-off score of 17.²³ According to the study that designed the Japanese PSC, a cut-off score of 17 provides a sensitivity of 80% and a specificity of 90%. Subjects were divided into a normal behavior (NB) group and a PB group according to PSC score.

Sleep-related factors, and lifestyle and food habits

Parents were asked about the most characteristic observation or hearing results, sleep behaviors, and lifestyle and food habits. With regard to sleep-related factors, parents were asked about their children's bedtime, sleep latency, sleeping hours, sleep bruxism, difficulty in falling asleep within 30 min, nightmares, feeling of low sleep quality, daytime strong somnolence, and lack of motivation. Observations were defined as positive for >3 episodes/week. With regard to lifestyle and food habits, parents were asked about the absence of father and/or mother at dinner time, whether the mother worked full time or part time (>3 days/week), whether parents arrived home late >3 times per week, skipping breakfast, <30 min of conversation among the family at dinner time, and having a late-evening snack. With the exception of the mother's employment and parents arriving home late, >3 episodes/week was required for a positive response.

GERD symptoms

The children's GERD symptoms were assessed using the Frequency Scale for the Symptoms of Gastroesophageal reflux disease (FSSG), which was completed by the parents. Developed in Japan, the FSSG is used in the initial diagnosis of GERD. It consists of 12 questions concerning dyspeptic and dysmotility symptoms.²⁴ Although the Questionnaire for the diagnosis of reflux disease (QUEST)²⁵ is also used in the initial diagnosis of GERD, its classification of symptoms as mild, moderate, or severe may be inappropriate for Japanese people.²⁴ Moreover, the content was not appropriate for adolescents. The FSSG evaluates seven acid reflux-related symptoms (questions 1, 4, 6, 7, 9, 10, and 12) and five dysmotility-like symptoms (questions 2, 3, 5, 8, and 11). When the cut-off score for FSSG was set at 8, the sensitivity was 62%, the specificity was 59%, and the reliability was 60%.²⁴

Statistical analysis

Children were classified into a PB group or an NB group according to a PSC cut-off score of 17.²³ Statistical significance was determined using the Mann–Whitney *U*-test for continuous data or the chi-squared test for categorical data. Logistic regression analysis was used to estimate the adjusted odds ratios (OR) and

Table 1 Male : female ratio

Gender	NB group (n = 1580)		PB group (n = 260)		Difference	
	n	%	n	%	χ^2	P
Male	753	47.7	137	52.7	0.27	NS
Female	827	52.3	123	47.3		

NB, normal behavior; PB, problem behavior.

95% confidence interval [CI] for having PB in all subjects. All statistical analysis was performed using SPSS 14.0 for Windows (SPSS, Tokyo, Japan). $P < 0.05$ was considered statistically significant.

Results

Of 1840 students, 950 were female (51.6%), and the mean age was 13.3 ± 1.8 years. The response rate was 81%. Based on the PSC cut-off score, the NB group consisted of 1580 students (85.9%), while the PB group had 260 students (14.1%). There was no difference in the male : female ratio between the two groups (Table 1). Table 2 lists the comparisons of continuous data. Compared to the NB group, the PB group had significantly longer sleep latency and higher FSSG scores ($P < 0.001$). There was no significant difference in bedtime, or sleeping hours. Table 3 lists the FSSG results: 4.2% of the NB group and 23.8% of the PB group had suspected GERD, respectively. Figure 1 shows the distribution of FSSG of each group. Table 4 lists the comparison of categorical data. The PB group had significantly greater sleep bruxism, difficulty in falling asleep within 30 min, nightmares, feeling of low sleep quality, daytime strong somnolence, and lack of motivation ($P < 0.001$). Furthermore, the PB group had a significantly higher number of episodes of absence of the mother at dinner time ($P < 0.016$), <30 min of conversation among the family at dinner time ($P < 0.001$), and skipping of breakfast ($P < 0.001$). After adjusting for age and sex, sleep bruxism, sleep latency, nightmares, a feeling of low sleep quality,

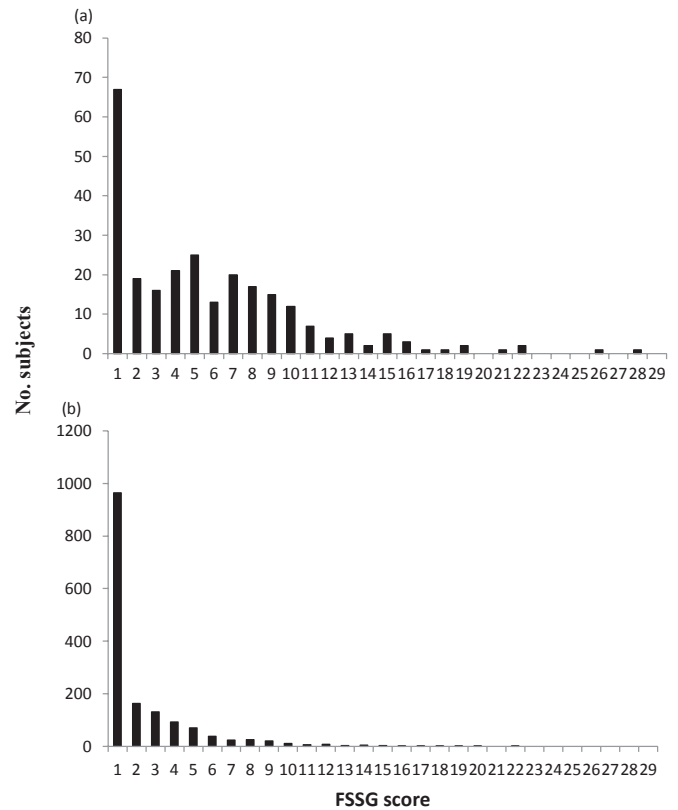


Fig. 1 Frequency Scale for the Symptoms of Gastroesophageal reflux disease (FSSG) scores for (a) the problem behavior group and (b) the normal behavior group.

lack of motivation, <30 min of conversation among the family at dinner time, and skipping breakfast were found to be significantly associated with PB. Among the sleep-related factors, a feeling of low sleep quality had the strongest association with PB with an adjusted OR of 12.88 (95%CI: 8.99–18.46), and among the lifestyle and food habits, <30 min of conversation among the family

Table 2 Sleep and GERD-related factors

Variables	NB group (n = 1580) Mean \pm SD	PB group (n = 260) Mean \pm SD	Z	P^\dagger
Bedtime (h)	10.3 \pm 2.7	10.3 \pm 2.8	-1.532	0.126
Sleep latency (min)	12.7 \pm 10.7	18.0 \pm 14.6	-5.388	<0.001
Sleeping hours	7.1 \pm 0.9	7.1 \pm 1.0	-0.587	0.557
FSSG score (points)	1.4 \pm 2.6	4.8 \pm 4.9	-13.627	<0.001

† Mann-Whitney *U*-test. GERD, gastroesophageal reflux disease; NB, normal behavior; PB, problem behavior.

Table 3 FSSG scores

NB group (n = 1580)				PB group (n = 260)			
FSSG		No. scoring > cut-off point †		FSSG		No. scoring > cut-off point †	
Range	Median	n	%	Range	Median	n	%
0–21	0	66	4.2	0–27	14	62	23.8

† 8 points (suspicion of GERD). FSSG, Frequency Scale for Symptoms of GERD; GERD, gastroesophageal reflux disease; NB, normal behavior; PB, problem behavior.

Table 4 Sleep-related factors and lifestyle and food habits

Categorical variables	NB group (n = 1580)		PB group (n = 260)		χ^2 [†]	P
	%	(n)	%	(n)		
Sleep-related factors						
Sleep bruxism	14.7	233	40.8	106	100.59	<0.001
Difficulty falling asleep within 30 min	5.9	93	20.8	54	67.28	<0.001
Nightmare	1.1	18	9.2	24	65.54	<0.001
Feeling of low sleep quality	5.9	94	57.3	149	513.76	<0.001
Daytime somnolence	4.1	64	20.8	54	103.98	<0.001
Daytime lack of motivation	3.0	47	28.8	75	241.38	<0.001
Lifestyle and food habits						
Absence of father at dinner time	13.1	207	17.3	45	3.34	0.068
Absence of mother at dinner time	3.2	50	6.2	16	5.77	0.016
<30 min of conversation among family at dinner time	2.5	39	6.2	16	10.46	0.001
Mother's employment (full time, or part time >3 days per week)	28.5	450	31.5	82	1.02	0.314
Late home arrival of parents (>three times per week)	4.4	70	5.8	15	0.91	0.341
Late-evening snack	9.0	142	10.8	28	0.85	0.358
Skipping breakfast	11.5	182	25.4	66	36.81	<0.001

[†]Pearson's chi-square test. NB, normal behavior; PB, problem behavior.

at dinner time had the strongest association, with an adjusted OR of 2.80 (95%CI: 1.32–5.99; Table 5).

Discussion

According to the PSC, 260 students (male, $n = 137$; female, $n = 123$) were found to have PB (14%). This prevalence rate is consistent with other studies that reported 12–14% of adolescents to have psychosocial issues.^{22,26,27} In the present study there was no difference in the results between male and female, which differs from another study that used the PSC.²² The difference between the present study and the previous research remains to be explained. To elucidate the reason for the difference, extensive research is needed.

Problem behaviors and sleep bruxism

Previous studies have reported an association between psychological problems in adolescents and sleep disorders and sleep bruxism in particular.^{28–30} The present study found a significantly higher frequency of sleep bruxism in the PB group (OR, 3.28; 95%CI: 2.29–4.69).

Micro-arousals usually occur prior to the onset of sleep bruxism.³¹ Children with sleep bruxism have a higher arousal index, and also score higher on questionnaires on PB.^{5,32} Studies have observed that emotional stress disturbs the quality of sleep.³³

Table 5 Logistic regression analysis for risk of problem behavior

Variables	Adjusted OR	95%CI
Sleep bruxism	3.28	2.29–4.69
Sleep latency (min)	1.02	1.00–1.03
Nightmares	3.21	1.32–7.80
Feeling of low sleep quality	12.88	8.99–18.46
Daytime lack of motivation	5.79	3.46–9.71
<30 min of conversation among family at dinner time	2.80	1.32–5.99
Skipping breakfast	1.66	1.08–2.55

CI, confidence interval; OR, odds ratio.

Another study reported that such stress can affect the transitions of sleep stages.³⁴ In other words, sleep fragmentation may result in behavioral and attention problems.³⁵ Insufficient psychological wellbeing may decrease the quality of sleep, leading to bruxism. It remains unclear, however, how emotional instability accompanied by PB physiologically affects the occurrence of bruxism. Sleep deterioration and PB might very well affect each other.

In the present study, the PB group was found to have significantly longer sleep latency. Another study reported a tendency towards prolonged sleep latency and REM latency in children with sleep bruxism, although it was not statistically significant.⁵ Emotional status has also been reported to affect the occurrence of arousals,³⁶ sleep fragmentation, and a prolonged REM period.^{37,38} The emotional state of adolescents with PB may similarly affect and alter the content and/or quality of sleep. In the present study, sleep bruxism was observed in 14.7% and in 40.8% of the NB and PB groups, respectively. The estimated prevalence of bruxism ranges between 18% and 5–20%.^{29,39} Although the precise confirmation of muscle activities associated with bruxism would require polysomnographic evaluation, parental accounts of subjective sleep bruxism have been previously used in other studies and are considered reliable because their reports are based on nearly daily and continuous observation.⁴⁰ Behavioral and physiological verification are necessary to elucidate the association between PB and bruxism. In addition, it is possible that GERD symptoms may be associated with the manifestation of bruxism.

Problem behaviors and sleep-related factors

Contrary to our expectation, there were no significant differences detected for bedtime and sleeping hours. Bedtime has been shown to have no significant association with PB.³ A statistical survey in Japan found that bedtime is delayed and sleeping hours shortened by several factors, including sports activity, adding more academic teaching after school until late at night, and, in adolescents, playing TV games and using the Internet in particular.⁴¹ These situations may not be different for the NB and PB

groups and, thus, no significant difference was seen. Adolescents with emotional insecurities or psychological anxiety experience difficulty falling asleep and maintaining sleep.³ In the present study, the time required for the PB group to fall asleep was significantly longer than that for the NB group. Furthermore, the PB group had significantly more difficulty falling asleep within 30 min, and experienced significantly more nightmares, feeling of low sleep quality, daytime strong somnolence, and lack of motivation. Moreover, regression analysis showed that the feeling of low sleep quality was strongly associated with PB. Past studies have reported that evening alertness ('eveningness') is associated with longer sleep latency, morning tiredness, and daytime sleepiness,⁴² and that eveningness is associated with behavioral problems in adolescents.^{43,44} Regarding the possible association between PB and sleep-related factors, an effect of daytime cortisol level has been suggested.^{44,45} Also, other possible associations have been reported. Micro-arousal, which often occurs associated with gastroesophageal reflux,³⁴ causes daytime sleepiness due to sleep deprivation,⁴⁶ and decreases the quality of sleep.^{47,48} Daytime somnolence observed in the present study is possibly associated with this low quality of sleep. Symptoms such as difficulty falling asleep and feeling of low sleep quality are suggestive of deterioration of sleep quality. Indeed, these symptoms may be an expression of PB. Further research, however, is needed to elucidate these associations.

Problem behaviors and lifestyle and food habits

The PB group had a significantly higher frequency of absent mothers at dinner time and <30 min of conversation among the family at dinner time. There is little evidence demonstrating a causal relationship between family meals and PB. A school-based survey on family meals and psychosocial wellbeing among US adolescents, however, indicated that family meals are inversely related to substance abuse, low academic performance, and depressive symptoms.⁴⁹ One of the most important benefits of family meals is conversation, because it provides a sense of togetherness and relaxation and they engage in laughter as a family.⁵⁰ Mental calm and stability generated by the conversation may help decrease the psychological insecurity experienced by some adolescents. The presence of the mother may have a significant impact on the nature of the conversation during a family meal.

Skipping breakfast is a major issue because the resulting inadequate nutrition can lead to learning problems and decreased daytime concentration.⁵¹ A statistical survey conducted by the Health, Labour and Welfare Ministry of Japan in 2010 reported that the prevalence rates of skipping breakfast were 5.6% and 5.2% in male and female subjects aged 7–14 years, respectively. Among those aged 15–19 years, the prevalence rates were 14.5% and 14.0% for male and female, respectively, and the rates continued to increase until the fourth decade of life. Recently, a PB called "Kireru" among Japanese adolescents has become a social issue. These adolescents become easily angered and are unable to control their feelings. According to a survey of junior and high school students in suburban areas, those who had breakfast were likely to have a decreased frequency of Kireru.⁵² Also, the School Breakfast Program showed significant associations between

eating breakfast and school performance, self-esteem, and psychosocial function.⁵³ Few studies have examined how skipping breakfast may be associated with psychological insecurity.⁵⁴ In the present study, however, skipping breakfast was associated with not only PB but also daytime lack of motivation. Further research is required to better delineate these associations.

Problem behaviors and GERD symptoms

Gastroesophageal reflux disease is characterized by the reflux of gastric contents into the esophagus, leading to several symptoms and/or complications. In Japan, the prevalence rate of GERD has been steadily increasing and now surpasses 30%.⁵⁵ In the present study 7% of the participants had GERD symptoms. The prevalence rate is nearly equal to the results of past studies.^{12,13} Also, compared to the 4.2% of the NB group who scored higher than the cut-off point (8) for GERD symptoms, 23.8% of the PB group were identified as having these symptoms. Compared with the prevalence rate in adults reported in Japan,⁵⁵ this high rate of GERD in the present adolescent PB group deserves attention. To our knowledge, large-scale data on GERD symptom in Japanese adolescents are scarce. The present data have clinical significance.

Several studies have suggested that GERD symptoms are associated with psychological problems, reporting that these symptoms may result in anxiety and/or depression due to the discomfort caused by reflux.^{14,17} Those studies indicated that psychiatric disorders such as anxiety or depression can influence an individual's perception of reflux symptoms, thus potentially leading to discomfort the following day. GERD events during sleep have been reported to increase micro-arousals.⁵⁶ Regarding the effect of GERD symptoms, an experimental study found that frequencies of electromyography bursts, RMMA episodes, and grinding noise were significantly higher after an acidic infusion than after a saline infusion, and that RMMA episodes including sleep bruxism were induced by esophageal acidification.²⁰

As already noted here, the occurrence of micro-arousals associated with gastroesophageal reflux might cause sleep deprivation and the decrease of sleep quality. Hence, discomfort and/or depression due to GERD symptoms, and decrease of sleep quality are possibly associated with PB. We believe that further studies including physiological experiments will elucidate these associations and will contribute to the treatment of PB in adolescents.

Conclusion

The present large-scale cross sectional study on Japanese junior high school students found that PB in adolescents are associated with some sleep problems, including sleep bruxism, as well as several lifestyle and food habits and GERD symptoms. The presence of PB should prompt medical personnel to investigate possible GERD symptoms and sleep bruxism, and parents to pay closer attention to these developments.

Acknowledgments

This study was supported by Grants-in-aid for Scientific Research B and C and Exploratory Research by the Japan Society

for the Promotion of Science. We are grateful for the cooperation of Kagoshima Dental Association and Kagoshima Prefecture Committee of Education. We also thank the staff of the Department of Orthodontics, Field of Developmental Medicine, Health Research Course, Graduate School of Medical and Dental Sciences, Kagoshima University for their invaluable assistance.

References

- Costello EJ, Egger H, Angold A. 10-year research update review: The epidemiology of child and adolescent psychiatric disorders: I. Methods and public health burden. *J. Am. Acad. Child Adolesc. Psychiatry* 2005; **44**: 972–86.
- Honjo S, Kasahara Y, Ohtaka K. School refusal in Japan. *Acta Paedopsychiatr.* 1992; **55**: 29–32.
- Stein MA, Mendelsohn J, Obermeyer WH *et al.* Sleep and behavior problems in school-aged children. *Pediatrics* 2001; **107**: e60.
- Fallone G, Owens JA, Deane J. Sleepiness in children and adolescents: Clinical implications. *Sleep Med. Rev.* 2002; **6**: 287–306.
- Herrera M, Valencia I, Grant M *et al.* Bruxism in children: Effect on sleep architecture and daytime cognitive performance and behavior. *Sleep* 2006; **29**: 1143–8.
- Hicks RA, Conti P. Nocturnal bruxism and self reports of stress-related symptoms. *Percept. Mot. Skills* 1991; **72**: 1182.
- Kahn M, Sheppes G, Sadeh A. Sleep and emotions: bidirectional links and underlying mechanisms. *Int. J. Psychophysiol.* 2013; **89**: 218–28.
- Gregory AM, Sadeh A. Sleep, emotional and behavioral difficulties in children and adolescents. *Sleep Med. Rev.* 2013; **16**: 129–36.
- Locke GR 3rd, Zinsmeister AR, Fett SL *et al.* Overlaps of gastrointestinal symptom complexes in a US community. *Neurogastroenterol. Motil.* 2005; **17**: 29–34.
- Shaker R, Castell DO, Schoenfeld P *et al.* Night time heartburn is an under-appreciated clinical problem that impacts sleep and daytime function: The results of a Gallup survey conducted on behalf of the American Gastroenterological Association. *Am. J. Gastroenterol.* 2003; **98**: 1487–93.
- Dickman R, Green C, Fass SS *et al.* Relationships between sleep quality and pH monitoring findings in persons with gastroesophageal reflux disease. *J. Clin. Sleep Med.* 2007; **15**: 505–13.
- Nelson SP, Chen EH, Syniar GM *et al.* Prevalence of symptoms of gastroesophageal reflux during childhood: A pediatric practice-based survey. Pediatric Practice Research Group. *Arch. Pediatr. Adolesc. Med.* 2000; **154**: 150–4.
- Ruigómez A, Wallander MA, Lundborg P *et al.* Gastroesophageal reflux disease in children and adolescents in primary care. *Scand. J. Gastroenterol.* 2010; **45**: 139–46.
- Kamolz T, Velanovich V. Psychological and emotional aspects of gastroesophageal reflux disease. *Dis. Esophagus* 2002; **15**: 199–203.
- Waring JP, Feiler MJ, Hunter JG *et al.* Childhood gastroesophageal reflux symptoms in adult patients. *J. Pediatr. Gastroenterol. Nutr.* 2002; **35**: 334–8.
- EL-Serag HB, Richardson P, Pilgrim P *et al.* Determinants of gastroesophageal reflux disease in adults with a history of childhood gastroesophageal reflux disease. *Clin. Gastroenterol. Hepatol.* 2007; **5**: 696–701.
- Bradley LA, Richter JE, Pulliam TJ *et al.* The relationship between stress and symptoms of gastroesophageal reflux: The influence of psychological factors. *Am. J. Gastroenterol.* 1993; **88**: 11–19.
- Miyawaki S, Tanimoto Y, Araki Y *et al.* Association between nocturnal bruxism and gastroesophageal reflux. *Sleep* 2003; **26**: 888–92.
- Miyawaki S, Tanimoto Y, Araki Y *et al.* Relationships among nocturnal jaw muscle activities, decreased esophageal pH, and sleep positions. *Am. J. Orthod. Dentofacial Orthop.* 2004; **126**: 615–9.
- Ohmure H, Oikawa K, Kanematsu K *et al.* Influence of experimental esophageal acidification on sleep bruxism: A randomized trial. *J. Dent. Res.* 2011; **90**: 665–71.
- Lam MH, Zhang J, Li AM, Wing YK. A community study of sleep bruxism in Hong Kong children: Association with comorbid sleep disorders and neurobehavioral consequences. *Sleep Med.* 2011; **12**: 641–5.
- Jellinek MS, Murphy JM, Little M *et al.* Use of the Pediatric Symptom Checklist to screen for psychosocial problems in pediatric primary care: A national feasibility study. *Arch. Pediatr. Adolesc. Med.* 1999; **153**: 254–60.
- Ishizaki Y, Fukai Y, Kobayashi Y *et al.* The cut off score of the Japanese version of the pediatric symptoms checklist: Screening of school-aged children with psychosocial and psychosomatic disorders. *J. Jpn. Pediatr. Soc.* 2000; **104**: 841–50.
- Kusano M, Shimoyama Y, Sugimoto S *et al.* Development and evaluation of FSSG: Frequency scale for the symptoms of GERD. *J. Gastroenterol.* 2004; **39**: 888–91.
- Carlsson R, Dent J, Bolling-Sternevald E *et al.* The usefulness of a structured questionnaire in the assessment of symptomatic gastroesophageal reflux disease. *Scand. J. Gastroenterol.* 1998; **33**: 1023–9.
- Jellinek MS, Murphy JM, Robinson J *et al.* The Pediatric Symptom Checklist: Screening school-age children for psychological dysfunction. *J. Pediatr.* 1988; **112**: 201–9.
- Murphy JM, Reede J, Jellinek MS *et al.* Screening for psychological dysfunction in inner-city children: Further validation of the Pediatric Symptom Checklist. *J. Am. Acad. Child Adolesc. Psychiatry* 1992; **31**: 1105–11.
- Ivanenko A, Crabtree VM, O'Brien LM *et al.* Sleep complaints and psychiatric symptoms in children evaluated at a pediatric mental health clinic. *J. Clin. Sleep Med.* 2006; **15**: 42–8.
- Ohayon MM, Li KK, Guilleminault C. Risk factors for sleep bruxism in the general population. *Chest* 2001; **119**: 53–61.
- Suwa S, Takahara M, Shirakawa S *et al.* Sleep bruxism and its relationship to sleep habits and lifestyle of elementary school children in Japan. *Sleep Biol. Rhythms* 2009; **7**: 93–102.
- Lavigne GJ, Rompre PH, Guitard F *et al.* Lower number of K-complexes and K-alphas in sleep bruxism: A controlled quantitative study. *Clin. Neurophysiol.* 2002; **113**: 686–93.
- Shang CY, Gau SS, Soong WT. Association between childhood sleep problems and perinatal factors, parental mental distress and behavioral problems. *J. Sleep Res.* 2006; **15**: 63–73.
- Manfredini D, Landi N, Fantoni F *et al.* Anxiety symptoms in clinically diagnosed bruxers. *J. Oral Rehabil.* 2005; **32**: 584–8.
- Lavigne GJ, Kato T, Kolta A *et al.* Neurobiological mechanisms involved in sleep bruxism. *Crit. Rev. Oral. Biol. Med.* 2003; **14**: 30–46.
- Beebe DW, Wells CT, Jeffries J, Chini B, Kalra M, Amin R. Neuropsychological effects of pediatric obstructive apnea. *J. Int. Neuropsychol. Soc.* 2004; **10**: 962–75.
- Halasz P, Terzano R, Parinno M *et al.* The nature of arousal in sleep. *J. Sleep Res.* 2004; **13**: 1–23.
- Germain A, Buysse DJ, Nofzinger E. Sleep-specific mechanisms underlying posttraumatic stress disorder: Integrative review and neurobiological hypothesis. *Sleep Med. Rev.* 2007; **12**: 185–95.
- Buysse DJ, Hall M, Begley A *et al.* Sleep and treatment response in depression: New findings using power spectral analysis. *Psychiatr. Res.* 2001; **103**: 51–67.
- Partinen M. Epidemiology of sleep disorders. In: Kryger MH, Roth T, Dement WC (eds). *Principles and Practice in Sleep Medicine*. Saunders, Philadelphia, PA, 2011; 437–52.

- 40 Cheifetz AT, Osganian SK, Allred EN *et al.* Prevalence of bruxism and associated correlates in children as reported by parents. *J. Dent. Child.* 2005; **72**: 67–73.
- 41 *Dai nikai kodomo seikatsu jittai kihon tyousa*. Benesse Educational Research and Development Center, Tokyo, 2010 (in Japanese).
- 42 Gaina A, Sekine M, Kanayama H *et al.* Morning evening preference: Sleep pattern spectrum and lifestyle habits among Japanese junior high school pupils. *Chronobiol. Int.* 2006; **23**: 607–21.
- 43 Gau SS, Shang CY, Merikangas KR *et al.* Association between morningness-eveningness and behavioral/emotional problems among adolescents. *J. Biol. Rhythms* 2007; **22**: 268–74.
- 44 Susman EJ, Dockray S, Schiefelbein VL *et al.* Morningness/eveningness, morning-to-afternoon, cortisol ratio, and antisocial behavior problems during puberty. *Dev. Psychol.* 2007; **43**: 811–22.
- 45 Kobak R, Zajac K, Levine S. Cortisol and antisocial behavior in early adolescence: The role of gender in an economically disadvantaged sample. *Dev. Psychopathol.* 2009; **21**: 579–91.
- 46 Bonnet MH. Sleep fragmentation as the cause of daytime sleepiness and reduced performance. *Wien. Med. Wochenschr.* 1996; **146**: 332–4.
- 47 Macaluso GM, Guerra P, Di Giovanni G *et al.* Sleep bruxism is a disorder related to periodic arousals during sleep. *J. Dent. Res.* 1998; **77**: 565–73.
- 48 Parrino L, Ferri R, Bruni O *et al.* Cyclic alternating pattern (CAP): The marker of sleep instability. *Sleep Med. Rev.* 2012; **16**: 27–45.
- 49 Eisenberg ME, Olson RE, Neumark-Sztainer D, Story M, Bearinger LH. Correlations between family meals and psychological well-being among adolescents. *Arch. Pediatr. Adolesc. Med.* 2004; **158**: 792–6.
- 50 Fulkerson JA, Story M, Neumark-Sztainer D *et al.* Family meals: Perceptions of benefits and challenges among parents of 8- to 10-year-old children. *J. Am. Diet. Assoc.* 2008; **108**: 706–9.
- 51 Zullig K, Ubbes VA, Pyle J *et al.* Self-reported weight perceptions, dieting behavior, and breakfast eating among high school adolescents. *J. Sch. Health* 2006; **76**: 87–92.
- 52 Kobayashi M. A study on “Kireru” from the survey of life conditions among junior and senior high school students. *J. Natl Inst. Public Health* 2005; **54**: 101–7.
- 53 Murphy JM, Pagano ME, Nachmani J, Sperling P, Kane S, Kleinman RE. The relationship of school breakfast to psychological and academic performance. *Arch. Pediatr. Adolesc. Med.* 1998; **152**: 899–907.
- 54 Hoyland A, Dye L, Lawton CL. A systematic review of the effect of breakfast on the cognitive performance of children and adolescents. *Nutr. Res. Rev.* 2009; **22**: 220–43.
- 55 Fujiwara Y, Arakawa T. Epidemiology and clinical characteristics of GERD in the Japanese population. *J. Gastroenterol.* 2009; **44**: 518–34.
- 56 Freidin N, Fisher MJ, Taylor W *et al.* Sleep and nocturnal acid reflux in normal subjects and patients with reflux oesophagitis. *Gut* 1991; **32**: 1275–9.