Association between lunar phase and sleep characteristics

Csilla Zita Turányi[1], Katalin Zsuzsanna Rónai[1], Rezső Zoller[1,3], Orsolya Véber[1], Mária Eszter Czira[1,7], Ákos Újszászi[1], Gergely László[1], András Szentkirályi[1,7], Andrea Dunai[1,3], Anett Lindner[1], Julianna Luca Szőcs[1], Ádám Becze[1], Andrea Kelemen[1], Zsófia Lendvai[1], Miklos Z Molnar[5,6], István Mucsi[1,2, 6] and Márta Novák[1,4]

[1] Institute of Behavioral Sciences, Semmelweis University, Budapest, Hungary

[2] Institute of Pathophysiology, Semmelweis University, Budapest, Hungary

[3] 1st Dept. of Internal Medicine, Semmelweis University, Budapest, Hungary

[4] Dept. of Psychiatry, University Health Network, University of Toronto, Toronto, Canada

[5] Harold Simmons Center for Kidney Disease Research and Epidemiology, Division of Nephrology and Hypertension, University of California Irvine Medical Center, Orange, CA; USA

[6] Dept. of Medicine, Division of Nephrology, University Health Network, University of Toronto, Toronto, Ontario, Canada

[7] Institute of Epidemiology and Social Medicine, University of Muenster, Germany

CORRESPONDING AUTHOR: István Mucsi, MD, PhD, Division of Nephrology, *University of Toronto, Toronto General Hospital, University Health Network, 585 University Avenue, Peter Munk Building, 11c-1268, Toronto ON M5G 2N2*
Tel.: 416-340-4084

Phone: (416) 340-4084

Fax: (647) 689-3070

e-mail: istvan@nefros.net

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ABSTRACT

Objectives: Popular belief holds that the lunar cycle affects human physiology, behavior and health, including sleep. To date, only a few and conflicting analyses have been published about the association between lunar phases and sleep. Our aim was to analyze the relationship between lunar phases and sleep characteristics.

Methods: In this retrospective, cross-sectional analysis data from 319 patients who had been referred for sleep study were included. Individuals with apnea-hypopnea index≥15/h were excluded. Socio-demographic parameters were recorded. All participants underwent one-night standard polysomnography. Associations between lunar cycle (new moon, full moon and alternate moon) and sleep parameters were examined in unadjusted and adjusted models.

Results: 57% of patients were males. Mean age for men was 45±14 years and 51±12 years for women. 224 persons had their sleep study done during alternate moon, 47 during full moon and 48 during new moon. There were no significant differences regarding age and gender between groups. Full moon was associated with lower sleep efficiency (median(%)[IQR] new moon 82[18], full moon 74[19], alternate moon 82[15], p<0.001), less deep sleep (median(%)[IQR] new moon 9[9], full moon 6[4], alternate moon 11[9], p<0.001) and increased REM latency (median (minutes)[IQR] new moon 98[74], full moon 137[152], alternate moon 97[76], p<0.001), even after adjustment for several covariables.

Conclusion: Our results are consistent with a recent report and the widely held belief that sleep characteristics may be associated with the full moon.

Key words: sleep parameters, lunar cycle, full moon, polysomnography

INTRODUCTION

The human culture has been very much interested in the cycles of the moon [1]. Beliefs in lunar effects on sleep date back to ancient times. The passage from full to crescent moon provided the basis for the earliest calendars of most civilizations and can be linked to Assyrian and Babylonian mythology. Nevertheless, evidence for the supposed influence of the moon on human behavior has proven particularly elusive. Surveys of workers in the mental health professions, however, show a persistent belief that the full moon may influence behavior [2, 3].

The observations made by Galileo Galilei of the phases of the moon cycle remain correct in today's astronomical understanding. There are 8 phases of the moon cycle, which succeed each other with a periodicity of 3.69 days: new, waxing crescent, first quarter, waxing gibbous, full, waning gibbous, last quarter, waning crescent. The synodic cycle is the interval between 2 successive new moons. This is the time it takes the moon to complete an orbit around the earth (29.53 days), corrected for the earth's orbit around the sun. Most studies associated with the influence of the moon on human behavior focus mainly on the full moon within the synodic cycle [4].

Several published reports suggest an association of the lunar cycle with menstrual cycle [5, 6]. The lunar cycle also has been suggested to have an impact on fertility and births [7-9]. However, no significant effect of the lunar cycle on the number of deliveries was found in Austria [10] and in American studies [11, 12]. Several papers reported associations between the lunar cycle and the frequency of hospital admissions due to various causes: cardiovascular disease [13], acute coronary events [14], gastrointestinal hemorrhage [15] and infectious diarrhea [16]. Lunar phases were also associated with the number of requests for appointment at a thyroid outpatient clinic [17]. On the other hand, a number of studies showed insufficient evidence or no association between various health-related events and the synodic lunar cycle [18-24]. Studies also showed that lunar periodicity

may be associated with traffic accidents [25], crime[26], suicides, aggravated assaults and psychiatric emergency room visits [7]. Little is known, however, about the association between the lunar cycle and sleep patterns.

Röösli et al. studied 31 volunteers and showed an association between lunar cycle and sleep characteristics. Subjective sleep duration was shortened and fatigue was increased at full moon. In contrast, sleep latency, wake up events, level of distress, mood and well-being were not associated with the lunar cycle [27]. A study monitoring wrist-activity showed no association of sleep duration and moon phase [28]. Lastly, the moon cycle had no effect on human daily rhythm, wake-up and to-sleep times in 4 volunteers [29]. An analysis of diaries kept by 196 participants showed no association between full moon and dream recall [30]. However, a recent study including 33 participants found that electroencephalogram delta activity during NREM sleep, an indicator of deep sleep, decreased by 30%, time to falling asleep increased by 5 min, and EEG-assessed total sleep duration was reduced by 20 min around full moon [31].

In the present work, we analyzed the relationship of synodic lunar phases with subjective and objective sleep characteristics. Specifically, we wanted to test the hypothesis that full moon is associated with lower sleep efficiency and deep sleep. We also wanted to quantify the association of full moon and sleep latency. There is a strong link between gender and sleep both in the structure of sleep as in the incidence of various sleep disorders [32, 33]. Accordingly, we have analyzed if the association between the lunar cycle and sleep was different in the sexes.

METHODS

Sample of patients and data collection

This retrospective, cross-sectional study was performed at the 1st Department of Internal Medicine, Semmelweis University, Budapest, Hungary. Data obtained from 319 consecutive patients, referred to the sleep laboratory for sleep studies, were analyzed between between January 2007 and November 2009. Exclusion criteria included technical limitations, moderate and severe obstructive sleep apnea (AHI ≥15) and sleep efficiency under 20%.

The ethics committee of the Semmelweis University had approved the study Before enrollment, patients received detailed written and verbal information regarding the aims and protocol of the study and signed informed consent. Socio-demographic information (age, gender, level of education) and details of medical history were collected at enrollment.

Questionnaires

Participants completed a battery of validated questionnaires, including the Athens Insomnia Scale (AIS) (score range 0–24, with higher scores indicating worse sleep, a cut-off score of 10 was used to identify patients with clinically relevant insomnia [34]) and Center for Epidemiologic Studies–Depression (CES-D) Scale [35] (scores range from 0 -60, with high scores indicating greater depressive symptoms, a cut-off score of 16 was used to estimate the frequency of potentially relevant depression in patients), Stanford Sleepiness Scale (SSS) [36] and subjective sleep log [37]. We also tabulated the Charlson Comorbidity Index [38].

Polysomnography

Standard, attended overnight polysomnography was performed in four acustically isolated and video monitored units in our sleep laboratory (SOMNOscreen^TM PSG Tele, SOMNOmedics GmBH, Germany, CE0494). Tests were always done on weekdays, "lights off" and "lights on" times were uniform and were set at 9 pm and 6 am, respectively. Sleep architecture was characterized by the

following parameters: sleep efficiency is the ratio of time spent asleep over the time spent in bed; sleep onset latency: time from lights out until sleep onset (defined as first epoch of stage 2); number of awakenings; arousal index: number of arousals per hour. The amount of four different stages of non-rapid eye movement sleep and REM sleep were determined as percentages of sleep period time (time from sleep onset until final awakening). Light sleep is the sum of stage 1 and 2, slow wave sleep or deep sleep is the combination of stage 3 and 4. Wake percentage is defined as the percentage of wake period from lights out to lights on. All recordings were scored visually per 30 s epochs by experienced scorers according to the criteria of Rechtschaffen & Kales [39].

Definition of sleep disorders

Apnea was defined as the absence of airflow for more than 10 s, hypopnea was defined as a clearly discernible reduction in airflow for more than 10 s, associated with an arousal and/or reduction in oxygen saturation greater than 3% [40]. OSA severity was defined by apnoe-hypopnea index (AHI), which is calculated as the number of apnea and hypopnea episodes per hour of sleep.

PLMS was defined by limb movement (LM) duration: 0.5–5 s with inter-movement interval: 5–90 s. A PLMS cycle consisted of at least four consecutive LMs. The periodic limb movement index (PLMI) was defined as the number of LMs per hours during sleep. We defined PLMS if PLMI ≥ 15 [41].

Statistical analysis

Statistical analysis was carried out, using the SPSS 17.0 (SPSS Inc., Chicago, IL, USA). Data were summarized using proportions, mean±standard deviation, or median (interquartile range − IQR), as appropriate. Data were analyzed using ANCOVA or Kruskal-Wallis test, as appropriate. Sidac post hoc analyses or Mann-Whitney test with Bonfferoni correction were conducted to explore the

differences of the sleep parameters between moon phase groups. The significance level was defined as $p < 0.05$.

Tests for interaction (ANCOVA) between gender and lunar phases were used to examine whether the association between sleep parameters and moon cycle is different between men and women. We investigated the association of lunar phases and objective sleep efficiency, light sleep%, deep sleep%, wake%, REM%, sleep latency and REM latency. Skewed variables were square root- or rank-transformed, as appropriate. We adjusted our analyses for several co-variables, reportedly associated with sleep characteristics: age [42], gender [33], smoking [43], coffee consumption [44], use of sleeping pills [45], regular exercise [46], Charlson Comorbidity Index and CES-D score [47].

Moon phase was determined using information from the Hungarian Astronomical Association sidereal calendar [48]. We analyzed our data in three different ways: first, we categorized lunar phases into three groups: new moon, full moon and alternate moon (Waxing Crescent, Waxing Gibbous, Waning Gibbous and Waning Crescent). For sensitivity analysis we repeated our analysis using three different cut off points: 1) New/Full moon and one day before and one day after; 2: New/Full moon and two days before and after; 3: New/Full moon and three days before and after.

RESULTS

Five hundred and twenty-two consecutive patients data were enrolled; two patients had a sleep efficiency under 20%, four recordings were excluded due to technical limitations and 197 patients had mild/severe obstructive sleep apnea. Thus, 319 patients were included in the final analysis.

The participant characteristics are presented in Table 1. The mean(±SD) age of the study participants was 45±14 years for men and 52±12 years for women. The mean BMI was 28.2±5.4 kg/m^2. Twenty three individuals used sleeping pills. Mean sleep efficiency was 78.2%. The median [interquartile range] Charlson Comorbidity Index was 1.0 [2.0].

One hundred and seventeen patient (36%) had mild obstructive sleep apnea, their mean AHI was 9.3±2.2, one hundred and fourteen (35%) had PLMS, their mean PLMI was 42.0±28.4, while one ninety-five (29.7%) of our patients reported insomnia symptoms, their mean Athens score was 13.5±3.5. There were no significant differences regarding age, gender, BMI, use of sleeping pills, coffee consumption, shift work, Charlson Comorbidity Index, CESD score and sleep disorders in the study sub-groups (Table 1).

Objective sleep parameters, recorded with polysomnography, showed significant associations with lunar phases (Table 2). Deep sleep (p<0.001), wake (p<0.001) and REM (p=0.002) percentages were significantly different between the three groups. Post hoc analyses revealed less deep sleep percentage (6.1[4] vs. 10.9[9], p<0.05) and REM percentage (10.1±6.6 vs. 13.9±6.6, p<0.05), higher wake percentage (28.7±12.3 vs. 20.2±12, p<0.05) at full moon compared to alternate moon phases. Sleep efficiency was significantly shorter (p<0.001), while sleep latency (p=0.001) and REM latency (p<0.001) was longer at full moon compared to other two moon phases. The results were similar in our sensitivity analyses using the three cut off points to define "full moon" specified in the methods section (not shown).

These associations remained significant after adjusting for age, gender, smoking, coffee consumption, use of sleeping pills, and regular exercise. Most of these associations remained significant after adjustment for the Charlson Comorbidity Index. Finally, adjustment for the Center for Epidemiologic

Studies Depression Scale score in the final model did not abrogate the significant associations for deep sleep, wake percentage, sleep efficiency, and REM latency.

The interaction between gender and lunar phases was significant for deep sleep (p=0.01) and sleep latency (p=0.01), and in general, the observed differences for the variables of interest were consistently more pronounced in women (Table 3). Interestingly, none of the assessed sleep parameters (neither subjective nor objective) were associated with pre- or postmenopausal status in this sample (not shown).

Subjective sleep-related parameters were not significantly different between the three groups (Table 4). Within gender strata, however, the self-reported sleep onset latency was longer at full moon in women (median[IQR]: new moon 30.0[25] min, full moon 52.5[66] min, alternate moon 25.0[50], p=0.04), and the difference was nearly significant among men (median[IQR]: new moon 30.0[45] min, full moon 60.0[76] min, alternate moon 30.0[45] min, p=0.06).

DISCUSSION

In this cohort of patients undergoing diagnostic polysomnography, we found that full moon was associated with less deep sleep, lower sleep efficiency, and longer REM latency. Furthermore, this association seemed to be more pronounced in women than men. A novelty of our study is the enrollment of patients referred to a sleep clinic, thereby extending previous observations regarding the association between lunar cycle and sleep variables to a clinical population with potential sleep disorders.

A few earlier studies offered support for an association between the lunar cycle and human behavior [7], but others did not find such a relationship [24].

A recent study reported similar results to the ones presented here. Those authors found that around full moon deep slow-wave sleep was decreased [31]. In our analysis we also found less deep sleep at the time of full moon, compared to other lunar phases.

Two previous studies reported that that people slept on average 20 minutes less during nights with full moon compared with new moon [27, 31]. In our analysis, we controlled for important covariates, including comorbidity and depressive symptoms, and the lunar phase remained independently associated with sleep efficiency. Similarly to our results, Cajochen et al. also reported a longer sleep latency and a decreased slow-wave sleep around full moon compared to other lunar phases [31]. They also found reduced sleep quality and total sleep time 0–4 days around the full moon. In our study, participants had been referred for a sleep center because of clinical suspicion for sleep disturbances, while the previous study enrolled healthy volunteers. Despite this relevant difference, the results are overall similar, suggesting that the observed associations might be present in subjects with sleep disorders as well as in normal sleepers [31].

The exact mechanism for the association between lunar cycle and sleep remains unclear, and additional studies are needed to confirm these findings and also to find potential mechanisms. Several potential mechanisms may be considered to explain these findings. When the moon is full, the Earth is between the Sun and the Moon. It cannot be excluded that the change in the electromagnetic radiation and/or the gravitational "pull off" of the moon during this phase may influence the release of neurohormones or neural activity [7]. Several observations suggest that the lunar tidal force affects certain biochemical processes [49]. A few studies have evaluated circalunar patterns of seizure occurrence [50, 51]. Furthermore, Transcranial Magnetic Stimulation (TMS) initiates EEG slow-wave activity in sleeping volunteers, suggesting that electromagnetic exposures may influence brain activity and sleep characteristics [52]. Thus, the solar radiation reflected by the full moon [53], and the lunar tidal force, might also modify the brain activity.

A nocebo effect is also possible, meaning that people tended to go to bed later during full moon because they expected to sleep less well, knowing that it was full moon [27]. However, we believe that this was unlikely to influence our results since people living in large cities are less likely to be aware of lunar cycle, and the majority of the participants in fact lived in the capital of Hungary. Furthermore, neither the patients, nor the personnel were aware of our planned analyses of the lunar cycle. Finally, our sleep suits had no windows; therefore, there is little chance that expectations related to the full moon modified our results.

Association between lunar phase and sleep might be explained by circalunar periodicity of serum hormone levels. Some animals are clearly influenced by the moon and possess internal clocks that follow the lunar cycle [54-56]. In humans, circalunar hormone cycle has been observed in both women (menstrual cycle rhythmicity) and men [57]. Celec et al. found a circalunar cycle of salivary testosterone and visual-spatial performance in young healthy volunteers of both sexes [58]. Cajochen

et al. suggested that the observed rhythm in sleep variables represents a circalunar rhythm property, running in synchrony with the lunar phases, reminiscent of other endogenous rhythms such as the circadian and circannual rhythms [31]. In addition, as mentioned before, there is a strong link between female sex hormones and sleep [32], and female reproductive steroids appear to be involved in the cardiac autonomic control during sleep in women [59]. This implies the existence of sex differences in the structure of sleep, as well as in the association between lunar phases and sleep. Although we did not measure hormone levels in our participants, therefore we cannot analyze these associations, our results suggest an increased sensitivity of women to lunar modulation.

In earlier times, before modern lighting, the light of a full moon could have kept people up at night, leading to sleep deprivation and consequent psychological issues, according to a hypothesis that awaits experimental support [60]. However, as Rotton et al. pointed out, the moon is a relatively minor source of light in our times, therefore human behavior would be much more erratic if it were affected by light levels of this magnitude [61].

Our multivariable adjusted models suggest that comorbidity and depressive symptoms are associated with sleep, as reported before [47]. The association of full moon with sleep efficiency and other sleep parameters remained significant after correcting for depression and comorbidity, and thus it is unlikely that these factors could explain our findings.

One of the strengths of our work is the relatively large sample with polysomnography data. Neither the patients, nor the personnel in the sleep laboratory were aware of our planned analysis, thus avoiding the confounding of self-fulfilling prophecy regarding a lunar influence on sleep. We adjusted for several potential confounding covariates and also analyzed the gender interaction. We

excluded the effect of light, furthermore everyone slept under standard circumstances, bedtime and wake up was at same time for the patients.

The retrospective, cross-sectional design prevented us of detecting the temporal change of sleep charactersitics as a function of the moon cycle in a within subject design. Secondly, we enrolled individuals referred to a sleep clinic for assessment, therefore the sample was not representative of the healthy general population. Furthermore, the fact that these participants had clinical suspicion for sleep problems, might have made them more sensitive to the lunar cycle. Another limitation of this study is the absence of the normal control group and hormonal profile measurements.

If other studies confirm our findings, we believe this could potentially influence clinical practice. We do ask patients during a comprehensive sleep evaluation not only about their health but also about "environmental factors" impacting their sleep (noise, light, etc). We consider pain, disturbing bed-partners or other potential interferences, both internal and external, when assessing sleep. In the same framework, we could include the lunar effect as a potential factor. If we detect that an individual is sensitive to the effects of moon phases, this could be explained to the patient, and it could be used during the treatment. Patients could be prepared for this effect, for example in terms of sleep related expectations.

CONCLUSION

The main result of this cross-sectional study is that there is an association of moon phases with both subjective and objective sleep parameters. Full moon was associated with a significantly reduced sleep efficiency and other sleep parameters; therefore, we propose that lunar phases may contribute to the complex regulation of sleep, especially in women. Accordingly, poor sleep and the consequent emotional lability and reduced daytime functioning can be partially related to the full moon.

Acknowledgments

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Table 1. Basic characteristics

	Total population (n=319)	New Moon (n=48)	Full Moon (n=47)	Alternate Moon (n=224)	p value*
Age (mean±SD)	47.8±13.5	49.9±13.9	50.4±15.8	46.8±12.9	0.165
Gender (female n (%))	144 (45.1)	24 (50.0)	21 (44.7)	99 (44.2)	0.767
BMI (mean±SD) (kg/m2)	28.2±5.4	28.4±5.0	29.7±6.6	27.7±5.1	0.593
Use of sleeping pills n (%)	23 (8.3)	2 (4.2)	2 (4.3)	19 (8.5)	0.381
Coffee consumption n (%)	158 (49.5)	15 (31.2)	19 (40.4)	124 (55.3)	0.917
Current Smoker n (%)	57 (17.8)	6 (12.5)	4 (8.5)	47 (20.9)	0.58
Shift worker n (%)	10 (3.1)	1 (2.0)	1 (2.1)	8 (3.5)	0.179
Charlson Comorbidity Index (median[interquartile range])	1.0[1]	1.5[1]	1.0[1]	1.1[1]	0.280
CES-D score (median[interquartile range])	14.0[16]	14.0[10]	14.0[15]	13.0[16]	0.739
Educational level (%)					0.945
Less than high school diploma	27.2	12.5	24.1	30.0	
High school graduate	30.3	37.5	24.1	30.1	
Higher education/ University	42.5	50.0	51.7	39.9	
Sleep disorders					
AHI n (mean±SD)	117(9.3±2.2)	13 (10.0±2.1)	14 (8.2±3.2)	90 (9.3±3.3)	0.101
PLMI n (mean±SD)	114(42.0±28.4)	16 (34.2±19.3)	15 (40.1±35.1)	83 (44.1±28.5)	0.860
AIS n (mean±SD)	95(13.5±3.5)	19 (12.7±3.1)	10 (13.3±3.4)	66 (13.4±3.7)	0.510

Note: Values expressed as mean ± SD: standard deviation, percentage (number of patients/total number of patients) or median[interquartile range],

BMI: body mass index, CES-D: Center for Epidemiologic Studies Depression Scale, AHI: apnea hypopnea index, PLMI: Periodic legs movement index,

AIS: Athens Insomnia Score; * test for heterogeneity/homogeneity Brown-Forsythe or Levene

Table 2. Polysomnographic sleep variables

Sleep parameter	New Moon	Full Moon	Alternate Moon	Unadjusted p	Adjusted model p*	Adjusted model p**	Adjusted model p***	Post-Hoc
Light sleep (%)	56 ±9.9	54.9±9.1	54.2±10.6	0.500	0.298	0.499	0.165	
Deep sleep (%)	8.8[9]	6.1[4]	10.9[9]	<0.001	<0.001	<0.001	0.002	F<A
Wake (%)	21.9±11.4	28.7±12.3	20.2±12	<0.001	0.004	0.004	0.024	F>A
REM sleep (%)	13.1±5.8	10.1±6.6	13.9±6.6	0.002	0.046	0.100	0.117	F<A
Sleep efficiency (%)#	82.3[18]	73.7[19]	82.2[15]	<0.001~	0.001	0.002	0.004	F<A, F<N
Sleep latency (min)#	12.1[14]	24.5[31]	13.3[19]	0.001~	0.009	0.010	0.077	F>N, F>A
REM latency (min)	98[74]	137[152]	97.5[76]	0.001	0.015	0.034	0.040	F>N, F>A

Notes: The results are presented as mean ± standard deviation or median [interquartile range]. REM: Rapid eye movement, N: New Moon category, F: Full Moon category, A: Alternate moon category. ANCOVA performed on the transformed variables, but untransformed means reported for interpretability; for ANCOVAs, post-hoc tests were performed with multiple test correction according to the Sidac method. $p<0.05$; ~: Kruskal-Wallis test, post-hoc tests were performed with Mann-Whitney tests with Bonferroni correction, $p<0.0167$); # variables were rank transformed.

* age, gender, smoking, coffee use of sleeping pills, regular exercise
** also adjusted for Charlson Comorbidity Index
*** also adjusted for Center for Epidemiologic Studies Depression Scale score

Table 3. Polysomnographic sleep variables by gender distribution

Sleep parameter	Gender	New Moon	Full Moon	Alternate Moon	p	Post-Hoc	Adjusted model p*	Adjusted model p**	Adjusted model p***
Light sleep (%)	Females	**55.6±9.1**	**56±9.7**	**51.9±9.3**	**0.04**		0.108	0.315	0.103
	Males	56.4±10.8	53.8±8.9	56.3±11.1	0.541		0.797	0.807	0.551
Deep sleep (%)	Females	**6[10]**	**6.1[3]**	**13.5[10]**	**<0.001**	**N<A, F<A**	**<0.001**	**<0.001**	**0.003**
	Males	9.6[7]	6.5[4]	9.4[7]	0.180		0.328	0.409	0.297
Wake (%)	Females	**24.9±10.4**	**30.5±10.2**	**20.9±11.5**	**0.001**	**F>A**	**0.006**	**0.005**	0.161
	Males	**18.8±11.8**	**27.2±15.4**	**19.7±12.3**	**0.013**	**F>A**	0.167	0.176	0.117
REM (%)	Females	**11.7±5.6**	**7.6±5.6**	**14.12±6.4**	**<0.001**	**F<A**	**0.003**	**0.012**	0.118
	Males	14.6±5.7	12.1±6.7	13.7±6.8	0.409		0.904	0.936	0.517
Sleep efficiency (%)#	Females	**77.4[17]**	**65.5[28]**	**81[16]**	**0.001** ~	**F<A**	**0.002**	**0.001**	**0.053**
	Males	**84.7[19]**	**75[18]**	**83.1[14]**	**0.011** ~	**N>F, F<A**	0.148	0.165	**0.056**
Sleep latency (min)#	Females	**18[18]**	**28[23]**	**14.4[18]**	**<0.001** ~	**N<F, F>A**	**0.012**	**0.01**	0.363
	Males	8.6[11]	17.2[27]	10.9[19]	0.060 ~		**0.05**	0.076	0.189
REM latency (min)	**Females**	**120.5[89]**	**177.5[129]**	**104[87]**	**0.001**	**N<F, F>A**	0.077	0.295	0.291
	Males	81[66]	122.5[141]	90.2[72]	0.075		0.082	**0.042**	0.072

Notes: The results are presented as mean ± standard deviation or median [interquartile range]. N: New Moon category, F: Full Moon category, A: Alternate moon category. ANCOVA performed on the transformed variable but untransformed means reported for interpretability; for ANCOVAs, post-hoc tests were performed with multiple test correction according to the Sidac method. p<0.05; ~: Kruskal-Wallis test, post-hoc tests were performed with Mann-Whitney tests with Bonferroni correction, p<0.0167);); # variables were rank transformed.
* age, gender, smoking, coffee use of sleeping pills, regular exercise
** also adjusted for Charlson Comorbidity Index
*** also adjusted for Center for Epidemiologic Studies Depression Scale score

Table 4. Subjective sleep characteristics

Total population	New Moon	Full Moon	Alternate Moon	p
Subjective sleep onset latency (min)	30[40]	40[70]	30[45]	0.10
Subjective sleep time (h)	6±1.7	5.9±1.1	5.3±1.6	0.43
Stanford sleepiness scale	2.6±1.1	2±1.4	2.5±1.1	0.70
Morning fatigue	3.2±1.2	2.8±1.3	2.6±1.2	0.59

Notes: The results are presented as median [interquartile range] or mean±standard deviation (ANOVA).