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Original Research Article

Effect of sleep and smart phone on serum melatonin level in first year medical students

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ABSTRACT

Background: Poor sleep quality among students have been reported with increasing hours of usage of mobile per day. The effects of sleep on health may be mediated through the circadian hormone melatonin which has wide-reaching effects on human physiology and is an emerging biomarker for adult chronic diseases. The poor sleep quality due to academic stress and excessive use of smart phone amongst the medical students may be responsible for the disturbance in circadian rhythm and varied melatonin secretion which may have serious physical and mental health effects. The aim of study was to see the impact of sleep and smart phone usage on serum melatonin level.

Methods: Sample size was 100, 3 were absent. Questionaries' was asked to all the study group regarding timing to go to sleep and sleep hours in night. 9 A.M Morning fasting blood samples were taken and serum melatonin was estimated by ELISA kit.

Results: Authors found only 19 students were with sleep deprivation. The average sleep hours in early sleepers was significantly more as compared to late sleepers. The study finding also suggested that there was significant usage of smart phone in late sleeper group, which may be due to high use of smart phone in the night. No association was found between bedtime and serum melatonin level. There was increase in serum melatonin in students whose usage of smart phone was high.

Conclusions: So, the students who sleeps late have less sleep duration and more usage of smart phone. Bed time, sleep duration and smart phone usage may have rhythm disturbance and phase shifting in melatonin secretion.

Keywords: Melatonin levels, Sleep, Smart phone

INTRODUCTION

Sleep is a vital, often neglected, component of every person's overall health and well-being. Sleep is important because it enables the body to repair and be fit and ready for another day. Most of us need around 8 hrs of good quality sleep a night to function properly. A key factor in how human sleep is regulated is exposure to light or to darkness. Exposure to light stimulates a nerve pathway from the retina in the eye to an area in the brain called the hypothalamus. There, a special centre called the suprachiasmatic nucleus (SCN) which initiates signals to other parts of the brain that control hormones, body temperature and other functions that play a role in making us feel sleepy or wide awake.[1] The authors have already found poor sleep quality among students with increasing hours of usage of mobile per day.[2,3]

The SCN works like a clock that sets off a regulated pattern of activities that affect the entire body. Once exposed to the first light each day, the clock in the SCN begins performing functions like raising body temperature and releasing stimulating hormones like cortisol. The SCN also delays the release of other hormones like melatonin, which is associated with sleep onset, until many hours later when darkness arrives.[1] The effect of sleep on health may be mediated through the circadian hormone melatonin, which has wide-reaching effects on human physiology and is an emerging biomarker for adult chronic diseases.[1]

Melatonin is a natural hormone made by our body's pineal gland. During the day the pineal is inactive. Melatonin secretion in humans exhibits diurnal variation: levels are lowest during the day, and peak overnight during sleep.[4] When the sun goes down and darkness occurs, the pineal is "turned on" by the SCN and begins to actively produce melatonin, which is released into the blood. Usually, this occurs around 9 pm. As a result, melatonin levels in the blood rise sharply and you begin to feel less alert. Sleep becomes more inviting. Melatonin levels in the blood stay elevated for about 12 hours - all through the night.

Besides adjusting the timing of the clock, bright light has another effect. It directly inhibits the release of melatonin. That is why melatonin is sometimes called the "Dracula of hormones" - it only comes out in the dark. Even if the pineal gland is switched "on" by the clock, it will not produce melatonin unless the person is in a dimly lit environment. In addition to sunlight, artificial indoor lighting can be bright enough to prevent the release of melatonin.[1] Melatonin release from the pineal gland may also be suppressed by exogenous factors, particularly natural and artificial light.[5] The poor sleep quality due to academic stress and excessive use of smart phone amongst the medical students may be responsible for the disturbance in circadian rhythm and varied melatonin secretion which may have serious physical and mental health effects.

The circadian hormone melatonin has wide reaching effects on human physiology. The impact of night- time light exposure due to studies, behavioural pattern, use of electronic media like smart phone on the serum melatonin levels of first year medical students.

Authors also aimed to see the impact of sleep and smart phone usage on serum melatonin level.

METHODS

The study was conducted in from September 2017 to April 2018. A cross sectional study was done on students of first year at Government Medical College Gondia. The study was approved by Institutional Ethical committee. Authors planned for purposive sampling, so our sample size was 100. Total 3 students were absent (47 boys and 50 girls). They were informed about the purpose of the study and asked to participate in the study. An informed written consent was taken from all the volunteers medical students prior to the start of study. A brief questionaries' was asked to all the study group regarding bedtime i.e timing to go to sleep and duration of sleep in night. 9 A.M Morning fasting blood samples were taken under all aseptic precautions and serum melatonin was estimated by ELISA kit (Ebascience). The students were then divided into two groups based on bedtime (bedtime after 12AM and the bedtime before 12 AM) and on the usage of the smart phone (more than 90 min).

Data analysis

Results of this study were analysed with statistical software as SPSS 21 version. Comparison between the groups was done using Mann Whitney "U" test of significance. Significance for the difference was set at $p<0.05$.

RESULTS

Table 1 shows that the duration of sleep is more in students who sleeps early as compared to the students who sleeps late, p value was 0.025 which is significant.

Table 1: Relation between bedtime and average hours of sleep.

Bedtime	No.	Sleep duration	p value
Early sleepers <12 AM	50	6.5±1.01	0.025*
Late sleepers >12AM	47	6.08±1.1	

Table 2 shows students who sleeps late spend more time on smart phone as compared to that the students who sleeps early spend less time on smart phone. The p value was 0.038 which is significant.

Table 2: Relation between bedtime and average hours on smart phone.

Bedtime	No.	Average hours on smart phone	p value
Early sleepers <12 AM	50	2.59±1.14	0.038 *significant
Late sleepers >12AM	47	3.2±1.58	

Table 3: Relation between sleep duration and melatonin levels.

Sleep duration	No.	Melatonin level	p value =0.762 Mann Whitney U test
8-9 hrs	9	26.95±11.33	
6-7 hrs	69	31.05±20.75	
<4-5 hrs	19	31.54±11.61	

Table 3 shows that there were only 9 students with adequate sleep whereas there were 69 students with mild sleep deprivation and 19 students with moderate to severe sleep deprivation. Serum melatonin levels were little on the higher side with students with sleep deprivation as compared to the students with adequate sleep. The p value was found to be 0.762 which is not significant.

Table 4: Relation between bedtime and melatonin levels.

Bedtime	No.	Melatonin level	p value
Early sleepers <12 AM	50	30.80±13.45	0.284 Mann Whitney U test
Late sleepers >12AM	47	30.72±22.35	

Table 4 shows that there is not much difference in the level of serum melatonin in students who sleeps early in the night as compared to the students who sleeps late in the night. Comparing the two groups for the levels of melatonin (values in Median) by Mann Whitney "U" test shows no significant difference in the early sleepers.

Table 5: Relation of smart phone usage with melatonin level.

Smart phone usage	No.	Melatonin levels	p value =0.406 Mann Whitney U test
Less than 90 min	17	27.82±13.87	
More than 90 min	80	31.39±19.45	

Table 5 Correlation between hours of usage and levels of melatonin did not show any significant correlation association (r=-0.66), however there was increase in serum melatonin in students whose usage of smart phone was for more than 90 minutes.

DISCUSSION

This study was conducted to determine the effect of sleep, and smart phone on serum melatonin of first year medical students. In this study group authors found most of the students (69) were in mild sleep deprivation. About 9 students were having adequate sleep. So, majority of the study population was having mild or no sleep deprivation. Authors found only 19 students were with sleep deprivation. The average sleep hours in early sleepers was significantly more as compared to late sleepers. The p value was 0.025 which was significant that suggest that late sleepers have less sleep time which may lead to sleep deprivation. The study finding also suggested that there was significant usage of smart phone in late sleeper group. The p value was 0.038 which suggested that the usage is more in students who sleeps late in the night, which may be due to high use of smart phone in the night. This may affect the sleep quality significantly.[3]

Sleep is regulated by the central circadian oscillator in suprachiasmatic nucleus in hypothalamus. The activity of this central oscillator is in turn controlled by hormone melatonin.[6] Though the exposure to light at night is known to suppress melatonin secretion, no association was found between time to go to sleep and serum melatonin level which similar to some earlier studies.[7] Authors also found increase in melatonin levels in the study group with reduced sleep (sleep deprivation). There was increase in serum melatonin in students whose usage of smart phone was for more than 90 minutes. Though correlation was not found to be significant. There are studies which showed the negative correlation between the smart phone usage and the melatonin.[8] There has been very few studies on effect of mobile phone usage on melatonin secretion but in one of the study researchers have demonstrated a reduced excretion of urinary metabolite of melatonin among person using mobile phone for more than 25 min/day.[9] Nocturnal illumination is known to acutely suppress melatonin formation and secretion by the pineal gland, an effect that should not be confused with the perturbation of the circadian system.[10-12] Studies in humans have addressed the roles of light intensity, duration, and spectral properties.[13-17] Moderately reduced levels of melatonin or 6-sulfatoxymelatonin have been reported to occur in the arctic and Antarctic summer.[18-21] However, their rhythms are maintained, but sometimes phase shifted. The interactions between light and melatonin may contribute to circadian dysfunction via two phenomena: a light-associated phase-shift of the melatonin rhythm on the one hand and acute suppression of melatonin by light of sufficient intensity on the other. The former phenomenon may yield both secondary influences on the circadian master clocks and on peripheral oscillators, dual effects which may lead to unfavourable, and indeed detrimental, phase positions or oscillator uncoupling. Moreover, the phenomenon of melatonin deficiency after light-induced acute melatonin suppression may in itself, i.e. irrespective of the former inappropriate phase position, cause or contribute to circadian dysfunction because the physiologically rhythmic endogenous regulator melatonin cannot exert its critical role in melatonin-dependent biochemistry at many organizational levels of individual cells, tissues and organs.

The limitations of this study were - (a) small sample size (b) serum melatonin should be done in various phases of night, single phase estimation may not be adequate to see the phase shift effect or circadian dysfunction.

CONCLUSION

The students who sleeps late have less sleep duration and more usage of smart phone. These students are hence prone for sleep deprivation and smart phone addiction. There was no significant difference in the level of melatonin in early sleepers and late sleepers, and also in sleep duration which is suggestive that timing to go to sleep, and sleep duration may not have significant role in melatonin secretion, and this may be the result of phase shifting with rhythm maintenance in melatonin secretion. Usage of smart phone also did not show low melatonin levels, in fact it was higher in students with more usage which again suggest the rhythm disturbance and phase shifting in melatonin secretion.

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