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Association of the Pattern and Quality of Sleep with Consumption of Stimulant Beverages, Cigarette and Alcohol among Medical Students

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ABSTRACT

Background: Sleep is important in maintenance of proper functioning of both mental and physical functions of human body. Studies have shown there is impact on the sleep parameters with the use of caffeine, cigarette and alcohol. As there is little availability of similar studies here in Nepal, we made an attempt to know the relation of consumption of such substances with the sleep quality and sleep parameters as per Pittsburgh Sleep Quality Index scale.

Methods: A cross sectional study was conducted among the undergraduate students at BP Koirala Institute of Health Sciences, Dharan. Students were asked to complete a self-administered questionnaire to give information about demographic variables and habit of consumption of caffeinated beverages, cigarette and alcohol. The Pittsburgh Sleep Quality Index was utilized after the permission from authority to evaluate sleep quality.

Results: Out of 350, almost half of the students (44.6%) had poor sleep quality. 40.8% students reported sleeping six hours or less per night and 10.1% used medications to sleep. 96% reported consuming caffeinated beverages, 20% consumed cigarettes and 38.3% consumed alcoholic beverages. There was significant association of poor sleep quality with the increased consumption caffeine, cigarette and alcohol ($p < 0.05$).

Conclusions: Poor sleep is prevalent among the undergraduate students of B P Koirala Institute of Health Sciences and the consumption of caffeine, cigarette and alcohol is associated with increment in poor sleep quality among them.

Keywords: Caffeinated beverages; pittsburgh sleep quality index

INTRODUCTION

Sleep is essential in maintenance good mental and physical health. Sleep is a part of daily biological rhythm which is indispensable for promoting health and optimal bodily function.¹ Insufficient sleep is a major public health concern and a common medical condition with serious adverse consequences.^{2,3} A number of factors are responsible for sleep deprivation among college students like substance use, technology, college scheduling and activities. Alcohol decreases sleep during the second half of the night, and causes multiple disturbances.^{4,5} Caffeine has been shown to have both positive and negative behavioral, cognitive and health effects depending on the amount consumed.⁶ Studies show that smoking status has a dose response relationship with the development and persistence of frequent sleep problems.^{7,8} As there is less literature from Nepal, we evaluated the extent to which the caffeinated beverage

use, smoking and alcohol consumption are associated with poor sleep quality in this population.

METHODS

This was a cross-sectional study. The study was done at BP Koirala Institute of Health Sciences, Dharan among the undergraduate students. It was done on the month of February, 2018 starting on 9th February till 10th March. The procedures used in this study were approved by the institutional review boards of the college. Permission to use the questionnaire was obtained from the corresponding authors through e-mails. Questionnaire containing demographic details, academic year and details regarding sleep and use of caffeinated beverages, alcohol and cigarette was used. All completed questionnaires were anonymous and no personal identifiers were assembled. Sleep latency have been categorized into 0(≤ 15 minutes), 1(16-30 minutes),

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2(31-60 minutes) and 3(>60 minutes). Sleep duration have been categorized into 0(>7 hours), 1(6-7 hours), 2(5-6 hours) and 3(<5 hours). Sleep efficiency have been categorized as 0(>85%), 1(75-84%), 2(65-74%) and 3(<65%). Sleep disturbance has been categorized into 0(no sleep disturbance during the past month), 1(less than once a week), 2(once or twice a week) and 3(three or more times a week). About the subjective sleep quality, categorized as 0(very good overall sleep quality), 1(fairly good), 2(fairly bad) and 3(very bad). Regarding the sleep medicine usage and also for daytime dysfunction categories have been made as 0(not taken during past month), 1(less than once a week), 2(once or twice a week) and 3(thrice or more times a week). Such categorization has been done in PSQI to obtain a cumulative score from the variables called PSQI score which gives a numerical score for sleep quality. The total score can be from 0-21, where score ≤ 5 is a good sleep and the score >5 is regarded as a poor sleep. In spite of minimum risk of the study, a documentation of written consent form as approved by the ethics committee was given to be filled.

The fresh batch of students was not selected for the purpose of the study as they were newcomers. Students who expressed an interest in participating in the study were invited in an auditorium where they were informed about the purpose of the study and were invited to participate in the survey. Students who didn't give consent were excluded. For the present analysis, subjects with incomplete information on sleep quality ($n = 16$) were excluded. The total number of undergraduate students at BPKIHS on 2018 was 1200 -according to the academic affairs of the college during the academic year 2017-2018. The participants were enrolled through convenience non-random sampling. The sample size was calculated at 95% confidence interval and 5% worst acceptable limit, the estimated sample size was 292 using Rao soft website. The number was increased by 20% to account for non-responder error.

Data were collected, coded by hand then entered into Statistical Package for Social Science (SPSS version 20.0) software and Strata analysis. Descriptive statistics was computed in the form of frequency and percentage for categorical data. Chi-square test was the main inferential statistic used to determine the relationship between variable with $P < 0.05$ considered statistically significant.

RESULTS

Among a total of 350 students from MBBS and BDS at BPKIHS, 77 students (22%) were from first year, 58(16.6%)

were from second year, 96(27.4%) were from third year and 119(34%) were from fourth year. 255(72.9%) students were MBBS and remaining 95(27.1%) were BDS students. They were of age group 19-27 years. The mean age of the participants was $21.97(\pm 1.37)$ years. 201(57.4%) participants were male and remaining 149(42.6%) were females. 334(95.4%) were Hindu, 5(1.4%) were Islam, 3(0.9%) were Buddhists and 1(0.3%) was Kirat and 4(1.1%) were Christian, while remaining 3(0.9%) belonged to other religions.

As represented in table 1, about the sleep latency, mean sleep latency was $20.71(\pm 16)$ minutes. Majority participants fell asleep in 16-30 minutes of going to bed. The range of sleep latency was 88 minutes, maximum 90 and minimum 2 minutes. The mean duration of sleep obtained by the participants was 389.47 minutes (± 60.94 minutes). The mean sleep efficiency of the participants was $90.49(\pm 6.01)\%$. Majority participants had sleep efficiency $>85\%$. Majority had sleep disturbances less than once a week. Majority reported fairly good sleep quality. Majority didn't take sleep medications during the past month. Majority participants had daytime dysfunction less than once a week. The PSQI score of the students ranged from 1-16. Among the two categories of sleep quality, 194(55.4%) had a score ≤ 5 (good sleep), whereas 156(44.6%) had a score >5 (poor sleep). The mean PSQI score was $5.45(\pm 2.597)$.

Regarding the consumption of caffeinated beverages, 14(4%) didn't consume any of the caffeinated beverages, and 336(96%) consumed some form of caffeinated beverages. Tea (80%) was the most common caffeinated beverage consumed followed by coffee (67.4%), coke/pepsi (67.4%), mountain dew (49.4%) and red bull (20.6%). The mean amount of caffeine consumed per day was 128.87mg (± 113.12). 14(4%) participants didn't consume any of the caffeinated beverages, 153(43.7%) consumed caffeine <100 mg per day, 139(39.7%) consumed caffeine in the range of 100-250 mg per day, whereas 44(12.5%) of the participants consumed caffeine >250 mg per day. Regarding the smoking, 280(80%) never consumed cigarette, 20(5.7%) were former smokers and 50(14.3%) were current smokers. 21(6%) consumed <10 cigarettes a week, and 29(8.3%) consumed ≥ 10 cigarettes a week. The mean number of cigarette smoked per day was $2.5(\pm 9.27)$. The mean amount of alcohol consumed among the participants was 16.15U/month (± 33.57). 198(56.6%) never consumed alcoholic beverages, 18(5.1%) were former alcohol consumers and 134(38.3%) are current consumers of alcoholic beverages. Beer is the most common alcoholic beverage consumed which is consumed by 34.3% followed by hard drinks (27.1%) and wine (19.1%). 2(0.6%) participants consumed alcoholic

beverages in the range of 0-4U per month, 34(9.7%) participants consumed alcoholic beverages in the range of 4-16 Units per month and remaining 98(28%) participants consumed alcoholic beverages >16 units per month.

Table 2 summarizes the relation of sleep quality with the demographic variables. There was strong association of sleep quality with the duration of enrollment of the

students (p=0.005). Students in second year and fifth year of bachelors were more likely to have poor sleep quality compared to other year students. It was most likely due to the stress of exams in the fifth year students and fear of curriculum among the second year students. There was no any significant association of sleep quality with the gender, stream of studies, age and religion of the students.

Table 1. Number of students as per the scores in PSQI parameters.

7 Components of PSQI	Score 0		Score 1		Score 2		Score 3	
	N	%	n	%	N	%	N	%
Subjective sleep quality score	88	25.14%	209	59.71%	49	14%	4	1.14%
Sleep latency	122	34.86%	138	39.43%	68	19.43%	22	6.29%
Sleep duration	81	23.14%	126	36%	125	35.71%	18	5.14%
Habitual sleep efficiency	306	87.43%	35	10%	7	2%	2	0.57%
Sleep disturbances	53	15.14%	265	75.71%	30	8.57%	2	0.57%
Sleep medicine use	312	89.14%	21	6%	11	3.14%	6	1.71%
Daytime dysfunction	83	23.71%	182	52%	67	19.14%	18	5.14%

Table 2. Characteristics of the study population.

Characteristics	All	Poor sleep quality		Good sleep quality		OR (95% CI)	P value
	N	N	%	N	%		
Gender							
Male	201	94	46.8%	107	53.2%		
Female	149	62	41.6%	87	58.4%	0.8(0.52-1.24)	0.337
Stream of the students							
MBBS	255	107	42%	148	58%		
BDS	95	49	51.6%	46	48.4%	1.4(0.91-2.36)	0.107
Duration of enrollment in Bachelors(years)							
Second year	77	43	55.8%	34	44.2%		
Third year	58	16	27.6%	42	72.4%	0.3(0.14-0.62)	0.001
Fourth year	96	38	39.6%	58	60.4%	0.5(0.28-0.95)	0.03
Final year	119	59	49.6%	60	50.4%	0.7(0.43-1.38)	0.39
Age category							
<22	132	62	46.9%	70	53%		
>22	218	94	43.1%	124	56.8%	0.8(0.55-1.32)	0.753

Table 3 shows the relation of sleep quality with the consumption of caffeinated beverages, cigarette and alcohol. There was significant association of the sleep quality with the consumption of the caffeinated beverages (p=0.004). There was increased likelihood of poor sleep quality with the increasing amount of caffeine consumption (p=0.000). Among the caffeinated beverages, there was significantly increased poor sleep quality among the users of coffee, tea, coke/pepsi and red bull, whereas use of Mountain dew was

not significantly associated with the poor sleep quality. There was significant association of sleep quality with the consumption of cigarettes (p=0.001). There was increased chances of poor sleep quality with the increase in consumption of number of cigarettes per day (p=0.001). The association of sleep quality was strong with the consumption of alcoholic beverages (p=0.003). There was increased chances of having poor sleep quality with the increase in units of alcohol consumed per month (p=0.011).

As per PSQI for sleep quality subscales, subjective sleep efficiency, sleep latency, sleep duration, sleep medication use, sleep disturbances and daytime dysfunction due to sleepiness, a dichotomous variable of optimal and suboptimal sleep quality was computed and gender wise comparison was done as shown in table 4. There was not any significant gender difference among the male and female undergraduate students.

When the individual parameters of PSQI were observed in relation to the caffeinated beverages consumption

then there was significant association of the increasing amount of caffeinated beverages with the sleep latency, sleep duration, sleep efficiency and daytime dysfunction. There was a significant association of the increasing amount of cigarette consumed with the sleep latency, sleep duration and not with sleep efficiency and daytime dysfunction. Then there was a significant association of the increasing amount of alcohol consumed with sleep duration and daytime dysfunction, but not with sleep latency and sleep efficiency which is exhibited in table 5.

Table 3. Consumption of caffeinated beverages, cigarette and alcoholic beverages in relation to sleep quality status.

Characteristics	All	Poor sleep quality		Good sleep quality		OR(95% CI)	P value
	N	N	%	N	%		
Consumption of caffeinated beverages							
No	14	1	7.1%	13	92.9%		
Yes	336	155	46.1%	181	53.9%	11.1(1.44-86.06)	0.02
Range of caffeine consumed							
No	14	1	7.1%	13	92.9%		
<100mg per day	153	38	24.8%	115	75.2%	4.2(0.54-33.93)	0.16
100-250 mg per day	139	88	63.3%	51	36.7%	22.4(2.85-176.52)	0.003
>250 mg per day	44	29	65.9%	15	34.1%	25.13(2.99-210.90)	0.003
Consumption of cigarette							
No	300	123	41%	177	59%		
Yes	50	33	66%	17	34%	2.8(1.48-5.23)	0.001
Range of cigarette consumed							
No	300	123	41%	177	59%		
<10 per week	21	11	52.4%	10	47.6%	1.5(0.65-3.85)	0.31
≥10 per week	29	22	75.9%	7	24.1%	4.5(1.87-10.91)	0.001
Consumption of alcoholic beverages							
No	216	83	38.4%	133	61.6%		
Yes	134	73	54.5%	61	45.5%	1.91(1.23-2.96)	0.003
Range of alcohol consumed							
No	216	83	38.4%	133	61.6%		
0-4 units per month	2	0	0%	2	100%		
4-16 units per month	34	18	52.9%	16	47.1%	1.8(0.87-3.72)	0.11
>16 units per month	98	55	56.1%	43	43.9%	2(1.26-3.32)	0.04

Table 4. PSQI sleep quality pattern by sex.

Characteristics	All	Male		Female		p-value
	N	n	%	N	%	
Sleep duration in hours)						
≤6	143	91	63.6%	52	36.4%	0.051
>6	207	110	53.1%	97	46.9%	
Sleep quality						
Good	194	107	55.2%	87	44.8%	0.337
Bad	156	94	60.3%	62	39.7%	

Sleep latency						0.677
<30 minutes	260	151	58.1%	109	41.9%	
≥30 minutes	90	50	55.6%	40	44.4%	
Habitual sleep efficiency						0.572
≥85%	306	174	56.9%	132	43.1%	
<85%	44	27	61.4%	17	38.65	
Sleep disturbances						0.543
<once a week	318	181	56.9%	137	43.1%	
≥once a week	32	20	62.5%	12	37.5%	
Use of sleep medications						0.534
<once a week	333	190	57.1%	143	42.9%	
≥once a week	17	11	64.7%	6	35.3%	
Daytime dysfunction						0.291
<once a week	265	148	55.8%	117	44.2%	
≥once a week	85	53	62.4%	32	37.6%	

Table 5. sleep quality parameters in relation to the lifestyle characteristics.

Sleep quality parameters	Sleep latency		P value	Sleep duration		P value	Sleep efficiency		P value	Daytime dysfunction		P value
	Short	Long		Short	Long		Less	High		Less	More	
Caffeinated beverages			0.001			0.006			0.005			0.001
No	14	0		4	10		1	13		12	2	
<100mg/d	125	28		50	103		10	143		129	24	
100-250 mg/d	94	45		63	76		22	117		98	41	
>250mg/d	27	17		26	18		11	33		26	18	
Cigarettes consumed			0.013			0.017			0.082			0.801
No	228	72		115	185		33	267		229	71	
<10/ d	17	4		9	12		4	17		15	6	
>10/d	15	14		19	10		7	22		21	8	
Alcoholic beverages			0.532			0.019			0.381			0.028
No	161	55		83	133		23	193		174	42	
0-4 U/m	1	1		0	2		0	2		2	0	
5-15 U/m	28	6		9	25		4	30		21	13	
>16 U/m	70	28		51	47		17	81		68	30	

DISCUSSIONS

The high prevalence (44.6%) of poor sleep quality among the undergraduates of BPKIHS is consistent with the results from sleep studies among college students in other countries.⁹⁻¹¹ There was no gender wise difference in the sleep quality which is in accordance with the Thai¹² and Ethiopian¹⁰ students but unlike that in Chilean¹¹ and Peruvian¹³ students which showed poor sleep quality among females more than in males. Upon analyzing the sleep parameters in various studies comparing with

males, female students have significantly longer sleep latency, shorter sleep duration, poor sleep efficiency, more daytime dysfunction, sleep disturbances and increased sleep medicine use.¹⁰⁻¹³ In our study there was not such gender specific differences in sleep parameters. Male students were had more likely to have short duration of sleep than females (63.6% vs 36.4%) but it was not statistically significant (p=0.051). There was significant association of poor sleep quality with the consumption of caffeinated beverages like in other studies. Like Hindmarch et al. have shown that

caffeinated beverages have a dose-dependent negative effect on sleep onset, sleep time, and sleep quality.¹⁴ We found similar results in our study too. The increment of the dose of caffeine was associated with the higher odds of poor sleep which agrees with the other studies^{12,13,15} Although caffeine is the primary ingredient in caffeinated drinks, many include additional ingredients that may have a stimulating effect. The amino acid like taurine, an ingredient in energy drinks, is thought to enhance the effects of caffeine.¹⁶ Little is known about their possible synergistic effects. Caffeine is adenosine receptor antagonist and hence can increase the arousal. It also can act on gamma-aminobutyric acid neurons present in posterior hypothalamus resulting in suppression of sleep promoting pathways.¹⁷ This explains the result of increment in the parameters of PSQI and PSQI score with increased amount of caffeine consumption.

The consumption of alcohol and cigarette also were significantly associated with poor sleep which is consistent with other studies.^{10,11} Increased amount of alcohol consumption and number of cigarette smoked were significantly associated with increased odds of having poor sleep quality like in the other studies.^{12,13} But the consumption of alcohol and cigarette were not associated with poor sleep in few studies.^{10,11} Increasing amount of caffeine consumption was associated with increased sleep latency, decreased sleep duration, decreased sleep efficiency and increased daytime dysfunction as the studies among Ethiopian¹⁰, Chilean¹¹ and Peruvian¹³ students. Similarly, increased amount of alcohol consumption was associated with decreased sleep duration and increased daytime dysfunction while among the Chilean students it was associated with better sleep efficiency and among Ethiopian¹⁰ students associated with increased sleep medicine use. Increasing consumption of cigarette was associated with the increased sleep latency and decreased duration of sleep while among Ethiopian¹⁰ students associated with increased sleep latency, decreased efficiency and increased sleep medicine use and among Peruvian¹³ students associated with increased sleep medicine use.

Studies show that smoking status has a dose response relationship with the development and persistence of frequent sleep problems.^{7,8} These disturbances have been attributed to the stimulant effect of nicotine.⁹ This helps to understand the increased PSQI score and the PSQI parameters like sleep latency and sleep duration with the increased number of cigarette smoked. Alcohol affects some neurotransmitter systems in the same way that sedative drugs do like alcohol facilitates GABA- mediated inhibition(GABA agonistic) and reduces release of acetylcholine(i.e. acetylcholine

antagonist).¹⁸ Alcohol also affects serotonin and glutamate, the neurotransmitters which act to regulate sleep and wakefulness. This might be the reason behind the increment of PSQI score and the PSQI parameters like sleep duration and daytime dysfunction with the increased amount of units of alcohol consumed by the students.

Our study has several limitations. First, given the cross sectional nature of our study, it is difficult to determine whether poor sleep quality is a result of factors including caffeinated beverage, alcohol or cigarette consumption or whether these behaviors resulted as a coping mechanism for the effects of poor sleep. Second, our use of a self-administered survey which relied on subjective measures of sleep quality and other covariates may have introduced some degree of error, and the period when the survey was administered could have influenced the sleep quality. Third, among the different sleep questionnaires like Epworth sleepiness scale, sleep disorders questionnaire, Athens sleep questionnaire and PSQI, sleep quality was computed using the PSQI, which relates good sleep quality to global scores of ≤ 5 and poor sleep quality with scores from 6 to 21. With this broad grouping, there could have been substantial differences among the subjects deemed to be poor sleepers, potentially masking important associations. Fourth, we used an average estimate of the amount of caffeine in a cup of coffee, tea which might be variable from one another depending on the type of coffee, tea, concentration of the coffee or tea leaves used in making them, which might have altered the calculation of amount of caffeine consumption in terms of milligrams. Fifth, we did not have information concerning frequency and timing of energy drinks consumption in the present study. Sixth, it is possible that the binary grouping of energy drinks consumption might have attenuated the magnitude of association towards rejection of null. Seventh, although we adjusted for several potential confounders, we cannot exclude the possibility of residual confounding due to misclassification of adjusted variables or confounding by other unmeasured variables. Eighth, the study population in our study is medical students and the findings might not be generalizable to all population. But as the age group of the students here matches with the common University and college going students in our setup, the findings might be quite generalizable to the college going students too. Finally, our sample was not a random type of selection which may limit generalizability of the results.

CONCLUSIONS

In summary, poor sleep quality is highly prevalent

among BPKIHS undergraduates and consumption of stimulant beverages, cigarette and alcoholic beverages is associated with poor quality sleep. The environment of college and academic demands create increased exposure to sleep-inhibiting factors, like psychological stress and many opportunities for social activities. The college students need to be made aware of the impact caffeinated beverage, cigarette and alcohol consumption has on sleep quality and patterns.

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