Relationship between Coffee Consumption and Sleep Quality among Medical Students from 2016 Batch in Udayana University

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Abstract: **Coffee consumption seems to be a trend among young people, school students and college students in Indonesia to provide them stimulation, enhance energy and reduce sleepiness before exam. Consuming coffee before going to bed can reduce or interfere with sleep by increasing sleep latency reducing sleep efficiency and reducing sleep duration due to the effects of caffeine. The aim of this study is to investigate the relationship between coffee consumption and sleep quality among medical students from 2016 batch in Udayana University. This analytic research with case control design was conducted using random sampling method. There are no significant difference between coffee consumption, age (p=0.080) and gender (p=0.171). Sleep quality was significantly associated with the type of coffee consumed (p=0.0001), time consumed (p=0.0001) and the number of coffee consumed in a week (p=0.021). Results show that there is a significant difference between coffee consumption and sleep quality (p=0.0001) with confidence interval 95% (Cl=1.75-3.73) so it can be concluded that there is a relationship between coffee consumption and sleep quality among medical students from 2016 batch in Udayana University.**

Keywords: **Coffee consumption, caffeine, sleep quality, medical students.**

1. INTRODUCTION

Consumption of coffee is very high in today's world. More than 80% of the world population consumes coffee every day.[8] Coffee is a source of caffeine which is normally consumed to increase concentration and relieve fatigue. Caffeine is a central nervous system (CNS) stimulant that is found in many drinks such as coffee, tea, energy drinks and soft drinks. Caffeine is a psychoactive substance that is most consumed in the world. In Indonesia more than 50% of the population and in America about 85% of the population consume caffeinated drinks at a daily basis.[8] The influence of lifestyle and the increase in cafes and coffee shops has caused an increase in the number of coffee consumers. According to National Coffee Association of United States in 2011, there was an increase in daily coffee consumption in adolescents in ages between 8-24 years old. Coffee consumption as the main source of caffeine has increased by 98% in the last 10 years in Indonesia.[7]

Caffeine can cause positive and negative effects to the body. One of the negative effects that caffeine can cause is it can affect the sleep quality of a person. Caffeine usually prolongs sleep latency, reduces total sleep time, sleep efficiency, and worsen sleep quality. Sleep is a condition where a person's consciousness goes down but brain activity remains active playing a role in regulating digestive function, controlling the heart and blood vessels, immune function, giving energy to the body and cognitive processing. Sleep quality is a condition in which sleep in an individual produces freshness and fitness when awakened.[6],[13]

Coffee consumption seems to be a trend among medical students to provide alertness, increase in energy and prevent sleepiness before exams.[7] Previous experimental research has shown that coffee consumed one to three hours before bedtime reduces sleep efficiency, reduce total sleep time, and increase sleep latency.[14] Therefore, in this study the researcher wants to examine the relationship between coffee consumption and sleep quality among medical students from 2016 batch in Udayana University.

2. METHODOLOGY

This analytical research with case control design was conducted using random sampling method. This study was designed to investigate the relationship between coffee consumption on sleep quality among medical students from 2016 batch in Udayana University. It was conducted for a period of 3 months from September to November 2019 at the Faculty of Medicine in Udayana University, Bali, Indonesia. Subjects are included in this research if they consume coffee drinks that contain caffeine. Subjects are excluded if they did not fill in personal data, consume soft drink, tea and other beverages that contains caffeine, use medications (prescription or over the counter, e.g., sleeping tablet, herbal supplement) to assist sleeping or alertness or have sleep related medical conditions. Coffee consumption was measured using a questionnaire recalling coffee intakes of subjects over the past month while sleep quality was measured using Pittsburgh Sleep Quality Index (PSQI) questionnaire. The final data set for analysis consisted of 100 samples consisting of 50 cases and 50 controls. Univariate variables are presented in the form of a frequency distribution table while bivariate variables are statistically tested using Chi Square test to see the relationship between the variables. If there are several conditions that are not met in the Chi Square test, the Fisher Exact Test or likelihood ratio test will be carried out. Statistical analysis for bivariate and univariate analysis was done using SPSS (Statistic Program for Social Science).

3. RESULTS AND DISCUSSION

3.1 Characteristics of Respondents

Table 1 shows the characteristics of respondents between coffee consumers and non coffee consumers. The demographic and socio-demographic characteristics such as age and gender were similar between cases and controls and showed no significant difference. Pearson chi square test was done to determine any difference between coffee consumption among male and female and showed no significant difference between coffee consumption and gender (p=0,171). Fisher's exact test was done to determine any difference between coffee consumption and age and showed no significant difference between coffee consumption and age (p=0,080). Similar findings were also found in a previous study conducted in Australia.[14] This shows that coffee is a major source of caffeine which is consumed by both male and female. Coffee consumption seems to be a trend among medical students and is commonly consumed by adolescents aged 19-24 years old.[7]

TABLE 1: Characteristic distribution of respondents

Characteristics	Coffee Consumers (n=50)		Non Coffee Consumers (n=50)	
	Frequency (n)	Percentage (%)	Frequency (n)	Percentage (%)
Gender				
Male	16	32	10	20
Female	34	68	40	80
Age				
19 years	0	0	2	4
20 years	12	24	12	24
21 years	28	56	20	40
22 years	10	20	12	24
23 years	0	0	2	4
24 years	0	0	2	4

3.2 Habitual Coffee Consumption

Table 2 shows the habitual coffee intake of respondents. The table below shows that a majority of cases consume coffee less than 2 cups a day and 3-4 times a week. Most of the cases prefer to drink latte and prefer to consume coffee in the evening. Most of the respondents consume coffee during examination week or completing tasks. Previous study also shows that about 55,2% of medical students consume coffee to prepare for their examinations.[7] This is because examinations and assignments are commonly faced by medical students in every block of the semester. This causes medical students to consume coffee so that they can be awake while preparing for their exams.

The current study shows that sleep quality was significantly associated with type of coffee consumed (p=0,0001), time consumed (p=0,0001) and cups of coffee consumed in a week (p=0,021). Those who consume coffee in the evening and 3-4 times a week reported to have a higher risk of poor sleep quality among coffee consumers. This result was also reported in a previous study where the proportion of poor sleep quality was higher among non daily coffee consumers. This is thought to occur because caffeine tolerance did not occur among them and sleep is still sensitive to the effects of caffeine in moderate coffee consumption habits.[7]

TABLE 2: Habitual coffee consumption of respondents

Coffee Consumption	Frequency (n)	Percentage (%)
Cups of coffee a day		
≤ 2 cups	50	100
3-4 cups	0	0
5-6 cups	0	0
≥ 9 cups	0	0
Type of coffee		
Cappuccino	14	28
Black coffee	4	8
Latte	22	44
Instant coffee	10	20
Others	0	0
Time consumed		
Morning	0	0
Afternoon	8	16
Evening	36	72
Night	6	12
Others	0	0
Coffee consumed in a week		
0	0	0
1-2 times	18	36
3-4 times	26	52
> 5 times	6	12
Reasons to consume coffee		
Not enough sleep	0	0
Boost energy	16	32
Exams/Tasks	22	44
Recreational	10	20
Others	2	4

3.3 Sleep Latency

Table 3 shows the sleep latency of respondents. There is a significant difference between sleep latency among cases and controls (p=0,04). Majority of coffee consumers took 30-60 minutes to actually fall asleep compared to non coffee consumers. Most of the non coffee consumers had a shorter sleep latency of < 15 minutes compared to controls. This research shows that coffee consumption increased sleep latency, reduced sleep efficiency and reduced sleep duration. Similar results were found in a previous study by Drapeu C.[5] This is because caffeine antagonizes adenosine receptor and causes a stimulatory effect by relieving drowsiness and increasing alertness temporarily. In this study, most of the participants consume coffee in the evening. In healthy adults, the half life of caffeine is about 4-6 hours, so when participants consume coffee in the evening, the stimulatory effect of the caffeine is still present causing them to have increased sleep latency, reduced sleep efficiency and reduced sleep duration.[9]

TABLE 3: Sleep latency of respondents

Sleep Latency	Coffee Consumers (n=50) n (%)	Non Coffee Consumers (n=50) n (%)
< 15 min	4 (8%)	34 (68%)
15-30 min	16 (32%)	12 (24%)
30-60 min	22 (44%)	2 (4%)
> 60 min	8 (16%)	2 (4%)

3.4 Sleep Efficiency

Table 4 shows the sleep efficiency of respondents. Coffee consumers had a shorter percentage of sleep efficiency compared to non coffee consumers. Majority of coffee consumers had sleep efficiency between 66%-74%. Most of the non coffee consumers had percentage > 85% which is considered to be a normal sleep efficiency. There is a significant correlation between sleep efficiency and coffee consumption (p=0,0001). However, a contrast result was found in a previous cross-sectional survey study, where coffee consumption was not significantly correlated with sleep efficiency.[11]

TABLE 4: Sleep efficiency of respondents

Sleep Efficiency	Coffee Consumers (n=50) n (%)	Non Coffee Consumers (n=50) n (%)
> 85%	4 (8%)	36 (72%)
75%-84%	6 (12%)	12 (24%)
66%-74%	32 (64%)	2 (4%)
< 65%	8 (16%)	0 (0%)

3.5 Sleep Duration

Table 5 shows the sleep duration of respondents. The study shows that there is a significant difference between sleep duration and coffee consumption (p=0,041). Coffee consumers had a shorter sleep duration compared to non coffee consumers.

TABLE 5: Sleep duration of respondents

Sleep Duration	Coffee Consumers (n=50) n (%)	Non Coffee Consumers (n=50) n (%)
> 7 hours	2 (4%)	22 (44%)
6-7 hours	34 (68%)	16 (32%)
5-6 hours	12 (24%)	8 (16%)
< 5 hours	2 (4%)	4 (8%)

3.6 Sleep Disturbances

Table 6 and 7 shows the sleep disturbances in coffee consumers and non coffee consumers. There was a significant correlation between sleep latency more than 30 minutes (p=0,005), waking in the middle of night or early morning (p=0,0001) and waking up to use the bathroom (p=0,018) among cases and controls. Frequency of participants having sleep latency > 30 minutes occurring > 3 times a week was higher in coffee consumers compared to non coffee consumers. Coffee consumers had a higher frequency of waking up in the middle of night or early morning at least 1-2 times a week compared to controls. Frequency of participants that woke up to use the bathroom < 1 time a week was higher among coffee consumers than non coffee consumers. Similar findings were found in a previous study done among medical students to find the effect of caffeine.[7] This is because caffeine is metabolized into theobromine which causes blood vessel dilation and also increases urine volume. The increased frequency of urination causes coffee consumers to frequently wake up in the middle of night to use the bathroom.[15],[4]

TABLE 6: Sleep disturbance in coffee consumers

Sleep Disturbances	Never n	Never %	<1 time a week n	<1 time a week %	1-2 times a week n	1-2 times a week %	>3 times a week n	>3 times a week %
Cannot get to sleep within 30 minutes	4	8	10	20	16	32	20	40
Wake up in the middle of the night or early morning	8	16	12	24	28	56	2	4
Have to get up to use the bathroom	18	36	22	44	10	20	0	0
Cannot breathe comfortably	40	80	10	20	0	0	0	0
Cough or snore loudly	26	52	10	20	6	12	8	16
Feel too cold	14	28	24	48	10	20	2	4
Feel too hot	14	28	22	44	12	24	2	4
Have bad dreams	24	48	22	44	2	4	2	4
Have pain	30	60	14	28	4	8	2	4
Other reasons	48	96	0	0	2	4	0	0

TABLE 7: Sleep disturbance in non coffee consumers

Sleep Disturbances	Never		<1 time a week		1-2 times a week		>3 times a week	
	n	%	n	%	n	%	n	%
Cannot get to sleep within 30 minutes	16	32	18	36	14	28	2	4
Wake up in the middle of the night or early morning	12	24	20	40	16	32	2	4
Have to get up to use the bathroom	22	44	18	36	6	12	4	8
Cannot breathe comfortably	42	84	8	16	0	0	0	0
Cough or snore loudly	40	80	10	20	0	0	0	0
Feel too cold	20	40	18	36	12	24	0	0
Feel too hot	28	56	14	28	8	16	0	0
Have bad dreams	34	68	10	20	6	12	0	0
Have pain	44	88	6	12	0	0	0	0
Other reasons	50	100	0	0	0	0	0	0

3.7 Coffee Consumption and Sleep Quality

Table 8 shows the relationship between coffee consumption and sleep quality. Results show that there is a significant relationship between coffee consumption and sleep quality (p=0,0001) with confidence interval 95% (Cl=1.75-3.73). Coffee consumers reported to have a higher risk of suffering from poor sleep quality compared to non coffee consumers. The risks of poor sleep quality among coffee consumers is 20.444 times greater than in non coffee consumers. Similar findings were reported in a previous study.[2] This is due to the pharmacodynamics and pharmacokinetics of caffeine.[3]

Caffeine primarily affects A_1 and A_{2A} adenosine receptors. Caffeine binds competitively to adenosine receptor which will cause increased levels of norepinephrine due to blockade of A_1 adenosine receptor and increased dopaminergic activity due to blockade of A_{2A} adenosine receptor giving stimulant effect which is characterized by difficulty sleeping after consumption of coffee. Caffeine also causes the release of neurotransmitters such as monoamines and acetylcholine and inhibits the release of gamma-aminobutyric acid (GABA) which acts as an inhibitory neurotransmitter.[10]

Caffeine stimulates the central dopaminergic transmission, particularly in the striatum. The striatum is the structure of basal ganglia, an area of the brain involved in the elicitation and learning of reward related behaviors and it contains the highest concentration of dopamine and dopamine receptors. Caffeine increases dopamine transmission in the ventral striatum (nucleus accumbens), and the dorsal striatum (caudate-putamen).[1] As caffeine blocks $A_{2A}R$, it could enhance DA signaling and increase dopamine in the nucleus accumbens causing coffee consumers to be more alert and awake.[14]

Coffee also contains other psychoactive compounds besides caffeine such as β-carbolines. β-carbolines has psychoactive effects towards the central nervous system (CNS). It can act as a neuromodulator by inhibiting monoamine oxidase (MOA) and inhibiting GABA release.[10],[12]

TABLE 8: Relationship between Coffee Consumption and Sleep Quality

Coffee Consumption	Sleep Quality				P Value
	Poor		Good		
	n	%	n	%	
Yes	46	71.9	4	11.1	0.0001
No	18	28.1	32	88.9	
Total	22	100.0	78	100.0	

4. CONCLUSION

Based on the research done it can be concluded that there is a significant relationship between coffee consumption and sleep quality among medical students from 2016 batch in Udayana University. This study also found that coffee consumption can increase sleep latency, reduce sleep efficiency, reduce sleep duration and cause sleep disturbances. Medical students from Udayana University should be aware of their habitual coffee intake as it can affect their sleep quality. For further research, dosage levels of caffeine which interferes sleep quality can be assessed. As caffeine being

consumed by a wide range of the population and found in many beverages and foods, it is necessary to understand the full health implications and how it may interfere with our daily behaviours such as sleep. Moreover, replication of this study in a large population-based sample is recommended to assess the stability of the findings.

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