RESEARCH ARTICLE

Cognition improvement strategies, study behaviours and stress among medical students of Dow University of Health Sciences: A cross-sectional study

Syed Muhammad Ashraf Jahangeer[1], Muhammad Hamdan[2], Ushna Sunain Ansari[3], Huzaif Saeed Khan[4], Rida Fatima[5]

Abstract

Objective: To determine the effects of cognition improvement strategies on academic performance, stress and sleep quality of medical students.

Method: The cross-sectional study was conducted at the Dow University of Health Sciences, Karachi, from March 2019 to March 2020, and comprised medical students regardless of gender and academic year. Academic performance was assessed through grade point average, while stress and sleep were assessed using the Perceived Stress Scale and Pittsburgh Sleep Quality Index. Data was analysed using SPSS 25.

Result: Of the 770 subjects, 748(97%) formed the final sample with mean age 20.32±1.49 years; 619(82.7%) females and 129(17.2%) males. Overall, there were 655(87.6%) consumers of cognitive enhancers and 93(12.4%) non-cunsumers. The mean Pittsburgh Sleep Quality Index score of consumers was 6.05±3.306, while that of non-consumers was 5.80±3.701. The respective mean Perceived Stress Scale scores were 21.18±6.09 and 20.5±6.8. There was no significant association of consumption of cognitive enhancers with academic performance and stress levels ($p>0.05$), but it was significant with sleep quality ($p<0.05$).

Conclusion: Majority of the students were found to be consuming cognitive enhancers, but no significant association of the stimulants was found with either academic performance or stress.

Keywords: Addiction, Caffeine, Medical students, Sleep, Stress. (JPMA 72: 1363; 2022)

DOI: https://doi.org/10.47391/JPMA.3801

Introduction

Cognitive enhancement encompasses all the interventions, either synthetic or natural, that are used for the purpose of boosting alertness, and increasing memory and concentration.[1] Cognitive enhancers are said to be any of the drugs used in order to obtain higher levels of alertness and for prolonging this state of alertness and focus.

As per the Diagnostic and Statistical Manual of Mental Disorders-5 (DSM-5),[2] caffeine, one of the commonly used cognitive stimulants, can cause physical, mental and psychomotor impairments upon its withdrawal. The use of certain smart drugs commonly prescribed, like methylphenidate and modafinil,[3] narcotics, like cocaine and amphetamine, and soft enhancers, like phyto drugs, soft drinks, vitamins, tonics,[4] tobacco,[1] coffee and caffeine pills, is practiced for cognitive enhancement. According to a research conducted in Pakistan, about one-fifth of students admitted to the use of psychoactive substances.[5] Caffeine and nicotine, two major substances, are the most common psychostimulant drugs used worldwide.[6] A recent study in a public-sector medical university found that caffeine was consumed by 95% students.[7] Some studies demonstrated that smoking was the preferred method of nicotine use for (78.9%)[8] and (26.3%)[9] students. The effects of caffeine are largely dose-related. A study revealed that at low doses, caffeine promotes wakefulness, confidence and vigour, while at high doses an individual portrays the characteristics of an addict, like having increased sense of power, which may lead to a euphoretic state.[10]

Studies showed that the common reasons behind cognitive stimulant consumption were to feel more alert, to wake up in the morning, to combat headaches, to ameliorate the mood, to concentrate while studying, and to deal with stress and depression.[11,12] Evidence suggests that the use of stimulants and high-caffeinated products increases with class seniority and male gender.[13] Also, perceived stress was found to be higher in medical students of higher age group.[14]

As can be imagined, the constituents of cognitive stimulants have a negative effect on sleep in one way or the other. This was supported by a study showing poor sleep had significant relation with smoking and caffeine consumption.[15]

It has been seen that the cognitive enhancers were being used more by those students who were going through stressful periods or were under any sort of academic pressure or those with psychiatric disorders.[4] Another study found that the quality of sleep was inversely related to,

[1]Department of Community Medicine, Dow University of Health Sciences, Karachi, Pakistan; [2-5]5th Year MBBS Student, Dow University of Health Sciences, Karachi, Pakistan.

Correspondence: Syed Muhammad Ashraf Jahangeer.
e-mail: ashraf.jahangeer@duhs.edu.pk

while caffeine consumption was directly related to, stressful periods. Nicotine consumption, however, did not vary with any of these factors.[16]

The high academic load of medical students makes them stressed. A study showed daily caffeine intake had a significant relationship with academic-related stressors.[17] The increase in consumption of cognitive enhancers was also noted in the pre-exam period.[18] To overcome these high stress levels, students make high use of cognitive enhancers. A study showed that academic stress in university students correlated inversely with the number of days left in the exams, compelling them to consume alcohol, caffeine and nicotine which ultimately compromised their sleep quality.[16]

As determined by the DSM-5, the potential of caffeine to cause addiction has proved that seemingly harmless caffeinated substances, like tea, coffee and energy drinks, can also be a cause of addiction and, ultimately, lead to withdrawal symptoms.[2] Influenced by peers, it has become a trend among the students to consume enhancers for improving their academic skills.

The current study was planned to determine the effects of cognition improvement strategies on academic performance, stress and sleep quality of medical students.

Subjects and Methods

The cross-sectional study was conducted from March 2019 to March 2020 at the Dow University of Health Sciences (DUHS), Karachi, which is a large-scale public-sector university. After approval from the institutional ethics review board, the sample size was calculated using OpenEpi calculator www.openepi.com[19] while keeping the lowest frequency of substance use at 2%, confidence limits as 1% at 95% confidence interval (CI). The sample was raised using consecutive sampling technique. Those included were medical students regardless of gender and academic year who volunteered to participate. Students who were on anti-depressant therapy or withdrawal rehabilitation therapy at the time of the study were excluded.

The participants were enrolled after they filled out a survey form through online Google Forms and printed questionnaires. The language of the survey form was English over which the subjects had a good command. Both the online and printed questionnaires were identical to standardise the data-collection process and to maintain the authenticity for eradication of potential sources of bias. All data was voluntary and was based on participant's own perception and assessment of substance usage. The participants were complimentarily given relevant information in the form of a brochure related to substance abuse.

The survey instrument comprised multiple questions regarding the participant's sociodemographic data, including age, gender, year of study, institute, job/volunteerism. The data was collected anonymously. The participants were asked about their source of cognitive enhancer, frequency and timing of intake, and average daily intake.

To appraise the sleep quality, the Pittsburgh Sleep Quality Index (PSQI) was used.[20] The total score ranging from 0 to 21 was calculated by the sum of seven sub-scores ranging 0-3. A sum of 5 or more indicated poor sleep quality, while a total score of 4 or less meant good sleep quality.

For classifying stress, the Perceived Stress Scale (PSS) was used.[21] It had 10 questions graded 0-4. Total score was categorised into low stress (0-13), moderate stress (14-26) and high stress (27-40). Academic performance was evaluated through self-made ranges of cumulative Grade Point Average (cGPA), which were: 3.6-4.0 (excellent), 3.1-3.5 (good), 2.5-3.0 (fair) and ≤2.5 (poor).

The subjects were asked if they tried to quit any specific substance that they were consuming. They were questioned about the reasons for taking these substances and the adverse effects they encountered upon consumption, which were further categorised into neurological, cardiac and digestive complaints. Lastly, their awareness regarding the constituents of cognition-enhancing items and their potential adverse effects was assessed. A pilot study was conducted for pretesting the questionnaires, and necessary changes were made.

The whole process was carried out in accordance with the STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) guidelines (Annexure).[22]

Data was analysed using SPSS 25. Categorical variables were expressed as frequencies and percentages, while quantitative variables were reported as mean±standard deviation. Descriptive analysis was carried out for the assessment of qualitative variables. The methods of cognitive enhancers consumption was compared with GPA ranges by using the chi-square test. For the evaluation of stress and sleep, total PSS and PSQI scores were compared to methods of consumption with the help of one-way analysis of variance (ANOVA) test. Data was found to be normally distributed as assessed by Kolmogorov-Smirnov test and Shapiro-Wilk test. Univariate analysis was conducted to explore the relationship involving the consumptions of cognitive enhancers, GPA, stress and sleep. $P<0.05$ was considered statistically significant.

Annexure: Stengthening the Reporting of Observational studies in Epidemiology (STROBE) Statement. Checklist of items that should be included in reports of cross-sectional studies.

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	1
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6
Bias	9	Describe any efforts to address potential sources of bias	5
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	N/A
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	6, 7
		(b) Describe any methods used to examine subgroups and interactions	N/A
		(c) Explain how missing data were addressed	N/A
		(d) If applicable, describe analytical methods taking account of sampling strategy	N/A
		(e) Describe any sensitivity analyses	N/A
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	8
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	15
		(b) Indicate number of participants with missing data for each variable of interest	N/A
Outcome data	15*	Report numbers of outcome events or summary measures	N/A
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8
		(b) Report category boundaries when continuous variables were categorized	6
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
Discussion			
Key results	18	Summarise key results with reference to study objectives	8-9
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	11
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	10-12
Generalisability	21	Discuss the generalisability (external validity) of the study results	13
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	N/A

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

Results

Of the 770 subjects, 748(97%) formed the final sample with mean age 20.32±1.49 years; 619(82.7%) females and 129(17.2%) males. Overall, there were 655(87.6%) consumers of cognitive enhancers and 93(12.4%) non-consumers.

The consumption of cognitive enhancers had no significant association with GPA (p=0.29). There was no significant difference in stress levels between the consumers and non-consumers (p=0.50). Consumption and stress levels also had no significant association (p>0.05). However, there was significant difference in sleep quality between the

Table-1: Consumption of cognitive enhancers, reasons for consumption, their side effects, stress and sleep quality of the medical students (n=748).

Particulars	n (%)
1. Consumption of any item	
a) Consumer females	537 (71.7)
b) Consumer males	118 (15.8)
a) Non-consumer females	82 (10.9)
b) Non-consumer males	11 (1.5)
2. Consumption Data among users*	
a) Tea	460 (70.2)
b) Coffee	261 (39.9)
c) Energy drinks	110 (16.8)
d) Cigarette/Pills/Chewing Tobacco	38 (5.8)
3. Reasons*	
a) For wakefulness	274 (41.8)
b) To increase alertness	258 (39.4)
c) For relieving headache	244 (37.2)
d) For its great taste	173 (26.4)
e) In periods of academic burden	162 (24.7)
f) To ameliorate your mood	98 (14.9)
g) To cope with stressful situations	80 (12.2)
h) In states of depression	25 (3.8)
4. Side Effects	
a) No symptoms	224 (34.2)
b) Neurological symptoms	164 (25.0)
c) Cardiac symptoms	147 (22.4)
d) Digestive symptoms	120 (18.3)
5. PSS Score	
a) Low stress (0-13)	89 (11.9)
b) Moderate stress (14-26)	509 (68.0)
c) High stress (27-40)	150 (20.0)
6. PSQI Score	
a) Good sleep quality (<5)	272 (36.4)
b) Poor sleep quality (≥5)	476 (63.6)

*the items are multiple response variables, hence, their frequency is >100%. Their percentages are calculated from the total count of consumers, i.e. 655; PSS: Perceived Stress Score, PSQI: Pittsburgh Sleep Quality Index.

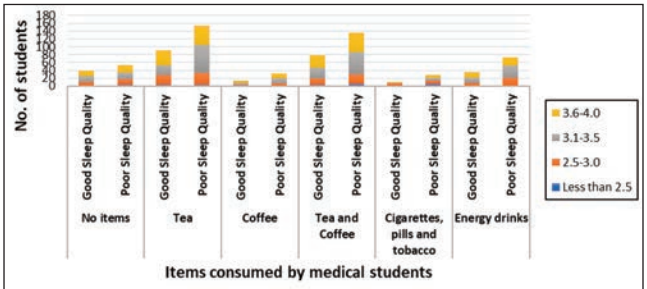

Figure: Histogram showing relationship of sleep quality with Grade Point Average (GPA) categories among various cognitive enhancer consumers.

consumers and the non-consumers (p=0.036) (Table 2). The sleep quality of energy drink consumers was significantly poor compared to tea consumers (p=0.05).

Cigarette, chewing tobacco/naswar and pills for cognitive enhancement were interpreted as control items. Of the total, 206(27.5%) subjects were able to remain symptom-free without the consumption of their substance of interest for approximately 21-24 hours. Among the 655(87.6%) consumers, 165(25.2%) reported an attempt to quit. Overall, 596(80%) subjects were aware that cognitive enhancers can cause addiction, while 417(55.7%) participants were not aware that taurine is a vital ingredient of energy drinks.

Table-2: Stress and sleep scores of the medical students.

	Items	n	Mean±SD	95% Confidence Interval (lower limit, upper limit)	p-value
PSS Score	Tea	246	20.75±7.00	19.87, 21.63	0.50
	Coffee	47	20.78±6.46	18.88, 22.68	
	Both tea and coffee	214	21.71±6.91	20.77, 22.64	
	Energy drinks	110	21.54±7.10	20.20, 22.88	
	Cigarette/pills/ chewing tobacco	38	22.18±6.40	20.07, 24.28	
	No items	93	20.50±6.80	19.10, 21.90	
	Total	748	21.18±6.90	20.69, 21.68	
PSQI Score	Tea	246	5.59±2.96	5.22, 5.96	0.036
	Coffee	47	6.06±3.40	5.06, 7.06	
	Both tea and coffee	214	6.21±3.22	5.77, 6.65	
	Energy drinks	110	6.67±3.64	5.98, 7.36	
	Cigarette/pills/ chewing tobacco	38	6.86±3.38	5.75, 7.98	
	No items	93	5.80±3.70	5.04, 6.56	
	Total	748	6.05±3.30	5.81, 6.28	

PSS: Perceived Stress Scale, PSQI: Pittsburgh Sleep Quality Index.

The mean PSQI score of the consumers was 6.05±3.306, while that of the non-consumers was 5.80±3.701. The respective mean PSS scores were 21.18±6.09 and 20.5±6.8. The relationship of sleep quality with GPA categories among the consumers was noted (Figure).

Discussion

Tea is the most widely consumed cognitive enhancer in the Indo-Pak region. Consequently, tea was found to be the most popular stimulant both in male and female students in the current study. Though the majority of students enrolled in the university and in the current study were females, tea was an equally popular stimulant in both the genders. A recent study conducted on the same population reported similar results.[7]

It is presumed that increased consumption of cognitive enhancers would have beneficial effects on academic performance. However, in the current study, no significant relation was found between the two, as was reported by studies conducted in Europe[23] and the United States.[24]

A study conducted on medical students showed higher odds of developing poor sleep quality with coffee and energy drink consumption.[25] This finding is consistent with

the current findings. The overall sleep quality of the medical students in the current study was poor, as assessed by the PSQI scale.

Majority of the students were found to be in moderate stress, but no significant relationship was found between the consumption of cognitive enhancers and stress levels of medical students, which was in line with an earlier study.[23]

The main reasons for consumption of items in the current study were to remain wakeful, to increase alertness, to relieve headache, and to be able to cope with academic stress. An American study showed that almost half of the participants used cognitive enhancers mainly to stay awake.[26]

Any substance which messes with the brain chemistry has adverse effects if misused. A study showed physical and psychiatric side effects of nootropics on consumers.[27] Students may benefit from these substances in the short term, but in the long run they can lead to adverse consequences. The current study demonstrated that the most common side effects due to excessive consumption of cognitive enhancers were neurological, followed by cardiac and digestive symptoms. Having knowledge of the adverse effects of cognitive enhancers on the body is essential for medical students since it is an important domain of neurosciences and psychiatry. The study found that almost 80% medical students were aware of the terrible consequence of cognitive stimulants i.e., addiction. The results are supported by a study done in Egypt.[28]

In the current study, only about one-fourth of the consumers of cognitive enhancers tried to quit. The prevalence of substance abuse, like alcohol, cannabis and other allopathic drugs, is not high among medical students at DUHS. Also, the likelihood of nootropics, like tea or coffee, causing intolerable addiction is highly unlikely. Therefore, there is not enough data to demonstrate that medical students tried to abandon the substances they were consuming.

The primary limitation of the current study was that the number of female participants greatly exceeded the number of male counterparts. Also, the dose-response relationship could not be evaluated. The length of the questionnaire caused exhaustion among the respondents and could have led to memory bias. Most of the data was self-reported, lacking the authenticity of the facts and figures deduced. Many participants might not have reported the use of certain illicit drugs, probably owing to the stigma these substances hold in society.

In terms of strengths, a pilot study was done for pretesting the questionnaires. Consequently, changes were made on the basis of the feedback. Also, the study population was diverse, involving students from multiple departments of the same university. Besides, standardized scales were used to assess the stress and sleep quality of the participants.

The current study has highlighted the need for devising policies along with the promotion of educational campaigns, stress management seminars and expanded nutritional programmes. Proper measures should be enforced in educational institutions to limit the use of these substances on campuses. Also, there is a need for data to be gathered and disseminated among students and public health centres.

Conclusion

Majority of the students were found to be consuming cognitive enhancers, but no significant association of the stimulants was found with either academic performance or stress. The association with sleep quality, however, was significant.

Acknowledgement: We are grateful to all the study participants.

Disclaimer: None.

Conflict of Interest: None.

Source of Funding: None.

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