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THE RELATIONSHIP BETWEEN CAFFEINE ADDICTION AND STRESS AMONG LEBANESE MEDICAL STUDENTS IN LEBANON

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THE RELATIONSHIP BETWEEN CAFFEINE ADDICTION AND STRESS AMONG LEBANESE MEDICAL STUDENTS IN LEBANON

Abstract

Stress and behavioral addiction are becoming major health problems growing in strength and prevalence. They are often associated with a large array of debilitating diseases and conditions including psychosocial impairments. Medical students remain a vulnerable territory for developing stress and addiction mainly relating to caffeine consumption. Methods: A cross-sectional design was utilized in this study. Results: The study revealed that academic and learning issues are the most stressful and alarming levels of caffeine dependence. Conclusions: This showed a high impact of academic issues on medical students stress and performance, which mandates thorough actions to be considered by both medical institutions and medical students to fight this stress and maintain a healthier life and academic development.

1. INTRODUCTION

Stress continues to be a global burden. It may be thought of as necessary to human thriving; however, challenging and unfavorable functioning may take place when many significant stressors are imposed repetitively or concurrently without resolve. Consequently, an individual's stress response in a stressful setting may ultimately **generate** chronic stress. There are different reasons for stress; these may vary between individuals depending on personal life styles, character and sustained situations. Research suggests that medical students perceive higher levels of stress than students in other health-related disciplines (Bachner et al 2008). Several studies conducted in various medical schools have concluded that in addition to stressors perceived by all university students, medical students are always subjected to conflicting demands (Tsimtsiou et al. 2015). They usually feel overworked and unprepared and continue to seek support and respect from faculty. They think of their inadequacy, insecurity and fear of making mistakes, and harming their patients. In addition, examinations, long hours of study, lack of free time, assignments, and grades are considered unique to medical students.

Moreover, some students may have additional stressful situations to consider. Research indicates that medical students claim that course structure, clinical experiences, and lack of support are common themes for producing stress (Palladino et al 2013). The demand of working with sick patients in a variety of settings while preparing for exams has been reported also as an additional source of stress for medical students. Preparation for a career in medicine is linked to higher levels of emotional stress and well-being among students (Vidyashree et al 2013). Regardless of the study year, medical students experience higher levels of stress and more physical and psychological symptoms than students in the other health-related disciplines. These symptoms range from mood disorders to severe depression from psychological point of view and result in systemic disturbances such as alterations in bowel habits, gastritis, headaches, palpitations and others non-specific disturbances.

Caffeine is known to affect basic and fundamental human processes such as sleep, arousal, cognition and learning and memory (Rivera-Oliver and Díaz-Ríos, 2014). For many years, it has been doubtful whether caffeine consumption is good or bad on human health. Koppelstaetter et al., (2008) reported that doses as little as 100mg of caffeine has a positive effect on frontopolar cortex of the brain. This part of the brain has been associated with attention and executive functions such as cognitive conflict tasks, error detection/monitoring, working memory, planning, monitoring, and problem solving. Low to moderate doses of caffeine (20–200 mg) reportedly produce increased well-being, happiness, energy, alertness, and sociability, whereas higher doses are more likely to produce anxiety, irritability and gastric discomfort (Juliano and Griffiths, 2004). Although consumption of low to moderate doses of caffeine is generally safe, an increasing number of clinical studies are showing that some caffeine users become dependent on the drug and are unable to reduce consumption despite knowledge of recurrent health problems associated with continued use (Juliano et al., 2012a; Oliver West and Gareth Roderique-Davies, 2008).

Thus, the World Health Organization and some health care professionals recognize caffeine dependence as a clinical disorder. Since caffeine is a psychoactive substance that stimulates the central nervous system, medical students use to consume it more than other students to overcome the stress they face due to studying. The paucity of knowledge regarding the trends of caffeine consumption among medical students in developed countries and especially in Lebanon has encouraged us to examine the relationship between caffeine addiction and stress among Lebanese medical students in Lebanon.

2. METHODOLOGY

2.1. Design

A cross sectional descriptive correlational design was used to asses and quantify the main sources of stress, caffeine consumption, caffeine intake behaviors, and examine the relationship between the stress and caffeine.

2.2. Subjects and Setting

A convenience sample of medical students enrolled in different studying years in different Lebanese universities is adopted in this study. The minimum required sample size was estimated through statistical calculation to ensure sufficient statistical power. The estimated minimum required sample size was 370 students based on a total population of 10000 students, margin of error of 5% and a confidence level of 95%. A total of 800 students were approached to participate in this study, 720 of them consented for enrollment (90% response rate) and only 596 students have completed appropriately and fully the questionnaire to be suitable for analysis.

2.3. Instruments/Tools

Medical Student Stressor Questionnaire (MSSQ): The short version of MSSQ used in the current study consists of 20 items representing the six main stressor domains studied among medical students. Stressors are grouped in six hypothetical groups: academic related stressors (ARS), intrapersonal and interpersonal related stressors (IRS), teaching and learning-related stressors (TLRS), social related stressors (SRS), drive and desire related stressors (DRS), and group activities related stressors (GARS). Based on score analysis perceived stress in each category is classified as mild, moderate, high and severe with respective scores of 0.00 – 1.00, 1.01 – 2.00, 2.01 – 3.00 and 3.01 – 4.00.

Caffeine consumption and dependence Scale: The Substance Abuse Module (SAM) is the only available structured interview that assesses caffeine dependence based on the International Diagnostic Interview-Substance Abuse Module (DSM V) criteria. This scale consists of 7 questions, their answers yield a diagnostic algorithm that was developed by the Washington University team and checked by members of the DSM-IV Field Trials. Daily caffeine consumption was calculated based on the daily intake of its different sources: coffee and its derivatives, soft drinks and energetic drinks. Beside a random plasma caffeine levels using high performance liquid chromatography was measured after blood collection from willing and consenting participants.

Statistical analyses

For the quantitative component collected data entry and analysis were performed using Statistical Package for the Social Sciences (IBM SPSS, Version 20). Descriptive results are reported as means and standard deviations or as percentages. Correlational analyses were used to asses relationships between studied variables, and other tests such as independent T-test and ANOVA were used to compare means.

3. RESULTS

3.1. Descriptive results of demographic variables.

The results of this study show that the mean age of the participants is 21.92±2.16 years, and that he majority of respondents belong to the first four academic years (462 students). Among all participants, 126(21.15%) students have one or both parents working as physician and 78 (13.08%) have one or both parents working in a health-related fields. The majority of students belong to families with an average income between 1000 and 3000 US dollars (43.95%), with 35.92% of families earning a monthly income of more than 3000 USD and only 20.13% of families are considered having poor income as mentioned in table 1.

Table 1: Average monthly income by all family members in US dollars

Average family monthly income	Number	%
Less than 1000	120	20.13
Between 1000 and 3000	262	43.95
Between 3000 and 6000	142	23.84
More than 6000	72	12.08

In addition, the majority of participants have their tuition fees managed by their families (87.91%) with partial contribution from students themselves in rare occasions (2.35%) or from scholarships (7.72%) as noted in table 2.

Table 2: management of study fees

Who manage study tuition	Number	%
Family	524	87.91
Students partial contribution	14	2.35
scholarship	46	7.72
Others	12	2.02

The results also revealed that 396 students (66.44%) are subject to high and severe academic related stress and that31.2% report equally high and severe stress related to teaching and learning and social related stressors domains. Group activity is reported high and severely stressful by 180 students (30.2%). The inter and intrapersonal related stressor (IRS) and the drive and desire related stressor (DRS) seem to have minor effects of students; respectively 168 (28.18%) and 90 (15.1%) students report them as causing high and severe stress (Table 3).

Table 3: MSSQ perceived stressors

Level of stress	ARS		IRS		TLRS		SRS		DRS		GRAS	
	N	%	N	%	N	%	N	%	N	%	N	%
None	24	4	24	4	22	3.7	28	4.7	14	2.3	26	4.4
Mild	46	7.7	232	39.3	204	34.2	158	26.5	368	61.7	188	31.5
Moderate	130	21.8	172	28.9	184	30.9	224	37.6	124	20.8	202	33.9
High	206	34.6	124	20.8	142	23.8	128	21.5	48	8.1	134	22.5
severe	190	31.9	44	7	44	7.4	58	9.7	42	7	46	7.7
Total	596		596		596		596		596		596	

Taking into consideration the general average of each stress domain as calculated using MSSQ, few significant results were noted. However, there is a significant difference related to gender between ARS, IRS and TLRS with females are more prone to be stressful in the three domains as reported respectively by general means (2.815, 1.679 and 1.852). Another significant difference is noted between income groups and ARS and IRS; in both domains students belonging to high-income families are less subjected to stress in both domains with respective general means of 2.161 and 1.021. Nevertheless, no significant differences are noted between different stress domains, parents' status and other demographics (omitted from analysis) (Table 4 and 5).

Table 4: Stress domains and gender

Stress domain	Gender	Mean± Standard deviation	P value
ARS	Male	2.234±1.038	<0.001
	Female	2.815±0.838	
IRS	Male	1.233±1.041	0.005
	Female	1.619±1.103	
TLRS	Male	1.441±1.033	0.003
	Female	1.825±1.028	

Stress domain	Gender	Mean± Standard deviation	P value
SRS	Male	1.572±0.959	0.19
	Female	1.876±1.032	
DRS	Male	0.856±1.052	0.26
	Female	1.571±1.005	
GARS	Male	1.571±1.005	0.8
	Female	1.808±0.961	

Table 5: Stress domains and income.

Stress domain	Income in USD	Mean± Standard deviation	P value
ARS	<1000	2.390±0.927	0.001
	1000-3000	2.617±0.899	
	3000-6000	2.933±0.834	
	>6000	2.161±1.200	
IRS	<1000	1.571±1.052	0.001
	1000-3000	1.696±1.059	
	3000-6000	1.148±1.079	
	>6000	1.021±1.050	
TLRS	<1000	1.503±1.162	0.187
	1000-3000	1.748±0.98	
	3000-6000	1.772±1.029	
	>6000	1.361±1.171	
SRS	<1000	1.659±0.849	0.56
	1000-3000	1.828±1.061	
	3000-6000	1.902±1.058	
	>6000	1.313±0.895	
DRS	<1000	0.837±1.056	0.146
	1000-3000	1.246±1.168	
	3000-6000	0.927±1.128	
	>6000	1±1.156	
GARS	<1000	1.479±0.897	0.06
	1000-3000	1.784±0.964	
	3000-6000	1.919±0.985	
	>6000	1.259±0.982	

Moreover, the value of Pearson's correlation coefficient has been calculated among different stress domains and positive correlation was found among all domains. All correlations were significant at the 0.01 level (table 6). The highest correlation is found between academic related stressors (ARS) and group activity related stressors (GARS), the latter correlates strongly with the teaching and learning related stressors domain. The intra and inter-personal stressors' domain correlates positively and significantly with social related stressors (SRS), correlating largely at its turn with both TLRS and IRS. Although small correlation is noted between DRS (drive and desire related stressors) and ARS, a strong one prevails between the former and TLRS.

Table 6: Pearson correlation coefficient between different stress domains

Correlating domains		Pearsons' coefficient
ARS	IRS	0.235
ARS	TLRS	0.481
ARS	SRS	0.385
ARS	DRS	0.185
ARS	GARS	**0.551**
IRS	TLRS	0.45
IRS	SRS	**0.52**
IRS	DRS	0.374
IRS	GARS	0.364
TLRS	SRS	**0.517**
TLRS	DRS	**0.505**
TLRS	GARS	**0.536**
SRS	DRS	0.353
SRS	GARS	0.417
DRS	GARS	0.278

On the other side of the study, the results has shown that the consumption rate of caffeine among participants is significantly high and harmful in some instances. Among participants, 446 (74.83%) declare regular caffeine intake with an average daily intake of 193.32 milligrams or 2.807 milligrams per kilogram of body weight per day. The average random plasma caffeine level is 16.495 microgram/ml (table 7). In addition, the main source of caffeine remains coffee and its derivatives. Soft drinks are second on the list as illustrated in table 8.

Table 7: Caffeine consumption pattern and caffeinemia

Caffeine concentration	Mean	Standard deviation
Daily caffeine intake in milligrams/day	193.32	361.81
Daily Caffeine intake in milligrams per KG of body weight per day	2.807	5.17
Plasma caffeine level in microgram/ml	16.495	12.32

Table 8: Main reported sources of caffeine.

Source of caffeine	N	%
Coffee and its derivatives	528	88.59
Coca and its derivatives	368	61.75
Energy drinks	209	35.06
Tea	170	28.52
Artificial juices	138	23.15

Strangely, medical students consider caffeine as an essential "ritual" to keep them awake as well as to enhance their mental and physical performance. This is despite their awareness of its addiction risks and potential side effects. Table 20 summarizes the participants' beliefs and behaviors regarding caffeine and its consumption. As evident, the

participants' beliefs that caffeine is addictive and can be harmful are prominent (72.15% and 68.45% respectively). However, nearly 70% of students believe that the harmful effects of caffeine addiction may be overlooked given the important alerting effect of caffeine. Some students report religious constraints for caffeine consumption (20.13%) and few of them found caffeine intake helpful in losing weight (16.1%). Besides, caffeine intake can sometimes be troublesome; coordination disruption is mentioned by 51.67% of participants (Table 9).

Table 9: Caffeine addiction survey

Item	Description	Number of Yes responses	%
1	I believe caffeine enhances performance (athletic, academic, artistic, etc).	402	67.45
2	I believe that caffeine can be harmful to my health and can hurt me.	408	68.45
3	I believe caffeine is addictive.	430	72.15
4	I believe that caffeine can disrupt coordination.	308	51.67
5	I have religious objections to caffeine consumption.	120	20.13
6	Have you ever used caffeine to wake up in the morning?	344	57.72
7	Have you ever used caffeine to stay awake?	416	69.8
8	Have you ever used caffeine to enhance physical performance?	266	44.63
9	Have you ever used caffeine to enhance mental performance?	366	61.4
10	Have you ever used drinks/pills with caffeine to lose weight?	96	16.1
11	Do you drink caffeine containing beverages on a daily basis (e.g. coffee, tea, soft drinks, etc)?	446	74.83

Moreover, excessive caffeine intake is not only addictive but toxic at certain level and can lead to significant dysfunction at both somatic and neuro-behavioral levels. Caffeine toxicity and withdrawal symptoms are evaluated among participants reporting regular caffeine intake (446 students). Restlessness, nervousness and anxiety are the most reported as table 10 shows. In addition, palpitations, hives and stomachache are the most frequent somatic manifestations reported.

Table 10: Undesirable caffeine effects/ caffeine toxicity

Sleep and anxiety related		
Inability to sleep	34	7.62 %
Inability to concentrate	30	6.72 %
Restlessness	240	53.81 %
Excitement	34	7.62 %
Irritation	38	8.52 %
Hyperactivity	50	11.21 %
Nervousness	210	47.08 %
Anxiety	200	44.84 %
Somatic related		
Red face	32	7.17 %
Hot flashes	22	4.93 %
Hives	70	15.69 %
Stomach aches	54	12.1 %

Sleep and anxiety related		
Headaches	28	6.27 %
Muscular twitches	18	4.03 %
Fast heart beats	144	32.28 %
Irregular heart beats	178	39.91 %
Rambling speech	68	15.24 %

Moreover, the withdrawal symptoms of caffeine have been evaluated in this study where withdrawal involved fatigue; headaches and carving prevail with respective percentages of 39.01%, 33.18% and 31.38%. In addition, irritability and drowsiness are reported at relatively lower rates (24.21% and 21.07% respectively). Table 11 highlights the main encountered withdrawal symptoms and their relative occurrence rates among study subjects.

Table 11: Caffeine withdrawal symptoms.

Withdrawal symptoms	**N**	**%**
Fatigue	174	39.01
Drowsiness	94	21.07
Depression and or anxiety	70	15.96
Stomach aches	34	7.62
Vomiting	24	5.38
Headaches	148	33.18
Irritability	108	24.21
Craving for caffeine	142	31.83

A Pearson's correlation test was carried out to examine the relationship between caffeine intake and various relevant variables. The results showed a significant correlation between daily caffeine intake, caffeine intake in Kg of body weight and random plasma caffeine level with Pearsons' coefficients of 0.955 and 0.747 respectively. Also, a significant correlation was found among the daily time spent online and the daily caffeine intake and caffeinemia (0.988 and 0.985 respectively), smoking occupies the second place correlating largely with caffeine intake (0.971) and plasma caffeine (0.573) as shown in table 12.

Table 12: Pearson's' correlation coefficient between caffeine related variables and some demographics.

	Daily caffeine intake	Plasma caffeine level
Living conditions	0.078	0.09
Daily time spent on internet	0.988	0.985
Smoking and Hubble bubble	0.971	0.573
Facebook account	0.365	0.688
Rate of application use	0.921	0.438
Adult sites visits	0.783	0.569

Furthermore, another Pearson's correlation test was carried out to examine the relationship between caffeine intake and caffeinemia on one hand and the stress domains on the other hand. The results of the study showed that daily caffeine intake was significantly

correlated with IRS (0.138), DRS (0.272) and TLRD (0.161), while caffeinemia was also strongly correlated with IRS (0.405), DRS (0.407) and TLRD (0.195).

Table 13: Pearsons' correlation coefficient between different stress domains, GPA categories, IAT categories, daily Caffeine intake and plasma caffeine level.

	ARS	IRS	TLRS	SRS	DRS	GARS
Daily Caffeine intake	-0.15	0.138*	0.161*	0.106	0.272**	0.041
Caffeinemia	-0.056	0.405**	0.195*	0.047	0.407**	-0.028

*** Significant results at 0.05, ** significant results at 0.01**

4. DISCUSSION

In our study, the major stressors were identified to be academic related stress and social stress. The vastness of academic curriculum, fear of failure or poor performance in the examination, and lack of recreation were found to be determinants for stress, which is consistent with Anuradha et al., 2017. Previous studies have also reported that academic curriculum, frequency of examinations, performance in examinations, competition with peers were common sources of stress among medical students (Kiessling et al., 2004). To add, the results of this research showed that there was a significant difference related to gender regarding academic related stress, IRS and TLRS. Anuradha et al., 2017 had very similar findings, in addition to a study from Pakistani medical school (Shah et al., 2010) which also found that the female students reported significantly higher levels of perceived stress than their male counterparts did. Moreover, the results of this study showed that there is a significant positive correlation between GARS, IRS, and TLRS and academic performance measured by the GPA. This is consistent with Sohail, 2013, where the results of the send up examination of the participants showed that despite the stress, majority of the students passed the examination. Moreover, the results of this study show that the majority of medical students are daily caffeine consumers. This is consistent with Al-Turki et al., 2016 that showed that 97.5% of medical students are considered as caffeine consumers and only 2.5% of the students are abstainers from caffeine. U.S. Food and Drug Administration (FDA) and American Medical Association (AMA) classify consumption into (1) low intake which is up to 199 mg/d, (2) moderate intake which is ranged from 200 to 399 mg/d and this is recognized as safe, (3) high intake which is defined as more than 400 mg/d.

Our findings also show that the majority of medical students are classified as high intake users. This was inconsistent with Al-Turki et al., 2016 that found that the majority of students are classified as low intake users by (49.3%). However, only (22.7%) are defined as high intake users which are higher than those in Japanese Medical School (15.2%). Similarly, Ahmad, Hinna, & Tayyab, 2017 found that, 66% of the medical students and 57% of non-medical students said that their caffeine production has increased since they entered the university, so medical students are consuming more amount of caffeine as compared to non-medical students. This could be attributed to the fact that medical students lead a more stressful academic life, they have to attend hectic wards and lectures, and their curriculum demands that they always stay active and receptive so they resort to taking caffeine to give themselves a boost, non-medical students are consuming a very high amount probably due to same reasons. Our findings show that coffee was the most popular source of caffeine for medical students and coca and its derivatives comes next in rank. This was consistent with Al-Turki et al., 2016 that found that that black/Arabic coffee, Pepsi, and Red bull are the preferable type of coffee, soft drinks, and energy drinks respectively among male students. However, female prefer the same types except in that Caffe latte/cappuccino is preferred in aspect of coffee. Similarly, Aslam et al., 2013 found that the most popular caffeinated beverage among students was tea followed by soft drinks and coffee respectively. Similar results have been reported by the study of Iran in which tea was the most popular beverage among high school students.

However, studies from Saudi Arabia and South Africa reported coffee and soft drinks were commonly consumed beverages among medical students (Lee et al., 2009). The results of this

study show that medical students are mostly aware of the benefits and negative effects of caffeine consumption but they require its intake to enhance physical and mental performance. This is consistent with an American study that stated that being more alert (56.5%) was the most common reason for caffeine consumption while keep awake in morning (76%) is the first reason for consumption. Similarly, Aslam et al., 2013, showed that majority of students perceived that caffeine consumption increases academic performance, increases IQ, helps in overnight study, increases self-confidence, increases reading power, increases recalling power, increases study hours and provide energy and improves group activity. More than half of the students reported that caffeine improves academic performance, build confidence, promote group activity, energize them and relieve fatigue. Research studies from other parts of the world reported similar findings. A study conducted in Turkey on medical students showed similar results that students reported caffeine consumption improves cognitive performance (Hidiroglu et al., 2013).

A systematic review from University of California conducted on relationship between tea, coffee, caffeine consumption and cognitive decline. This review did not prove any significant association of reducing cognitive decline among tea and coffee consumer; hence research studies did not prove protective effect of coffee consumption and reduction in cognitive decline (Arab et al., 2013). In addition, the results of this study showed moderate comparable correlation figures between daily caffeine intake and stress domains and amount of time spent online. This is consistent with Richards and Smith, 2015, found that there is initial positive relationships between total weekly caffeine intake and stress, anxiety, and depression. After adjusting for dietary, demographic, and lifestyle covariates, the effect on stress disappeared. However, consuming >1000 mg/w remained a predictor of high anxiety, and caffeine consumption in general appeared to be associated with higher instances of depression compared with non-consumption (although the effect was also most pronounced in those who consumed >1000 mg/w).

Finally, the results of this study showed that students experienced withdrawal symptoms when they tried to reduce caffeine consumption, and the mostly experienced were restlessness, anxiety and nervousness. This was consistent with Al-Turki et al., 2016 which found that (15.5%) of the consumers tried to quit consumption but they couldn't and developed some symptoms like difficulty in concentration, feeling nervous, anxious, irritable, and urge to consume caffeine. These results support those reported by Strain et al. (1994). Lee et al, 2009, found that medical students are aware of the side effects of caffeine, particularly with regard to its effects on the heart. Some, however, appeared to be misinformed since they considered hot flushes and acne as side-effects (21.9% and 16.4%, respectively). Headaches, fatigue and drowsiness (63.9%, 52.8% and 40%, respectively) were frequently given as withdrawal symptoms. Many students wrongly believed that aggression (27.2%) and forgetfulness (12.8%) were caffeine withdrawal symptoms.

Limitations

This study as per its design is not able to postulate a causal relationship, which might be work need to be done in further research.

5. CONCLUSION

Lebanon is considered a third-world country but medical education level in considered one of the best in the Mediterranean area. However, no large studies have been conducted to determine the prevalence of stress in the Lebanese medical students. Our study showed a high impact of academic issues on medical students stress and performance, which mandates thorough actions to be considered by both medical institutions and medical students to fight this stress and maintain a healthier life and academic development.

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