Relation between insomnia and stress, anxiety, and depression among Egyptian medical students

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Background
There has been a growing attention paid to depression, anxiety, and stress among college students. Only few studies have assessed these topics among medical students, and fewer still have been conducted in Arab countries. Furthermore, the relation of depression, anxiety, and stress to insomnia has not been thoroughly investigated.

Participants and methods
This cross-sectional, questionnaire-based observational study explored the prevalence of stress, anxiety, and depression and their relationship to insomnia among 980 undergraduate medical students of Mansoura University. The data were gathered using a demographic questionnaire, the Insomnia Severity Index, and the Depression Anxiety Stress Scale.

Results
The prevalence of symptoms of stress, anxiety, and depression was 63.7, 66.9, and 59.2%, respectively. There were significant associations with multiple demographic variables. There was a significant positive correlation between Insomnia Severity Index score and stress, anxiety, and depression scores. Different stressors were identified by the students, including residence, working while being educated, studying more than 4 h a day, difficulty studying in English, problems communicating with the teaching staff, fear of failure in the future, death of a family member, chronic illness of a family member, physical health problems, and problems due to coping with academic demands.

Conclusion
Stress, anxiety, and depression are common among medical students in Egypt, and are correlated with insomnia.

Keywords:
anxiety, depression, Depression Anxiety Stress Scale, Insomnia Severity Index, insomnia, medical students, stress

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Introduction

Several studies have investigated different sleep practices and difficulties among college students [1–3] and medical residents [4], but only few were conducted on medical students. Depression, anxiety, and stress were assessed among university students in several studies [1,5,6], and among medical students in few studies as well [7–9], but their relation to insomnia is still under-investigated.

Medical students face tremendous stress because of enormous and continuous academic demands that alter their sleep habits. The quality and quantity of sleep may change after enrollment in a medical school because of exam anxiety, a tense environment, and irregular schedules [10].

Dyssomnia reduces an individual's ability to cope with daily tensions and increases the incidence of depressive and anxiety disorders. Irregularity in sleep–wake pattern not only causes manifest mental and physiological depression but also leads to derangements of social and occupational activities [11].

Sleep disturbances are important symptoms in many psychiatric illnesses, such as mood and anxiety disorders. Because sleep disturbances usually precede other symptoms of depression, it has been speculated that a depressed mood may be a consequence of sleep disturbance or that a hormonal or neurotransmitter change causes both a depressive state and sleep disturbance [12]. Sleep disturbance can be a comorbidity, a cause, or a symptom of psychiatric disorders [13]. The presence of psychiatric illness may also complicate the diagnosis and prognosis of sleep disorders [14].

Some researchers have advocated that a diagnosis of depression in the absence of sleep disturbance should be made cautiously. Sleep disturbance is a risk factor for suicide, and persistent sleep problems increase the risk for relapse and recurrence of depression. While difficulty in initiating or maintaining sleep (including early morning

awakening) has been broadly described in depressed patients, hypersomnia is less common and could be a feature of atypical depression [15].

A long-term prospective study was conducted on 1053 men who provided information on sleep habits during medical school. The authors concluded that insomnia in young men was an indicator of a high risk for subsequent clinical depression and psychiatric distress that continued for at least 30 years [16].

A study among 572 Mexican medical students concluded that sleep difficulties were associated with stress, anger, worry, cognitive hyperarousal, and hypervigilance [17].

Changes in the sleep architecture in patients with depression and anxiety has been established [18,19]. Disruption in circadian rhythm and hypothalamic–pituitary–adrenal axis activity have been identified in patients with sleep disorders, as well as in patients with anxiety and depression [15,20].

Hypothesis

We hypothesize that symptoms of depression, anxiety, and stress are common among Egyptian medical students, and are related to insomnia.

Aim

This study sought to evaluate the prevalence of symptoms of stress, anxiety, and depression and their relationships to insomnia in different academic classes of undergraduate medical students in Mansoura University, and to explore whether certain variables or stressors could be associated with these symptoms.

Participants and methods

Study design

This was a cross-sectional, questionnaire-based, descriptive study conducted from May 2015 to September 2015.

Participants

The study sample consisted of undergraduate medical students who were enrolled at Mansoura University in Egypt.

Sample size was calculated based on the prevalence of depression, anxiety, and stress among Egyptian medical students stratified by the grade. In the reviewed literature, the prevalence for the three disorders was found to be 63.6, 78.8, and 57.8%, respectively [21]. By setting α at 0.05 and maximum accepted error as 5%, we calculated 140 students to be the minimum proper sample size to achieve 80% statistical power. Thus, the minimum number of students from each educational year was 140 students. Sample size calculation was done using the StatCalc software (Epi Info, version 7.0.8.3 for MS Windows, 2011; CDC, Atlanta, Georgia, USA).

We recruited 980 medical students, including 140 students from each educational year from the first year till the internship year. We used a systematic random sampling technique by skipping each third and fourth name on the class list. The recruitment and collection of data continued for 7 weeks. We excluded students who were on sedatives or narcotics for any acute or chronic medical condition.

This study was approved by the research and ethics committees of the university. Informed consent was obtained from all participants, and confidentiality of the information collected was assured.

Instruments

(1) The students were asked to complete a self-administered questionnaire written in Arabic and developed by the authors. Questions were related to social and demographic profile and different possible stressors including problems with studying in the English language, fear of failure, death of a family member, chronic illness of a family member, physical health problems, problem due to coping with academic demands, problems in communication with the teaching staff, and student residence during the study.

(2) The Depression Anxiety Stress Scale 21 (DASS 21) is a condensed 21-item version of the full DASS, which originally consisted of 42 items. The three scales contain seven items that evaluate the dimensions of depression, anxiety (symptoms of psychological arousal), and stress (the more cognitive, subjective symptoms of anxiety). The severity ratings are based on percentile scores with 0–78 classified as normal, 78–87 as mild, 87–95 as moderate, 95–98 as severe, and 98–100 as extremely severe [22]. The scale was psychometrically validated for the Arabic culture [23].

(3) The DASS is a quantitative measure not a categorical measure of clinical diagnoses. Emotional syndromes such as depression and anxiety are intrinsically dimensional; they vary along a continuum of severity (independent of a specific diagnosis). It can lead to a useful assessment of disturbance, for example, a mild score means that the person is above the population mean but probably still way below the typical severity of someone seeking help; it does not mean a mild level of disorder [22].

(4) Insomnia Severity Index
The Insomnia Severity Index (ISI) is a seven-item self-reported questionnaire assessing the nature, severity, and impact of insomnia. The usual recall period is the 'last month' and the dimensions evaluated include severity of sleep onset, sleep maintenance, early morning awakening problems, sleep dissatisfaction, interference of sleep difficulties with daytime functioning, noticeability of sleep problems by others, and distress caused by the sleep difficulties. A five-point Likert scale is used to rate each item (e.g. 0 = no problem; 4 = very severe problem), yielding a total score ranging from 0 to 28. The total score is interpreted as follows: absence of insomnia (0–7); subthreshold insomnia (8–14); moderate insomnia

(15–21); and severe insomnia (22–28). Three versions of this scale are available – patient, clinician, and significant others – but the present study focused on the patient version only [24]. We used the Arabic version of the questionnaire [25].

Statistical analysis

The data were collected, coded, revised, and fed into the statistical package for the social sciences (SPSS) (version 20, 2011; IBM Corp., New York, New York, USA). Qualitative data were presented as numbers and percentages. Quantitative data with parametric distribution were presented as means, SDs, and range. The χ^2-test using qualitative data was performed to compare the two groups, and the Fisher exact test was used when the expected count in any cell was less than 5. Comparisons between more than two groups were conducted using the one-way analysis of variance. Spearman's correlation coefficients were used to assess the relation between two quantitative parameters, and the criterion for assessing significance was set at less than 0.05.

Results

Demographic and clinical characteristics of the participants

Demographic characteristics of our sample are shown in Table 1. The participants comprised 980 medical students, 66.3% of whom were women. The mean age of the participants was 21.9 ± 2.08 years, and the age range was 18–25 years.

Clinical characteristics of our sample are shown in Table 2. Out of the included students, 624 (63.7%) reported symptoms of stress, 656 (66.9%) reported symptoms of anxiety, and 580 (59.2%) reported symptoms of depression.

Stress symptoms were mild in 13.2%, moderate in 20.1%, severe in 19.8%, and extremely severe in 10.3% of the students.

Anxiety symptoms were mild in 14.9%, moderate in 14%, severe in 11.8%, and extremely severe in 26.2% of the students.

Depression symptoms were mild in 14.4%, moderate in 27.4%, severe in 13%, and extremely severe in 4.4% of the students.

There were more students reporting significant stress in the early years of education. A higher percentage of second-year students reported stress (75.3%), whereas severe and extremely severe stress were more common among the first-year students (40.3%).

A higher percentage of third-year students reported anxiety (79.8%). Severe and extremely severe anxiety were more prevalent among first-year students (47.9%), second-year students (46.8%), and third-year students (45.8%).

A higher percentage of second-year students reported depression (85.3%), with severe and extremely severe depression more common among sixth-year students (42.7%) and among second-year students (41.2%).

Table 1 Demographic characteristics of the study sample

	N (%)
Sex	
Male	330 (33.7)
Female	650 (66.3)
Age	
Mean ± SD	21.9 ± 2.08
Range	18–25
Regular physical exercise	
No	596 (60.9)
Yes	383 (39.1)
Caffeine intake	
<6 cups/day	144 (14.7)
>6 cups/day	836 (85.3)
Work while educated	
No	806 (82.3)
Sometime	138 (14.1)
Part-time	24 (2.4)
Full-time	11 (1.1)
Studying hours	
<4 h/day	459 (46.8)
>4 h/day	521 (53.2)
Student residence during study	
With family	639 (65.2)
University campus	215 (21.9)
Outside campus	126 (12.9)
Problems with studying in English language	
No	809 (82.6)
Yes	171 (17.4)
Fear of failure in future	
No	729 (74.4)
Yes	251 (25.6)
Death of a family member	
No	764 (77.2)
Yes	223 (22.8)
Chronic illness of a family member	
No	705 (71.9)
Yes	275 (28.1)
Physical health problems	
No	898 (91.6)
Yes	82 (8.4)
Problem coping with academic demands	
No	724 (73.9)
Yes	256 (26.1)
Problems in communication with teaching staff	
No	790 (80.7)
Yes	189 (19.3)

Mean insomnia score was 10.84 ± 7.15. According to the ISI, insomnia was present in 27.7% of the students. It was moderate in 18%, severe in 9.7%, and subthreshold in 41% of the students.

Initial insomnia was mild in 29.3%, moderate in 20.9%, severe in 16.5%, and extremely severe in 5.7% of the students.

Maintenance insomnia was mild in 29.4%, moderate in 19.6%, severe in 15.7%, and extremely severe in 6.3% of the students.

Late insomnia was mild in 30.3%, moderate in 19.4%, severe in 15.2%, and extremely severe in 4.2% of the students.

There was a statistically significant difference regarding the presence or absence of insomnia according to the ISI in different years of education. Among first-year students, 50% had moderate to severe insomnia, compared with 39.3, 22.9, 14.3, 29.3, 18.6, and 19.3% of second, third,

Table 2 Clinical characteristics of the study sample

	N (%)
Depression severity	
Normal	400 (40.8)
Mild	141 (14.4)
Moderate	269 (27.4)
Severe	127 (13.0)
Extremely severe	43 (4.4)
Stress severity	
Normal	359 (36.6)
Mild	129 (13.2)
Moderate	197 (20.1)
Severe	194 (19.8)
Extremely severe	101 (10.3)
Anxiety severity	
Normal	324 (33.1)
Mild	146 (14.9)
Moderate	137 (14.0)
Severe	116 (11.8)
Extremely severe	257 (26.2)
Stress present/absent	
Absent	356 (36.3)
Present	624 (63.7)
Anxiety present/absent	
Absent	324 (33.1)
Present	656 (66.9)
Depression present/absent	
Absent	400 (40.8)
Present	580 (59.2)
Stress score	
Mean ± SD	9.46 ± 5.30
Range	0–21
Anxiety score	
Mean ± SD	6.40 ± 4.73
Range	0–21
Depression score	
Mean ± SD	6.57 ± 3.99
Range	0–21
Initial insomnia	
Absent	270 (27.6)
Mild	287 (29.3)
Moderate	205 (20.9)
Severe	162 (16.5)
Extremely severe	56 (5.7)
Maintenance insomnia	
Absent	284 (29.0)
Mild	288 (29.4)
Moderate	192 (19.6)
Severe	154 (15.7)
Extremely severe	62 (6.3)
Late insomnia	
Absent	303 (30.9)
Mild	297 (30.3)
Moderate	190 (19.4)
Severe	149 (15.2)
Extremely severe	41 (4.2)
ISI score	
Mean ± SD	10.84 ± 7.15
Range	0–28
ISI interpretation	
Absence of insomnia	307 (31.3)
Subthreshold insomnia	402 (41.0)
Moderate insomnia	176 (18.0)
Severe insomnia	95 (9.7)
Insomnia present/absent	
Absent	709 (72.3)
Present	271 (27.7)

ISI, Insomnia Severity Index.

fourth, fifth, sixth-year students, and interns, respectively.

Different variables in relation to stress, depression, and anxiety

Different variables in relation to stress, anxiety, and depression are shown in Table 3. There was a significant association between stress and each of the following: sex, with more stress in females; caffeine intake, with more stress in those consuming more than six cups/day; and problems in communication with the teaching staff ($P = 0.008$, 0.003, and 0.000, respectively).

There was also a significant association between anxiety and each of the following: sex, with more anxiety among females; death of a family member; problems in communication with the teaching staff; and working during educated ($P = 0.007$, 0.000, 0.000, and 0.001, respectively).

Different stressors in different years of education

Different stressors among students in different years of education are shown in Table 4. Working during education was reported as stressful by 172 (17.6%) students, with 14.1% of the students working sometimes, 2.4% working part-time, and 1.1% working full-time. There was a statistically significant difference in working during education among different academic years, with more working students during internship ($P = 0.000$).

Studying more than 4 h a day was reported as stressful by 30% of the students, with a greater number of sixth-year students studying more than 4 h a day and reporting that as stressful. There was a statistically significant difference regarding studying hours per day in different academic years ($P = 0.000$).

Residence was considered as stressful by 20% of the students, with 21.9% of the students living in the university campus and 12.9% living outside the campus. There was a statistically nonsignificant difference between student residence in different years of education ($P = 0.080$).

Difficulty studying in English was reported as stressful by 17.4% of the students, with higher prevalence among the first 3 years of education (64.3% of first-year students, 22.1 of second-year students, and 22.9% of third-year students). There was a statistically significant difference in difficulty studying in English among different educational years ($P = 0.000$).

Fear of failure in the future was reported as stressful by 25.6% of the students. It was more prevalent among interns (40%). There was a statistically significant difference regarding fear of failure in the future in different years of education ($P = 0.000$).

Death of a family member was reported as a stress by 22.8% of students. It was more prevalent among interns (40%). There was a statistically significant difference regarding death of a family member in different years of education ($P = 0.000$).

Chronic illness of a family member was reported as a stress by 28.1% of the students. It was more prevalent among the sixth-year students (43.6%). There was a statistically significant difference regarding chronic illness of a family member in different years of education ($P = 0.043$).

Chronic physical health problem was reported as a stress by 8.4% of the students. It was more prevalent among

Table 3 Different variables in relation to stress, anxiety, and depression

	Stress *N* (%)			Anxiety *N* (%)			Depression *N* (%)		
	Absent (*N*=356)	Present (*N*=624)	*P*-value	Absent (*N*=324)	Present (*N*=656)	*P*-value	Absent (*N*=400)	Present (*N*=580)	*P*-value
Sex									
Male	139 (39.0)	192 (30.7)	0.008	128 (39.5)	202 (30.8)	0.007	127 (31.8)	203 (35.0)	0.290
Female	217 (61.0)	432 (69.2)		196 (60.5)	454 (69.2)		273 (68.2)	377 (65.0)	
Regular physical exercise									
No	202 (56.7)	393 (62.9)	0.047	186 (57.6)	410 (62.5)	0.138	234 (58.5)	362 (62.5)	0.205
Yes	154 (43.3)	231 (37)		137 (42.4)	246 (37.5)		166 (41.5)	217 (37.5)	
Caffeine									
<6 cups/day	68 (19.1)	76 (12.2)	0.003	56 (17.3)	88 (13.4)	0.108	59 (14.8)	85 (14.7)	0.967
>6 cups/day	288 (80.9)	548 (87.8)		268 (82.7)	568 (86.6)		341 (85.2)	495 (85.3)	
Work while educated									
No	277 (77.8)	530 (84.9)	0.027	246 (75.9)	560 (85.5)	0.001	320 (80.2)	486 (83.8)	0.153
Sometime	66 (18.5)	72 (11.5)		64 (19.8)	74 (11.3)		62 (15.5)	76 (13.1)	
Part-time	9 (2.5)	15 (2.4)		12 (3.7)	12 (1.8)		14 (3.5)	10 (1.7)	
Full-time	4 (1.1)	7 (1.1)		2 (0.6)	9 (1.4)		3 (0.8)	8 (1.4)	
Studying hours									
<4 h/day	170 (47.8)	289 (46.3)	0.681	167 (51.5)	292 (44.5)	0.038	191 (47.8)	268 (46.2)	0.634
>4 h/day	186 (52.2)	335 (53.7)		157 (48.5)	364 (55.5)		209 (52.2)	312 (53.8)	
Student residence during study									
With family	221 (61.8)	418 (66.9)	0.201	204 (63.0)	435 (66.3)	0.583	267 (66.8)	372 (64.1)	0.566
University campus	83 (23.3)	132 (21.2)		76 (23.5)	139 (21.2)		81 (20.2)	134 (23.1)	
Outside campus	52 (14.9)	74 (11.9)		44 (13.6)	82 (12.5)		52 (13.0)	74 (12.8)	
Problems with studying in English language									
No	304 (85.4)	505 (80.9)	0.085	276 (85.2)	533 (81.2)	0.127	328 (82.0)	481 (82.9)	0.706
Yes	52 (14.6)	119 (19.1)		48 (14.8)	123 (18.8)		72 (18.0)	99 (17.1)	
Fear of failure									
No	266 (74.7)	463 (74)	0.846	235 (72.5)	494 (75.3)	0.349	309 (77.2)	420 (72.4)	0.088
Yes	90 (25.3)	161 (25.9)		89 (27.5)	162 (24.7)		91 (22.8)	160 (27.6)	
Death of a family member									
No	270 (75.8)	494 (79)	0.232	230 (71.0)	534 (81.4)	0.000	317 (79.2)	447 (77.1)	0.418
Yes	86 (24.2)	130 (20.9)		94 (29.0)	122 (18.6)		83 (20.8)	133 (22.9)	
Chronic illness of a family member									
No	258 (72.5)	447 (71.5)	0.767	226 (69.8)	479 (73.0)	0.285	303 (75.8)	402 (69.3)	0.027
Yes	98 (27.5)	177 (28.5)		98 (30.2)	177 (27.0)		97 (24.2)	178 (30.7)	
Physical health problems									
No	340 (91.9)	558 (91.5)	0.103	400 (92.4)	498 (91.0)	0.011	448 (91.8)	450 (91.5)	0.637
Yes	30 (8.1)	52 (8.5)		33 (7.6)	49 (8.9)		40 (8.2)	42 (8.5)	
Problem coping with academic demands									
No	265 (74.4)	458 (73.4)	0.752	253 (78.1)	471 (71.8)	0.035	307 (76.8)	417 (71.9)	0.089
Yes	91 (25.6)	165 (26.6)		71 (21.9)	185 (28.2)		93 (23.2)	163 (28.1)	
Problems in communication with teaching staff									
No	320 (89.9)	469 (75.1)	0.000	288 (89.2)	502 (76.5)	0.000	318 (79.7)	472 (81.4)	0.513
Yes	36 (10.1)	155 (24.8)		35 (10.8)	154 (23.5)		81 (20.3)	108 (18.6)	

sixth-year students (15%). There was a nonsignificant difference regarding chronic physical health problem in different years of education ($P = 0.063$).

Problems due to coping with academic demands was reported as a stress in 26.1% of the students. It was more prevalent among the sixth-year students (60%), and fifth-year medical students (42.9%). There was a statistically significant difference regarding problem while coping with academic demands in different years of education ($P = 0.000$).

Problems in communications with teaching staff was reported as a stress in 19.3% of the students. It was more prevalent among fifth-year students (36%) and first-year medical students (25.7%). There was a statistically significant difference regarding problems in communication with the teaching staff in different years of education ($P = 0.000$).

Relation between insomnia and stress, anxiety and depression

There was a significant association between stress, anxiety, and depression and the presence of insomnia as identified by the ISI, as well as between different types of insomnia, including initial insomnia, maintenance insomnia, and late insomnia, and stress, anxiety, and depression ($P = 0.000$).

Initial insomnia was moderate to extremely severe in 61.4% of those with stress, 56.7% of those with anxiety, and 44.5% of those with depression.

Maintenance insomnia was moderate to extremely severe in 59.9% of those with stress, 57% of those with anxiety, and 42.4% of those with depression.

Late insomnia was moderate to extremely severe in 47.8% of those with stress, 40.5% of those with anxiety, and 42.4% of those with depression.

Table 4 Different stressors in different years of education

	N (%)								
	First year	Second year	Third year	Fourth year	Fifth year	Sixth year	Internship	χ^2	*P*-value
Work									
No	127 (90.7)	134 (95.7)	130 (92.9)	120 (85.7)	126 (90.0)	101 (72.1)	69 (49.2)	153.889	0.000
Sometime	9 (6.4)	5 (3.6)	7 (5.0)	12 (8.6)	13 (9.3)	35 (25)	57 (40.7)		
Part-time	3 (2.1)	0 (0.0)	1 (0.7)	8 (5.7)	1 (0.7)	2 (1.4)	9 (6.4)		
Full-time	1 (0.7)	1 (0.7)	2 (1.4)	0 (0.0)	0 (0.0)	2 (1.4)	5 (3.6)		
Studying hours									
<4 h/d	81 (57.9)	57 (40.7)	56 (40.0)	67 (47.9)	52 (37.1)	38 (27.1)	108 (77.1)	90.353	0.000
>4 h/d	59 (42.1)	83 (59.3)	84 (60.0)	73 (52.1)	88 (62.9)	102 (72.9)	32 (22.9)		
Residence									
With family	91 (65)	102 (72.9)	107 (76.4)	109 (77.9)	103 (73.6)	75 (53.6)	52 (37.1)	110.622	0.080
University campus	21 (15.0)	26 (18.6)	14 (10.0)	17 (12.1)	23 (16.4)	52 (37.1)	62 (44.3)		
Outside campus	28 (20)	12 (8.6)	19 (13.6)	14 (10.0)	14 (10.0)	13 (9.3)	26 (18.6)		
Problems with studying in English language									
No	50 (35.7)	109 (77.9)	108 (77.1)	131 (93.6)	134 (95.7)	137 (97.9)	140 (100.0)	469.686	0.000
Yes	90 (64.3)	31 (22.1)	32 (22.9)	9 (6.4)	6 (4.3)	3 (2.1)	0 (0.0)		
Fear of failure in future									
No	120 (85.7)	120 (85.7)	93 (66.4)	100 (71.4)	110 (98.6	102 (72.9)	84 (60.0)	74.489	0.000
Yes	20 (14.3)	20 (14.3)	47 (33.6)	40 (28.6)	30 (21.4)	38 (27.1)	56 (40.0)		
Death of a family member									
No	115 (82.1)	108 (77.1)	120 (85.7)	98 (70.0)	130 (92.9)	102 (72.9)	84 (60.0)	72.201	0.000
Yes	25 (17.9)	32 (22.9)	20 (14.3)	42 (30.0)	10 (7.1)	38 (27.1)	56 (40.0)		
Chronic illness of a family member									
No	120 (85.7)	95 (67.9)	93 (66.4)	109 (77.9)	114 (81.4)	79 (56.4)	95 (67.9)	42.935	0.043
Yes	20 (14.3)	45 (32.1)	47 (33.6)	31 (22.1)	26 (18.6)	61 (43.6)	45 (32.1)		
Physical health problems									
No	132 (94.3)	130 (92.9)	128 (91.4)	129 (92.1)	130 (92.9)	119 (85.0)	130 (92.9)	117.527	0.063
Yes	8 (5.7)	10 (7.1)	12 (8.6)	11 (7.9)	10 (7.1)	21 (15.0)	10 (7.1)		
Problem coping with academic demands									
No	102 (72.9)	126 (90.0)	91 (65.0)	129 (92.1)	80 (57.1)	56 (40.0)	140 (100.0)	201.928	0.000
Yes	38 (27.1)	14 (10.0)	49 (35.0)	11 (7.9)	60 (42.9)	84 (60.0)	0 (0.0)		
Problems in communication with teaching staff									
No	104 (74.3)	107 (76.4)	107 (76.4)	112 (80.0)	90 (64.0)	131 (93.6)	140 (100.0)	80.183	0.000
Yes	36 (25.7)	33 (23.6)	33 (23.6)	28 (20.0)	50 (36.0)	9 (6.4)	0 (0.0)		

Correlation between Insomnia Severity Index score and stress, anxiety, and depression scores

There was a significant positive correlation between the ISI score and the stress score ($r = 0.710$, $P = 0.000$), the anxiety score ($r = 0.655$, $P = 0.000$), and the depression score ($r = 0.284$, $P = 0.000$).

Discussion

To our knowledge, this was the largest study assessing the prevalence of symptoms of depression, anxiety, and stress in relation to insomnia in medical students in the Arab world.

The current study established the high prevalence of symptoms of stress, depression, and anxiety among medical students and the clear association of these conditions with insomnia.

In the current study, 63.7% of the students had symptoms of stress, 66.9% had symptoms of anxiety, and 59.2% had symptoms of depression. These findings are in agreement with those of several studies that have reported a higher prevalence of stress, anxiety, and depression among medical students than in the general population [26,27]. In Arab countries, three studies from Egypt, Saudi Arabia, and the United Arab Emirates, respectively, reported high rates of anxiety and depression among medical students [21,28,29]; however, the studies did not correlate these findings with insomnia.

Our results are similar to those of a 2014 study on first-year medical students at Egypt's Menoufiya University. In that study, depression, anxiety, and stress were reported in 63.6, 78.4, and 57.8% of the participants, respectively [21].

Studies from around the world have reported prevalence rates of stress among medical students ranging from 30 to 50% [26,30]; these levels are higher than those found in students of other schools [31,32].

During the initial years of medical school enrollment, the reasons for stress are related primarily to academic and social factors, whereas in the later years, physical factors generate more stress. Typically, the excessive study hours, high academic demands, lack of time for leisure activities, lack of peer support, distance from family, lack of communication with the teaching staff, high parental expectations, and economic difficulties are causes of anxiety and stress among medical students [5,33]. The presenting result could manifest itself in various ways, including failure to cope in stressful situations, performance anxiety, social phobia, depression, or panic disorders [34].

Some college students are still learning to cope with stress [35]. Without adequate restorative sleep, they may

not have adequate resources to cope with academic stress [36].

Different stressors identified in our study were problems in communications with the teaching staff, problem while coping with academic demands, difficulty studying in English, residence, studying more than 4 h a day, working during education, chronic physical health problem, chronic illness of a family member, death of a family member, and fear of failure in the future. The first six of these stressors directly relate to college life and their effect may be more amplified among medical students.

In Egypt, undergraduate medical students who get poor grades will obtain their postgraduate training outside the residency programs offered by medical schools at Egyptian universities, which diminishes their career prospects compared with those of their more academically successful classmates, who can enter the residency program. Consequently, students develop insomnia in the process of prolonging their study hours [37].

One of the stressors for medical students identified in our study was that they has to study in English, although most students had studied in Arabic in high school. The fact that most of the scientific and academic material worldwide is presented in English justifies the need to study medicine in English [38].

Living in a campus was identified as stressful by some of the students. This could be attributed to poor dormitory conditions, more economic stress, distance from the family, less structured environment, and problems dealing with roommates.

Studying more than 4 h a day and having to work during medical education could impair the quality of their life of students, affecting the leisure time, time to practice regular physical exercise, time to interact with family and friends, and time allowed for sleep.

In our study, there was no significant association between stress, anxiety, or depression, and physical exercise. This was in contrast to the findings of different researches – that exercise not only improves self-esteem and reduces social withdrawal but also reduces anxiety and depression and improves cognitive functioning. These effects could result from an exercise-induced increase in the cerebral blood flow and from the effect on the hypothalamic–pituitary–adrenal (HPA) axis, which connects with the limbic system, which in turn controls motivation and mood, the amygdala, which generates fear in response to stress, and the hippocampus, which plays an important role in memory formation, mood, and motivation [20].

In our study, there was a significant association between stress and caffeine consumption. Caffeine causes dopamine release in the prefrontal cortex, the principal area involved in reward, and thus increases alertness, reduces fatigue, and elevates mood. Thus, moderate caffeine intake (<6 cups/day) is associated with less depressive symptoms [39].

Symptoms of excessive caffeine consumption are similar to those of anxiety, and both could be due to sympathetic nervous system over activity. Because caffeine may be involved in the precipitation, exacerbation, and maintenance of anxiety disorders, anxiety symptoms could be reduced by caffeine withdrawal or restriction. Caffeine reduces slow–wave sleep (SWS) in the early part of the sleep cycle, can reduce rapid eye movement (REM) sleep later in the cycle, and leads to initial and intermittent insomnia [39].

The higher prevalence and higher levels of stress, anxiety, and depression among students in their initial years of education could be explained by the fact that students acquire better coping strategies over time.

In our study, stress, depression, and anxiety were more prevalent among females, a finding that was consistent with those of other studies that have found that female students reported more stress [26,40], although in one of these studies the mean number of stressors was similar for both male and female students [40]. While this difference could be real, it could also be due to the fact that females are more likely to report concerns or tend to over report symptoms. Some researchers have also suggested that sex may influence how medical students perceive stress [30].

In our sample, insomnia was present in 27.7% of the participants. This is comparable to what Loayza *et al*. [41] found in their study among medical students, where 28.15% of the medical students had insomnia.

The current study establishes a clear association between insomnia and stress, depression, and anxiety. Higher insomnia scores were associated with higher stress, depression, and anxiety scores. This finding is in agreement with what Ford and Kamerow [13] concluded in their study in 1989, that insomniacs are more likely to present with depression and anxiety than are noninsomniacs. This is also similar to what Chang *et al.* [16] found in their study among medical students, that insomnia is a risk factor for clinical depression.

Changes in the objective sleep architecture of depressed patients include impaired sleep continuity, increased wakefulness, reduced sleep efficiency, increased sleep onset latency, reduced total sleep time, shortened REM latency, increased duration of the first REM period, and increased REM density [42]. The normal decrease in slow–wave activity from the first to the last non-REM episode is also disrupted [18]. Some of these abnormalities are present during remission and are associated with an increased risk for relapse [19].

Reduced SWS in those with depression may be due to abnormalities in the orbitofrontal and anterior cingulate cortex or due to decreased regional cerebral blood flow, as observed in imaging studies in these areas during SWS [43,44].

The sleep–wake cycle is regulated by two processes, the circadian process and the homeostatic process. The homeostatic drive to sleep is wake-dependent and thus increases in proportion to the amount of time since the last sleep [45]. The timing of REM sleep is linked to the

circadian rhythm, and slow–wave activity is a marker of the homeostatic drive. Sleep abnormalities in those with depression indicate a disruption in both homeostatic and circadian drives [46].

Whether circadian rhythm disruption is a cause, a result, or comorbid with depression requires more research. An alternative explanation is that deficiencies in neurotransmitters, such as serotonin, noradrenaline, or acetylcholine, lead to the phase advance of sleep rhythms in depression [15].

Anxiety, which may be a state or a trait, includes increased arousal, which could affect sleep. Studies have found a significant decrease in total sleep time, an increase in waking after sleep onset, and a prolongation of sleep onset latency in patients with anxiety disorders [47].

Patients with chronic insomnia are in a state of continuous emotional arousal. They handle stress through internalizing emotions, resulting in emotional arousal. At bedtime, they are anxious and ruminate about different stressors in their lives. Emotional arousal causes physiological arousal, which then causes difficulties in sleep initiation or maintenance. They develop 'fear of sleeplessness', which then further heightens their emotional arousal and exacerbates their sleep difficulties [48].

In our study, stress levels correlated with ISI scores. Stress affects sleep architecture and circadian rhythms. Both sleep and stress are closely linked to the HPA axis and the autonomic nervous system, which can explain the relationship between sleep and stress. Stress has been associated with the activation of the HPA axis. Corticotropin-releasing hormone and cortisol are known to cause arousal and sleeplessness. Stress-induced elevation of plasma adrenocorticotropic hormone is associated with increased REM sleep. Sleep deprivation results in reduced amplitude of the cortisol profile in the morning and elevated cortisol the following evening [12].

During SWS, sympathetic activity is reduced and the HPA axis is subject to a marked inhibition. During REM sleep, HPA activity increases to reach a diurnal maximum shortly after morning awakening. Because the onset and end of sleep involve HPA axis activity, the temporal relationship between the axis and sleep indicates the effect of stress on sleep [48].

The immune system also influences the relationship between stress and sleep. This link is established by the cytokines, such as interleukin-1β, tumor necrosis factor, and interferon, all of which participate in the regulation of sleep. In the absence of interleukin-1β or tumor necrosis factor, sleep is interrupted, and if these cytokines are injected, non-REM sleep increases. Interleukin-1β contributes to the immune-regulating feedback chain, which activates the HPA axis, a possible mechanism linking stress and sleep. Blood IL-1β levels vary in the sleep–wake cycle, and blood tumor necrosis factor is related to the slow–wave activity of the brain. While chronic stress reduces natural killer cell activity, there further exists a strong correlation between the degree of loss of sleep continuity and natural killer cell function [49].

Conclusion

Stress, anxiety, and depression are prevalent among medical students in Egypt, and are positively correlated to insomnia. Symptoms are more common among females and during initial years of education. Different stressors were identified among medical students, including residence, working while educated, studying more than 4 h a day, difficulty studying in English, problems communicating with the teaching staff, fear of failure in the future, death of a family member, chronic illness of a family member, physical health problems, and problems due to coping with academic demands. Stressors varied in different years of education.

Limitations

The present study had some limitations. First, we could not compare the mental status of the students before and after joining medical school due to the absence of baseline data about mental status of students at the time of enrollment to medical schools in Egypt. Second, not including subjects from private medical schools limited the generalizability of our results. In addition, the study did not use a tool to diagnose depression or anxiety as the scale we used was a quantitative and not a categorical measure of clinical diagnoses.

Recommendations

Assessment of the mental state of medical students upon their enrollment in medical schools and during the first 3 years of their education is highly recommended. Failure to detect mental illness among medical students can increase morbidity and affect their academic performance, careers, and quality of life. Early detection of mental illness can shorten the duration of the illness and reduce social and functional impairments. Incorporating educational material about good sleep hygiene and the effect of sleep on one's mental state is recommended. Moreover, coping with stress should be integrated into the curriculum. Establishing student counseling units in medical schools to provide support and guidance and early detection of mental illness among students are critical.

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Conflicts of interest

There are no conflicts of interest.

References

1 Lemma S, Gelaye B, Berhane Y, Worku A, Williams MA. Sleep quality and its psychological correlates among university students in Ethiopia: a cross-sectional study. BMC Psychiatry 2012; 12:237.

2 Lund HG, Reider BD, Whiting AB, Prichard JR. Sleep patterns and predictors of disturbed sleep in a large population of college students. J Adolesc Health 2010; 46:124–132.

3 Suen LK, Tam WW, Hon K. Association of sleep hygiene – related factors and sleep quality among university students in Hong Kong. Hong Kong Med J 2010; 16:180–185.

4 Nojomi M, Ghalhe Bandi MF, Kaffashi S. Sleep pattern in medical students and residents. Arch Iran Med 2009; 12:542–549.

5 Sreeramareddy CT, Shankar PR, Binu VS, Mukhopadhyay C, Ray B, Menezes RG. Psychological morbidity, sources of stress and coping strategies among undergraduate medical students of Nepal. BMC Med Educ 2007; 7:26.

6 Moo-Estrella J, Pérez-Benítez H, Solís-Rodríguez F, Arankowsky-Sandoval G. Evaluation of depressive symptoms and sleep alterations in college students. Arch Med Res 2005; 36:393–398.

7 Eller T, Aluoja A, Vasar V, Veldi M. Symptoms of anxiety and depression in Estonian medical students with sleep problems. Depress Anxiety 2006; 23:250–256.

8 Dyrbye LN, Thomas MR, Shanafelt TD. Systematic review of depression, anxiety, and other indicators of psychological distress among U.S. and Canadian medical students. Acad Med 2006; 81:354–373.

9 Sherina MS, Rampal L, Kaneson N. Psychological stress among undergraduate medical students. Med J Malaysia 2004; 59:207–211.

10 Parthasarathy S. Sleep and the medical profession. Curr Opin Pulm Med 2005; 11:507–512.

11 Lashkaripour K, Bakhshani NM, Mafi S. Sleep quality assessment of medicine students and physician (medical) assistants. Interdiscip J Contemp Res Bus 2012; 4:443–450.

12 Ahrberg K, Dresler M, Niedermaier S, Steiger A, Genzel L. The interaction between sleep quality and academic performance. J Psychiatr Res 2012; 46:1618–1622.

13 Ford DE, Kamerow DB. Epidemiologic study of sleep disturbances and psychiatric disorders. An opportunity for prevention? JAMA 1989; 262:1479–1484.

14 Sateia MJ. Update on sleep and psychiatric disorders. Chest 2009; 135:1370–1379.

15 Nutt D, Wilson S, Paterson L. Sleep disorders as core symptoms of depression. Dialogues Clin Neurosci 2008; 10:329–336.

16 Chang PP, Ford DE, Mead LA, Cooper-Patrick L, Klag MJ. Insomnia in young men and subsequent depression. The Johns Hopkins Precursors Study. Am J Epidemiol 1997; 146:105–114.

17 Tafoya SA, Jurado MM, Yépez NJ, Fouilloux M, Lara MC. Sleep difficulties and psychological symptoms in medicine students in Mexico. Medicina (B Aires) 2013; 73:247–251.

18 Armitage R. Sleep and circadian rhythms in mood disorders. Acta Psychiatr Scand Suppl 2007; :104–115.

19 Steiger A, Holsboer F. Nocturnal secretion of prolactin and cortisol and the sleep EEG in patients with major endogenous depression during an acute episode and after full remission. Psychiatry Res 1997; 72:81–88.

20 Sharma A, Madaan V, Petty FD. Exercise for mental health. Prim Care Companion J Clin Psychiatry 2006; 8:106.

21 Abdallah AR, Gabr HM. Depression, anxiety and stress among first year medical students in an Egyptian public university. Int Res J Med Med Sci 2014; 2:11–19.

22 Lovibond SH, Lovibond PF. *Manual for the Depression Anxiety Stress Scales*, 2nd ed. Sydney: Psychology Foundation of Australia; 1995.

23 Taouk M, Lovibond PF, Laub R. Psychometric properties of an Arabic version of the Depression Anxiety Stress Scale (DASS); 2001. Available at: *http://www2.psy.unsw.edu.au/Groups/Dass/Arabic/Arabic.htm*. [Accessed 12 June 2016].

24 Morin CM, Belleville G, Bélanger L, Ivers H. The Insomnia Severity Index: psychometric indicators to detect insomnia cases and evaluate treatment response. Sleep 2011; 34:601–608.

25 Suleiman KH, Yates BC. Translating the insomnia severity index into Arabic. J Nurs Scholarsh 2011; 43:49–53.

26 Dahlin M, Joneborg N, Runeson B. Stress and depression among medical students: a cross-sectional study. Med Educ 2005; 39:594–604.

27 Rosenthal JM, Okie S. White coat, mood indigo: depression in medical school. N Engl J Med 2005; 353:1085–1088.

28 Amr M, El-Gilany A, El-Sayed M, El-Sheshtawy E. Study of stress among medical students at Manssoura University. Banha Med J 2007; 37: 25–31.

29 Carter AO, Elzubeir M, Abdulrazzaq YM, Revel AD, Townsend A. Health and lifestyle needs assessment of medical students in the United Arab Emirates. Med Teach 2003; 25:492–496.

30 Bayram N, Bilgel N. The prevalence and socio-demographic correlations of depression, anxiety and stress among a group of university students. Soc Psychiatry Psychiatr Epidemiol 2008; 43:667–672.

31 Al-Dabal BK, Koura MR, Rasheed P, Al-Sowielem L, Makki SM. A comparative study of perceived stress among female medical and non-medical university students in Dammam, Saudi Arabia. Sultan Qaboos Univ Med J 2010; 10:231–240.

32 Schmitter M, Liedl M, Beck J, Rammelsberg P. Chronic stress in medical and dental education. Med Teach 2008; 30:97–99.

33 Wolf TM. Stress, coping and health: enhancing well-being during medical school. Med Educ 1994; 28:8–17.

34 Elzubeir MA, Elzubeir KE, Magzoub ME. Stress and coping strategies among Arab medical students: towards a research agenda. Educ Health (Abingdon) 2010; 23:355.

35 Fischer J. Parent relationships, emotion regulation, psychosocial maturity and college student alcohol use problems. J Youth Adolesc 2007; 36:912–926.

36 Hamilton NA, Catley D, Karlson C. Sleep and the affective response to stress and pain. Health Psychol 2007; 26:288–295.

37 Ez ElArab H, Rabie M, Ali DH. Sleep behavior and sleep problems among a medical student sample in relation to academic performance: a cross-sectional questionnaire-based study. Middle East Curr Psychiatry 2014; 21:72–80.

38 Maher J. The development of English as an international language of medicine. Appl Linguist 1986; 7:206–218.

39 Lara DR. Caffeine, mental health, and psychiatric disorders. J Alzheimers Dis 2010; 20:S239–S248.

40 Amr M, Hady El Gilany A, El-Hawary A. Does gender predict medical students' stress in mansoura, egypt? Med Educ Online 2008; 13:12.

41 Loayza HMP, Ponte TS, Carvalho CG, Pedrotti MR, Nunes PV, Souza CM, *et al.* Association between mental health screening by self-report questionnaire and insomnia in medical students. Arq Neuropsiquiatr 2001; 59 (2-A):180–185.

42 Benca RM, Obermeyer WH, Thisted RA, Gillin JC. Sleep and psychiatric disorders: a meta-analysis. Arch Gen Psychiatry 1992; 49:651–670.

43 Drevets WC. Orbitofrontal cortex function and structure in depression. Ann N Y Acad Sci 2007; 1121:499–527.

44 Maquet P, Degueldre C, Delfiore G, Aerts J, Péters JM, Luxen A, Franck G. Functional neuroanatomy of human slow wave sleep. J Neurosci 1997; 17:2807–2812.

45 Borbély AA. A two process model of sleep regulation. Hum Neurobiol 1982; 1:195–204.

46 Nutt DJ. Neurobiological mechanisms in generalized anxiety disorder. J Clin Psychiatry 2001; 62 (Suppl 11):22–27. discussion 28.

47 Monti JM, Monti D. Sleep disturbance in generalized anxiety disorder and its treatment. Sleep Med Rev 2000; 4:263–276.

48 Staner L. Sleep and anxiety disorders. Dialogues Clin Neurosci 2003; 5:249–258.

49 Han KS, Kim L, Shim I. Stress and sleep disorder. Exp Neurobiol 2012; 21:141–150.