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ASSOCIATIONS BETWEEN ACADEMIC STRESSORS, REACTION TO STRESS, COPING STRATEGIES AND MUSCULOSKELETAL DISORDERS AMONG COLLEGE STUDENTS

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ABSTRACT

BACKGROUND: The adverse health effects of stress are enormous, and vary among people, probably because of differences in how stress is appraised and the strategies individuals use to cope with it. This study assessed the association between academic stress and musculoskeletal disorders (MSDs) among 1365 undergraduates.
METHODS: This was a cross-sectional study conducted in a Nigerian university at the beginning of the 2010/2011 academic session with the same group of participants. The Life Stress Assessment Inventory, Coping Strategies Questionnaire, and Short Musculoskeletal Function Assessment were administered as tools of data gathering.
RESULTS: Students' stress level and associated MSDs were higher during the examination period than the pre-examination periods. Stressors were significantly associated with increased risk of MSDs in both sexes were those related to changes (odds ratio (OR) = 1.7, p = 0.002) and pressures (OR = 2.09, p = 0.001). Emotional and physiological reactions to stress were significantly associated with MSDs in both sexes, with higher odds for MSDs in females, whereas cognitive and behavioral reactions showed higher odds (though non-significant) in males. The risk of MSDs was higher in respondents who adopted avoidance and religious coping strategies compared with those who adopted active practical and distracting coping strategies.
CONCLUSIONS: Stress among students could be significantly associated with MSDs depending on individuals' demographics, stressors, reactions to stress, and coping methods. Interventions to reduce stress-induced MSDs among students should consider these factors among others.
Key Words: Academic stressors, Coping strategies, Musculoskeletal disorders

INTRODUCTION

Stress contributes to health problems worldwide. Its presence is felt in home, office, industry, and academic environments. It is a common element in life regardless of race or cultural background. The emotional and physical ways in which we respond to pressure can cause mental and physical symptoms. The effects of stress vary with the ways it is appraised, and the coping strategies used differ between individuals and are influenced by ethnic, cultural, and socioeconomic characteristics (1). Thus, there is no universal definition of stress.

The etiology and pathogenesis of stress is complex and multi-factorial and varies across environments. Among university students, perceived stress may take the form of academic stress with multiple triggering factors (academic stressors), such as academic demands, finances, time pressures, health concerns, and self-imposed stressors (2).

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Previous studies have shown academic stressors to be good models of naturally occurring stress in humans, and empirical evidence has shown that undergraduates suffer psychosocial distress due to unsupportive interaction with other students and teachers and financial hardship(3).

Psychosocial stress is high among freshmen, women, and international students because of the adjustment they must make in their social, academic, and cultural lives in a new environment, having left all previous support persons such as parents, siblings, and high school friends (4). They are faced with loneliness, anxiety, depression, and disorientation. Also, previous studies have shown that poor coping strategies and variations in personality types may contribute to additional stress in certain individuals, leading to a negative pattern of behavior, development of psychosomatic symptoms, and decreased academic performance (3, 5).

An increasing body of evidence suggests that university students experience high levels of stress due to intensive academic workloads, the knowledge base required, and the perception of having inadequate time to develop it (6). Anecdotally, students report the greatest sources of academic stress to be taking and studying for examinations with respect to grade competition and mastery of a large amount of information in a small amount of time (7, 8). Various studies have consistently shown that examinations are among the most common of students' stressors. This stress can disrupt the internal and external environment of the student's body and cause physiological changes that tend to disturb homeostasis (9, 10).

Often, academic demands and self-imposed stressors collide, tipping the balance and resulting in disequilibrium and excessive stress (11). Such heightened stress could lead to associated symptoms such as sleep disturbance, which results in physical stress placed on the body. Psychosocial, individual, and physical stressors are also encountered often in an academic environment. Individual variables that can influence one's response to stress include age, sex, physical-ability status, lifestyle (smoking and alcohol-drinking habits), ethnicity, adiposity, and genetic predisposition. Previous studies have shown that variability in students' maturity (such

as the complete development of the prefrontal cortex, which is the area of the brain responsible for decision making) is related to greater variability in their strategies for coping with stress (12). Physical stress imposed on the body includes poor study posture and sitting on chairs improperly in overcrowded classes, which could produce muscle strain and joint imbalance, and soft-tissue stresses. This could become habitual, leading to more chronic, recurring pain and episodes of pain.

Additionally, prolonged static posture/loading or sustained exertion is common and occurs more often among students preparing for examinations. In this posture, the muscles must hold the body in a single position for a long time, leading to prolonged immobility with subsequent reduction in blood flow that result in muscle tension and susceptibility to musculoskeletal injury. Adverse academic environmental factors such as poor lighting, extreme temperature, and noise can also increase the risk of injury and subsequent development of musculoskeletal disorders.

Thus, it has been hypothesized that heightened academic stress, especially during examinations, is associated with an increased incidence of musculoskeletal disorders among undergraduates (13). However, there is a paucity of statistical data on the association or causal relationship between academic stress and MSDs in the literature, whereas several studies have focused on the immunological (9, 10), hematological (14), and hormonal outcomes of academic stress (1, 8).

Against this background, the present study examined the association between academic stress, reaction to stress, coping strategies, and incidence of MSDs among undergraduates in South-South Nigeria. The results could be useful to students without MSDs to adopt appropriate measures to prevent it, and to those with MSDs to modify their lifestyle and adopt better coping strategies to prevent a chronic disorder. The information could also assist in designing appropriate intervention programs, including modification of academic curricula, to reduce unnecessary stress among students during semester examinations.

MATERIALS AND METHODS

Recruitment of Subjects: This was a cross sectional study conducted on 1365 undergraduates (570 males and 795 females) in a Nigerian University, to evaluate the association between academic stressors, reaction to stress, coping strategies and musculoskeletal disorders. The participants were recruited from the faculty of basic medical sciences, arts and sciences. They were assessed at the beginning of the 2010/2011 second semester to establish their baseline stress level and musculoskeletal disorders. Similar assessment was repeated during the second semester examination on the same group of participants. Ineligibility criteria include: pregnancy, active athlete, diabetes mellitus, other non-communicable diseases, decline in participation, inadequate response to questions asked on the questionnaire and non-participation in the 2010/2011 second semester examination.

Assessment Measures: A four-section, semi-structured, self-administered questionnaire was used to survey the participants. The first part requested general information on respondents' socio-demographic profile, such as age, sex, year of study, marital status, socioeconomic background of parents, area of residence, and participant's lifestyle (smoking, alcohol intake, and physical-activity status).

The second part of the questionnaire was a 51 item assessment scale adapted from Student-Life Stress Inventory (SLSI) (15), and measures stressors and reaction to stressors by the respondent. It has a total score of 115 for stressors and 140 for reaction to stressors. The assessment of stressors consists of 23 items measuring five categories of stressors (frustrations, conflicts, pressures, changes, and self-imposed stressors). Frustrations are measured with a seven-item subscale assessing frustrations associated with delays, daily hassles to reach goals, lack of available resources, etc. The conflict subscale consists of three items and measures academic stress caused by having two or more alternatives that are both desirable and undesirable and having goals with both positive and negative impacts. The three-item changes subscale measures academic stress that occurs due to life changes. The self-imposed stress subscale consists of six items and measures stress

resulting from students' need to compete. The pressures subscale consists of four items and measures academic stress resulting from competition, deadlines, and work overload. Reaction to stressors is assessed with 28 items measuring four categories of reactions to stressors (physiological, fourteen items; emotional, four items; behavioral, eight items; and cognitive, two items). The physiological reactions subscale measures responses such as trembling, sweating, exhaustion, weight loss/gain, and headache. The emotional reactions subscale measures reactions such as crying, drug use, smoking, and irritability. The cognitive reactions subscale measures the ability to analyze and think about stressful situations and to use effective coping strategies to reduce stress. Each item on the stress scale was scored based on a 4-point scale (i.e 1= never, 2= occasionally, 3= often, 4= most of the times). The scores on the stress scale were dichotomized (1 and 2 vs 3 and 4) and summed to produce a total of 1-115. Scores of 1-20 indicated no stress whereas 21-69 indicated low stress; 70-115 indicated high stress.

The reaction subscale was also assessed on a 4-point scale, dichotomized (1 and 2 vs 3 and 4) and summed to produce total scores ranging from 1-14 for physiologic reaction, 1-4, 1-8 and 1-2 for emotional, behavioral and cognitive reactions respectively. Scores of 1-7 indicated low physiologic reaction whereas 8-14 indicated high physiologic reaction to stress. Similarly, scores of 1-5 indicated low behavioral response whereas 6-8 indicated high behavioral response to stressors. Also, scores of 1 indicated low cognitive reaction whereas scores of 2 indicated high cognitive reaction to stress. The SLSI has been reported to have high internal consistency and reliability, as indicated by a Cronbach's α of 0.92, and acceptable concurrent validity (16).

The third part of the questionnaire assessed participants' coping strategies using the Coping Strategies Questionnaire (CSQ) (17). It consists of 63 items and measures four types of coping: (a) active practical coping; this is task-oriented coping and depends on proactive responses to stress, (b) active distractive coping; this scale involves coping strategies such as getting involved in sports or recreational activities and having leisure time, thereby distracting oneself from the work, (c) avoidance coping; which

involves withdrawal behaviors and redirection of personal resources toward something else, such as shifting attention to other activities, drinking, smoking, and excessive sleep, and (d) religious coping; getting involved in religious activities. Scoring for the coping strategies is as follows: 1 (*never*), 2 (*seldom*), 3 (*occasionally*), 4 (*often*), and 5 (*most of the time*). A score of 1 indicates that a particular coping strategy is not used, scores of 2–3 indicate low usage, and scores of ≥4 indicate high usage. The higher scores represent a higher usage for specific coping strategy (18).

The fourth part of the questionnaire assessed the incidence of MSDs before and during the examination using the Short Musculoskeletal Function Assessment (SMFA). This is a 46-item questionnaire developed by Swiontkowski *et al* (19) from the original 101-item Musculoskeletal Function Assessment (MFA) questionnaire. It was designed to study differences in the functional status of patients with a broad range of musculoskeletal disorders. It consists of two parts; the dysfunction index and the bother index. The dysfunction index consists of 34 items assessing patients' perception of their functional performance. The bother index was designed to assess the extent to which patients are bothered by their dysfunction in their recreation and leisure, sleep and rest, and work and family. Items in both sections use a 5-point response format ranging in the dysfunction index from 1 (*good function*) to 5 (*poor function*) and in the bother index from 1 (*not at all bothered*) to 5 (*extremely bothered*). The SMFA questionnaire is a valid, reliable, and responsive instrument for clinical assessment and is extensively used (20).

Ethical approval was obtained from the University of Uyo Research and Ethics Committee, and written informed consent was obtained from study participants prior to commencement of the survey.

Statistical Analysis: Frequencies and simple percentages were computed for categorical variables and descriptive statistics were reported as mean ± standard error of means for quantitative variables. Differences between groups were compared using the independent sample t-test, and univariate relationships between categorical variables were analyzed with a chi-square test.

Furthermore, a multivariate analysis was performed with multiple logistic regressions; hence, odds ratios and corresponding 95% confidence intervals were estimated. All statistical computations were performed using the Statistical Package for Social Sciences (SPSS 17.0); $p < 0.05$ was considered statistically significant.

External quality assessment was conducted among hospital based medical laboratories in west Amhara region of Ethiopia from February to March, 2011 by a research team in Bahir Dar University. The region studied covers an estimated 10,826,171 people. There are eight medical laboratories based in government hospitals and a Regional Health Research Center in this region which gives laboratory services for ART service users. The laboratories under study are shown in Table 1.

RESULTS

Socio-demographic characteristics of respondents: socio-demographic variables of the 1365 students who participated in this study showed that 570 (41.8%) were males and 795 (58.2%) were females. The mean (±SD) age and BMI of respondents were 24.92±00.24 (years) and 23.79±0.11 (kg/m^2) respectively. Also, 96.6% were single while 3.4% were married. Sixty-one point eight percent (61.8%) were from nuclear families whereas 38.2% were from extended families. Additionally, 59.9% drink alcohol, 6.4% smoke, 50.6% reside on campus, 39.6% were physically active, 38.4% were students from Faculty of Sciences, 32.7% were from Faculty of Arts and 28.9% were from the Faculty of Basic Medical Science. Most of the respondents (31%) were in their second year of study. Also, 36.5% of the participants had MSDs with higher prevalence (64.8%) among females, singles (94.3%); those from extended families (58.8%), off-campus residence (51.4%), physically active (71.3%), from Faculty of Arts (36.3%), non-smokers (93.9%), alcohol drinkers (59.9%) and in the second year of study (34.3%).

Significant differences in BMI, sex, marital status, and physical-activity status were found between those participants with and those without MSDs at $p = 0.001$, whereas year of study was significant at $p = 0.037$. However, other

demographic variables such as age ($p = 0.083$), family size ($p = 0.064$), smoking habit ($p = 0.731$), residence ($p = 0.255$), and faculty ($p = 0.458$) did not significantly differ between the participants with and without MSDs (Table 1).

Table 1: Socio-Demographic characteristics of respondents

variable	Total (1365)	With MSDs (n=512)	Without MSDs (n=853)	P-value
Age (years)	24.92 ± 0.24	24.86 ± 0.16	24.93 ± 0.13	0.083
BMI (kg/m^2)	23.79 ± 0.11	24.56 ± 0.24	22.94 ± 0.107	0.001$^¥$
Sex				
Male	570 (41.8)	180 (35.2)	390 (45.7)	0.001$^¥$
Female	795 (58.2)	332 (64.8)	463 (54.3)	
Marital Status				
Single	1319 (96.6)	483 (94.3)	836 (98.0)	< 0.001$^¥$
Married	46 (3.4)	29 (5.7)	17 (2.0)	
Family size				
Nuclear	844 (61.8)	212 (41.4)	309 (36.2)	0.064
Extended	521 (38.2)	300 (58.6)	544 (63.8)	
Alcohol intake				
Drinkers	818 (59.9)	297 (58.0)	521 (61.1)	0.287
Non-drinkers	547 (40.1)	215 (42.0)	332 (38.9)	
Smoking habit				
Smokers	88 (6.4)	31 (6.1)	57 (6.7)	0.731
Non-smokers	1277 (93.6)	481 (93.9)	796 (93.3)	
Residence				
On campus	691 (50.6)	249 (48.6)	442 (51.8)	0.255
Off campus	674 (49.4)	263 (51.4)	411 (48.2)	
Physical activity status				
Active	541 (39.6)	147 (28.7)	394 (46.2)	0.001$^¥$
Inactive	824 (60.4)	365 (71.3)	459 (53.8)	
Faculty				
Basic Medical Sciences	395 (28.9)	142 (27.7)	253 (29.7)	0.458
Arts	446 (32.7)	186 (36.3)	282 (33.1)	
Sciences	524 (38.4)	184 (35.9)	318 (37.3)	
Years of study				
Years 1	373 (27.3)	118 (23.0)	255 (29.9)	0.037*
Years 2	423 (31.0)	176 (34.4)	247 (29.0)	
Years 3	225 (16.5)	93 (18.2)	132 (15.5)	
Years 4	194 (14.2)	72 (14.1)	122 (14.3)	
Years 5	150 (11.0)	53 (10.4)	97 (11.4)	

$^¥$$P<0.001$, significant at 0.1%. *$P<0.05$, significant at 5%

Stressors and reaction to stress: Table 2 shows significant gender differences in the number of respondents who experienced a high level of stress before and during the examination: more females (43%) experienced a high level of stress than did males (38.4%) during the examination. Distribution of academic stressors based on gender shows significant differences in the changes ($p = 0.009$), pressures ($p = 0.001$), and frustrations ($p = 0.001$) subscales, whereas non-significant differences were found on the conflicts and self-imposed subscales ($p = 0.819$ and 0.064, respectively).

Table 2: Distribution of stress among respondents before and during examination

Stress	Male (n = 570)			(Female (n = 795)			
	Before Examination N (%)	During Examination N (%)	P-value	Before Examination (%)	N	During Examination (%)	N P- value
Low	395 (69.3)	351 (61.6)	0.007**	516 (64.9)		453 (57.0)	0.001***
High	175 (30.7)	219 (38.4)		279 (35.1)		342 (43.0)	

**P < 0.01, significant at 1%, ***P>0.001, significant at 0.1%

More women experienced a high level of stress due to changes (60.3%) and pressure (48.9%), whereas a high level of stress due to frustrations and self-imposed stressors were more common in males than in females.

Additionally, emotional, behavioral, and physiological reactions to stress differed significantly between the sexes at $p = 0.004$, 0.01 and 0.001, respectively. Emotional and cognitive reactions predominated in females, whereas behavioral and physiological reactions were more prevalent in males (Table 3).

Table 3: Distribution and reactions to academic stressors (by gender) among respondents during examination

	Total (n = 1365)	Males (n = 570)	Females (n = 795)	P - value
Stressors				
Changes				
High	781 (57.2)	302 (53.0)	479 (60.3)	0.009**
Low	584 (42.8)	268 (47.0)	316 (39.7)	
Conflicts				
High	348 (25.5)	143 (25.1)	205 (25.8)	0.819
Low	1017 (74.5)	427 (74.9)	590 (74.2)	
Pressures				
High	593 (43.4)	204 (35.8)	389 (48.9)	< 0.001**
Low	772 (56.6)	366 (64.2)	406 (51.1)	
Frustrations				
High	418 (30.6)	211 (37.0)	207 (26.0)	< 0.001**
Low	947 (69.4)	359 (63.0)	588 (74.0)	
Self imposed stress				
High	241 (17.7)	114 (20.0)	127 (16.0)	0.064
Low	1124 (82.3)	456 (80.0)	668 (84.0)	
Reactions				
Emotional				
High	462 (33.8)	168 (29.5)	294 (37.0)	0.004**
Normal	903 (66.2)	402 (70.5)	501 (63.0)	
Cognitive				
High	440 (32.2)	178 (31.2)	262 (33.0)	0.501
Normal	925 (67.8)	392 (68.8)	533 (67.0)	
Behavioral				
High	460 (33.7)	214 (37.5)	246 (30.9)	0.011*
Normal	905 (66.3)	356 (62.5)	549 (69.1)	
Physiological				
High	535 (39.2)	265 (46.5)	270 (34.0)	< 0.001**
Normal	830 (60.8)	305 (53.5)	525 (66.0)	

*P<0.05, significant at 5%; **P<0.01, significant at 1%; ***P>0.001, significant at 0.1%

Coping strategies adopted by respondents: Table 4 shows the various strategies adopted by the respondents to cope with stress. There were significant differences in active, practical, and religious copings between the two sexes at $p = 0.001$. Avoidance and active distracting coping strategies did not significantly differ between the two sexes. However, men adopted more active practical (47.2%) and active distracting (28.9%) coping strategies than women did, whereas women adopted more avoidance (33.0%) and religious (48.7%) coping strategies than men did.

Table 4: Coping strategies used by respondents during examination

Coping strategies	Total (n = 1365)	Male (n = 570)	Female (n = 795)	P - value
Active practical				
High	539 (39.5)	269 (47.2)	270 (34.0)	< 0.001¥
Low	826 (60.5)	301 (52.8)	525 (66.0)	
Avoidance				
High	423 (31.0)	161 (28.2)	262 (33.0)	0.072
Low	942 (69.0)	409 (71.8)	533 (67.0)	
Active distracting				
High	380 (27.8)	165 (28.9)	215 (27.0)	0.476
Low	985 (72.2)	405 (71.1)	580 (73.0)	
Religious				
High	570 (41.8)	183 (32.1)	387 (48.7)	< 0.001¥
Low	795 (58.2)	387 (67.9)	408 (51.3)	

¥P>0.001, significant at 0.1%

Distribution of Musculoskeletal Disorders: Table 5 shows the distribution in both sexes of MSDs according to the affected body parts before and during the examination. More cases of MSDs were reported by respondents during than before the examination. Head/neck, upper limb/shoulder, trunk, and lower back/waist disorders differed significantly between the two periods in females ($p = 0.008, 0.001, 0.002,$ and 0.001, respectively); whereas in males, significant differences were found only in head/neck disorders ($p = 0.003$).

Table 5: Gender specific prevalence of musculoskeletal disorders before and during examination

Body distribution of MSDs	Before examination		During examination		p-value before vs. during exam	
	Male (n=139)	Female (n=270)	Male (n=180)	Female (n=332)	Male	Female
Head/neck disorders	29 (20.9)	89 (31.9)	66 (36.7)	142 (42.8)	0.003**	0.008**
Shoulder/upper limb disorder	41(29.5)	47 (17.4)	65 (36.1)	113 (34.0)	0.261	0.000¥
Trunk disorder	38 (27.4)	46 (17.0)	34 (18.9)	92 (27.7)	0.098	0.002**
Lower back/waist	42 (30.2)	68 (25.2)	60 (33.3)	145 (44.0)	0.638	0.000**
Lower limb	32 (23.0)	43 (15.9)	31 (17.2)	60 (18.1)	0.251	0.557

*P<0.05, significant at 5%; **P<0.01, significant at 1%; ¥P<0.001, significant at 0.1%

Association between stressors, reaction to stress, coping strategies and MSDs: Table 6 shows the results of the multivariate analysis for sources of stress, reaction to stressors, and the various coping strategies and prevalent MSDs in both sexes. The significant sources of stress in both sexes were those related to changes (OR = 1.7, CI: 1.206–2.399, $p = 0.002$) and pressures

(OR = 2.09, CI: 1.366–3.183, *p* = 0.001). However, when stratified according to sex, subscale scores for changes and pressures were significant only in females.

Emotional and physiological reactions to stress were significantly associated with MSDs in both sexes, but with associated higher odds for MSDs in females than in males (OR = 4.43, CI: 2.358–8.337, *p* = 0.001 and OR = 2.19, CI: 1.270–3.779, *p* = 0.005, respectively), whereas cognitive and behavioral reactions (though non-significant) were associated with higher odds in males than females (OR = 1.37, CI: 0.845–2.216, *p* = 0.202 and OR = 1.75, CI: 0.163–18.739, *p* = 0.645, respectively).

Finally, male respondents who adopted avoidance and distracting coping strategy had higher odds for MSDs (OR = 1.17, CI: 0.532–2.565) and (OR = 1.23, CI: 0.894–1.689) respectively, whereas those who adopted practical and religious coping had reduced odds for MSDs (OR = 0.29, CI: 0.199–0.410) and (OR = 0.67, CI: 0. 32–1.184), respectively.

Similarly, distracting and religious coping were associated with higher odds for MSDs in females (OR = 1.04, CI: 0.784–1.373) and (OR = 1.16, CI: 473–2.819), respectively, whereas those who adopted practical and avoidance coping had reduced odds for MSDs (OR = 0.32, CI: 0.148–0.689) and (OR = 0.42, CI: 0.286–0.606) respectively.

Table 6: Multiple logistic regression showing association between academic stress, coping strategies variables and MSDs odd ratios and 95% confidence intervals).

Variables	Both sexes AOR (95% CI)	P-value	Male AOR (95% CI)	P-value	Female AOR = (95% CI)	P-value
Academic stressors						
Change (high/low)	1.70 (1.206-2.399)	0.002✢	0.82 (0.486-1.383)	0.457	0.03 (1.745-5.254)	<0.001¥
Conflict (high/low)	1.13 (0.833-1.535)	0.431	0.10 (0.688-17.61)	0.690	1.02 (0.656-1.573)	0.943
Frustration (high/low)	1.04 (0.750-1.439)	0.818	0.96 (0.591-1.567)	0.878	1.42 (0.879-2.280)	0.152
Pressure (high/low)	2.09 (1.366-3.183)	0.001✢	1.26 (0.682-2.319)	0.464	2.93 (1.351-6.355)	0.007✢
Self-imposed (high/low)	0.93 (0.407-2.129)	0.866	0.91 (0.490-1.699)	0.773	0.98 (0.534-1.795)	0.945
Reaction to stress						
Emotional (high/low)	1.54 (1.977-2.419)	0.043*	0.87 (0.485-1.561)	0.640	4.43 (2.358-8.337)	<0.001¥
Cognitive (high/low)	1.05 (0.760-1.462)	0.750	1.37 (0.845-2.216)	0.202	0.88 (0.543-1.422)	0.599
Behavioral (high/low)	0.63 (0.150-2.642)	0.526	1.75(0.163-18.739)	0.645	0.14 (0.016-1.184)	0.071
Physiological(high/low)	2.09 (1.378-3.926)	0.006✢	1.26 (0.682-2.319)	0.464	2.19 (1.270-3.779)	0.005✢
Coping strategies						
Practical (active/non active)	0.01(0.01-0.054)	0.000	0.29 (0.199-0.410)	0.000	0.32 (0.148-0.689)	0.004✢
Avoidance (active/non active)	1.40 (0.934-2.102)	0.103	1.17 (0.532-2.565)	0.698	0.42 (0.286-0.606)	0.000¥
Distracting (active/non active)	0.56 (0.233-1.332)	.189	1.23 (0.894-1.689)	0.204	1.04 (0.784-1.373)	0.797
Religious (active/non active)	1.28 (0.626-2.623)	0.498	0.67 (0.32-1.184)	0.147	1.16 (0.473-2.819)	0.752

Adjusted for age, family size, year of study, smoking habit, physical activity, alcoholic intake and BMI.
*P<0.05, significant at 5%; ✢P<0.01, significant at 1%, ¥P<0.001, significant at 0.1%

DISCUSSION

The results of this study showed that the proportion of stressed students and individual stress levels were higher during the examination period than the pre-examination periods (i.e., the beginning of the semester). This coincides with the higher prevalence of MSDs recorded at the examination period. These findings provide added support to prior studies that implicate studying and taking examinations as the greatest source of academic stress among students (7, 8).

Current evidence suggests that academic stressors are good models of naturally occurring stress in humans (1), and a link between stressors peculiar to academic environments and the development of MSDs has been established (21). Such stressors include the high mental

workload/pressure, time pressures, difficult academic work, demanding examinations, poor social support from parents, friends, and relatives, and monotonous work (22, 23). These assertions have gained added support from findings of other studies in the literature. In a study carried out by Smith et al. (24), a comprehensive regression model, revealed that high mental pressure was a significant lower-back-MSD risk factor. Students with high mental pressure at school had about three times the odds of reporting low-back pain. Similarly, Lundberg (25) found that psychosocial stress can increase the activity of the trapezius muscle with associated development of neck pain. A consistent finding was obtained in a study carried out by Birch et al. (26) that demonstrated increased activity of the trapezius, infraspinatus, deltoid, and extensor digitorum muscles following time pressure. These could lead to an increased biomechanical load and resulting MSDs of the affected body parts.

Several theories/hypotheses have attempted to explain the causal link between stress and the incidence of MSDs. However, physiological mechanisms uphold the neurohormonal theory, which suggests that the hypothalamic-pituitary-adrenocortical (HPA) axis is activated by a wide variety of stresses, which in turn stimulate the synthesis and secretion of glucocorticoids (27). In addition, plasma concentrations of norepinephrine (NE), epinephrine (E), adrenocortropic hormone (ACTH), cortisol (Cor), and prolactin are proven to reflect stress level(1).

Empirical evidence suggests that stress responses can cause dysregulation of the autonomic nervous system and the hypothalamic-pituitary-adrenal axis (27). According to the model proposed by Aptel et al. (28), four pathways through which different physiological dimensions of the stress response can directly increase MSD risk have been described. These pathways include catecholamine, adrenal gland, reticular formation, and immune system pathways. Stress-induced catecholamine release enhances arteriolar vasoconstriction, which leads to reduced nutrient delivery within the microcirculatory system of muscles and tendons, resulting in poor healing of micro lesions in tendon fibers and finally muscle fatigue and pain. Stress can also cause the adrenal glands to release corticosteroid, which can disrupt mineral balance

through the effect on the kidneys, with consequent edema. Again, reticular formation is activated by stress, leading to an increased level of muscle activity and an increase in biomechanical load. In the immune system, stress can lead to increased production of cytokines, causing inflammation of tendons and resulting in MSDs (29).

Apart from psychosocial factors, academic stressors also encompass biomechanical (physical stress). Physical stress could be imposed on the body by protracted periods of poor study posture such as sitting on a chair improperly, static loading, or sustained exertion and mechanical contact stress (30). These could lead to muscle and joint imbalance, strain, and soft-tissue stresses that could become habitual, resulting in chronic or recurring pain and episodes of pain.

Another significant finding of the present study was the effect of individual variables on the prevalence of MSDs. Such variables as gender, body mass index (a measure of obesity), and physical activity status differed significantly between those with and those without MSDs. These could have directly or indirectly influenced the prevalence of MSDs through their effect on stress tolerance, stressors, reaction to stress, and coping strategies adopted to combat stress. For instance, female participants experienced higher levels of stress and MSDs, and the most common forms of stress among them were those related to changes and pressures, whereas frustrations and self-imposed stressors were more common in males. In addition, while cognitive and emotional reactions to stress were more common in females, behavioral and physiological reactions were predominant in males. Males engaged in more active practical and distracting coping, whereas females utilized religious and avoidance coping.

The higher levels of stress and MSDs found among female participants in the present study lend credence to the results of several studies with similar findings (31, 32). This could be because women naturally tend to perceive more stress than men (33), they have stronger reactions (mostly emotional) to stress than men do (34), and they generally desire to be noticed and loved and to seek perfect solutions to problems (35). Emerging evidence suggests that gender is an important biological determinant of psychosocial stress and human health, with a clear pattern for

sex-specific prevalence of several physical disorders (36).

Unlike men, women are physiologically predisposed to autoimmune diseases, chronic pain, depression, and anxiety disorders (37, 38). There are strong indications that these may be sex-hormone mediated (39).

Additionally, on the basis of gender-role theory, gender-role socialization and gender-role strain could provide another useful explanation. Women in general, and especially married women, have multiple roles to play, such as a mother, wife, and student, resulting in role strain. Therefore, they tend to face more stress and associated complications such as MSDs (40). This could provide a useful explanation for the high prevalence of MSDs among married women in the present survey.

According to this theory, women are expected to be emotionally expressive, dependent, kind, submissive (gender-role expectations) (41), and to have a tendency toward being more emotionally intense. Unlike men, women are expected to act as caregivers for the family. These gender-role expectations for women predispose them to increased levels of stress because they are expected to provide care and support for others before themselves (41).

These gender-role expectations contradict with the real nature of women who need to be cared for, supported, and socially oriented in a relationship (35). Thus, in the present study, the main stressors associated with higher odds for MSDs in women than in men were those related to changes, pressure, and conflict likely from gender-role strain, socialization, and academic concerns (42).

Also in line with the socialization model of stress response, gender-role expectations and gender stereotypes may influence people's response to stress and their adoption of a particular coping strategy (43), which could affect an individual's stress level and associated adverse outcomes. For instance, the higher prevalence rate of MSDs found among female students in the present study could have depended on their reactions to stress and the particular coping strategies adopted to cope with high academic demands. Men adopted more active practical and distracting coping, which are problem-focused, whereas women adopted more religious and avoidance coping strategies, which are emotion-focused in nature. Men in this study adopted more active, dominant, positive steps toward solving situations; whereas women adopted more passive, self-restraining, yielding, and patient approaches in the face of adversity. Adopting practical coping was associated with lower odds for MSDs in males than in females, whereas adopting religious coping was associated with higher odds for MSDs in females than in males. These findings are consistent with others in the literature. In 2005, Gilgil (44), in a cross-sectional survey in Turkey, found that being female and religious were among the risk factors associated with a higher likelihood of developing low-back pain. This is probably because being religious is associated with having restricted activity related to low-back pain. Further, Renk and Creasy (45) found out that female participants were more likely to adopt emotion-focused coping strategies than their male counterparts were. Similarly, Yoo (46) reported that male participants scored higher on problem-focused coping strategies, whereas females scored higher on emotion-focused coping strategies. In a study by Struthers et al. (47), students who engaged in problem-focused coping were more likely to be motivated and performed better than students who engaged in emotion-focused coping. Men tend to externalize their reaction to stress, while women tend to internalize their reaction with depression and guilt (48). These findings support the socialization hypothesis of gender variation in stress-coping strategies.

Gender-specific reactions to stress were obvious in the present study. While women exhibited more cognitive and emotional reactions, behavioral and physiological reactions were more common in men. These variations could be explained neurobiologically. According to the gender-specific neuro-activation model underlying central stress response (36), stress in men has been shown to be associated with increased cerebral blood flow (CBF) in the right prefrontal cortex (RPFC) and a reduction in CBF in the left orbitofrontal cortex, whereas in women, stress primarily activates the limbic system. The RPFC activation in males has been shown to be associated with a physiological index of stress-response-salivary cortisol (36). This is

associated with negative emotion, whereas according to the model, stress in women is associated primarily with activation of the limbic system, which is associated with the emotional reaction to stress. This could explain the cognitive and emotional stress reactions found in females and the physiological and behavioral reaction found in males in the present study. These gender differences in stress reactions were also associated with variation in the risk of developing MSDs.

Women who reacted emotionally to stress had significantly higher odds (OR = 4.43%) for MSDs, whereas males who exhibited behavioral reactions were more likely to sustain MSDs than females. Physiological reactions in males and cognitive reactions in females were associated with a lower risk for MSDs in both genders.

Apart from a higher level of stress (role strain), other reasons for increased MSDs in females may be that women are more willing to report MSDs than are men, and they are more exposed and vulnerable to risk factors for MSDs. These are thought to be associated with sex-linked biological factors, different pain sensitivity, and social or psychological factors (49).

Another important finding of this study was that the overall prevalence of MSDs (37.5%) and the sex-specific prevalence (35.2% for males and 64.8% for females) obtained during the semester examination were within the range of 15–80% obtained in most previous studies (50, 51, 52). Brennan et al. (51) reported a prevalence of 32% among students engaged in education programs that were physically demanding. In a similar study in Australia, Nyland and Grimmer (53) found a prevalence of 63% among physiotherapy undergraduates, whereas in another study among Australian student nurses, a higher prevalence (80%) of MSDs was reported (52). In China among Chinese medical students, MSD prevalence was 67.6% (24). These discordant prevalence rates observed across studies could be ascribed to the lack of a standard definition of MSDs and different instruments and scales for MSD measurement, resulting in different case definitions and data-collecting procedures among various studies (54). For instance, in some studies, neck disorders are classified separately from shoulder disorders, while in others, neck

and shoulder disorders are combined together. Additionally, in some epidemiological studies, MSDs may be defined based only on symptoms, while in others, the definition may include symptoms and findings of physical examinations, thus making the results incomparable between studies.

Interestingly, we also found that participants with MSDs had a higher BMI and lower physical activity status than those without MSDs. These findings lend credence to results of other studies in the literature (55, 56). It has been suggested that the causal pathway through which high BMI causes MSDs is mechanical load, which is thought to initiate degenerative changes in the joints(57) and low-grade systemic inflammation (58, 59, 60). The higher incidence of MSDs among physically inactive respondents is consistent with the existing research indicating that an imbalance between the physical demands of a work environment and the physical capability of an individual is a risk factor for MSDs (61).

The non-significant differences in age between those with and those without MSDs could have arisen because the respondents fell within a close age range (adolescents and young adults). However, inconsistent associations between age and MSDs have been reported in previous studies. While in some studies, MSDs are common in older adults ≥45 years (62), probably due to physiological and physical strength changes in musculoskeletal structures, other studies have shown that MSDs are not uncommon in the younger population and have been observed from early teens, especially when exposed to associated risk factors such as multiple academic/work stress dimensions (51, 63, 64), as observed in the present study.

This study was limited by constraints of a cross-sectional survey. Thus, there is a likelihood of oversampling students with than without MSDs. Also, self reported symptoms could suffer from a recall bias leading to over or under estimation of severity, since the symptoms could range from non-specific to specific and severity could range from mild, moderate to severe. Additionally, this cross-sectional study cannot attribute the MSDs to academic stress alone. Despite these limitations this study gained

strength from the large sample size which gave a fair representation of the study population.

In conclusion, university students are exposed to high academic stress, especially during examination periods. This could be significantly associated with musculoskeletal disorders depending on the stressors, reaction to stress, and strategies adopted to cope with the stress. These factors should be considered among others in any intervention to reduce MSDs associated with academic stress among college students.

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REFERENCES

1. Al-Ayadhi LY. Neurohormonal changes in medical students during academic stress. Annals of Saudi Medicine 2005; 9(1): 36-40.
2. Pamela, L. Premenstrual syndrome and academic stress in emerging adulthood women, 2009. Available at (http://www.nursing,arizona.edu/library/091)
3. Busari AO. Validation of student Academic Stress Scale (SASS) European Journal of Social Sciences 2011; 21 (1): 94-105.
4. Seyedfatemi N, Tafreshi M, Hagani H. Experienced stressors and coping strategies among Iranian nursing students. BioMed Central Nursing 2007; 6:11. dio: 10.1186/1472-6955-6-11.
5. Busari AO, Eniola MS. Effect of Stress Management Training on self image of visually impaired Individuals; Essays in Education. Online Journal, University of South Carolina Aiken 2007; 19:10.
6. Carveth, JA, Gesse T, Moss N. Survival strategies for Nurse-Midwifery students. Journal of Nurse-Midwifery 1996; 41: 50-54.
7. Abouserie, R. Sources and levels of stress in relation to locus of control and self esteem in University students. Educational psychology 1994; 14, 322-300.
8. Christopher EE, Koofreh JD, Uduak PA, Nyebuk ED. Academic stress and menstrual disorders among female undergraduates in Uyo, South Eastern Nigeria: the need for health education. Nigerian Journal of Physiological Science 2011; 26: 193-198.
9. Khansari DN, Murgo AJ, Faith RE. Effects of stress on the immune system. Immunol Today 1999; 11:170-175.
10. Matalka K, Sidki A, Abdul-Malik SA Thewaini AJ. Academic stress-influence on Epstein - Barr virus and Cytomegalovirus reactivation, cortisol and prolactin. Laboratory Medicine 2000; 31 (3):163-168.
11. Michie F, Glachan M, Bray D. An evaluation of factors influencing the academic self-concept, self-esteem and academic stress for direct and re-entry students in higher education. Educational psychology 2001; 21:455-472.
12. Kagan J, Baird A. Brain and behavioral development during childhood. In M. S Gazzaniga (Ed.). The cognitive neuroscience 2004; 93-104. Cambridge MA: MIT press.
13. Päivileino. Symptoms of stress predict musculoskeletal disorders. Journal of Epidemiology and Community Health, 1989; 43:293-300.
14. Faiya Q, Jane A, Masood AK, Ghazala S. Effect of Examination stress on blood cell parameters of students in a Pakistani Medical college. Journal Ayub Medical College Abbottabad 2002; 14 (1): 20-22.
15. Gadzella BM, Fullwood HL, Ginther DW. Student-life Stress Inventory, 1991. Paper presented at Texas Psychological Association Convention San Antonio, TX (ERIC 350-345).
16. Gadzella B, Catharine C. Stress difference among university female students. American Journal of Psychological Research 2006; 2: (1); 21-27.
17. Kausar R. Cognitive appraisal coping and psychological distress in carers of physically disabled people in Pakistan. Journal of Behavioral Sciences 2001; 2 (1-2): 47-68.
18. Kausar R. Perceived Stress, Academic Workloads and use of coping strategies by

University students. Journal of Behavioral Sciences 2010; 20:31-36.

19. Swionikowski MF, Engelberg R, Martin DP, Agel J. Short musculoskeletal function assessment questionnaire: validity, reliability and responsiveness. Journal of Bone and Joint Surgical (American) 1999; 81:1245-1260.

20. Gadzella BM. Student-life stress inventory: identification of and reactions to stressors. Psychological Report 1994b 74 (2); 395-402.

21. Sami-Abdo RA, Redhwan AA, Mustafa AA, Krishna GR. Stress and Coping Strategies of Students in a Medical Faculty in Malaysia. Malaysia Journal Medicine Science 2011; 18(3): 57–64.

22. Per-Olof Ö, Bertil SH, Istvan B et al. Incidence of shoulder and neck pain in a working population: effect modification between mechanical and psychosocial exposures at work? Results from a one year follow up of the Malmö shoulder and neck study cohort. Journal of Epidemiology and Community Health 2005; 59:721-728. doi:10.1136/jech.

23. Jeniffer E, Jenifer C, Jeffrey FP et al. The influence of stress on the menstrual cycle among newly incarcerated women. Women and health issues 2007; 17 (4):202-209.

24. Smith DR. Wei Ning, Ishitake T, Wang R. Musculoskeletal Disorders among Chinese Medical Students. Kurume medical journal 2005; 52:139-146.

25. Lundberg U, Forsman M, Zachau G. et al. Effects of experimentally induced mental and physical stress on motor unit recruitment in the trapezius muscle. Work Stress 2002; 16:166-178.

26. Birch L, Juul-Kristensen B, Jensen C, Finsen L, Christensen H. Acute response to precision, time pressure and mental demand during simulated computer work. Scandinavian Journal of Work, Environment and Health 2002; 26: 299-305.

27. Belkic K, Schwartz J, Schnall P et al. Evidence for mediating econeuro cardiological mechanisms, Occupational Medicine 2000; 15 (1): 117-162.

28. Aptel M, Cnockaert J. Stress and work-related musculoskeletal disorders of upper extremities. Trade Union Technical Bureau (TUTB) news letter, 2002 no 19-20. Available at: http://www.etuc.org/tutb/uk/newsletter.html

29. Puduvalli VK, Sella A, Austin SG, Forman AD. Carpel tunnel syndrome associated with interleukin-2 therapy. Cancer 1996; 77(6):1189-1192.

30. Smith DR, Leggert PA. Back pain in the young: A Review of studies conducted among school children and university students. Current Pediatric Review 2007; 3(1): 69-77.

31. Wijnhoven HA, de Vet HC, Picavet HS. Prevalence of musculoskeletal disorders is systematically higher than in men. Clinical Journal of Pain 2006; 22(8): 717-724.

32. de Carvalho MV, Soriano EP, de Franca Caldas A Jr., Campello RI, de Miranda HF, Caval Canti FI. Work related musculoskeletal disorders among Brazilian dental students. Journal of Dental Education 2009; 73(5):624-630.

33. Beena C, Poduval PR. Gender differences in work stress of executives. Psychological Studies 1992; 37:109-113.

34. Misra R, Castillo LG. Academic stress among college students: comparison of American and international students. International Journal of stress Management 2004; 11(2): 132-148.

35. Hashim IH, Zhiliang Y. Cultural and gender differences in perceiving stressors: A cross-cultural investigation of African and Western students in Chinese colleges. Stress Health 2003; 19: 217-225.

36. Wang J, Korczykowski M, Rao H et al. Gender differences in neural response to psychological stress. Oxford Journal of Medicine: Social Cognitive and Affective Neuroscience 2007; 2(3): 227-237.

37. Kajantie E, Philip DI. The effect of sex and hormonal status on the physiological response to acute psychosocial stress. Psychoneuroendocrinology 2006; 31:151-176.

38. Otte C, Hart S, Neylan TC, Marmar CR, Yaffe K, Mohr DC. A meta-analysis of cortisol response to challenge in human aging: importance of gender. Psychoneuro Endocrinology 2005; 80-81.

39. Mallinkrodt B, Leong FT. Social support in Academic programs and family environment. Sex differences and role conflicts for graduate students. Journal of counseling and development 1992; 70(6): 716-723.

40. Kidder DL. The influence of gender on the performance of organizational citizenship behaviors. Journal of management 2002; 28(5): 629-648.

41. Helgeson VS. Relation of agency and communication to well-being: evidence and potential explanations. Psychological bulletin 1994; 166: 412-428.

42. Talabani A, Hassanali P. Adolescent females between tradition and modernity: socialization in South Asia immigrant culture. Journal of Adolescence 2000; 23:615-627.

43. Crocker PE, Graham TR. Coping by competitive athletes with performance stress: gender difference and relationships with effect. The sports psychologist 1995; 9(3): 325-338.

44. Gilgil E, Kacar C, Butun B et al. Prevalence of low back pain in a developing urban setting. Spine 2005; 30(9): 1093-1098.

45. Yoo J. Coping profile of Korean competitive athletes, International Journal of Sport Psychology 2001; 32: 290-303.

46. Renk K, Creasey G. Relationship of gender, gender identity and coping strategies in late adolescents. Journal of adolescence 2003; 26: 159-168.

47. Stuthers CW, Perry RP, Menec VH. An examination of relationship between academic stress, coping, motivation and performance in College examination. Research in Higher Education 2002; 4(5): 581-592.

48. Ogle RS, Maier-katkin D, Bernard TJ. A theory of homicidal behavior among women. Criminology 1995; 33 (2): 173-193.

49. Denton M, Prus S, Walters V. Gender differences in health: a Canadian study of the psychosocial, structural and behavioral determinants of health, Social Science and Medicine 2004; 58: 2585-2600.

50. Brennan G, Shafat A, MacDonncha C, Vekins C. Lower back pain in physically demanding college academic programs: a questionnaire based study. BioMed Central Musculoskeletal Disorders 2007; 8:67.

51. Smith DR, Leggat PA. Musculoskeletal disorders among rural Australia Nursing Students. Australian Journal of Rural Health 2004; 12 (6): 241-245.

52. Nyland LJ, Grimmer KA. Is undergraduates' physiotherapy study a risk factors for low back pain? A prevalence study of low back pain in physio-therapy students. BioMed Central Musculoskeletal Disorders 2003; 4:22.

53. Boocock MG, Collier JM, McNair PJ, Simmonds M, Larner PJ, Armstrong B. A framework for the classification and diagnosis of work-related upper extremely conditions: Systematic Review, Seminars in Arthritis and Rheumatism 2009; 38: 296-311.

54. Strine TW, Hootman JM. US national prevalence and correlates of low back and neck pain among adults. Arthritis and Rheumatism 2007; 57:656-665.

55. Shiri R, Karppinen J, Leino-Arjas P. Solovieva S, Viikari-Juntura E. The association between obesity and low back pain: meta-analysis. American Journal of Epidemiology 2010; 171 (2): 135-154.

56. Heuch I, Hagen K, Nygaard O, Zwart JA. The impact of body mass index on the prevalence of low back pain: the HUNT study. Spine 2010; 35 (7): 764-768.

57. LeGars L, Borderie D, Kaplan G et al. Systemic inflammatory responses with plasma C-reactive protein elevation in disc-related lumbosciatic syndrome. Joint Bone Spine 2000; 67:452-455.

58. Burke JG, Watson RW, McCormack D et al. Intervertebral discs which cause low back pain secretes high levels of pro-inflammatory mediators. Journal of Bone and Joint Surgery (Britain) 2002; 84: 196-201.

59. Luike M, Solovieva S, Lamminen A et al. Disc degeneration of the lumbar Spine in relation to overweight. International Journal of Obesity 2005; 29:903-908.

60. Talpos-Nuculescu C, Lungeanu D, Anghel M, Stratul SL, Bcur A. The role of physical exercise in preventing musculoskeltal disorders caused by the dentel professionals,

Timisoara Medical Journal 2010; 60(4): 293-298.

61. Chau N, Bhattacherjee A, Kunar BM. Lorhandichap Group. Relationship between job, life style, age and occupational injuries. Journal of Occupational Medicine 2009; 59:144-119.

62. McMeeken J, Tully E, Stillman B et al. The experience of back pain in young Australians. Man Ther 2001; 6:213-220.

63. Hakala P, Rimpela A, Salminen JJ, Virtanen SM, Rimpela M. Back, neck and shoulder pain in Finnish adolescents: national cross sectional surveys. British Medical Journal 2002; 325:74.