Original Article

Relationship between the Development of Musculoskeletal Disorders, Physical Activity Level, and Academic Stress among Undergraduates Students of University of Nigeria

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Abstract

Background: Academic stress is a common experience among university students. It can affect the body composition of the students through behavioral changes, which further affect their physical activity level (PAL). Musculoskeletal disorders could arise from the interaction of these factors. This study aimed to determine the relationship between PAL, academic stress, selected anthropometric indices, and the development of MSDs among a selected Nigerian population.

Materials and Methods: This was a cross-sectional study of 256 (129 females and 127 males) undergraduates of the University of Nigeria, Enugu Campus aged 15–30 years using Student's Stress Inventory to evaluate academic stress, the short-form of the International Physical Activity Questionnaire to determine the PAL, and a Standard Nordic Musculoskeletal Questionnaire to assess MSDs.

Results: The results showed a high PAL with the male students having more PAL (61.4%) than female students. Secondly, the prevalence of MSDs among the population was high (66.02%) and the students faced moderate academic stress with the prevalence being more among the female students (75.2%). A significant difference was observed between academic stress and the development of MSDs ($P = 0.009$).

Conclusion: This study's findings support the hypothesis that increased academic stress and low level of physical activity are linked to increased risks of MSDs among students. Thus, it is warranted that the University curriculum is re-adjusted and incorporate public enlightenment programs on possible causes and prevention of musculoskeletal disorders, stress management, and coping strategies.

Keywords: Academic stress, musculoskeletal disorders, Nigeria, physical activity level, students

<H1>Introduction

Musculoskeletal disorders (MSDs) are injuries that affect the muscles, tendons, ligaments, joints, nerves, blood vessels, and all structures that play a role in the support of the movement.[1,2] This results in a single event or cumulative trauma, negatively impacting daily activities.[3,4] These disorders vary among different individuals and increase with age and repeated trauma, resulting in minor physical disabilities, pain or discomfort, and possessing the possibility of negatively affecting the individual's capacity to perform activities of daily living.[5]

The university is considered the workplace for students whose capacity to achieve their crucial goals of learning and social integration is largely dependent on an effective and stress-free environment.[6,7] Graduation of students who would be useful to themselves and armed with the capacity to meaningfully contribute to the socio-economic development of their society is the fundamental goal of any learning institution. This can only be achieved through the joint effort of the students, staff, and the university administration.[8]

The global prevalence of musculoskeletal disorders is between 20% and 33%, which varies based on the nature of the activity being carried out and affecting both adolescents and adults alike,[9] whereas students have a prevalence rate between 32.9% and 89.3% in different countries of the world. This can bring about a possible decrease in the educational attainment of students.[10] Musculoskeletal disorders have a complex and multifactorial origin.[11] Some of these factors such as physical, emotional, and social conditions could interact to predispose one to develop this disorder, with stress being the most vital predisposing factor.[12] Tantawy *et al*.[10] also stated in their study that future researchers should incorporate assessing the physical activity level (PAL) of students. This is because physical activity during leisure and work has been linked to reduced incidence of several occupational health issues, with musculoskeletal disorders inclusive.[9,13-16]

Previous literature suggests a PAL decline in young adults at the point of transition into early adulthood, with the highest decline happening at the point of admission into a university.[17,18] PA and stress are reciprocally interconnected.[19] One of the most prominent stressors in the lives of students is academic stress, which comes with serious implications for the psychological and physical health of individuals.[20] Some academic stressors such as mental workload, difficult academic work, examinations, and poor social support have been noted to increase the risk of developing MSDs.[21] Students go through physical stress during their courses of study, as they usually adopt poor study posture while sitting and/or standing in their classrooms, which usually leads to muscle strain and joint imbalance, thereby causing chronic and recurrent episodes of pain over time.[22]

Despite the negative effects of increased BMI, low PAL, and academic stress on students, there is a paucity of studies in the Nigerian literature aimed at determining the association between these variables (academic stress, physical activity level, and selected anthropometric indices) and the development of MSDs among the selected population. Most of the studies done in this literature only focused on determining the prevalence of MSDs and their associated risk factors as separate

entities without considering the relationship between these risk factors and the disorders, also, some of them focused only on students in a particular field, without considering all students of the institution. Academic stress is a common experience among university students and it can affect the body composition of the students through behavioral changes,[23] such as changes in their PAL. Musculoskeletal disorders (MSDs) could arise from the interaction of these factors; hence, this study is aimed at complementing and filling the gap existing in the literature supporting the findings of previous researchers, by determining the relationship between the development of MSDs and their associated risk factors, with a focus on the academic stress, selected anthropometric indices (BMI, WC, and forearm girth ([G]) and the PAL of the students.

<H1>Materials and Methods

<H2>Study design and setting

This study utilized a cross-sectional quantitative research method to explore the relationship between the development of musculoskeletal disorders, PAL, and academic stress among undergraduate students of the University of Nigeria, Enugu campus in Enugu Metropolis.

<H2>Study participants and sampling

A total of 256 participants (129 females and 127 males) were recruited for this study between February 10 and May 6, 2021. Study participants were conveniently recruited to include undergraduate students of the UNEC who are within the age ranges of 15 and 30 years. Those with a history of cardiorespiratory diseases, physical disability, psychiatric and psychological disorders, as well as those who smoke and those with a prior diagnosis of idiopathic pain; complex regional pain syndrome; chronic stress and anxiety disorders; retinopathy; and neurological, vascular, cardiac, renal, respiratory, musculoskeletal diseases such as kyphosis, scoliosis, and rheumatoid diseases were excluded from the study.

A minimum sample size of 250 was calculated for a student population of over 36,000 at 95% power, 0.05 level of error, an effect size of 0.73 with an equal allocation ratio (1:1), under a two-tailed independent *t*-test using the G* power 3.0.10 software. However, 256 participants were recruited for this study.

<H2>Data collection tool and technique

The research instruments used in this study include a stadiometer and weighing scale (Omron) for assessing the height and weights of the participants as well as the estimation of their body mass index (BMI). Non-elastic tape rule for measuring the waist circumference and the forearm girths

of the participants. Others were International Physical Activity Questionnaire, short-form (IPAQ-SF), Student Stress Inventory (SSI), stopwatch, the Nordic Musculoskeletal Questionnaire, and a self-adapted proforma for documenting the participants' demographics (age, sex, height, weight, waist circumference, forearm girth, and body mass index [BMI]).

Nordic Musculoskeletal Questionnaire (NMQ) was designed by Kuorinka *et al*.[24] It contained a body map to indicate nine symptom sites: neck, shoulders, upper back, elbows, low back, wrist or hands, hips or thighs, knees, and ankle feet. It is a binary response questionnaire with "yes" and "no" showing the presence or absence of musculoskeletal disorders.[10] The questionnaire also captured data on the incidence of musculoskeletal symptoms in the last 7 days and 12 months. Making use of the test-retest methodology, the reliability found was about 0.8. While comparing pain in the last 7 days, sensitivity was between 66 and 92%, whereas specificity ranged from 71 to 88%.[24-26]

International Physical Activity Questionnaire, short-form (IPAQ-SF) was developed as a tool for cross-national evaluation of physical activity, and standardized, health-associated physical activity behaviors' of people in several countries, and in various socio-economic environments.[27,28] IPAQ-SF has been recommended in time-limited situations, as it is easier and more realistic to use than the long-form.[27] It consists of vigorous-intensity activity, moderate-intensity activity, walking, and sitting.[29] It has remained the most commonly used physical activity questionnaire[30] and has persistently shown to have high reliability between 0.66 and 0.88.[29] It has a test–retest repeatability of 0.8 and criterion repeatability of 0.8 and criterion validity of about 0.3.[27]

Student Stress Inventory (SSI) was designed to help in determining the level of stress among undergraduate students, it comprises four negative items, used to measure 4 subscales (with each subscale, having 10 items) namely, physical, interpersonal, academic, and environmental factors.[30] SSI has been found to have a reliability coefficient of 0.857, with a good content validity, an overall score of 0.805 (80.5%), an excellent coefficient of 0.857, and high reliability, based on Cronbach's alpha values, ranging from 0.708 to 0.900.[31] SSI score within the range of 122–160 shows severe stress, 81–121 have moderate stress, whereas those within 40–80 experience mild stress.

Secondly, the participants' height (m) and weight (kg) were measured using a standard BMI protocol and apparatus (RGZ-120, made in China; weight/[height]^2 = BMI).[32] Waist circumference was measured with a non-elastic tape using the midway point between the iliac crest

(along the midaxillary line) and the costal margin,[33] whereas forearm girth was taken with the forearm in supination and the elbow in 90° flexion using the tape measure, which was placed at the bulkiest part of the forearm without compressing the skin.

Finally, NMQ, IPAQ-SF, and SSI were administered to the participants by the researcher, to assess the development of MSDs, PAL, and academic stress, respectively, and get the necessary information relevant for the study.

<H2>Ethical consideration

Ethical approval for this study was obtained from the Research and Ethics Committee of the University of Nigeria Teaching Hospital, Enugu State, Nigeria. Participation in this study was voluntary as participants were free to withdraw from the study at any moment. The protocol for the study was explained to the participants, and their informed consent was sought and obtained. Privacy and confidentiality of the participants were ensured using numerical coding, in place of their names in the course of data collection. Every measurement procured from the participants during data collection was used for the research purpose alone.

<H2>Data analysis

The data obtained were processed and analyzed using Statistical Package for Social Science (SPSS) version 21. A summary of the variables was done using descriptive statistics of mean, standard deviation, frequency, and percentages. A test of normality for the continuous variables measured on a ratio scale was done using the Shapiro–Wilk test. An association between the variables was determined using the spearman moment correlation rank and inferential chi-square with the level of significance set at $P < 0.05$.

<H1>Results

The majority of the participants were between the ages of 20 and 25 years, representing 82.4% of the study participants, and the majority of the participants (99.2%) were predominantly single students as shown in Table 1.

Table 2 describes the anthropometric indices of the participants, using the minimum and maximum mean and standard deviation of different indices for both males and females. For male students, the mean and standard deviation for their weights, heights, BMI, WC, and FG were 69.87 ± 12.18, 1.75 ± 0.09, 23.00 ± 3.24, 77.83 ± 7.28, and 27.64 ± 2.49, respectively. For female students, the mean and standard deviation of their weights, heights, BMI, WC, and FG were 65.15 ± 10.96, 1.64 ± 0.06, 23.71 ± 3.69, 77.42 ± 8.02, and 26.59 ± 2.08, respectively, revealing a normal range of

BMI for all participants, whereas male participants showed a higher range of FG and WC than the female participants.

Table 3 shows a description of the physical activity and academic stress levels of the participants and the prevalence of musculoskeletal disorders. It shows that the prevalence of MSDs among the population was high (66.02%) and the students faced moderate academic stress with the prevalence being more among the female students (75.2%). Table 4 shows the general prevalence of musculoskeletal disorders among the students and the prevalence of the specific regions of the body. Also, 66.02% of the study participants had at least one musculoskeletal disorder.

There was no statistical difference between PAL and the development of musculoskeletal disorders as the *P*-value was greater than 0.05 [Table 5]. There was a statistical significance between academic stress and the development of musculoskeletal disorders as the *P*-value was greater than 0.05 [Table 5]. There was a very weak relationship with no statistical significance between indices of anthropometry and musculoskeletal disorders as shown in Table 6.

<H1>Discussion

The purpose of this study was to determine the PAL, academic stress, selected indices of anthropometry (BMI, FG, and WC), and development of MSDs, among a selected Nigerian population. Musculoskeletal disorders (MSDs) are widespread global disorders, which can affect all individuals regardless of their age, socio-demographic background in society, and gender.[34] The major finding of this study is a significant association between academic stress and the development of MSDs among the students. This finding provides added support to previous studies, which reported a positive association between academic stress and MSDs among undergraduate students.[10,35] This finding suggests that stress is a possible risk factor for the development of MSDs, especially among students and in the academic environment.

Thus, our study population reported a general prevalence of MSDs that is relatively moderate to high among the students. Although this is not a novel finding, previous studies in the literature have indicated a high prevalence of MSDs among undergraduate students.[10,22] However, probable explanations for this finding could be that stressors in the academic environments result from the consequence of students' constant sitting for a significant period,[36] and the use of a specific posture that results in a single event or cumulative trauma that negatively impacts daily activities[3,4] and emotional and psychosocial stresses on the musculoskeletal systems.[22]

Some theories have been proposed to explain the pathophysiological link between the MSDs among students and the psychosocial stressors they experience. Examples are the neurohormonal theory that posits that stresses of all forms stimulate the hypothalamic–pituitary–adrenocortical axis to activate the secretion of hormones responsible for energy-demanding homeostasis. Such hormones include glucocorticoids, plasma concentrations of norepinephrine, epinephrine, adrenocorticotropic hormone, cortisol, and prolactin.[37,38] Aptel *et al*.[39] further explained that stresses could cause MSDs through arteriolar vasoconstriction caused by catecholamine release, which can trigger reduce nutrition supply within the microcirculatory system of muscles and tendons, resulting in inadequate repair of micro lesions in tendon fibers and, ultimately, muscular fatigue and discomfort. Secondly, Aptel *et al*.[39] theorized that stress could stimulate the adrenal glands to produce corticosteroids, which can disturb mineral balance via the kidneys, resulting in edema. Alternatively, activates reticular development, resulting in greater muscle activity and biomechanical load. It could also increase the production of cytokines in the immune system, leading to inflammation of the tendons.[22]

Another important finding of this study is the influence of students' socio-demographic distribution and anthropometric variables on the prevalence of MSDs. Especially, variables such as gender, PAL, BMI, and FG were related to the prevalence of MSDs in the study population. For instance, the majority of the students reported moderate academic stress with a higher incidence occurring among the female students. This agrees with the findings of other studies in the literature, which have reported a higher prevalence of academic stress among female students.[10,22,40] Ekpenyong *et al*.[22] explained that this is probably because females are more likely to feel stress (particularly emotional stress), and they have a strong need to be acknowledged and appreciated, as well as to find excellent answers to issues. Furthermore, women are predisposed biologically to autoimmune illnesses, chronic pain, depression, and anxiety disorders.[41,42] Although there were no significant relationships found between gender and reported academic stress in this study, the result further showed that the male gender had a higher incidence of MSDs when compared with their female counterpart, indicating that the gender with the highest level of stress does not coincide with the highest prevalence of MSDs. This finding is contrary to the report of Ekpenyong *et al*.[22] where female students reported a higher incidence of MSDs when compared to their male counterparts. However, this is not a novel finding as Ayanniyi and Udofia[43] have previously shown higher MSDs in males. Probable explanations for this higher incidence of MSDs in males could mean

that men are exposed to other risk factors of MSDs than females. Examples include exposure to occupational stressors,[44] a high level of PAL among men,[45] and psychosocial stressors.[22]

Furthermore, the results obtained from the current study showed that the majority of the students had a high PAL, which contradicts the finding of Hendi *et al*.[46] that the majority of their participants had low PAL. The findings of this study also revealed that male students are more physically active than female students, adding credence to possible reasons for the observed high incidence of MSDs among male students. This finding conforms to the findings of Goje *et al*.[47] and Rajappan *et al*.,[48] which stated that female students are less active than their male counterparts. However, there was no significant association between the PAL of students and the development of MSDs. This is in contrast to the result of the study carried out by Hendi *et al*.[46] on health specialty students in Saudi Arabia, which reported a significant association between the development of MSDs and PAL in the students. This difference in findings could be due to the heterogeneity of the study population that participated in this study, as the students were drawn from all faculties on the campus.

Again, the findings of this study showed no significant association between anthropometric indices and the development of MSDs. Similarly, Tantawy *et al*.[10] have previously reported no statistical significance in the association between BMI and the development of MSDs. However, this is in contrast to the observations of Shiri *et al*.,[49] Heuch *et al*.,[50] and Ekpenyong *et al*.[22] as they reported a higher incidence of musculoskeletal disorders occurring among students with higher BMI. There was no significant association between height and the development of MSDs, which is in contrast to the finding by Ekechukwu *et al*.,[35] as a statistical significance in the relationship between the development of neck MSD and the heights of the students was found, suggesting that height is a significant predictor of MSDs. No statistical significance was found between FG and the development of MSDs. However, to the best of the researcher's knowledge, there is a paucity of studies in the literature on the association between the anthropometric variables, as obesity is associated with increased dimension and body mass.[51] This suggests that increased BMI also implied increased FG, which justifies the statement made by Sagun *et al*.[52] that some anthropometric measurements including FG are rarely used for estimating body composition.

More so, the anthropometric variables did not coincide with the body parts that are most affected by MSDs. Elbow was reported as the most affected body part among the students, followed by the neck, with the knee being the least affected. However, this varies with the findings of previous

studies where the neck was mostly shown to be the most affected.[10,53] However, as mentioned earlier, the least affected body part is the knee in the work of Tantawy *et al*.[10] These observed differences could be because of differences in the population studied and the academic settings.

<H2>Limitations and recommendations

The restrictions of a cross-sectional survey limited the scope of this study. Secondly, because symptoms can range from non-specific to particular and intensity can range from mild to severe, self-reported symptoms may suffer from memory bias, resulting in over or underestimation of severity. More so, the MSDs cannot be attributed only to academic stress in this cross-sectional investigation. Despite these limitations, the study was strengthened by the high sample size, which provided a representative sample of the study population.

<H1>Conclusion

The findings of the study showed there was a high prevalence of MSDs among the selected population. Generally, students have a high PAL, with the male students being more physically active. The students faced moderate academic stress with the prevalent being more on the female students. The study also revealed a significant relationship between academic stress and the development of MSD but there was no significant relationship between the PAL, selected anthropometric indices, and the development of MSDs. Thus, it is warranted that the university curriculum can be re-adjusted in this regard and incorporate public enlightenment programs on possible causes and prevention of musculoskeletal disorders, stress management, and coping strategies. Ergonomic adjustments to the chairs and desks utilized by students to suit the anthropometry of the students are recommended.

<H2>Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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<H2>Conflicts of interest

There are no conflicts of interest.

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Table 1: General characteristics of participants (N = 256)		
Variable	**Frequency**	**Percentage (%)**
Age		
15–19	33	12.9
20–25	211	82.4
26–29	9	3.5
>30	3	1.2
Gender		
Male	127	49.8
Female	129	50.2
Marital status		
Single	254	99.2
Married	2	0.80
Level		
100	25	9.8
200	60	23.5
300	85	33.2
400	41	16.0
500	45	17.6

Table 2: Selected anthropometric indices of participants						
Variables	**Males (*n* = 127) X ± SD**	**Males (min)**	**Males (max)**	**Females (*n* = 129) X ± SD**	**Females (min)**	**Females (max)**
Weight (kg)	69.87 ± 12.18	25.65	140.5	65.15 ± 10.96	44.00	101.8
Height (m)	1.75 ± 0.09	1.50	1.95	1.64 ± 0.06	1.50	1.82
BMI (kg/m^2)	23.00 ± 3.24	17.47	38.95	23.71 ± 3.69	15.71	37.39
WC	77.83 ± 7.28	65.00	118.0	77.42 ± 8.02	60.00	98.50
FG	27.64 ± 2.49	21.5	37.00	26.59 ± 2.08	21.00	33.00

Table 3: Percentage values of participants PAL, academic stress, and reported musculoskeletal disorder

Variables	Male		Female	
	Frequency	**(%)**	**Frequency**	**(%)**
Physical activity				
High	78	61.4	62	48.1
Moderate	14	11.0	20	15.5
Low	35	27.6	47	36.4
Academic stress				
Mild	52	40.9	29	22.5
Moderate	72	56.7	97	75.2
Severe	3	2.4	3	2.3
Musculoskeletal disorder				
Low	0.00	0.00	0.00	0.00
Medium	101	79.5	98	76.0
High	26	20.5	31	24.0

Table 4: Prevalence of musculoskeletal disorders among students of University of Nigeria Enugu Campus

Musculoskeletal disorder	**Frequency**	**Prevalence (%)**

General **region specific** Neck	169 119	66.02 46.48
Shoulder	95	37.11
Elbow	226	88.28
Wrist	82	32.03
Hip	86	33.59
Knee	58	22.66
Ankle	71	27.73
Upper back	105	41.02
Lower back	101	39.45

Table 5: Association between PAL, academic stress, and development of musculoskeletal disorders

	Musculoskeletal disorders		**Chi-square**	***P*-value**
	High	**Medium**	**1.095**	**0.58**
Physical activity				
High	29.0	111		
Low	8.00	26.0		
Medium	22.0	60.0		
Academic stress				
Mild stress	10.0	71.0		
Moderate stress	46.0	123		

Severe stress	3.00	3.00		
*Indicates significance at $P < 0.05$				

Table 6: Association between indices of anthropometry and development of musculoskeletal disorders

	Height	**Weight**	**BMI**	**WC**	**FG**
Musculoskeletal Disorder (*r*)	0.009	0.086	0.118	0.05	0.009
***P*-value**	0.88	0.17	0.06	0.43	0.85