Original Research Article

Ergonomics Workstation Assessment of Musculoskeletal Disorders in University of Port Harcourt

ABSTRACT

This study examines the experiences of musculoskeletal discomfort among staff and students of the University of Port Harcourt as it relates to their workstations. Questionnaires were designed to extract information from respondents on their experience of musculoskeletal pains and other discomforts. A total of 320 questionnaires were distributed randomly to staff and students across the three campuses of the University of Port Harcourt. One hundred and forty (140) questionnaires were distributed to staff (academic, 60 and non-academic, 90) out of which 115 were retrieved. Similarly, 170 questionnaires were distributed to students out of which 163 were retrieved; altogether 278 out of 320 yielded a 86.9% response rate. The study revealed that there is a strong relationship between the workstation set up and development of musculoskeletal discomfort in classrooms and offices at the University of Port Harcourt. Most staff and students experience low back and neck pains due to poor ergonomic practices. Furthermore, most of the student respondents spend their reasonable time sitting in class receiving lectures (47%) and studying/reading (18.3%), respectively. While a handful of students (9%) stand for most of the time receiving lectures; due to limited number of seats. A multiple regression analysis on workstation against MSDs (lower backaches, headaches, neck & upper backaches and neck & shoulder aches) yielded a coefficient of variance, R^2 of 87%. The sensitivity analysis on the regression model gave the following results: R^2 = 29.94, 1.23, 41.7, and 14.12% for workstation against i) lower backaches; ii) headaches; iii) neck & upper backaches; iv) neck & shoulder aches, respectively. The result of analysis of variance (anova) on the differences in questionnaire response to simple ergonomic workstation (the cause) and those of musculoskeletal disorder (the effect) showed not significant. This not only confirmed the consistency of responses but also in agreement with Kendall's w-statistic for staff and students level of agreement, < 50% in all cases.

Key words: Ergonomics workstations, Assessment, Musculoskeletal Disorder, University of Port Harcourt.

1. INTRODUCTION

The academic environment is not usually thought of when considering occupational health issues, yet, this environment demands high productivity and excellent performance from staff and students. These demands come with some penalty on staff and students particularly with respect to Musculoskeletal Disorders (MSDs). Musculoskeletal Disorders, are prevalent where ergonomic workstation setups are not practiced [1]. The academic institution is a

highly active environment with multi-disciplinary programs, activities and individuals with various functions that are exposed to different hazards. However, due to the nature of most of the activities, it is likely that musculoskeletal disorder (such as body aches and pains) may be a problem.The classroom for instance just like any other work environment, good implementation of ergonomics is required for the maintenance of good health, improvement in work performance, learning and motivation [2].

According to the Centre for Disease Control and Prevention [3], musculoskeletal disorders are classified as injuries that affect the joints, muscles, nerves, cartilages, tendons and discs in the spine. Musculoskeletal disorders are pains which can be caused by the sedentary nature of a job or task. It is said that holding same position slowly diminishes elasticity in the soft tissues in the back. Triano and Selby [4] affirmed that a healthy body can only tolerate staying in a position for about twenty (20) minutes. There have been widespread agreements that ergonomics workstation set up fosters creative and innovative performance [5], and lack of it would result in a decline in higher situational control, thereby threatening the performance and productivity [6]. The use of a good workstation design improves the posture of the staff and students in their daily functions to enhance performance and productivity and thus, the possibility of musculoskeletal disorders associated with these functions are significantly reduced [7, 8].

Some studies have identified among other things poor health status of workers arising from constant exposure to occupational health hazard as one of the cardinal factors militating against employees' effective performance and productivity [3, 9]. According to Patron [2], students spend at least eight (8) or more hours in the academic environment and many of the chronic diseases that may manifest later in their lives may be due at least in part to unfavourable environment or exposure.

The purpose of this study is to assess the Musculoskeletal Disorders (MSDs) and the associated factors, in this case the workstation setup at the University of Port Harcourt. Evaluations are made based on questionnaire approach and statistical analyses. Effects of MSDs are many which include but not limited to low productivity, absenteeism, poor concentration in class lectures/studies, etc. This study therefore is to assess the effect of poor workstation setup on staff and students with respect to MSDs and establish any relationship that may exist.

2. MATERIALS AND METHODS

2.1 STUDY AREA

University of Port Harcourt was selected as the study area on the basis of size (see Figure 1). It is located within the coordinates of Latitude 4°5′19.24″ and Longitude 6°55′25.41″ in Choba, Port Harcourt, the administrative capital of Rivers State. Port Harcourt metropolis is predominantly made up of traders, civil servants and oil company workers, with an estimated population of 1,005,904 (2006) inhabitants. The city is host to the University of Port Harcourt, Choba; University of Port Harcourt Teaching Hospital, Alakahia; Rivers State University of Science and Technology, Nkpolu; University of Education, Rumuolumini; College of Arts and Science, several broadcast stations and many oil servicing companies, respectively.

Sources: Google map, 2015

Figure 1: Map of the study area (University of Port Harcourt)

2.2 STUDY POPULATION

The study population comprises of teaching staff, non-teaching staff and students of the University of Port Harcourt. The probability sampling technique, precisely the stratified sampling technique was used to select the respondents for the study. The estimation of sample size using prevalence formula [10] was adopted as Equation (1

$$N = \frac{z^2 P(1-P)}{T^2} \quad (1)$$

Where N = sample size; and T = Tolerance error, ,P = Prevalence from previous studies and z = 1.96, level of significance or standard normal deviation

In this study, P = 0.07 and Tolerance error, T = 0.03

Thus, the sample size for the study is obtained via Equation (1) as follows:

$$N = \frac{1.96^2 (0.07)(1-0.07)}{0.03} = 277.88$$

For attrition rate of 7.5%, then N = 300 persons

2.3 DATA COLLECTION

Data collection involved selection of the sample population, questionnaire design and distribution, collation, and tabulation in frequency tables for analysis. The data for this study were obtained through questionnaire as the primary source while the secondary sources were those from literature, observations and personal communication with the participants.

2.3.1 Inclusion Criteria

The criterion includes academic and non-academic staff as well as students who were 18years and above at the time of study who gave their informed written consent for the study/research

2.3.2 Exclusion Criteria

The criteria excluded women who were pregnant and other staff and students that were sick at the time of data collection (questionnaire distribution) or those that may have suffered one kind of pain or another due to physical deformity.

2.3.3 Participants

Essentially, the population of this study comprises teaching staff, non-teaching staff and students of the University of Port Harcourt. The experience of musculoskeletal discomforts among staff and students at different workstations associated with the University environment was investigated using sampled population. Given the entire population of both staff and students of the University numbering over 25,000, a study population of 320 was

selected. The participants distribution is as follows: for academic staff 60 and non-academic staff 90 and 170 for students, respectively. The staff-student ratio is approximately 1:2. However, we observed from personal communication with the university staff that non-academic staff are more prone to completing questionnaires than academic staff. This explains why more questionnaires were distributed to the non-academic staff. The socio-demographic information of the sampled population (participants) is all about gender, age distribution, education, hour spent on work stations, etc (see Table 1).

2.3.4 Questionnaire

The questionnaire design was of two major parts. The first part addressed the background information of the participants with respect to age, gender, and status on campus, that is, staff (academic/ non-academic) or students (see Table1). The second part consisted of thirty one questions distributed as follows: i) five questions on time at various work schedules; ii) six questions on Break schedules; iii) seven questions on simple ergonomics checklist for eliminating possible MSDs; iv) eight questions on experience with lower back pains; and v) five questions on experience with neck and shoulder pains. The questionnaires were of self-completion format; and thus had three answer options, namely '*yes*', '*no*' and '*undecided*'. Examples of the questionnaires (part 2) are found as "key" in Figures 3-7 (see Results & Discussion Section) and in Appendix as questionnaire response frequency tables (see Tables A1 – A5).

2.3.5 Procedure

Prior to the questionnaire administration a pre-test was carried out on twenty randomly selected staff and students from a sister institution, State University of Science Technology to get their inputs and know where improvement could be made. The questionnaires were subsequently revised based on the information and feedback provided by these participants. The questions are based on information obtained from literature and personal communications with staff and students of the study Area.

2.4 DATA ANALYSIS

The questionnaire was designed on three answer options with the following ratings: 3 for '*yes*', 2 for '*no*', and 1 for '*undecided*', respectively. Frequency tables were constructed to record the responses for each question (see Appendix A) which were subsequently

transcribed to bar graphs to avoid duplication of results in both tables and graphs. Kendall's coefficient of concordance (w) was adopted to test for the degree of agreement between respondents on the questionnaire parameters. Kendall's coefficient is a non-parametric statistic used to assess degree of agreement among respondents [11]. Its values range from zero (no agreement) to unity (complete agreement). Intermediate values signify low or high degree of unanimity between respondents.

The formula for calculating Kendall's coefficient (w) is given as Equations (2) – (4):

$$w = \frac{12\sum\left(R_i - \overline{R}\right)^2}{m^2 n\left(n^2 - 1\right)} \tag{2}$$

$$R_i = \sum_{j=1}^{m} r_i \times j \tag{3}$$

$$\overline{R} = \frac{1}{2} m(n+1) \tag{4}$$

Where R_i is given by Equation (3) and it represents the total rank or rating given by respondents; i is an object, given a rank/rating, r_i by respondent j; m represents the total number of respondents while n represents the total number of objects (in this case, questions); and $\overline{R}$ is the mean value of the total rating and is given by Equation (4).

The difference in staff and students questionnaire responses were evaluated using Analysis of Variance (ANOVA), single factor using Microsoft Excel. The results were compared with those of Kendall's. Furthermore, regression analysis was carried out to establish the degree of relationship between workstation setup and musculoskeletal disorders as multiple regression (see Equation 5):

$$y = a_0 + a_1 x_1 + a_2 x_2 + a_3 x_3 + a_4 x_4 \tag{5}$$

Where y = Ergonomic workstation setup; x_1 = lower backache; x_2 = headache; x_3 = neck & upper back ache; and x_4 = neck & shoulder ache.

A sensitivity analysis was carried out on Equation (5) to determine the contribution of each of the independent variables (x_1, x_2, x_3, & x_4) as measured by the coefficient of variance (R^2). In effect, this analysis offered the opportunity to rank the independent variables in their order of importance based on the experiences of the respondents on MSDs.

3. RESULTS AND DISCUSSION

3.1 Socio-demographic Data Distribution

Table 1 shows the demography survey of the respondents. The socio-demographic feature of the respondents, showed that more males than females were among sampled population. ~~were~~ Available in the table are three distinct age groups of 18-30, 31 – 50 and 51years & above. The highest to the least in number of respondents follow the order of the age groups (see Table1)

Table 1: Socio-demographic Statistics

Gender	No. of Respondents	Percentage (%)	Age Bracket	No. of Respondents	Percentage (%)	Sample frame	No. of Respondents	Percentage (%)
			18-30	134	48.2	Teaching Staff	32	11.5
Male	186	66.9	31-50	85	30.6	Non-Teaching staff	83	29.9
Female	92	33.1	51 and above	59	21.2	Students	163	58.6
	∑ 278	100		∑ 278	100		∑ 278	100

3.2 Cause – Effect Relationship: Workstation and Musculoskeletal Disorders

For multiple regression analysis, the 'cause' is taken as the questionnaire responses on ergonomic workstation setup (see Table A1) while 'effect' represents four questionnaire groups (see independent variables in Equation 5) on neck, back (lower & upper), shoulder aches, etc (see Table A4 – A5). Adopting the positive responses on the applicable questionnaire parameters as input data for XLSTAT simulation yielded a multiple regression of Equation (6) with coefficient of variance, R^2 of 0.8696, indicating high positive relationship. Physical inspection of various workstations at the University of Port Harcourt confirmed poor knowledge of ergonomics in procurement of office and classroom furniture and the resultant effect is the MSDs. Apparently, the multiple regression model has confirmed the existence of case-effect relationship.

$$y = -193.115 + 0.994x_1 + 0.177x_2 + 0.898x_3 + 0.916x_4 \qquad (6)$$

To assess the contributions of each independent variable with respect to R^2, sensitivity analysis was performed and the results are presented in Table 2. From column 4 of Table 2, we observe the order of importance of the four independent variables, with x_3 in the first position, followed by x_1, x_4 and x_2, respectively. The benefit of sensitivity analysis is the ranking it brings about, thus, less contributory variables can be dropped if need be. In

situation where three independent variables are needed instead of four, then x_2 is to be dropped from Equation (6).

Another set of results were obtained by carrying out analysis of variance, ANOVA on the variables used for regression modelling. Analysis of variance for staff and students' responses for workstation setup and the four independent variables were investigated. The comparisons of staff and students' responses to questionnaire parameters at 5% level of significance revealed the questionnaire groups for which ANOVA indicate "significant" or "not significant" (see Tables 3-4, and *Appendixes B1 – B4*)

Table 2: Coefficients of variance (R^2) for Sensitivity Analysis

Model No.	Multiple Regression Models	Coefficient of Variance, R^2 for :	
		All Dependent Variables[±]	Each variable, %
1	$y = f(x_1)$	0.2994	x_1: 29.94
2	$y = f(x_1, x_2)$	0.3117	x_2: 1.23
3	$y = f(x_1, x_2, x_3)$	0.7284	x_3: 41.7
4	$y = f(x_1, x_2, x_3, x_4)$	0.8696	x_4: 14.12

[±]*All dependent variables in column (2) for a given model number in column (1)*

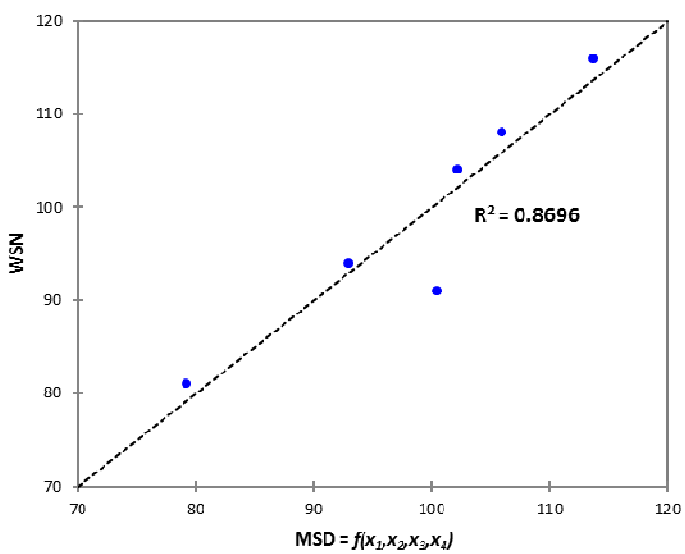


Figure 2: A multiple regression plot for Workstation setup against Musculoskeletal Disorder

Table 3: ANOVA for staff versus students for x_1 = LBA[±]

Groups	*Count*	*Sum*	*Average*	*Variance*
Staff	8	725	90.625	297.9821

Students	8	905	113.125	461.5536

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	2025	1	2025	5.332205	0.036707	4.60011
Within Groups	5316.75	14	379.7679			
Total	7341.75	15				

[±] *Lower back ache*

Table 4: ANOVA for workstation setup and four independent variables

Groups[±]	*Count*	*Sum*	*Average*	*Variance*
y = WSN	7	675.5	96.5	196.4167
x_1 = LBA	7	749	107	100
x_2 = HA	5	476	95.2	197.2
x_3 = NUBA	4	333	83.25	329.5833
x_4 = NSA	5	510	102	58.5

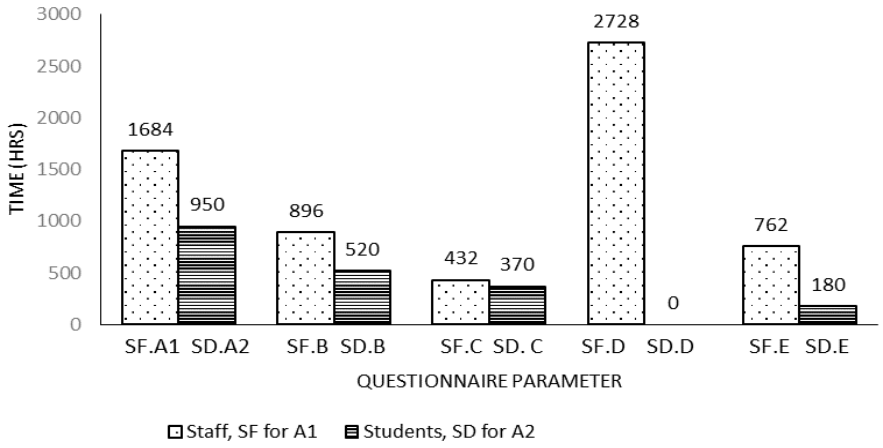
ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	1572.191	4	393.0478	2.385219	0.080833	2.795539
Within Groups	3790.05	23	164.7848			
Total	5362.241	27				

[±] *WSN = workstation setup; LBA = Lower back ache; HA = Headache; NUBA = neck & upper back ache; and NSA = Neck and shoulder ache.*

3.3 Time versus work schedule

Figure 3 shows that staff spend the largest amount of time sitting and this is followed by time on computer, reading, standing and on telephones, respectively. On the part of the students the largest amount of time is spent on receiving lectures, studying/reading, telephones and standing, respectively. For both staff and students more than fifty percent (50%) of their time is spent sitting for either computer and reading (for staff) or receiving lectures and reading (for students). The issue of poor workstation in the university and reported cases of musculoskeletal disorder, particularly waist pains, back ache, neck and shoulder aches, etc due to prolonged sitting were established as being related with a coefficient of variance, R^2 of 0.8696. This is in agreement with literature [10].

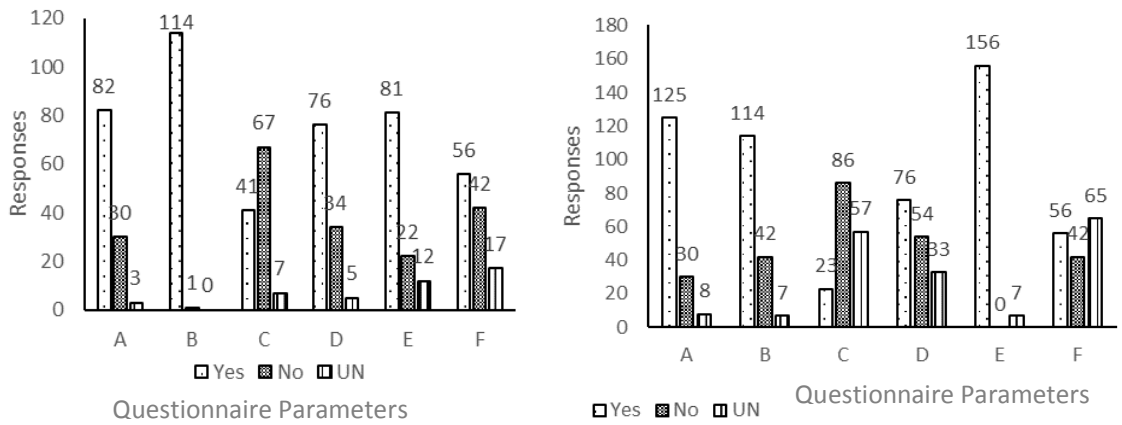


Key for Figures 3:
A1: *Time spent using computer; A2: Time spent receiving lectures B: Time spent studying/reading; C: Time spent on the telephone; D: Time spent standing; SF = Staff and SD = Students..*

Figure 3: Time at various work schedules in a year

3.4 Break Schedule

Given the staff response on break schedule, it is observed that they take break away from the office amidst prolonged computer use (see Figure 4a). The largest number of students agreed that breaks are taken between study hours (see Figure 4b). However, the Kendall's w-statistic for staff and students responses on break schedule indicates very low values of 8.4 and 38.9% (see Table 5). These values indicate lack of agreement amongst respondents on break schedule, which is apparent in Figures 4a & b. The combined values of 'no' and 'undecided' seem to outweigh the 'yes' response option. This indicated a gap on level of awareness on the subject matter. Analysis of variance (ANOVA) on the difference between staff and students questionnaire responses indicates not significant. Inspite of low level of agreement by Kendall's w-statistic, the difference in their responses is not significant indicating consistency in both responses (see Table 6).



(a) Staff **(b) Students**

Key 4a & b:
A: *Breaks taken during office hours (for staff) or after each class (for students);* ***B:*** *Breaks taken after prolonged computer use (staff) or between prolong lecture hours (for students);* ***C1:*** *Time taken to strectch after sitting for long;* ***C2:*** *Breaks are sufficient between lectures;****D:*** *Are breaks sufficent?;* ***E:*** *No breaks;* ***F1:*** *Is annual leave always taken?;* ***F2:*** *Sufficient break is given before and after examination*

Figure 4 :Break schedule

Table 5: Summary of Kendell's statistic (w)[±] for staff and students responses on break schedule

PARAMETER	Staff			Students		
	R_i	$\overline{R}$	$(R_i - \overline{R})^2$	R_i	$\overline{R}$	$(R_i - \overline{R})^2$
Q1	309	348	1521	314	492	31684
Q2	344	348	16	351	492	19881
Q3	264	348	7056	311	492	32761
Q4	301	348	2209	329	492	26569
Q5	299	348	2401	294	492	39204
Q6	269	348	6241	317	492	30625
TOTAL			∑19444			∑180724
W	= 0.084014 (8.4%)			= 0.388689 (38.86%)		

[±]*The same procedure is employed for the analyses of the other questionnaire responses by applying Equations (2) – (4) to determine the degree of agreement amongst respondents (see Table 6)*

Table 6: Summary of Kendall's w-statistic and Test of Significance

Questionnaire Grouping	**Kendall's w-statistic (%)**		**t- Test Results for Staff and Students for:**	
	Staff	**Students**	**Individual Variables**	**Combined Variables, y, x_1, x_2, x_3, and x_4**
Ergonomic workstation checklist	16.0	10.0	y : not significant	*Not Significant*
Lower Back ache	32.4	47.0	x_1 : significant	
Headaches & Eye Strain	3.0	0.9	x_2 : not significant	
Neck and upper Back ache	20.3	20.8	x_3 : not significant	

Neck and Shoulder ache	8.4	1.0	x_4 : significant	
Daily Break Schedule Per Hour	8.4	38.9	not significant ±	

± *The daily break schedule per hour is not part of the independent variables in Equation (6) (ie, not part of the MSDs)*

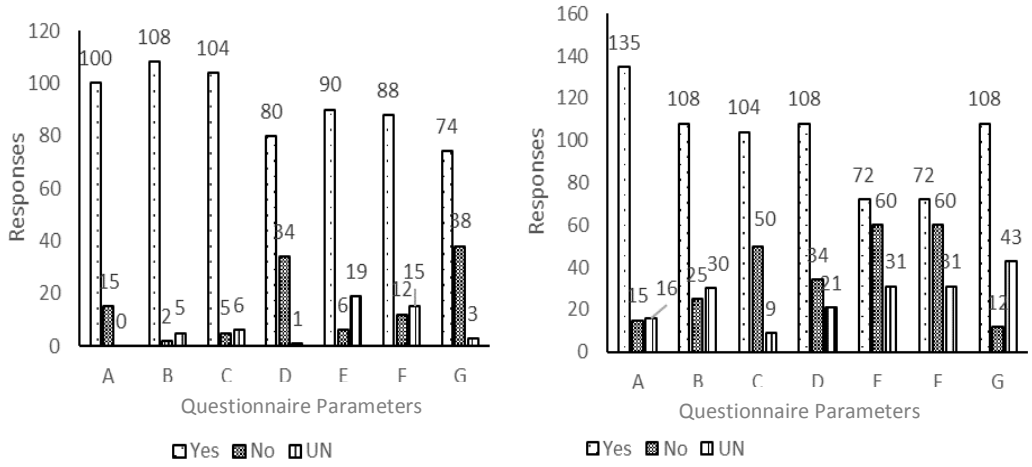
.

3.5 Response at Simple Ergonomics Checklist

The staff and students' responses to simple ergonomics checklist are both complimentary and high positive values (the 'yes' option) across the seven questionnaire parameters (questions) are 7 out of 7 for staff and 5 out of 7 for students (see Figure 5). The positive response indicates the respondents who answered "yes" are in the range of 64.3 – 93.9% for staff and 63.8 - 81% for students as against two other options ("no" and "undecided"). Only 2 out of 7 questionnaire parameters that a gap was observeved for which the responses on the part of students recorded 56% (that is, 'no' and 'undecided' combined)

The Kendall's w-statistic for staff and students questionnaire responses ('yes' option) yielded 16.0 and 10.0%, respectivlely (see Table 6); indicating low level of agreement. However, analysis of variance carried out on staff and students'responses indicates "not significant'(see Table 6). Apparently, there is consistency in both responses.

In addition, Figure 5a shows teaching and non-teaching staff workstations in the University of Port Harcourt are likely to cause MSDs challenge of muscle and joint ache. Apparently, the level of Safety education on Ergonomics workstation setup was found to be very low. Also, Figure 5b shows a good number of students that are likely to experience musculoskeletal aches / pains due to poor ergonomic set up at their lecture halls and study areas. Also, this highlights the level of Safety education on Ergonomics and workstation setup for which there is a gap.



a) Staff b) Students

Key for Figures 5a & b:

A: *No working clearance between leg, knee and desk;* ***B:*** *No standing alternative with sitting & working;* ***C:*** *You don't work within normal reach of arms/legs;* ***D:*** *There is not enough room for a tall staff;* ***E:*** *No comfortable space between edge of seat and back of knees;* ***F:*** *Keyboard is at a height which places the forearms approximately parallel with the floor; and* ***G:*** *Arm rest is not used or adjusted to support or suit arms movement.*

Figure 5: Staff/ Students response to simple ergonomics checklist

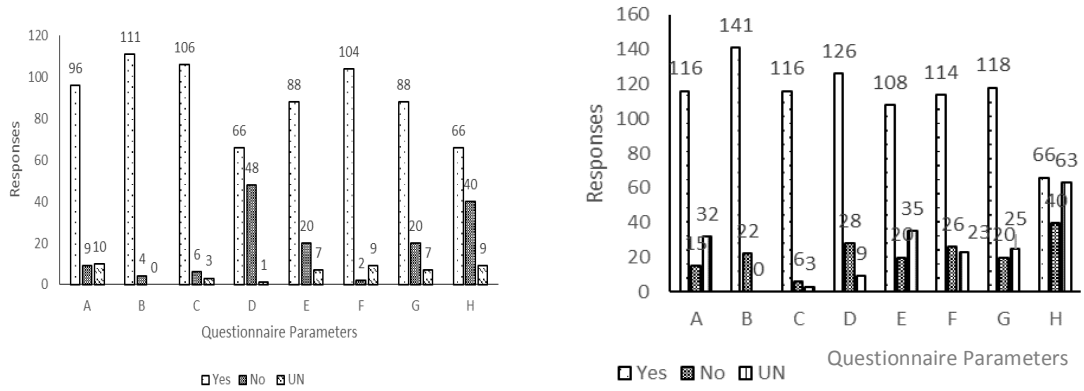
3.6 Response on Experience of Lower Back Aches

The number of staff and students that answered 'yes' option to all the questions are by far higher than those with 'no' and 'undecided' options with the exception of questions D & H for staff (see Figure 6a) and question H for students (Figure 6b). The range of the positive responses of the questions is 7 out of 8 for both staff and students. The Kendall's w-statistic for staff and students on the experience of back aches are 32.4 and 47.0%, respectively. This implies that the level of agreement amongst the respondents on the issue of lower backaches is moderately low for both staff and students. The level of agreement may be blamed on the level of awareness of the respondents on effects of poor workstation setup.

The high positive responses of staff *(see Appendixes A2)* and students on the experience of lower back ache show to a large extent that the teaching and non-teaching staff as well as students workstations in the University of Port Harcourt are prone to cause MSDs of disc and spine, leading to back ache. In effect continuous neglect of proper ergonomics in the workstation set up of offices, may result into temporary injuries in a short term or permanaent injuries in a long term. In turn this would lead to poor performance, decreased

efficiency and loss of time. The students' responses also highlighted the fact that most seats used in their lecture rooms have no back rest. Hence, it is likely that continuously neglect of proper ergonomics in the workstation set up of class rooms, may result to injuries which would in turn lead to poor performance, decreased efficiency and loss of time.

Analysis of variance on the 'yes' responses of staff and students for the workstation and musculoskeletal disorder (back ache, lower & upper neck and shoulderaches) indicated not significant. This is a confirmation of consistency in staff and student responses.



a) Staff b) Students

Key for Figures 6a & b:

A: *You bend over to use monitor, keyboard, input device or while making notes?;* ***B:*** *Backrest that provides support in the lower back is absent;* ***C:*** *Your feet touch the floor when sitted*

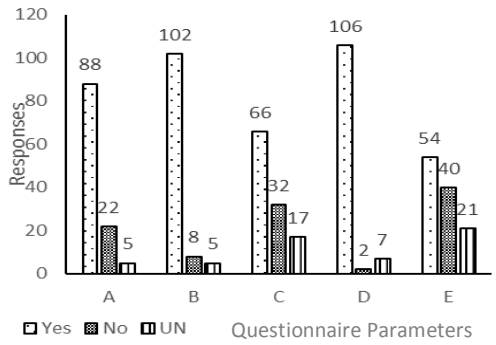
D: *Your feet do not touch the floor when sitted;* ***E:*** *Absence of comfortable space between the edge of the seat and the back of the knees;* ***F:*** *You lean forward to read blurry text;* ***G:*** *You lift loads away from the body, thereby increasing load on the lower back that results in reaching and bending; and* ***H:*** *You stand for several hours.*

Figure 6: Staff and Students responses on experience of lower back aches

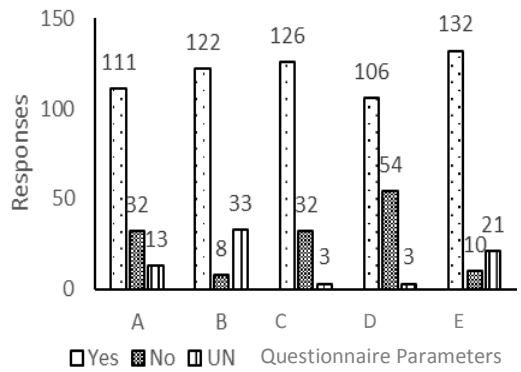
3.7 Response on Experience of Neck and Shoulder Aches

The positive (or yes) response level of 57.4 – 92.2% for staff and 68.1 – 81.0% for students on the issue of neck and shoulder aches are supportive of poor ergonomics workstation setup at the University of Port Harcourt. On the responses to the questions, a total of 4 out of 5 and 5 out of 5 were recorded for staff and students with high positive values, respectively. As evident in Figure 7a, poor workstations and ergonomic practice make a number of the University staff prone to neck and shoulder aches/pain which could lead to development of MSDs. Better ergonomics awareness and proper workstation design can curb this menace. To a great extent the students' workstations in the University of Port Harcourt are likely to cause neck and shoulder aches (see Figure 7b) which may result to

MSDs. Physical observation / inspection of the existing workstations in Univcersity of Port Harcourt indicates that there are no real ergonomic considerations in the procurement of classroom furniture as some seats or desks are either too high or too low. Thus, continuous neglect of proper ergonomics in the workstation set up of class rooms, may result to discomfort which apparently leads to poor performance on the part of students.



a) Staff



b) Students

Key for Figures 7a & b:
A: *Long reaches to frequently used input devices;* ***B:*** *When hunching the shoulders due to high work surface;* ***C:*** *When placing work above the shoulder;* ***D:*** *There is no arm rest; and* ***E:*** *The seat is too low or desk too high.*

Figure 7: Staff and Students response to neck and shoulder aches

It is interesting to note that the major findings from this study which includes poor awareness of ergonomic workstation, the resultant effects of poor ergonomic (pains in lower and upper backs, necks) in staff and students are in agreement with the findings of Nwaogazie et al. [10], where most office – based civil servants in Rivers State, Nigeria suffers from pains in their lower back. Also, with reference to the finding on poor workstation for staff and ergonomical compliance furnitures for lecture hall/classrooms, this agrees with the affirmation of Devereux et al. [12] that the ergonomical compliance of the office and workstation environment is a major contributing factor to musculoskeletal disorder.

4. CONCLUSION & RECOMMENDATION

4.1 CONCLUSION

Based on the results of this study, the following conclusion can be made:

i) The awareness of ergonomics workstation is low at the University of Port Harcourt;

ii) Most respondents experience pain in lower and upper backs, and necks;

iii) Most respondents maintain awkward postures at work or in the classroom as they frequently lean forward, bend their necks or sit in classrooms or offices that do not allow enough leg room or knee clearance;

iv) Most of the staff respondents spend reasonable part of their time using computer (26%) and standing while teaching (42%);

v) Most of the students respondents spend their reasonable time sitting in class receiving lectures (47%) and studying/reading (18.3%), respectively;

vi) A handful of students (9%) stand for most of the time receiving lecture due to limited number of seats;

vii) Some seats and desks are too high, while some are too low leading to hunching of shoulders or slouching resulting in shoulder and back pain; and

viii) Due consideration is not given to ergonomics in the procurement of furniture.

4.2 RECOMMENDATION

From this study, Musculoskeletal Disorder (MSD) amongst staff and students from the University of Port Harcourt can be reduced to its barest minimum by the following actions:

i) The workstations for staff and students within the University of Port Harcourt should be upgraded and ergonomically compliant;

ii) The University management should frequently organize safety seminar on ergonomic workstation setup for students and staff of the institution;

iii) The University should carry out frequent ergonomic audit of all its workstations including the students lecture hall; and

iv) There should be sufficient breaks between lectures for students of the institution.

ETHICAL APPROVAL

Ethical certificate was obtained from the University Ethics committee for the study. Also, informed written consents were obtained from staff and students who participated in the study.

COMPETING INTRESTS

Authors have declared that no competing interests exists.

REFERENCES

Boo S., Winkel J. Shahnavaz H. Prevalence of Musculoskeletal Disorders at Workplaces in the People's Republic of China. International Journal of Occupational Safety and Ergonomics. 2000; 6(4):557 – 574.

Patron DD. Classroom ergonomics implications for health, safety and academic performance [webpage on the Internet] Huntington Valley, PA. The Free Library. 2009. [Accessed November 11, 2013]. Available from: *http://www.thefreelibrary.com/Classroom+Ergonomics+Implications+for+Health,+Safety+%26+Academic...-a01073984348.*

Centre for Disease Control and Prevention (CDC). National Institute for Occupational Safety and Health (NIOSH). US Department of Health and Human Services. 1997.

Triano JJ and Selby NC. Manual Material Handling To Prevent Back Injury. Spin-Health Trusted Information of Pain Relief. 2006. Available @: *http//www.spine-health.com/wellness/ergonomics/manual-material-handling-prevent-back-injury*

Mfon E. Essential Occupational Health and Safety. Dorand Publishers. 2009; 38-55.

Karakolis T and Callaghan JP. The impact of sit-stand office workstations on workers discomfort and productivity: A review. Applied Ergonomics. 2014;45:799 – 806.

WISHA service Division. Office Ergonomics – Practical Solutions for a safer workplace. Washington State Department of Labour and Industries. 2002. F417-133-000.

Choobineh A, Lahmi M, Shahavaz H, Jazani RK, and Hosseini M. Musculoskeletal Symptoms as Related to Ergonomic Factors in Iranian Hand-Woven Carpet Industry and General Guidelines for Workstation Design. International Journal of Occupational Safety and Ergonomics (JOSE). 2004; 10 (2):157 – 168.

Omokhodion FO and Osungbade OO. Health Problems of Automobile Mechanics in Nigeria. Journal of Borno Medical. 2002;26: 102-104.

Nwaogazie IL, Omuruka TC and Adaramola SS. Work-Related Musculoskeletal Disorders: A case of office-based civil servants in Rivers State, Nigeria. International Journal of TROPICAL DISEASE & Health. 2016;18 (1):1-13.

Nwaogazie Ify L. Probability and Statistics for Science and Engineering Practice, University of Port Harcourt Press (2nd Edition, 2006). De-Adriot Publishers, Enugu. Nigeria 3rd Edition. 2011.

Devereux IG, Vlachonikolis BPW. Potential Interaction between physical and psychological risk factors in the work place associated with musculoskeletal disorders. Journal of Occupational and Environmental Medicine. 2000;59 (4):269 - 270.

APPENDIX A

SAMPLE OF QUESTIONNAIRE RESPONSE FREQUENCY TABLES FOR STAFF

Table A1: Ergonomic workstation checklist

S/N	ITEMS	Yes	No	UN
1	No working clearance between the leg, knee and the desk;	100	15	Nil
2	No standing alternative with sitting and working;	108	2	5
3	You don't work within normal reach of arms/legs;	104	5	6
4	There is not enough room for a tall staff;	80	34	1
5	No comfortable amount of space between the edge of the seat and the back of the knees;	90	6	19
6	The keyboard is at a height which places the forearms approximately parallel with the floor;	88	12	15
7	Arm rest is not used or adjusted to support or suit arms movement.	74	38	3

Table A2: Lower Back ache

S/N	ITEMS	Yes	No	UN
	Do you experience lower backache when:			
8	You bend over to use monitor, keyboard, input device or while making notes;	96	9	10
9	Back rest that provides support in the lower back is absent?	111	4	0
10	Your feet touch the floor when sitted	106	6	3
11	Your feet do not touch the floor when sitted;	66	48	1
12	Absence of comfortable amount of space between the edge of the seat and the back of the knees;	88	20	7
13	You lean forward to read blurry text;	104	2	9
14	You lift loads away from the body, thereby increasing load on the lower back that results in reaching and bending;	88	20	7
15	You stand for several hours.	66	40	9

Table A3: *Head ache & Eye strain*

S/N ● IT EM S● Y es● ITE MS ● Ye s● N o● U N● Yes ● No ● U N● No● UN ● ●

● ●
● Do you **strain your Eye or have Headaches** when:● Do you **strain your Eye or have Headaches** when:● **15**
● Focusing on the displayed text on your monitor’s screen, which often results twisting and leaning whe

n
tryin
g to
find
a
glare
-free
angl
e to
view
from
● 82
● 24
● 9●
15●
Focu
sing
on
the
displ
ayed
text
on
your
moni
tor’s
scree
n,
whic
h
often
resul
ts
twist
ing
and
leani
ng
whe
n
tryin
g to
find
a
glare
-free
angl
e to
view
from
● 82
● 24
● 9●

82● 24● 9● ● ● 16 ● You experience difficulty in adjusting to the differences in light levels, with respect to your eyes sensitivity**● 102● 16●** You experience difficulty in adjusting to the differences in light levels, with respect

to your eyes sensitivity• **1 02• 102 • 6• 6• 7 • • 1 7•** Reflected overhead lights may cause white spots on screen, often resulting in twisting and leaning when trying to find a glare-free angle to view **• 10 6• 6 • 3• 7• • • 17 •** Re

flected over head lights may cause white spots on screen, often resulting in twisting and leaning when trying to find a glare-free angle to view
● 106● 6● 3● 17●
Reflected over head lights may cause white spots on

screen, often resulting in twisting and leaning when trying to find a glare-free angle to view
● 106● 6● 3● 106● 6● 6● 3● ● 18● Low lighting and shadows make it difficult to see hard copy
● 92● 16● 7● 3● ● ● 18● Low lighting

and shadows make it difficult to see hard copy
• 92
• 16
• 7•
18•
Low lighting and shadows make it difficult to see hard copy
• 92
• 16
• 7•
92•
16•
7• •
• 19
• The glare reflecting from work surfaces shine into your eyes and are more

difficult to avoid,• **74• 36• 5• • • 19•** The glare reflecting from work surfaces shine into your eyes and are more difficult to avoid,• **74• 36• 5• • • 74• 36• 5• • •**

Table A4 Neck and upper Back ache

S/N • ITEM

S● Yes● ITEMS ● Yes● No● UN● ● Yes ● No ● UN● ● No● UN ● ●● ●● Do you experience **neck and upper back** ache when:● ● ● Do you experience **neck and upper back** ache when:● ● Do you experience **neck and upper back** ache

whe
n:• •
•20
• Do
cum
ents
that
are
laid
flat
on
the
desk
surfa
ce
resul
t in
leani
ng
forw
ard
and
tiltin
g the
head
dow
nwar
d;• 7
3• 3
8• 4
• •2
1• Y
ou
freq
uentl
y lift
item
s
locat
ed
betw
een
knee
and
shou
lder
heig
ht;•
20•
Doc
ume
nts
that

are laid flat on the desk surface result in leaning forward and tilting the head downward;**• 73• 38• 4• •21•** You frequently lift items located between knee and shoulder height;**• 73• 38• 4• •21•** You frequently lift items locat

ed betw een knee and shou lder heig ht;● **21●** You freq uentl y lift item s locat ed betw een knee and shou lder heig ht;● **54● 38● 23● ●22** ● Lo ads are regul arly lifte d/car ried with two hand s belo w 50 lbs for men and belo w 44 lbs for wom

en
;**● 75**
● 22
● 18
● ●2
3● Y
ou
bend
forw
ard
to
view
text
or
imag
es on
your
com
puter
scree
n;**● 8**
6● 1
6● 1
3● ●
22●
Load
s are
regul
arly
lifte
d/car
ried
with
two
hand
s
belo
w 50
lbs
for
men
and
belo
w 44
lbs
for
wom
en
;**● 75**
● 22
● 18
● ●2
3● Y

ou bend forward to view text or images on your computer screen;• **8 6• 1 6• 1 3• • 75• 22• 18• •23** • You bend forward to view text or images on your computer screen;• **8 6• 1 6• 1 3• • 23•** You bend forward to view text or images on your

com
puter
scree
n;**• 8**
6• 1
6• 1
3• •
86•
16•
13•
•

Tabl
e
A5:
Nec
k
and
Sho
ulde
r
ache
S/N
• IT
EM
S• Y
es•
ITE
MS
• Ye
s• N
o• U
N•
Yes
• No
• U
N•
No•
UN
• •
• •
• Do
es
your
neck
and
shou
lder
ache
whe
n:**•**
Does
your

neck and shoulder ache when:• **• 24 •** Long reaches to frequently used input devices; **• 88 • 22 • 5• 24•** Long reaches to frequently used input devices; **• 88 • 22 • 5•** Long reaches to frequently used input devices;

• 88 • 22 • 5• 88• 22• 5• • • 25 • When hunching the shoulders due to high work surface;• **25•** When hunching the shoulders due to high work surface;• **102 • 8• 8• 5 • • 2 6• 5• • • 26** • When placing load/work above the shoulder;• **66 • 32**

● 17 ● ● 2 7● There is no arm rest; **● 10 6● 2 ● 7● 26●** When placing load/work above the shoulder; **● 66 ● 32 ● 17 ● ● 2 7●** There is no arm rest; **● 10 6● 2 ● 7● 66● 32● 17● ● 27 ●** There is no arm rest; **● 10 6● 2 ● 7● 27●** There is no arm rest; **● 10 6● 2**

● 7● 106 ● 2● 2● 7 ● ● 2 8● The seat is too low or desk too high.
● 54 ● 40 ● 21 ● ● 7● ● ● 28 ● The seat is too low or desk too high.
● 54 ● 40 ● 21 ● ● 28● The seat is too low or desk too high.
● 54 ● 40 ● 21 ● ● 54● 40● 21●

APPENDIX B

ANALYSIS OF VARIANCE OUTPUTS FOR DEPENDENT VARIABLES

Table B1 : ANOVA for y = workstation setup (WSN)

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Staff	7	644	92	158.6667
Students	7	707	101	499

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	283.5	1	283.5	0.862139	0.371441	4.747225
Within Groups	3946	12	328.8333			
Total	4229.5	13				

Table B2 ANOVA for x_2 = EHA

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Staff	5	456	91.2	179.2
Students	5	496	99.2	275.2

ANOVA

Source of Variation	*SS*	*Df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	160	1	160	0.704225	0.425732	5.317655
Within Groups	1817.6	8	227.2			
Total	1977.6	9				

Table B3: ANOVA for x_3 = NUBA

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Staff	4	288	72	176.6667

Stiudents	4	378	94.5	828.3333

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	1012.5	1	1012.5	2.014925	0.205563	5.987378
Within Groups	3015	6	502.5			
Total	4027.5	7				

Table B4: ANOVA for x_4 = NSA

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Staff	5	416	83.2	511.2
Students	5	597	119.4	114.8

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	3276.1	1	3276.1	10.46677	0.011963	5.317655
Within Groups	2504	8	313			
Total	5780.1	9				