Workstation Ergonomic Risk Factors and its associations with Common Musculoskeletal Complaints among Academic Staff of a Ghanaian Higher Institution: A survey

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Abstract

Background: Despite the exposure of academic staff to the ergonomic risk factors associated with workstation seat, the prevalence of musculoskeletal complaints (MSCs) is under-reported in higher institutions of learning in Ghana. We therefore evaluated the workstation seat in relation to the academics' body dimensions and the associations of the outcome with MSCs.

Materials and Methods: Participants in this cross-sectional study were academic staff of a foremost health training institution in Ghana. They were enrolled into the study using convenience sampling method. We evaluated the body-chair dimension of the participants individually at each workstation using non-elastic 3-meter long tape measure. Nordic Musculoskeletal Questionnaire and ergonomics assessment checklist were used to determine the prevalence and ergonomic risk factors of MSC. Data analysis involved mean, frequency and standard deviation. We analyzed the association between body-chair dimensions and self-reported MSCs with Chi square test, at $P < 0.05$ level of significance.

Results: Eighty-two (82) academic staff comprising 54, (65.9%) males and (28, 34.1) females participated fully in the study, of which 69 (84.2%) were Senior Lecturers. Thirty-four (41.5%) of the lecturers had worked between 5 and 10 years. The period and point prevalence of MSCs were 64.6% and 59.6% respectively. The body-chair mismatch and workstation ergonomic risk factors were significant associated with ($P < 0.001$) MSCs.

Conclusion: Our findings indicate moderate prevalence of MSCs among the participants with low back pain being the most reported complaint, which seemed to have a link with body-chair dimension mismatch. These findings are implicated for procurement policy, regarding workstation seat in higher institutions.

Introduction

In recent years, there have been rising concerns about workplace physical ergonomic risk factors and its imminent health outcome. The enormity of the reported work-related hazards such as musculoskeletal complaints (MSCs) seems to be the harbinger for increasing awareness among institutions of higher learning. Aside from their exposure to cognitive pressure (Harris, 2013) [1] and organization issues (Boatca, Dragbici, & Carutasi, 2018) [2]; workstation seats constitute potential physical ergonomic risk factors among faculty members in the universities, which seem to be insufficiently reported in Ghana's higher institutions of learning. Deficiencies in the working environment could affect the service outputs of individuals, organizations and the communities. A well-planned ergonomic working environment does not only implies health benefits for the individuals and organization but could also lead to increased quality of life and high service productivity gains (Battinia, Facciob, Personaa, Sgarbossaa, 2011) [3]. Complaints among workers are largely dependent on the nature of works (including the workstation arrangements), which justify adequate evaluation of potential ergonomic risk factors on population basis (Lasota, 2020) [4]. Faculty members in the universities spend long hours using computers for lecture presentations, e-

learning activities, research proposals, publications (including administrative tasks) which can predisposes them to MSCs (Tai et al, 2019) [5]. A need thus arises for ergonomic assessment of their workstations to ascertain the extent of association with work-related physical hazards.

Physical ergonomic risk factors entail the aspects of a job or task that impose biomechanical stress on human body segments. Forceful exertions, high repetitions, and awkward posture assumptions (either singly or in combination), are most often associated with the occurrence of MSCs (Sundstrup et al, 2020; Gajbhiye, et al, 2021) [6–7], increasing costs (Zare et al., 2016) [8], and lost work time (Anton et al., 2020) [9]. Moreover, severe MSCs can lead to permanent disabilities with attendant compromise of return to work rehabilitation program, and reduced performance in the daily activities of living (Marak et al., 2020) [10]. Most often, the administrative arrangement in the university hardly allows room for ergonomic inputs during procurement of workstation seats. Rather, this responsibility is largely borne by procurement officers whose focus is at variance with the requisite ergonomic features regarding the workstation seats. This existing breach potentiates body-chair misfits among the staff, which could serve as potential risk factors for MSCs. However, information concerning ergonomic risk factors precipitated by workstation seat and its associations with common MSCs among academic staff is under-explored in Ghanaian universities. Previous efforts have been directed to the classroom furniture (Bello et al, 2015; Adu, & Adu, 2015) [11–12]. The present study sought to evaluate the ergonomic risk factors and its associations with common MSCs among academic staff of selected schools of a notable health training institution in Ghana. We hypothesized that body-chair dimension misfit would not be associated with MSCs.

Materials And Method

Study Sites

The study was conducted at selected Schools in the College of Health Sciences of the University of Ghana, which were University of Ghana Medical School, University of Ghana Dental School and School of Biomedical and Allied Health Sciences. The College is an amalgamation of various institutions (schools) in the University of Ghana that train health professionals.

Participants

The participants in the cross-sectional study were academic staff (including heads of departments and academic coordinators) sampled from three schools within the College of Health Sciences, University of Ghana. Participants were included if they were academic staff from Senior Lecturers and above, and those without any physical disabilities that can be aggravated by measuring procedures. We excluded staff whose tasks were purely administrative, and those who had spent less than six months in their office prior to the conduct of this study (Fig. 1). We calculated the sample size for this study with the Taro

Yamane formula given as:
$$n = \frac{N}{1 + N(e)^2}$$

Where N is given as 134 as the study population in the three schools and e, as the marginal error given as 0.05. Thus, a sample population (n) of 100 staff was estimated to participate in the study.

Instruments for data collection

The Nordic Musculoskeletal questionnaire (NMQ) (Crawford 2007) [13] was used to identify risk factors of musculoskeletal disorders in seven different dimensions at the workplace. It presents 28 multiple-choice questions in two well-differentiated sections with some items in reverse order. Section 1 (general), refers to symptoms in 9 parts of the body (neck, shoulders, elbows, wrists/hands, upper back, lower back, hip/thighs, knees, and ankles/feet) experienced during the last 12 months and/or 7 days. Section 2 contains additional questions relating to the neck, the shoulders and the lower back with further detailed items. A body map indicates the nine symptom sites to assist completion of the form. Assessors ask the respondents if they have had any musculoskeletal problem in the last 12 months and/or last 7 days, which has prevented their normal activities. We screened the ergonomic risk factors with ergonomics assessment checklist at each workplace. It consists of 18 closed ended questions and an open question, which needs more clarity. The questionnaire is normally completed with the aid of a body map with which to interpret various ergonomic risk factors.

Procedure for data collection

We obtained approval for this study from the Ethics and Protocol Review Committee of the School of Biomedical and Allied Health Sciences, University of Ghana (Ref Number: SBAHS/AAPT/10628546/2020-2021). An informed consent was sought from all participants, which was preceded by distribution of information sheet, to explain the study protocol and participants' expected roles. We also sought permission from various schools through a letter from the head of department of physiotherapy to the school administrators in the selected schools. Following the approval to embark on the study, convenient date and time were arranged via phone calls and personal contacts with the staff regarding data collection process.

The procedure commenced with detailed and simplified explanation of the study to the potential participants. We obtained socio-demographics information using a well-structured data capturing form. The standardized Nordic Musculoskeletal Questionnaire was administered, followed by the ergonomic risk factor checklist. The questionnaire and the checklist took approximately (20) minutes to complete.

Body-chair dimension measurements

Participants were measured in sitting postures in their usual attire and footwear while keeping their hips and knees at an angle of 90-degree, with their feet flat on the floor. The principal investigator, with the assistance of other investigators performed a trial measurement to attain the right skill set. The

measurement procedures involved body dimensions (buttock popliteal length, popliteal height and hip height), and workstation seat dimensions (i.e., seat height, seat depth, table top height and elbow height) using tape measure in line with the procedure outlined by Parcels et al., (1999) [14], as follows:

Body dimension measurements

Popliteal height (PH): measured from the vertical distance from the popliteal at the apex of the underside of the knee to the floor while keeping the knees at an angle 90° of flexion.

Gluteal popliteal length (GPL): measured from the horizontal distance from the furthest point on the posterior surface of the buttock to the apex of the popliteal space while the knee was kept at 90° of flexion.

Knee height (KH): measured from the lateral knee condyle to the floor with the knee and hip positioned at an angle 90°.

Workstation seat dimension (Fig. 2)

Seat Depth (SD): measured as the distance taken from the front of the backrest to the front of the seat surface.

Seat Height (SH): measured as the vertical distance from the floor to the highest point on the front of the seat surface.

Table Bottom Height (TBH): Measured from the under surface of the table to the floor.

Determination of body-chair mismatch

We determined match and/or mismatch body-chair dimension based on the existing rules postulated by Parcels et al., (1999) [14] and Castellucci et al., (2014) [15].

- a. Mismatch for PH and SH: If SH is either greater than 95% or less than 88% of the PH.
- b. Mismatch for GPL and SD: If SD is either less than 80% or greater than 95% of GPL
- c. Mismatch for KH/TBH: If the (knee clearance) space between seat surface and TBH is less than 2.5 cm or greater than 3 cm.
- d. Mismatch SH/TBH: If the SH is less than 64% or greater than 77% of TBH

Data analysis

Data analysis was performed using Statistical Package for Social Sciences (SPSS) software, (version 26). Descriptive statistics involved frequency means, standard deviation and percentage. The crude

association between MSCs and body chair dimensions was analyzed using Chi-square test at a level of significance acceptable at $p < 0.05$.

Results

Socio-demographic characteristics of the participants

Eighty-two (82) university lecturers participated and completed the current study. They comprised 54 (65.9%) males and 28 (34.1%) females. Sixty-Nine, (84.1%) of the staff were senior lecturers, while only 2 (2.4%) were professors. Majority, 79 (96.3%) of the participants were married, and 34 (41.5%) had worked for between 5 and 10 years. Also, 64 (78.1%) reported being moderately physically active (Table 1).

Prevalence and patterns of musculoskeletal complaints among the participants

The period and point prevalence were 64.6%, and 59.6% respectively (Fig. 3). The most reported complaint was lower back 39 (73.6%), while elbow 4, (7.5%) constitutes the least (Table 2) MSCs. In addition, 29 (35%), and 9 (11%) of the staff reported hypertension and diabetes respectively, as their comorbid conditions (Fig. 4).

Table 1
Socio-demographic characteristics of the
participants

Variable	Frequency	Percent
Age		
34-50	48	58.5
51-68	34	41.5
Sex		
Male	54	65.9
Female	28	34.1
Marital status		
Single	3	3.7
Married	79	96.3
Rank		
Senior lecturer	69	84.2
Associate professor	11	13.4
Professor	2	2.4
Years of experience		
5-10	34	41.5
11-15	29	35.4
16-30	19	23.1
Alcohol		
Yes	23	28.1
No	59	71.9
Physical activity level		
Low	10	12.2
Moderate	64	78.1
High	8	9.7

Assessment of the participants' anthropometry, chair dimensions, mismatches in body-chair dimensions and ergonomic risk factors.

The participants' body dimension measurements indicate a mean buttock-popliteal and elbow height as 49.5 ± 3.2 cm and 26.7 ± 2.3 cm respectively. Similarly, the respective mean scores for the seat and table heights are 51.4 ± 3.9 cm and 75.4 ± 1.8 cm (Table 3). In addition, the ergonomic assessment of body-chair match/mismatch showed that higher number of the participants used mismatched workstation seats with the highest proportion, 61 (74.4%) obtained in the buttock-popliteal length/seat depth compared to 21 staff (25.6%) who conformed to the required matched body-chair dimensions (Table 4). Figure 3 shows the ergonomic risk among the academic staff. Moreover, majority of the participants 44 (53.7%) had high ergonomic risk factors, as compared to 38 (46.30%) who were exposed to low ergonomic risk (Fig. 5)

Table 2
Patterns of musculoskeletal complaints regarding the participants, symptoms across nine joints in the body.

Body part	Frequency [n=82]	Prevalence	95% CI
Neck	35	66.0	52.1-77.7
Shoulder	18	33.9	22.3-47.9
Elbow	4	7.5	2.7-18.8
Wrist	8	15.1	7.6-27.7
Upper back	19	36.5	24.4-50.7
Lower back	39	73.6	59.8-83.9
Hips/thighs	10	18.9	10.3-31.9
Knees	20	37.7	25.5-51.7
Ankle	11	20.7	11.7-34.1

Table 3
Anthropometric and chair dimension
measurements at workstations of the staff in
mean and standard deviation

Anthropometric measure (N=82)	mean±SD
Popliteal height (cm)	47.4±2.6
Buttock popliteal height (cm)	49.5±3.2
Elbow height (cm)	26.7±2.3
Knee height (cm)	45.6±5.1
Seat height (cm)	51.4±3.9
Seat depth (cm)	50.4±3.3
Table bottom height (cm)	75.4±1.8

Table 4
Ergonomic assessment of academic staff-chair match/mismatch

Body-chair	Frequency (N=82)	Percent
Popliteal height/ seat height		
Match	27	32.9
Mismatch	55	67.1
Buttock popliteal length/Seat depth		
Match	21	25.6
Mismatch	61	74.4
Knee height/ Table bottom height		
Match	23	28.1
Mismatch	59	71.9

Associations of musculoskeletal complaints with body-chair dimension and ergonomic risks at work place.

Chi-square analysis showed significant associations ($p < 0.05$) between MSCs and mismatches in the selected domains of the body-chair dimensions. Similarly, MSCs were significantly associated ($p < 0.05$)

with ergonomic factors in the workstations of the participants (Table 5).

Table 5
Chi-square analysis of the association of the musculoskeletal complaints with body-chair dimensions as well as ergonomic risk factors at the participants workstations.

Body-chair dimension	Prevalence of MSCs		χ^2	<i>p</i> value
Popliteal height/ seat height	No	Yes		
Match	10	17	8.240	0.04*
Mismatch	9	46		
Buttock popliteal height/ Seat depth				
Match	9	12	18.4	0.003*
Mismatch	15	46		
Knee height/ Table bottom height				
Match	8	15	8.4	0.009*
Mismatch	11	48		
Ergonomic Risks				
Low	24	5	23.9	<0.001
High	14	39		

Discussion

The main aim of this study was to evaluate the ergonomic risk factors and its associations with common MSCs among the academicians in a Ghanaian health training institution. Our findings indicated moderate period and point prevalence of MSCs among the participants with the highest prevalence found on low back. More than half of the participants experienced high ergonomic risk factors while all the selected domains of the body-chair dimensions were mismatched among majority of the participants. Ergonomic risk factors and body-chair dimensions mismatch were significantly associated with MSCs.

Socio-demographic characteristics of the participants

Male academic staff were more than their female counterparts in this present study. Kumah et al., (2016) [16] and Sirajudeen et al., (2018) [17] had earlier reported more male academics staff than the female

staff in higher institution of learning in their studies. The gender discrepancy can be explained by the dominance of males over their female peers due to many factors including cultural discrimination against women particularly in developing countries. Female individuals have often had to bear an unfair distribution of household responsibilities in comparison to their male counterparts and suffered in terms of their career prospects as well as a reduced ability to be able to meet up with their targets. In addition, majority of the participants were within the age range 34-50 years. This suggests that the mainstream workforce in the university were within the middle age range. Given the physical, organizational and cognitive task demands of the academic tasks, a virile population of workers is required for optimal execution. The staff had worked for between 5 and 10 years which implies that all the staff had worked over an appreciable length of time. The inherent physiological adaptation of their body to the workstation seat might have resulted in the moderate prevalence of MSCs.

Prevalence and pattern of musculoskeletal complaints among the participants

The most reported MSCs were found in the lower back and neck among over half of the participants. The findings were not surprising given the increasing needs to use electronic and computer devices for academic tasks. Moreover, the uses of such devices often require prolonged sitting, thus culminating in low back and neck dysfunctions. These findings are consistent with the reports on similar study population by Velasco Garrido et al., (2020) [18]; and Masilamani & Ganapathy, (2020) [19] indicating pain at the waist, neck, and several parts of the spine (particularly the lumbo-sacral region).

The period prevalence (the last 12 months or the last 7 days) and point prevalence were moderate 64.6%, and 59.6% respectively. Low back pain and neck problems were the most prevalent MSCs. A previous study by Chaiklieng et al (2010) [20], reported an annual prevalence of low back pain as ranging from 15 to 45% with point prevalence of 45%. The present study revealed higher prevalence of MSCs which can be attributed to many factors, including workstation arrangements such as the types of seat and desk used, and workloads. Regular physical activities have been reported to be beneficial in reducing the incidence of musculoskeletal disorders (Ezzati and Riboli, 2013) [21]. However, only 10 (12.2%) of the participants were found to be physically active while majority of them 64 (78.1%) were moderately active. These findings were in tandem with that of Soroush and Hassan (2015) [22] who reported high level of physical inactivity among his cohort of sample population who were academic staff.

Body-chair dimensions and ergonomic risk factors at workstation of the academic staff

The study shows that more participants were using workstation seats that were not commensurate with their body dimensions. The proportion of the participants with mismatched seats was higher compared to those reported in the previous studies (Chaiklieng et al. 2010; Adu et al, 2014) [20] [12]. Indeed, most

measured office seats and desks in this study were less users-friendly regarding the adaptability and adjustability features to accommodate varying body dimensions. Rather, the provision of most of the chairs was premised on one-size-fits-all concept perhaps due to cost implications. The higher proportion of body-chair mismatches in the present study is consistent with the findings of Adu and Adu (2015) [12]. Many organizations seem to put more attention on the cost implications over the ergonomic considerations that can guarantee comfort for their staff. This breach puts demand for the inputs of some professionals (including Physical Therapists and Occupational Therapists) in the assessment and recommendation of workstation for academic staff prior to procurements.

Likewise, half of the participants had high ergonomic risk 53.7%, as compared to low-risk ergonomic risk 46.30%. Expectedly, academic staff perform most activities in prolonged sitting, and for a long duration thus potentiating high prevalence of MSCs (Tai et al. 2019) [5]. Our finding is in agreement with the previous report (Mohan et al. 2014) [23], where appreciable number of the participants were similarly exposed to high ergonomic risk.

Furthermore, there were significant associations between MSCs and all the domains of the body-chair dimension. Similar findings have been reported for other populations such as IT industry (Math et al. 2019) [24] and undergraduate students (Bello et al, 2015) [11]. Furthermore, MSCs was significantly associated with the workstation ergonomic risks. Algani et al. (2020) [25] presented similar findings in which the increased prevalence of MSCs was blamed on the physical work components among academicians.

Conclusion

Based on our findings, we concluded that there are moderately high prevalence of MSCs among the sample of academic staff in this study, which seems to have a link with the body-chair mismatch and workstation ergonomic risk factors. We thus recommend requisite ergonomic considerations in the procurement process of workstation seats as well as work station design. Despite the high level of adjustability of the emerging workstation chairs in the market, there is no ideal single form of workstation seat that can satisfy the comfort of every staff. A time-honored approach therefore, is the engagement of relevant professionals such as Physical and Occupational Therapists within the existing incentive structure of the university to provide expertise in the assessment of workstation seats prior to the procurements.

Declarations

Ethics approval and consent to participate:

We obtained approval for this study from the Ethics and Protocol Review Committee of the School of Biomedical and Allied Health Sciences, University of Ghana (Ref Number: SBAHS/AAPT/10628546/2020-2021). All the methods were performed in accordance with the Declaration of Helsinki. The participants

also gave their informed consent having briefed them thoroughly about the purpose of the study and their expected roles.

Consent for publication:

Not Applicable

Availability of data and materials:

The datasets generated during and analyzed during the current study are not publicly available due to the potential implications on the status of the Institution infrastructure and Administrative Policy, but are available from the corresponding author on reasonable request.

Competing interests:

The authors declare that they have no competing interests" in this section

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Authors' contributions:

AIB, contributed significantly to the conception, design of the study, and interpretation of the data. He made the first draft of the manuscript; EEA, contributed immensely to the execution, and analysis of data; PON & FTI, participated in the reviewing, and/or revising of the manuscript for intellectual content. AIB, EEA, PON & FTI, approved the manuscript to be published.

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Figures

Figure 1

Flow chart for the recruitment of participants

Figure 2

Common swivel chair used by academic staff

Figure 3

The period and point prevalence of musculoskeletal complaints among the staff

Figure 4

Prevalence of underlying clinical conditions reported by the participants during the survey

Figure 5

Ergonomic risk among the academic staff as assessed independently with ergonomics assessment checklist at each workplace.