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Original Article

Technology impacts academia's day-to-day activities: association between musculoskeletal body injuries and nursing faculties' knowledge and practice on workstation ergonomics

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ABSTRACT

Introduction: A poorly designed workplace and improper physical alignment during computer use for long durations may result in poor health outcomes and occupational disability. The aim of study is to identify the association between nursing faculty members knowledge and practice about computer workstation ergonomics and musculoskeletal body injuries.

Methods: A descriptive cross-sectional study was conducted at the Faculty of Nursing, Alexandria University, Egypt. A convenience sampling of 133 nursing faculty members reported their knowledge of workstation ergonomics and rated their musculoskeletal pain (MSP) location and severity on valid and reliable self-administered questionnaires designed for the purpose. Those with musculoskeletal disorders were excluded.

Results: Nursing faculty members had good and very good levels of knowledge about computer workstation ergonomics (58.6% and 13.5%). Most reported pain in their neck, shoulder, lower back, lower arm, and wrist (88.0%, 81.2%, 73.7%, and 71.4%, respectively). There is a significant positive correlation between computer use practices and MSP severity in most body parts in the questionnaire. Regression analysis revealed that the duration of computer use, and keying were significant risk factors for developing MSPs.

Conclusion: Nursing faculties are advised to apply the principles of computer workstation ergonomics, practice stretching exercises, and take frequent breaks and that these principles are included in the workplace orientation training of new staff nurses and refresher training for existing staff nurses to prevent injuries, discomfort and distress and loss of productive hours to the workplace.

Keywords: Faculty members, Digital Learning, Ergonomics, Musculoskeletal, Nursing, Pain

Introduction

The technological revolution has recently been considered a vital pillar for easing the learning process in higher nursing educational institutions.[1] Therefore, the computer has become an essential educational tool for all faculty members who spend substantial amounts of time using different platforms to communicate with their students, prepare electronic content, conduct virtual lectures, correct assignments, and provide online feedback. Although technology makes the

academic's job easier and faster, it may adversely impact their health. Using computers with such persistence and a poorly designed workplace, improper physical alignment for long durations may result in serious health outcomes and occupational disability.[2] Musculoskeletal disorders (MSDs) are the most common health complications caused by extended periods of time spent in front of computer screens. The MSDs are cumulative in nature that intensified or triggered by repetitive motions and protracted uncomfortable or enforced body postures. The lower back, neck, shoulders, forearms, and hands are the most affected body parts.[3] The MSDs' symptoms include throbbing pain, numbness, tingling, aching, stiffness, and burning sensations.[4]

Work-related body injury is a type of MSD that lasts more than one day, impacts day-to-day activities, and is associated with work-related contexts.[5] The poorly structured workplace may result in an overwhelming physical discomforts or Musculoskeletal pain (MSP). Therefore, expanding faculty members' knowledge and enhancing their practice of workstation ergonomics is essential to avoid computer-misuse MSDs.[6]

Ergonomics is the scientific study of human work which refers to "a systematic process of designing and arranging the human workplace that aims to improve the working environment and thereby reduce the risk of bodily injury".[7] In a similar vein, computer workstation ergonomics is targeted to improve the users' productivity, work efficiency, health, safety, and comfort. Hence, compliance with ergonomics principles makes it easy to work with computers and create an effective and safe match between users and their workstations.

Maintaining a neutral body posture is a core concept for recognizing the best way to set up the proper computer workstation. Such a comfortable position is extremely helpful in decreasing the stress and strain on the musculoskeletal system, thereby reducing the risk of bodily injuries.[8] Computer workstation ergonomics is concerned with the ideal positioning of the monitor, the keyboard, and the mouse. Adjusting the seat height, using the backrest, and resting the feet on the ground are also essential.[9] Furthermore, to correctly follow the ergonomics rules, the head, neck, and trunk need to be neutral and upright, and the wrist and elbow need to be aligned using the chair's armrests. Moreover, using a mouse pad and similar accessories and taking frequent breaks during which exercises are performed is recommended. This can be very helpful and effective in preventing muscle strain.[10]

Unlike other academic disciplines, nursing education emphasizes the importance of adequately using body mechanics and workstation ergonomics. For instance, many undergraduate and postgraduate nursing courses include special modules concerned with training nursing students about the proper techniques of maintaining a neutral body posture while providing care. Accordingly, nursing faculty members should be equipped with enriched information about the concepts, principles, and theories behind workstation ergonomics.[11] So, they are expected to advocate and be a role model in implementing computer workstations correctly. The present study's findings may spotlight the gap between nurse educators' awareness of the devastating influence of incompliance with ergonomics and their actual practices. Therefore, the aim of the study was to identify the relationship between nurse academic knowledge and practice about computer workstation ergonomics and musculoskeletal body injuries.

Methods

A quantitative, descriptive study was conducted at the Faculty of Nursing, Alexandria University, Egypt. While those who had a previous history of musculoskeletal disorders such as lumbar and cervical disc disorders, spondylosis, and carpal tunnel syndrome was excluded from the study. Sample size was calculated based on EPI-Info Program taking confidence level 95%, margin of error 5, population proportion, 50 and population size 164 of working nursing faculty member and minimum sample size 116 faculty member. A convenience sampling of 133 nursing faculty members who utilized the computer in their education was included in the study subjects.

The standardized ergonomic knowledge questionnaire was developed by Sirajudeen et al.,[12] to assess the ergonomic knowledge of computer professionals. It consists of three sections; Section One consists of personal characteristic items such as age, gender, height, weight, and Body Mass Index (BMI). Section Two includes questions on details regarding computer use such as daily keying, mouse usage, desktop and/or laptop usage for academic and non-academic purposes, an external keyboard, and external mouse use.[12] Section Three comprises 35 questions: 16 True/False (T or F) and 19 Multiple-Choice Questions (MCQ) questions. The questionnaire items are mainly assessing the participants' knowledge about seven dimensions

related to computer workstation ergonomics (5 questions per each dimension) as follows; (a) Knowledge about MSDs and their risk factors; including definition and goal of ergonomics, cumulative trauma disorders, signs, symptoms, and risk factors of MSDs. (b) Working Postures, including the appropriate posture of the computer user's head, neck, trunk, arm and elbow, wrist and hand, thigh, and feet. (c) Seating (Chair), including the adjustable backrest, low back support, seat height, pan, and base. (d) Keyboard/ Mouse; including keyboard level, mouse size, grip, placement, and pad. (e) Monitor, including position, level (height), tilt, distance (from the user), and monitor glare. (f) Table and Accessories, including placement of telephone and documents, document holder, telephone usage, edge of table's top, and leg room. (g) Rest Breaks and Exercises include the periodic alternation of computer tasks, micro, mini breaks, stretching, and eye exercises.
According to Sirajudeen et al.,[12] the correct answer scored one, while the incorrect response scored zero. Since questions are randomly distributed, the author developed a correction guide with item-related sections and an answer key. The total scores ranged from 0-35 that categorized into four levels of knowledge: poor (scores <40%) , fair (scores 40% - <60%) , good (scores 60% - <80%) , and very good (scores>80%). The tool was tested for validity by a panel of experts that yielded an overall content validity index of r=0.98. The test-retest reliability of the sections is fair to high. Pearson's correlation coefficient of the seven sections using 95% confidence intervals (r) ranged from r= 0.75 to r= 0.91 (p<0.001).[12]

Body map tool was developed by Corlett and Bishop (1976) to assess respondents' pain location and severity.[13] It includes a diagram of the human body divided into parts, and a certain number identifies each body part. Respondents document the pain location and rate the severity on a five-point scale ranging from very severe "5" to very mild "1". The scale was proved to be valid and reliable. It showed excellent test-retest reliability, and the Intraclass correlation coefficient (ICC) was 0.97.[14]The total score is used to identify the mean scores of MSDs.[15] The re-check process for validity and reliability was done and revealed accepted levels. A pilot study was carried out on 10% of the study subjects to test the research tools' feasibility, clarity, and applicability. Faculty members included in the pilot study were excluded from the study.

The researchers developed an electronic questionnaire form and sent the relevant link to eligible faculty members via their academic email. The aim of the study was clearly stated in the first section of the form, followed by the online consent form. Once the participants accepted to participate in the study by clicking the agree button, they proceeded to fill out the questionnaire. Only one response per participant was allowed.

Official approval for conducting the study was obtained from the responsible authorities at the Faculty of Nursing, Alexandria University, to facilitate the research implementation after explaining the aim of the study (13/3/2022). Confidentiality of the obtained data will be assured, and participants' anonymity will be respected. Participation in the study will be entirely voluntary. The right to refuse to participate or withdraw from the study was ascertained after reassuring us that the collected data would be only used for research purposes.
The Statistical Package for Social Sciences (SPSS) version 23 was utilized for data analysis. Descriptive statistics were used to describe demographic characteristics, body injuries among faculty members, and their awareness of workstation ergonomics. Linear regression analysis was performed to predict the risk or protective factors for the occurrence of MSDs and academic knowledge about workstation ergonomics as well as computer use practice. Pearson's Correlation Coefficient was used to identify the relationship between academicians' practice and the occurrence of computer misuse-related body injuries. All the statistical analyses were considered significant at p-value <0.05.

Results

Table 1 illustrates that 37.6% of nursing faculty members were 40to less than 50 years, and 82.7% were females. Regarding academic rank, lecturer and assistant lecturer constituted 10.5% and 27.1%. Moreover, 45.9% had more than 15 years of academic experience. Regarding the academicians' practices in educational computer use, the same table shows that nearly half of the faculty members use an external mouse when using the laptop (48.9%), and only 11.3% of faculty members take a break once in 0-2 hours. Faculty members have been using computers for 20.10±7.96 years. Daily, academic faculty members spend6.07±4.69 hours using a computer and 3.66±4.38 keying or typing on the computer (Table 1).

Table 1: Faculty members' Socio-Demographic Characteristics and their Computer Use Practices.

a. Faculty members' Characteristics		**No. (%)**
Age (in years)	<30	17 (12.8)
	30-40	42 (31.6)
	40-50	50 (37.6)
	50& more	24 (18.0)
Gender	Male	23 (17.3)
	Female	110 (82.7)
Academic Rank	Professor	18 (13.5)
	Assistant Professor	18 (13.5)
	Lecturer	14 (10.5)
	Assistant Lecturer	36 (27.1)
	Demonstrator	31 (23.3)
	Instructor	16 (12.1)
Years of experience (years)	<5	23 (17.3)
	5-10	32 (24.1)
	10-15	17 (12.8)
	15 & more	61 (45.8)
b. Faculty members' Practices in academic computer use.		
In the case of a laptop, using	External Keyboard	14 (8.1)
	External Mouse	65 (48.9)
Frequency of taking a break while working on a desktop or laptop	Once in 0-2 hrs.	15 (11.3)
	Once in 2-4 hrs.	44 (33.1)
	Once in 4 hrs. or more	74 (55.6)
The Source of information regarding appropriate ergonomic workstation layout, Tips, and Techniques for Computer Use:	Not Aware	22 (16.5)
	College	56 (42.0)
	Family or Friends	20 (15.0)
	Internet	21 (15.8)
	News Paper	3 (2.4)
	Television	11 (8.3)
Durations of using and keying on the computer (Mean±S.D.)	Years of using computer	20.10±7.96
	Hours of using a computer/day	6.07±4.69
	Hours of Keying (Typing)/day	3.66±4.38

Figure 1 illustrates that the majority of the nursing faculty members suffered from neck and shoulder pain during the distance learning era (88.0% and 81.2%, respectively). They also reported pain in the mid and lower back (71.4% and 73.7%). Moreover, 71.4% of the faculty members complained of lower arm and wrist pain.

Figure 2 illustrates faculty members' mean scores of knowledge about computer workstation ergonomics. The mean scores of the faculty members' knowledge about the definition of ergonomics, musculoskeletal disorders, and their risk factors were 3.35±1.02. Moreover, the mean score of working postures was 3.32±1.12, seating (chair) 3.54±1.14, keyboard/ mouse 3.29±1.12; the monitor was 2.85±0.95, table and accessories 3.77±1.23, rest breaks and exercises were 2.75±0.84.

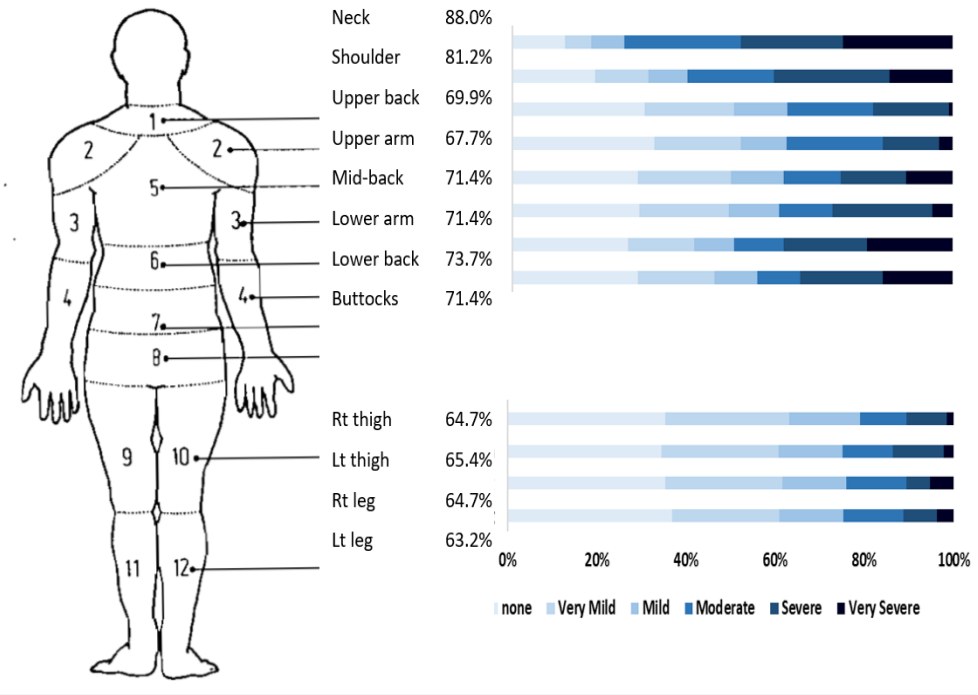

Figure 1: Frequency and Severity of Body Pain among Faculty Members Working on Computer.

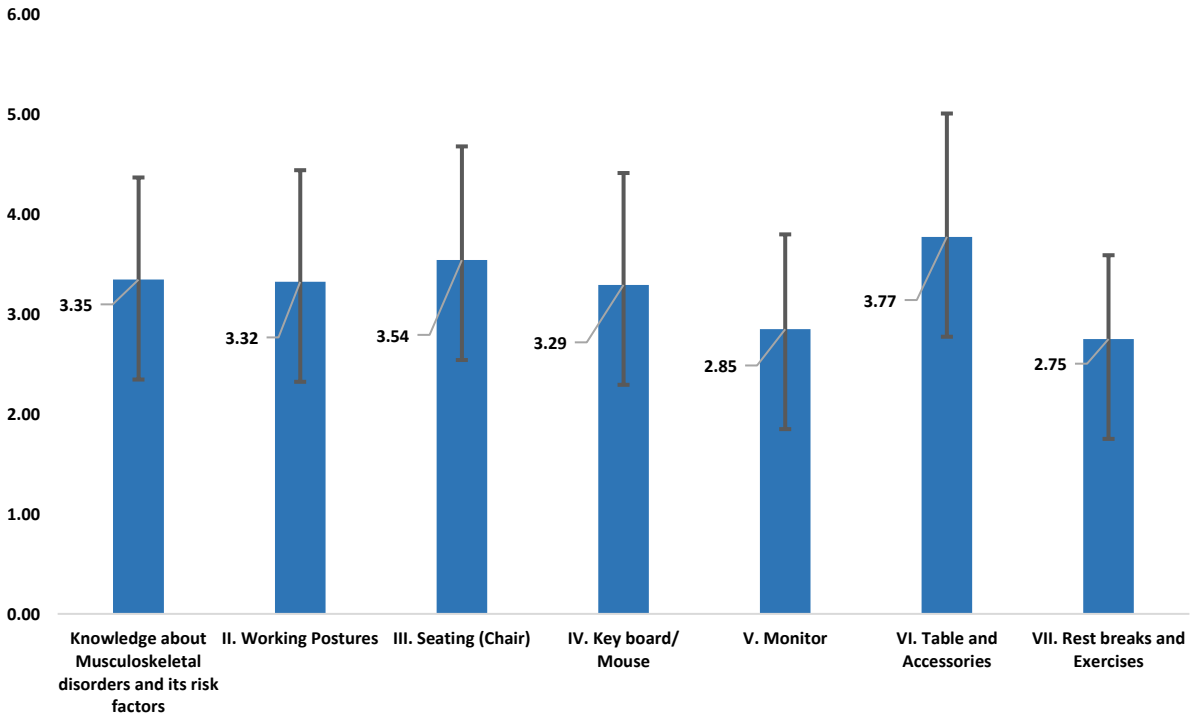

Figure 2: Faculty members' Mean Scores of Knowledge about Computer Workstation Ergonomics (n=133)

It was found that more than half of the nursing academic faculty members had a good (score 21-27) level of knowledge about computer workstation ergonomics (58.6%) and 13.5% of them obtained very good scores (Score 27-35), while 26.3% of them had fair scores (14-20) and 1.5% of them achieved poor knowledge score (<13).

The Regression analysis reveals no significant associations between faculty members' knowledge of computer workstation ergonomics and the occurrence of musculoskeletal body injuries. On the other hand, associations were between faculty members' computer use practices and their musculoskeletal body injuries. The duration of using the computer and keying (typing) were significant risk factors for developing musculoskeletal body injuries (p-value = 0.043 and p-value <0.001, respectively), while the frequency of taking breaks is a significant protective factor against

musculoskeletal body injuries (p-value = 0.020). The linear regression also shows no associations between years of using computers, external mouse use, and the occurrence of musculoskeletal body injuries, as illustrated in Table 2.

Table 2. Regression Analysis Regarding Academicians' Knowledge of Computer Workstation Ergonomics, their Computer Use Practices, and Musculoskeletal Body Injuries

Dimensions	Unstandardized Coefficients		Standardized Coefficients	t	p-value
	B	Std. Error	Beta		
a. Academicians' Knowledge of Computer Workstation Ergonomics					
(Constant)	31.007	7.172		4.323	<0.001
I. Knowledge about Musculoskeletal disorders and their risk factors	1.981	1.210	.143	1.638	0.104
II. Working Postures	-1.008	1.195	-.080	-.844	0.400
III. Seating (Chair)	-1.459	1.404	-.117	-1.039	0.301
IV. Keyboard/ Mouse	1.341	1.160	.106	1.156	0.250
V. Monitor	-2.382	1.728	-.160	-1.378	0.171
VI. Table and Accessories	.181	1.163	.016	.156	0.877
/II. Rest breaks and Exercises	-1.452	1.470	-.086	-.987	0.325
Total Score	-1.459	1.404	-.430	-1.039	0.301
b. Academicians' Computer Use Practices.					
(Constant)	16.584	5.982		2.772	0.006
Years of using computer	-.240	.141	-.135	-1.698	0.092
Hours of using the computer	.548	.268	.170	2.048	0.043*
Hours of Keying (Typing)	1.944	.456	.360	4.262	<0.001**
Mouse Use	-1.745	2.268	-.062	-.770	0.443
Frequency of Taking Breaks	-3.977	1.690	-.194	-2.353	0.020*

a. Dependent Variable: Musculoskeletal Body Injuries *Significant at * p-value ≤0.05 ** p-value <0.0001

The correlation Matrix illustrates no correlation between the years of using computers and the occurrence of musculoskeletal pain. A significant positive correlation between the duration of computer use, duration of keying (typing) per day, and the severity of musculoskeletal pain in all body parts, especially the neck, shoulder, upper back, mid-back, lower arm, lower back, and buttocks, as p-value <0.001 for each. On the other hand, there are significant negative correlations between the frequency of taking breaks and musculoskeletal pain. This reflects that prolonged computer use is accompanied by musculoskeletal pain. It is noticed that the frequency of taking a break is negatively correlated with musculoskeletal pain in the neck (r=-0.319, p-value <0.001), shoulder (r=-0.276, p-value=0.01), upper arm (r=-0.194, p-value=0.025), mid-back (r=-0.294, p-value=0.001), lower arm, (r=-0.211, p-value =0.015) and lower back (r=-0.299, p-value <0.001) as illustrated in Table 3.

Table 3: Correlation Matrix between the Academic' Computer Use Practices and Severity of Musculoskeletal Bodily Pain

Area of Body Pain	Musculoskeletal Pain Mean ± S.D.		Years of using computer	Hours of using the computer	Hours of Keying (Typing)	Mouse Use	Frequency of taking a break
Neck	3.17±1.62	R	.023	.332**	.298**	-.026	-.319**
		p-value	.789	<0.001	<0.001	.768	<0.001
Shoulder	2.65±1.73	R	.130	.405**	.318**	-.091	-.276**
		p-value	.135	<0.001	<0.001	.312	.001
Upper back	1.76±1.52	R	<0.001	.257**	.373**	-.096	-.100
		p-value	.999	.003	<0.001	.274	.254
Upper arm	1.72±1.56	R	-.108	.277**	.307**	-.030	-.194*
		p-value	.217	.001	<0.001	.733	.025
Mid-back	1.96±1.75	R	-.013	.441**	.364**	-.056	.294**
		p-value	.879	<0.001	<0.001	.524	.001
Lower arm	1.93±1.68	R	-.117	.353**	.319**	-.013	-.211*
		p-value	.180	<0.001	<0.001	.882	.015
Lower back	2.4±1.92	R	.036	.446**	.324**	-.048	.299**
		p-value	.680	<0.001	<0.001	.584	<0.001
Buttocks	2.2±1.89	R	-.027	.304**	.323**	.081	-.011
		p-value	.758	<0.001	<0.001	.351	.896

r =Pearson correlation *Significant at * p-value ≤0.05 ** p-value <0.001 *** p-value<0.0001
r ≥0.9 very strong correlation r 0.7-<0.9 strong correlation r 0.5-<0.7 moderate r 0.3-<0.5 weak

Discussion

Nursing academia has been moving toward broader applications of technology, where digital devices and computers have become indispensable educational tools. So, the nurse educators spent lengthened time using the computer to plan the classes, prepare presentations, audio-visual material, and upload the course materials. Besides, the digital revolution and the possibility to access documents electronically created a global attitude towards green computing. Many higher educational institutions support electronic academic activities to reduce the costs of printing and photocopying documents. Hence, students are asked to submit their assignments, projects, and classwork through various digital learning management platforms16. In this context, the faculty members sustained a static posture while reading and correcting assignments. This ultimately may contribute to the development of occupational disorders.

Musculo-Skeletal Disorders are the most prevalent distance learning-related health conditions among nursing faculty members. The current study findings identified that neck and shoulder pain conditions have the highest incidence among faculty members., Most neck pain may be attributed to improper anatomical positions with increased neck flexion. This could be justified by increased neck flexion which causes a greater biomechanical burden on the cervical spine and overstretching of the neck muscles resulting in more musculoskeletal discomfort and risk of neck injury.[17] Likewise, Queiroz et al. (2018) found that the body area most affected by computer misuse is the neck region.[18] These findings are supported by Sirajudeen et al. (2018), who reported that neck conditions are the most prevalent MSD among University students in Saudi Arabia.[19] A study by Lorusso et al. (2009) also noted that neck pain is the most prevalent symptom among Italian university students who overuse computers and technological devices.[20]

In addition, nearly three-quarters of nursing faculty members in the present study recorded lower arm, wrist, mid, and lower back pain through the technology-based learning These

findings could be attributed to several predisposing factors that include, but are not limited to, (a) awkward static posture, (b) low force static contractions, (c) repetitive wrist/hand movements, (d) poor design of the workstation, (e) non-neutral and maladaptive positions.[21] For instance, sitting for an extended period and having a monotonous work style are significant risk factors for developing such MSDs, which results in increased intradiscal pressure stiffness of the lumbar spine and affects the lower back muscles' strength.[22] This is evident in our study findings, where most faculty members reported spending more than six hours using and keying on the computer. Further, a recent systematic review reported that poor sitting posture and lack of daily physical activities might be strong predictors of low back pain caused by sitting, not only prolonged sitting, and the little amount of time for stretching exercise after work.[23]

The MSDs symptom severity is influenced by multiple factors such as posture, type of device, duration of use, and gender.[24] Additionally, after a comprehensive review of multiple kinds of literature, it was found that females are more at risk of developing MSDs using the computer than males.[21,25] Moreover, the present study findings illustrated that the vast majority of faculty members were females. This is in line with the findings of Meaza et al. (2020), which showed that female faculty members were three times more likely to develop MSDs than males.[26]Besides, this finding may be due to the biological differences between both genders, such as body size, muscular capacity, hormonal condition, and increased biological vulnerability of females than males23. Furthermore, evidence suggests that females have lower thresholds and higher pain sensitivity, particularly those employed who have more commitments at home and work.[21]

The current study findings illustrated that more than half of the nursing faculty members had good knowledge of computer workstation ergonomics. The high levels of knowledge can be explained by the fact that the study participants are academic staff who completed the nursing informatics course in their postgraduate studies, which include a module about computer workstation ergonomics. So, it was not surprising that most of the participants in the present study were knowledgeable about all items of ergonomics, such as the appropriate seat height, and reported the importance of the adjustable backrest. These findings contrast with those of Chacko and Chetan (2018), which inferred that most participants need to be made aware of ergonomics and associated factors.[27]

Correspondingly, the findings of the regression analysis in this study spotlighted the association between faculty members' computer use practices and their MSDs. It is clear that the duration of using the computer and keying are significant risk factors for developing such pain, while the frequency of taking breaks is a significant protective factor against musculoskeletal body injuries. Moreover, the literature reported that the duration of electronic device usage may contribute to musculoskeletal-related symptoms. This could be attributed to a failure in supporting the forearm while typing on the keyboard, which increases the load on the trapezius muscle, resulting in neck pain. In et al. (2015) found an appositive association between the duration of computer use and posture, with the neck being one of the body regions showing joint movement increase from the middle to the end of a typing session.[28] Alshahrani et al. (2021) also assessed the effect of long-term device usage on neck flexion, and their findings revealed a negative association between the duration of digital device use and neck flexion ability.[29] Gustafsson et al. (2017) reported an association between shoulder pain, numbness/tingling in the hand, and the number of texts sent daily.[30]

Surprisingly, there is no association between faculty members' knowledge of computer workstation ergonomics, years of computer and external mouse use, and the occurrence of MSDs. A plausible reason for this observation could be the less frequent postural shifts, which are known to be associated with musculoskeletal symptoms, such as loss of flexibility or wrist extension, shoulder abduction, and ulnar deviation.[31]

A significant negative correlation was displayed between the frequency of taking breaks and musculoskeletal pain. This denotes that prolonged computer use is accompanied by musculoskeletal pain, which can be explained by sitting for uninterrupted extended periods that adversely impact the vertical torso morphological position and degree of spinal loading.[32] From the neuro-anatomical theory standpoint, the complex and sustained sitting posture habit might activate the incessant compression on the intervertebral disc and decrease the disc nutrition, causing stiffness and chronic soreness.[33] Moreover, sustained pressure decreases blood circulation to joints, muscles, tendons, and ligaments and decreases tissue regeneration opportunities, leading to painful tensional syndromes.[33] In this regard, Jung

et al. (2020) indicated that the hunched posture adopted during working resulted in spinal muscle augmentation, decreased muscle endurance, and tendon inflammation, thus possibly being a factor in reports of increased back pain among digital users.[34] Furthermore, negative consequences of computer use may be due to high workload, faculty members' expectations, or job tension among staff and high job demands.[35]

Conclusions

Nursing faculty members had adequate knowledge of computer workstation ergonomics. Regrettably, the majority of them had computer-misused-related pain in their neck, shoulder, lower back, lower arm, and wrist. The computer use practices were positively correlated with the severity of MSP in most body parts. The duration of using the computer and keying were significant risk factors for developing MSP, while the frequency of taking breaks was a significant protective factor. Hence, it is recommended that faculty members apply the principles of computer workstation ergonomics, practice stretching exercises, and take frequent breaks and that these principles are included in the workplace orientation training of new staff nurses and refresher training for existing staff nurses to prevent injuries, discomfort and distress and loss of productive hours to the workplace.

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