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Academic Safety and Health (ASH) requirements for ICT usage by PhD students in developing countries: A case of University of Dar Es Salaam (UDSM), Tanzania and Makerere University, Uganda

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ABSTRACT

The socio-economic effects of poor safety and health computer working environment are enormous to not only users but also their enterprises at large. This study examined universities' commitment towards safety and health requirements in computers usage by PhD students, using a case of University of Dar es Salaam and Makerere University. Responses from 221 respondents were analyzed using regression analysis. Observation to rooms and facilities used, supplemented the information. The study found that although the universities had tried to improvise rooms with chairs and tables for the PhD works, little attention to ergonomics was paid. Reported risks and snags encountered include eye strains, sight fatigue, headaches, tension stress, limbs disorders including disk degenerative disorders. The study proposed for the Universities to abide on provision of ergonomic obligatory environment possible including orientation of users to computer ergonomic principles, measures that are hoped to minimize computer usage related disorders. Policy makers and legislators are urged to come up with policies, laws and regulations to reinforce the intended behaviors and deeds. Importantly is also to individual PhD students to take active measures to ensure for sustainably safe and ill-health free computer related environment, despite the working environment they are exposed to.

Keywords: *Ergonomics, Academic Safety; health requirements; ICT Usage; PhD students; academic safety and health requirements.*

BACKGROUND INFORMATION

Since the 1990s to date, computers and related technologies have formed an integral part of a growing range of business and other activities, resulting in rising computer usage (Shi, 2011). With such development, it seems almost impossible to live without computers and internet nowadays (Shi, 2011). Choobineth et al. (2006), assert that computer is essential in almost any work and few professions can be found in which computer is not used to perform the tasks. Globally computers are used by a variety of people to carry out a number of ICT related activities in various sectors such as manufacturing, agriculture, health, telecommunication, and logistics to mention a few. Today, existing electronic services are numerous including but not limited to online learning, e-banking, e-procurement, e-health, e-government, e-voting, e-commerce, e-dating, e-ticket booking, e-mailing, among others. According to Barnatt (2010), groups of individual that mostly involve usage of computers including among others - secretaries, typists, data entry clerks, telesales operators and academicians whose jobs depend more or less on computers and related equipments are termed as habitual computer users/operators. The groups are vulnerable to safety and health risks related to computer usage (Barnatt, 2010).

The major aim of computer usage in Universities by students is meant mostly for academic purposes. In the higher learning education sectors, apart from the instructors, postgraduate students are among the heavy users of ICT. PhD scholars have been almost reliant on the ICT and the Internet to attain their major academic goal of obtaining a doctorate degree efficiently and effectively on time (Shi, 2011). This is attributed by the requirement for postgraduate programs to allow more of individual works at individual as well as group level assignments, term papers and writing their dissertations. Unlike the bachelor and masters study levels whose learning is characterized by lectures and less of individuals assignments, and whose study durations range from one to mostly three years, duration for PhD studies worldwide normally range from three to up to six years or more. For example under the Tanzanian University Qualification Framework out of 540 credits as minimum requirement for PhD, a half of 540 credits (270 credits) goes to dissertation while the remaining 270 credits makes coursework part with 2 semesters making 135 credits per semester. This course work is mainly individual based assignments. When compared to masters by coursework & dissertation, 1/3 of 180 total credits required, which is 60 credits goes to dissertation while the remaining 120 credits makes coursework part, 60 credits per each of the two semesters (TCU, 2012). In Uganda the minimum number of credit hours is 240 and are to be covered in at least three years (six semesters) as compared to only 120 credits done in three years for bachelor degree level, and only one to two years for masters is spent to have 120 credits hours (NCHE, 2011), while in Rwanda, a minimum of 540 credits for PhDs as compared to 180 credits required for masters level (Rwandan Qualification Framework, 2007). In Europe, a PhD takes a minimum of 4 calendar years equivalent to minimum of 480 credits hours (UCL, 2015). This implies that, PhD journey takes the longest period of time compared to other levels.

With such increased ICT usage in performing tasks, over a decade now great many questions have arisen concerning the links that may exist between the use of computers and the health and safety of those who use them. This study has defined the term health to refer to the physical, mental and social well-being of computer operators, while it uses the term safety as Robert's (2011) to refer to the extent to which an interface allows users to perform their work free from the risk of human, equipment, data, or environmental accidents or losses. Studies (Tittranonda et al., 1999; Marcus et al., 2002; Schlossberg, Marrow and Llosa, 2004) document computer usage risk factors in workplace among others to include number of hours of computer use and working in non-neutral body postures (e.g., reaching for mouse, looking up at a computer monitor etc.). Evidence indicates that the long-term use of computers is linked to a range of potential health problems, or "computing related disorders (CRDs)" such as joint pain, upper limb disorders, swollen tendons, eye problems, tension stress and fatigue, headaches, and skin complaints (Barnatt, 2010; Lasa, 2006). This is attributed to the excessive performance of repetitive and dextrous operations.

Computer usage coupled with other ICT related technologies including the Internet on daily basis by the users equally exposes PhD students to a variety of computer related safety and health risks and snags while carrying out their PhD work. According to Schlossberg, Marrow and llosa (2004), when compared to undergraduate students, graduate students may be at greater risk for musculoskeletal symptoms and disorders due to the intensive computer use required for review, data analysis and thesis writing, as well as employment as graduate student researchers and teaching assistants. It is therefore important that PhD students as part of habitual computer users are appropriately equipped to ensure that they are safe and ill-health free all the times they work with computers. For example, in some countries such as the UK and US, it is already made obligatory to hosting institutions to ensure that users/operators of computers work with all the comfort and safety required. Barnatt (2010) exemplifies that the UK Display Screen Equipment Regulations 1992 obliges every employer to carry out a "suitable and sufficient" analysis of every workstation they provide for the use of habitual users or operators.

However, there is no evidence how this problem is being handled in universities in developing countries. Assessment of extent of ICT components such as hardware, software or furniture conditions, workstation relocations, lighting etc. and how they are used, their health related impacts and respective injury avoidance mechanism by the PhD students is important to ensure a safe and health computer related working environment. Although there are a number of documented potential risks related to heavy computer usage by PhD students, at the time, health risks associated with computer usage in the region and developing countries in general are not yet to be aired. This study seeks to fill this gap. The study is conducted because of a need to address these key issues to avert future problems related to ICT use. It assesses the commitment to safety and health requirements for computer and other ICT related devices usage by PhD students for longer hours in the pursuit of their PhD studies at the UDSM and Makerere Universities.

Specifically the study sought to do the following,

i. To assess the technological aspects and their influence on preventing ICT usage related risks.
ii. To assess the role of individual concerns on preventing ICT usage related risks
iii. To assess the PhD computer working environment and its role on safety and health risks reduction among PhD students.

JUSTIFICATION OF THE STUDY

Health is considered important as it enables a person to work, and 'paid' work alleviates poverty thereby facilitating the achievement of the Millennium Development Goals (MDGs). According to Jain, Puplampu & Amponsah-Tawiah (2012), the poverty cycle is a result of hazardous work environment, which results to ill-health work force and eventually results to poverty. The effects of poor safety and health are enormous not only on the economic prospects for graduates; but also to their enterprises, nations, and the world as a whole (see also Dorman, 2000). In fact, it is of no use for example obtaining a doctorate degree after such a long time pain ending up with permanent ill-health. The study's findings are hoped to have not only contribution to knowledge on health and safety measures commitment amid heavy computer usage among PhD students, it will also have policy and practical implications to the universities and the responsible authorities. Besides, it will help to trigger passive measures by institutions to enable PhD students work safely and responsibly with ICTs and to monitor their own standards and practice. More so, it will enable the responsible authorities to set clear expectations of behavior and/or codes of practice relevant to responsible use of ICTs not only to Universities but also in other intensive users of ICTs. The study further creates awareness to future country scholars on unsafe behavior relating to ICT usage, through putting in place appropriate plans for IT safety and health requirements as part of their induction courses.

THEORETICAL LITERATURE REVIEW

The Three E's Framework

The three E's framework is regarded as the traditional approach to health and safety of workers. The three Es of safety, standing for Engineering, Education, and Enforcement (Geller, 1996; Guastello 1993; Heinrich, et al., 1980; Petersen, 1996; Wilde, 1998), focus on: 1) seeking to develop engineering strategies that decrease the probability of a worker engaging in a risk behavior; 2) Educating and training employees regarding equipment, environmental hazards, policies and procedures; and 3) Enforcing the policies and procedures related to operating equipment, wearing proper personal protective equipment, and handling specific hazardous substances (Geller, 1996; Guastello 1993; Heinrich, et al., 1980; Petersen, 1996; Wilde, 1998). Engineering strategies to decrease risk behaviors in computer and ICT should be performed to ensure safe and health ICT work environment. This requires the designing of safe equipment, safe environmental settings and safe protective devices (Geller, 1996; Guastello 1993; Heinrich, et al., 1980; Petersen, 1996; Wilde, 1998). The employees in computer and ICT environment need to be educated and trained on how to use equipment commissioned to them. They need to know the ICT environmental hazards, policies and procedures. Accordingly, there should be discipline to enforce compliance of the policies and procedures to ensure safety and health (Geller, 1996; Guastello 1993; Heinrich, et al., 1980; Petersen, 1996; Wilde, 1998).

Flow of Change Model

According to Iverson and Erwin (1997) causes of occupational injuries can be attributed to two causes which are the characteristics of the work environment (work practices) and the characteristics of the individual. Geller (1998) conceived the flow of change model, on employee safety and health environment. He proposed that there are three types of behavior for employees namely: other-directed, self-directed and automatic behavior (Geller, 1998). The other-directed behavior is exhibited when a behavior is first learned. External guidance or motivation is required to produce the target behavior. Self-directed is a type of behavior exhibited after a person has practiced the newly acquired behavior and can do it without external guidance. It is internally motivated. The automatic behavior is achieved after frequently and consistently repeating the target behavior until it becomes a habit (Geller, 1998). It is necessary to use external guidance in the use of ICT and computer injury prevention methods to make individual users and who host them compliant. This will be the other-directed behavior. Legislation is required to enforce this behavior change. After repeated, frequent and consistent compliance to the policies and regulations regarding ICT safety and health requirements, the behavior will become self-directed and eventually become automatic for both individual ICT operator as well as the responsible institution.

EMPIRICAL LITERATURE REVIEW

Safety and health risks related to prolonged computer usage

Because computer work requires long time sitting in front of screen, typing keyboard, dragging mouse and managing with files etc., habitual computer operators are exposed to number of ergonomic related consequences including eye strains, upper musculoskeletal system or having frequently neck and shoulder pain (Nina & Zhiyong, 2003). Studies (Grandjean, 1987; Punnett & Berqvist, 1997; Tittranonda et al., 1999; Marcus et al., 2002) further indicate that prolonged computer usage, improper work habits, poor workstation design and an inappropriate work environment had resulted in muscle soreness, fatigue and injury. According to Wilson and Best (2005), tendonitis is the most common problem, involving tendon inflammation and localized pain in the elbow, forearm, wrist or hand.

According to the report by the National Institute of Occupational Health, 40 per cent of people working predominantly with computers in the United States suffered some repetitive strain injury (RSI) symptoms, with over ten per cent experiencing constant discomfort (Barnatt, 2010). The data from Swedish insurance showed that about 18 percent of disability payments expend for musculoskeletal disorders especially spend on neck and shoulder complains already 10 years ago (Nygren et al.1995). In Denmark, in the year 2002, about 28% of employees of general working were tortured by pain or stiffness in the neck, shoulder, arm, hands, or wrists. Furthermore, it shows that work-related neck and shoulder pain take up 25%, while arm pain occupies 15% in 15 European countries (Claire et al 2008:87). In higher learning institutions, a survey of 1544 graduating seniors at Harvard University, reported that over half of the students experienced symptoms with computer use, and 12.6 % experienced symptoms after computing for one hour or less (Katz et al., 2000). Risk factors were academic concentration in computer science, and using a computer more than 20 hours per week. This means, if the situation is not checked in advance, it may end up costing the habitual computer operator in terms of suffering, medical expenses, lost career opportunities and reduced quality of life, and organizations in terms of days lost, impaired work performance, reduced productivity and increased compensation claims.

According to Sellschop (2015), most often, computers have been placed on classroom desks or tables with little attention given to potential postural problems that could result. Although of recently, there have been a growing number of studies initiated worldwide on the issues of workstation design and set-up in schools, nonexistent or scant studies are available in developing countries as compared to developed countries. Besides, studies on problems related to prolonged computer usage among PhD students and how they are confronted are missing in developing countries. Although Nzyuko (2015) investigated on adherence to safety and health requirements in computer usage in Dar es Salaam region, his study focus was on occupational health and safety (OSHA) among banking and academic institutions, and not with PhD students. It is important that computer usage is maintained in an optimal way with respect to the PhD students' computer user's health. The application of ergonomics principles can play an important role in the provision of a safe and healthy work environment for computer users. When understood and applied, ergonomics can increase efficiency and performance; reduce fatigue, reduce negative work stress, keep skilled staff on the job; improve internal public relations; and reduce liability exposure (Pater and Button, 1992). Besides, it is of no use obtaining a doctorate degree after such a long time pain ending up with permanent ill-health due for something that could have been easily avoidable.

Approaches to safety and health relating to Computer usage

Rodrigues (1993) envisages that with good positioning, good work place design and good working practices in general, computers are clean, quit and safe to use. According to Barnatt (2010) considerations to ensure safety and health have to be looked in terms of Technology (suitable Hardware, and Software); Procedures and processes (Training, guidelines provision e.g. standing and posing working after every certain times); and, Environmental support (type of working chair; lighting etc.). Research also indicates that personal factors, workplace factors and ergonomic variables have important but differing associations. According to National Committee for Injury Prevention and Control (NCIPC, 1989), the injury prevention strategies can be grouped into two namely Passive Structural Strategy and Active Behavioral Strategy. Passive approaches involve changing products or environments to make them safer for all, irrespective of the behavior of individuals (NCIPC, 1989). Nzyuko (2015) adds that, in the passive structural strategy the hosting company provides a safe environment and in the case of ICT (computer) use, ergonomic facilities are provided. Active approaches rely on individuals to take an active role in protecting themselves, irrespective of hazards in their environments (NCIPC, 1989).

In practice, most of the passive requirements will be met by purchasing modern computer hardware and software, and by installing them in a work location with adequate space and where appropriate attention has been paid to lighting arrangements (including measures to reduce screen glare and reflection to ensure an appropriate contrast between the display screen and the background environment). In many cases, the item of equipment requiring most attention to meet the above requirements will be the adjustability or otherwise of the user/operator's chair (with a great many cheaper office chairs not featuring adjustable back height and tilt). Furthermore, surfaces should have a matt finish to avoid glare and reflections (Barnatt, 2010). Barnatt (2010) adds that no item of workstation equipment should generate excess heat that could cause user/operator discomfort. Besides, all electromagnetic radiation outside of the visible spectrum should be screened to negligible levels (Barnatt, 2010; Lasa, 2006). Others are employment of appropriate ergonomics principles right from the software designs, and/or employment of software to provide feedbacks to the user/operator on its status and performance (Lasa, 2006).

According to a study by Harborview Injury Prevention and Research Center (2002) and DiLillo, Peterson & Farmer (2002) it is not possible to reduce injury without some element of behavior change. These are part of active approaches and it involves taking active role in protecting themselves, irrespective of hazards in their environments. The habitual computer user/operator (such as PhD student) is therefore expected to change his behavior for self protection. Besides, the structural intervention paradigm requires human adaptation. The ICT operator must understand his vulnerability and develop the desire for protection. Although change of behavior into new behavior or an unpleasant or unwelcome is not automatic, after some practices, the new behavior becomes self-directed, habitual or automatic (Geller, 1998).

The following are some practices an individual may adopt for safety and health adherence (Barnatt, 2010; Lasa, 2006). They include planning for periodically interrupted by such breaks or changes of activity [so] as to reduce their workload at that equipment. Breaks taken before the onset of fatigue, and that the number of breaks is more important than their duration. In other words, many short breaks are far more effective than a few long breaks (and indeed some researchers advise display screen equipment workers to close their eyes for 30 seconds every 15 minutes or so) [Barnatt, 2010; Lasa, 2006]. If possible, breaks should also be taken away from the workstation and spent on non-screen activities (as opposed to doing nothing). Finally, breaks from display screen work should be included in work time. Barnatt (2000) urges users to position top of screen at eye level, wrist support if required, forearms roughly horizontal, desk about 70 cm high, footrest if required and chair with adjustable seat height as well as adjustable back height and tilt. See also Figure1. Scholars (Iverson & Erwin, 1997; Sleet, 1998; Gielen & Girasek, 2001) thus, urges for combination of both work environment (work practices) and the individual behavioral changes as the best advice and practice. That is, regardless of any regulation, careful, limited and regularly-interrupted computer use may offer best injury prevention results possible.

A number of authors (such as Mohammady et al., 2010; Sadeghi, Moghaddam & Rahdar, 2012; Rothstein et al., 2012; van Dijk, et al. (2015) suppose that working condition would improve over long-term when the ergonomically educated, trained and oriented users become an integral part of workplace safety programs. For example, a study performed on 75 computer users showed that the trained group gained higher cores on knowledge, attitude, perceived behavioral control, intention, as well as observing the neutral posture as the target behavior compared with the group without intervention (Sadeghi, Moghaddam & Rahdar, 2012). Employment of most effective knowledge transfer strategy possible will improve computer users ergonomics knowledge and practices, and have impacts in changing computer users attitude behavioral control, and intention to observe the proper ergonomic principles all the times working with computers. Rozline et al., (2017) relates the failure with ignorance or indifference where some organizations or at least managers simply do not realize the value of ergonomic planning.

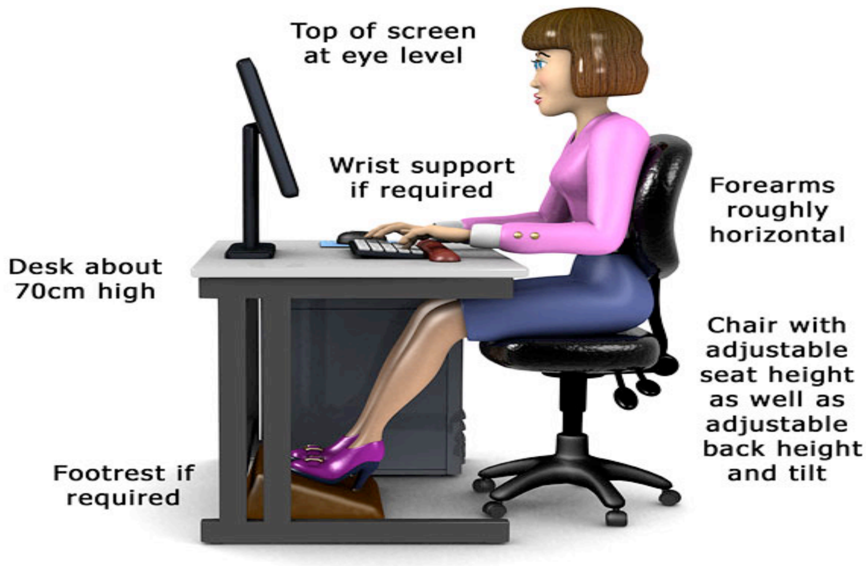

Fig 1: *Recommended ICT working posture*
Source: *Barnatt (2010)*

However, the literature review has established that there is no documentation on any study that has been done on the adherence to academic safety and health requirements in the use of computers and other ICT not only among PhD students but also in the academic institution in developing countries at large. This study therefore was thought to be of great interest since it may be the first of its kind to be undertaken in East Africa.

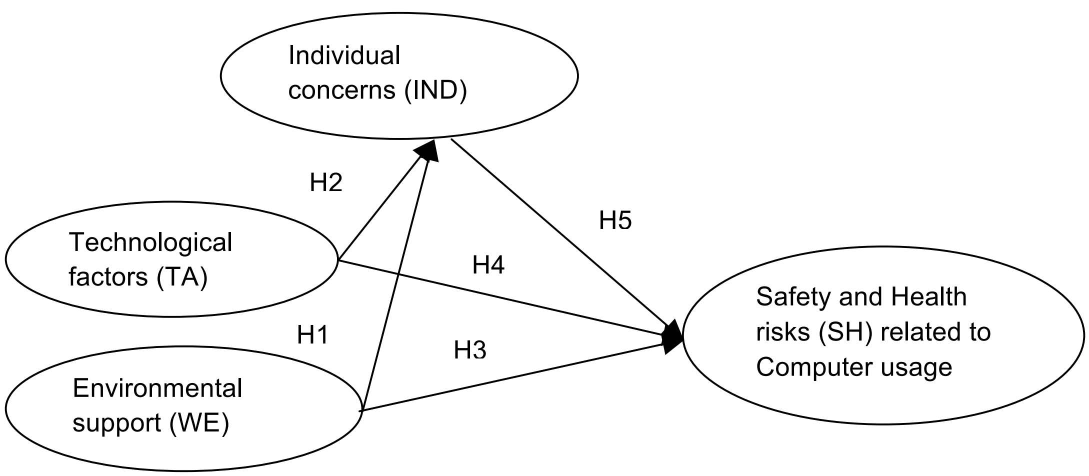

Figure 2: *Study's concept*

From the review conducted, the study formulates a conceptual model presented in Figure 2, which consists of series of relationships. The study opines that, equipping computer users with ergonomically safe and healthy computer hardware and software, and providing them with adequate environmental support (in terms of working room, chairs and tables), it will trigger individual concerns towards safety and health related to computer use. The study further opines that where individual computer users are consciously enough to adhere to computer work safety and health procedures then there will be ensured safety and health computer work environment. Also, where there is ergonomically supportive working environment, there will be ensured safety and health computer work environment.

HYPOTHESES

The study has the following hypotheses:

H1: "*Supportive working environment (WE) significantly influences individual concerns towards safety and health adherence (IND)*"

H2: "*Presence of ergonomically suitable technological factors (TA) significantly influences the individual concerns towards safety and health adherence (IND)*".

H3: "*Supportive working environment (WE) significantly influences the extent of Safety and Health risks related to computer usage (SH).*"

H4: "*Presence of ergonomically suitable technological factors (TA) significantly influences the extent of Safety and Health risks related to computer usage (SH)*"

H5: "*Individual concerns on ergonomically safe and health computer work environment (IND) significantly influences the extent of Safety and Health risks related to computer usage (SH)*"

METHODOLOGY

This study was carried out to PhD students enrolled in various PhD programs in the University of Dar es Salaam (UDSM) and Makerere University (MUK). Although the selection of UDSM and MUK was conveniently based, it was considered representative given the fact that, they are both old and relatively large universities in East Africa with each having numerous PhD programs, as compared to many other new universities in the region. Both electronic and printed close-ended questionnaires were distributed to a sample of 250 PhD students, drawn from a cross-sectional survey organized in the Universities under study. There were however 221 participants (response rate of 88.4%) responded till this presentation was made. Out of that the researcher managed to get 151 (68.3%) respondents from the University of Dar es Salaam and 70 (31.7%) respondents from Makerere University. The distribution of respondents per PhD programmes based on respondents' convenience of access is presented using Figure 3. To ensure validity and reliability of data, face validity was carried out through reviewing of questionnaires by experts and pre-testing of questionnaire prior it was used in a wider scale of data collection. Internal consistence of the instrument was tested if Cronbach's alpha coefficient of 0.70 or more was attained to indicate reliability of the instrument. A Cronbach's alpha of 0.877 was obtained after a reliability test indicating that the instrument was reliable. Adaptation of questions from other previous related studies ensured more efficiency for validity and reliability than developing own questions (Saunders et al., 2003; Kessy, 2010). This is because such questions are already tested for validity.

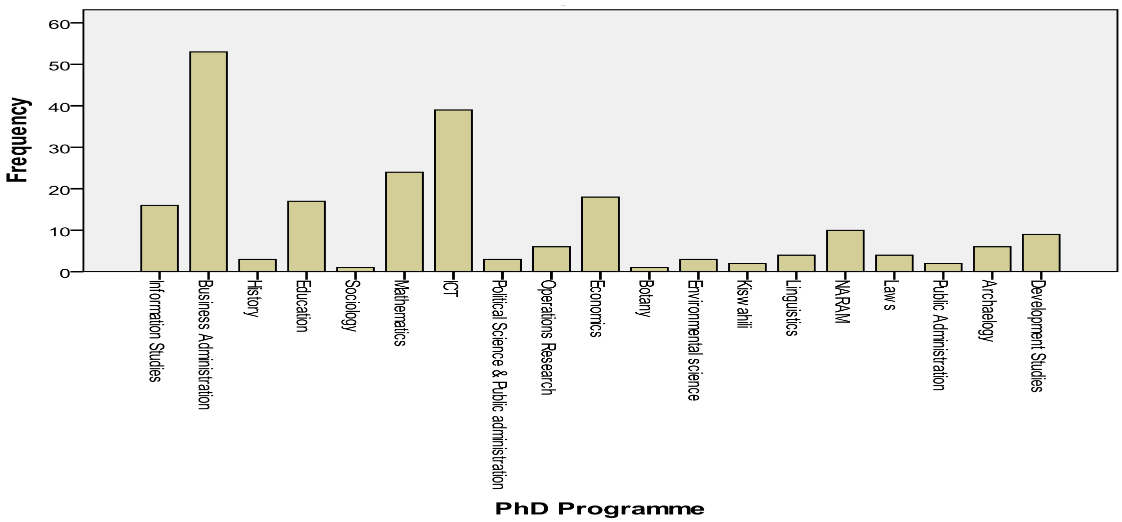

Figure 3: *Participants from various PhD programmes*

Table 1: *Respondents' Universities of PhD studies, Age and Gender*

Demographic data	Attribute	Frequency	Percent
University of PhD Studies	UDSM	151	68.3
	MUK	70	31.7
	Total	***221***	***100.0***
Age	Below 30 years	2	0.9
	Between 31- 40 years	117	52.9
	Between 41- 50 years	85	38.5
	Above 50 years	17	7.7
	Total	***221***	***100.0***
Gender	Male	150	67.9
	Female	71	32.1
	Total	***221***	***100.0***

FINDINGS

The study revealed that majority of ongoing PhD students accounting for 84 respondents (38%) had spent between one to three years for their PhD studies, followed by 80 (36.2%) who had already spent between three to five years, while 20 (9%) students had already spent more than five years, and 37 respondents (16.7%) had spent less than one year and they were on going. See Table 2. The mean number of hours respondents spent on computers for their PhD works was 8.20. Majority (78 respondents equivalent to 35.3% of all) worked for 8 hours, followed by 9 hours (16.7%), followed by 10 hours (14.5%), followed by 6 hours and 7 hours (with 10.4% each), implying that a total of 193 (87.3%) out of all respondents worked with computers for their PhD works not less than six hours. The rest were below 5% each. Figure 4 presents the number of hours on daily basis respondents spent working with computer.

Table 2: *Respondents' PhD study durations*

PhD study duration	Frequency	Percent
Under One year	37	16.7
between One year and Three years	84	38.0
Between three years and five years	80	36.2
Above Five years	20	9.0
Total	221	100.0

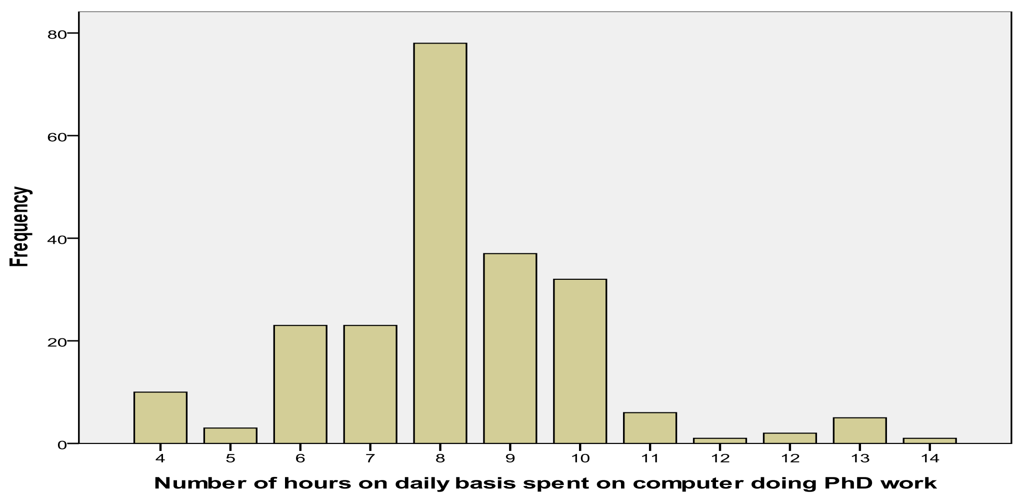

Figure 4: *Number of hours on daily basis respondents spent working with computer*

Although the universities under study had tried to improvise rooms with chairs and tables for the PhD students only, little attention was paid to Ergonomics issues. The PhD rooms were not aerated enough, had un-adjustable chairs and tables that would improve PhD workspaces and environments to minimize risk of injury or harm to the PhD students. It further revealed through in-depth interviews with selected informants that these students had encountered a number of ergonomic related risks like eye strains resulting to eye defects, sight fatigue, headaches, tension stress, limbs disorders, double vision and some of them who had just finalized their thesis, had disk inflammatory/degenerative disorders and could not sit well to add value to the society through their respective organizations and for that matter therefore, they were sometimes forced to be flown to hospitals and other physiotherapy centers to seek medical treatment hence leading to un planned additional expenses.

The findings in Table 3 stipulates the safety and health problems the respondents had encountered and the extent they have suffered based on five points Lickert scale from never, seldom, sometimes, often and always. Besides that 27% of respondents had ever been absent from work, and 14% of respondents had ever been hospitalized due to disorders resulting from prolonged computer use. When responses with "sometimes", "often "and "always" were summed up, it indicated that most of respondents had in one way or another experienced some cases of suffering due to poor ergonomic computer working environment. The findings show that 80.5% had suffered from backaches; while 78.2% of the respondents had suffered from neck-aches.

Also, 75.6% had suffered from headaches; while 62.4% had suffered from wrist and hand pains; whereas 58.4% had suffered from eye strain disorders; and 47.6% had suffered from watering eyes; while 47.0% had suffered from blurred vision.

Table 3: *Safety and Health risks respondents have ever suffered*

	Responses				
Statements/Questions	Never	Seldom	Sometimes	Often	Always
SH1-Have you ever suffered from eye strain disorders due to prolonged use of computers?	49(22.2%)	23(18.4%)	61(27.6%)	42(19.0%)	26(11.8%)
SH2-Have you ever suffered from blurred vision due to prolonged use of computers?	59(26.7%)	58(26.2%)	49(22.2%)	39(17.6%)	16(7.2%)
SH3-Have you ever suffered from watering eyes due to prolonged use of computers?	64(29.0%)	62(23.5%)	51(23.1%)	43(19.5%)	11(5.0%)
SH4-Have you ever suffered from headaches due to prolonged use of computers?	24(10.4%)	31(14.0%)	85(38.5%)	57(25.8%)	25(11.3%)
SH5-Have you ever suffered from backaches due to prolonged use of computers?	16(7.2%)	27(12.2%)	91(41.2%)	48(21.7%)	39(17.6%)
SH6-Have you ever suffered from neck aches due to prolonged use of computers?	21(9.5%)	26(11.8%)	82(37.1%)	54(24.4%)	37(16.7%)
SH7-Have you ever suffered from wrist and hand pain due to prolonged use of computers?	37(16.7%)	46(20.8%)	61(27.6%)	57(25.8%)	20(9.0%)
SH8-Have you ever been absent from work because of disorders resulting from prolonged use of computers?	114(51.6%)	47(21.3%)	24(10.9%)	19(8.6%)	17(7.7%)
SH9-Have you ever been hospitalized due to any related computer risks resulting from prolonged use of computers?	136(61.5%)	53(24.0%)	17(7.7%)	11(5.0%)	4(1.8%)

Regression analysis between conceptualized independent variables and dependent variables

Recall, in order to determine the influence of predictors on the extent of safety and health risks related to computer usage in the universities under study, we had hypothesized five relationships. Supportive working environment (WE) and Technological factors (TA) were postulated to have significant influence to Individual concerns towards computer safety and health related issues (IND). While supportive working environment (WE), technological factors (TA), and individual concerns towards computer safety and health related issues (IND) were postulated to have influence on extent of safety and health risk related to computers usage (SH). Before any analysis was done, factor analysis (See Table 4) was conducted for the purpose of computing factor scores so that could in turn be used for regression analysis (Tabachnick & Fidell, 2007). Burns and Grove (2005) elucidate that factor analysis is useful for grouping large numbers of variables, disentangle them and identifying clusters of variables that are closely linked together. Items that did not load strongly (i.e. loading below 0.50) on the intended factors were dropped and were not considered in subsequent analysis (see also Hair et al., 2010).

Table 4: *Factor Analysis*

	Component			
	1	2	3	4
TA4-I ensure that no item of workstation equipment generates excess heat that could cause me discomfort	.868			
TA5-I use a flat screen monitor compliant CRT displays in order to screen electromagnetic radiation outside of the visible spectrum to negligible levels	.782			
TA6-I employ software to provide feedbacks on the operator status and performance	.764			
TA3-Radition reduction shields are provided to computer I use	.722			
WE3-I use ergonomic tables with adjustable base for keyboard		.864		
WE2-I am provided with adjustable seat height as well as adjustable back height and tilt to support me in my PhD studies		.814		
WE5-There is provision of foot and hand support in out ICT working environment		.807		
WE7-My PhD working room has adequate space		.794		
SH2-If have suffered from blurred vision due to prolonged use of computers			.892	
SH5-If have ever suffered from neck aches due to prolonged use of computers			.888	
SH7- If have ever suffered from wrist and hand pain due to prolonged use of computers			.830	
SH1-If have suffered from eye strain disorders due to prolonged use of computers			.743	
SH-If have ever suffered from backaches due to prolonged use of computers			.658	
IND3-I stand and pose after every certain times when working with a computer				.736
IND5-I make sure that my forearms are roughly horizontal when working with computers				.735
IND6-I take regular short breaks (e.g. after every 30 minutes) from computer to reduce ergonomic workload				.729

However, before a factor analysis output are interpreted and used for subsequent analysis, literature (such as Hair et al. 2010) suggests that KMO and Bartlett's test have to be scrutinised so as to confirm whether it is appropriate to use factor analysis procedure or not. According to Kaiser (1974), the KMO value is supposed to be greater than 0.5, and the p-value for the Bartlett's test should be less or equal to significance level (0.05) if factors are to be considered adequate for analysis. Results from this study revealed that KMO value was 0.812>0.5 while the p-value for Bartlett's test was 0.000<0.05 (Table 5). The findings confirm that it is appropriate to interpret and use factor analysis because the sampling is adequate and the correlation matrix is not an identity matrix.

Table 5: *KMO and Bartlett's Test*

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.812
Bartlett's Test of Sphericity	Approx. Chi-Square	2361.498
	df	231
	Sig.	.000

Through regression analysis, evaluations of independent variables (WE and TA) on dependent variables (IND) revealed that the coefficients for WE and TA are 0.168 and 0.611 respectively. The results mean that; a proportional change in a (1) standard deviation of supportive working environment corresponds to a 0.168 increase in standard deviation of individual concerns towards safety and health risks related to computer usage. Also, a proportional change in a (1) standard deviation of technological aspects corresponds to a 0.611 increase in standard deviation of individual concerns towards safety and health risks related to computer usage. Besides, the p-values for WE and TA are p=0.018 and p=000 indicating that they significantly influence the individual concerns towards risks related to prolonged computer usage (IND). Hence H1 and H2 are accepted.

Evaluations of independent variables (WE, TA, and IND) on dependent variables SH, revealed that the coefficients for WE, TA and IND are -0.221, -0.030, and -0.126 respectively. Each proportional change in a (1) standard deviation of supportive working environment, technological aspects and individual concerns corresponds respectively to a -0.221, -0.030, and -0.126 increase in standard deviation of extent of safety and health risks related to computer usage. Again, each proportional change in a (1) standard deviation of technological aspects corresponds to a -0.030 of increase in standard deviation of extent of safety and health risks related to computer usage, while a proportional change in a (1) standard deviation of individual concerns towards safety and safety risks related to computer usage corresponds to a -0.126 increase in standard deviation of extent of safety and health risks related to computer usage. At the same time, the p-values for WE, TA and IND are p=0.004, p=0.371 and p=0.005 respectively implying that although they all indicated negative coefficients to imply that each increase/improvement of WE, TA and IND leads to decrease in risks related to computer usage, it is only increase in WE and IND that could significantly (at p=0.004 and p=0.005 respectively) influence the extent of reduction in safety and health risks related to computer usage. TA (p=0.371) insignificantly influenced the extent of safety and health risks relating to computer usage (SH).

Additionally, further evaluation indicates that coefficient of determination (R^2) for the regression model between WE and TA to IND is 0.471 meaning that 47.1% of the variability of the dependent variable individual concerns towards risks related to computer usage is accounted for by the two independent variables: supportive working environment and technological factors, while the remaining percentage is accounted for by other factors not considered in the model. Also, the coefficient of determination (R^2) for regression model between WE, TA, and IND to SH is 0.288 meaning that 28.8% of the variability of the dependent variable safety and health risks related to computer usage is accounted for by the two independent variables: supportive working environment and individual concerns, while the remaining percentage is accounted for by other factors not considered in the model. That is the more supportive the working environment and individual concerns the less the safety and health risks related to computer usage.

Furthermore, evaluation of ANOVA value for the two relations provides that the models are very significant (p=0.031) and (p=0.000) in predicting the reduction of safety and health risks related to computer usage and individual concerns towards risks related to computer usage as actual significant values are less than the hypothesized significant value of 0.05. In this case working environment and technological factors makes unique and significant contributions to dependent variable individual concerns (IND) while working environments and individual concerns make a unique contribution to dependent variable safety and health risks related to computer usage (SH). These findings thus support hypotheses H1, H2, H3 and H5 but rejects H4. Table 6 summarises.

Table 6: *Regression analysis results of Hypothesised relationships*

	Hypothesis	Regression path	Unstandardised B-Coefficient	Standardised B-Coefficient	Coefficients p-value	ANOVA p-value	R-Square (R^2)
Mo	H1	WE→IND	0.168	0.121	0.018	0.000	0.471
	H2	TA→IND	0.611	0.646	0.000		
Model 2	H3	WE→SH	-0.221	-0.205	0.004	0.031	0.288
	H4	TA→SH	-0.030	-0.058	0.371		
	H5	IND→SH	-0.126	-0.109	0.005		

*Significance at 5%.

Thus, the regression model of individual concerns on risks related to computer usage against three independent variables (supportive working environment and technological factors) is presented hereunder.

$$IND = 0.611TA + 0.168WE + E$$

Where

TA = Technological Aspects
WE = Supportive Working Environment
IND= Individual Concerns
E= Error term

Moreover, the regression model of safety and health risk related to computer usage against three independent variables is presented hereunder.

$$SH = -0.030TA - 0.221WE - 0.126IND + E$$

Where

SH = Safety and Health risks related to computer usage
TA = Technological Aspects
WE = Working Environment
IND= Individual Concerns
E= Error term

DISCUSSION

Recall, this study was carried out in UDSM and MUK. Results have indicated that universities offer PhD programmes in various disciplines locally as well as foreign students for a period of 3 to 6 years or even more. It was also seen that, computers have turned indispensable in almost every academic work including PhD study works. This lengthy stay means more hours are spent with computer usage. This study had five postulates. Constructs supportive working environment (WE and technological factors (TA) were hypothesized to significantly influence individual concerns towards safety and health risks related to computer usage (IND). The study also had postulated constructs technological factors (TA), individual concerns (IND), and supportive working environment (WE) to influence the extent of safety and health risks related to computer usage (SH).

Working Environment

The study's findings revealed that supportive working environment (WE) significantly (ß= 0.168, p= 0.018) influences individual concerns towards safety and healthy risks related to computer usage. On top of that, supportive working environment (WE) was found to significantly (ß= -0.221, p=0.004) influence the extent of safety and health risks related to computer usage. A proportional change in a (1) standard deviation of supportive working environment corresponds to a 0.168 increase in standard deviation of individual concerns towards safety and health risks related to computer usage. Besides, a proportional change in a (1) standard deviation of supportive working environment corresponds to a -0.221 increase in standard deviation of safety and health risks related to computer usage. This means that, where appropriately provided, working environment not only can to a great extent influence individual concerns towards safety and healthy risks a habitual computer user may be exposed to, despite the length of period he/she will be doing computer works; but also significantly influences the extent of reduction in safety and healthy risks a habitual computer user may be exposed to, despite the length of period he/she will be doing computer works. According to Shi (2011), working environment refers to as factors (that provided by a hosting institution) including working premises such as office tables and chairs setting, quality of the air, acoustic conditions, temperature and lighting in the room that together enhance computer user's comfortability in working with a computer. The UK Display Screen Equipment regulations (1992), directs that every employer is responsible for occupational safety and health requirements of employees including provision of "suitable and sufficient" analysis of every workstation for the use of habitual users or operators. From the findings, the situation under observation was however different. Failure to pay attention to ergonomics issues, such as aerated rooms, adjustable chairs and tables increased the risk of injury or harm to the PhD students including eye strains, sight fatigue, headaches, tension stress, limbs disorders, double vision and inflammatory disorders. These and many others do not only reduce students' efficiency, they also have economic consequence resulting from unplanned additional expenses.

This study urges the responsible parties (such as schools/faculties/colleges, departments, postgraduate studies directorates, supervisors, and systems administrators etc.) to ensure that all works health and safety policy, programs, statutes, and regulations are fully complied. Time to time thorough assessment of every workstation in use by PhD students is important. This is because; working conditions associated with them may differ depending on the exact location of the unit, the individual user/operator concerned, and the work being conducted. Motamedzadeh et al., (2009), argues that the main problem to achieve a good design is that humans are different in various aspects and dimensions of life such as body size (physically) and also intelligence (mentally). Whenever there is hardware, software or furniture changes, workstation relocations, substantial increases in the time spent using the workstation, changes in job requirements (such as for increases in data entry accuracy or speed), or changes in lighting appropriate fittings positioning need to be considered (CWA, Health & Safety Sheets 2017). Rodrigues (1993) supposes that prevention is easiest if action is taken early through effective analysis of each workstation.

Besides, since good positioning does not happen automatically, orienting users to computer ergonomics principles including encouraging them to read the ergonomic manuals can make a difference. According to Shanrakumari et al. (2012), the students who had read documents on ergonomics put the principles into practice when compared to those who had attended formal training sessions. To that extent Rozline et al., (2007), advises for establishment of positions like Safety, Health and Environment Officer (SHE), Safety and Health Officer (SHO) etc. cadres that may help imparting computer users' awareness on proper human computer interaction, implications, improvement ways and basic considerations.

Technological factors

In this study, the term "technological factors" was used to denote a set of hardware (e.g. monitor, keyboard layout, printers/scanners etc.) and software (programs) incorporated in computers in use by PhD students that favor ergonomics (repetitive strain injury etc). Although postulated influencing relationship of independent variable 'technological factors (TA)' to dependent variable 'individual concerns (IND)' was found to be positive and significant ($ß=0.611$, $p=0.000$), [implying that a proportional change in a (1) standard deviation of consideration of technological factors corresponds to a 0.611 increase in standard deviation of individual concerns towards safety and health risks related to computer usage], the influence of technological aspects on extent of safety and health risks related to computer usage ($ß=-0.030$) though was found negative (indicating that a proportional change in a (1) standard deviation of consideration of technological factors corresponds to a -0.030 increase in standard deviation of safety and health risks related to computer usage), its p-value ($p=0.371$) signifies insignificant influence. This may imply that where the hardware and software allows for adjustability (such as positioning, radiation, brightness, color etc.) of the computers in use, they will increase computer users' consciousness before operating them. The findings indicating insignificance influence of 'technological factors to safety and health risks relate to computer usage, slightly deviates from the previous studies (such as Barnatt, 2010; NCIPC, 1989) which considers technological factors to have significant influence on the extent of safety and health risks related to computer usage. The deviation however is in line with Rodrigues (1993), who argues that technology is not the problem in itself, but rather the manner in which it is used. Rodrigues (1993) further adds that the fault lies not with the technology but with human beings themselves who in an attempt to upgrade and improve their services consciously fail to address the human factors. This is also supported by Van Dijk et al. (2015) who indicate that orientation that encourages right human- computer-interaction practices facilitates students to form positive computer usage habits at an early stage, such that regardless of technology in question, a user can still take an active role to prevent the risks.

Individual concerns

The findings confirmed that, the more the individual computer user is concerned on adherence to ergonomic requirements, the less the safety and health risks related to computer usage results. The findings ($ß=-0.126$, $p=0.005$) indicate a significant influence of individual concerns on safety and health risks related to computer usage. In other words, a proportional change in (1) standard deviation of individual concerns towards safety and health risks corresponds to a -0.126 increase in standard deviation of safety and health risks related to computer usage. The findings may imply that, where a PhD student using computer is concerned, he/she will consciously adhere to computer usage ergonomics related safety and health guidelines hence avoiding for example bad postures that can trigger fatigue, back and/or pain, muscle strain, and, in later stages, pain. The findings correspond to previous studies (such as Injury Prevention and Research Center, 2002; DiLillo, Peterson & Farmer, 2002) whose findings assert that it is not possible to reduce injury without some element of behavior change.

This study therefore urges the habitual computer users to take active role in protecting themselves, irrespective of hazards in their environments. In fact, good work place design, ensuring good working practices including positioning and taking regular breaks with computer work, all are done by human being (Rozline et al., 2007). Habitual computer users such as PhD students are expected to understand their vulnerability and develop the desire for protection. Although, change of behavior into new behavior or an unpleasant or unwelcome behavior may require external guidance including orienting users (*as was suggested by significant number of* *respondents in this study*) to proper computer ergonomic safety and health guides, introduction of legislation and policies for enforcement to give initial guidance, after some practices the new behavior becomes self-directed, habitual or automatic (Gielen, 1992; Sleet, 1998; Gielen & Girasek, 2001). In other words, the PhD students should not solely rely on computer work environment the hosting institution have improvised for their PhD works, they should instead take active role to consciously protect themselves through not only ensuring that the hardware/software, tables, chairs, room lighting and background environment are in appropriate balance but also that they maintain posture that is safe and ill-health free for them.

Numerous studies (such as Rozline et al., 2007; Mohammady et al., 2010; Sadeghi, Moghaddam & Rahdar, 2012; Van Dijk et al. 2015) have demonstrated a positive impact of education on increasing individuals' ergonomics knowledge. For example, a study performed on 75 computer users showed that the trained group gained higher scores on knowledge, attitude, perceived behavioral control, intention, as well as observing the neutral posture as the target behavior compared with the group without intervention (Sadeghi, Moghaddam & Rahdar, 2012). This is also in line with NCIPC (1989), who asserts that, good posture doesn't happen naturally, rather, operators must be taught how to use their body correctly and understand that is it up to them to make full use of the adjustability of their furniture and equipment to ensure good body balance support. NCIPC (1989) adds that computer operators need to be made aware of the early warning signs of computer-related disorders and the necessity to report suspected overuse or vision evident so that any corrective action required can be implemented without delay. Keykhaie et al. (2014) argues that by means of training sessions, users will be able to learn the adequate way of using the workspace, caring for his/her body through the adoption of correct computer ergonomic measures. Van Dijk et al. (2015), argues that computer users' education serves a far broader purpose when it seeks to empower computer users to take an active part in making the workplace safe, rather than simply to encourage worker compliance with management safety rules. With employment of effective knowledge transfer strategies possible it is possible to bring the anticipated impacts.

CONCLUSION AND STUDY IMPLICATIONS

Given a variety and intensity of computer usage in the modern world and workplace, considerations on how to minimize safety and health risk related to such heavy usage is essential. Basing on the findings the first model indicates that both supportive working environment and use of appropriate ergonomic devices positively and significantly influence critical individual concerns towards safety and health risks related to computer usage. In the second model, with exception of technological aspects, the hypothesized independent variables supportive working environment and individual concerns were found to significantly influence extent of safety and health risks related to computer usage. The more the environment is improved and individuals are concerned towards safety and health on computer usage the less the ergonomic risks on computer usage. This means, while the appropriation of working environment and ergonomic devices positively influenced individual concerns towards safety and health risks resulting from heavy computer usage, both supportive working environment and individual concerns related negatively to safety and health risks related to prolonged computer usage by PhD students implying that improvement in working environment triggers more individual concerns which together with supportive working environment eventually results to reduced risks related to computer usage. These findings have a number of implications: Hosting institution need to ensure that any heavy computer use is supplied with ergonomically comfortable facilities including computers and other ICT work environment, ergonomic devices, equipment and furniture, including taking all reasonable measures to avoid any computer related disorders. The role of education/training and awareness creation on improving individuals' knowledge, insights and attitude on the safest ways of using the workspace, caring for his/her body through the adoption of correct ergonomic measures has featured out in this study. With effective knowledge transfer strategies possible it is possible to bring the safety and health risks related to computer usage down. Policy makers and legislators need to come up with appropriate policies, laws and regulations that can aid to persuade and reinforce the intended behaviors and deeds by hosting institutions to their PhD students. Most importantly is to respective individual PhD students to take active measures to ensure that the computer related environment is sustainably safe and ill-health free irrespective of whether or not supportive working environment is provided.

LIMITATION OF THE STUDY

The findings for this study may have some limitations:

- Data for this study was collected mainly from two universities; UDSM and MUK. Besides, from MUK the researchers relied solely on electronic response, hence turning response rate being low, that may have affected the final results.
- Proving with any degree of certainty the longer-term health impacts of computer use remains problematic. Not least this is because widespread computer use is still a relatively modern phenomenon, with the boundaries between computers and other electronic devices also continuing to blur.

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