Direct Research Journal of Engineering and Information Technology
Vol. 9 (7), Pp. 293-304, August 2022
ISSN 2354-4155
DOI: https://doi.org/10.26765/DRJEIT701536492
Article Number: DRJEIT701536492

http://directresearchpublisher.org/drjeit/

Full Length Research Paper

Assessment of Computer users Workstation Ergonomics in Computer Village, Petroleum Training Institute, Effurun, Delta State, Nigeria

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Received 11 July 2022; Accepted 19 August 2022; Published 31 August 2022

ABSTRACT: This study was carried out to evaluate the workstations of Petroleum Training Institute computer village users (operators) by randomly selecting thirty shops with sixty-five operators. Statistical Packages for Social Sciences (SPSS) version 25 was used to analyze the operator's anthropometric data, which was collected by measuring various body dimensions. The existing furniture measurements in the randomly selected 30 businesses were also measured using measuring tape, and the design was evaluated using an assessment checklist. Questionnaires were employed to assess the participant's body locations of discomfort. This investigation discovered a misalignment between existing store furniture design and operator anthropometric data. Also, operators in this computer village of the study experienced musculoskeletal disorders with the highest prevalence of shoulder (3.02±0.779), followed by eye (3.00±0.832), lower legs (2.98±0.828), nape (2.91±0.766), fingers (2.85±0.662) and the wrists (2.56±0.998). The study hypothesis was tested with Chi-square statistics at 5% level of significance with P-value of 246.22 which falls within the acceptance region, hence accepting the Ho and rejecting the Ha. These results show that the existing furniture was planned or acquired without taking into account the user's anthropometric data, which is why the participant developed musculoskeletal disorder. Therefore, additional research should be conducted for the development of shop furniture in accordance to the anthropometry data of the user community.

Keywords: Anthropometric, musculoskeletal, ergonomics, workstation, cognitive

INTRODUCTION

Ergonomics is a human-systems approach to designing work systems that takes into account cognitive, organizational, physical, environmental, and other aspects (Kibria and Rafiquazzman, 2019). It can also be defined as the science of studying people at work and then developing tasks, jobs, information, tools, equipment, facilities, and the working environment so that people can be safe and healthy, effective, productive, and pleasant. Acute or cumulative injury or dysfunction of the soft tissues, including tendons, ligaments, blood vessels, and nerves, caused by risk factors such as awkward posture, repeated motions, and violent exertions (WorkPlace, 2020).

According to Chiu et al, computers are viewed as an essential component of our lives, and their users frequently suffer from musculoskeletal disorders (MSDs) such as risks of neck, shoulder, and lower back problems, as well as other health-related issues such as eye fatigue, headaches, and mental fatigue, even though these occur when uncomfortable postures and body movements are frequently maintained over long periods of time (Raj-Kumar and Kumar, 2017).

However, awareness of ergonomics existed a long time ago, but the implications and impact of good ergonomics were not taken into account by employers. However, as the years passed, Office Ergonomics gradually gained importance in organizations, and now many employers take note of the working environment where employees must work, and thus focus was then placed on the Musculoskeletal Disorders people face in their daily lives (Chacko and Chetan, 2018).

Furthermore, a study conducted by Johnson et al. (2008) among computer users in a Nigerian University community discovered that the most common areas of complaint are the back, neck, eyes, and wrist, while another study performed in the Netherlands in 2003 by Akrouf et al. (2016) of 'Ergonomics in Back pain' discovered that poor awkward postures cause fatigue, strain, and eventually pain as well as structural deformation of the body, muscular contractures, pain in the back and (Amin et al., 20167). Children have unique characteristics in terms of body size, stature, and stage of growth and development, and these may be related to the role of ergonomics in their work habits, though there is no specific knowledge about their bone development and calcification, how bone density peaks in the late teens, and how much poor ergonomics is responsible for children's back pain later in life, simply because this is the first generation to suffer from back pain (Choudhary et al., 2008). With computers increasingly infiltrating every nook and cranny of today's fast-paced culture, musculoskeletal diseases (MSDs) are becoming more common among computer users, who represent a diverse cross-section of Nigeria's population. It has become critical to address computer users' workstations in terms of ergonomic design (furniture) and the prevention of MSDs and other related illnesses. The question remains, to what extent are the workstations in the Petroleum Training Institute's computer village fit for users, and how can we identify, analyze, and control this ergonomic hazard imposed in our workstation without introducing another danger.

The goal of this study is to evaluate the ergonomics of computer users' workstations, with objectives such as performing anthropometric design of computer user workstation furniture (chair and desk) dimensions and comparing the results obtained from this study with recommended standard ergonomic design.

Hypothesis of the study

Null Hypothesis (H_o)=Poor ergonomics exist in users' workstation, hence there are possible MSDs

Alternate Hypothesis (H_a)= Poor ergonomics does not exist in users' workstation, hence there are no possible MSDs

METHODOLOGY

Research area

This study was carried out at the PTI computer village, Effurun, where all the Institute computer business centres are located.

Research design

This study employed survey tools, which entailed asking the same set of questions to a large number of people using a standard questionnaire adapted from the Cornell Musculoskeletal Discomfort Questionnaire (CMDQ) to determine WMDSs and a standard checklist adapted from the National Institute of Health (NIH) to determine if there is a mismatch between the operators and their furniture, as well as a quantitative survey based on the anthropometric design of the operators.

Target population

The targeted population for this study is thirty (30) shops with sixty-five (65) workstation.

Sampling procedure and sample size

This study used the research method of (Kibria and Rafiquazzman, 2019) by measuring computer workstation furniture dimensions and comparing them to ergonomic standard design dimensions with the help of survey instruments such as a questionnaire and an observation checklist (Kibria and Rafiquazzman, 2019). For this investigation, thirty (30) stores computer workstations furniture were chosen at random. The study was conducted from approximately 1700 hours to 1730 hours for a period of one month and two weeks, excluding Saturdays and Sundays, with each day analyzing one shop. The following furniture dimensions will be measured and recorded in centimeters (cm) in the selected shops: sitting height (SH), seat depth (SD), seat width (SW), popliteal height (PH), buttock popliteal height (BPH), desk height (DH), sitting elbow height (SEH), backrest height (BH), sitting shoulder height (SSH), seat to deck clearance (SDC), and thigh clearance (TC). The measurements were performed on an even floor in the Frankfurt and Frontal plane positions, as shown in (Figures 1 and 2). Figures 1 and 2 clearly illustrate the operator measured anthropometric dimension in the Frankfurt and Frontal Planes. This is critical in ensuring that all participants' measurement processes are completed correctly and accurately in order to minimize measurement error in data gathering.

Legend

Sitting hip breadth

The sitting hip breadth was taken with the operator was sitting in the frontal plane and was measured across the widest portion of the hips.

Sitting stature

Operators were asked to sit in the Frankfurt plane and the measurement for the sitting stature was taken from the floor to the vortex of the head with the hair pressed down.

Sitting height

The sitting height was measured as the distance from the seat surface to vortex of the head.

Sitting elbow height

The sitting elbow height was measured from the bottom tip of the elbow to the sitting surface with the elbow positioned

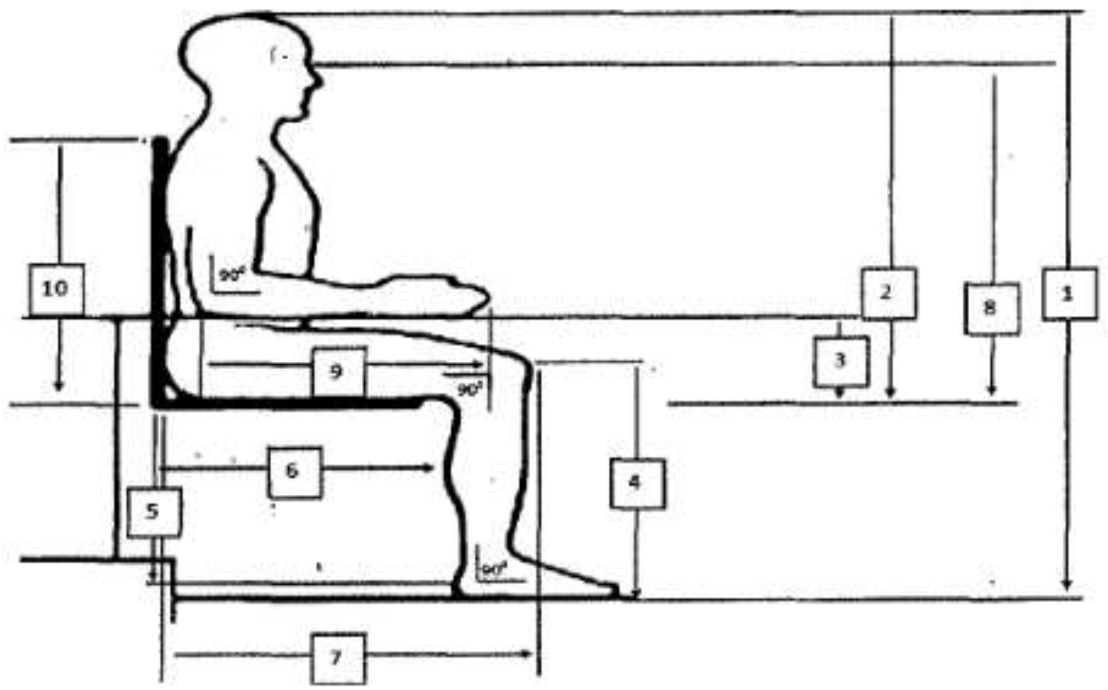

Figure 1: Some of the measured anthropometry data in the Frankfurt Plane

Legend

1 — Sitting Stature	2 — Sitting Height
3 — Sitting Elbow Height	4 — Sitting Knee Height
S — Popliteal Height	6 — Buttock Popliteal Height
7 — Buttock Knee Length	8 — Sitting Eye Height
9 — Forearm Hand Length	10 — Sitting Shoulder Height

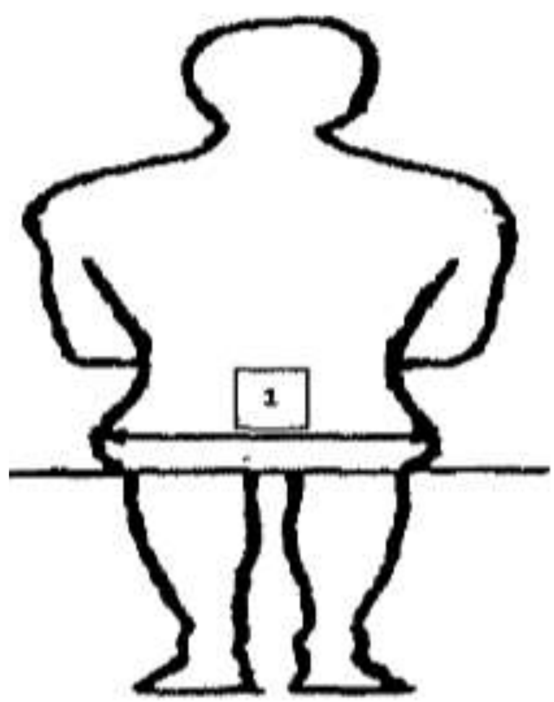

Figure 2: Some of the measured anthropometry data in the frontal plane.

at angle 90 to the horizontal with the upper arms hanging freely.

Sitting knee height

The sitting knee height was measured as the vertical distance from the floor to the uppermost point of the knee point with the knees placed at angle 90 to the horizontal.

Popliteal height

The popliteal height was measured as the vertical distance from the foot-rest to the lower surface of the thigh immediately behind the knee.

Buttock popliteal height

The buttock-popliteal height was measured with g knee flexion from the posterior surface of the buttock to the posterior surface of the knee or popliteal space.

Buttock knee length

The buttock-knee length was measured as the horizontal distance from the most posterior point on the buttocks to the most anterior point on the knee.

Thigh Clearance

The thigh clearance was measured as the vertical distance from the sitting surface to the top of the thigh at its intersection with the abdomen.

Sitting eye height

The sitting eye height was measured as the vertical distance from the seat surface to the eyes.

Forearm-hand length

The forearm-hand length was measured as the distance from the posterior end of the elbow to the longest finger of the hand while the upper arm was at an angle of 90^0 with the lower arm.

Sitting shoulder height

The sitting shoulder height was measured as the vertical distance from the top of the shoulder at the acromion process to the students' sitting surface.

Description of shop furniture measurements

Seat height

The seat height as measured as the vertical distance from the floor to the top of the front edge of the seat.

Seat depth

The seat depth was measured as the horizontal distance, of the sitting surface from the back of the seat, at a point where it was assumed that the buttock begins to the front of the seat.

Seat width

The seat width was measured as the horizontal distance available for sitting, as per one student from the edge viewed from the Frankfurt plane.

Seat backrest height (Upper and Lower)

The seat backrest height (upper and lower) was measured from the seat surface to the top of the backrest in the available design.

Seat slope

The difference in height and breadth between the two edges was measured as viewed from the Frankfurt Plane and was calculated using SOHCAHTOA. To calculate the seat slope:

$$\text{Tan}\theta = \frac{\text{Opposite}}{\text{Adjacent}}$$

$$\theta = \text{Tan}^{-1}\left[\frac{\text{Opposite}}{\text{Adjacent}}\right]$$

Seat to desk clearance

The difference in the horizontal distance from the top of the front edge of the table top to the seat backrest pan was measured.

Table height

The table height was measured as the vertical distance from the floor to the top of the front edge of the table.

Table depth

The table depth was measured as the horizontal distance of the sitting surface from the back of the seat, at a point viewed from the Frankfurt plane.

Table Slope

The difference in height and breadth between the two edges was measured as viewed from the Frankfurt Plane was calculated using SOHCAHTOA. To calculate the table slope,

$$\text{Tan}\theta = \frac{\text{Opposite}}{\text{Adjacent}}$$

$$\theta = \text{Tan}^{-1}\left[\frac{\text{Opposite}}{\text{Adjacent}}\right]$$

Length of table top

The length of table top was measured as the horizontal distance available for writing and working as per one student from the edge viewed from the Frankfurt plane.

Table clearance

The difference in the vertical distance from the floor to the bottom of the front edge of the desk was measured.

Measuring instruments

The measuring instrument used for this study is a metal measuring tape was used to measure the chairs and table dimensions, sitting height, sitting elbow height, sitting shoulder height, knee height, popliteal height and eye height, Buttock-Popliteal Length, Buttock-knee Length and Forearm- Hand Length (Figure 3).

Figures 3: Massband, Measuring Tape, 5m *(Source:www.reichelt.com)*

Data source

Data were obtained from primary sources only. The source of data involves data which were directly obtained from the respondents and also from anthropometric design of operators' furniture.

Method of data collection

Data were collected using the self-administered questionnaire, checklist and anthropometric design of furniture already listed in the sampling procedure and sample size. The questionnaire contains only closed end questions, the checklist contains questions that only need ticking and the anthropometric design of furniture was used to obtain the dimension of the furniture.

Method of data analysis

The data obtained from this study were analyzed statistically using Statistical Package for Social Science (SPSS) version 25. The SPSS was used in obtaining average (mean) and Standard Deviation and the study hypothesis was tested with chi-square. The formula for the Chi-square statistic to be used in the chi square test is

$$\chi^2 = \sum \frac{(O-E)^2}{E}$$

Where,
x^2 = chi-square
O = observed value
E = expected value
$\sum$ = sum of observe value minus expected value all square divided by expected value.

Method of data presentation

Results obtained are presented statistically in tables and bar charts respectively.

RESULTS

Demographic description of the respondents

A total of sixty-five (65) questionnaires were distributed at random to the respondents with fifty-three (53) of the questionnaires retrieved. Table 1 shows the gender of the respondents of this study (Figure 4). The value for the male gender is 21 (39.6%) and the female is 32 (60.4%) an indication that there are more female operators in the computer village than male. Table 2 shows the ages of the respondents (Figure 5). The findings of this study shows that 2 (3.8%) of the respondents are in the ages of 10-17 years while 51 (96.2%) of them are 18 years and above. Table 3 shows the level of education of the respondents (Figure 6). The shows that 2 (3.8%) of the respondents had no formal education, 1 (1.9%) of the respondents had primary education, 29 (54.7%) had secondary education while 21 (39.6%) of them had tertiary education.

Table 4 shows areas of discomfort experienced by respondents in mean and standard deviation such as nape (back of the neck), shoulder, lower back, elbow, forearm, wrists, finger, eyes, thigh, knees, lower leg, and ankle or feet. The nape, shoulder, lower back, wrists, fingers and eyes has a mean±S.D of 2.91±0.766, 3.02±0.779, 2.98±0.828, 2.56±0.998, 2.85±0.662 and 3.00±0.832 respectively, which indicates that most of the respondents answered agree. While on the other hand the elbow, fingers, thigh, knees, lower legs and ankles or feet has a

Table 1: Gender of respondents.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	male	21	32.3	39.6	39.6
	female	32	49.2	60.4	100.0
	Total	53	81.5	100.0	
Missing	System	12	18.5		
Total		65	100.0		

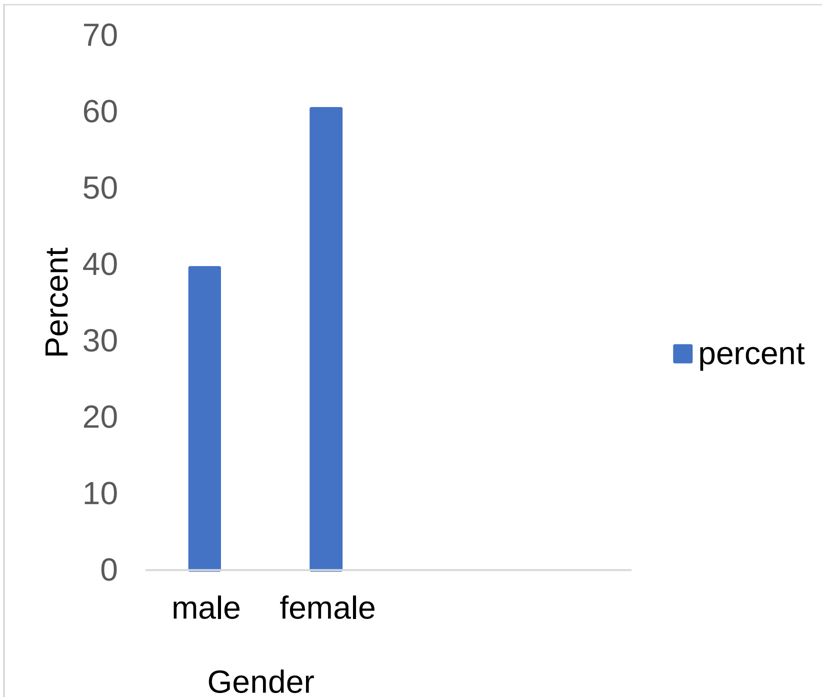

Figure 4: Gender of respondents

Table 2: Age of respondent.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	10-17	2	3.1	3.8	3.8
	18+	51	78.5	96.2	100.0
	Total	53	81.5	100.0	
Missing	System	12	18.5		
Total		65	100.0		

mean±S.D of 2.02±1.028, 2.19±1.085, 1.65±0.905, 1.89±1.031 and 1.81±0.971 respectively, which most the respondents disagreed on pains in the aforementioned areas.

DISCUSSION

Characteristics of the existing chairs and tables in the selected shops

From (Table 4), the seat surface height, seat depth, seat width, upper backrest height, lower backrest height, and seat slope are the important dimensions for the design of chairs while table height, table width, length of table top and table slope are the dimensions that are essential for the design of tables. This study showed that, three types (designs) of chairs and tables were identified in the sixty-five shops sampled. The furniture in shops classified as Type A, shows dimensions of the seat height as 120cm, however, the furniture of the shops classified as Type B design, shows seat heights which have an average of 85cm and the furniture seat height of have an average of 48cm were classified as Type C Design. This shows that

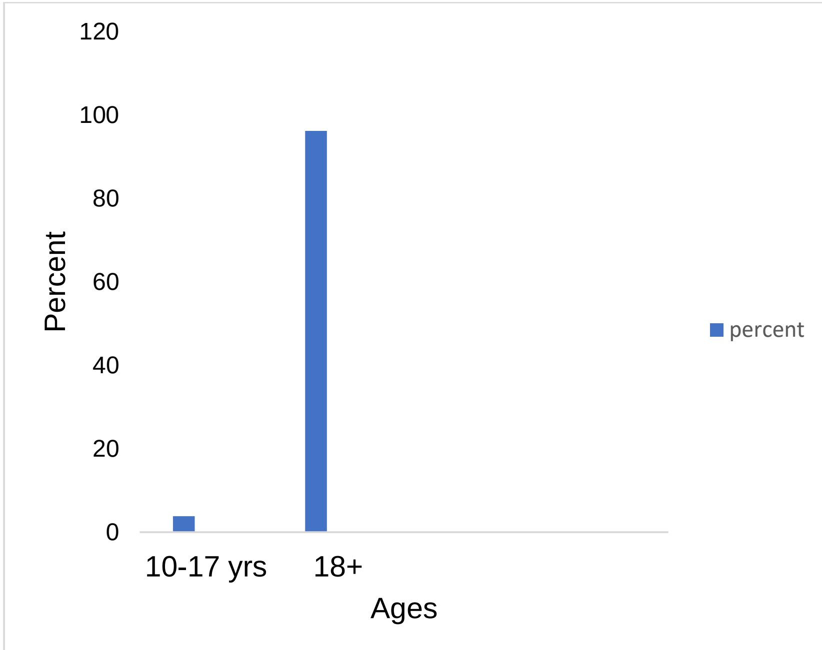

Figure 5: Ages of respondents.

Table 3: Level of education.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	2	3.1	3.8	3.8
	Primary	1	1.5	1.9	5.7
	Secondary	29	44.6	54.7	60.4
	Tertiary	21	32.3	39.6	100.0
	Total	53	81.5	100.0	
Missing	System	12	18.5		
Total		65	100.0		

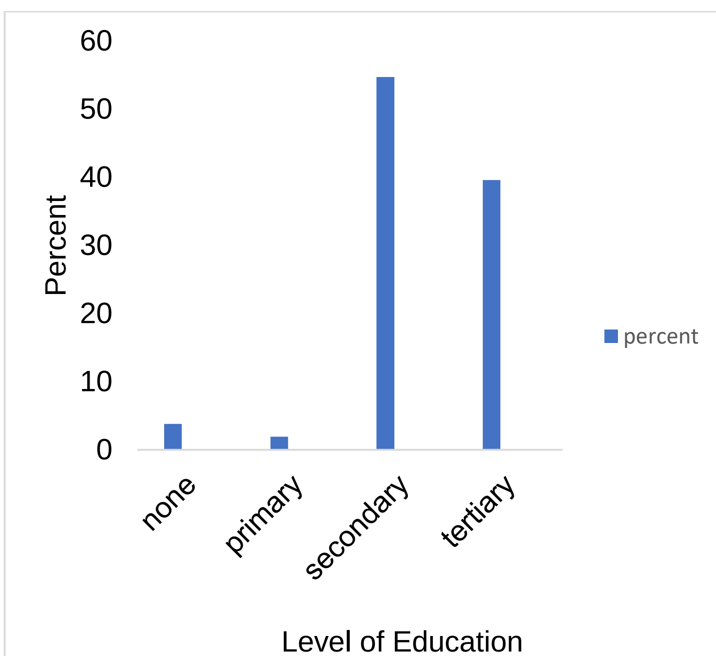

Figure 6: Level of education

Table 4: Areas of discomfort experienced by respondents **(n=53)**

	Pain in the nape	**Pain in the shoulder**	**Pain at the lower back**	**Pain in the elbow**	**Pain in the forearm**	**Pain in the wrists**
Valid	53	52	52	53	52	52
Missing	12	13	13	12	13	13
Mean	2.91	3.02	2.98	2.02	2.19	2.56
Std. Deviation	0.766	0.779	0.828	1.028	1.085	0.998

	Pain in the fingers	Pain in the eyes	Pain in the thighs	Pain in the knees	Pain in the lower legs	Pain in the ankles/feet
Valid	53	53	52	51	53	52
Missing	12	12	13	14	12	13
Mean	2.85	3.00	1.65	1.86	1.89	1.81
Std. Deviation	0.662	0.832	0.905	1.167	1.031	0.971

Type A chair height falls in line in with the recommended height of 112.5cm adjustable (Kibria, G., and Rafiquazzman, 2019). The chairs in Type A have seat depth of 50cm and width 45cm and Type B and C have an average of 41cm and 42cm for both seat depth and width respectively. However, the seat surface slope angles for Type A shops is 3^0 with Type B seat slope angles having an average of2^0, and 0^0 for shops classified as type C. The seat upper and lower backrest height for Type A is 30cm and 20cm, Type B are 25cm and 15cm while for Type C it is 0cm because they have no upper and lower backrest. The seat to desk clearance in Type A, B and C workstation have an average of 15cm, 17cm and 14cm respectively. From (Table 4), the recommendation given by (Kibria, G., and Rafiquazzman, 2019) shows that Type A, B and C are in conformity to ergonomic compliance except for Type C chairs which have no backrest.

Ergonomically furniture (Chair and Desk) design means design the seat parameters like seat height, seat depth, seat width, backrest, armrest and desk height by considering users' anthropometric measurements and ergonomic principles. To develop ergonomic workstation furniture, Hoque (2014) analyzed eleven anthropometric measurements: stature, sitting height, sitting shoulder height, politeal height, sitting elbow height, hip breadth, buttock politeal length, knee height, shoulder breadth, and sitting eye height. Design nature of Seat parameters affects the sitting postures of user while sitting (Haworth, 2008). Postural dynamics of users is important element of workstation design that significantly affected by human-computer interface (Taifa et al., 2017).

The average table height for Type A, B, and C workstation furniture was 72cm, 71cm, and 70cm, respectively. The responders had enough legroom because their seat to desk clearance could be adjusted. The average table depth for all three Types is 54cm, 60cm, and 53cm, respectively. The table slope for Types A, B, and C is 0^o, and the length of the table top for Types A, B, and C is 120cm, 100cm, and 90cm, respectively. Most of the computer workstation guidelines such as (OSHA, 2016; Canadian Standards Association, 1989; Australian Standard, 1990) and other researchers recommend the height adjustable desk for easily accommodate the knee without any problems (Deros,2009). Desk height should be adjustable with suitable keyboard-forearm relation and adequate leg room.

Sloping tables reduce the trunk and flexion of seated persons engaged in reading and writing. Based on assertion, Chaffin et al. (2016) proposed that tables should be at an angle of 15^0 towards the user so that the visual angle may be reduced and allow the user to have an upright posture of the trunk, however, (Chaffin et al., 2016) suggested that the table should have an angle of inclination between 15^0 and 20^0. This study observed that the table slopes of existing tables were 0^o which is lower than the above recommendations and may cause the users to experience discomforts in their back of neck, shoulders, elbows, forearms, lower back and lower legs which confirms the high respondents complains for nape, shoulder, lower back, elbow, forearm, wrist and finger pains (Table 5). The operators' anthropometric data was considered for fitness. The sitting stature has a mean±S.D of 122.5±0.096 with a corresponding sitting shoulder height of 73.0±0.138. Considering the seat heights of this study, the Type C shops seat height will cause them some sort of discomfort, thereby exposing the operators to risk of pains in the nape, shoulder and back. The buttocks popliteal height and hip breadth all have their mean±S.D values to be 46.0±0.246 and 38.5±1.112 respectively. This allows all the operators in the three Types of furniture some space for movement, making it suitable for them all to work with less discomfort (Table 5).

A high seat compresses the underside of the thigh, causing pain and restricting blood circulation. While low seats may lead operators to reach out for goods on the table, a sitting person may shift forward his buttocks on the seat to compensate, or they may tend to use the legs to support oneself in the case of low chairs, causing the body to take unnatural positions. This is consistent with the findings of Dianat et al (2013). The Type B furniture sets were found to be more appropriate for the pupils based on their mean popliteal height. The average buttock popliteal length for the operator that is compatible with the existing seat depth of Type A, B, and C shop chairs. According to Dianat et al., a shallow seat depth may give the user the impression of falling off and result in a lack of support for

Table 5: Comparison of chair and desk dimensions of the three types of furniture dimensions with standard furniture dimension.

S/N	Furniture dimension	Standard furniture Dimension (cm)	Type A Shops (cm)	Type B Shops (cm)	Type C Shops (cm)
1.	Seat height	112.5 (adjustable)	120	85	48
2.	Seat depth	45	50	40.5	41
3.	Seat width	58.5	45	41.5	42
4.	Seat backrest height (upper)	45 minimum	30	25	0
5.	Seat backrest height (lower)	15-25	20	15	0
6.	Seat Slope	0-45º	3º	2º	0º
7.	Seat to desk clearance	23-33	15	17	14
8.	Table height	52.38-85.42	72	71	70
9.	Table depth	90	54	60	53
10.	Table surface slope	2-25º	0º	0º	0º
11.	Length of table top	160	120	100	90

Table 6: Anthropometry dimension of operators from the selected shops (n = 65)

S/N	Anthropometry measurement	MEAN	SD	RANGE
1.	Sitting Stature (cm)	122.5	0.096	115 – 130
2.	Sitting Shoulder Height (cm)	73.0	0.138	70 – 76
3.	Sitting Elbow Height (cm)	22.0	0.246	18 -26
4.	Sitting Knee Height (cm)	50.0	0.062	48 – 52
5.	Popliteal Height (cm)	50.0	0.985	42 – 58
6.	Buttock Popliteal Height (cm)	46.0	0.246	42 – 50
7.	Hip Breadth (cm)	38.5	1.112	30 – 47
8.	Buttock Knee Length (cm)	49.0	0.385	44 – 54
9.	Thigh Clearance (cm)	19.0	0.138	16 – 22
10.	Sitting Eye Height (cm)	58.5	1.112	50 – 67
11.	Forearm Hand Length (cm)	43.0	0.385	38 – 48
12.	Sitting Shoulder Height (cm)	48.5	0.650	42 – 55

the lower thighs.

In this study, Type B and C had the highest prevalence of complaints about the nape, shoulder, lower back, forearms, wrists, fingers, and eyes. The soreness in the neck can be ascribed to the frequent upward and downward movement of the head caused by the lack of an angle board for reading and no document holder either beside the screen or between the screen and keyboard. Some chairs in types B and C have no backrests for the lower back and shoulders, while others have backrests that are too tiny to support them while sitting. While the forearms, wrists, and fingers are in an unnatural posture due to the lack of an armrest in Type B and C workstation seats.

As a result, these operators are at risk of experiencing discomfort in the aforementioned regions. Observations were also made in the study on the locations of reduced discomfort, which may be seen as elbows, thigh, knee, lower legs, and ankle/feet. This is due to the fact that the keyboard and mouse settings, as well as the worksurface settings, are in accordance with traditional ergonomics design.

A study carried out by (Benden et al., (2014) confirmed that a forward inclining seat slope of 2-25º affects the lumbar spine positively and improve the posture of the other parts of the spine. The respondent while typing may assume a forward inclination due to the observed 2-3° angles of the seats. However, this level of slope may be comfortable for respondent as it helps to keep the knee at 90º to the horizontal reducing stress on the knee.

The upper and lower backrest heights are designed with the sitting shoulder height in mind. This study discovered that the top seat backrest height for Type A and B store seats ranged from 25 to 30cm (Table 5). Type C's upper and lower backrests are lower than the average sitting height of 73.20cm (Table 5), which is consistent with the study done by (Yadollah et al., 2015; Musa et at., 2013). This study shown that the incompatibility between the present seat backrest height and the respondents' mean sitting height resulted in a mean S.D of 3.020.779, which is the highest complaint by respondents (Table 5).

The average sitting elbow height of 22cm (Table 5) was utilized to calculate the arm rest height. The armrest provides additional comfort for the respondents by giving support for the elbow, arm, and upper arms. This minimizes weight on the seat pan and tension in the spine and other structures. This study, however, discovered that the existing chairs in Type C stores lack an armrest, indicating that the operators' anthropometry data were not taken into account prior to the design or purchase of the furniture, as described by (Musa et al., 2013). This could have caused responders to experience shoulder, forearm, and lower back pain (Table 6).

Yadollah et al. (2015) reported that the height of the table with respect to the person using it is very important for the shoulders and torso height depending on the position and

Table 7: Chi-square Statistics.

Categories	Observed	Expected	Residual= (Obs-Exp)	$(Obs\text{-}Exp)^2$	Component= $(Obs\text{-}Exp)^2/Exp$
1	5	53.57	-48.57	2359.04	44.04
2	65	53.57	11.43	130.64	2.44
3	51	53.57	-2.57	6.60	0.12
4	57	53.57	3.43	11.76	0.22
5	45	53.57	-8.57	73.44	1.37
6	64	53.57	10.43	108.78	2.03
7	65	53.57	11.43	130.64	2.44
8	65	53.57	11.43	130.64	2.44
9	60	53.57	6.43	41.43	0.77
10	63	53.57	9.43	88.92	1.66
11	65	53.57	11.43	130.64	2.44
12	64	53.57	10.43	108.78	2.03
13	65	53.57	11.43	130.64	2.44
14	63	53.57	9.43	88.92	2.44
15	62	53.57	8.43	71.06	1.33
16	63	53.57	9.43	88.92	1.66
17	65	53.57	11.43	130.64	2.44
18	65	53.57	11.43	130.64	2.44
19	65	53.57	11.43	130.64	2.44
20	5	53.57	-48.57	2359.04	44.04
21	4	53.57	-49.57	2457.18	45.87
22	65	53.57	11.43	130.64	2.44
23	9	53.57	-44.57	1986.48	37.08
24	65	53.57	11.43	130.64	2.44
25	17	53.57	-36.57	1337.36	24.96
26	65	53.57	11.43	130.64	2.44
27	65	53.57	11.43	130.64	2.44
28	65	53.57	11.43	130.64	2.44
29	65	53.57	11.43	130.64	2.44
30	65	53.57	11.43	130.64	2.44

supporting arms as a work surface above the elbow causes arm abduction resulting in an increase in the stress of the shoulders, arms and necks. A high table height may make a person to bend forward or be forced to raise shoulders resulting in muscle strain on the back and shoulders as the user would not be able to make use of the backrest. Table heights of 70 to 72cm in Type A, B and C shops (Table 5) is in lower than the addition of the mean sitting elbow height of 22.0cm and mean sitting height of 73.0cm (Table 5) which gives a total of 3.02cm mean which agrees with the report by (Dianat et al. 2013). This may have accounted for participants complains of discomforts in the shoulders, lower back, forearms and elbow. The distance between the elbow and the hand, known as the forearm hand length, was utilized to determine the table depth. Table depths at Type A to C stores range from 53 to 60cm, which is greater than the participants' average forearm hand length of 43cm. This will enhance the available work area for the targeted group and may cause users to lay less of their loads or things on their thigh, reducing pressure and pain on the thigh and lower legs, which fits with the study by (Samira et al., 2013). This conclusion justifies the lower number of reports of thigh and tower leg discomfort.

Sloping tables reduce the trunk and flexion of seated persons engaged in reading and writing. Based on assertion, (Chaffin et al., 2006) proposed that tables should be at an angle of 15^0 towards the user so that the visual angle may be reduced and allow the user to have an upright posture of the trunk, however, (Chaffin et al., 2006) suggested that the table should have an angle of inclination between 15^0 and 20^0. This study observed that the table slopes of existing tables are 0^0 which is lower than the above recommendations and may cause the users to experience discomforts in their back of neck, shoulders, elbows, forearms, lower back and lower legs which confirms the high student complains for neck and lower back pains.

Research hypothesis test

Where $\chi^2 = \sum \frac{(O-E)^2}{E}$

x^2 = chi-square

O = observed value

E = expected value

∑ = sum of observe value minus expected value all square divided by expected value.

n=30

degree of freedom= n-1= 29

P value (X^2_{cal}) = 246.22

Alpha= 5%

$X^2_{tab} = X^2_{0.025,\,29}$ and $X^2_{0.975,29}$

X^2_{tab}= 16.0 and 605.0

H_o=Poor ergonomics exist in users' workstation, hence

there are possible MSDs.
H_a= Poor ergonomics does not exist in users' workstation, hence there are no possible MSDs.

Conclusion: since X^2_{cal} lies in the acceptance region, we accept H_o and reject H_a, hence poor ergonomics exist in users' workstation, therefore there are possible MSDs at 5% level of significance. This indicates that the computer users' workstation in the computer village in PTI, Effurun, Delta state are ergonomically poorly designed (Table 7).

Conclusion

According to the findings of an examination of computer users' workstation ergonomics at PTI Effurun, Delta State, the operators are at risk of MSDs since their workstation does not correspond to standard ergonomic workstation designs. This research observed highest prevalence of prevalence pain complaints of shoulder (3.02±0.779), followed by eye (3.00±0.832), lower legs (2.98±0.828), nape (2.91±0.766), fingers (2.85±0.662) and the wrists (2.56±0.998). The study hypothesis was tested with Chi-square statistics at 5% level of significance with P-value of 246.22 which falls within the acceptance region, hence the H_o was accepted and the H_a was rejected. This indicates that their workstation is not ergonomically designed. This can result in either a chronic or acute effect, which can have a negative impact on their economy due to missed work and frequent hospital visits.

Based on the findings of this research, the following recommendations are made:

i. Operators are advised to make use of adjustable chair that can adjust its height, armrest, upper and lower backrest.
ii. There should be a document holder, an angled board and the use of headset if using the phone and keyboard.
iii. For the laptop users, they should obtain the necessary accessories such as external keyboard and mouse.

In order to deal with the advancements of computer technology and reduce the health risk factor due to non-ergonomics designs for computer workstations, a modification of the existing model is important. Nowadays, the ergonomics standards, guidelines and recommendations for computer workstations are easily available and these are usually not a compulsory requirement. However, a great concentration on the working environment of computer users and related with their comfort is important. The presented guidelines, recommendations and findings provide a useful support for ergonomics design and may use to improve future research.

Funding

This study did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Acknowledgement

Petroleum Training Institute, Delta State, Nigeria is the only technical school established for the training of technical manpower for Nigeria's oil and gas sector. We would like to acknowledge the Head of Department of the Industrial Safety and Environmental Technology, graduate students and other administrators that made this work a success.

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