

## Evaluation of Ergonomics Deficiencies in Nigerian Computer Workstations

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### Abstract

The prevalence of Computer Workstations (CW) strain in developing countries such as Nigeria is becoming worrisome. This study is aimed at identifying ergonomic compliance in Nigeria computer workstations. To do this, structured questionnaires were employed to assess the health risk factors and checklist with oral interview was also used to measure physical dimensions of the CW under investigation. The major ergonomic deficiencies are includes: CW poor furniture, lighting and temperature control. The study reveals that 72%, 66%, 47%, 46% and 35% shown relative errors in terms of Chair height, chair back/arm rest, temperature, desk height and lighting respectively. The study also revealed that most of the Work Related Musculoskeletal Disorder (WRMD's) complained injuries are: eye strain, shoulder pain, arm pain and back pain. Suggestions to reduce or eliminate these deficiencies were offered.

**Keywords:** Workstations; WRMD's; Ergonomics; Anthropometric

### Introduction

As a result of rapid growth of Information and Communication Technology (ICT) in Nigeria i.e. with its application in the following areas: e-learning, e-payment, e-transact, e-government, e-banking, e-registration etc. As a result more and more Nigerians users are getting glue to their computer system [1]. Its uses pervade all aspect of human life, and its benefit cannot be over emphasized. However, poor interaction between the computer and the user can lead to health problem, such as eyestrain, backache and swollen wrist [2,3]. These health problems are:- neck strain, hand and wrist tendinitis, carpal tunnel syndrome, tennis and golfer's elbow, low back pain, shoulder tendinitis, bursitis etc. These injuries are commonly called **Work Related Musculoskeletal Disorder (WRMD's)**, [4].

Johnson et al. reported that computer users in Nigeria Universities experience eye strain and neck pain, an average of 71% Nigerian computer users complain of WRMD's low back pain, while 69% complain of finger pain [5,6]. Nearly 53% of Computer users in Obafemi Awolowo University in Nigeria experience high ergonomic hazard [7]. Thus this poses serious challenges on overall organizational productivity [8].

Yang, reported that an average of approximately one billion US dollars is paid annually as insurance compensation claims to computer workers for WRMD's injuries [9]. Nearly 600,000 workers are kept out of workplace as a result of computer related injuries [10]. The above statistics shows the enormity of injuries experienced in Computer Workstations (CW). Despite the interest and application of ergonomics is growing in developing countries such as Nigeria, the impact is still far from being satisfactory.

From the revelation above, there is an indication that there is a poor interaction between the computer equipments and the users [5]. This implies there is ergonomic deficiency in computer workstations practice. There is substantial evidence that ergonomic practice can reduce if not eliminate WRMD's injuries [11]. Ergonomic will reduce potential injuries and ill health, improve performance and productivity, reduce man-hour lost through absenteeism, and reduce if not eliminate cost of compensation claim by workers.

**Ergonomics** is the application of scientific knowledge to the workplace in an effort to improve the wellbeing and efficiency of the

worker [12]. While **Workstation** refers collectively to the computer, keyboard, desk chair and space provided for a work [2].

### Method

The method employed in evaluating ergonomic deficiencies in Nigeria computer workstations involves physical measurement of relevant dimension of workstations using modified structured checklist as in [13] to collect CW anthropometric measurements and rate of pain, and a questionnaire as in [14] to assess CW user's perception of injuries currently experienced. A total of 100 workstations within these Nigerian institutions namely: University of Benin, Edo State IT center, Zenith bank PLC and Coca Cola PLC were investigated. These institutions were chosen because of frequent use of computer and internet that are easily found in these workstations. And frequent users in the study refer to those that uses computer for an average of five hours per day, and for the period of six years.

### Instruments

Simple measurement tape were used to measure length and height, goniometer were used to measured angle, thermometer were also used to measure temperature, visual analogue scale (VAS) to measure rate of pain and light meter were used to measure light level.

### Procedure

Factor parameters in terms of anthropometry measurements for: chair height, Chair armrest, chair knee angle, desk height, keyboard elbow tilt, monitor height, monitor viewing distance, monitor directly in front, workstation lighting, computer workstation temperature, and

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intensities of injury pain were measured for ergonomic compliance. Participants were also assessed on pain severity and locations.

## Computer workstation

The lists of parameters as per anthropometry are:

- i. Chair height: This was measured as distance from the floor to the top of the chair surface using tape. Recommended chair height is between 15'-22' [15].
- ii. Chair armrest: This was measured as angle elbow with the body using goniometer. Recommended chair armrest between 80°-90° [15].
- iii. Chair knee angle: This was measured as knee angle using goniometer. Recommended knee angle is between 80°-90° [16].
- iv. Desk height: This was measured as distance from the floor to the top of the desk using tape. Recommended desk height is between 22'-29' [17].
- v. Keyboard elbow tilt: This was measured using goniometer. Recommended angle is between 90°-110° [15].
- vi. Monitor height: This was measured as distance from the floor to the edge of the monitor using tape. Recommended chair height is between 36'-46' [15].
- vii. Monitor viewing angle: This was measured as distance from the eye to the top and eye to bottom of the screen using goniometer. Recommended viewing angle is between 15°-30° [16].
- viii. Monitor directly front: This was measured as distance from the body to the edge of the screen using tape. Recommended distance is between 18'-24' [12].
- ix. Workstation lighting: This was measured as the lighting in workstation using light meter. Recommended light rate is between 300-600 lux [17].
- x. Workstation temperature: This was measured in degrees using thermometer. Recommended temperature is 20°-27° [17].

## Data Analysis

Data were analyzed using descriptive statistics (relative error,

frequency, and percentage). Relative error (%) is use to find the ratio between the absolute error and absolute value of the correct value.

## Result/Discussion

The aim of this study was to evaluate the ergonomics deficiencies in Nigerian workstations, identify its associated health implications and profess suggestions that will help reduce/eliminate these risk factors. The response rate of the respondents was 100%; this is as a result of their enthusiasms towards finding solution to WRMD's injuries. The study has reveal detail knowledge on ergonomic deficiencies in Nigerian workstations and its effects on user's health.

Result of the investigation showed that chair height, chair arm/back, temperature and desk height returned high error of 72%, 66%, 47% and 46% respectively, as reflected in Tables 1 and 2, an indication that there are poor furniture and uncontrolled temperature in the workstations, an indication that majority of employer in this part of the world do not border about workers welfare in terms of working facilities provide for them instead employers are more concern about profit margin. This study also shows that arm, back and shoulder pain is a reflection of poor furniture. As also reported by [5]; it claim that poor/unadjustable CW chairs can induce arm and back pain/strain.

Workstations lighting showed 35% relative error, as against the recommended lighting level rate of (relative error  $\leq 10$ ) [17]. This is as a result of the use of fluorescent with flicker in some cases as noticed, lack of window blind and computer facing the window in other cases.

The 47% relative error recorded in temperature is an indication that Nigerian workstations uses fans instead of air conditioner as observed during the investigation. And fans are known not to be effective in controlling physical temperature of a workstation.

The locations of pain among Nigerian users as in Table 3 are: eyestrain 36%, shoulder pain 22%, back/arm pain 34%, neck pain 2% and wrist pain 6%. Shoulder, back/arm and neck pain shows a sum total of 58%, and this is also a reflection of poor furniture [6].

Table 4 shows that 57% pain are caused by furniture, 4% pain are caused by monitor/keyboard, 10% by light, 7% by temperature, 22% don't know the cause of their pain. 57% of pain caused by furniture is also an indication of poor furniture in Nigerian CW.

Table 5 shows that 25% rated their pain as 4, 19% as 3, 18% as 5, 5%

| Parameter                              | Temperature (°c) | Chair height (Inches) | Desk height (inches) | Knee angle (°) | Keyboard elbow tilt (°) |
|----------------------------------------|------------------|-----------------------|----------------------|----------------|-------------------------|
| Min-Max                                | 22.0-27.0        | 15.0-22.0             | 22.0-29.0            | 80-90          | 90-110                  |
| Maximum relative error                 | 18.4             | 34.2                  | 42.4                 | 1.0            | 2.4                     |
| Minimum relative error                 | 29.0             | 38.2                  | 3.26                 | 1.8            | 5.71                    |
| Min and Max error (%) in approximation | 47               | 72                    | 46                   | 3              | 8                       |

**Table 1:** Relative Error (%) between measured and recommended physical measurement.

N=100, Max=Maximum, Min=Minimum, %=Percentage. Min-Max is the lower and upper limit of the acceptable range. Max error is % of error above upper limit, Min error is the % of error below lower limit, and Min and Max error is the % sum of Max and Min error.

Relative error was used to measure the deviation of user CW dimensions from the recommended dimensions. Relative error=absolute (measure-recommended)/recommended X 100

| Parameter                              | Monitor height (inches) | Monitor viewing distance (°) | Lighting (lux) | Monitor in front (inches) | Chair arm/back rest (°) |
|----------------------------------------|-------------------------|------------------------------|----------------|---------------------------|-------------------------|
| Min-Max                                | 36.0-46.0               | 15.0-30.0                    | 300-600        | 18-24                     | 80-90                   |
| Maximum relative error                 | 0                       | 14.65                        | 28.6           | 0                         | 37.6                    |
| Minimum relative error                 | 5.71                    | 13.16                        | 6.8            | 1.2                       | 28.2                    |
| Min and max error (%) in approximation | 6                       | 28                           | 35             | 1                         | 66                      |

**Table 2:** Relative Error (%) between measured and recommended physical measurement.

| Location of pain | Frequency | Percentage (%) |
|------------------|-----------|----------------|
| Eyestrain        | 36        | 36%            |
| Shoulder pain    | 22        | 22%            |
| Back pain        | 13        | 13%            |
| Arm pain         | 21        | 21%            |
| Neck pain        | 2         | 2%             |
| Wrist pain       | 5         | 6%             |

**Table 3:** Frequency showing location health pain and rating of pain using VAS.

| Location of pain | Frequency | Percentage (%) |
|------------------|-----------|----------------|
| Furniture        | 57        | 57%            |
| Monitor/keyboard | 4         | 4%             |
| Lighting         | 10        | 10%            |
| Temperature      | 7         | 7%             |
| Don't know       | 22        | 22%            |

**Table 4:** Showing causes of pain.

| Rate of Pain using VAS | Frequency | %   |
|------------------------|-----------|-----|
| 2                      | 3         | 3%  |
| 3                      | 19        | 19% |
| 4                      | 25        | 25% |
| 5                      | 18        | 18% |
| 6                      | 5         | 5%  |
| 7                      | 1         | 1%  |
| No pain                | 29        | 29% |

**Table 5:** Showing rate of pain using VAS.

as 6, 3% as 2, 1% as 7. And a sum total of 71% experienced pain while using computer, only 29% were without pain; an indication that 71% experienced pain, while 29% do not. Out of the 71%, 49% are severe i.e. pain rate of between 4-7 rating. This is an indication that there are WRMD's injuries associated with CW users.

## Conclusion

The result of this study revealed that most of the complained WRMD's injuries are eye strain, shoulder pain, arm pain and back pain. And this is as result of poor furniture by CW users, and not adhering to recommended lighting and temperature [18]. Though there could be other factors that could also cause injuries; but these are beyond the scope of this study. However, my recommendations are as follow:

- Computer workstations furniture should be ergonomics recommended ones; adjustable with back, arm and foot rest.
- Accepted fluorescent lighting should be put in place. Avoid un-curtained (un-shaded) window, and monitor should not face the source of light.
- Air conditioner should be used as temperature controlled cooler.

- Employer should learn to take health care of their workers above profit consideration.
- Awareness of ergonomics practice should be consciously brought to the door step of employers by Ergonomics Society of Nigeria.

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