International Journal of Science and Healthcare Research
Vol.2; Issue: 2; April-June 2017
Website: www.gkpublication.in/ijshr
Original Research Article *ISSN: 2455-7587*

Developing an Observational Technique of Assessing and Identifying Ergonomic and Health Risk Factors Associated with Office Work: A Study of Selected Offices in Three State-Owned Tertiary Institutions of Katsina State in Nigeria

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ABSTRACT

Work place safety and health has become a global mechanism of response to various occupational hazards, injuries and diseases. Due to the neglect of basic safety and health regulations in Nigeria, office work especially in the governmental sector, has come to be associated with ergonomic and health related issues such as musculo-skeletal disorders and eye syndrome as a result of exposure of workers to certain risk factors. Musculo-skeletal disorders and eye syndromes are common complaints among typists, secretaries, computer workers and other related office activities with grave consequences on workers' productivity and the national economy. The objective of this study is to identify and assess the level of exposure of office workers in the three tertiary institutions of Katsina State of Nigeria, in the category of typists, secretaries, personal assistants, computer workers and other related clerical activities. The methodology adopted in the study is a non-participant, un-obtrusive observation using Rapid Office Stress Assessment Checklist Technique (ROSA). The checklist provided specific stressor variables and the health related risk factors associated with the office work. The findings of this study is that, workers in the three state-owned tertiary institutions in Katsina State of Nigeria, are exposed to ergonomic and other health related risk factors due to poor work facilities and poor working habit. It is therefore concluded that, in order to achieve a sustainable and productive office work environment, the working facilities and work behaviour of the workers must be changed and improved and that office safety and health regulations must be made as part of the organisational practice.

Key Words: Office Ergonomics, Ergonomic Risk factors Observational Technique.

INTRODUCTION

Office work environment involves a lot of repetitive movements, activities and events which potentiate serious threat to the health, welfare and overall employees' productivity. For example, keyboarding activities among typist, secretaries and computer users has been spotted as a prime factor in the development of carpal tunnel syndrome, shoulder pains and neck disorders [1-3] sitting for a very long period of time has been associated with lower back disorder and several cases of cardiovascular diseases. [4-6] On the other hand, viewing distance of a computer screen has been proved to cause vision syndrome and upper back musculo-skeletal disorders. [7] Similarly, improper designs of work furniture or facilities, awkward sitting posture and poor work behaviour have been associated with various cases of musculo-skeletal disorders. [8] In all these health related activities in an office environment, the first step towards ensuring safety and health of the employees and making the environment sustainable and hazard free to develop the right techniques and methods of assessing and evaluating the activities, objects, events and work behaviour within the office work environment which pose hazard and danger to the health of the employees. [9-11] This is because, identifying the risk factors associated with office work at an earlier stage has been proved to be effective in the prevention of health and

ergonomic related syndromes and complaints among the workers. [12-14] Standard methods and techniques of identifying and assessing the level of exposure of workers to ergonomic and health related risk factors in an office work situation will give a proper clue into the action level to be taken in the prevention of the prevalence of such health issues. [15] Thus, in this study, efforts were made to develop a standard ergonomic checklist which points to the level of exposure of office workers in the 3 state-owned tertiary institutions of Katsina State in Nigeria. The checklist has been able to cover important aspects of ergonomic risk factors, based on which conclusion was drawn in respect of the level of exposure of workers to the cases of work related musculo-skeletal disorders and other health related problems.

Office Ergonomics

The goal of ergonomics is to make work and labour easier for the humans. It is a concept which recognizes human elements in terms of designing work place and work facilities to suit individual needs. [16] The goal of every ergonomic design of work place and work facilities is to recognize the unique human capabilities and to counteract human weaknesses. In short, the goal is to optimize the multiple points of harmony and interface between the overall work environment and workers. The most common approach to ergonomics is the physical aspect of ergonomics which has to do with optimizing the interface between humans and equipment. [17, 18]

Based on the above, office ergonomics is concerned with making office work easier and it is an integral aspect of office occupational safety and health. In carrying out daily office work, most of the activities are physical and repetitive in nature involving body movement such as carrying out typing jobs, arranging and preparing records, making call, writing reports, minuting files, holding meetings (involving sitting for a very long time), preparing accounts and ledger and general clerical work. In the process of carrying out such physical activities as part of daily life, the target of office environment ergonomic designs is to ensure that nobody suffers pains or injury in the wrists, shoulders, neck, back, eye injury or even loss of sight as a result of unprotected glare of the computer screen and general body pains accompanied by headache. [19, 20]

All the activities of office work system are entirely carried out by human beings. Hence, the central issue in office ergonomics is that, the *comfort and happiness of the people who carry out office work must not be compromised.* [21] Providing comfort to the office worker is a process of total organization of the work space and its components such as computers, desk, chairs, floor measurement (work space) and other adjustable working tools designed to suit individual worker's need. An office ergonomist is therefore someone who applies special skills and expertise in order to ensure such comfort to the worker so as to enhance their healthy well-being and to achieve maximum productivity. Poor office ergonomics *leads to the cases of musculo-skeletal injuries and health related problems.* [22, 23] In this connection, the roles of office ergonomist keeps changing as the changing technology is always introducing new challenges capable of affecting workers' health and comfort. [24]

Designs and specifications of work components (facilities) such as chair, desk and work station must consider the nature, capabilities and limitations of the person who uses them through the proper application of principles of "Anthropometrics". This is to say that, well-designed office workspaces require good anthropometric data in order to have accurate data of the workers so as come up with designs which accommodate differences in the workers' population. Similarly, this exercise is not a static affair which could be dispensed once and for all as recent obesity epidemic compels a number of anthropometric changes that have

significant impact on designs of office facilities. [25]

However, this might not work well in the third world as it is not possible to measure every worker every now and then as a result of changes in body mass caused by obesity. The major concern of office ergonomics is to set up office work space and the work facilities so that it fits workers and their jobs in order to fulfil the basic ethics of "fitting the job to the person and not fitting the person to the job". In the study of office ergonomics, the main concern is with the study and analysis of the kind of work you do in the office, the office environment, the task to be carried out and the tools with which you use to carry your job all within the context of office organization. [26] When the office work workstation is set up with right ergonomic facilities and the ergonomic principles in mind the result will be:

(a) Reduction or avoidance of body pains and weakness as well as the cases of headaches or eyestrain.
(b) Reduction in neck and back pains/disorders.
(c) Prevention of bursitis or tendon problems as a result of carrying out repetitive tasks.

When all the above health issues are resolved as a result of effective office organization, with all the ergonomic facilities put in place, work productivity will be enhanced.

Office Ergonomic Risk Factors

Office ergonomic risk factors are office work conditions and activities which expose workers to high level of office work-related musculo-skeletal disorders, eye syndrome, cardio-vascular diseases and other health related issues. [27,28] Various research efforts in the field of ergonomics have been able to identify both occupational and non-occupational risk factors which increase the exposure of workers to Musculo-skeletal disorders (MSDs) and other health problems. The most critical issue worthy of consideration in the analysis of factors that result in the development of musculo-skeletal disorders is the balance between local soft tissue fatigue and the individual's ability to recover from this fatigue. [29] Thus, in controlling local soft tissue fatigue, sufficient blood supply becomes a critical factor. [30]

If there is adequate supply of blood flow to the soft tissues performing stressful and repetitive work activities, metabolic balance can be ensured so as to prevent or reduce excessive fatigue on the soft tissue that can expose workers to the development of work-related musculo-skeletal disorders. However, constant exposure of workers to risk factors related to work place activities will naturally make it more difficult to maintain this balance, and this increases the chances and probability of some workers to develop a perpetual condition of MSDs. [31] The major ergonomic risk factors to consider in an office environment are as follows:

1. Highly Repetitive Work Activities:

As earlier highlighted, office tasks such as typing job, ledger preparation using keyboards, use of mouse as an input devise etc., are highly repetitive work activities which can endure for a very long time and which will ultimately pose pressure on the soft tissues in the wrist, shoulders, neck and upper back regions. In fact, any work tasks and cycles are repetitive in nature, and are frequently controlled by hourly or daily production targets and work processes. Highly repetitive work activities that endure for a very long time, and when coupled with other risks factors such as high force and/or awkward postures, can bring about the etiology of work-related musculo-skeletal disorders. A criteria to consider job cycle as highly repetitive is when the work cycle time is 30 seconds or less. [32] The Following tips serve as control measures in reducing the exposure of workers to such office repetitive task which potentiate the development of work-related musculo-skeletal disorders.

(a) Engineering Controls – This is a technique of eliminating physical excessive force in the job demand and by way of devising easier to use work place facilities such as ergonomic adjustable chairs, ergonomic mouse, ergonomic key boarding facilities, etc. Forceful and awkward posture control as kinetic office activities will reduce worker fatigue and allow highly repetitive tasks to be performed without a significant increase in musculo-skeletal disorder risk for most workers.

(b)Work Practice Controls – This involves provision of safe & effective guidelines for carrying out work tasks. This preventive strategy can have a significant reduction in the prevalence of work-related musculo-skeletal complaints and further exposure of workers to risk factors. In addition to this approach, effective ergonomic training and education of workers on the right sitting posture and training them on how to take full responsibility for musculo-skeletal disorder prevention can serve as another sustainable prevention strategy.

(c) Job Rotation – Job task enlargement and job shifts also serve as good strategies for reducing duration, frequency and severity of musculo-skeletal disorder risk factors. Workers can rotate between workstations and tasks to avoid prolonged periods of performing a single task, thereby reducing fatigue and static workloads which are good predictors for the development of musculo-skeletal disorders and other health issues.

(d) **Counteractive Stretch Breaks** – This is a process of reviewing and making adjustment to the work place ergonomic policy such as sitting time in the office, policy of time break, shift and rotation, holidays, sabbatical etc. These are implemented in order to provide an opportunity for increased circulation needed for recovery of the damaged cells and soft tissues.

2. Forceful Exertion

Many of the office tasks such as typing using mechanical typewriters require high force loads on the human body. Similarly, typing habits which involve pounding and generating a lot of muscular effort can increase high force requirements. This is closely associated with fatigue which can ultimately lead to musculo-skeletal disorders. The control measures in eliminating excessive, forceful exertion during work can be seen as mentioned below:

(a) **Engineering Controls** – The first step to eliminate excessive force requirements especially in typing jobs is by improving the designs and specifications of keyboards and computer mouse to incorporate ergonomic features of soft touch typing. This strategy will reduce worker fatigue and the risk of exposure to musculo-skeletal disorder formation. At the same time, devising mechanical assists, counter balance systems, adjustable height lift tables and workstations, powered equipment and ergonomic tools will reduce work effort and muscle exertions.

(b) **Work Practice Controls** – Work process improvements such as using carts and dollies to reduce lifting and carrying demands, sliding objects instead of carrying or lifting, and eliminating any reaching obstruction to reduce the lever arm required to lift the object.

(c) **Proper Body Mechanics** – This also has to do with behavioral changes which require changing the work habit of workers and training them on the proper use of these ergonomic devices for reducing forceful, muscular efforts in carrying out office activities. Workers should be trained to use proper lifting and work techniques to reduce force requirements.

3. Repetitive/Sustained Awkward Postures

Awkward postures place excessive force on joints and overload the muscles and tendons around the affected joint. Joints of the body are most efficient when they operate closest to the mid-range motion of the joint. Risk of MSD is increased when joints are working outside of this mid-range repetitively or for sustained periods of time without adequate recovery time. The control measures of reducing repetitive and sustained awkward postures are listed below:

(a) **Engineering Controls** – The control strategy to be applied here is to try to eliminate or reduce awkward postures with ergonomic modifications that seek to maintain joint range of motion to accomplish work tasks within the mid-range of motion positions for vulnerable joints. This is achieved through massive ergonomic campaigns and education of workers to create awareness in them in order to assume balanced work postures based on regular ergonomic tips. Modification to work facilities which carry ergonomic features of adjustability to satisfy individual worker's need can help significantly in reducing the conditions of unbalanced work postures. Thus, proper ergonomic tools should be utilized that allow workers to maintain optimal joint positions.

(b) **Work Practice Controls** – Work procedures that consider and reduce awkward postures should be implemented. In addition, workers should be trained on proper work technique and encouraged to accept their responsibility to use their body properly so as to avoid awkward postures whenever possible.

(c) **Job Rotation** – Job rotation and shifts are also applied as sustainable ways to reduce repeated and sustained awkward postures that can lead to musculo-skeletal disorders.

(d) **Counteractive Stretch Breaks** – This is to implement rest or stretch breaks to provide an opportunity to counteract any repeated or sustained awkward postures and allow the body sufficient time to recover from bio-mechanical disruption of soft tissues, nerves and bones as a result of awkward work postures.

From the above discussion of conditions and activities of work place that expose workers to the development of work related musculo-skeletal disorders, systematically identifying, recognizing and controlling these ergonomic risk factors become important part of the organization's commitment to providing sustainable safety and health measures at office work place for all team members.

Observational Methods of Assessing Office Ergonomic Risk Factors

This is a review of various methods that have been developed to assess the level of exposure of workers to various ergonomic and health related risk factors associated with office occupational activities. Work related musculo-skeletal disorders and eye syndrome are common health issues among computer users and other related clerical work. [33] The choice of a particular method of identifying and assessing the risk factors especially for musculo-skeletal disorders is contingent upon the objective and the purpose of the research.

Various techniques have been identified to be effective in the assessment of such health related risk factors. These techniques and methods have been categorized under the following three main headings: [34]

(i) Self-reports Method: This is a way of getting the view of the workers from self-report opinion survey data on workplace exposure to both physical and psycho-social factors by using such methods as worker diaries, interviews and questionnaires;

(ii) **Observational Methods**: This method is further categorise into: (a) Simpler techniques that involves systematic way of

recording workplace exposure of which an ergonomist/observer records and assesses number of work place factors using specifically designed pro-forma sheets for establishing priorities for workplace action level and intervention; and (b) Using more advanced method that requires the assessment of postural variation for highly dynamic activities that record data either on videotape, photographs or by using a computer software dedicated for such purpose.

(iii) **Direct Measurements Method**: This is by using monitoring instruments whereby sensors are attached directly to the subject for the measurement of exposure variables at work.

As earlier highlighted, the choice among the methods available is contingent upon the application concerned and the objectives of the study. In general, observation-based assessments is dictated by the levels of costs, capacity, versatility, generality, exactness, and the particular needs of occupational safety and health practitioners (or those from related professions) who have limited time and resources at their disposal and need a basis for establishing priorities for intervention. [35]

From the above categories of choice of observational methods of ergonomic and health risk factor assessment especially in an office work environment, the most common methods which are applicable to office occupational activities are as follows:

1. Quick Exposure Check (QEC): This is an observational tool developed which allows Occupational Safety and Health Practitioners to evaluate and assess the level of workers' exposure to office related risks factors for musculoskeletal disorders and provide an action level for effective ergonomic intervention and control. [36] This tool relies on epidemiological evidence from the investigation of OSH practitioners' aptitudes for undertaking assessments. The Quick Exposure Check Method (QEC) allows the four main body areas to be assessed and the evaluation involves both the workers and Occupational Safety and Health Practitioners. [37,38] It is therefore a participatory approach to ergonomic risk factor assessment. The result of trials of QEC as an observational method has been able to determine its effectiveness, usability, intra- and inter-observer reliability, and validity which show that it could be applied to a wide range of working activities. [39] The tool focuses primarily on physical workplace factors, but also includes the evaluation of psycho-social work elements or work place factors. Tasks can normally be assessed within 10 minutes. It has been designed with a scoring system of each level of risk factor exposure, and it is based on the score of each risk factor the action level and priorities for intervention will be proposed. The scores of the assessment will also subsequently be used for the evaluation of the effectiveness of any intervention strategy. Thus, QEC can contribute to a holistic assessment of all the elements of a work system.

2. Rapid Office Stress Assessment (ROSA): This method of office ergonomic risk factor assessment also works similar to QEC method discussed above. However, the only variation with QEC method is that, Rapid Office Strain Assessment (ROSA) was designed to quickly quantify risks associated with computer work and to establish an action level for change based on reports of worker discomfort. [40] In other words, it combines the use of both self-report questionnaire from the workers' complaints of musculo-skeletal disorders and scoring system of the office risk factors. The risk factors associated with computer will be identified together with standards on office design for the chair, monitor, telephone, keyboard and mouse. The risk factors will be plotted in a diagrammatic style and coded as increasing scores from 1 to 3. ROSA final scores ranged in magnitude from 1 to 10, with each successive score representing an increased

presence of risk factors. A ROSA final score of 5 might therefore be useful as an action level indicating when immediate change is necessary. ROSA has also proved to be an effective and reliable method for identifying computer use risk factors related to discomfort. [41]

3. Rapid Upper Limp Assessment (RULA) Method: RULA as an observational method in ergonomics, was developed to evaluate the exposure of individual workers to risk factors associated with upper limps or upper extremity musculo-skeletal disorders. [42] RULA ergonomic assessment method evaluates the biomechanical and postural load requirements of job tasks/demands on the neck, trunk and upper extremities. [43] Its design is a single page worksheet for assessing the required body posture, force, and repetition. Based on the assessment of each part of the upper limp, scores are entered for each body region in section A for the arm and wrist, and section B for the neck and trunk. After the data for each region is collected and scored, tables on the form are then used to compile the risk factor variables, generating a single score that represents the level of exposure to the development of musculo-skeletal disorder risk.

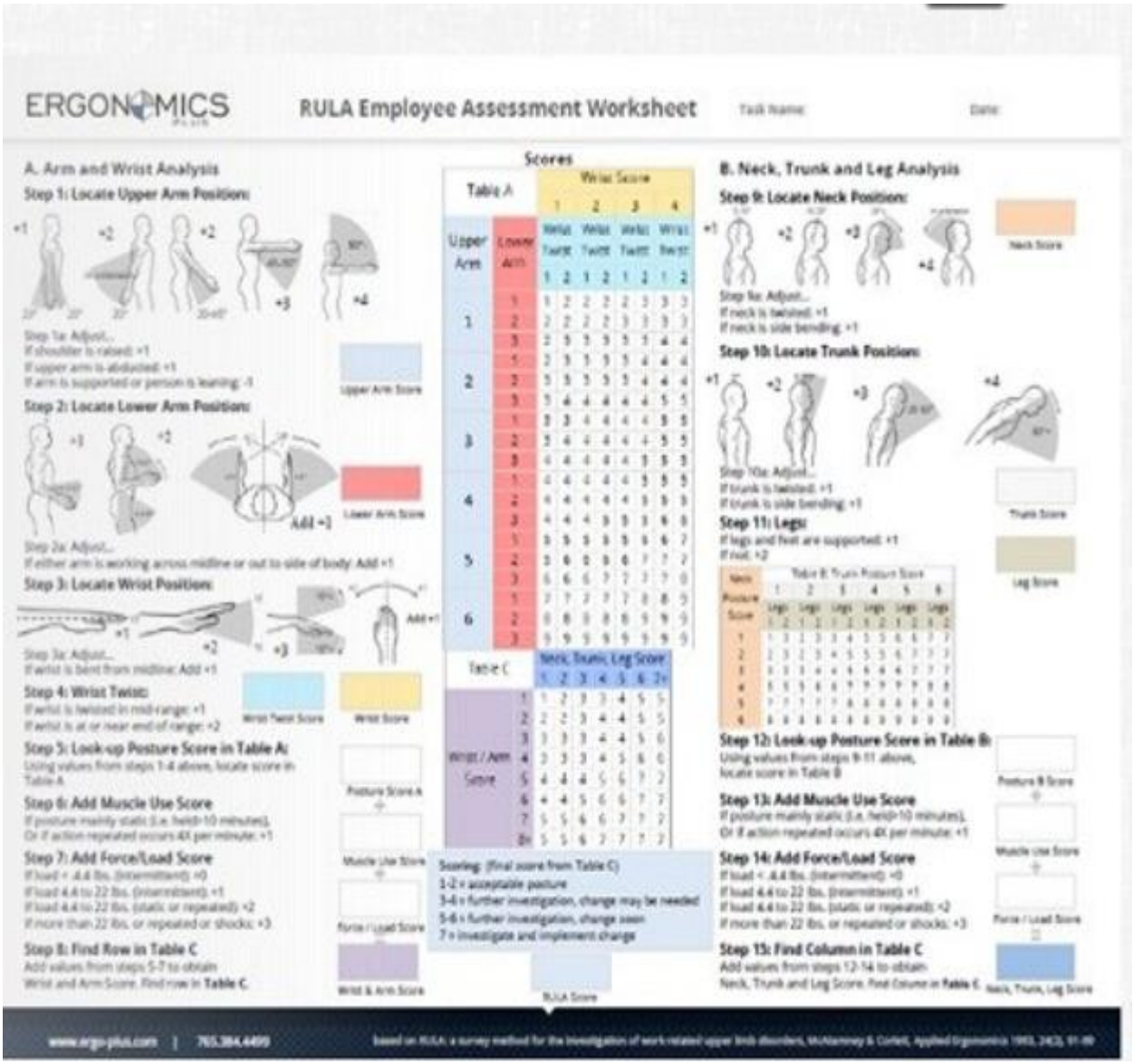

Figure 1. Step by Step Rapid Upper Limp Assessment
(Adapted from McAtamney, L., & Corlett, E. N. 1993)

In some instances, before getting started with the assessment using RULA method, the evaluator should prepare an exploratory interview with the worker being evaluated so as to gain more insight about the job tasks and demands, and this should be followed by an observation of the worker's movements and postures during several work cycles. Selection of the postures to be evaluated should be based on: 1) The most difficult postures in the work tasks (based on worker interview and initial observation), 2) The posture which is being sustained for the longest period of time, or 3) The posture with the highest force loads.

In an ideal observational setting, it is advisable to conduct RULA as quickly as possible so that multiple positions and tasks within the work cycle can usually be evaluated without a significant waste of time and effort. [44] When using RULA, only the right or left side is assessed at a time. It is after interviewing and observing the worker that is when an evaluator should decide whether only one arm should be evaluated or if an assessment should be carried out for both. Figure 1 below is the sketch of step by step RULA Method of ergonomic risk factor assessment: [45]

(Rapid Upper Limb Assessment)

The steps and processes of carrying RULA method of observation are designed for easy use, and will therefore require no advanced degree in ergonomics or expensive equipment. [46] Using the RULA worksheet, the evaluator will assign a score for each of the following body regions: upper arm, lower arm, wrist, neck, trunk, and legs. After the data for each region is collected and scored, tables on the form are then used to compile the risk factor variables, generating a single score sheet that represents the level of MSD risk as outlined below. [47]

Score	Level of Musculo-Skeletal Disorder Risk
1-2	Negligible Risk Which Requires No Action
3-4	Low Level Risk, May Require Modifications
5-6	Medium Risk, Need Further Investigation, Change Soon
6+	Very High Risk, Must Implement Changes Now

Figure 2: RULA Method Score Sheet
(Adapted from Massaccesi et al., 2003)

4. Rapid Entire Body Assessment (REBA): Rapid entire body assessment also works in a similar fashion with RULA method discussed above. It has been developed to fill a perceived need for a practitioner's observational field tool, specifically designed to observe unpredictable working postures found in health care and other service industries. [47] As a risk factor assessment tool in ergonomics, it uses a systematic process to evaluate whole body postural MSD and risks associated with job tasks. It is uses single page worksheet with specific focus on the evaluation of the required or selected body posture, forceful exertions, type of movement or action, repetition, and coupling. [48,49]

In REBA method, a worksheet is prepared and the evaluator will assign a score for each of the following parts of the body: wrists, forearms, elbows, shoulders, neck, trunk, back, legs and knees. After getting the data for each of the above body regions, scores will be awarded then tables on the form is then used to compile the risk factor variables, generating a single score that signifies the level of MSD risk:

Score	Level of Musculo-Skeletal Disorder Risk
1	Negligible Existence of Risk, No Action is Required
2 - 3	Low Level of Risk, Changes May be Needed
4 - 7	Medium Risk, Needs Further Investigation and Changes Soon
8 -10	High Vulnerability to Risk Factors, Investigate and Implement Changes Now
11+	Very High Risk, Implement Changes

Figure 3: REBA Method Score Sheet
(Adapted from Massaccesi et al., 2003)

REBA worksheet is designed with two main body segments sections labelled as A and B. Section A (left side) is the section which covers neck, trunk, and leg. Section B (right side) covers the arm and wrist. This division of the worksheet into segments helps to make sure that any awkward or constrained postures of the neck, trunk or legs which might influence the postures of the arms and wrist are included in the assessment. Score Group A (Trunk, Neck and Legs) postures first, then

score Group B (Upper Arms, Lower Arms, and Wrists) postures for left and right. For each of the body region, there is a posture scoring scale and additional adjustments which need to be made, considered and accounted for in the score.

5. Check-list Method: Checklist is another valid and popular method of assessing risk factors associated with office repetitive job tasks. [50] Checklist is designed to help an evaluator identify office based jobs or tasks with design-related hazards that may increase the risk of developing worker musculoskeletal pains/discomfort, decrease performance and increase an organizations' operational costs. [51] The use of checklist in ergonomics is easier and less costly and its focus is to identify whether certain, common hazards in relation to office work exists. The checklist should be used with the full participation and input of an employee and their supervisor. When using the checklist one should always:

(a) Try to understand fully the task(s) that are performed during the day, how long the employee performs the task(s) for and/or how often;
(b) Seek the views of the employees about the design, set-up and organization of their workstation and work areas;
(c) Consider individual needs in terms of anthropometrics of the workers based on body size, previous injury, etc.
(d) Observe all the manual and physical tasks being done when practicable.

The design of office ergonomic checklist does not have to take a specific format, and the design is determined by the objective of the research. However, as a rule of thumb, and based on the previous studies in the field of ergonomic risk factor assessment, the design of office ergonomic checklist covers aspects of work environment such as the office facilities, work style (work policy), work behaviour (work postures) office layout, light, ventilation, temperature and humidity indices, noise etc.

The Research Methodology

This is the master blue print of the entire research process from problem identification, through data collection and analysis to final reporting of the findings and conclusions. In essence, methodology is the research working guide. [52] Methodology gives a focus to the research in order to answer research questions. The methodology deals with the research design, population of the study, methods of drawing sample from the population, instruments of data collection, method of data presentation and analysis.

The Research Design:

The first step in research is coming up with the research "design" or framework of "study". As a matter of research tradition, the design of a research study begins with the selection of a topic and a paradigm. A paradigm is essentially a worldview, a whole framework of beliefs, values and methods within which research takes place. [53,54] It is therefore, a world view within which researchers work. In the real sense of it, a research paradigm is a trajectory of viewing world events and phenomena of interest, or a set of assumptions about how things work. It is the orientation and the philosophy which guides the actions of the researcher in the data collection method and analysis. This research adopted a qualitative strategy of inquiry as its framework. It is thus a research paradigm rooted in the philosophy of interpretive/descriptive method of data collection and analysis. It is qualitative in nature because it adopts the systematic strategy of qualitative inquiry in its data collection method and analysis. Therefore, the result and conclusion of this research is based on the qualitative method of data collection and qualitative, interpretivist, constructivist and descriptive analysis of the various phenomenon of interest.

The diagram below is a schematic description of the qualitative research process from the beginning to the end, and which is specific to the nature of this research. This is adapted from Merriam (2009)

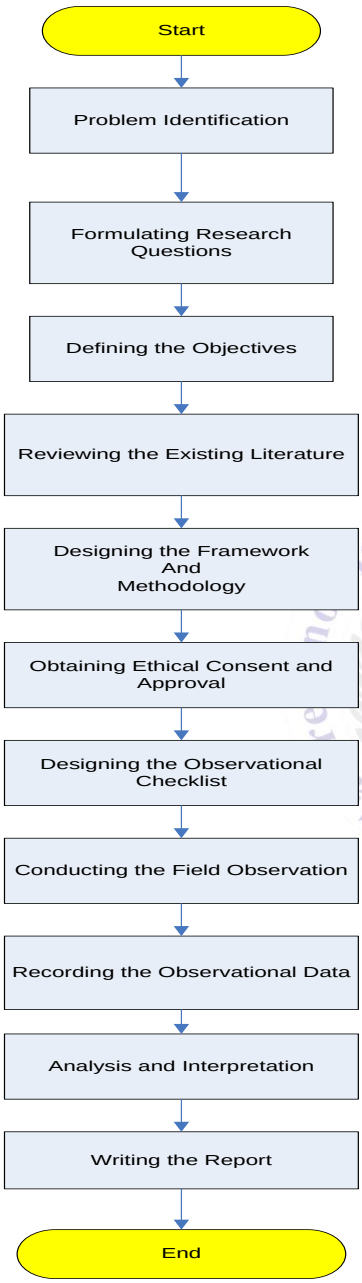

Figure 4: Qualitative Research Flow Chart
(Adapted from Merriam, 2009)

Area of the Study

This study is conducted in Katsina State of Nigeria and it covers the three tertiary institutions owned by Katsina State Government. Katsina State was among the North Central States of Nigeria, which was later curved out of Kaduna State in 1987. Now it is lying in the North-Western Geo-Political Zone. It is bounded in the North by Niger Republic, in the East by Kano State, in the South by Kaduna State and by Sokoto State in the West. The State covers an area of 26,785 Square Kilometers. [55] The study covers the period of October 2015 to January, 2016 as an exploratory assessment of the office ergonomic risk factors in the offices of the three institutions. The three tertiary institutions are Hassan Usman Katsina Polytechnic Katsina town, Isah Kaita College of Education Dutsinma town and Yusuf Bala Usman College of Legal and General Studies in Daura town. As a matter of reality in research, it is not possible for the investigation to cover every office of each of the selected institutions. Therefore, the observation was only limited to the Central Registries, Offices of the Registrars, and Offices of the Bursars for each of the three institutions. This is because, there offices are the hubs of official activities in all the three institutions.

Target Population of the Study

Target population represents the group of people from which the researcher gets the data necessary for the study. It refers to the group of people from which the information or research data will be extracted. [56] It is the entire target of the research, and thus it is the complete collection of all the element units that are of interest in a particular investigation. Similarly, it is the group to which the researcher will want to generalize the findings of the study. [57] It could therefore be said it is an aggregate or totality of objects or individuals with one or more characteristics in common that are of interest to the researcher. The target population of this research is typist, secretaries, personal assistants, computer users and related clerical activities. The justification for choosing to study this group of people is because literature has associated them identified with complaints of office

work related musculo-skeletal disorders. [58,59]

Sample and Sampling Strategy

Sampling involves a collection of some (subset) elements of a population. Sampling enables a researcher to study a relatively small number of units in place of entire target population which are to be included in the study and it is therefore more ideal to select a sample that is the representation of the entire population. [60] The sampling method adopted in this research is cluster sampling; a situation where by each institution where the investigation was conducted, was taken as a cluster. So in this case, each tertiary institution is regarded as cluster. Randomized cluster sampling was applied using lottery method in the selection of the 3 institutions out of total of 7 State-Owned tertiary institutions of Katsina State.

As a qualitative method of study, the size of the sample is always relatively small in order to be able to generate qualitative data. [61,62] Based on this justification, the sample size is 9 people, one person in each office (Central Registry, Office of the Registrar and Office Of the Bursar) of each of the 3 institutions. Sample of convenience is adopted in the selection of the target people for the study based on the work activities of each of the office workers. This is because, as there is no fixed rule in determining the size and number of the clusters, sampling strategy can be determined through the prudence and the discretion of the researcher. [63,64]

Method of Data Collection

As a qualitative method of research which matches with the research object, the method for data collection is also a qualitative method. Observational method of data collection is applied in the study. Observation as a method of data collection uses vision as main means of data collection. It is the procedure by which one or more persons examine what is happening in some real life situation and then classify and record the happenings according to some planned scheme. Observation is the most popular method of data collection and is used in both quantitative and qualitative research. [65] Similarly using observational strategy of data collection in the research process offers an investigator the opportunity to gather 'live' data from naturally occurring social situations. In this way, the researcher can look directly at what is taking place *in situ* rather than relying on second-hand accounts.

Direct, non-participant un-obtrusive observation was applied as the method of assessing office ergonomic risk factors in the 3 tertiary state owned institutions of Katsina State of Nigeria. Similarly, the observation is a structured one in the sense that only the phenomena of interest as outlined in the observation checklist/schedule was observe because it is not possible to observe everything. In order to outline the focus of the observation, an office ergonomic checklist was adapted from Christ Brunt Office Ergonomic Checklist as used in previous studies. [66]

This type of checklist is designed to quickly assess and identify ergonomic risk factors capable of causing the development of work related musculo-skeletal disorders in the office work environment. That is to systematically study, assess and analyse the risk factors associated with the nature of computer/typing job, clerical and general office work environment in order to draw conclusion and to establish an action level for change and improvement in relation to the risk factors observed. Below is the design and specification of the checklist used in recording the observational data in the three institutions that were studied:

OFFICE ERGONOMICS OBSERVATIONAL CHECKLIST DESIGNED FOR OFFICE ERGONOMICS ASSESSMENT FIELD TRIPS TO 3 STATE-OWNED TERTIARY INSTITUTIONS IN KATSINA STATE OF NIGERIA 6th October, 2015 – 7th January, 2016

No.	What to Observe	Risk Factors	Exposure (Is the Risk Factor Present?)	Notes
1.	Chairs in relation to the anthropometrics of the workers	1. Not equipped with adjustable designs. 2. No full & adjustable lumbar support 3. The width of the seat too squeezed (10x10 inches) 4. The height of the chairs so short (18 - 20 inches) and no height adjustment 5. The chairs have no full back support. 6. The design of the chairs is hard, rough wood, with no adequate cushion support 7. The chairs higher than the tables or shorter than the tables. 8. The arm rest not adjustable and highly elevated	Yes, there is the presence of Risk Factor for lower and upper back pains, shoulder pains due to shoulder abduction from the short chairs in relation to the tables height	There is need for change in the designs of the chair to provide ergonomic features to support the individual worker's need.
2.	Office Desk/Work Surface	1. The desks are so much elevated above the chairs, and in some cases very much lower than the chair. There is no match between the desks height and the chairs. The desks height is 36 inches and the chairs 20 – 22 inches. 2. The desk and the work stations are not adjustable to accommodate individual needs 3. There is no adequate space for the work surface to accommodate all required working equipment such as mouse, keyboards files, and writing material/reference materials 4. The work surface of the desks very rough and have no cushions for softening effects. 5. The employees cannot move freely using the surface of the work station. 6. There is no adequate space for free movement of legs under the work stations.	Yes, there is a risk factor for shoulder pains where the tables are so elevated above the chairs and back pains where the chairs are higher than the tables. Due to the squeezed nature of the work space, there is a risk factor for neck disorder due the twists of neck to refer to other things on the desk	The desks should be designed in relation with the sizes of the chairs There should be adequate working space to allow for reference to other working materials. The surfaces of the tables should have soft cushioning effects. The designs of the tables should have a sit-stand, adjustability to allow workers adjust it to meet their needs.
3	Computers/typing machines	1. The computers are old models with huge un-protected cathode ray tubes 2. The computers are not designed with adjustable screen to take care of individual needs. 3. The workers use manual heavy typewriters which require hard stroke The key boards of the typewriters are elevated above 5 inches. 4. The keyboards of the computers are too horizontal.	Yes, there is a risk factor for wrist and shoulder pains because of the elevated shoulders and hard stroke when typing. There is a risk factor for neck disorder because the computers do not have the screen adjuster to regulate the position of the screen. There is a great risks for eye syndrome due to unprotected screens.	The heavy manual typewriters should be replaced with soft touch typing keyboards in all the offices. All the computers should be designed with screen protectors All the computers should have screen adjusters.
4.	The Work Postures	1. Head tilted downward while working on the desk 2. Head is turned to the other side while working 3. Head not directly over the spine 4. Neck turned around to the other side while working 5. Arm unsupported while using keyboards. 6. Wrist not neutral while typing (too horizontal below 5^0 degrees or too vertical above $15^{0.}$ 8. Wrist pronated and over bent while typing 9 The back is bent, forming C shape(Acute angle) rather than neutral S-shape 10. Legs not firmly fixed on the floor to support the mass of the entire body.	Yes, there is a risk factor for back pains, neck disorder, acute tenosynovitis and shoulder pains	The workers assume un-neutral postures as a result of the poor designs of the work facilities. The workers assume un-neutral postures due to the lack of ergonomic training concerning work postures.

Table to be continued…….				
5.	The designs of the mouse	1.The mouse are not designed with track-rollers to reduce the rate of wrist extension, deviation and shoulder abduction 2. There is no adequate work-space for mouse use	Yes, there is a risk factor for carpal tunnel syndrome as a result of wrist extension and pronation when using mouse as a pointing device. There is a risk factor for shoulder pains due to constant shoulder abduction	There mouse should be designed with track-rollers to reduce the consistent cases of shoulder abduction and wrist extension and pronation
6.	The screen viewing distances	1. Screen is very closed to the eyes while working(Approximately Closer than 25 inches) 2. The position of the screen not in line with the position of the face due to the irregular height of the tables in relation to the height of the chairs.	Yes, there is a risk factor for eye syndrome because the monitor is very close to the eyes, closer than 25 inches. There is a risk factor for neck disorder because the screen is higher or lower than the position of the chair.	The screen position should be regulated some distances away from eyes' Computer Glasses should be provided to the workers. The design of the chairs should be harmonized with the design of the desks/work stations
7.	The working hours/Sitting time	1. Workers work for 8 hours with rest or break. 2. Throughout the work hours observed, the work continued without adjustment or changes to the sitting arrangement or position	Yes, There is a risk factor for general body pains as a result of repetitive work movements without break and without changing the sitting position and work arrangement	There should be reduction of working hours by allowing some hours as leave and rest to enable workers recover from occupational over use.

Please add any other comments, observations or employee concerns in the space provided below (Add extra sheets if necessary):……
……
……

The above checklist represents an anecdotes/summary or jottings of the main events, activities or actions discovered in the field of observation in relation to ergonomic/health risk factors associated with office occupational activities. These anecdotes are developed into full scale descriptive analysis of actions, events and activities of research interest.

METHOD OF DATA ANALYSIS

In the issue of analysing the observational data, the analysis is purely based on what the eyes have seen, recorded or measured and in this case, the approach to the analysis is based on the description, interpretation or generating a meaning from the notes and anecdotes on the pre-designed ergonomic checklist as well as the field notes developed from the jottings made in the checklist. Thus the method of analysis of the observational data in this study is purely descriptive/interpretive method. This study, therefore provides a descriptive and interpretive account of what has been observed and recorded in the office work environment of the 3 state-owned tertiary institutions of Katsina of Nigeria. Interpretive analysis, as a systematic approach to interpreting data from observational study focuses on the interpretation of spontaneous behaviour of individuals and events within the study environment. [67] This therefore calls for maximum display of naturalism in the content and the context where the study is taking place. Unlike the rest of designs and structures, and due to the reason that human behaviour is very unpredictable, the data covered by the observational studies should therefore be analysed by reflective and interpretive techniques of analysis. [68] Thus, an interpretive analysis involves a process of critical thinking of the investigator's experience of the study environment in such a way that, the analysis reflects as much as possible the value free interpretation of what has been observed. The process of interpretive analysis of observational data is a rigorous efforts towards coming out with an unbiased opinion and interpretation of what one has learnt or discovered, what one has accomplished as the goal of the observation. [63] The process of such critical thinking has to do with asking the question of Why this? And Why not that? What did one think about this? Did one experience makes one change the way one thought

about a particular social issue? What worked and what didn't? Why was one experience important? How is this experience connected to one's study or investigation? Can one use what one learned in other ways?

This should be followed by the decisional aspect of the analysis and this is the process of exploring how to incorporate new discovery, knowledge or data gathered from the field of study into the current state of mind for final analysis. [69] Thus, it is about what decisions or interpretation is to be made based on the discovery and whether the discovery has changed any of the researcher's beliefs, opinions, and truths.

Based on the above description of the systematic process of interpreting observational data, in this study, certain careful steps were followed according to the above authority based techniques of interpreting the observational data and making meanings from the events, activities and the images of interest. The process of collecting such data involves rigorous focus of attention on what has been scheduled in the observational checklist while at the same time mentally blocking other trivial issues which do not form part of this study. Therefore, the interpretation of the observational data in this work is purely reflective, mental or cognitive process of attaching meaning to the data gathered by observational strategy of inquiry.

The Ethics of the Methodology

This aspect is concerned with the due process and ethical consideration of the method employed in the research process. The method has taken into cognizance the need to obtain permission from appropriate authorities and concerned persons before conducting the study. In this respect, formal approval was requested from the principal officers of the three tertiary institutions as they were intimated about the purpose of the research verbally. It was made clear to them that the study was meant to improve the working condition of the workers and it would be used for work place policy changes and educational purpose only. In similar vein, all the image data that were captured, due permission was granted and hence bear no infringement. Therefore verbal consent was given before embarking on the research, in conformity with ethical requirement of any field study. Verbal approval is enough as verbal instructions are regarded as part of official procedure in the Nigerian Governmental offices.

RESULT AND DISCUSSION

This section of the study brings the presentation and discussion of the result of the observation of risk and health factors associated with office occupational activities in the three State-owned Tertiary Institutions of Katsina State in Nigeria. The discussion is a summary of the interpretation of what has been recorded from the observational checklist. The interpretation of the objects, events and activities observed are presented based on the following headings:

Office Desk and Chairs

The designs of both the chairs and desks do not take the anthropometric data of the respondents into consideration as outlined above. Using measurement tape, the height of the chairs are too short for the comfort of the worker and the tables are having rough surfaces and narrow work space, and in most cases higher than the chair and in some other instances, reverse is the case whereby the tables are shorter than the chairs.

The average height of the chairs is 20 to 21 inches, while the table is 33 – 34 inches in height and width of the chair sitting surface is ranging from 11x11 to 12x12 inches which is too squeezed for the comfort of the worker whose average width is 22 inches. In a situation where the table is higher than the chair as discovered in other offices, the workers who perform typing job will be force to lift up and hang their upper limps to perform any operation which is a good factor for the etiology of upper limp

disorder and damage to the shoulder rotator cuff.

In a case where the chair is higher than the table, the tendency is for the workers to assume forward leaning posture with the mass of the body trunk curving in an acute angle formation which is a good predictor for the neck, lower and upper back disorders. Similarly, the back support of the chairs is approximately around 11 inches and do not give a full support to the lumbar and upper back regions to the workers who are averagely 25 inches long from the lumbar region to the end of the neck, and in some instances, some chairs do not have back support. At the same time, the design of the chairs is not adjustable to cater for the needs of the individual worker such as provision for height adjustment and forward and backward elasticity. Therefore the chairs and desks that were observed in these three institutions are good factors for the prevalence of neck, lower back, upper back and shoulder disorders as highlighted in previous work. [70]

As captured in the image data, the model of the chairs are designed with short back support, and some others no back support at all. The design of their size is too small to be able to accommodate tall and fat persons (compared to the ideal model of ergonomic chairs, with full back support and adjustability to suit individual needs. The arm and wrist support of all the chairs is hard and sometimes so much elevated. Some chairs do not have arm and wrist support at all. Soft and comfortable support of the forearm on the work surface during keyboard operation may increase comfort, decrease muscular load of the neck and shoulders, and decrease the time spent in ulnar deviation. [71]

The figures below show the typical examples of the type of the chairs and desks discovered in the from the field observation.

Figure 5 above is a chair from Hassan Usman Katsina Polytechnic, Katsina city with a short back support and the design of the chair is so much elevated above the desk and the general work surface. Looking carefully at the seat, something has been improvised by the user to secure comfort which could be interpreted as lack of satisfaction with the design of the chair. This design of chairs has a natural tendency to force the worker to lean forward with their mass of the body on the desk to be able to perform any clerical work. Similarly, the arm rest of the chair is designed with a hard wood and resting hand on this kind of hard wood will generate discomfort to the elbow region. This is a good predictor scenario for the cubital tunnel injury. [72]

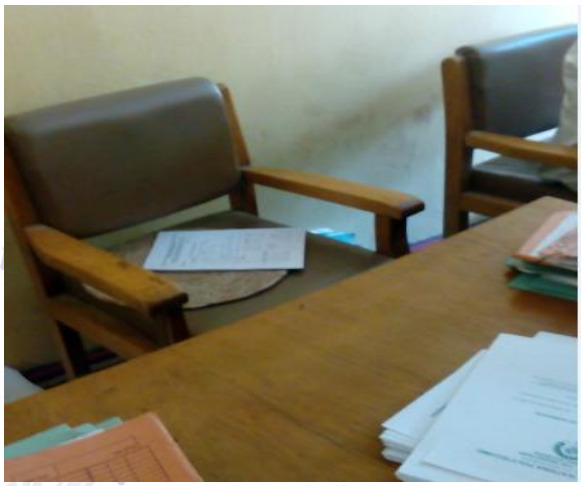

Figure 5: Poor Design of Office Chairs from Hassan Usman Katsina Polytechnic
(Source: Hassan Usman Katsina Polytechnic in January 2016)

Figure 6: Poor Design of Office Chair from Yusuf Bala Usman College of Legal and General Studies Daura
(Source: Yusuf Bala Usman College Daura February, 2016)

Figure 6 above is the type of office chair from Yusuf Bala Usman College of Legal and General Studies in Daura town. The design of this type of chair has the

potentials for back pain and pains in the elbow region as highlighted in the type of chair used in Hassan Usman Katsina Polytechnic above. The back support is not enough to provide full support for the anthropometric height of the workers from lumbar region to the end of the neck and spine. In an ideal situation, a full support is needed up to the head area. [22]

Figure 7: Poor design of Office Chair from Isah Kaita College of Education Dutsinma
(Source: Isah Kaita College of Education Dutsinma, March, 2016)

Figure 7 above, has the same potentials for upper extremeties and back disorder as the chair is designed so much above the work surface.

The Model of Computers for Typing Work

The type of computers discovered in the specified offices in all the three institutions where this study was conducted are out dated models of computers with huge and protruded cathode rays tubes which have no provision for screen protector to shield the workers against excessive radio-activity of cathode rays tube and to protect the eyes from vision syndromes. In the like manner, the computers are not designed with provision for adjustability in order to regulate the viewing distance according to individual needs. Using this model of computers exposes the users to the danger of cathode rays tube radiation which goes direct to the eyes and therefore causes the epidemic of eyes syndrome. Again, lack of screen adjustability can more often predispose the worker to the instances of neck disorder and strain. Figure 8 below is an example of the model of computer discovered in one of the offices in Isah Kaita College of Education Dutsinma:

Figure 8: A computer with unprotected and Un-adjustable Screen
(Source: Isah Kaita College of Education Dutsinma March, 2016)

Figure 9: Model of Computer with unprotected Screen
(Source: Hassan Usman Katsina Polytechnic, January 2016)

From Figure 8 above, it could be seen that the of computer is not having any ergonomic design to take care of human factor such as adjustable and protected screen to prevent the occurrence of neck disorder and eye syndrome. Another type of computer with unprotected screen is also shown in figure 9 as discovered in one of the offices in Hassan Usman Katsina polytechnic. Although, the model of this computer is bit modern compared to the model above, it is still having the health

implication of precipitating the cases of neck disorder and eye syndrome because the screen is also bare and unprotected and there is no provision for screen adjustability.

The Work Station and the Work Surface

The design of work station/work space is too narrow to allow for free body movement when performing any operation. There is no adequate space for required reference to documents or adequate space for putting the computer, mouse and keyboards together. This is because the tables/desks used in carrying out work are designed with very small space and as such, in performing typing job and other clerical operations, a worker is forced to squeeze his body or place the typing material at other places away from the table with so much inconvenience. This will cause stress and strain of neck which will eventually occasion the etiology of neck disorder. Moreover, in a situation where the computers are placed in such limited working space as is the case with most of the offices where computers are used, there is a going to be a gradual development of eye syndrome.

The Computer Mouse

The computer mouse used as a data entry devise, have not been designed with ergonomic feature of track-rollers which help to reduce the level of wrist extension, pronation and shoulder abduction as a result of constant movements of upper region of the arms. Using this type of computer mouse poses serious danger of shoulder and wrist pains. The mouse in Figure 8 above is a typical mouse used in almost all the offices observed.

The Position of the Screen/Monitor:

The appropriateness of the work station determines the correct position of the computer monitor and the position of the monitor is another factor to consider in assessing the office ergonomic risk factors. The monitor should always be positioned approximately at eye height and arms distance away. In the same way, the distance between the monitor and the eyes should be at approximately "25" inches. However, due to the poor designs of both the desk and the chairs and due to lack of match between the chair height and the height of the table, the position of the screen in the work stations is higher or lower than the viewing position. This nature of screen position will force workers to protrude their heads and necks downward or strain their necks upward to be able to see the writings in the monitor. It has been observed that, due to the squeezed nature of the work station, the screen is always very close to the eyes. These are good risk factors for neck disorder and eye syndrome.

Sitting Postures/ Typing Behaviour:

In order to observe the sitting postures of workers, direct, unobtrusive method was employed. It is unobtrusive in the sense that the workers were not made to be aware that their sitting postures form part of the research process. This provided an opportunity to observe live and direct behaviour. Unobtrusive observation tries to prevent a reactive measurement effect, a situation where the subjects change their behaviour when they notice that they are being observed. [73] Recording observational data in relation to human behaviour is somewhat difficult and thus it requires skills and artistry of the highest order. In this section of observational data capturing, the sitting postures were observed at a time when workers' attention was so much taken by their job, especially in the registry units where many workers' attention has been taken by their work. Therefore, the workers were not aware that they were being observed. This presented the data of natural behaviour of the workers (Naturalistic Inquiry).

The sitting postures that were observed were in most cases a posture with body trunk leaning forward in an acute angle formation rather than upright (neutral posture) or at worst forming a "C" shape, and the head posture is slouching

forwarding in between the arms. Under this work posture, work continuous without break for several hours. This working posture as carefully observed is a natural result of poor work facilities such as poor design of the office chairs and desks provided to the workers. As already highlighted, the chairs lack full back support, arm and wrist rests and the tables are higher than the chair or chair higher than the table which are not adjustable. It is also linked to the poor working habit of the workers as a result of lack of ergonomic training concerning sitting postures and other issues in relation to office occupational safety and health.

This work behaviour will continue to violate the body bio-mechanical properties leading to neck and back disorder. Similarly, the typing habit as observed is not a soft touch typing. The general typing habit is a "pounding" rather than using soft touch which requires less pressure on the wrist tendons and ligaments. Where the heavy mechanical typewriters have to be used, heavy stroke is needed and the result is that the wrists are deviated, extended or pronated too horizontally below 5^0 or too vertically curved above 15^0 which all are associated risk factors for wrist carpal tunnel injury and the damage to the ligaments. [74]

The Working Hours

Working hours and sitting time in office carrying out highly repetitive jobs such as typing have great health implications as far as office occupational safety and health is concerned. The number of hours spent performing a repetitive work activity such as typing job determines the level of exposure of workers to the risk factor for work related musculo-skeletal disorders. [75] Similarly, break and rest in the number of working hours help in reducing the dangers associated with static load, a situation where there is a pressure and load on the lower back and hips when the situation is sustained for a reasonable number of hours. [76]

From the observation of the number of hours spent without break, it was discovered that workers in the all the offices observed from the three tertiary institutions were not officially allowed some hours as work break and rest. Throughout the period covered by the observation, which is from 9.00 am to 12.00 p.m., no any work break is observed. In order to confirm whether there is a policy of work break, some of the officers were asked and they confirmed that there is no clear policy on timing and break as a routine organisational procedure. They indicated that the office timing is strictly tied to the Public Service Circular/Regulation of 2015 which stresses that normal office hours should start from 7.30 am to 3.30pm every day from Monday to Thursday except only on Friday where work closes at 12.30 p.m. In some Governmental Departments, staffs are required to resume work by 2.30 p.m. after the completion of their Friday Prayer. These longer sitting hours can be associated with rapid etiology of work related musculo-skeletal disorders and other cardio-vascular diseases.

CONCLUSION

Based on what has been observed and recorded on the above office ergonomic risk factor assessment checklist and the interpretive analysis of the observational data, the workers in the 3 State-Owned Tertiary Institutions in Katsina State of Nigeria where this observation was carried out are exposed to the various ergonomic hazards capable of causing work related musculo-skeletal disorders, eye syndromes and other health issues. Hence, there is a need for intervention as employees have expressed their dissatisfaction with the work environment in terms of office facilities and work policy of lack of break and work shift. Moreover, the intervention should include creating ergonomic awareness and training on work postures as it was observed that workers are lacking in awareness concerning ergonomic and other issues on work place safety and health.

The action level to be taken for the improvement of work place ergonomics and general safety and health within the office environment of the 3 state-owned tertiary institutions of Katsina State in Nigeria is by improving the level of office facilities to encompass all the ergonomic features, changing and improving the work policy in relation to work break and timing, office hours, routine changes and work shifts, etc. These will help to secure the employees against work related musculo-skeletal disorders and other occupational diseases for a sustainable and productive work environment.

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How to cite this article: Gambo A. Developing an observational technique of assessing and identifying ergonomic and health risk factors associated with office work: a study of selected offices in three state-owned tertiary institutions of Katsina state in Nigeria. International Journal of Science & Healthcare Research. 2017; 2(2): 1-23.

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