

## Ergonomic Survey of Commercial Motor-Cyclist in Nigeria

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### ABSTRACT

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*The significance of the applications of ergonomics in design of equipment, machine, machine tools and components of technological systems cannot be overemphasized. This study considers the ergonomics of motorcycle used for commercial transportation in Nigeria using participatory ergonomic intervention approach (PEIA), and expert opinion pull to evaluate characteristics of motorcycles and the musculoskeletal disorder associated with occupational cycling. The prevalent risk factors identified in the study were found to be bimodal with state of road (27 %) and stress/fatigue (27 %). These factors were responsible among other musculoskeletal problems for cumulating pains stress, strain and other discomforts at the operator's shoulder, lower back, thigh, eyeball, chest, hand, ankle, and calf. Mismatch between the driver and the motorcycle characteristics was generally suspected as the reason for the untold hardship experienced in the occupation. This suggests the need for a bio mechanics study of commercial and noncommercial motorcyclist in Nigeria. Ergonomics of motorcycle for sustainable design and development of users friendly means of transportation should be considered in-depth in other to improve particularly the safety, comfort and productivity of business motorcycle riders.*

**Keywords:** Motorcycle, Body part, Stress, Business Riding, Posture

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Date of Submission: 14 January 2016



Date of Accepted: 05 February 2016

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### I. INTRODUCTION

Ergonomics and its applications in virtually all things that man uses have in recent times gain significant attention of researcher, designers, operators, policy makers, occupational health workers, manufacturers, production and operations managers, ergonomist and engineers. Thercent developments in transportation business in developing countries such as Nigeria where poor road network coupled with large unpaved roads linking towns and villages within the country is glaringlyfound has encouragedthe increase in the use of different models of motorcycles (most of which are imported as *Tokunbo*). as well as the number of unemployed youth who ventures into businessriding of this means of transportation otherwise called *Okada*. This event did not preclude the unprecedented high rate of accident and other related musculoskeletal trauma often reported by the usually untrained operators of these auto-cycles. However,the *okada* ridding has reduced significantly the rate of unemployment among educated and uneducated youths in Nigeria. This means of commercial transportation in Nigeria has been on the increase since 1990s and its preference over other available means of transportation was premised on its affordability, convenience, fuel economy, ease of manipulating through thick vehicular congestion especially in densely commercial centers, low cost of purchase, parking space required and its inexpensive maintenance cost. Registered motorcycles in Nigeria were estimated at 31.11% of the total stock of registered vehicles in the year 2005(Arosanyin, 2007). This estimate apparently has increased with increase in population and the precarious situation of unemployment in the country. Most of the motorcycles used in Nigeria are either used or brand-new imported from countries like Japan, India, China, Belgium, and Germany whose design standards are not specifically meant for Nigerians. The consequences of this were the attendantdifficulties, stress and discomfort experienced by the users which include lack of adequate adjustability of part that impact on the comfort, performance and effectiveness of the operator of motorcycle. Business ridding of motorcycles is highly risky and demandingas it expose the operator and passengers to grievous hazard which include fatigue, exposure to pollution from the exhaust of other vehicles on the road, damage to body parts due to noise, motion and vibration etc. The workspace of a motorcycle operator is open to all direct and indirect risks hence the highly prevalence of discomfort, restriction to fixed position, prolong stresses for long distance driving on poor road network leading to accident, body injury or death.A motorcyclist is considered to be more vulnerable to personal injury than a car driver. (Chesham *et al*, 1993, David *et al* 2004).

Work-related musculoskeletal disorder (MSD) and other forms of postural damages may result in physiological illnesses that are developed due to prolonged mechanical stresses imposed on the musculoskeletal system (Lloyd, 1996). Normal and Wells reported that physical risk factors like awkward posture, vibration, exertion repetition and duration were found to be associated with high levels of MSD in the neck, shoulder and arm. This is evidenced by the rate of patronage of hawkers of herbal medicines around the corners of motorcycle parks and garages. The design of the components of motorcycle such as clutch lever, speedometer, odometer, rear brake pedal, gear change levers are critical to ergonomic of the means of transportation. Different legislations however exist in some states in the federation particularly in highly commercial and urban centers and at the federal capital territory (FCT) that controls the use of motorcycle as means of transportation. This study seeks to investigate the ergonomic of motorcycles used for commercial purposes and determine the prevalence of musculoskeletal disorder leading to discomfort, absence for work, and other related hazards. The results from this survey would also serve as source of valuable information to manufacturer of motorcycle who has interest in capturing market in Nigeria whose economy has been considered as the fastest-growing market in Africa (Yuval *et al.*, 2012 and Acha, 2014).

### **Posture**

The posture adopted by motorcycle rider is unobjectionably a seated posture with all the attendant risks of musculoskeletal traumas. This is an important ergonomic risk factor that has been found to have determining influence on the comfort and performance of the operator of technological system. The variations in the design of elements which interfaces with the operators of different brands of motorcycle often imposes awkward posture which leads to stress and strain on human body parts as well as general work related health challenges. Riding of motorcycle especially the two-wheeled types for commercial purposes could not be considered as comfortable as the length of time and frequency of exposure postural damage become significantly traumatic. The seated posture is characterized by the lower back pains caused by the weight of the body (head neck, upper arm, and thoracic) which is transferred to supporting area – the ischial-tuberosities of the pelvis and their surrounding tissues- coupled with vibration, static positioning for a long time (Akinbo *et al.* 2008, Onawumi, and Lucas, 2012). Various intervention programs are required to correct such damages resulting from long term effects of work related musculoskeletal disorders suffered from awkward work posture.

### **Safety**

The safety of motor-cyclist has remained issue of concern with the level of exposure of riders to unprotected man-machine system, lack of body supports and other stress induced conditions. A number of personal protective wears such as helmet clothing including jackets, boots, and gloves are legislated to serve as safety equipment for cyclists. However, the attitude of business cyclists to safety rules and regulations and the enforcement of the same need much to be deserved.

## **II. MATERIALS AND METHOD**

A survey of 300 motorcycle operators from urban centers which represent adequately the distributive spread of Southwestern Nigeria was conducted using participatory ergonomic intervention approach (PEIA). The instruments of the approach include structured questionnaire, interview, ergonomist expert opinion poll and physical assessment of relevant elements the man-machine system.

### **Personal Data**

The demographic data of the respondents were collected together with other personal data like educational background, years of work experience; hours spent riding for commercial riding purposes and the model of the motorcycle used.

### **Musculoskeletal Problems**

Work related musculoskeletal disorder associated with operators' occupation were investigated. The time dependent of the stress on thirteen body areas were considered through personal interview and questionnaire. The influence of work posture and component design on normal activity of the job, house chore and other responsibilities were included in this survey. To enhance adequate completion of the long list of the questions involved the questionnaire was designed to allow respondents to indicate a yes or no answer to each of the question.

### **Evaluation of Motorcycle Characteristics**

The participatory ergonomic intervention approach used seeks to evaluate selected components which has interface with the operator. These include seat, handle bar, end of hand grip, grip shift lever, fuel tank, exhaust pipe, side mirrors, shock absorber (rear and front), kick starter lever, oil level indicator, speedometer and

odometer. This method considers vehicle and road condition and rider’s environment from rider’s opinion and perceptions. The assessment of adequacy of the components under investigation were sort for with yes or no questions and based on individual opinion of the operators of the different types of the motorcycles

**III. RESULTS AND DISCUSSION**

The operators of Okada in Nigeria peak through the 19-30 rider age bands as shown in Figure 1. About 57 % of the respondents in this group are specifically youths who are drop outs from secondary school education and likewise recognized with some vices such as right of way violations (ROWVs), drug abuse, wrong overtaking and street fight which continues to posse social risks to the society. Younger riders of the 13-18 age brackets are significantly low with 3 % of the respondents in the group. This category of riders was known for excessive speeding while driving. However, Okada business riding has effectively accommodated the unemployed youths and keeps them usefully engaged in productive venture.

Figure 2 shows the limits of the experience of the operators with 82 percent having maximum of six years’ experience. This suggests that occupational ridding of motorcycle has neither future nor job security.

No particular challenging skill different from riding skills is acquired during the work life and because of the occupational health hazards like anemia, rheumatics and other musculoskeletal disorders characterizing the job a large number of people desert the job too earlier than expected. Figure 3 shows that the maximum qualification of about 85 % of the operators is WAEC/SSCE among which 27 % of are with school certificate. The general low level of education was found to have direct link with the rider attitude and risk perception of motorcycling.

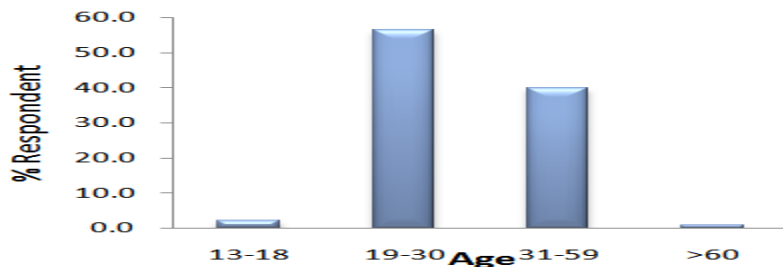


Fig. 1: Age of Motorcycle Operators

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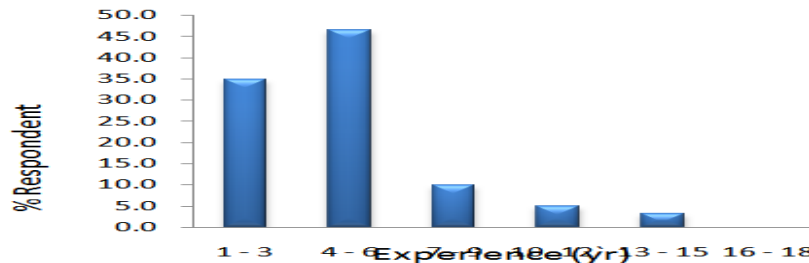


Fig. 2: Experience of the Operators of Motorcycle

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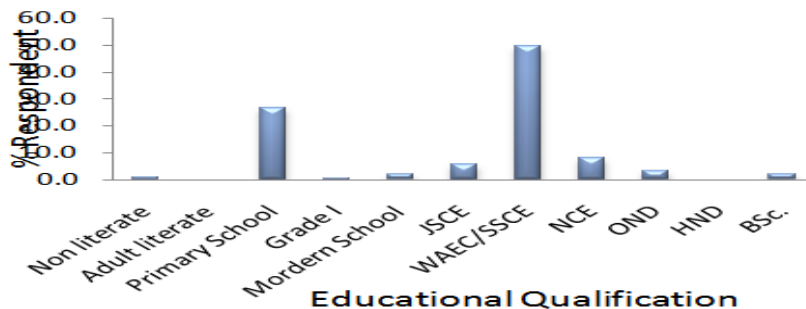


Fig. 3: Educational Qualification of Respondents

It is also a considered opinion that business riding of motorcycle is free for all able adults and a means of livelihood for the uneducated as well as unemployed.

Eighty-five percent of the operators personally own the motorcycle they are using for the commercial purposes. This provides the freedom to spend more hours on the job each day even at the expense of their wellbeing and safety. Figure 4 indicate that 48 % of the respondents cover between 50 and 100 km per day while about 40 % run the motorcycle for over 100 km in a day. An interview of the riders posits that business riders were generally categorized into two namely the owners and paid riders. The class belonging to the owners were observed to be more courteous and safety considerate than the paid riders.

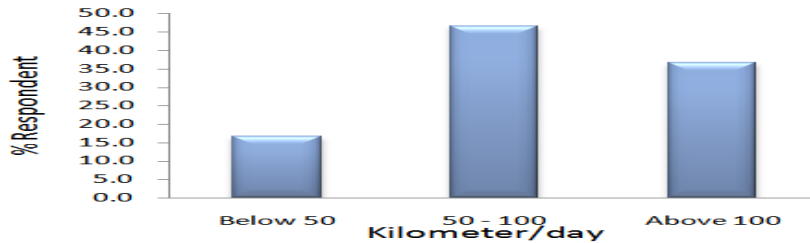


Fig. 4: Kilometer Covered

Eighty-five percent of the operators personally own the motorcycle they are using for the commercial purposes. This provides the freedom to spend more hour on the job each day even at the expense of their wellbeing and safety. Figure 4 indicate that 48 % of the respondents cover between 50 and 100 km per day while about 40 % run the motorcycle for over 100 km in a day. Most of the respondents often set sales target for each day job which they work beyond normal 8 hr day job in order to meet them as shown in Figure 5. This suggests the reason for the excessive physical load that the riders are exposed to and since there is no control or enforcement of kilometer limit by any organized safety body the operators also stress the motorcycles beyond expectation. This situation placed considerable socioeconomic and psychological pressure on the riders thereby compounding ergonomic challenges and creating high potential for accident leading to physical and mental disorder. Sweddiwedhipong et al (2011) in their study presented similar picture for the riders in Thailand.

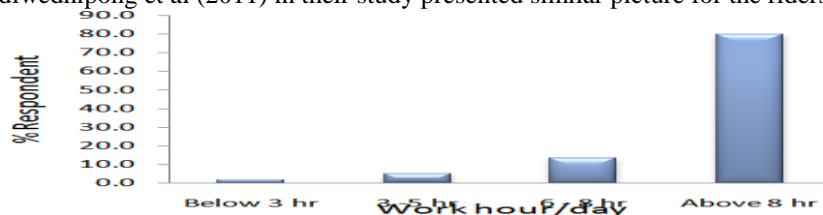


Fig 5: Work hour per Day of Business Riding

The Occupational Risk factors (ORFs) identified by the riders were found to include posture, health condition, component design, bump, state of road, working environment and stress/fatigue. The ORFs were found to be bimodal with about 27 % of respondents ranking road and stress/fatigue ranked high among the identified risk factors as shown in Figure 6. Other closely significant risk factor is the working environment of the rider. The high riding hours of the motorcyclist increased the level of exposure hence the high frequency of reported injuries and health hazards.

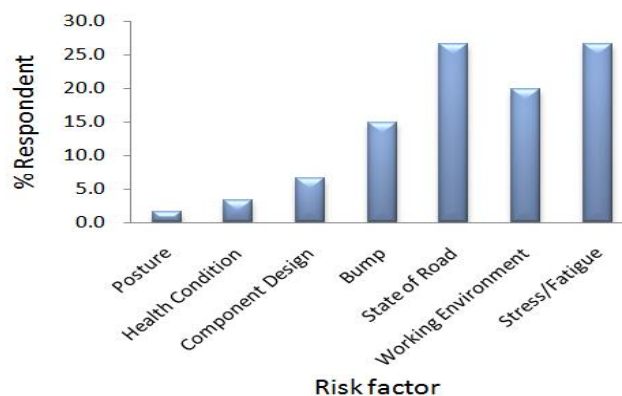


Fig 6: Identified Occupational Risk Factors

Seventy-three percent of the motorcycles are of Jincheng make as shown in Figure 7. This could be as result of its availability in the market affordability and the repair mechanics. The riders have little of no control on its importation in the county hence the forced adaptation of the cyclist and the business riders in particular. The popular choice of Jincheng as indicated by the respondents was partly to its stability and esthetics and not necessarily due to comfort or fitness of the technological system. This survey reveals the individual rider's experience of stress on related body elements with time.

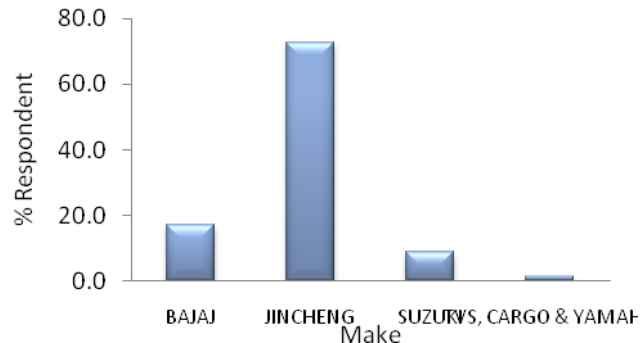


Fig 7: Make of Motorcycle Used

Significant stresses were experienced on the assessed thirteen body parts as shown in Figure 8. The stress experience equally ranked high on hand and thigh (49 %), at much earlier period of riding while it became traumatizing on the buttock and foot (26 %, 24 %) after a long period of over 9 hours of riding. The general concession was in favor of shoulder as the part on which stress which leads to pain and other discomforts are felt followed by neck, arm, head and lower back as shown in figure 9. The neck and head were also upset which forced affected riders to assume some awkward position within the period of endurance of the body strain and riding stress. Design features of the motorcycles studied contributed significantly ( $p=0.5$ ) to the musculoskeletal disorder suffered by the rider population studied.

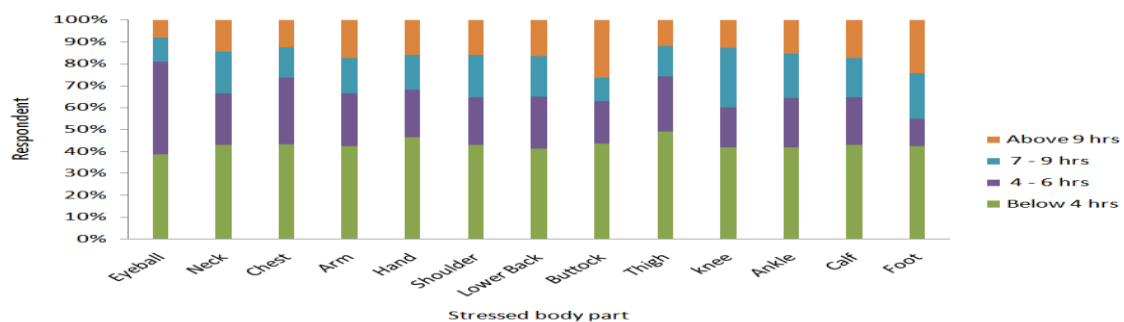


Fig 8: Stress Experience on body parts

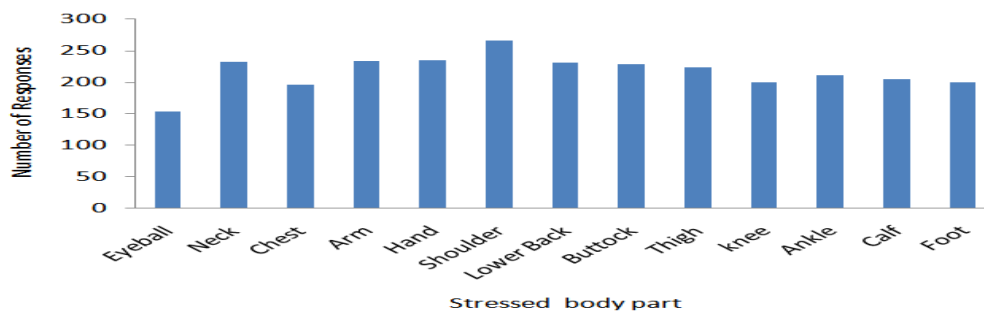


Fig. 9: Number of Responses to Stresses on Body Element

#### IV. CONCLUSION

Nigeria is recognized as a major importer of motorcycles most of which were found to be contributor to ergonomic risks experienced by its operators. The stress, pain and discomforts are associated with design failure which results from the use of anthropometric dimension that is foreign to Nigerian user population. Motorcycle is a major means of transportation especially in the developed country where unemployment has brought setback in the economy. The hazard posed by the imported technological system on human operator is still under study with observed mismatch between the motor cycle and its rider. This work has established the need

to devote more research effort to the ergonomic design of motorcycle and the inclusion of local content relating to the anthropometric dimension of adult population of Nigeria. The unavailability of anthropometric data bank for Nigeria technological system user population should be addressed alongside 2020 MDGs. Workable legislative framework refraining indiscriminate importation of unfit automobile will go a long way in the enforcement of ergonomic rules and the attending comfort, productivity, safety and effective and efficient operation of machine. The supports of statutory government agencies in charge of customer protection such as Federal Road Safety Commission and International Standard Organization would go a long way to enforce necessary rule, regulation and standards made to control the importation of motorcycle thereby reducing the accident rate of the important motor vehicle and enhance productivity of commercial rider in Nigeria. FRSC.

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