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Tactile Acuity among Commercial Motorcyclists in Uturu, Nigeria

C. D. Ubani[1], S. K. Oparah[2*], A. A. Nwankwo[1] and E. E. Osim[3]

[1]Department of Physiology, College of Health Sciences, Abia State University, Uturu, Nigeria.
[2]Department of Internal Medicine, College of Medical Sciences, University of Calabar, Nigeria.
[3]Department of Physiology, College of Medical Sciences, University of Calabar, Nigeria.

Author's contributions

This work was carried out in collaboration between all authors. Author CDU was involved in the study design, literature search, writing of protocol, data collection and statistical analysis of this manuscript. Author SKO was involved in the study design, literature search, statistical analysis, and wrote the first draft of the manuscript. Author AAN was involved in the study design, writing of protocol and data collection author EEO was involved in the study design, writing of protocol, reviewed the statistical analysis and the first draft of the manuscript. All the Authors read and approved the final manuscript.

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ABSTRACT

Aims: To determine and compare tactile acuity of commercial motorcyclists with that of their age and sex matched controls.
Study Design: Cross sectional study.
Place and Duration of Study: The study was done in Uturu, a suburban university town in South Eastern Nigeria, from July 2014 to August 2014.
Methodology: We determined two point discrimination threshold distances on the right thumbs of two hundred (200) consenting commercial motorcyclists aged between 18 to 60 years and two

**Corresponding author: Email: sidkele@yahoo.com;*

hundred (200) of their age and sex matched controls.
Results: The mean values of two point discrimination threshold distances were 6.03 mm (Standard Deviation = 2.484) and 4.31 mm (Standard Deviation = 2.046) in the test and control subjects respectively (t =7.558; $p < .001$). There was positive linear association between two point discrimination threshold distance and the age of the subjects, and their duration of operation as commercial motorcyclists (r = .752; $p < .001$ and r = .770; $p < .001$), respectively. Duration of service as a commercial motorcycle operator ($p < .001$), age ($p = .004$) and impaired sense of fine touch ($p < .001$) were independent predictors of deficits in tactile acuity.
Conclusion: Tactile acuity was impaired in the assessed Nigerian commercial motorcycle operators compared with their controls. Measures of mitigating effects of the occupation on tactile acuity should be explored.

Keywords: Tactile acuity; commercial; motorcyclists; Nigeria.

1. INTRODUCTION

Motorcycles have been a means of transport and sporting activities since the 19th century, and their use has long been regarded as fraught with health issues [1,2,3]. In resource poor sub Sahara African settings such as obtainable in Nigeria, commercial motorcycle operators who operate several hours daily without adorning adequate protective gears are prone to associated occupational hazards facilitated by avoidable exposure to health hazards.

In the course of their operation, commercial motorcyclists constantly rub their palms on the motorcycle handles, engaging their fingers to accelerate the machines and to lift passengers` loads. The aforementioned activities encourage excessive pressure on cutaneous mechanoreceptors, on the palms and fingers, which is known to impair tactile acuity [4,5]. Tactile acuity described as the keenness of the sense of touch, refers to a person`s ability to recognize touch sensations on the body as separate with precision. Although differences exist in tactile acuity between different digits of the same hand, reports have demonstrated no significant difference in tactile acuity between homologous fingers of the two hands [6,7]. Tests of two point discrimination threshold, using blunt dividers on the skin to determine the minimum distance between two points that can be perceived as separate, is a simple and inexpensive way of assessing tactile acuity [5]. Increase in value of the two point discrimination distance implies impairment of tactile acuity.

Other ways of measuring tactile acuity include passive methods such as the Grating Orientation Threshold and the Two-point orientation discrimination (2POD). In the latter test, a subject tries to identify the axial orientation of the two points of skin contact with the instrument [8]. Assessment of Grating orientation threshold involves a participant identifying the orientation of a grating comprising of equally spread grooves and ridges, of varying widths, presented in either of two orientations [9,10]. This method precludes the interference by intensity clues in the measurement. Recently developed psychophysical procedure for evaluating tactile acuity involves the use of charts having characters with dot patterns, similar to Braille, or raised Landolt rings of different sizes and orientations [11]. These charts which are easily administered, do not demand control of the duration and force of application of contact. Although there had been criticisms of the adequacy of the two point discrimination test in measuring tactile spatial acuity [12,13,14], it is still widely employed especially in resource poor settings faced with constraints in the availability of facility for neurophysiological recordings and funds.

There is no existing report on the state of tactile acuity among commercial motorcyclists in Nigeria, whereas reports exist of some other sensory impairments such as in the auditory and visual functioning of these motorcycle operators in Nigeria [3,15]. In this study, we determined and compared the tactile acuity of commercial motorcyclists in Uturu, a sub urban community in south eastern Nigeria, with that of their matched controls. Our study is hinged on the null hypothesis that there is no difference in the state of tactile acuity in commercial motorcycle operators compared to their matched controls.

2. SUBJECTS AND METHODS

This cross sectional study involved two hundred male commercial motorcyclists aged 18 to 60 years, who ply their trade from 6am to 8pm daily. The study was done in Uturu; a sub urban

university community in Abia state, south eastern Nigeria. The control subjects were age and sex-matched participants, drawn from the university community in Uturu, who were not motorcyclists. None of the participants had pain or any other local neurological or dermatological conditions affecting their tested hands. Those with history of diabetes mellitus, hypertensive, renal, chest, cardiac or eye diseases and those who have spent less than one year as commercial motorcyclists or who declined to fully participate in the study were excluded. It is noteworthy that the prevalent practice in the local community is to discourage left handedness right from early childhood, in line with cultural norms and beliefs. As a result most individuals tend to present with right handedness during adulthood. The study involved only participants who gave informed consent. Clearance was obtained from the ethical committee, College of Medicine and Health sciences of Abia state university, Uturu.

A simple random sampling technique was applied in the selection of both test and control subjects. Questionnaires were used to obtain data on demographics and duration of working as a commercial motorcyclist. Fine touch sensation was tested on the finger tip of the self-reported dominant hand (right index finger) with a wisp of cotton wool, for both test and control groups, with their eyes closed and the results were recorded accordingly. Two point discrimination tests were carried out with a pair of blunt dividers and a meter rule, on the right thumb of both test and control groups with their eyes closed, and the results corresponding to the inter-point distances at which the participants could no longer distinguish two points as separate were recorded.

Data was analyzed using SPSS version 22 statistical package. Means and standard deviation (SD) were used for continuous variables, and simple proportions were used for categorized data. Chi square and student's t test were used to compare proportions and numerical variables respectively. Linear correlation was used to determine the association between two point discrimination distance and some other variables (age of the test subjects and their duration of operation as commercial motorcyclists). Regression analysis was employed to determine the predictors of impaired tactile acuity in the subjects. The level of significance was set at $p < .05$.

3. RESULTS

This study was carried out on 200 male commercial motorcycle operators in Uturu, a sub urban university town in south eastern Nigeria, and 200 of their age and sex-matched controls.

The test and control subjects had the same age range of 18 to 60 years with the mean ages of 41.89 years (SD =11.88) and 39.47 years (SD =11.40), respectively (t = 2.07; p = .039). The mean duration of their occupation as commercial motorcycle operators is 6.89 years; SD = 3.23, with a range of one to twenty years of operation.

Sixty seven percent of the motorcycle operators (test subjects) had impaired sense of fine touch compared with 25.5% of the controls, whereas 33% and 74.5% of the test subjects and controls had normal results of fine touch examination respectively (χ^2 = 69.28; $p < .001$). The mean value of the two point discrimination result was significantly higher in the test subjects (6.03mm; SD = 2.484) compared to the value (4.31mm; SD = 2.046) obtained from the controls (t =7.56; $p <$ .001). The results of the fine touch and two point discrimination examinations are as shown in Table 1.

There is a positive linear association between two point discrimination distance and the age of the test subjects, and with their duration of operation as commercial motorcyclists (r = 0.752; $p < .001$ and r= 0.770; $p < .001$, respectively). (Figs. 1 and 2).

Table 1. Outcome of fine touch and two point discrimination tests in the test subjects and controls

Test	Test subjects (n=200)	Controls (n=200)	P-value
Fine touch			
Normal result	66 (33%)	149 (74.5%)	< .001
Impaired result	134 (67%)	51 (25.5%)	
2 point discrimination			
Mean value (mm)	6.03	4.31	< .001
S.D	2.484	2.046	

Impaired sense of fine touch, higher duration of operation as a commercial motorcyclist and increasing age of subjects were independent predictors of prolongation (impairment) of the two point discrimination distance; in a descending order (Table 2).

With the participants sub grouped into young (≤ 39 years) and middle aged (≥ 40 years) groups, the predictive effect of age on two point discrimination was lost in the younger motorcyclists (p =.434), despite persistence of the predictive effects of fine touch outcome and duration of operation (Tables 3 and 4).

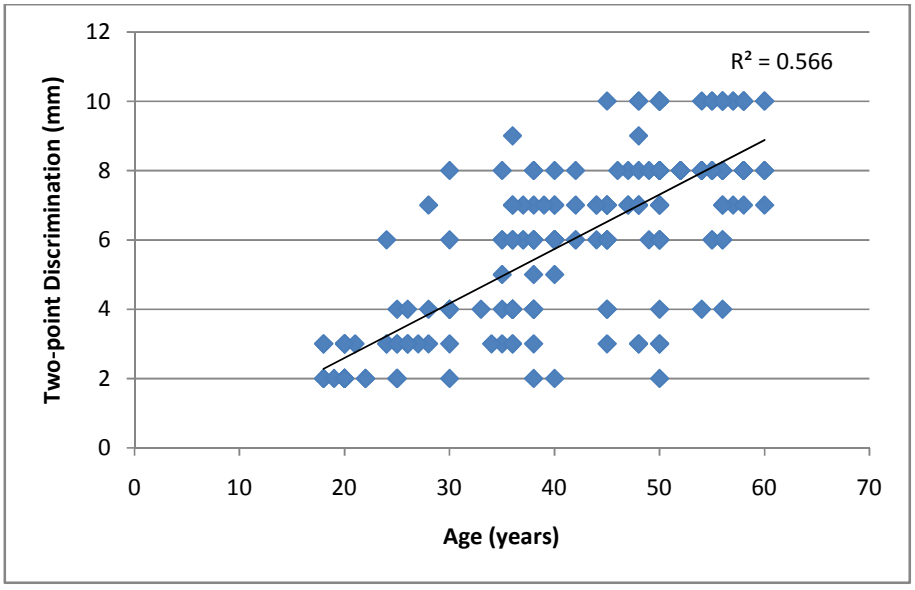

Fig. 1. Correlation of two point discrimination threshold with age of the test subjects
r = 0.752; p < .001

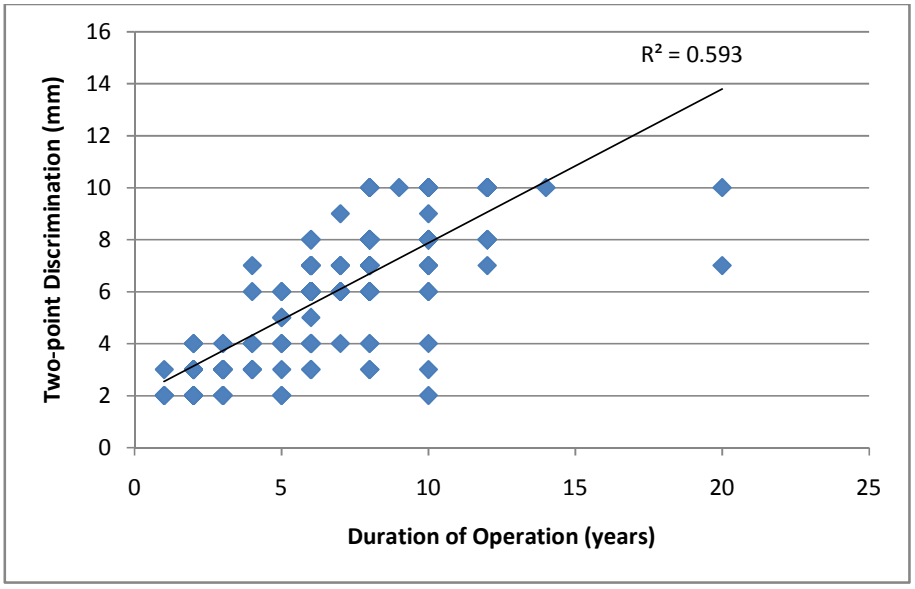

Fig. 2. Correlation of two point discrimination threshold with duration of operation as a motorcyclist
r= 0.770; p < .001

Table 2. Predictors of two point discrimination threshold distance among the test subjects

Independent variable	Beta coefficient	Std error	T	P- value
Age (in years)	.166	.012	2.876	.004
Duration of operation (in years)	.339	.042	6.163	< .001
Fine touch test outcome	- .482	.248	- 10.221	< .001

Dependent variable: Two point discrimination distance (mm)

Table 3. Predictors of two point discrimination threshold distance among the young (≤39 years) test subjects

Independent variable	Beta coefficient	Std error	T	P- value
Age (18 - 39 years)	.056	.019	.786	.434
Duration of operation (in years)	.459	.058	6.231	< .001
Fine touch test outcome	- .526	.233	- 9.126	< .001

Dependent variable: Two point discrimination distance (mm)

Table 4. Predictors of two point discrimination threshold among the middle aged (≥ 40 years) test subjects

Independent variable	Beta coefficient	Std error	T	P- value
Age (40 - 60 years)	.217	.026	2.813	.006
Duration of operation (in years)	.273	.058	3.405	< .001
Fine touch test outcome	- 4.85	.474	- 7.188	< .001

Dependent variable: Two point discrimination distance (mm)

4. DISCUSSION

Our study demonstrates that impairment of tactile acuity, as tested on the fingers, is more frequent in the commercial motorcycle operators compared to their controls. Excessive pressure on the cutaneous mechanoreceptors may result to loss of tactile acuity in the affected parts of the body [4,5]. This may explain the observed propensity to develop deficits in the tactile acuity of these motorcycle operators as they exert pressure on the cutaneous mechanoreceptors on their fingers and palms by frequently rubbing their palms and fingers on the motorcycle handles, engaging the fingers to accelerate the motorcycles, lifting of passengers` goods and other activities in the process of operating the motorcycles. Repetitive motor tasks are thought to result in degradation of somatic sensory representation, with consequent motor control problems and sensory abnormalities [16,17].

Moreover, the observation that length of service as a commercial motorcycle operator is an independent predictor which has a direct relationship with the value of two point discrimination threshold distance, suggests that impairment in tactile acuity is an occupational hazard associated with commercial motorcycle operators. Worsening of spatial tactile acuity and manual dexterity have been demonstrated to be present in persons exposed to occupations involving repetitive fine motor tasks [18,19,20]. Plying their trade in a resource poor setting as obtained in Nigeria, most of the motorcycle operators do not use, and may not even see the need for hand gloves and other protective gears, stemming from ignorance and economic constraints.

Our observation that age of the subjects and deficits in the sense of fine touch were independent predictors of impaired tactile acuity is not surprising. Age differences have been shown to occur in tactile acuity at finger tips with older individuals having poorer performances [21,22]. This corroborates age related changes on the fingers of older subjects as documented by some researchers [7,23]. This may explain our observation that the effect of age on tactile acuity is seen in the older participants. Loss of mechanoreceptors with increasing age has been suggested as an explanation [24]. It has long been observed that increasing age is a known risk factor for some forms of peripheral neuropathy [25,26]. On the other hand, two point discrimination thresholds which was employed to assess tactile acuity in this study, is a cortical sensory function requiring proper conveyance of the modality of touch hinged on adequately functioning cutaneous mechanoreceptors, peripheral sensory nerve fibers and the dorsal

column pathway of the nervous system. Hence, changes in conduction of fine touch modality as a result of suboptimal functioning of the mechanoreceptors brought about by the effects of excessive pressure alluded to above, is a plausible explanation.

This study is the first to document evidence of impaired tactile acuity among commercial motorcycle operators in Nigeria. Our findings in this study may have some far reaching implications. In recent times, the use of motorcycles for commercial transportation has been either prohibited or restricted in major cities of Nigeria in a bid to reduce the incidence of road traffic accident and crimes. In addition to presence of impaired tactile sensations [27], the perceived recklessness of these commercial motorcyclists may among many other factors be as a result of clumsy hand movements, poor coordination and disproportionate application of force when grasping objects, seen as a result of motor control problems and abnormal sensation developed as a consequence of degradation of sensory representation caused by repetitive fine motor tasks [16,18].

We conclude that tactile acuity is impaired in commercial motorcycle operators in the Nigerian community compared with controls. Ways of reducing the risk of impaired tactile acuity in commercial motorcyclists should be explored.

5. CONCLUSION

Our study reveals that two-point discrimination threshold value was higher in commercial motorcyclists compared to the controls. There was a positive linear association between two-point discrimination threshold distance and the age of the commercial motorcyclists and with their duration of operation as motorcyclists. We conclude that tactile acuity is impaired in commercial motorcycle operators in the Nigerian community compared with controls. Ways of reducing the risk of impaired tactile acuity in commercial motorcyclists should be explored.

CONSENT

Informed consent was given by all the participants of this study.

ETHICAL APPROVAL

Ethical clearance was obtained from the ethical committee, College of Medicine and Health sciences of Abia state university, Uturu, Nigeria.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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