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Effects of Air Pollution on the Vital Capacity of Commercial Motorcyclists in Nigeria Population

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Authors' contributions

This work was carried out in collaboration among all authors. Author GUE gave the concept, designed the study and carried out the data acquisition. Author CUO performed the data analysis. Author ODN interpreted the data and drafted the paper. Author NDN performed the critical revision of the paper. Author GUO supervised the study. All authors read and approved the final manuscript.

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ABSTRACT

Background: Ambient air pollution is a serious challenge to human health in most West African countries including Nigeria.
Objective: The objective of the study was to determine the effects of dust inhalation on the vital capacity of commercial motorcyclists in Abakaliki metropolis.
Methods: 200 subjects participated in this study, 100 commercial motorcyclists (test group) and 100 non-motorcyclists (control group). The mean ± S.D of their age, height and weight were calculated. Vital capacity was measured using a spirometer. A questionnaire and consent form was filled by every participant before the commencement of the study. A handheld laser dust measuring device called air sampler PCE-PCO 1 was used to analyze the quantity, quality and sizes of particulate matters present in the research area.

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Data were analyzed using descriptive and inferential statistics; Mean and standard deviations were calculated and the Z-test was used to test if the mean were significantly different. Level of significance was set at 95%.

Results: The age of participants were within the range of 25 – 30 years. Commercial motorcyclists were exposed to particulate matter 0.5, 1.0 and 2.5 μm. The vital capacity of commercial motorcyclists was significantly lower than that of non-motorcyclists (p =0.01). Furthermore, a significant decrease in the vital capacity of commercial motorcyclists was observed when correlated with the number of years spent in the job (p = 0.03). There was also a significant correlation between vital capacity and hours spent per week among commercial motorcyclists (r = 0.245).

Conclusion: Commercial motorcyclists need to be encouraged to adopt respiratory health safety strategies like use of full-face helmets, practice of active cycle of breathing techniques and also, be educated on air pollution hazards by public health workers.

Keywords: Ambient air pollution; occupational hazards; lung capacity.

1. INTRODUCTION

According to Ekpenyong et al. [1] ambient air pollution is a serious challenge to human health in most West African countries, including Nigeria and decreases the life span of people who are continuously exposed to it [1]. In Nigeria, studies have shown an increase in the level of ambient air pollutant in many urban cities, including Abakaliki metropolis, the capital city of Ebonyi State. Some jobs expose workers to more ambient air pollution than others Kjell et al. [2]. Transportation by commercial motorcycle, known as Okada, is a form of urban city transportation that conveys passengers from one destination to another, even to the outskirts of the city, for commercial gain. Commercial motorcyclists are among workers that can be exposed to unusual large amounts of air borne particulate matters Herve et al. [3]. They spend a large portion of their working time at roadsides, which increases their exposure to airborne particulate matter Herve et al. [3]. Particulate matters are usually in the size range from about 1 to 100μm in diameter and they settle slowly under the influence of gravity. Particulate matters are classified by size of the particles into ultrafine PM<0.5 μm, coarse PM1.0 – 2.5 μm, fine PM>2.5 μm and PM≤ 10 μm Brook et al. [4]. These airborne particles are composed of solid and liquid components that originate from road dusts, industrialization, vehicle exhaust, forest fire and wind blow soil. Particle size, surface area, and chemical composition determine the health risk posed by the particulate matters Brook et al. [4]. Particulate and gaseous pollutants coexist in the air and may induce adverse health effects, whereas compelling data implicate particulate matters as a major perpetrator of various types of pulmonary diseases, particulate matters rarely exists by itself within the ambient environment because gaseous and semi volatile compounds are constantly changing and interacting (Schwartz and Morris) [5]. Many of these vapor-phase compounds attach to the surface of particulate matters and/or by themselves form secondary aerosol particles Schwarz and Dockery [6]. These particulate matters, when inhaled into the lungs, causes a decline in normal lung volumes and capacities Peters et al. [7]. The potential mechanisms by which ambient air pollution may cause decline in lung function include alterations in autonomic function, local and systemic inflammation and increase reactive oxygen species Brook et al. [4]. Lung diseases that may be cause by ambient air pollution include bronchitis, pneumoconiosis etc. Ghio and Devlin [8]. These diseases decrease the normal lung volumes and capacities such as vital capacity. Vital capacity is the maximum amount of air expelled from the lungs after a maximum inspiration. It is a combination of inspiratory reserved volume, tidal volume, and expiratory reserved volume. Vital capacity can be measured using spirometer Theodoros [9]. In addition to other physiological measurements, the vital capacity can be used to make a diagnosis of underlying lung diseases. For instance, in restrictive lung disease, vital capacity is decreased while in obstructive lung disease, it is usually normal or slightly reduced. It can also be used to determine the involvement of respiratory muscles in neuromuscular diseases. The vital capacity of a normal adult ranges between 3 to 5 liters. Factors that can affect vital capacity include age, sex, height, weight and ethnicity Braun and Lundy [10]. Vital capacity increases with an increase in height, and decreases with an increase in body mass index (BMI).

Many studies have been carried out to determine the effects of air pollution on the respiratory system of motorcycle taxi drivers and commuters Lawin et al. [11], Chan et al. [12], Nazelle et al. [13], Tsai et al. [14], Ekpenyong et al. [1]. Martin et al. [15] carried out a study to evaluate the association between chronic exposure to outdoor air pollutants and adult lung function, and showed that exposure to particulate matter <10 μm in diameter, nitrogen dioxide and sulfur dioxide were associated with lower adult forced expiratory volume in one second (FEV_1). Forbes et al. [16] conducted a study to investigate the association of long-term exposure to ambient air pollution with lung function in 7613 adults. The result showed 10 μgm−3 increase in NO_2 exposure was associated with lower levels of FEV_1. James et al. [17] revealed that exposure to air pollution adversely affects the growth of lung function during the period of rapid lung development.

The menace of air pollution with respect to lung volumes and capacities may have been well documented in Nigerian. However, no study has investigated the effects of air pollution on the vital capacity of commercial motorcyclists in Abakaliki metropolis where majority of the people are engaged in motorcycling to earn a living, especially in dust emitting areas. Hence the need for this study to bridge the gap in knowledge about the effect of air pollution on the vital capacity of commercial motorcyclists in Abakaliki metropolis.

2. METHODS

This was a cross sectional study. The study was conducted on commercial motorcyclists and non-motorcyclists.

One hundred commercial motorcyclist (test group) and 100 non-motorcyclist (control group) were purposively sampled.

A pocket spirometer (version: micro medical gold standard spirometer, M503 with serial port: SN24424, CE0120) was used to measure vital capacity. Questionnaire was used to determine participant's age, sex, ethnicity, and years in the job. Participants with respiratory diseases and habitual smokers were excluded. Questionnaire was developed by the authors and it was interviewers – administered.

A handheld laser dust measuring device called air sampler PCE-PCO 1 was used to analyze the quantity, quality and sizes of particulate matters present in the research area.

Hand sanitizer was dispensed for the participants, their identifications confirmed via questionnaire, weight and height measured. Each participant was screened via the questionnaire in other to ensure that he meets the inclusion criteria to participate in the study.

Vital capacity was assessed as follows: Participants were told to sit on a chair for at least 3 minutes to relax and stabilize vital signs. The procedure for an expiratory maneuver was performed according to the American Thoracic Society (ATS 1994) and European Respiratory Society guideline.

2.1 Statistical Analysis

The age, height and weight of each subject were described by mean and standard deviation. The mean duration of the groups was analyzed using inferential statistics of Pearson moment rank correlation coefficient in relation to their mean vital capacity. The mean vital capacity of both groups was compared using a Z-test. Level of significance was set at 95%.

3. RESULTS

Table 1 shows the total number of participants (200), gender, ethnicity, age groups, marital status, education, weight and height of the participants. It also shows the population of the participants (commercial motorcyclists and Non-commercial motorcyclists). Furthermore, Table 1 shows job experience in years of the commercial motorcyclists and work duration in hours per week by the commercial motorcyclists.

Table 2 shows a significant difference between the vital capacity of commercial motorcyclists and non-commercial motorcyclists ($P = 0.0134$). It also shows significant difference in the height and weight of commercial motorcyclists when compared with non-motorcyclists ($P = 0.0211$ and 0.0321 respectively). Furthermore, Table 2 shows the mean and standard deviation of the number of hours spent per week and number of year commercial motorcyclists spent on the job.

Table 1. Demographic characteristics of study participants

Variables	**Number**
Gender	Male
Male	200
Ethnicity	
Igbo	200
Age group (Years)	
25 – 27	148
28 – 30	52
Marital status	
Married	51
Single	149
Population	
Commercial motorcyclists (CM)	100
Non motorcyclists (Non-CM)	100
Education	
Primary	10
Secondary	145
Tertiary	45
Job experience (Years)	
1 – 4	82
5 – 8	18
Work duration (Hours/week)	
60	41
78	44
90	15
Weight (kg)	
65 – 70	68
71 – 75	88
76 – 80	44
Hight (Meters)	
1.50 – 1.60	70
1.62 – 1.71	85
1.72 – 1.82	45
Total number of participants	200

Table 2. Characteristics of participants

Variables	**CM**		**Non CM**		**P-value**
	Mean	**SD**	**Mean**	**SD**	
Age (years)	27.48	3.06	25.8	1.55	0.5434
Height (M)	1.688	0.04	1.708	0.07	0.0211
Weight (kg)	69.64	4.97	71.16	3.33	0.0321
Vital capacity (ml)	3520.6	18.32	4331.4	66.3	0.0134
Number of years as CM	15.75	20.73	0.00	0.00	
Hours per week as CM	189.65	98.04	0.00	0.00	

CM: Commercial motorcyclists
Non-CM: Non-commercial motorcyclists
SD: Standard deviation

Table 3. Correlation between number of years and hours per week spent on the job with vital capacity among commercial motorcyclists

Variables	**R – value**	**P – value**
Number of years spent on the job versus vital capacity	0.162	0.03
Hours spent on the job per week versus vital capacity	0.245	0.001

Table 3 shows a significant relationship between the vital capacity and number of years spent on the job among commercial motorcyclists. It also shows a significant correlation between vital capacity and hours spent working per week among commercial motorcyclists.

4. DISCUSSION

There was significant difference between the weight of commercial motorcyclists and non-motorcyclists, an indication that body weight may influence the vital capacity. This finding is in line with the study done by Pavlica et al. [18] who reported that a significant association exists between vital capacity and weight among adult population. Similar to the findings in this study James et al. [17] reported a significant association of height and vital capacity across three major US race.

The significant decrease observed in the vital capacity of commercial motorcyclists when compared with the non-motorcyclists implies that commercial motorcyclists may be susceptible to impaired lung function because of their exposure to ambient air pollution. This finding agrees with the study done by Forbes et al. [16] who studied the association between chronic exposure to outdoor air pollutants and lung function among adult. They found that exposure to particulate matter was associated with poor lung function especially FEV_1. Also, Martin et al. [15] investigated the association between long-term exposure to ambient air pollution and lung function in 7613 adults. They found a strong relationship between exposure to air pollution (NO_2) and impaired lung capacity.

The significant decrease observed in the vital capacity of commercial motorcyclists when correlated with the number of years spent in the job suggests that adverse respiratory health effects of air pollution exposure may be duration dependent. Significant correlation was observed between vital capacity and hours spent per week by the commercial motorcyclists. This agrees with the finding of Korn et al. [19] who found that the adverse health effect of inhaled dust is dependent on its size, duration, distribution and nature of the dust. This finding is also in accordance with the study done by James et al. [17] who reported that exposure to air pollution adversely affects lung development and functions especially between ages 10 and 18 years.

5. CONCLUSION

Commercial motorcyclists have significantly lower mean vital capacity than non-commercial motorcyclists. Their reduced vital capacity may predispose them to lung function impairment. The significant correlation observed between vital capacity and number of years and hours spent per week among commercial motorcyclists is an indication that exposure to dusts with reference to duration may cause lung function inadequacies.

6. LIMITATIONS

Inability to measure lifestyles variables of the participants.

7. RECOMMENDATIONS

Full-face helmets should be used by commercial motorcyclists to prevent dust inhalation and concurrent lung impairments. Full face helmet can give 80 to 90 percent reduction of dust inhalation. Currently, commercial motorcyclists in Abakaliki metropolis wear nothing to protect their lungs.

Education of commercial motorcyclists by public health workers on the risks of air pollution through health out reaches.

Practice of active cycle of breathing techniques to prevent respiratory impairments.

Improved air quality as a health promotion strategy through Government policies.

LESSONS LEARNED

1. Paucity of knowledge on respiratory health among commercial motorcyclists.
2. Poor educational qualifications amongst commercial motorcyclists as determined through questionnaire.

DECLARATION

The authors declare that this is our own work, and all the sources used in this paper have been duly acknowledged and there is no conflict of interest.

CONSENT

As per international standard or university standard, Respondents' written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

Ethical approval was obtained from Ebonyi State University Ethical Committee (reference number EBSU/REC/BMS/1908/03/001).

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Ekpenyong CE, Ettebong EO, Akpan EE. Urban city transportation mode and respiratory health effect of air pollution: A cross-sectional study among transit and non-transit workers in Nigeria. BMJ. 2012; 2:1253.
   DOI: 10.1136/bmj.2012.001253
2. Kjell T, Ingvar AB, Tohr N, Bengt J. Occupational exposure to particulate air pollution and mortality due to ischaemic heart disease and cerebrovascular disease. J Occup Environ Med. 2007;64 (8):515 -19.
3. Herve L, Lucie AF, Arsene AK, Antoine VH, John B, Jacqueline W, et al. Comparison of motorcycle taxi driver's respiratory health using an air quality standard for carbon monoxide in ambient air: a pilot survey in Benin. Pan Afr Med J. 2018;30:113.
   Doi: 10.11604/pamj.2018.30.113.14975
4. Brook R.D, Franklin B, Cascio W, Nicolas S, James K, Freeman L. Air pollution and cardiovascular disease: A statement for healthcare professionals from the expert panel on population and prevention science of the American Heart Association. Circulation. 2004;109:2655–71.
5. Schwartz J, Morris R. Air pollution and hospital admissions for cardiovascular disease in Detroit, Michigan. Am J Epidemiol. 1995;142:23–35.
6. Schwartz J, Dockery DW. Increased mortality in Philadelphia associated with daily air pollution concentrations. Am. Rev. Respir. Dis. 1992;145:600–4.
7. Peters A, Liu E, Verrier RL, Decramer F, Rabe B, Timbrell F. Air pollution and incidence of cardiac arrhythmia. J Epidemiol. 2000;11(11):11-7.
8. Ghio AJ, Devlin RB. Inflammatory Lung injury after bronchial instillation of air pollution particles. Am. J Respir and Crit Care Med. 2001;164:704-708.
9. Theodoros Vassilakopoulos. Control of ventilation and respiratory muscles. Clinic respir med. (4th edition); 2012.
10. Braun, Lundy. Race, ethnicity and lung function; A brief history. Can. J. Respir. Ther. 2015;51(4):99–101.
11. Lawin H, Agodokpessi G, Ayelo P, Kagima J, Sonoukon R, Mbatchou Ngahane BH. A cross-sectional study with an improved methodology to assess occupational air pollution exposure and respiratory health in motorcycles taxi driving. Sci Total Environ. 2016;550:1-5.
12. Chan LY, Lau WL, Lee SC, Chan CY. Commuter exposure to particulate matters in transportation mode in Hong Kong. Atmos Environ. 2002;36:1–7.
13. Nazelle AD, Fruin S, Westerdahl D, Martinez D. A travel mode comparison of commuter's exposures to air pollutions in Barcelona. Atmos Environ. 2012;39:151-159.
14. Tsai DH, Wu YH, Chan CC. Comparison of commuter's exposure to particulate matters while using different transportation modes. Sci Total Environ. 2008;40(440): 3–9.
15. Martin A, Schikowski T, Carsin AE, Cai Y, Jacquemin B, Sanchez M, et al. Adult lung function and long-term air pollution exposure: A multicentre cohort study and meta-analysis. Eur Respir J. 2015;45(1): 38-50.
16. Forbes LJ, Kapetanakis V, Rudnicka AR, Cook DG, Bush T, Stedman JR, et al. Chronic exposure to outdoor air pollution and lung function in adults. Bmj. 2009;64 (2):645-46.

17. James WL, Edward A, Frank G, Hita V, Duncan T, Kiros B, et al. The effect of air pollution on lung development from 10 to 18 years of age. N Engl J Med. 2004;12 (15):351-355.
18. Pavlica TV, Bozic-Krstic, Rakic R. Correlation of vital lung capacity with body weight, longitudinal and circumference dimensions, biotechnology & biotechnological equipment. 2010;24 (Sup1):325-328.
DOI: 10.1080/13102818.2010.10817856
19. Korn D, Dominici F, Peng RD, Bell ML, Pham L, McDermott A, et al. Fine particulate air pollution and hospital admission for cardiovascular and respiratory diseases. J Am Med Ass. 2010; 295:1127-1134.

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