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Impact of Road Sweeping on Cardiopulmonary Functions in Female Professional Road Sweepers from Port Harcourt Metropolis

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Abstract

Professional Roadside sweeping is associated with significant exposure to dust and vehicular emissions. Port Harcourt, the industrial and economic hub of Nigeria's oil-rich Rivers State is a nidus for such environmental pollutants. Assessing the functionality of the cardiovascular and respiratory systems in such personnel will be quite revealing. Thus, this study assessed the cardiovascular and pulmonary functions of Professional Road Sweepers in Port Harcourt (PRS-PH). Using the multistage approach, including the purposive and snowball sampling techniques, the present study sampled a total of one hundred subjects (comprising 50 female road sweepers and 50 female non-road sweepers) who were within the ages of 18 and 60 years and residents of the area for five (5) years and above. Following standard methods, the digital spirometer was used to assess the lung functions (Forced Vital Capacity (PVC), Forced Expiratory Volume (FEV1), FVC/FEVI ratio) of Professional Road Sweepers in Port Harcourt Metropolis. The result indicated significant ($p<0.05$) difference in the blood pressures of the exposed group with respect to that of the unexposed group. The study revealed significantly ($p<0.05$) raised levels of Forced Vital Capacity (FVC), Forced Expiratory Volume in 1 second (FEV1), and FEV1/FVC ratio. This outcome is suggestive of a possible restrictive lung disorder in the road sweepers; In conclusion, the results of the study reveal a risk of cardiopulmonary disorders among the road sweepers. These findings will offer valuable insight and raise awareness and establish comprehensive measures that could protect these essential workers from cardiorespiratory hazards associated with their occupation.

Keywords: Professional Road Sweepers; pulmonary function test; blood pressure; occupational hazards.

INTRODUCTION

With the increasing need for formulation and implementation of occupational health and safety management systems, many scholars have focused on the existence of such as well as their efficacies (Podgórski, 2010; Mohammadfam *et al.,* 2017; Bianchini *et al.,* 2017; Çalış & Büyükakıncı, 2019). Organizations with Occupational Health and Safety Assessment certification have had a higher level of occupational health and safety experience. And this position supports the view that occupational health and safety management systems exert a significant strategic impact on workplace health and safety (Zanko, 2012; (Mohammadfam *et al.,* 2017).

A safer work environment/condition is described as not only less stressful but enhancing productivity (Balderson *et al.,* 2016; Siregar *et al.,* 2020). Indeed, the recognition of work environment/condition hazards helps in significantly reducing the risk of accidents/injuries and other health conditions (Namian *et al.,* 2016; Pandit *et al.,* 2019). More so, reduced exposure of personnel to occupational hazards can also reduce the employee's absences due to illness or injuries which will

ultimately result in increased efficiency and productivity as well as expanding the employee's relations and morale (Ose, 2005; Asumeng *et al.*, 2015).

Considering road sweepers, their exposure to different hazards often leads to various health problems, which include respiratory disorders, such as mucous membrane irritation, allergy, rhinitis, asthma, bronchitis, hypersensitivity pneumonitis, etc., (Nku, 2005; Priyanka & Kamble, 2017; Johnson & John, 2020). Additional health issues include musculoskeletal disorders, ocular challenges, headache, fatigue, dizziness, anaemia, gastrointestinal problems, and injury or accident. (Wahab & Ogunlola, 2014; Etim *et al.*, 2019; Johnson & John, 2020).

To make matters worse, street sweepers often do not use personal protective equipment (PPE) which may minimize risk from exposure to workplace hazards; in fact, records have it that there is very poor use of PPE amongst these; thus, the raised risk of occupational hazards workforce (Wahab & Ogunlola, 2014; Etim *et al.*, 2019). Furthermore, indications of traumatized cardiopulmonary health could suggest serious risks to cardiovascular health and overall well-being; such conditions may predispose individuals to increased risk of heart disease, stroke, and other cardiovascular conditions (Rumsfeld *et al.*, 2013; Levine *et al.*, 2021). Of course, pulmonary function tests (PFTs) are noninvasive tests that show how well the lungs are working and that the outcome of the tests may help healthcare provider diagnose and decide the treatment of certain lung disorders (Schlegelmilch & Kramme, 2011; Ponce *et al.*, 2023).

Consequently, the present study set out to evaluate the possible impact of road sweeping on cardiopulmonary functions in professional road sweepers from Port Harcourt Metropolis.

MATERIALS AND METHODS

Study Design

The study was a cross-sectional survey on professional road sweepers in Port Harcourt Metropolis using multistage approach which included purposive and snowball sampling techniques for the subjects. Data was collected and analysed sequentially from each study subjects. Data collection included both qualitative and quantitative methods. Quantitative data was presented in numerical values and from which statistical inferences from the study subjects were made. Qualitative data used non-numerical data such as observations and interviews.

Study Area

The study area was Port Harcourt Metropolis. Port Harcourt is the capital of Rivers State, southern Nigeria. The area is comprised of the following local government areas: Port Harcourt, Obio-Akpor and Oyigbo and parts of Okrika, Ogu–Bolo, Ikwerre, Etche and Eleme local government areas. Port Harcourt Metropolis was selected for the study considering its high population density and busy nature and the possible huge turn-over of refuse that demands proper cleaning. Of course, the outcome provides precise prevalence of cardiopulmonary health conditions amongst street sweepers. The metropolis plays host to many commercial activities, such as oil and gas exploration, banking, national offices, large/small scale businesses. The area is one of Nigeria's leading industrial centres. Due to heavy movement of people and car traffic, with its related production of carbon wastes, fumes, aerosol, bioaerosol and dust on the road, road sweepers and refuse disposing personnel may be exposed to cardiopulmonary related conditions.

Study Population

The target population for this research comprised female road sweepers who were at the time employees of registered environmental cleaning firms in Port Harcourt.

Sample Size Determination

Using the multistage approach, including the purposive and snowball sampling techniques, the present study sampled a total of one hundred subjects (comprising 50 female road sweepers and 50 female non-road sweepers) who were within the ages of 18 and 60 years and residents of the area for five (5) years and above. Recall that the female non-road sweeper subjects had similar demographic profile and served as control group.

Eligibility Criteria

The subjects recruited for the study were consenting, non-smoking female road sweepers and non-road sweepers within ages 18 and 50 years, with no obvious health conditions and residents of the area for five (5) years and above. All surveyed sweepers had been on the job for up to a year or more. All others that fell out of the aforementioned criteria were excluded from the study.

Data Collection Tools and Techniques

A structured proforma was used to collate the subjects' demographic profile and used to record each participant's measured cardiopulmonary data. The cardiopulmonary data of each subject were recorded using appropriate equipment and consumables some of which are electronic spirometer, sterile disposal mouth pieces, sphygmomanometer, stadiometer and recording notes. The sphygmomanometer was used to check the subjects' blood pressure while the stadiometer was used to measure the respondents' weight and height. The procedure for recording each subject's lung function parameters (Forced Vital Capacity (FVC), Forced Expiratory Volume in first second (FEV1), Forced Expiratory Ratio (FEV1/FVC%) and Peak Expiratory Flow (PEF)) using the an electronic spirometer, were as

reported by Wanger, (2011) and Ruppel & Enright, (2012).

Data analyses

Quantitative data obtained from the study were subjected to statistical analysis using the IBM's statistical product and service solution (SPSS) version 21.0. Statistical significance was determined using the independent sample T-test tool of the SPSS. P-value less than 0.05 was considered as statistically significant.

Ethical Clearance

Ethical clearance was obtained from the Faculty of Basic Medical Sciences Research Ethics Committee of the Rivers State University before the beginning of the study. In the same way, administrative permissions were also obtained from local municipal authorities and the heads of the respective cleaning firms the subjects were working for. Written informed consent from each participant was also obtained from each participant. Identities and personal information of all subjects were held in strong confidence.

RESULTS

Here, the results of the current study are presented in tables and charts and were interpreted accordingly.

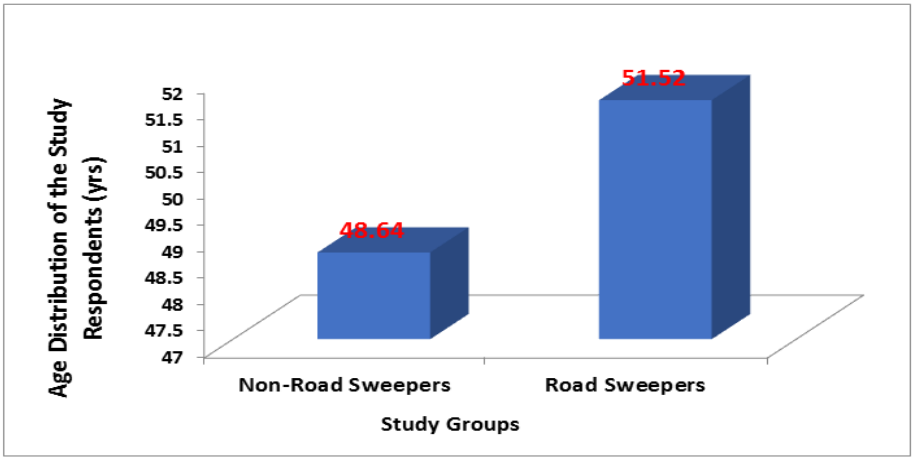

Figure 1: Age Distribution of the Study Respondents (years)

The data on Figure 1 shows the age distribution of the study respondents. It was noted that the road sweepers had a mean age of 51.52 years whereas the non-road sweepers had a mean age of 48.64 years and there was no statistical significance (P>0.05) between these two mean ages.

Table 1: Changes in some pulmonary function parameters among female Road sweepers in Port Harcourt

S/N	Parameters	Study Groups	
		Non-Road Sweepers	Road Sweepers
1.	FVC (l/s)	1.80 ± 0.06	1.82 ± 0.62 [a]
2.	FEV1 (l/s)	1.30 ± 0.04	1.63 ± 0.46 [a]
3.	FEV6 (l/s)	1.80 ± 0.07	1.82 ± 0.61 [a]
4.	FEV1/FVC (%)	72.31	92.13 ± 10.06 [a]

Values represent mean ± SD, n=50; [a] Significant at p<0.05 when mean values of Road Sweepers are compared to that of non-Road Sweepers;

Table 1 shows the result of the possible changes in some pulmonary function parameters among female Road sweepers in Port Harcourt Metropolis. The mean values of FVC, FEV1, FEV6 and FEV1/FVC ratio in the Road Sweepers were all found to be significantly (p<0.05) raised when compared to their non—road sweeping counterparts.

Table 2: Changes in blood pressure parameters among female Road sweepers in Port Harcourt

Study Groups	Blood Pressure Parameters		
	Systolic Blood Pressure (SBP) (mmHg)	Diastolic Blood Pressure (DBP) (mmHg)	Mean Arterial Pressure (MAP) (mmHg)
Non-Road Sweepers	115.00 ± 8.14	72.20 ± 9.32	86.32 ± 8.67
Road Sweepers	148.16 ± 15.37 [a]	90.36 ± 11.55	109.24 ± 11.27

Values represent mean ± SD, n=50; [a] Significant at p<0.05 when mean values of Road Sweepers are compared to that of non-Road Sweepers;

The data on Table 2 shows the changes in blood pressure parameters among female Road sweepers in Port Harcourt Metropolis. It was observed that all blood pressure parameters including systolic blood pressure (SBP) diastolic blood pressure (DBP) and mean arterial pressure (MAP), were raised in the Road sweeping subjects when compared to their Non-Road Sweeping counterparts; although, only that of the SBP was statistically ($P<0.05$) significant.

DISCUSSION

It has been noted that occupational exposure to hazards and unhealthy working scenarios are the most likely causes of mild obstructive disease and pulmonary function parameter changes (Habybabady *et al.,* 2018). Similarly, records have it that, sneezing, coughing, eye irritation, lung tissue swelling, asthma and throat infections may be more prevalent among individuals exposed to occupational dust (Habybabady *et al.*, 2018; Schweitzer *et al.*, 2018).

Considering the forgoing, the present study made a focused investigation by comparing pulmonary functions and blood pressure parameters of dust-exposed street sweepers with those of unexposed individuals in Port Harcourt Metropolis. The key findings are so discussed in the following paragraphs.

The present study recorded a mean age of 51.52 years for the road sweepers whereas the non-road sweepers had a mean age of 48.64 years although, there was no statistical significance between these two mean ages. With a mean age falling within the middle age calls to mind that the efficiency of the pulmonary or respiratory system which is ordinarily greatly impacted by aging (Janssens, 2005; Britto *et al.*, 2009) may adversely limited by such occupational hazard as frequent exposure to dust and others. In fact, an earlier report (Neuberger *et al.*, 1988) concluded that heavy and long-term exposure to respirable particulates maybe *related to raised lung cancer mortality after age 60*. Considering the above finding on the mean age of female road sweepers in our locale, calls for more caution and care for such individuals to guaranty safe respiratory health is very important, especially from relevant stakeholders and government at all levels.

The present study also found that the values of FVC, FEV1, FEV6 and FEV1/FVC ratio in the Road Sweepers were all significantly elevated in the Road sweepers when compared to their none—Road sweeping counterparts. Dust is comprised of the most commonly found harmful particles in the atmosphere, and street sweepers are exposed to a combination of soil, sand and gravel dust particles, vehicle dust, bioaerosols and plant particles (Ajay *et al.,* 2014). During pulmonary ventilation, tiny particles are deposited in the lower parts of the respiratory system, and they become inaccessible to the self-cleansing mechanisms of the body, such as mucociliary clearance. The continued exposure to such condition will no doubt adversely affect the cardiopulmonary functions such individuals (Shadab *et al.*, 2013; Johncy *et al.*, 2014).

Now, considering the above result of the present study, it can be said that elevations in the pulmonary parameters in the road sweeping females could be a physiologic compensatory mechanism to some restrictive conditions possibly induced by such exposures in the road sweepers. Although aging can significantly depress lung function efficiency (Abdullah *et al.*, 2019) but exposure to dust and poor air-quality can harm the respiratory system by adversely impacting lung tissue, causing inflammation, and contributing to a variety of respiratory diseases (Etim *et al.*, 2019; Johnson & John, 2020). Furthermore, the magnitude of these effects is known to vary with the size and type of dust particles, in addition to the duration and intensity of exposure (Kramme *et al.*, 2011). So, the subjects in the present study should be regularly checked for possible pulmonary disorder to enable early diagnosis and prevention of its related diseases.

CONCLUSION

The present study has thus revealed that the road sweepers in the study area present with adversely impacted cardiopulmonary indices possibly due to their working conditions/environment. Therefore, providing the subjects as well as other street sweepers with the appropriate respiratory protection equipment, and periodic health checks for any early diagnosis of pulmonary dysfunction, could be effective for preventing many types of pulmonary damage.

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