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LUNG FUNCTION, OXYGEN SATURATION AND SYMPTOMS AMONG STREET SWEEPERS IN CALABAR-NIGERIA

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Summary: Chronic inhalation of dust impairs lung function and may cause respiratory symptoms. However, knowledge about the type of dust that can cause these problems is uncertain. Very little attention has been paid to the health of workers chronically exposed to dust raised by street sweeping without precautionary measures. Therefore, a study of lung function, oxygen saturation and symptoms among female street sweepers and their control groups in Calabar, Nigeria was carried out. Ventilatory function tests were done using 200 female street sweepers whose length of service was less than two years and 200 sex, age, weight, and height - matched external controls who were not exposed to any known air pollutant. The percentage of oxygen saturation(SPO_2) of both the subjects and their control population was determined using a pulse oximeter. Respirable dust level in the test sites was 0.194 ± 0.002mg/m^3 and it was significantly higher ($P<0.001$) than in control sites, which was 0.015 ± 0.003mg/m^3.There was no significant difference in the mean values of SPO_2 between the test and control subjects. However, there was also a higher prevalence of back pain (40.5% vs 2.0%; $P<0.001$), cough (25.5% vs 12.0%; $P<0.001$), chest pain (13.0% vs 4.0%; $P<0.001$); Catarrh and sneezing (6.0% vs 0.5%; $P<0.01$) among the street sweepers than in their control. Lung function values, namely; FVC, FEV_1, FEV_1% and PEFR were not significantly different in the two groups. Street sweeping without precautionary measures may predispose to respiratory and non-respiratory symptoms.

Key Words: *Lung function, street sweepers, dust, symptoms, oxygen saturation.*

Introduction

Street sweeping is associated with exposure to dust. In Calabar, the capital city of Cross River State of Nigeria, street sweeping is one of the popular occupations of the less privileged. In the occupation, dust is raised during sweeping with brooms, and by vehicular movement as well as other human activities. Street sweepers are chronically exposed to the dust raised. Street sweepers in Calabar do not observe internationally recommended precautionary measures against inhalation of dust, e.g. wearing of facemasks and watering of streets to minimize inhalation of dust. It is likely therefore, that chronic inhalation of dust will affect their health and lung function in particular.

Knowledge about what dusts and chemicals cause disease and how, is uncertain (Ellenhorn and Barcelloux, 1988). Studies have linked exposure to dust generated from heavy goods vehicles (mostly with diesel engines) and busy traffic with respiratory problems (Carlos, 1999). There is also evidence of a link between chronic exposure to dust from heavy traffic and lung cancer as well as other types of cancer (Feychting *et al*, 1998). Exposure to dust has long been associated with the prevalence of varying degrees of airway obstruction and respiratory symptoms in man (Noor *et al*, 2000). A high incidence of cough, chronic bronchitis, sneezing and eye irritation coupled with infection of the throat has also been reported (Mandryks *et al*, 2000). Paved road dust found on the surface of streets in South California in the USA consisted of a complex mixture of soil dust, deposited motor vehicle exhaust particles, tyre dust, brake lining wear dust, plant fragments and other biological materials (Glovsky *et al*, 1997). Chronic inhalation of the paved road dust in USA was associated with the high incidence of asthma. The dust raised by street sweeping in Calabar, Nigeria was similar since it also consisted of a complex mixture of soil dust, deposited motor

vehicle exhaust particles, tyre dust, break lining wear dust, plant fragments, in addition to other biological materials. It is therefore possible that in our environment, street sweeping with brooms without precautionary measures will similarly pose health problems.

In spite of the several reports on the effects of exposure to dust on lung function, there is however, no study on the effect of chronic exposure to dust raised by street sweeping on the lung function of the sweepers in Nigeria. Respiratory and non-respiratory symptoms associated with street sweeping have also not been documented. It was therefore the aim of this study to determine the lung function status, associated respiratory and non- respiratory symptoms as well as oxygen saturation level of street sweepers exposed to dust generated from street sweeping for a period of less than two years in Calabar, a capital city in South eastern Nigeria.

Materials and Methods

Two groups of subjects comprising dust exposed (test) and control groups were studied. Both the test and control groups comprised women who worked and lived in Calabar metropolis in Cross River State of Nigeria.

Test Subjects:

Two hundred female dust exposed street sweepers in Calabar metropolis who have been involved in street sweeping for less than two years were used for this study. Their ages ranged from 18 years to 57years. Their height and weight ranged from 1.44 meters to 1.85 meters and 40kg to 95kg respectively. The study received the approval of all the participants and informed voluntary consent was obtained from each subject. The sweepers used only brooms for sweeping. They did not observe any precautionary measures like wearing of facemasks to prevent the inhalation of dust. The streets were also not watered to minimize the raising of dust.

Control Subjects:

A total of two hundred apparently healthy female subjects were used as controls for the study. They were under-graduates and civil servants engaged in non-dusty occupations and not exposed to any other air pollutant. All the subjects were non-workers and were age and sex-match with the test subjects. The anthropometric parameters (age, height and body weight) of the control group were also similar to the test (dust – exposed) group.

Procedure

Subjects were called in groups and instructed on the test procedure. For easy understanding of the test procedures, demonstrations of the test were performed and all doubts cleared. All constricting clothing such as braziers were
loosened to prevent alteration of test results from restricted thoracic expansion and abdominal mobility. A modified British medical council respiratory disease questionnaire was administered to all subjects before the test was performed. The questionnaire recorded names, length of service, smoking habit, any history of respiratory (pulmonary) disease, while height without shoes and weight with light clothing were measured and recorded.

Peak expiratory flow rate (PEFR) was measured with a mini-Wright peak flow meter. Forced vital capacity (FVC) and Forced expiratory volume at the first second (FEV_1) were measured with a vitalograph Spirometer (Vitalograph limited Buckingham, England). Forced expiratory volume in one second as a percentage of the force vital capacity (FEV_1%) was computed from the values of FVC and FEV_1. Three trials were made per subject at one minute intervals using each instrument and the best reading was taken. The spirometric records were obtained at body temperature and pressure saturated with water vapour. The oxygen saturation level (SPO_2) was obtained from both the test and control groups using a digital finger pulse oximeter (SPO model 5500).

Dust sampling

The concentration of respirable dust in both the test and control sites was measured using a gravimetric dust sampler designed and constructed in the Department of Physics, University of Calabar, Nigeria. The instrument measured the concentration of respirable dust as it maintains a constant supply of air in litres per minute through its filter for 4 hours. The respirable dust was sampled in four control and four test sites and their mean values calculated.

Statistical Analysis

The students unpaired t-test was used to compare the means of test and control values. Chi square test was used to test for significance between two proportions or percentages. A P- value that was less or equal to 0.05 was taken as statistically significant. Data are presented as mean and standard error of mean (SEM)

Results

Table 1 shows the comparison of mean values of anthropometric, lung function parameters and SPO_2 in control and test groups. There were no significant differences in the anthropometric parameters between the control and test subjects. Although the values of the lung function indices appeared lower in the test than in control group, there was no statistically significant difference in the lung function parameters between the control and the test subjects. There was also no significant difference between the mean values of SPO_2 of the control and test groups.

Table 1. *Comparison of mean values of anthropometric, lung function parameters and oxygen saturation in control and test groups.*

Parameters	Control (n =200)	Test (n = 200)	P value
Age (yrs)	29.78 ± 0.59	30.77 ± 0.62	NS
Height (m)	1.61 ± 0.005	1.59 ± 0.0048	NS
Weight (Kg)	59.78 ± 0.71	58.77 ± 0.79	NS
FVC	2.68 ± 0.04	2.62 ± 0.036	NS
FEV_1	2.13 ± 0.04	2.08 ± 0.03	NS
FEV_1 %	79.54 ± 0.46	79.34 ± 0.36	NS
PEFR	365.44 ± 4.30	355.34 ± 4.25	NS
SPO_2	98.11± 0.12	97.42± 0.64	NS

NS = not statistically significant

Figure 1 shows the comparison of dust level between control and test sites. The mean concentration of respirtable dust level in control sites (N=4) was $0.015\pm 0.003 mg/m^3$, this was significantly lower ($p<0.001$) than the mean dust level in the test sites which was $0.194 \pm 0.002 mg/m^3$.

Figure II illustrates the Comparison of respiratory symptoms observed among the control and test subjects (expressed as percentage). Comparison of respiratory symptoms observed among the control and test subjects showed a significantly higher prevalence of respiratory symptoms among the test group than their control. Cough topped the list of the respiratory symptoms (25.5% vs 12. 0%; $p< 0.001$), chest pain (13.0% vs 4.0%; $P<0.01$) and catarrh and sneezing (6.0% vs 0.5%; $p<0.01$).

Figure III shows the comparison of non - respiratory symptoms observed among the control and test subjects (expressed as percentage). The non-respiratory symptoms studied, revealed a higher prevalence of back pain (40.5% vs 2.0%; $P<0.001$) among the test group than their control. Other symptoms such as headache, limb pain and abdominal pain were not significantly different in the two groups ($P>0.05$).

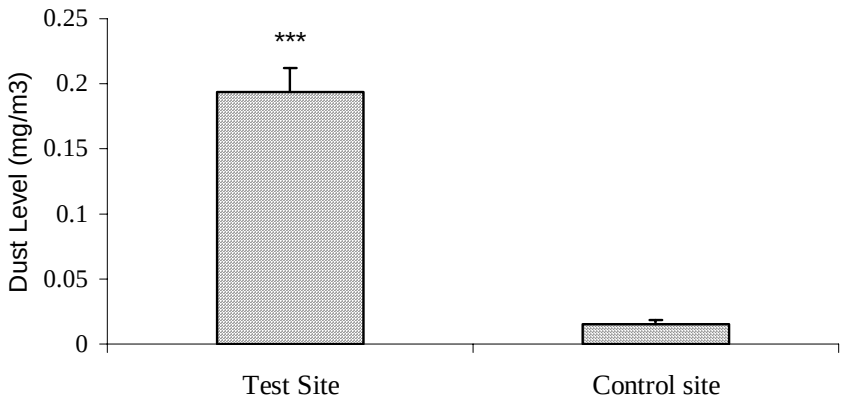

*Fig.1 Comparison of Dust Level between Control and Test Sites. Values are mean ± SEM, n =4; *** = P<0.001.*

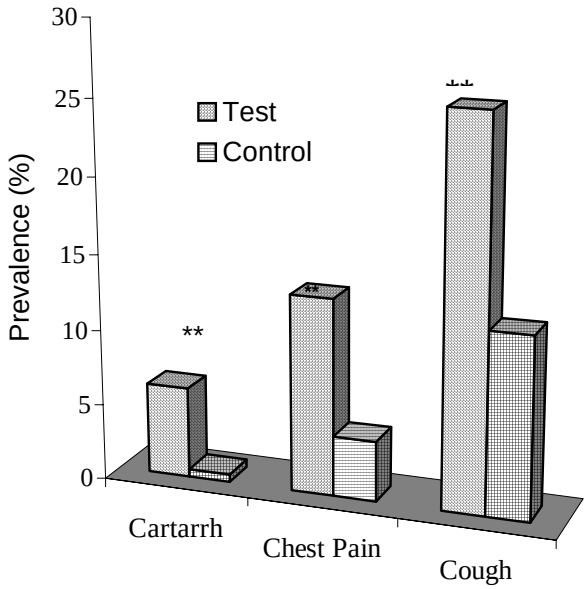

Fig. II *Prevalence of Respiratory symptoms among the street sweepers (test) and their control.*

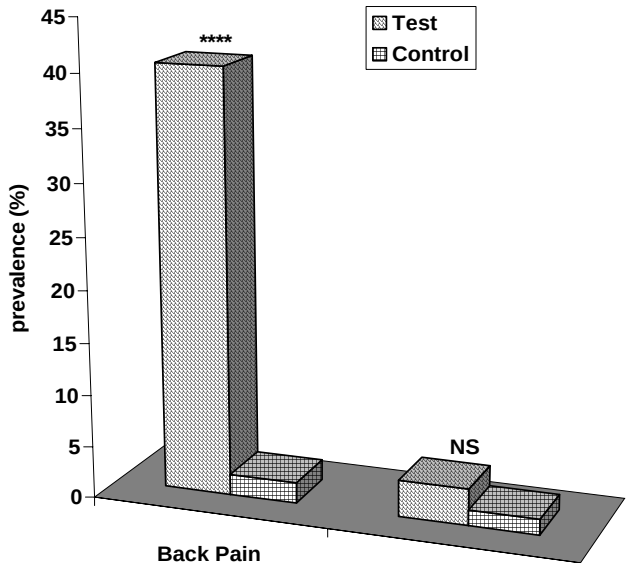

Fig. III *Prevalence of Non-Respiratory Symptoms among street sweepers (test) and their control.*

Discussion

The mean lung function values FVC, FEV_1, FEV_1% and PEFR for the control group obtained in this study were similar to the normal values reported for females by other investigators (Osim and Esin, 1996). These values therefore showed that the control group that participated in the study were apparently healthy Nigerian women.

It has been established from various reports that anthropometric parameters, viz; age, sex, height, weight and ethnicity are factors that account for variations in FVC, FEV_1 and PEFR (Cotes, 1975; Aderele and Oduwole, 1983; Jaja and Fagbenro, 1995; Njoku and Anah, 2004). These factors were taken into consideration. The control and test groups had mean values of anthropometric parameters that were not significantly different. The lung function values in the control and the test groups with similar anthropometric indices also showed that there was no significant difference between the two groups. Although, there was no statistically significant difference between the control and the test group, all the mean lung function values obtained from the test group, were apparently lower than in their control group. This may suggest a gradual deterioration of the lung function of the subjects with chronic exposure. The lack of any significant difference may be due to the short duration of exposure of the street sweepers to dust. None of them had served as street sweepers for more than two years. It is likely that with time the lung function of the street sweepers will be significantly lower and so, may develop serious respiratory disorders. This highlights the significance of the lenght of exposure to dust and lung function impairment; (Alakija *et al*, 1990; Urom *et al*, 2004). It is also possible that poisonous gases such as carbon monoxide, sulphur dioxide, nitrogen dioxide, benzene, formaldehyde, lead, polycyclic hydrocarbons and ammonia emitted from vehicles and decomposing matter may also impair lung function. Unfortunately, environmental gas levels were not measured owing to technical problems.

The study also showed a higher prevalence of respiratory symptoms among the street sweepers. The major presenting symptoms were cough, catarrh as well as sneezing. It is likely that paved road dust which is a complex mixture of soil dust, deposited motor vehicle exhaust particles, tyre dust, brake lining wear dust, plant fragments and other biological materials is allergenic (Glovsky et al, 1997) and may therefore irritate the respiratory tract leading to cough and other respiratory symptoms. The fact that the street sweepers rarely used any protective devices

such as face masks and were exposed to a high dust level generated at the test sites may have contributed to increase in the prevalence of these symptoms. This study has shown that the major presenting non-respiratory symptom was back pain which was found to be significantly higher among street sweepers than in their control. Back pain as a dominant non-respiratory symptom is not surprising since the street sweepers always bent low to sweep the streets with brooms. The other non-respiratory symptoms such as headache, abdominal and limb pain were however, not significantly different between the street sweepers and their control. It is therefore likely, that poor or bad working posture, which stretches the spine, may be responsible for the higher prevalence of back pain among the street sweepers. The oxygen saturation level (SPO_2) of test group was not significantly different from the control group. This clearly demonstrates that despite the apparent reduction in the lung function indices of the test subjects, their level of oxygen saturation was not yet impaired.

In conclusion, street sweeping in Calabar metropolis by women raises a lot of dust with attendant respiratory and non-respiratory symptoms.

The apparent lowering of all respiratory function indices among sweepers in comparison with their control subjects in less than two years of exposure suggests the possibility of serious lung function impairment with chronic exposure. There is therefore, the need to introduce safety measures such as the wearing of facemasks, watering of streets and provision of other protective devices in street sweeping in Calabar to reduce the inhalation of dust by the street sweepers.

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