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Impact of occupational exposure to Municipal Solid Wastes, Saw-dust and Paint on Reproductive Hormones among Workers in Port Harcourt, Nigeria

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ABSTRACT

Over the recent decades, there has been increasing global concern about exposure to work place chemicals and their impact on human health. This study is therefore aimed at assessing the impact of occupational exposure to municipal solid wastes, saw-dusts and paint, on the reproductive hormones levels among exposed workers in Port Harcourt, Nigeria. A cross-sectional analytical study was carried out on 157 apparently healthy male subjects comprising 45 unexposed (control), and 112 exposed (test) subjects. The test subjects consist of 37 workers involved in municipal solid waste disposal, 40 workers in saw-mill, and 35 in paint factory. Information on their anthropometric parameters and duration of exposure were obtained from subjects. 5ml of blood was collected from each subject by venipuncture, processed and serum used for assay of Luteinizing Hormone (LH), Oestrogen and Testosterone levels. The results showed a decrease in the mean level of luteinizing hormone (mIU/ml) among solid waste workers ($p < 0.05$), saw-mill workers ($p < 0.05$) and paint factory workers ($p > 0.05$) when compared with the control subjects. Also, the serum oestrogen (pg/ml) decreased among solid waste workers ($p > 0.05$), saw-mill workers ($p < 0.05$) and paint workers ($p < 0.05$), compared to control group subjects. Similarly, the serum levels of testosterone (ng/ml) decreased among solid waste workers ($p < 0.05$), saw mill workers ($p > 0.05$) and paint factory workers ($p > 0.05$), when compared with control group subjects. The reductions in all the hormones in the test subjects were duration-of-exposure-dependent. This study shows that occupational exposure to municipal solid wastes, saw-dusts and paint decreases the serum levels of male reproductive hormones. This could negatively impacts on their reproductive functions.

Keywords: Reproductive parameters, hormones, industry, workers, infertility.

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INTRODUCTION

Over the past decades, urbanization has led to the establishment of industries whose processes of production or products may involve either utilization and or generation of chemicals to the environment. Workers in these industries are exposed to these environments and may be contaminated with these chemical hazards either by inhalation and/or by direct contact with the skin¹. The link between exposure to toxic contaminants and the health of humans is gaining increasing concern as an important worldwide problem. The danger of chemical toxicity is recognized to be greatest in developing countries, including Nigeria²⁻³. The present study was therefore undertaken to assess the impacts of occupational exposure to municipal solid wastes, saw-dusts and paint on some reproductive hormones among male workers in these industries, in Port Harcourt, Nigeria.

MATERIALS AND METHOD

Study area/ study population:

This study was carried out among workers in municipal solid waste disposal, paint factory and sawmill companies in Port Harcourt, South-South Nigeria. Ethical clearance was sought for and approval given by the Institutional ethical committee of the University of Port Harcourt. Those who satisfied the inclusion criteria (apparently healthy and without any clinical disorder; age 18 to 50 years; at least six months of occupational exposure) and who willingly gave their informed consent were admitted into the study. All the subjects admitted for this study were of similar socio-economic and demographic status.

Study Design:

This is a cross-sectional analytical study carried out between March and November, 2015. A total of 157 apparently healthy male subjects were recruited for this study. This comprises 45 unexposed (control) subjects and 112 exposed (test) subjects. The test subjects consist of 37 workers involved in municipal solid waste disposal; 40 subjects working in saw-mill; and 35 working in paint factory. A multi-stage sampling method was used in the random selection of the test subjects from the relevant companies.

Data Collection:

Each subject was given a consent form to fill after explaining the study protocols. A structured questionnaire was administered and relevant information on their Personal and socio-demographic data were obtained. Weight (kg) was measured using “Harson Emperors” weighing balance, while Height (m) was determined with a measuring tape. The body mass index (BMI) was calculated using the formula: $BMI (kg/m^2) = \text{Weight}/(\text{Height} \times \text{Height})$.

Hormone Analysis:

Five millilitres (5ml) of blood sample was aseptically drawn from each subject through venipuncture into a plain sample bottle, centrifuged at 2000rev/min for 15 minutes using a centrifuging machine (Universal 320, Hettich Zentrifugen, Germany), and sera separated and used for estimation of Luteinizing Hormone, Testosterone and Oestrogen, as described in previous studies⁴

Statistical Analysis:

The data obtained were analysed using Statistical Package for Social Sciences (SPSS) version 20.0 software. One-Way Analysis of Variance (ANOVA) and Dunnett's Post hoc test was used to determine the level of significance between the control and study groups. The differences were considered significant at ($P \leq 0.05$). The results, expressed as Mean \pm SD, and Mean \pm SEM, are presented in tables.

RESULTS AND DISCUSSION

The results for the anthropometric characteristics of the subjects in the population studied (table 1) shows a non-significant ($P > 0.05$) difference in the age, weight, height and BMI of subjects respectively in the three test groups, when compared with the control group subjects. The serum levels of reproductive hormones (Table 2) show a reduction in Luteinizing Hormone among subjects in all the respective test groups: solid waste workers ($P < 0.05$), saw-mill workers ($P < 0.01$) and paint workers ($P > 0.05$), when compared with the control group subjects. Also, oestrogen was observed to significantly ($P < 0.05$) decrease among the saw-mill and paint industry workers, with a non-significant ($P > 0.05$) decrease among the solid waste workers, when compared with subjects in the control group. Similarly, a significant ($P < 0.05$) decrease in the serum level of Testosterone was observed among subjects in the saw-mill; with an insignificant decrease ($p > 0.05$) among those in solid waste and paint ($P > 0.05$) industries respectively, when compared with that of subjects in the control group. The reductions in the serum levels of these reproductive hormones among the exposed (test) subjects were observed to be duration-of-exposure-dependent (Table3), and significant ($p < 0.05$) for leuteinising hormone among workers exposed for 0.5-3 years, 4-10 years, and > 10 years respectively, when compared to the control group subjects. Similarly, oestrogen and testosterone were each observed to decrease dose-dependently among the workers exposed for 0.5–3 years ($P > 0.05$), 4–10 years ($P > 0.05$), and > 10 years ($P < 0.05$) respectively, when compared with those from subjects in the control group.

Table 1: Anthropometric characteristics of subjects in the various occupational groups studied.

Groups	Age(years)	Weight(Kg)	Height(m)	BMI(Kg/m ²)
Control	30.40 ± 5.85	74.28 ± 9.86	2.00 ± 0.00	25.28 ± 3.36
Municipal solid waste	30.28 ± 8.03	71.12 ± 11.81	2.00 ± 0.00	24.84 ± 3.20
Saw-mill industry	31.00 ± 8.67	76.52 ± 13.26	2.00 ± 0.00	27.28 ± 4.08
Paint industry	29.96 ± 8.04	77.13 ± 16.25	2.00 ± 0.00	26.29 ± 4.05

Values are expressed as mean ± SD; n = 25

Table 2: Serum level of reproductive hormones among subjects in the various occupational groups studied.

Study Group	Hormonal Parameters		
	Luteinizing Hormone (mIU/ml)	Estrogen (pg/ml)	Testosterone (ng/ml)
Control (n = 45)	11.80 ± 0.94	63.34 ± 3.88	3.66 ± 0.16
Municipal solid waste (n = 37)	8.89 ± 0.46*	63.07 ± 6.66	3.43 ± 0.42
Saw-mill industry (n= 40)	7.04 ± 0.59*	21.64 ± 2.11*	2.97 ± 0.36*
Paint industry (n=35)	10.13 ± 0.58	41.32 ± 4.39*	3.21 ± 0.25

Values are expressed as mean ± SEM; * = significant at p ≤ 0.05

Table 3: Impact of duration of exposure on serum level of reproductive hormones among test subjects.

Duration of exposure(years)	Hormonal Parameters		
	Luteinizing Hormone (mIU/ml)	Estrogen (pg/ml)	Testosterone (ng/ml)
(Control) n =45	11.80 ± 0.94	63.34 ± 3.88	3.66 ± 0.16
(0.5–3) n=47	9.21 ± 0.40*	45.81 ± 4.51	3.40 ± 0.27
(4 – 10) n=39	7.79 ± 0.68*	47.40 ± 7.58	3.13 ± 0.35
(>10) n= 26	7.86 ± 1.42*	36.01 ± 2.57*	2.11 ± 0.24*

Values are expressed as mean ± SEM. * = significant at p ≤ 0.05

The results obtained from this study show duration of exposure-dependent reductions in the serum levels of Leuteinising hormone, oestrogen and testosterone among workers in the various occupations studied.

Municipal solid waste workers, paint factory workers, and saw-mill workers represent a high risk population group who are daily exposed to toxicants while performing their jobs⁵. In this study, these workers (test subjects), are daily occupationally exposed to various gaseous and liquid chemicals, fumes, metals and degrading substances in their work environment, which may have been absorbed into the body circulation either by inhalation, and/or through the skin.

Reports from previous studies indicate that municipal solid wastes, saw-dusts and paints contain certain chemicals including toluene, benzene, copper, cadmium, arsenic, mercury, lead and chromium⁶⁻⁷. These chemicals are known to impair the neurochemical mechanisms

in the brain which control the release of gonadotropins by the anterior pituitary gland, as well as cause pathophysiological changes along the hypothalamic-pituitary-gonadal axis⁸⁻¹¹.

Therefore, the reductions in the serum levels of Leuteinising Hormone, Oestrogen and Testosterone observed in this study suggest that the neurochemical mechanisms involved in the synthesis and/or secretion of these hormones, along the hypothalamic-pituitary-gonadal axis, are impaired. Also, the duration-of-exposure-dependent effects observed in the reproductive hormones among all the test subjects indicate that impairments caused by these work-place chemicals could be due to prolonged and/or cumulative effects of exposure of these workers to these environmental toxicants.

CONCLUSION:

The results from this study has revealed that prolonged exposure to municipal solid wastes, saw-mill dusts and paint could result to impairments in the serum levels of reproductive hormones, and hence in their reproductive functions and capacities. The results from this study will be useful as baseline data for reproductive and environmental health researchers and practitioners. It will also provide additional basis for the formulation and implementation of policies to address the adverse health effects of improper waste management and work environment practices on reproductive health, especially in developing countries.

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