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Health Impact Assessment of Solid Waste Disposal Workers in Port Harocurt, Nigeria

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Abstract: The various health risks associated with solid waste disposal workers in Port Harcourt, Rivers State of Nigeria, were investigated. The aim is to assess the extent of exposure in terms of inhalation of toxic substances and its inherent adverse health effects on them since the workers are not adequately protected while doing their jobs. About 10 mL of venous blood was collected from each of the 35 solid waste disposal workers aged 21-50 years and from each of the 15 control subjects of the same age bracket who are not exposed. A well structured questionnaire was also given to all the solid waste disposal workers to assess their health profile. Haematological parameters, liver function test (LFT) and toxic substance (Pb, Cu, Zn) concentration in the blood were carried out. There were slight decrease in the haematological parameters and liver function test (LFT) results, as compared with the control subjects. The values obtained are: Hb 13.43±1.14 g dL^{-1}, HCT 37.13±3.22%, WBC 6.35±1.86×10^9 L^{-1}, platelet 236.15±104.33×10^9 L^{-1}, neutrophil 42.60±11.11% and monocyte 3.05±2.41% for solid waste workers. While the values for control subjects are: Hb 14.69±0.4 g dL^{-1}, HCT 41.77±2.74%, WBC 7.23±1.21×10^9 L^{-1}, platelets 282.40±33.76×10^9 L^{-1}, neutrophil 58.65±5.87% and monocyte 5.77±2.03%. The lymphocyte counts for waste disposal workers was significantly higher (50.42±11.30%) and (32.83±5.32%) for the control subjects. The AST values increased significantly for solid waste workers with a mean AST concentration of (11.19±2.36 μ L^{-1}) and 8.97±4.07 μL^{-1} for the control subjects. And mean total bilirubin increased progressively as the number of years of exposure increased (19.00 μmol L^{-1}). The peak value was for workers exposed for about 7 year. The result also showed that mean lead, copper and Zinc concentrations were high for the solid waste workers (Pb = 0.07±0.05 mg L^{-1}, Cu =0.22±0.08 mg L^{-1} and Zn = 0.56±0.48 mg L^{-1}) while that of control subjects were Pb = 0.02±0.01 mg L^{-1}, Cu =0.11±0.04 mg L^{-1} and Zn = 0.30±0.04 mg L^{-1}. Malaria parasitaemia was high amongst the solid waste disposal workers. Adequate Personal Protective Equipment (PPE) should be provided to avoid epidemic among the workers. It can be inferred that the lymphocytosis observed in this category of workers may indicate the presence of bacterial and protozoal infections, while a mild eosinophilia might be as a result of allergic disorders and helminthic infections.

Key words: Solid waste workers, health risk, dump site, toxic waste exposure assessment and inhalation of pollutants

INTRODUCTION

Waste can best be defined as an unwanted material, useless or worthless and of no value to the possessor. This does not mean that waste is intrinsically valueless; some may have zero value to the possessor, but have potential use or value to another. Waste generation started from the early man, who used natural forest resources as food and shelter and subsequently discard off the remnants either as food remains or as human wastes. These wastes were discarded into the natural environment and this phenomenon remain unabated (Oducha, 1994).

Before now, waste generated did not constitute much of a problem or health risk as the population was small and the land mass was almost considered limitless. With this concept, the tendency was to dispose off waste without recourse to the consequences on the environment and they were allowed to go through the natural process of decomposition.

But as man continued with his match to civilization, the type, quality and quantity of wastes generated began to change (Chindah, 2004). More so, human population began to increase and man began to live in closer units. This proportionately increased the amount of waste generated, without adequate waste management system

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in place. Solid waste management in Nigeria is poor and it has been identified as a major environmental and public health problem. Its menace is great, ranging from defacing the aesthetic nature of the city, unpleasant odour and contamination of water bodies. However, in order to curb this environmental nuisance, both government and private agencies engaged young men suspected to be healthy looking to clear the wastes dumped openly in various parts of the city. The irony of these group of people is that no Behaviour Based Practice (BBP) was inculcated into them. In otherwords, they did the work without any protective device as a safety measure.

The present study therefore, is aimed at determining the health impact or risks associated with solid waste disposal workers. It also looks at the type or common diseases found among these category of workers and its relationship with the type of work they do.

MATERIALS AND METHODS

Setting and description of sample site: Four different solid waste disposal companies located in Woji and Diobu areas of Port Harcourt, Nigeria, were used for this study. Port Harcourt capital of Rivers State, Nigeria is thickly populated and highly industrialized and with high number of waste dumps. Informed consent was sought from the directors of the waste companies before samples were collected from their staff. The study was carried out between February to June 2006, using male subjects with age range of 20 to 52 years and who have variously worked in waste disposal outfits for about one to seven years.

Study population: A total of 50 males were used in this study. Thirty-five of them were used as Solid waste workers, while 15 men were used as control subjects, who were not involved in waste disposal. The low sample size was as a result of the difficulty encountered and the unwillingness of some of the solid waste workers to collect their blood samples, even after providing some incentives.

Blood sample collection: A standard clean venepuncture technique as described by Dacie and Lewis (1999) was used to collect 10 mL of Venous Blood from each volunteer. Two milliliters of venous blood was dispensed into dipotasium Ethylene Diamine Tetra-Acetic (EDTA) anticoagulant tube and mixed properly. This sample was used for determination of haematological parameters. Three milliliters of the venous blood were also dispensed into lithium heparin anticoagulant tube and mixed thoroughly. The plasma derived from the lithium heparin anticoagulated blood were used for liver function tests (LFT). The remaining 5 mL of the venous blood were dispensed into dry plain tubes without any anticoagulant. The sera derived from the plain tubes were used for the determination of the concentration of lead, copper and Zinc. All the analyses were done on the same day of sample collection.

Analysis of samples: All the haematological parameters (Hb, PCV, WBC and differential counts) were analyzed using Dacie and Lewis (1999) methods. For the liver function test (LFT), a single cell visible spectrophotometer with a continuous wave length range from 335 to 1000 nm was used for determination of the individual concentration of each of the liver function test. The determination of heavy metals was done using the atomic absorption spectrophotometer (model Perkin-Elmer 30303B). The Atomic Absorption Spectrophotometer (AAS) provides accurate quantitative analysis of metals in blood water, sediments or rocks. All AAS samples were analyzed in solution form after digestion.

Data analysis: All obtained data were analysed statistically using students test and correlation coefficient.

RESULTS

A baseline haematological data for solid waste disposal workers and control subjects were established as in Table 1. While in Table 2 the duration of exposure of

Table 1: Baseline haematological values of solid waste disposal subjects and controls

	Subjects (n = 35)		Controls (n = 15)				
Haematological parameters	No.	Mean±SD	No.	Mean±SD	df	t	Probability
Hb (g dL^{-1})	35	13.43±1.14	15	14.69±0.40	48	5.73	<0.01
Haematocrit (%)	35	37.13±3.22	15	41.77±2.74	48	4.64	<0.01
WBC ($\times 10^9$ L^{-1})	35	6.35±1.86	15	7.32±1.21	48	2.12	<0.01
Platelet (%)	35	236.15±104.33	15	282.40±33.76	48	2.35	<0.01
Neutrophils (%)	35	42.60±11.11	15	48.65±5.87	48	6.66	<0.01
Lymphocytes (%)	35	50.42±11.30	15	32.83±5.32	48	7.45	<0.01
Monocytes (%)	35	3.05±2.41	15	5.77±2.03	48	4.12	<0.01
Eosinophils (%)	35	3.11±2.36	15	2.29±1.04	48	1.56	>0.01
Basophils (%)	35	0.51±0.58	15	0.45±0.43	48	0.43	>0.01

p<0.01

Table 2: Baseline haematological values of solid waste disposal subjects with respect to duration of exposure

	No. of years of exposure					
	1-2	3-4	5-6	7-8		
Haematological parameters	Mean±SD				t	Probability
Hb (g dL^{-1})	12.86±1.32	13.80±0.92	14.02±0.78	14.33±1.03	2.26	<0.01
Haematocrit (%)	35.71±3.58	37.73±2.59	39.12±1.88	39.40±2.46	2.26	<0.01
WBC ($\times 10^9$ L^{-1})	6.64±2.60	6.58±1.18	6.47±1.28	5.73±1.33	2.63	<0.01
Platelet ($\times 10^9$ L^{-1})	277.02±143.39	215.45±55.10	204.58±41.54	203.08±73.26	2.63	<0.01
Neutrophil (%)	40.45±8.43	46.91±10.80	47.49±13.80	48.50±10.04	1.85	<0.01
Lymphocyte (%)	51.76±5.68	47.28±6.04	46.98±14.27	46.18±13.27	2.89	<0.01
Monocyte (%)	4.26±2.67	2.95±1.15	2.89±1.50	1.41±0.71	-1.70	>0.01
Eosinophil (%)	2.71±2.83	3.01±2.61	3.14±1.72	3.73±1.43	3.55	<0.01
Basophil (%)	0.81±0.65	0.58±0.29	0.41±0.49	0.18±0.35	-1.61	>0.01

p<0.01

Table 3: Baseline liver function values of solid waste disposal subjects and controls

	Subjects (n = 35)		Controls (n = 15)				
Liver function values	No.	Mean±SD	No.	Mean±SD	df	t	Probability
Total bilirubin (μmol L^{-1})	35	9.92±5.25	15	10.81±1.94	48	-0.87	>0.01
Conjugated bilirubin (μmol L^{-1})	35	2.56±2.94	15	2.34±1.34	48	0.36	>0.01
ALT (U L^{-1})	35	6.51±4.25	15	6.43±2.88	48	0.08	>0.01
AST (U L^{-1})	35	11.19±2.36	15	8.97±4.07	48	2.41	<0.01
AIK.Phos (U L^{-1})	35	19.83±5.44	15	20.34±3.28	48	-0.83	>0.01

p<0.01

Table 4: Baseline liver function parameters of solid waste disposal subjects with respect to duration of exposure

	No. of years of exposure					
	1-2	3-4	5-6	7-8		
Liver function parameters	Mean±SD				t	Probability
Total bilirubin (μmol L^{-1})	7.43±4.40	8.18±3.37	9.16±6.57	19.00±1.73	2.13	<0.01
Conjugated bilirubin (μmol L^{-1})	3.26±3.21	2.06±0.84	2.04±2.91	1.98±0.90	-0.38	>0.01
AST (μ L^{-1})	5.58±3.06	8.43±5.44	9.20±3.54	9.58±3.60	-0.42	>0.01
ALT (μ L^{-1})	5.20±2.15	5.30±2.40	5.80±2.48	6.50±3.46	-0.86	>0.01
AIK.Phos (μ L^{-1})	18.16±8.66	18.10±5.28	18.08±6.95	18.01±6.52	0.00	>0.01

p<0.01

Table 5: Baseline copper, zinc and lead concentrations of solid waste disposal subjects and controls

	Subjects (n = 35)		Controls (n = 15)				
Metal concentration (mg L^{-1})	No.	Mean±SD	No.	Mean±SD	df	t	Probability
Cu	6	0.22±0.08	2	0.11±0.04	7	2.56	<0.01
Zn	6	0.56±0.48	2	0.30±0.04	7	1.30	>0.01
Pb	6	0.07±0.05	2	0.02±0.01	7	2.50	<0.01

the number of years they have worked as waste workers. There were some slight decreases in haemoglobin levels, mean haematocrite, concentration, platelets etc., as compared with the control subjects. Lymphocyte counts were high for the subjects compared to the control. In the process of doing the differential, leucocyte counts of the solid waste disposal workers; it was observed that there is high malaria parasitaemia. Malaria parasite was seen in 90% of the solid waste disposal subjects, while there was an only 42% case in control subjects.

The baseline data for Liver Function Test (LFT) shows that there was significant increase in the aspartate aminotransaminase (AST) of the solid waste disposal workers (p>0.01) (Table 3). There was a progressive increase in the total bilirubin level with respect to increasing number of years of exposure (Table 4). Other LFT values did not show much difference. The result of the heavy metals (copper, Zinc and Lead) are described in Table 5. It shows the Copper (Cu) and Lead (Pb) were significantly increased in the waste disposal workers in comparison to the control subjects.

DISCUSSION

Solid waste today has become the number one serious environmental problem facing the country (i.e., Nigeria) with its consequent effects on the pollution of water, air and land. The problem of solid waste in our Urban and rural areas cannot be over emphasized. The oil boom era with its high pace of consumption and

population opened the flood gate for serious waste generation. At the moment, virtually all our major cities and towns across the country are faced with the problems of solid waste management.

As men who are engaged in solid waste disposal spend half of their time and days clearing the heaps of refuse on the streets, there is every likelihood that this may affect their health and socio-economic well-being. The result obtained from this study was based on the research findings carried out in Port Harcourt, Nigeria. There is a dearth of information on health impact assessment of solid waste disposal workers in Nigeria, hence, this research work was undertaken to provide at least a baseline data from which other future researchers on related issues could refer to. Even though waste disposal business has its attendant risks or problems, it still provides means of livelihood to some dynamic youths and adults, which makes them to carter for themselves and families.

The lymphocyte showed significant increase in the case of the solid waste workers. The lymphocytosis observed in this category of workers may indicate the presence of bacterial infections, protozoal infections and granulomatous processes like hypersensitivity pneumonitis (Cheesbrough, 2002). A mild eosinophilia was observed in the solid waste disposal workers, meaning that there might be allergic disorders and helminthic infections. It was also observed from this study that the years of exposure has no serious impact on the solid waste disposal workers blood indices, probably because those who have consistently worked for that length of time (7-8 years) may become supervisors and are in less contact with the waste or toxicants.

The high malaria parasitaemia seen in the solid waste disposal subjects may be due to the fact that the waste dumps offer an excellent breeding ground for mosquitoes, the vectors of the malaria parasites (WHO, 1995). Since the solid waste disposal workers are not adequately protected while at work, the female anopheles mosquitoes sees them as easy preys for their blood meals. This accounts for the slight decrease in their haemoglobin concentration and their complaint of general body malaise (Cheesbrough, 2002).

The mean AST level of the solid waste disposal subjects was significantly higher than that of the control subjects. Raised AST level are associated with hepatocellular damage and viral hepatitis (Wilson and Waugh, 1996). Because AST is widely distributed in body tissues, many other diseases involving cellular injury may be accompanied by increases in AST levels, such as severe bacteria infections, malaria and pneumonia (Cheesbrough, 2002). There was no significant difference in the other liver function tests.

There is a progressive increase in the total bilirubin level as the number of years of exposure increased. The highest value is in the (7-8) years group. Another important health risk observed in this study is the high level of blood lead among the solid waste disposal workers (0.07 ± 0.05 mg L^{-1}), as compared with the control subjects (0.02 ± 0.01 mg L^{-1}). This finding agrees with the report of Nriagu *et al.* (1996) that our environment is highly polluted and these solid waste workers inhale the toxic substances from both the highly polluted waste dumps and vehicle smokes. Low level lead exposure that was previously thought innocuous is now of great concern due to the type of gasoline in use in Nigeria. (Needleman and Allred, 1990; Okoye, 1994). The normal range of lead concentration in the human serum is under 20 mg L^{-1}. Lead is toxic as it has affinity for cell membranes and mitochondria oxidative phosphorylations. Substantial evidence indicate that lead in the air can cause neurological harm and impair body chemistry and bone growth. The formation of red blood cells may be inhibited even by low-level exposure to lead in the air. At higher levels lead (Pb) may cause anaemia.

The mean Copper concentrations significantly increased in the waste workers (Table 5). Plamenac *et al.* (1985) reported that there might be occupational inhalation exposure to copper sulphate containing fungicides. Since the waste dump contains all manner of things, including agricultural products, it could probably be the source of exposure to the waste workers. The mean Zinc concentration of the waste workers slightly higher than that of the control subjects, this may be that the route of exposure of zinc is by ingestion or by inhalation of Zinc vapour that may not be much in the waste dumps. The information obtained from the questionnaires that were administered to the solid waste disposal workers showed that majority of them had symptoms such as cough, soreness of throats and sometimes headache. These symptoms may be attributed to exposure to low levels of the pollutants present in the environment.

In conclusion, periodic evaluation of the solid waste disposal workers should be made as a policy in order to monitor their health status. Adequate protective wears, such as nose masks, handgloves, protective clothing and safety boots should be provided to them, to ensure their safety and that of the public in general. Also the introduction of lead free gasoline and other newer refinery techniques for crude petroleum will go a long way towards reducing the respiratory hazards from vehicular or machinery fuel combustion.

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