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Indices of Cardiovascular Diseases and Malaria Parisitemia amongst Solid Waste Disposal Workers in Port Harcourt Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Authors CKW and EEU designed the study. Author EEU wrote the protocol, the first draft of the manuscript and managed the literature searches. Authors AOO and FUA performed the laboratory analysis. All authors read and approved the final manuscript.

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ABSTRACT

The aim of this study was to evaluate the health risks of solid waste disposal workers and scavengers, involved in the handling and disposal of municipal wastes, especially their cardiovascular health. The study was carried out in Port Harcourt, Nigeria from 2011 to 2013. Male solid waste disposal workers and scavengers (n=100) aged between 19 and 53years who have worked from six months to 15 years in waste disposal industry, were used in this study. Twenty six percent were aged 40 years and above while 74% were aged between 19 to 39 years. These were compared with 100 male subjects of same age group (21 to 50) who were not solid waste disposal workers; they served as the control group. Their blood pressures (systolic and diastolic) were measured using a standard mercury sphygmomanometer, weight was measured using calibrated electronic scale and height was measured using a Stadiometer. Body Mass Index (BMI) was

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calculated by the formula (weight/height^2). These were used as indices of cardiovascular disease in the volunteers. The level of malaria parasitemia was evaluated. A well-structured questionnaire was given to each volunteer in this study as a behavioral determinant. Mean systolic pressure of the solid waste disposal workers and the control group were 136±13.58 mmHg (Mean ± SD) and 117±12-04 mmHg respectively. The diastolic pressures were 88±12.73 mmHg and 71±10.71 mmHg respectively. This was significant ($p<0.01$) despite the fact that the solid waste disposal workers had a lower BMI value (24.25±3.19 Kg/M^2) than the controls (29.46±3.75 Kg/M^2). The increase in blood pressure cuts across duration of exposure, 55.84% of the solid waste disposal workers reported regular alcohol intake, while 43.27% reported current tobacco use against 20% and 7% of the control group. There was no significant difference ($p>0.01$) when the blood pressures of solid waste disposal workers aged 40 and above was compared with that of 19 to 39 age group. Prevalence of malaria parasitaemia was higher in the solid waste disposal workers in comparison to the controls 92% and 69% respectively.

Keywords: Solid waste disposal workers; scavengers; blood pressure; basal metabolic index; malaria parasitemia.

1. INTRODUCTION

Solid waste arising from human activity has become a major environmental problem causing extensive pollution, which threatens human health [1].There has been a significant increase in municipal solid waste generation in Nigeria over the last few decades. Humans increasingly exploit resources as the population increases, using natural resources both for daily life and to improve overall living standards. The result is the depletion of natural resources and further negative effects on human life [2]. In Nigeria, this is largely because of the rapid population growth and economic development. It is common to find large heaps of garbage lying in disorganized manner in and around cities due to the inability of municipal waste management companies to handle the large quantities of waste. There is a rise in the number of people involved in disposal of solid waste as a means of livelihood because of the recently introduced Private Partnership Scheme (PPS) in waste management by various state governments and predominantly driven by an informal sector of the nation's economy. The informal waste management sector, therefore, provides one of the best income-generation opportunities for many unskilled labourers and utilizes low-scale inexpensive technologies [3].

1.1 Health Effects of Waste on Solid Waste Disposal Workers

Research evidence shows that if physical, chemical, and biological hazards exceed tolerable limits, occupational diseases may develop [4]. Several studies have reported the existence of work-related health and safety risks for waste collectors such as exposure to elevated concentrations of biological aerosols [5-9], respiratory and gastrointestinal complaints, [10-14], infectious diseases like hepatitis A, B, and C, HIV, and syphilis [15-17].

Wachukwu and Eleanya, [18] reported increased liver enzymes, leucocytopenia, and work related dermatologic infections amongst the SWDWs (solid waste disposal workers). Gelberg [19] found work-related dermatologic, neurologic, hearing, and respiratory symptoms, as well as sore and itching throats, to be more prevalent among landfill employees than among off-site employees. Similarly, Zuskin [20] indicated that acute and chronic respiratory symptoms, as well as changes in ventilatory capacity, might develop in association with the work exposure of sanitation employees; Tuomi [21] found a high prevalence of cardiovascular and muscoskeletal disorders among Finnish municipal workers in physically demanding jobs [20,21].

These people live in unhygienic conditions and the nature of their occupation exposes them to potentially pathogenic bio-aerosols that may lead to the spread of various diseases. The abundance of fleas and offensive odours in waste disposal sites, along with the lack of proper protective devices, make working conditions even more unhygienic. Rag pickers collect plastics, paper, glass bottles, rubber materials, and ferrous and non-ferrous metals from dump sites, which can be risky as they are exposed to various infectious agents [22] and toxic substances that may cause illness. In addition, they face social abuse from certain elements of society, which may lead to social problems. They also commonly smoke and drink alcohol [23]. Their health challenged is increased

because, waste is not sorted out before disposal in Nigeria, all categories of waste are dumped together in the dumpsite.

2. MATERIALS AND METHODS

2.1 Description of Sample Site

This study was carried out in five different waste disposal companies and in the central dumpsite in Port Harcourt metropolis from 2011 to 2013. The waste disposal companies whose staff volunteered willingly after formal discussions with their directors are located at Artillery, Eneka, Rumuokoro, Rumuagholu and Rumueme, the central dumpsite was located at Rumuolumeni. All the sites are in Port Harcourt metropolis. These areas were chosen because of high population of people living around there and hence, high number of waste disposal sites.

2.2 Study Population

Two hundred males were used in this study. Hundred are solid waste disposal workers (SWDWs) and scavengers (referred in this study as volunteers) while, 100 are men who do not work nor live around waste disposal sites (referred to in this study as controls). Incentives (free analgesic drugs and free blood group testing) were given to all the participants of this study.

2.3 Measurement of Blood Pressure

Three blood pressure measurements were taken using a standard mercury sphygmomanometer according to the standardized conditions of the American Heart Foundation [24]. Following a 30 minutes rest period, measurements were taken in a seated upright position at intervals of not less than three minutes. During each measurement, the first, fourth and fifth phase of the korofoff sounds were recorded. Three Cuff sizes (bladder sizes of 12X23 cm, 12X28 cm and 14X40 cm) were used depending on the size of the right upper arm of the study subject

Interobserver and intraobserver variation were assessed throughout the survey as part of the quality assurance procedures [25]. Mean systolic and mean diastolic blood pressures were calculated, and the second and third measurements were averaged. Hypertension was defined according to the World Health Organization and International Society of Hypertension criteria: systolic blood pressure of at least 140 mmHg, and diastolic pressure of at least 90 mmHg or both [26].

2.4 Measurement of Height

Height was measured to the nearest 0.1 cm using a Stadiometer consisting of a steel tape attached to a straight wall and a wooden headboard. The headboard was positioned with the participant's shoeless feet and back against the wall, and head held in the Frankfort horizontal plane.

2.5 Measurement of Weight and Calculation of BMI (Body Mass Index)

Body weight was measured to the nearest 0.2 kg with the subject standing motionless on an electronic weighing machine without shoes or any heavy outer garments, and weight equally distributed over each leg [27]. The body metabolic index (BMI) was calculated as weight (Kilograms)/Height^2 (meters^2) [28]. BMI groups are referred as follows; <25, 25 to 29.9, and ≥30 as "lean," "overweight," and "obese," respectively.

2.6 Blood Sample Collection

A standard clean venepuncture technique was used to collect 2 mls of venous blood from each volunteer from the antecubital vein. The blood sample was dispensed into dipotassium EDTA anticoagulant tube and mixed, the whole blood samples were used for determination of malaria parasitemia. Duplicates of thin and thick films were made from each blood sample collected on a clean, grease free glass slide. The thin film was fixed with absolute ethanol and air-dried, stained with Giemsa stain. The thick film was allowed to air dry and stained with Field's stain A and B.

2.7 Malaria Parasite Identification in Thick and Thin Films

For the thick film, a drop of oil immersion was placed around the edge of the film. The oil was spread to cover an area about 10 mm in diameter. An area that was well stained and not too thick was located. The stained slide was examined for malaria parasite and malaria pigment. About 200 fields were examined. One hundred high power fields of the thick film were examined before recording a slide as negative. If positive, the thin film was read to determine the species. The results were reported using the

number of pluses to indicate the level of parasitaemia. The second slide from each participant was used if the first was damaged or unreadable.

For the thin film, the stained film was scanned thoroughly using x40 microscope objective lens, in a strip running the whole length of the film, and then an area was selected where the parasites were evenly located. The film was examined by longitudinal method, using oil immersion lens, this was continued until 200 cells were counted because the 200-cell count provided more accurate result than less. The percentage of the parasite specie was determined directly on the differential white blood cell counter dividing each number by two.

2.8 Administration of Questionnaire

A well structured questionnaire was given to each volunteer in this study. It included questions about smoking, alcohol intake, age, duration of exposure (for solid waste disposal workers) health status, frequently used medication, history of CVD (Cardiovascular diseases, if any).

2.9 Statistical Analysis

For optimal utilization of information obtained from the questionnaire response, blood pressure (systolic and diastolic) body mass index (BMI) results, malaria parasitemia, and length of exposure. Computer based Graph pad prism and Microsoft Office Excel 2007 were used for the analysis.

3. RESULTS

From the table, there is higher alcohol consumption among the volunteers than the controls 57% and 32% respectively, 45% and 30% of the controls and volunteers respectively neither smoke cigarette nor consume alcohol. The most frequent complaint amongst the participants in this study was general body pain 56% of the volunteers and 21% of the controls. This is followed by headache (33%, 8%) cough (30%, 8%), chest pain (28%, 5%), weakness (23%, 3%), fever (22%, 3%) in the volunteers and control respectively. Gastrointestinal symptoms were diarrhoea (25%, 2%), dyspepsia (15%, 2%), vomiting (10%, 1%) and dysentery (10%, 1%) amongst the volunteers and controls respectively. The muscoskeletal complaints were low back pain (23%, 5%) and Arthralgia (11%, 3%) volunteers and controls respectively. Only 6% of the volunteers had a history of CVD before they started waste disposal job. The questionnaire analysis shows that the SWDWs had more health challenges than the controls.

From the table and figure, there is a significant increase in the systolic pressures of the volunteers in comparison to the controls with mean values of 134.08 mmHg ±10.50 and 118.10 mmHg ±13.26, correlation coefficient value (r) 0.8915 (*P*<.001).

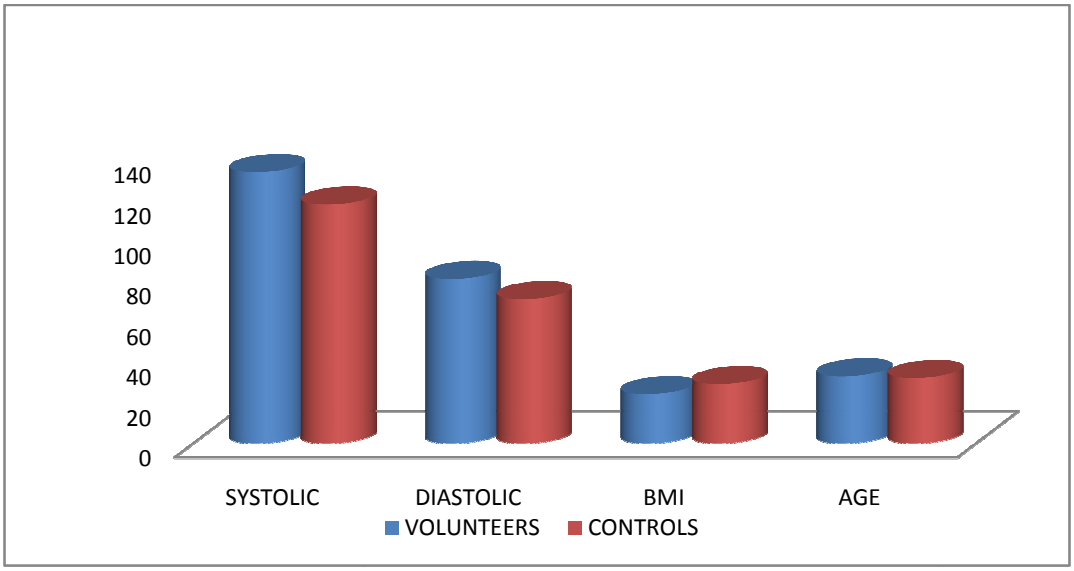

Fig. 3.1. A comparison of the mean systolic, diastolic, BMI and age of volunteers and controls

Table 3.1. Result of the analysis of the questionnaire response of the participants

Health effect	Volunteers % respondents	Controls % respondents
Only alcohol consumption	57	32
Only cigarette smoking	42	15
Both alcohol consumption and cigarette smoking	32	12
None alcohol consumption and cigarette smoking	30	45
General body pain	56	21
Headache	33	8
Cough	30	8
Weakness	23	3
Fever	22	3
Chest pain	28	5
Skin rashes	19	1
Gastrointestinal symptoms		
Diarrhoea	24	2
Dyspepsia	15	2
Vomiting	10	1
Muscoskeletal complaints		
Low back pain	23	5
Arthralgia	11	3
History of CVD	11	6

Table 3.2. Mean systolic, diastolic and BMI values of the volunteers and control groups

Participants	Systolic (mmHg)	Diastolic (mmHg)	BMI (Kg/M^2)	AGE (Yrs)
volunteers n=100	134.14±10.50	81.25±11.86	24.13±3.16	33.13±7.56
controls n=100	118.10±13.26	71.33±11.94	29.27±3.89	32.28±7.59
Correlation coeffi	0.8915	0.9486	0.9761	-0.08
P value	<.0001	<.001	<.001	0.4494
P value Summary	***	***	***	ns

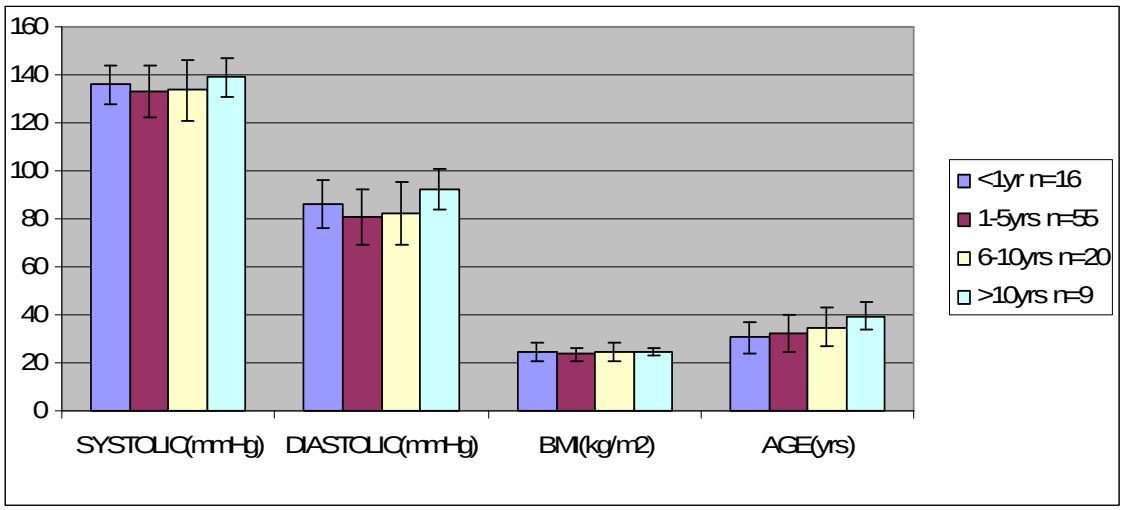

Fig. 3.2. Comparisons of exposure groups

There is a significant increase of diastolic pressures of the volunteers when compared to the controls with mean values of 81.25 mmHg ±11.86 and 71.33 mmHg ±11.94 respectively, r is 0.9486 (*P*<.001).

There is a significant decrease in the mean BMI values of the volunteers and the controls with mean values of 24.13 Kg/M^2 ±3.16 and 29.27 Kg/M^2 ±3.89 respectively, r is 0.9761 (*P*<.001).

Sixty three percent (63%) of the volunteers had lean body weight, (9% of <1yr exposure, 38% from 1 to 5years of exposure, 12% from 6 to 10years of exposure, and 4% from >10 years of exposure), 34% were overweight, (6% from <1 year exposure, 17% from one to five years of exposure, 6% from 6 to 10years of exposure and 5% from >10 years of exposure) and only 3% (1% from <1 year exposure and 2% from 6 to 10 years of exposure) are. obese. The control has 8% of lean body weight, 54% overweight and 37% obese.

The difference in age of the volunteers and the controls is not significant. Mean values are 33.13 years ±7.6 and 32.28 years ±7.62 respectively, with r is -0.08063 (*P*=.4).

Table 3.4 and Fig. 3.3 shows the effect of age on the blood pressures of the solid waste disposal workers. From the table, the mean and standard deviation of blood pressure and BMI values for the volunteers aged less than forty and greater or equal to forty years. There is no significant difference between the systolic, diastolic pressures and BMI values. Mean systolic pressure is 134.52±8.04 mmHg and 132.89±15.5 mmHg respectively, mean diastolic pressures are 81.61±10.23 mmHg and 86.76±15.2 mmHg, while mean BMI are 23.87±3.17 Kg/M^2 and 24.80±3.11 Kg/M^2 respectively.

Table 3.5 and Fig. 3.4 show the comparison of the SPB (systolic blood pressure), DBP (diastolic blood pressure), and BMI of the volunteers and the control groups less than 40 years of age. The mean SPB, is 134.52±8.04 mmHg, 115.34±11.37 mmHg respectively. Their mean DBP is 81.61±10.23 mmHg, and 74.61±5.62 mmHg respectively, while their mean BMI is 23.87 Kg/M^2 ±3.17, 29.35Kg/M^2 ±3.94 respectively. There is a significance difference between their mean SPB, and DBP (*P*=.05) though the volunteers have a significant lower BMI value (P=.03).

Table 3.3. Comparisons of exposure groups

Exposure group	Systolic (mmHg)	Diastolic (mmHg)	BMI (kg/m2)	AGE (yrs) CVR
<1yr n=16	135.85±8.16	85.94±10.16	24.65±3.77	30.44±6.23
1-5yrs n=55	132.96±10.57	80.8±11.72	23.72±2.76	32.25±7.58
6-10yrs n=20	133.55±12.75	82.55±13.19	24.57±4.12	34.8±7.98
>10yrs n=9	138.89±7.88	92.33±8.76	24.76±1.68	39.56±5.46

Table 3.4. Effect of age on blood pressure of the volunteers

Age group	<40yrs vs >40yrs all test		
	Systolic (mmHg)	Diastolic (mmHg)	BMI (kg/M^2)
<40yrs(n=74)	134.52±8.04	81.61±10.23	23.87±3.17
>40yrs(n=26)	132.89±15.5	86.78±15.2	24.8±3.11
T-test	0,3210	0.3381	0.4057
P value	.5	.5	.5
P value summary	ns	ns	ns

Table 3.5. Comparison of SBP, DBP AND BMI of V and controls < 40 years

Age group	Systolic (mmHg)	Diastolic (mmHg)	BMI (kg/M^2)
<40yrsT n=74	134.52±8.04	81.61±10.23	23.87±3.17
<40yrsC n=70	115.34±11.37	74.61±5.62	29.35±3.94
P value	.02	.05	.03
p value summary	***	*	***

Table 3.6 and Fig. 3.5 show the total number of volunteers with normal, raised and decreased systolic and diastolic blood pressures, as well as BMI amongst the volunteers and controls. From the table it can be seen that the total number of volunteers with cardiovascular diseases is higher than that of the controls (25% and 15%) respectively. Nineteen percent of volunteers had raised diastolic blood pressure against nine percent of the controls. The scenario is different with the BMI, 53% of the controls had increased BMI against 38% of the volunteers.

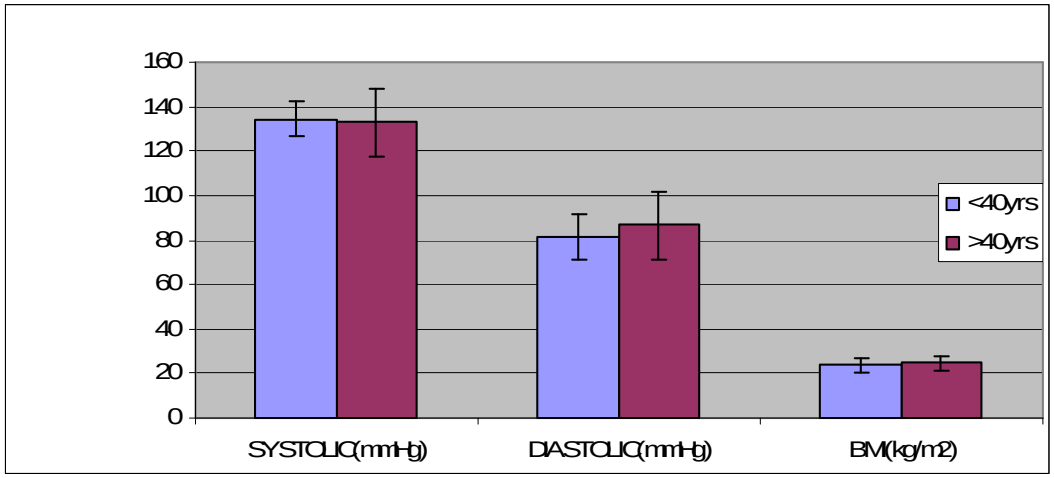

Fig. 3.3. Effect of age on blood pressure

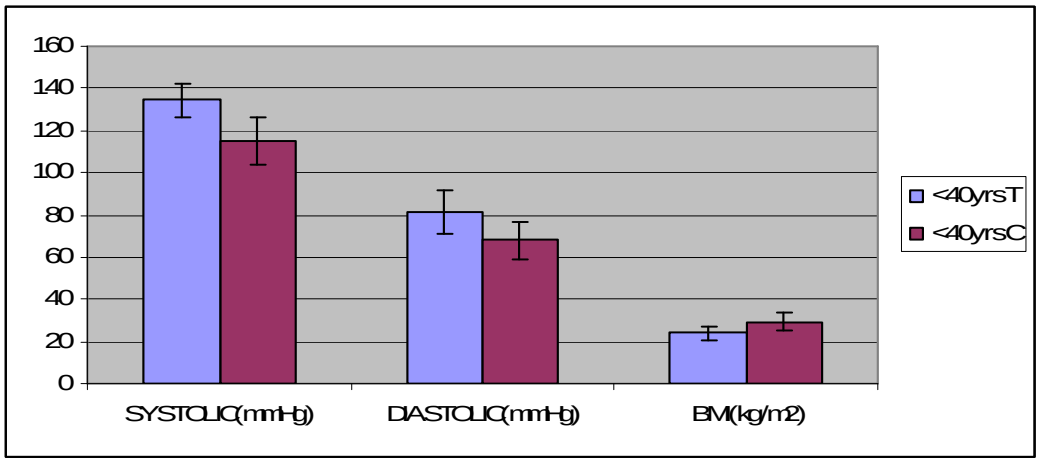

Fig. 3.4. Comparison of SBP, DBP AND BMI of subjects and controls < 40 years

Table 3.6. Prevalence of CVDs cases amongst the participants

	Systolic	Systolic	Systolic	Diastolic	Diastolic	Diastolic	BMI	BMI	BMI
	Norm	↑	↓	Norm	↑	↓	Norm	↑	↓
Volunteers	67	25	8	76	19	5	57	5	38
Controls	81	15	4	88	9	2	58	32	10

Key:Norm = Normal values of systolic, diastolic, and BMI
↑ = Increased values of systolic, diastolic, and BMI
↓ = Decreased values of systolic, diastolic, and BMI

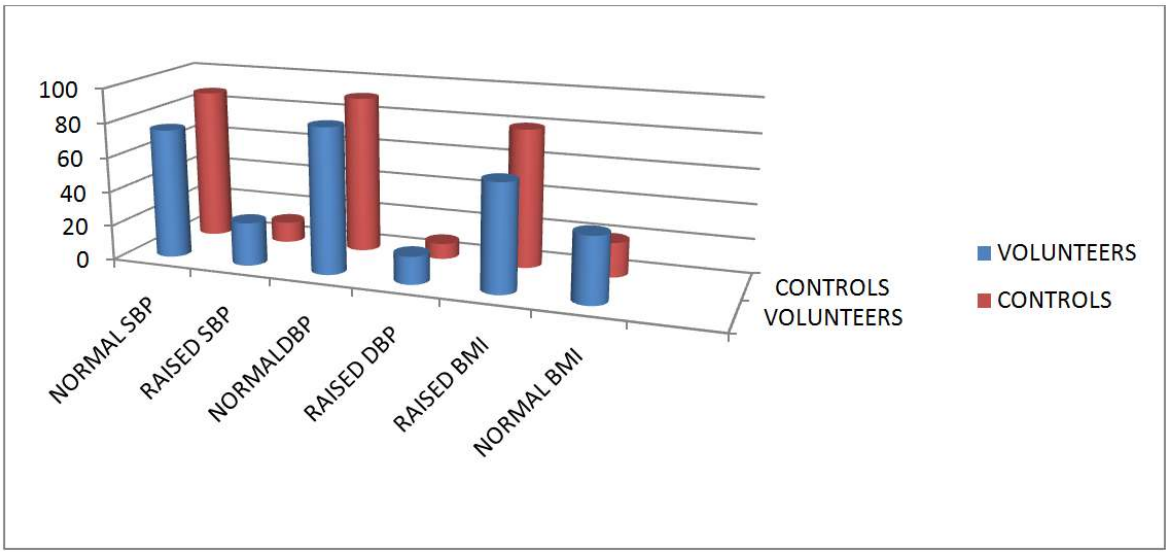

Fig. 3.5. Prevalence of CVDs

Table 3.7 shows the effect of cigarette smoking on the blood pressures of the volunteers and the controls group.

There is no significant difference between the systolic and diastolic pressures of the cigarette smokers and non-cigarette smokers amongst the volunteers. The systolic pressures for the smokers and non-smokers are 134.6 mmHg ±1.84, and 131.0 mmHg ±1.43 respectively ($p>0.05$), while the diastolic pressures are 84.3 mmHg ±2.5 and 83.4 mmHg ±2.0 respectively. For the controls there is a significant difference between the smokers and non smokers with systolic and diastolic pressures of 135.1 mmHg ±1.7, 122.4 mmHg ±1.5 and 82.57±1.9 mmHg, 72.3 ±1.1 mmHg respectively, $p <0.05$.

Table 3.8 shows the effect of alcohol consumption amongst the volunteers, and the control groups. There is no significant difference in the systolic pressure and diastolic pressures of volunteers who consume alcohol and those who do not consume alcohol, with values of 134.1±1.5 mmHg, 132.0±1.44 mmHg $p>0.1$ and 83.7±2.4 mmHg, 83.1±1.9 mmHg respectively, $p > 0.05$. For the controls, there is a significant difference in the systolic and diastolic pressures

Table 3.7. Effect of cigarette smoking on blood pressures of the volunteers and controls

	Volunteers		Controls	
	Systolic (mmHg)	**Diastolic (mmHg)**	**Systolic (mmHg)**	**Diastolic (mmHg)**
Smokers	134.6±1.84	84.3±2.5	135.1±1.7	82.57±1.9
Non smokers	131.0 ±1.43	83.4±2.0	122.4±1.5	72.30±1.1
p value	0.13	0.77	< 0.01	< 0.01
p value summary	ns	ns	***	***

Table 3.8. Effect of alcohol consumption on blood pressure

	Volunteers		Controls	
	Systolic (mmHg)	**Diastolic (mmHg)**	**Systolic (mmHg)**	**Diastolic (mmHg)**
Alcohol consumers	134.1±1.5	83.7±2.4	134.7±1.43	83.7±1.6
Non alcohol consumers	132.0±1.4	83.1±1.9	125.7.4±1.7	72.15±0.9
p value	0.13	0.78	< 0.01	< 0.01
p value summary	ns	ns	***	***

of the people who consume alcohol and those that do not consume alcohol with systolic and diastolic pressure values of 134.7±1.43 mmHg, 125.7.4±1.7 mmHg and 83.7±1.6 mmHg, 72.15±0.9 mmHg respectively, $p<0.01$.

Table 3.9 shows the prevalence of malaria parasitemia amongst the volunteers and control groups. There was more prevalence of malaria parasitaemia in the volunteers than in the controls 92%, 69% respectively.

Table 3.9. Prevalence of malaria parasitemia and typhoid fever

	Malaria parasite	
	Seen	**Not seen**
Volunteers	92	8
Controls	69	31

4. DISCUSSION

Manual waste collection is easily learned and usually does not require literacy or vocational training. This job provides a source of livelihood to extremely poor people. MSW collectors are considered the poorest of the poor. Many people view waste collectors as a nuisance or source of shame. In India, it was concluded that the social stigma of waste pickers remains a problematic issue. It was commented that the socioeconomic status of the waste collectors is low, and their working conditions are unfavourable [29]. Even in Japan, the discrimination against waste management workers still exists [30].

All the SWDWs collectors and controls in this study were men and the majority of both groups were in the young-age groups. The same findings were reported from Palestine and Nigeria [31,32]. It was concluded that formal waste collection is mainly performed by male employees [33]. This may be because the females may not be able to cope with both the stressful nature, the unsightly and offensive odours that emanate from waste dumps. In addition, the waste disposal is done mostly at night. Waste collection in Nigeria mainly use old and traditional equipment and depends on the physical power of the collectors.

Prevalence of health disorders between two groups according to the direct exposure to solid waste; exposed (volunteers) and non-exposed (controls) was compared. The risk was notably higher among the volunteers (Table 3.1 above). The most frequent complains encountered among the volunteers were malaise (56%), cough (30%), fatigue (28%), headache (23%). Other symptoms include; fever (22%), night sweating. This supports the report of Ekram [34] and these probably constitute symptoms of organic dust toxic syndrome [35].

The volunteers had higher percentage of diarrhoeal disease compared with the controls. This finding agrees with the reports of [35-37]. Since waste handling may cause dust full of microorganisms and bacterial endotoxins to become aerosolized, direct skin contact of these waste matters stuffed with fungal spores, bacteria, viruses and parasitic ova that can cause diarrhoea via feacal-oral route. However, Nielsen [38] did not find any excess of GIT symptoms among the household waste collectors possibly due to lower concentration of bacteria they estimated in the waste.

Nineteen percent of the volunteers had skin rashes (Table 3.1), Ekram [34] reported that *Tinea versicolour* and *Tinea corporis* were the commonest organisms implicated in the skin infections of municipal waste workers. Gellin, [39], Poulsen, [35], Ray [12] reported that observed skin diseases amongst municipal waste workers pointed to callused palms, bruises, dermatitis, folliculitis, abrasions, and xerosis. Travis, 2000 reported that the high bacterial concentrations at the landfill site (2.25 CFU/m^3, colony-forming units per cubic meter) also could explain the significant number of dermatological problems such as unusual acne, warts, cysts, and itching skin.

Hypotension was more prevalent among the exposed group (Table 3.2) (5% and 2% of volunteers and controls respectively) who are supposed to exert more physical activity and lose water and salt in sweating. This is in support of the report by Ekram [34]. However, in contrast to the report of Ekram [34] the MSWs also showed a higher risk of hypertension (25% and 15%, 19% and 9% SBP and DBP of the volunteers and controls respectively). Likewise, weight loss and low BMI (38% and 10% of volunteers and controls respectively) were evident among the volunteers whereas over weight and obesity were more prevalent among the control group (Table 3.2).

From the solid waste disposal workers (Table 3.8), 30% of those who neither drink alcohol nor smoke cigarette had increased blood pressure. No literature was found on the

cardiovascular diseases amongst solid waste disposal workers. This elevated systolic and diastolic pressures may be the inhalation of the fine particle concentrations in their work environments particularly those in the ultrafine range can provoke alveolar inflammation, release mediators capable of exacerbating lung disease and increasing blood coagulability in susceptible individuals. It was also hypothesized that particle inhalation induces an inflammatory response in the lungs with a subsequent release of chemical mediators that alter the autonomic nervous system control of cardiac rhythm. Air pollution can lead to increased rate of cardiovascular diseases. A study by Pope [40] and Dominici [41] confirmed the epidemiological association between exposure to air pollution and cardiovascular morbidity and mortality.

A high prevalence of increased blood pressure was observed amongst a relatively young population of the volunteers in the different exposure groups in this study (Table 3.3, Fig. 3.2). This finding is consistent with other CVD risk factors amongst different professional groups in Nigeria [42].

The higher the BMI, the greater the risk of developing health problems. Cardiovascular disease and high blood pressure have been linked with overweight. Reports that SBP and DBP are found to increase linearly over BMI range have been made [43]. Obesity; now recognized as an independent risk factor for cardiovascular disease is closely associated with hypertension [44]. However, results from this study shows increased SPB and DBP, despite low BMI values amongst the volunteers in this study (Table 3.2, Fig. 3.1).

Ninety two percent of the volunteers had malaria parasitemia against the 62 percent of the control group (Table 3.9); this is due to their occupational hazards as the mosquitoes find the waste dumps a good breeding ground. In addition, most of the SWDWs and scavengers do not wear PPE at work which increases their exposure to mosquito bite. The 62% parasitemia of the control groups agree with the result of other researchers on the prevalence of malaria parasitaemia in some communities in Nigeria, Matur et al. [45] Ukpai and Ajoku, [46]. Malaria is acknowledged to be by far the most important tropical parasitic disease causing great suffering and loss of lives (WHO, 1993).The days of labour lost, the cost of treatment of patients and the negative impact of the disease make malaria a major social economic burden (WHO, 1993).

5. CONCLUSION

Solid waste disposal workers undoubtedly face many occupational hazards especially in Nigeria, a developing country with inadequate health care programs. The findings in this study has brought to light another aspect of their challenge; elevated blood pressure. Determining health effects, disease patterns, and possible occupational risk factors in landfills workers or garbage-handlers can be helpful in reducing illnesses, improving working conditions, increasing productivity, and controlling costs.

CONSENT

All authors declare that 'written informed consent was obtained from the patient (or other approved parties) for publication of this case report and accompanying images.

ETHICAL APPROVAL

The authors sought and obtained permission from Rivers Ministry of Environment in Port Harcourt the capital of the state where this study was carried out. The government empowered this ministry to coordinates all activities of waste disposal and the companies that employ staff for the direct disposal.

The consent of the directors and line managers of individual companies whose staff participated in this study was obtained prior to the study.

Also, the consent of the individual waste disposal worker was obtained before samples were collected from them. The aim of the study was explained to them, the process of the study was equally explained; they were informed that the government and policy makers will use the result of the study to enact laws that will ensure that the process of their jobs become less hazardous. Because many of them were illiterate, written consent could not be obtained from them but oral consent was obtained. The local language was used to explain the details to them. There was no form of coercion; employees who declined to participate in the study were not forced to do so.

Consent was obtained from each of the controls who participated in the study. The authors took time to explain the purpose of the study to each participant, and the ones that gave their consent participated in the study. This explain the reason why it took a space of two years to collect the samples used in this study.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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