Journal of Applied Sciences

ISSN 1812-5654

science alert

ANSInet
an open access publisher
http://ansinet.com

Journal of Applied Sciences 10 (17): 1968-1972, 2010
ISSN 1812-5654

The Health Profile and Impact Assessment of Waste Scavengers (Rag Pickers) in Port Harcourt, Nigeria

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Abstract: The objective of this study was to determine the health profile and impact assessment of waste scavengers in Port Harcourt, Nigeria. To isolate and identify the potential pathogens that degrade the waste, samples were collected from 7 dumpsites and one control site. Serial dilutions of the samples were carried out and aliquots (0.1 mL) of the diluted samples were inoculated into appropriate media. Similarly, blood, stool, urine and nasal swabs were collected from 80 waste scavengers and 20 control subjects. The blood samples were used for the determination of haematological parameters and widal test, while urine, stool and nasal swabs were used for microbiological analysis. Five genera of bacteria were isolated from the waste dumpsites, which include *Staphylococcus* sp., *Escherichia coli*, *Salmonella* sp., *Pseudomonas aeruginosa* and *Bacillus* sp. while the control sites showed growth of *Bacillus* sp., only. The culture result from waste scavengers also showed similar organisms, such as *Staphylococcus aureus*, *E. coli* and *Salmonella* sp. There was significant decrease in the haemoglobin levels, haematocrit and Neutrophil counts of rag pickers as compared with the control subjects ($p<0.05$). Mean values for waste scavenger were Hb 12.12±1.85g dL^{-1}, HCT 36.33±16.7% and Neutrophil 33.33±14.06%, while control subjects were Hb 14.48±04 g dL^{-1}, HCT 42.66±9.47% and Neutrophil 56.55±16.83%. The AST for waste scavengers was slightly increased, while the other LFT values were decreased compared to the control subjects. It can be inferred that waste scavengers serve as vehicles for the transmission of certain pathogens that degrade waste, thereby, constituting some public health hazards.

Key words: Waste Scavengers, rag pickers, health profile, microbial degradation, waste dumpsite, impact assessment

INTRODUCTION

Microbial degradation of solid waste implies the breaking down of organic components of waste to inorganic form by microorganisms, which can readily serve as nutrient for a variety of other organisms. The problem of waste dump is global and is as old as the existence of man (Nally and Parr, 1984).

Because these wastes are not properly disposed off, they constitute serious health problems, such as dissemination of infectious diseases to man and animals living within the vicinity (Lorentz *et al*., 2000). Another problem is the poor management of waste, which may result to the pollution of soil, air and fresh waters (Nwaokwe, 2004). In most cities and towns in Nigeria and other African countries, wastes are dumped indiscriminately on the streets or roads, forming ugly refuge mountains, obstructing traffic and posing serious health risk to humans (Falase, 2004). Some of these wastes are inert materials such as glass; metals, plastics and ceramics, but large amounts are the biodegradable wastes (Boulter *et al*., 2002).

Though there are available methods of waste disposal, such as composting, landfill and incineration, open dumping continues to be the only method available in Nigeria particularly in major cities like Port Harcourt. The non-chalant attitude of the people on issues concerning waste management and environmental best practices has become a major source of worry. Wastes are left on the streets (open dump) for days or weeks, without proper sorting before they are disposed to the final dumpsites or relocated to open lands (Mbata, 2008).

When wastes are dumped on land, soil microorganism such as bacteria, fungi and worms (helminthes) readily colonize the waste carrying out degradation or transformation of degradable (organic)

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materials in the waste. Similarly, mesophilie, thermophilic and their thermo-tolerant bacteria in the waste use the constitutuents as nutrient, thus detoxifying the materials as their digestive process, breakdown complex organic molecules into simpler less toxic molecules (Boulter *et al*., 2002). Most of these microbes are potential human pathogens (such as Salmonella species, Escherichia coli, Fungi and protozoans) and may cause severe health hazards (Falomo, 1995).

Despite the attendant health risks inherent in waste dumpsites, certain persons make their living by foraging the waste for survival. These individuals are referred to as waste scavengers, rag pickers or alumi pickers (Medina, 1997). Scavengers carry sacks and sticks while they roam garbage dumps and any hidden treasure beneath trashes are carted away in their sacks, no matter the dirt. Apart from taking the recoverable wastes, they also carry the pathogens that degrade the wastes and inhale offensive odours. Another effect is that the rag-pickers may suffer eye irritation due to dust particles or poisonous chemicals in the waste, respiratory disease with coughing, sneezing, skin disease and cuts from sharps (i.e., bottles, needles etc.). This present Study is aimed at determining the relationship between the health profile of waste scavengers and microbial load burden of dumps in Port Harcourt, Nigeria and ways of curbing the menance or danger posed by this group of people to the larger society.

MATERIALS AND METHODS

Study area and population: The research was conducted in Port Harcourt, Nigeria. Port Harcourt is a cosmopolitan city, highly industrialized and occupied by people from different ethnic groups, both Nigerians and foreigners. The study was carried out between June 2007 to April 2008, using male subjects within the age bracket of 20-45 years and control subjects of 20-35 years who are undergraduates. A total of 100 males were used, 80 were waste scavengers while 20 were students (control subjects). Also, 7 dumpsites and one control site (mostly sand) were used for the study. The dumpsites are located at different parts of the city. The low number of subjects (or sample size) was as a result of the non-compliance of most of the scavengers to allow collection of samples from them, despite the free blood grouping test and other incentives provided for them.

Ethical consideration: An informed consent was directly sought by meeting with the various waste scavengers to willing volunteer themselves for this study, certain motivating incentives were provided for them.

Collection of samples and Enumeration of bacterial isolates: Waste samples (10 g) were collected from 7 different waste dumps and 1 control site. Samples were collected from the top, middle and bottom of the waste for even distribution and to ensure that a sizeable number of organisms are collected or not missed. The samples were collected in sterile containers, using a special spatula. Thereafter, 1 g of the waste sample was added into 9 mL of 0.1% bacteriological peptone (10^{-1} dilution). Further ten-fold serial dilutions were made upto 10^{-4}, using steril pipettes. Cultures from the last two dilutions (10^{-3} and 10^{-4}) were made by transferring an aliquot (0.1 mL) into surface dried nutrient agar (AB 087534), MacConkey agar (BI053305COT) and Samonella-Shigella agar (BB4312218) plates and spread evenly with a spreader (i.e., bent glass rod). The culture plates were incubated aerobically at 37°C for 24 h.

Waste scavengers: Samples collected from the waste scavengers include blood, stool, urine, nasal swab and sputum.

Blood: About 10 mL of blood was collected from each waste Scavenger and control subjects. Five milliliter of the blood sample was transferred into EDTA bottle for Full Blood Count (FBC) and malaria parasite estimation, while the remaining 5 mL was put into plain bottle for determination of Liver Function Test (LFT) and widal test. The haematological parameters (i.e., haemoglobin estimation and White Blood Count (WBC) were carried out according to the method of Dacie and Lewis (1999).

Stool: Stool culture was also done by inoculating few quantities into selenite F. broth for 24 h at 37°C, to reduce the range of enterobacteria organisms. The overnight broth culture was then subcultured onto Deoxycholeate Citrate Agar (DCA), Macconkey agar and Salmonella Shigella Agar (SSA) and incubated at 37°C for 24 h. Isolates were identified using the method of Harrigan and McCance (1976) and Cheesebrough (2000).

Urine: Mid-Stream Urine (MSU) was collected into sterile leak-proof containers for culture and urinalysis. The urine culture was done on Cystine Lactose Electrolyte, Deficiency agar (CLED), Blood agar and Chocolate agar plates, using a standard wire-loop. Discrete colonies grown were identified according to Chessbrough (2002).

Nasal swab: The scavengers head was immobilized and the sterile swab stick gently inserted into the nostril and the swab was gently and slowly withdrawn with a rotating motion. The swab was put into Amies transport medium

and capped securely (Ballows and Herman, 1990). Thereafter, the nasal swabs were inoculated on Blood agar, Chocolate agar and MacConkey agar plates and incubated at 37°C for 24 h.

Sputum: The subjects were asked to produce sputum in the morning after making a deep cough. The sample was collected into a sterile wide-necked leak proof container. Sputum was examined macroscopically for mucoid or muco-purulent, blood stained or salivary areas. The sputum culture was done on Blood agar, chocolate agar and MacConkey agar plates. Isolates were identified using the method of Harrigan and McCance (1976) and Chessebrough (2000).

Liver Function Test (LFT): For the Liver Function Tests (LFT), a single cell-visible spectrophotometer with a continuous wave length range of 335 to 1000 nm was used for the determination of the individual concentration of each of the liver function test. Bilirubin, alkaline phosphates (ALP), aspartate amino Transaminases (AST) and alanine amino Transaminases (ALT) were determined according to Tietz (1997).

Data analysis: Statistical analyses were performed using a statistical package of Social Science (SPSS) for window version 9 (SPSS INC. Chicago IL USA). The descriptive data were given as a Men±Standard Deviation (SD) and percentages.

RESULTS

The results obtained from the rag pickers were compared with those of the control subjects. From the waste dumpsites, the bacteria isolated were *Proteus* sp. 3(1.3%), *Klebsiella* sp. 4(13.7%), *Sal.* sp. 5(17.2%) and *E. coli* 7(24.1%). The most frequently encountered organisms are *Escherichia coli* (1.2 x10^6 cfu g^{-1}), *Salmonella* sp. (2.1 x10^6 cfu g^{-1}), *Klebsiella* sp. (1.1 x10^6 cfu g^{-1}) and *Staphylococcus aureus* (1.4 x 10^6). While the least encountered are *Proteus* sp. (1.4 x 10^6 cfu g^{-1}) and *Pseudomonas* sp. (1.1 x10^6 cfu g^{-1}). Few fungi species were isolated, such as *Candida albicans* (1.4 x 10^6 cfu g^{-1}) and *Aspergillus* sp. (0.2 x 10^6 cfu g^{-1}) (Table 1).

From the result, *Staphylococcus aureus* was isolated from 28(32%) of the rag pickers, while 2(25%) from the control subjects. *E. coli* was isolated from 15(18.5%) of rag pickers and 2(25%) of control. *Pseudomonas* sp. was found in 3(3, 7%) of rag pickers and 1(12.5%) for control subject (Table 2).

Table 3 shows the distribution of bacteria isolates according to sample types amongst waste scavengers (rag pickers), the result showed that the rag pickers harboured similar organism that were found on the waste dumpsites. The organisms include *Staph. aureus*, *E. coli*, *Salmonella* and *Klebsiella.*

The haematological values for waste scavengers and control subjects are shown in Table 4; there were slight

Table 1: Bacteria and fungi isolated from the different dump sites and control sites

Bacterial/Fungi	A	B	C	D	E	F	G	H control	Total (%)	X	SD
	----------(cfu g^{-1})----------										
Proteus sp.	1.4×10^6	-	-	-	-	0.6×10^6	-	-	1.7	0.57	0.72
Klebisiella sp.	-	-	1.1×10^6	-	-	0.2×10^6	-	-	2.6	0.68	0.51
Salmonella sp.	2.1×10^6	-	-	1.9×10^6	1.3×10^6	1.1×10^6	1.2×10^6	-	7.6	1.52	0.45
Escherichia coli	1.2×10^6	1.2×10^6	1.4×10^6	1.1×10^6	1.4×10^6	1.2×10^6	1.1×10^6	-	8.60	1.23	0.125
Staphylococcus aureus	1.4×10^6	1.4×10^6	1.2×10^6	1.4×10^6	1.1×10^6	1.2×10^6	1.2×10^6	-	8.9	1.27	0.125
Bacillus sp.	-	-	-	-	-	-	-	0.1×10^6	-	0.1	0
Pseudomonas aeruginosa	-	-	-	-	1.1×10^6	-	-	-	1.1	0	0
Aspergillus sp.	0.2×10^6	1.0×10^6	-	-	-	-	-	0.1×10^6	1.2	0.6	0.40
Candida sp.	-	1.2×10^6	-	1.1×10^6	-	-	0.1×10^6	-	2.4	0.8	0.608
Total	6.3×10^6	4.8×10^6	3.7×10^6	6.7×10^6	4.9×10^6	3.8×10^6	3.9×10^6	1.0×10^6	34.10	-	-
Mean ×	1.26	1.2	1.23	1.34	1.225	0.76	0.65	0.333	4.26	-	-
SD	0.68	0.16	0.15	0.34	0.15	0.56	0.57	0.40	3.46	-	-

A-Z: Represents different dumpsites; H: Represents control site

Table 2: Distribution of bacteria/fungi isolates according to the number of rag pickers per dumpsite

Bacteria species	A (N = 15)	B (N = 10)	C (N = 15)	D (N = 15) (%)	E (N = 5)	F (N = 10)	G (N = 10)	H (N = 20)	Total
Staphylococcus aureus	7(33.3)	5(12.50)	4(40)	2(15.38)	2(18.8)	2(28.5)	4(40)	2(25)	28(32)
Escherichia coli	3(14.29)	2(25.00)	3(30)	2(15.18)	2(18.18)	2(28.57)	1(10)	2(25)	17(19)
Strept sp.	4(19.05)	0(0)	2(20)	4(30.77)	2(18.18)	0(0)	0(0)	1(12.5)	13(15)
Klebsiella sp.	2(9.52)	0(0)	1(10)	1(7.69)	2(18.18)	1(14.29)	2(20)	1(12.50)	10(11)
Salmonella sp	4(19.05)	0(0)	0(0)	3(23.08)	1(9.09)	1(4.29)	1(10)	1(12.50)	11(13)
Candida sp.	1(4.76)	1(12.50)	0(0)	1(1.69)	0(0)	1(14.29)	1(10)	0(0)	5(6)
Pseudomonas aeruginosa	0(0)	0(0)	0(0)	2(18.18)	0(0)	0(0)	1(10)	1(12.50)	4(4)
Total	21(100)	8(100)	10(100)	13(100)	11(100)	7(100)	10(100)	8(100)	88(100)

A-Z: Represents different dumpsites; H: Represents control site; ( ): Values in parenthesis represents percentages

Table 3: Distribution of bacteria/fungi isolates according to samples collected amongst Rag Pickers and Control

	Subjects (N = 80)					Control (N = 20)				
Bacteria species	Stool	Urine	Nasal Swab	Sputum	Total	Stool	Urine	Nasal Swab	Sputum	Total
Staphylococcus aureus	0(0)	15(60)	10(83)	15(75)	40(50)	0(0)	1(20)	1(100)	0(0)	2(25)
Escherichia coli	3(13)	8(32)	1(8)	0(0)	12(15)	0(0)	2(40)	0(0)	0(0)	2(25)
Strept sp.	0(0)	0(0)	0(0)	2(10)	2(2.5)	0(0)	0(0)	0(0)	1(100)	1(12.5)
Klebsiella sp.	0(0)	0(0)	1(8)	3(15)	4(5)	0(0)	1(20)	0(0)	0(0)	1(12.5)
Salmonella sp.	18(78)	0(0)	0(0)	0(0)	18(22.5)	1(100)	0(0)	0(0)	0(0)	1(12.5)
Candida sp.	2(9)	0(0)	0(0)	0(0)	2(2.5)	0(0)	0(0)	0(0)	0(0)	0(0)
Pseudomonas aeruginosa	0(0)	2(8)	0(0)	0(0)	2(2.5)	0(0)	1(20)	0(0)	0(0)	1(12.5)
Total	23(100)	25(100)	12(100)	20(100)	80(100)	1(100)	5(100)	1(100)	1(100)	8(100)

Values in parenthesis represents percentages

Table 4: Haematological values of rag pickers and baseline values for controls

	Subject (n = 80)	Control (n = 20)			
Haematological parameters	Mean±SD	Mean±SD	df	t	p-value
Haemoglobin (g dL^{-1})	12.12±1.859	14.48±11.04	98	-1.84	<0.05
Wbc (x10^9 L^{-1})	7.23±0.66	8.32±3.64	98	-2.55	<0.05
Haematocrit (%)	36.33±16.7	42.66±9.378	98	-1.63	<0.05
Neutrophil (%)	33.33±14.06	56.55±16.83	98	-13.39	<0.05
Lymphocytes (%)	63.3±50.76	34.63±6.31	98	-0.59	>0.05
Monocytes (%)	0.30±0.001	3.77±0.75	98	-4.05	<0.05
Eosinophils (%)	3.46±0.15	2.32±0.28	98	2.50	>0.05
Basophils (%)	0.11±0.002	0.55±0.015	98	-2.57	<0.05

Table 5: Liver function values of rag pickers and baseline values of controls

	Subject (n = 80)	Control (n = 20)			
Liver function value	Mean±SD	Mean±SD	df	t	p-value
Total Bilirubin (Umol L^{-1})	10.82±4.96	11.72±4.91	98	0.73	<0.05
Congugated Bilirubin (Umol L^{-1})	3.46±1.18	2.99±0.86	98	1.07	>0.05
ALT (U L^{-1})	6.81±2.34	6.72±1.79	98	0.84	<0.05
AST (U L^{-1})	10.17±5.11	9.22±3.12	98	0.79	>0.05
ALK Phos (U L^{-1})	20.94±6.33	21.41±5.98	98	-0.30	<0.05

decreases in the haematological parameters, except lymphocytes and eosinophiles that increased significantly in the case of the waste scavengers.

The mean Liver Function Test (LFT) values for waste scavengers were slightly raised, especially conjugated bilirubin and Aspartate Aminotransaminase (AST) when compared with the control subjects (Table 5). Other LFT values did not show much difference.

DISCUSSION

Waste scavengers or rag pickers or alumi-pickers (as they are popularly called) are those who forage the waste dumpsites searching for the hidden treasure in the waste. Apparently healthy young men are involved in this business which serves as a source of livelihood for them. This type of occupation has its attendant problems, no matter how lucrative it may be. Ironically they are not usually well protected and they go about with shabby clothes and worn-out shoes or slippers. Every discarded aluminum, clothes, bottles or plastics are picked and sold to those who carry out small scale businesses, with just little stipend.

However, these group of people are faced with a lot of health hazards and challenges that they are not aware of. They are potential carries of those pathogens that degrade the waste, which means they serve as vehicles for transmission of pathogens that are capable of causing diseases in the body. From the study carried out those microorganisms isolated from the waste dumpsites, were also isolated from them, which confirm that they are indeed carriers of potential pathogens (i.e., organisms that are capable of causing disease). For instance, *Salmonella* sp. that was isolated both from the dumpsites and waste scavengers are capable of causing typhoid fever and food poisoning. Similarly, *Staphyloccus aureus* can cause food poisoning, wound infections, acute *osteomyelitis* in children and young adults *Pseudomonas aeruginosa* can also cause wound and burns infections and are recalcitrant to treat with some antibiotics (Wachukwu *et al*., 2002).

Another major organism is *Escherichia coli*, which is one of the organisms that cause Urinary Tract Infection (UTI) and gastroenteritis in children. Also present in the waste dumps are the endorsporse forming bacteria such as *Bacillius* sp. These organisms produce spores and are commonly found in the soil. Because most of the waste scavengers are not well protected and if they have any abrasion (i.e., cut) on the skin or leg, the tendency of these pathogens gaining entry into the body is obvious and the resultant effect will be infection, general body malaise and in some cases death.

The organic content of waste serve as nutrients for these organisms and waste containing some of these

potential pathogens like *Salmonella.* sp., *E. coli* or *Staph aureus* may contaminate underground water through seepage or contaminate municipal water supply through broken pipes, thereby, leading to epidemics of high proportion. Persons living within the vicinity of the waste dump could ingest the water and suffer from *Salmonellosis* (Brooks *et al*., 2004).

The lymphocyte showed significant increase in the case of the waste scavengers. The lymphocytosis observed in this group of people may indicate the presence of bacterial infections, protozoal infections and granulomatous processes like hypersensitivity pneumonitis (Chessbrough, 2002). Mild eosinophilia was observed among the waste scavengers, meaning that there might be allergic disorders and helminthic infections.

The mean AST level of the waste scavengers was higher than the control subjects Raised AST level may be associated with hepatocellular damage and viral hepatitis (Wilson and Wraught, 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 (Brooks *et al*., 2004). There was no significant difference in the other liver function tests. However, there might be progressive increase in the total bilirubin and AST levels as the number of years of exposure increases.

It can be inferred that from this study that waste scavenging has posed a great threat to the society, in terms of encouraging the production of sub-standard, fake and adulterated consumables in Nigeria. In addition, they constitute public health menace by spreading and distributing potential pathogens to people in the larger society. One way of curbing the problem of waste scavenging is to create more employment or skills for the young and dynamic youths. Environmental education and enlightenment campaign will also help to curb the damage inherent in waste scavenging.

ACKNOWLEDGMENT

The authors wish to appreciate Miss Beatrice Daminabo for typing the manuscript. We also thank the waste scavengers for volunteering themselves and allowing us collect their samples.

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