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Occupational Exposure to Waste: Effect on Weight, Pre-diabetes, Cough and Flu in a waste-treatment Facility in Lagos, Southwestern Nigeria

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Abstract

The Simpson Transfer Loading Station in Lagos, Nigeria, was established to treat and reduce waste volume before being transferred to permanent dumpsites. This study determined the demographic characteristics of workers and the effects of occupational exposure to waste in the facility. Structured questionnaires were used to collect demographic data from 21 study participants, including age, gender, educational level, and frequent diseases expressed. After that, the body mass index (BMI) and fasting blood glucose of the participants were measured using a glucometer. The results showed that 18 (85.71%) of the respondents were male, while 3 (14.29%) were female. Most of the respondents were in the age class 31–40 years old, with 11 members (52.38%), followed by the age class > 40 with 7 representatives (33.33%), and the age class 21–30 with 3 members (14.29%). Respondents with primary education made up 2 (9.52%) of the total, those with secondary education made up 6 (28.57%), and those with tertiary education consisted of 13 members (61.90%). Four (19.01%) of the respondents had normal body weight, 9 (42.86%) were overweighed, and 8 (38.10%) were obese. Fifteen (71.43%) of the respondents had normal blood glucose, 5 (23.41%) were pre-diabetic, and 1 (4.76%) was diabetic. One (4.76%) of the respondents reported headache, 7 (33.33%) complained about flu, and 13 (61.90%) reported cough. It can be inferred from the results that occupational exposure to waste had negative effects on the workers. Management and workers in the facility need to take steps to reduce occupational exposure to waste and prioritize personal hygiene.

Keywords: Blood glucose, Body mass index (BMI), Cough, Dumpsites, Pre-diabetic

Commentary

Wastes are unwanted and unusable materials or objects that have been discarded, disposed of, or are being disposed of.[1,2] Waste generation rates are increasing globally as a result of increasing urbanization and population, a thriving economy, and rising living standards in developing countries.[3] Global waste generation totaled 2.24 billion metric tons in 2020 (or 0.79 kilograms per person per day), and it is projected that this amount will rise by 73% to 3.88 billion metric tons by the year 2050.[4] Nigeria generates between 0.65 and 0.95 kg of waste per capita every day, amounting to an average of 42 million metric tons of waste per year.[5] This amounts to more than half of the 62 million metric tons of waste that are produced annually in sub-Saharan Africa.[5]

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The oldest and most common means of waste management is disposing of it in a landfill or dumpsite because it is cost-effective, simple to manage, and capable of holding large amounts of waste.[2,6] Apart from being a separate waste disposal facility, landfills serve as an endpoint for waste treated or managed by other waste disposal methods.[7] Some landfill sites are used to store waste temporarily, during which the waste will be sorted, compacted, and treated before being conveyed to a permanent site or recycled.[2] Landfills are classified into three types: secured or sanitary landfills, controlled landfills, and open dumps.[7] In contrast to controlled landfills, which are non-engineered disposal sites where waste is dumped in line with minimum defined requirements of site operation,[7] open dumps are places where waste is unlawfully dumped and left in huge amounts. A carefully planned excavation (or structure built on top of the ground) that has a bottom liner, a leachate collection system, a cover, and the surrounding hydrogeologic environment is what is known as a secure landfill.[7]

Waste management reduces the adverse effects of waste on the environment and human health. However, poorly managed landfills can cause serious environmental and health problems.8, 9 Poorly managed landfills can release poisonous chemicals and pathogenic microorganisms into the environment, resulting in air, water, and soil pollution.[2,10] Occupational exposure to some chemicals in waste has been implicated in hazards such as dermatitis, disorders of the central nervous system, liver and kidney damage, flu-like conditions, and bronchitis or asthma.[11] Moreover, workers may be infected by biological agents such as bacteria, viruses, and fungi in decomposing waste, resulting in diseases such as diarrhea, cholera, dysentery, skin diseases, runny noses, sneezing, and coughing, among others.[11,12] The burden of waste-related diseases is greater in developing countries due to a paucity of funds, poor technology, and poor policy. In Africa, 23% of the burden of diseases is linked to environmental factors, of which waste generation is a top factor.[13]

Considering the huge disease burden of waste management, there is a need to constantly monitor the health of workers and people living near waste management facilities. In Lagos, the Simpson Transfer Loading Center was commissioned to temporarily store waste, during which the waste will be sorted, treated, and volume reduced through compaction before being transferred to a permanent landfill. These activities potentially constitute health and environmental burdens, as mentioned earlier. Yet, literature searches showed that there is a dearth of documented studies on the health and environmental effects of the operations in the facility whose findings can be used to plan ameliorative strategies. As a result, this study was aimed at determining the occupational effects of the facility with regards to body mass index (BMI), blood glucose levels, and diseases frequently expressed.

Materials and methods

Description of study location

The Simpson Transfer Loading Station is located in Sura, Lagos Island, Lagos State, Nigeria. Lagos is geographically located between latitude 6° 31' 27.7644" N and longitude 3° 22' 45.1416" E in the southwestern region of the country.[14] Lagos State is bordered to the north and east by Ogun State, to the west by the Republic of Benin, and to the south by the Atlantic Ocean. The state's vegetation is tropical, with a brief dry season from December to February and a lengthy rainy season from March to November.[15] Lagos has a small landmass but several bodies of water, including the ocean, lagoons, rivers, streams, creeks, and estuaries.

Lagos State, which has about 592,000 enterprises and businesses, is responsible for more than 65% of Nigeria's commercial and industrial operations, 45% of the country's electricity consumption, 50% of the consumption of petroleum products, and more than 70% of the nation's freight volume.16 Lagos is highly cosmopolitan and the most populous city in Nigeria, with about 21 million people, and generates about 25% of Nigeria's total gross domestic product.[17] Furthermore, Lagos has a vehicular density of 224 vehicles per kilometer as against a world average of 11 per kilometer.[16] All the aforementioned have resulted in enormous waste generation in the state, which was put at about 12,000 metric tons of waste at a generation per capita (GPC) of 0.72 kg per person per day.[16] To effectively manage the massive waste generated, some dumpsites and waste management facilities were established throughout the state, including the

Simpson Transfer Loading Station on Lagos Island. This facility sorts, treats, and compacts waste before it is conveyed to a permanent dumpsite. However, there are concerns that occupational exposure to toxic chemicals and biological agents in the facility may have a negative impact on health. Consequently, this study was carried out to assess the effects of the facility's operations on workers.

Study population and data collection

Twenty-one (21) workers in the waste management facility who indicated interest were enrolled in the study. The enrollees were given questionnaires to indicate demographic data, namely sex, age, and education level, as well as illnesses frequently occurring among workers. The weight and height of the participants were then measured, after which their blood samples were taken to determine blood glucose levels.

Determination of blood glucose

The fasting blood glucose of the participants was measured using a Fantastik-Accu Glucose Meter (IVD version 180705-1), as described by Yahaya et al.18 The participants were made to fast for 8 hours, after which a drop of blood was taken from them and applied to a test strip. The strip was put into the glucose meter, and the reading, in mg/dL, was shown on the screen.

Calculation of body mass index (BMI)

The body mass index of the respondents was calculated using equation 1.

$$BMI\ (Kg/m^2) = Body\ weight/Height^2 \quad (1)$$

Criteria for selection of participants

Participants must have given their permission to take part in the study and have worked at the facility for at least one year. Excluded participants are those who failed to meet the inclusion criteria.

Ethics approval and consent to participate

This study was approved by the Office of the Study Center, National Open University of Nigeria, Lagos. The guidelines for conducting research on humans as outlined by the Center were strictly followed. Moreover, consent of the participants was obtained prior to the start of the study.

Data analysis

The Statistical Package for the Social Sciences (SPSS) version 24 was used to analyze the data, and the results were shown in percentages and frequency distribution tables.

Results

Gender distribution of the respondents

Table 1 shows the gender distribution of workers at Simpson Transfer Loading Station in Lagos. 18 (85.71%) of the respondents were males, while 3 (14.29%) were females.

Table 1: Gender distribution of respondents at Simpson Transfer Loading Station, Lagos

Gender	Frequency	Percentages (%)
Male	18	85.71
Female	3	14.29
Total	**21**	**100**

Age distribution of the respondents

The age distribution of the respondents is shown in Table 2. The majority of the respondents were age class 31–40 years old, with 11 members (52.38%), followed by age class >40 with 7 representatives (33.33%), and age class 21–30 with 3 members (14.29%).

Table 2: Age distribution of respondents at Simpson Transfer Loading Station, Lagos

Age (year)	Frequency	Percentage(%)
1-10	00	00
11-20	00	00
21-30	3	14.29
31-40	11	52.38
>40	7	33.33
Total	**21**	**100**

Educational Qualifications of the respondents

The educational qualifications of respondents are revealed in Table 3. Respondents with primary education were 2 (9.52%) of the total, those with secondary education made up 6 (28.57%), and those with tertiary education consisted of 13 members (61.90%).

Table 3: Educational qualifications of respondents at Simpson Transfer Loading Station, Lagos

Education qualification	Frequency	Percentage (%)
No formal education	0	0.0
Primary education	2	9.52
Secondary education	6	28.57
Tertiary education	13	61.90
Total	21	100

Body mass index (BMI) of the respondents

Table 4 shows the BMI of the respondents. 4 (19.01%) of the respondents had normal body weight, 9 (42.86%) were overweighed, and 8 (38.10%) were obese.

Table 4: Body mass index (BMI) of respondents at Simpson Transfer Loading Station, Lagos

BMI (Kg/m^2)	Frequency	Percentage (%)
Underweight (<18)	00	00
Normal weight (18.1–24.9)	4	19.01
Overweight (25.0–29.0)	9	42.86
Obese (>30)	8	38.10
Total	21	100

Blood glucose levels of the respondents

The fasting blood glucose of the respondents is shown in Table 5. 15 (71.43%) of the respondents had normal blood glucose, 5 (23.41%) were pre-diabetic, and 1(4.76%) was diabetic.

Table 5: Fasting blood glucose levels of respondents at Simpson Transfer Loading Station, Lagos

Fasting blood glucose (Mg/dl)	Frequency	Percentage (%)
Normal (≤ 100)	15	71.43
Pre-diabetes (100-125)	5	23.41
Diabetes (≥ 126)	1	4.76
Total	21	100

Common diseases among respondents

Common diseases expressed by respondents are displayed in Table 6. 1 (4.76%) of the respondents reported headache, 7 (33.33%) complained about flu, and 13 (61.90%) reported cough.

Table 6: Common diseases among respondents at Simpson Transfer Loading Station, Lagos

Disease	Frequency	Percentage (%)
Headache	01	4.76
Flu	07	33.33
Cough	13	61.90
Total	21	100

Discussion

The current research was carried out at Simpson Transfer Loading Station in Lagos, Nigeria, and determined the effects of human occupational exposure to waste. The demographic characteristics of the workers showed that the majority of them were males of middle age (31–40) and mostly possessed tertiary education. This finding is consistent with the finding of the study on waste pickers in Lagos, Nigeria, by Omosimua et al.,[19] in which males were dominant. In addition, Ogwueleka and Naveen[20] also reported the dominance of middle-aged men (aged 21–40) among waste workers in Abuja, Nigeria. Furthermore, in a study of e-waste workers carried out in Lagos, Ibadan, and Aba, all in Nigeria, by Ohajinwa et al.,[21] the majority of the workers were middle-aged men (30–39 years). However, in contrast to the current study, Ohajinwa and colleagues reported the dominance of secondary school holders. Similarly, Adeyi and Adeyemi[22] reported the preponderance of secondary school holders among waste workers in Lagos and Ibadan, Nigeria. The Simpson Transferred Loading Station is a modern facility built to treat and compact waste before being transferred to permanent dumpsites. Because of this, the operations in the facility require a higher level of professionalism. This could be why the facility has a higher percentage of workers with tertiary education than the other studies.

The 42.86% prevalence of overweight and 38.10% incidence of obesity observed in the current study are higher than the 22.1% overweight/obesity prevalence reported in Lagos by Bello et al.[23] Moreover, the 23.41% incidence of hyperglycemia observed in the present study is higher than the 5.8% national hyperglycemia incidence rate in Nigeria reported in a systematic review and meta-analysis by Adeloye et al.[24] This suggests that occupational exposure to waste could increase body weight and

blood glucose. This finding is consistent with that of Kouznetsova et al.,[25] who reported a significantly increased rate of hospitalization for diabetes among residents living close to dumpsites in New York City compared to clean areas. The result is also in line with the finding of a systematic review on the effects of e-waste exposure by Parvez et al.,[26] wherein hyperglycemia was reported. Norsa'adah et al.[27] also found an association between dumpsite exposure and diabetes mellitus among people living near a dumpsite in Kelantan, Malaysia. The current study is also consistent with the findings of the study of waste pickers at an open dumpsite in Latin America by Cruvine et al.,[28] in which 32.6% were overweight and 21.1% were obese. Polychlorinated biphenyl, persistent organic pollutants, heavy metals, and other toxic substances in waste may reduce insulin sensitivity, disrupt glucose metabolism, malfunction pancreatic beta cells, or alter their morphology, as well as cause oxidative damage and hormonal imbalances, all of which can result in hyperglycemia.[25,26] Toxic substances in waste can also disrupt lipid metabolism or elevate serum lipids, resulting in obesity. Some waste contains bisphenol A and phthalates, which can cause the body to over secrete insulin, making the body less sensitive to the hormone and leading to obesity and diabetes.[18]

The high prevalence of cough and flu among the workers in the current study is consistent with the finding of Abiola et al.,[29] who found that respiratory diseases are more common among residents living close to dumpsites in Lagos than those living far away. Adeyi and Adeyemi[22] also reported several diseases, including typhoid, cough, chest tightness, diarrhea, joint pain, skin irritation, and cancer among waste handlers in Lagos and Ibadan, Nigeria. Moreover, Okpara et al.[30] reported the prevalence of diseases such as cholera and diarrhea among individuals living close to dumpsites in Benin, Edo State, Nigeria. Illnesses such as flu, eye irritation, and fatigue were also reported among people living close to landfills in South Africa.[31] However, in contrast to the current study, the number of diseases reported in the previous studies was higher. The Simpson facility is a modern facility and has individuals with higher education levels, which might have translated to more personal hygiene and use of protective gear, lessening the occurrence of diseases. Exposure to bioaerosols and pathogens such as fungi and bacteria in waste can inflame the airways and thus could be responsible for the cough and flu noticed in the current study.[31] Furthermore, nitrogen dioxide, sulfur dioxide, and hydrogen sulfide, which are frequently released by waste, can cause nasal and throat inflammation, bronchoconstriction, and respiratory diseases.[31,32]

Conclusion

The results showed that most of the workers at Simpson Transfer Loading Station are middle-aged men with tertiary education. Most of the workers were overweight or obese, some of whom were pre-diabetic. Furthermore, the majority of them frequently had flu and cough. As such, occupational exposure to waste had negative effects on the workers. Both management and workers need to take steps to reduce occupational exposure to substances in waste. Workers should also prioritize personal hygiene.

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