



## Knowledge, Risk Perception and Practices Regarding the Hazards of Unsanitary Solid Waste Disposal among Small-Scale Business Operators in Sokoto, Nigeria

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### *Authors' contributions*

*This work was carried out in collaboration between all authors. Authors KJA, MOO, EUY and AMK gave the study concept and design, and drafted the manuscript. Authors MOR, BAI, KUA and IJN gave the study concept and design, and performed data collection, analysis and interpretation. All authors read and approved the final manuscript.*

### *Article Information*

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### **ABSTRACT**

**Introduction:** Unsanitary solid waste disposal practices are very prevalent across sub-Saharan Africa and pose serious threat to the health of the populace. This study was conducted to assess the knowledge, risk perception and practices regarding the hazards of unsanitary solid waste disposal among small-scale business operators in Sokoto, Nigeria.

**Methods:** A cross-sectional study was conducted among 285 small-scale business operators selected by a multistage sampling technique. Data were collected with a set of pre-tested interviewer-administered, semi-structured questionnaire. Data were analyzed using IBM SPSS version 20 statistical package.

**Results:** The ages of the respondents ranged from 18 to 65 years (mean = 28.59 ± 7.09). They

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were predominantly males (80.4%), single (66.0%), and had at least secondary education (91.2%). Less than two-thirds (56.8%) had good knowledge of sanitary solid waste disposal with majority of them having some misconceptions. While most of them (85.3%) had good knowledge of the hazards of unsanitary solid waste disposal, less than two-thirds perceived themselves (57.9%) or their workers and neighbors (58.9%) to be at risk from the hazards. Unsanitary solid waste disposal practices were very prevalent among the respondents (ranging from 22.8 to 57.9%), and the sole predictor was misconception on sanitary solid waste disposal (Odds Ratio = 2.626,  $p < 0.001$ ).

**Conclusion:** Although the respondents had good knowledge of the hazards of unsanitary solid waste disposal, their risk perception was sub-optimal and unsanitary solid waste disposal practices were very prevalent among them. Small-scale business operators should be targeted for health education intervention to reduce misconceptions and facilitate sanitary solid waste disposal practices.

*Keywords: Knowledge; risk perception; practices; hazards; unsanitary solid waste disposal.*

## 1. INTRODUCTION

Solid waste generation arising from human activities continues to rise correspondingly with population growth, urbanization and industrialization across the globe, and has become a major source of environmental hazards. According to the World Health Organization (WHO), an estimated 25% of deaths and diseases globally, and nearly 35% in regions such as sub-Saharan Africa is linked to environmental hazards [1,2].

Of serious concern is the fact that, even though solid waste disposal has been identified as the second most serious problem that city dwellers face (after unemployment), as noted in a United Nations Development Program Survey almost two decades ago [3], the situation only continues to worsen with the unabated growth of the world's urban population.

Currently, an estimated 54 per cent of the world's population lives in urban areas, and this is expected to increase to 66 per cent by 2050, with the largest urban growth expected to take place in India, China and Nigeria. By 2050 India is projected to add 404 million urban dwellers, China 292 million and Nigeria 212 million [4]. This is alarming as most municipal authorities in the developing world currently lack the power, resources, and trained staff to provide their rapidly growing populations with the land, services and facilities needed to comfortably support human life, including water and sanitation [5]. By 2050 the situation could spiral out of control unless appropriate measures are taken.

In many developing countries, about one-third to two-thirds of the solid waste that is generated is

not collected, and the uncollected waste is dumped indiscriminately in the streets and in drains, contributing to flooding, breeding of insects and rodent vectors and contributing to the spread of diseases. Even waste that is collected is often disposed of in uncontrolled dumpsite or burned, polluting local water resources, and the air [6].

Unsanitary solid waste disposal is very prevalent in many sub-Saharan African countries. A study in Ghana reported disposal of solid wastes at refuse dumps and open gutters by 82.8% of households [7], while another study in the same country by Boadi and Kuitunen [8], reported that over 80% of the population do not have home refuse collection services.

In a study on solid waste management practices in the business sector of Gweru, Zimbabwe, as many as 96% of the enterprise operators interviewed reported that the waste collection services were erratic and inadequate [9]. In addition, approximately 46% store their refuse up to a week or more on their business premises before it is collected, and the most common method of disposal was open dumping followed by burning [9].

Across Nigeria, examination of municipal solid waste management in Owerri [10], Lagos [11], Akure [12], Minna [13], and Kano [14], showed high levels of solid wastes generation and unsanitary solid waste management practices; and the most common disposal methods used were open dumping and burning. A striking feature of solid waste generation in Nigerian cities is the fact most of the municipal wastes are generated by market traders, independent sellers/street vendors and employees in urban business enterprises [15-17].

In Nigeria, a small business or small-scale enterprise is a business that employs a small number of people (up to 50); and with its total investment between 10 thousand and 2 million Naira, excluding the land holdings, but including the working capital [18]. Small-scale business activities predominate the business sector, and account for a substantial and increasing share of urban employment in most developing countries where a large majority of the urban poor depend on these activities for their employment. In addition, the failure of the government sector to provide adequate jobs and income to generate opportunities for the rapidly growing urban population is believed to have contributed to the large proportion of the business sector employment [17]. The population explosion in urban communities in Nigeria is also connected to the migration of people from rural to urban areas in search of employment. In a study conducted in three metropolitan cities in Nigeria (Bauchi, Lagos and Port Harcourt), more than 2/5<sup>ths</sup> (40.59%) of the street traders were migrants from rural areas [16].

Several studies have established strong links between indiscriminate solid waste disposal and several adverse health and environmental effects including respiratory symptoms, breeding ground for communicable disease vectors, aesthetic degradation, urban heat islands, blockage of drainage channels leading to flooding, surface water contamination and ground water pollution [8,11,19,20]. The most worrisome finding is the poor knowledge of sanitary solid waste disposal, inadequate knowledge of health risks caused by unsanitary solid waste disposal, and poor risk perception (even among participants with a high prevalence of adverse health effects from unsanitary solid waste disposal), which were found to be associated with the unsanitary solid waste disposal practices, as noted in many studies across sub-Saharan Africa, including Guinea [21], Kenya [22], and Nigeria [23].

While several community based studies on solid waste management have been conducted in Nigeria, there are limited studies among workers in small-scale enterprises, and they are known to generate substantial proportions of municipal wastes. This study was premised on the assumption that assessment of knowledge, risk perception, and practices regarding the hazards of unsanitary solid waste disposal would provide an insight into the magnitude of the problem; and also generate useful information for designing appropriate interventions for addressing

identified gaps in knowledge, in addition to facilitating sanitary solid waste disposal practices among small-scale business operators.

## 2. MATERIALS AND METHODS

This was a cross-sectional study among small-scale business operators in Sokoto metropolis, Sokoto state, Northwestern Nigeria, between November and December 2014. Sokoto state has a population of 3,696,999 people, based on the 2006 census with an estimated population of 4,802,298 projected for 2015 [24]. Sokoto metropolis is both the capital and center of economic activities in the state. It comprises 4 Local Government Areas (of the 23 in the state) with a combined population of 809,387 based on the 2006 census, and covers an area of 60.33 square kilometers [25]. The Hausas and Fulanis are the most predominant ethnic groups in the state, they are mainly farmers, while the non-natives belong to Igbo, Yoruba and Igala ethnic groups among others, and are mainly involved in small-scale businesses. Employees and operators of small-scale business establishments that were aged 18 years and above, and have worked for at least 6 months in the respective business establishments were considered eligible for this study.

The sample size was estimated at 275 using the Fisher's formula for calculating sample size for cross-sectional descriptive studies [26], using a 21.7% prevalence of unsanitary solid waste disposal from a previous study [23], a precision level of 5% and an anticipated participant response rate of 95%. The eligible participants were selected by a multistage sampling technique. At the first stage, Sokoto metropolis was divided into 12 business districts and 7 of them were selected by simple random sampling using the ballot option. At the second stage, the selection of business establishments in each of the selected districts was done by systematic sampling technique using the list of business establishments in the respective districts to constitute the sampling frame. One of every 3 business establishments was selected in the selected districts at the end of which 48 business establishments were selected. At the third stage, the selection of participants in the selected business establishments was done by a systematic sampling technique using the staff list in the respective business establishments to constitute the sampling frame. One of every 5 eligible participants was selected in the selected

business establishments at the end of which 285 participants were selected.

A standardized, semi-structured, interviewer-administered questionnaire was developed and used to obtain information on participants' socio-demographic characteristics, knowledge of sanitary methods of solid waste disposal, the hazards of unsanitary solid waste disposal, participants' risk perception, and participants' solid waste disposal practices. It was reviewed by researchers in the Department of Community Health, Usmanu Danfodiyo University, Sokoto, Nigeria. Corrections were made based on their inputs on content validity. The questionnaire was pretested on 20 employees and operators of small-scale business establishments in one of the business districts not selected for the study. The questionnaire instrument shows good internal consistency (Cronbach's alpha = 0.81) and stability (2 weeks test / retest correlation coefficient was 0.74). Five resident doctors assisted in questionnaire administration after being trained on the conduct of survey research, the objectives of the study, and questionnaire administration.

Institutional ethical clearance was obtained from the Ethical Committee of Usmanu Danfodiyo University Teaching Hospital, Sokoto, Nigeria. Permission to administer the questionnaires was obtained from the Management of the respective business establishments selected for the study. Informed consent was also obtained from the participants before questionnaire administration.

Data were analyzed using the IBM Statistical Package for the Social Sciences (SPSS) Version 20 statistical computer software package. Respondents' knowledge of sanitary solid waste disposal was scored and graded on a 7-point scale. One point was awarded for a correct response, while a wrong response or a non-response received no points. This gives a minimum score of '0' and a maximum score of '7' points. Those that scored  $\geq 4$  of 7 points were considered as having 'good' knowledge, while those that scored  $< 4$  of 7 points were graded as having 'poor' knowledge. Knowledge of the hazards of unsanitary solid waste disposal was scored and graded on an 8-point scale. One point was awarded for a correct response, while a wrong response or a non-response received no points. This gives a minimum score of '0' and a maximum score of '8' points. Those that scored  $\geq 5$  of 8 points were

considered as having 'good' knowledge, while those that scored  $< 5$  of 8 points were graded as having 'poor' knowledge. Frequency distribution tables were constructed; and cross tabulations were done to examine the relationship between categorical variables. The chi-square test was used to compare differences between proportions. Logistic regression analysis was used to determine the predictor of unsanitary solid waste disposal practices. All levels of significance were set at  $p < 0.05$ .

### 3. RESULTS

#### 3.1 Socio-demographic Characteristics of Respondents

All the 285 questionnaires administered were completed and used for analysis, giving a response rate of 100%. The ages of the 285 respondents ranged from 18 to 65 years (mean =  $28.59 \pm 7.09$ ), and most of them (86.7%) were aged between 20 and 39 years. They were predominantly males (80.4%), single (66.0%) and practiced Islam as religion (68.1%). Majority of them (63.5%) had tertiary education, and most of them (91.9%) have practiced for 1 – 10 years (Table 1).

#### 3.2 Respondents' Knowledge of Sanitary Solid Waste Disposal

Less than three-fifths, 162 (56.8%) of the 285 respondents had good knowledge of sanitary solid waste disposal practices, and there was no association between good knowledge of sanitary solid waste disposal and any of the socio-demographic characteristics of respondents ( $p > 0.05$ ). The majority of respondents knew incineration (70.2%), burial in a pit (74.7%), and storage in refuse bins for collection and disposal at sanitary landfill sites by municipal waste management authorities (93.7%) as sanitary methods of solid waste disposal. Although the majority of respondents knew that open dumping of solid waste within premises (66.3%) is an unsanitary disposal method, the majority of respondents misinterpreted storage of solid waste in refuse bins for disposal at designated open dumping sites (91.6%), burning of solid waste dumped in open spaces around the premises (51.6%) or burning of waste stored in steel bins (55.4%) as sanitary methods of solid waste disposal (Table 2).

**Table 1. Socio-demographic characteristics of respondents**

Variables	Frequency (%) n = 285
<b>Age group (in years)</b>	
Below 20	12 (4.2)
20 -29	165 (57.9)
30 -39	82 (28.8)
40 - 49	21 (7.4)
50 and above	5 (1.8)
<b>Sex</b>	
Male	229 (80.4)
Female	56 (19.6)
<b>Marital status</b>	
Single	188 (66.0)
Married	94 (33.0)
Separated	1 (0.4)
Widowed	2 (0.7)
<b>Religion</b>	
Islam	194 (68.1)
Christianity	91 (31.9)
<b>Education</b>	
Primary and below	25 (8.8)
Secondary	79 (27.7)
Tertiary	181 (63.5)
<b>Length of practice (in years)</b>	
1 - 10	262 (91.9)
11 - 20	19 (6.7)
21 and above	4 (1.5)

### 3.3 Respondents' Knowledge of the Hazards of Unsanitary Solid Waste Disposal

Most of the 285 respondents, 243 (85.3%), had good knowledge of the hazards of unsanitary solid waste disposal, and there was no association between good knowledge of the hazards of unsanitary solid waste disposal and any of the socio-demographic characteristics of respondents ( $p > 0.05$ ). The hazards most commonly known to the respondents were unsightly environment and bad odor (95.1%), breeding of flies and mosquitoes (89.1%), air pollution (88.1%) and blockage of drainage system (87.0%). Other hazards known to the respondents are as shown in Table 3.

### 3.4 Respondents' Risk Perception of the Hazards of Unsanitary Solid Waste Disposal

The majority of respondents (57.9%) perceived themselves, and their workers and neighbors (58.9%) to be at risk from the hazards of unsanitary solid waste disposal (Fig. 1). There was no association between risk perception of the hazards of unsanitary solid waste disposal and respondents' knowledge of hazards, or any of their socio-demographic characteristics ( $p > 0.05$ ).

### 3.5 Respondents' Solid Waste Disposal Practices

A majority of the 285 respondents, 213 (74.7%), store their solid waste in refuse bins for collection

**Table 2. Respondents' knowledge of sanitary solid waste disposal**

Sanitary method of solid waste disposal	Response (n = 285)		
	Yes	No	I don't know
	No (%)	No (%)	No (%)
Open dumping of refuse within the premises	88 (30.9)	189 (66.3)	8 (2.8)
Burning of refuse dumped in open spaces around the premises	147 (51.6)	126 (44.2)	12 (4.2)
Burning of refuse stored in steel bins	158 (55.4)	109 (38.2)	18 (6.3)
Incineration	200 (70.2)	37 (13.0)	48 (16.8)
Burial in pit	213 (74.7)	47 (16.5)	25 (8.8)
Storage in refuse bins for collection and disposal at sanitary landfill site by municipal waste management authorities	267 (93.7)	5 (1.8)	13 (4.6)
Storage in refuse bins for disposal at designated open dumping sites	261 (91.6)	20 (7.0)	4 (1.4)
<b>Knowledge grade</b>			
<b>Frequency (%)</b>			
Good	162 (56.8)		
Poor	123 (43.2)		

and disposal at a sanitary landfill site by the municipal solid waste management authority. A large proportion of the respondents (57.9%) store and burn their solid waste in steel bins, while approximately a third of the respondents practiced other unsanitary solid waste disposal methods such as storage in refuse bins for disposal at designated open dumping sites (34.7%) and burning refuse dumped in open spaces around the shop/factory premises (Table 4).

A significantly higher proportion of the respondents that misinterpreted burning refuse in open places around the shop/factory premises as a sanitary method of solid disposal were engaged in the unsanitary practices (42.2%) as compared to those without such misconceptions (21.7%),  $\chi^2 = 13.601$ ,  $p < 0.001$  (Table 5). In the logistic regression model, respondents that misinterpreted burning refuse in open spaces around the shop/factory as being a sanitary method of disposal were more than twice as

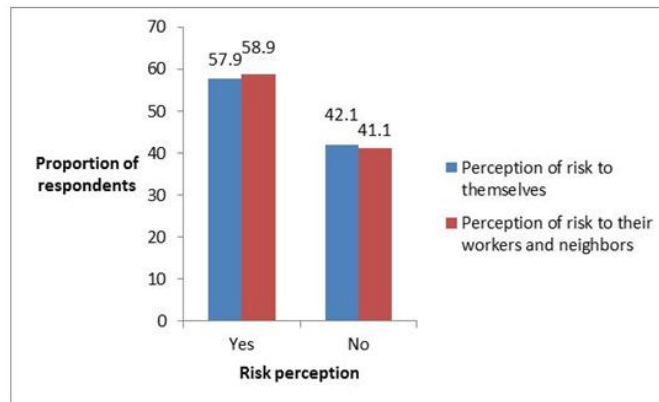
likely to engage in this unsanitary practice as compared with those without such misconceptions (Odds Ratio = 2.626, 95% CI = 1.561 – 4.418,  $p < 0.001$ ).

**4. DISCUSSION**

Although, a majority of the respondents knew some of the sanitary solid waste disposal methods, less than three-fifths (56.8%) had a good knowledge of sanitary solid waste disposal methods. This finding is similar to the finding in a study conducted in a business district in Kenya [27], which reported that only 54.8% of the respondents had sound knowledge of good solid waste management approaches. In addition, there was no association between good knowledge of sanitary solid waste disposal and any of the socio-demographic characteristics of the respondents in both this study and the Kenyan study. Even though, other studies in Africa had also observed poor knowledge of sanitary solid

**Table 3. Respondents’ knowledge of the hazards of unsanitary solid waste disposal**

Hazards of unsanitary solid waste disposal	Correct response frequency (%) n = 285
Unightly environment with bad odor	271 (95.1)
Breeding of disease vectors (such as flies and mosquitoes)	254 (89.1)
Breeding of rodents and poisonous snakes	217 (76.1)
Land degradation	207 (72.6)
Pollution of surface and ground water	238 (83.5)
Air pollution	251 (88.1)
Fire outbreaks	228 (80.0)
Blockage of drainage systems	248 (87.0)
<b>Knowledge grade</b>	<b>Frequency (%)</b>
Good	243 (85.3)
Poor	42 (14.7)



**Fig. 1. Respondents’ risk perception of the hazards of unsanitary solid waste disposal**

**Table 4. Respondents' solid waste disposal practices**

<b>Solid waste disposal practices*</b>	<b>Frequency (%)</b> <b>n = 285</b>
Open dumping within the premises	65 (22.8)
Burning in open places around the premises	92 (32.3)
Burning of refuse stored in steel bins	165 (57.9)
Burial in a pit near the shop or within the factory premises	68 (23.9)
Storage in refuse bins for collection and disposal at a sanitary landfill site by municipal waste management authorities	213 (74.7)
Storage in refuse bins for disposal at designated open dumping sites	99 (34.7)

\*Multiple responses allowed

**Table 5. Distribution of practice of burning refuse in open spaces around the shop/factory due to its misinterpretation as a sanitary method of solid waste disposal**

<b>Burning solid waste in open spaces misinterpreted as a sanitary disposal method</b>	<b>Practiced burning solid waste in open spaces</b>		<b>Test of significance</b>
	<b>Yes</b>	<b>No</b>	
	<b>No (%)</b>	<b>No (%)</b>	
Yes	62 (42.2)	85 (57.8)	$\chi^2 = 13.601,$ $p < 0.001$
No	30 (21.7)	108 (78.8)	

waste disposal [21,28], a very disturbing finding in this study is the fact that the majority of respondents misinterpreted two unsanitary solid waste disposal methods, including burning of solid waste dumped in open spaces around the premises (51.6%), or burning of solid waste stored in steel bins (55.4%) as being sanitary methods of solid waste disposal. This could have serious implications on their perception of risk and choice of solid waste disposal practices.

Similar to the good knowledge of the hazards of unsanitary solid waste disposal observed among most of the respondents in this study (85.3%), a majority (83.5%) of the respondents in a study in Onitsha, Nigeria [29], also had a high level of knowledge of the health hazards caused by improper waste management. However, in contrast to the finding of this study whereby there was no association between good knowledge of the hazards of unsanitary solid waste disposal and any of the socio-demographic characteristics of the respondents, a statistically significant association was observed between the educational status of the respondents and knowledge of solid waste management in the Onitsha study. In another community based study in Jos [30], education level was found to be a predictor of good knowledge of the impact of improper waste management approaches on human health. The differences between the findings in this study and the other studies could be related to the differences in the socio-demographic composition of the study

participants. While this study was conducted among a more homogeneous population of small-scale business operators (predominantly with a secondary level of education and above), the other studies were conducted among a more diverse group of residents (with a wide variation in educational status).

The sub-optimal risk perception among the respondents in this study, with nearly three-fifths of the respondents perceiving themselves (57.9%), and their workers and neighbors (58.9%) to be at risk from the hazards of unsanitary solid waste disposal practices despite the excellent knowledge of the hazards of unsanitary solid waste disposal demonstrated by most of them (85.3%). This implies that other factors besides knowledge or the awareness of risk, influence risk perception. This is further corroborated by the finding in a study among villagers residing close to the Kadhodeki dumpsite in Nairobi, Kenya [22], which found that, while only 8.4% of the respondents had adequate knowledge of the health risks posed by the dumpsite, close to three-fifths (56.3%) perceived themselves to experience a high health risk from the dumpsite. This is probably connected to the high prevalence of respiratory, abdominal, and other symptoms (presumably attributed to the air pollution emanating from the dumpsite) among the respondents. In another study among residents living near a solid waste disposal site, they considered air pollution as their major problem next to insecurity [31]. A

study in India also reported significantly higher prevalence of both upper and lower respiratory symptoms and impaired lung function among workers employed at a municipal solid waste disposal site (at an open landfill), compared with matched controls [19].

Although, the majority of respondents practiced various sanitary solid waste disposal methods, a substantial proportion were engaged in a couple of unsanitary solid waste disposal practices such as disposal at open dumping site (34.7%) and burning of refuse dumped in open places around shop/factory premises (32.3%). These findings concur with the high prevalence of unsanitary solid waste disposal reported in studies from other African countries including Ghana [32], Sierra Leone [33], Kenya [34], Ethiopia [35], and the Democratic Republic of Congo [36], thus bringing to the fore the enormous burden of exposure of populations across the continent to the hazards of unsanitary solid waste disposal.

An important finding in this study is identifying the misconception that burning refuse in open spaces around a shop/factory as being a sanitary method of solid waste disposal. The respondents having that misconception were more than twice as likely to engage in that practice as compared with those without that particular misconception (Odds Ratio = 2.626, 95% CI = 1.561 – 4.418,  $p < 0.001$ ). It is evident that the respondents engaged in unsanitary solid waste disposal practices out of lack of knowledge, and while this offers a plausible explanation for their sub-optimal perception of risk from the hazards of unsanitary solid waste disposal, it also emphasizes the need for enhanced training on appropriate sanitary solid waste disposal practices through a periodic mass public health education program. This is strongly supported by the finding in a study among rural residents in south-east Nigeria which reported a significant increase in the respondents' knowledge of sanitary waste disposal practices following exposure to mass media campaigns on the safe disposal of excreta [37].

## 5. CONCLUSION

Although the participants in this study had good knowledge of the hazards of unsanitary solid waste disposal practices, their perception of risk was suboptimal and unsanitary solid waste disposal practices were prevalent among them. Small-scale business operators should be targeted for health education intervention to

reduce misconceptions and to facilitate sanitary solid waste disposal practices.

## CONSENT

As per international standard or university standard, patient's written consent has been collected and preserved by the author(s).

## ETHICAL APPROVAL

As per international standard or university standard, written approval of Ethics committee has been collected and preserved by the author(s).

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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