International Journal of Environmental Health Research

ISSN: 0960-3123 (Print) 1369-1619 (Online) Journal homepage: https://www.tandfonline.com/loi/cije20

Levels and determinants of perceived health risk from solid wastes among communities living near to dumpsites in Kenya

Dickson A. Amugsi, Tilahun Nigatu Haregu & Blessing U. Mberu

INTERNATIONAL JOURNAL OF ENVIRONMENTAL HEALTH RESEARCH
https://doi.org/10.1080/09603123.2019.1597834

Taylor & Francis
Taylor & Francis Group

ARTICLE

Check for updates

Levels and determinants of perceived health risk from solid wastes among communities living near to dumpsites in Kenya

Dickson A. Amugsi[a], Tilahun Nigatu Haregu[b] and Blessing U. Mberu[a]

[a]African Population and Health Research Centre (APHRC), Nairobi, Kenya; [b]Baker Heart and Diabetes Institute, Australia

ABSTRACT

Many countries in sub-Saharan Africa have poor solid waste management systems, putting people living near dumpsites at higher risk of disease infections. Good risk perception could enhance individual- and community-level protection and prevention efforts. The objective of this study was to examine the levels and determinants of perceived health risk associated with exposure to solid waste dumpsites in Kenya. The level of risk was measured on a five-point Likert scale. The results showed that about 27% and 42% of the study population in Nairobi and Mombasa, respectively, perceive that they have little or no health risk from the nearby dumpsites. Study site, family size and wealth index were associated with risk perception in the multivariate analysis. A sizable proportion (42%) of the population living near dumpsites has lower risk perception. Health promotion interventions are needed to enhance risk awareness and perception in these communities.

ARTICLE HISTORY
Received 4 January 2019
Accepted 14 March 2019

KEYWORDS
Determinants; Kenya; risk perception; solid waste

Introduction

With the increasing rate of urbanization, the amount of waste generated from cities is increasing rapidly (The World Bank 2018). In sub-Saharan Africa where nearly 55% of the urban population live in slums, poor solid waste management (SWM) is a critical challenge (Kubanza and Simatele 2016). Without expansion of existing systems, this challenge could result in negative consequences on health and livelihood of the population. Along with creating better health systems that can effectively address these consequences, countries should also institute sustainable strategies for SWM in major cities (Boadi and Kuitunen 2005b; Parrot et al. 2009; Yoada et al. 2014).

As it is also true in many African cities, the two major cities in Kenya, Nairobi and Mombasa, are also facing a challenge of SWM. At the border of both cities are dumpsites where people also live in the nearby places. While some residents considered the dumpsites as source of their livelihood, many others are exposed to these poorly managed wastes on day-to-day basis. This exposure has negative impact on the health and well-being of these population, including women and children (Henry et al. 2006; Troschinetz and Mihelcic 2009; Ziraba et al. 2016). The negative health impacts of poor SWM exposure include but not limited to incidence of cancer, low-birth weight, congenital abnormalities, unsightly conditions and infectious disease morbidity (Ncube et al. 2017). The consequences of living near solid waste (SW) dumpsite as outlined above suggest the need for deliberate policy interventions to address the waste-borne hazards and vulnerabilities of the population living near dumpsites.

CONTACT Dickson A. Amugsi damugsi@aphrc.org African Population and Health Research Centre, APHRC Campus, P.O Box 10787-00100, Nairobi, Kenya

Perception of risk from exposure to different forms of wastes is an important factor that influences individual- and community-level efforts to address these challenges (Mukama et al. 2016). While high level of perception of risk can positively influence the intentions to take actions, low level of risk perception could hamper efforts that tend to address the challenges in such settings (Jerie 2016). Therefore, understanding perception of risk from SW exposure will help inform public health and urban development efforts in the exposed areas.

Although there exists considerable evidence about the problem of SWM and its health consequences in urban areas of Africa, there is still a limited evidence on risk perception of poor SWM among people living near dumpsites, especially in Kenya. There is, therefore, a need to illuminate these risk perceptions as well as their correlates in the context of Kenyan cities. Availing such evidence will inform policies, strategies and interventions that aim to improve SWM and by extension the health and well-being of communities exposed to poor SWM. In this regard, this study was designed to examine the levels and determinants of perceived health risk from SW among communities living near SW dumpsites in Kenya. More specifically, the study has described the levels of perception of risk by various background variables and identified factors that have effect on the levels of perception of risk from exposure to poor state of SWM.

Methods

The study settings of Nairobi and Mombasa

According to the 2009 Census, in the administrative area of Nairobi, 3.1 million inhabitants lived within 696 km^2 (269 sq. mi). It has only one official dumpsite – the Dandora dumpsite, which is located north east of the city, about 7.5 km from the central business district. However, there are many other unofficial dumpsites scattered across the city. The current municipal SW generated daily in the city is estimated to be 4016 tons (Njoroge, Kimani, and Ndunge 2014). The responsibility of waste collection lies with the Nairobi City County, however, available estimates suggest that only 50% of waste generated in the city is collected and the total waste reuse and recycling is estimated at about 100–150 tons/day, amounting to approximately 5% of total waste generated (Allison and von Blottnitz 2010). The official designated dumpsite at Dandora has reached full capacity and has been noted to be responsible for gross environmental and public health hazards (United Nations Environment Programme (UNEP) 2005) and already causing significant environmental pollution and damages to human health, especially to more than 200,000 people living in the surrounding settlements. Mombasa is the second largest city in Kenya with a population of about 720,000 and within 45 m above sea level. The city has the largest seaport in East Africa and is an important tourist destination. It has one official dumpsite, located in Mwakirunge, 15 km from the town centre and one transfer station located at VOK. The Mombasa Municipal council collects about 68% of the 650 metric tons of total waste produced daily. Community-based organizations, including youth groups in different parts of the city are also involved in garbage collection as a way of generating income (Kithiia and Dowling 2010).

Ethical approval

Ethical clearance to conduct the study was obtained from Amref Health Africa Ethics and Scientific Review Committee (Ref: AMREF-ESRC P201/2015). All participants provided written informed consent. The respondents were told of their right to abstain from participating in the study or withdraw from it at any time, without reprisal; and measures to ensure the confidentiality of information provided.

Data source

This paper used data collected as part of Urban Africa Risk Knowledge (Urban ARK) project (https://www.urbanark.org/) funded by DFID and ESRC and implemented in Kenya and Senegal as part of the larger Urban ARK project. In this paper, we used data from Nairobi and Mombasa, which were collected between April and June 2016. In both cities, data were collected from households with different levels of exposure to the municipal dumpsites. Three sites – Korogocho, Siaka and Makadara – were included from Nairobi. Similarly, two sites – Bamburi and Kisauni – were included from Mombasa. The survey assessed both individual- and household-level risk of poor SWM in these sites. Interview administered questionnaire with head of household was the primary method of data collection. The data were collected using Open Data Kit (ODK) programmed tablets. This helped to capture the data in real time thereby minimizing errors associated with paper-based data collection processes. After each day of data collection, the data were uploaded on a safe APHRC (African Population and Health Research Center) server from where they were extracted into statistical analysis software for analysis.

Sample size determination and sampling

The formula used in determining the sample size for the survey is as follows:

$$n = \frac{t^2_{\frac{\alpha}{2}} p(1-p)\ .\ D_{eff}.N_{resp}}{\varepsilon^2} \tag{1}$$

where n = estimated sample size; t = abscissa of the normal curve that cuts of an area (alpha) at the tails which is determined by the desired confidence level. In the case of the current survey, the desired confidence level was 95%; p = proportion of the population that possess a given attribute that is key for the survey. This may be obtained from a previous survey or in its absence, it is estimated with the possible maximum value of 0.5 which gives the largest possible sample size; α= level of statistical confidence, 5% in the case of this study; ε= the margin of error to be tolerated was set at 5%; D_{eff} = design effect which arises from the effect of clustering associated with increased variances. In this study, a design effect of 2 was used; N_{resp} = potential non-response due to various factors which may include refusal by some respondents. It was assumed that the sensitivity of the issues in this survey may lead to some non-response and as such, a non-response adjustment of 5% was applied to sustain an optimal sample size.

Using the values provided above, the estimates for the sample sizes for the survey were obtained. The samples were allocated to the various locations of the cities, proportionate to the population sizes.

Allocation of the sample to strata

In this survey, the locations constituted strata and within each location, the enumeration areas (EAs) were the primary sampling units (PSUs) for the selection of the sample. The sample design was stratified cluster sample design. The estimated sample sizes were allocated to the locations using the proportional allocation method. This method was preferred to equal allocation because it produces low variances in the estimates. Since the stratified cluster sample design was adopted for the survey, it was important to fix the number of interviews to be done in each cluster. Building on the demographic and health survey practices (Aliaga and Ren 2006) and as the surveys were implemented in urban areas where household density was expected to be high, we interviewed a fixed number of 20 households per EA (cluster). Within each stratum (location), an independent selection of EAs (clusters) was done using the probability proportional to population size (PPS) method. The measure of size for the selection of the EAs was the number of households.

The selection of the sample

There were two stages of sample selection in the survey. At the first stage, the selection involved the clusters which were also referred to as PSUs. At the second stage, the households, which were the ultimate sampling units (USUs), were selected for the interviews. Within the households, there was no selection as the head of the household was the respondent to all the issues of the survey. In the absence of the head of the household, the next most senior member of the household was interviewed. The selection of the households was done using the systematic sampling method (Lavrakas 2008). This method has been proved theoretically to be identical to the simple random sampling method. The survey team carried out a quick count of the households in the EA and based on this information determined a sampling interval for the selection of the households. The team then moved from one end of the EA to the other through the sampling interval and selecting the households for interview.

Data collection processes

Trained field interviewers along with rigorous data quality checks were employed in the data collection. The field interviewers who already had extensive experience in data collection, underwent a 3-day intensive field work training using the APHRC's training protocol. The training was facilitated by researchers from APHRC, who included the principal investigator, project manager, field coordinator, data programmer and data management specialists. The objective of the training was to provide the field workers with skills regarding their role in the data collection process to ensure high-quality data. The training consisted of a combination of theory and practical exercises, focusing on the overall aims of the study, the study tools, research ethics and mock interviews. A field-based pilot was conducted and was followed by a debrief session to learn from the experience. All detected deficiencies with the questionnaire were rectified before it was used in the main data collection.

In each city, data collection was undertaken by a team of field workers comprising one supervisor and 10 interviewers. In addition, there was a dedicated office data editor who was responsible for reviewing the data on a daily basis and providing frequent feedback to the supervisors. We implemented a continuous process of data quality checks in the field using spot checks, sit-in interviews, and editing of completed surveys. For the spot checks, team leaders randomly selected 10% of the households for revisits after the household had been interviewed. Spot checks included a combination of both blinded and non-blinded interviews, with the number of spot checks conducted being equally divided between the two approaches. Non-blinded spot checks involved randomly selecting already collected information and going back to verify the information collected with the concerned households or respondents. In some circumstances, blinded spot checks were carried out by conducting an entirely new interview and comparing with what was originally collected. In rare circumstances, where the inconsistency realized was more than 5%, complete re-interviews were conducted.

Measurement and variables

Data were collected on basic sociodemographic variables including age, sex, educational status, marital status, family size, duration of stay in the area, and ownership of the living units. Wealth index was computed using the principal component analysis methods. The index was constructed from household assets data. These assets consisted of a television/radio, bicycle/motorcycle, or car, as well as dwelling characteristics, such as a source of drinking water, sanitation facilities, and type of flooring material. The duration of stay variable was categorized into four levels: less than 1 year, 1–5 years, 6–20 years, and more than 20 years. The education variable was recoded into four categories: no education/incomplete primary, complete primary, secondary, and college/university. This was performed in order to preserve sample size for the analysis. Five variables were used to assess perception of risk from poor SWM in the study areas. These included the types of perceived risks, levels of perceived risk, ways of exposure to the risks, perception of who is most at risk and perception of ability to address these risks. Level of perceived risk was measured on a five-point Likert scale with 1 = no risk at all, 2 = little risk, 3 = moderate risk, 4 = high risk and 5 =very high risk. Respondents were asked to rate their perceived risk on this five-point scale. This was the main variable used to measure level of risk in this study.

Data analysis

Data were analysed using SPSS 24.0. Basic background variables were described for each site using numbers and proportions. Risk variables were also described using proportions, separately for Nairobi and Mombasa. χ^2 statistics were used to examine bivariate associations between levels of perceived risk and basic background variables. Ordinal regression was used for the multivariate analysis of the predictors of levels of risk. The potential predictors of perceived health risks included in the multivariate model were identified in the literature and subjected to bivariate analysis to establish which variables were significantly related to the perceived risks measures. All significant variables in bivariate analyses were included in the multivariate analysis. Additionally, variables that were not significant but were considered critical by the researchers were included in the analysis. Such variables included education and gender. In all, 10 predictor variables were included in the model. All assumptions for the use of ordinal regression were checked before running the model and analysis was carried out using the PLUM procedure or command. Goodness of fit for the model was checked using Pearson χ^2 and Cox and Snell R^2 and other measures of goodness-of-fit tests. Also, Multicollinearity among predictors was checked using variance inflation factors (VIF) and none of the predictors were strongly correlated. p values $<$ 0.05 were considered as statistically significant.

Results

Characteristics of the study population

A total of 2397 study participants participated in this study. Of these, 1238 (52%) were from Mombasa and the remaining 1159 (48%) were from Nairobi. More than two-third (71%) of them were men. The highest level of education completed for 40% of the study participants was secondary level. The details of background characteristics of the study participants are shown in Table 1.

Perception of risk from poor solid waste management

While most of the study participants were aware of the existence of risks that could result from poor management of SW, 152 (12%) and 47 (4%) of participants from Mombasa and Nairobi, respectively, stated that there were no risks that people could face from poor state of waste management. Among all the participants, 8% of the men and 9% of the women did not think that poor SWM could result in some risks.

Among the major risks perceived to be associated with poor SWM, health risks, dirty environment and air pollution were the three top risks mentioned by more than half of the participants in both study sites. The level of risk perception in Nairobi was almost twice that of Mombasa (50% vs. 28%). About 42% of the study participants in Mombasa and 27% of them in Nairobi, respectively, perceived that there was little or no risk associated with poor SWM. Majority of the study participants believed that they were exposed to this risk through bad smell. Almost all perceived that children were at the most risk. More than two-third of the study participants felt that their communities cannot address the problem of SWM without support from others, including the government. The distribution of these risk perception variables is displayed in Table 2.

Table 1. Background characteristics of the study population.

	Mombasa	Nairobi
Sex		
Male	853 (68.9%)	847 (73.3%)
Female	385 (31.1%)	309 (26.7%)
Total	1238 (100%)	1156 (100%)
Age groups		
<18	2 (0.2%)	9 (0.8%)
18–28 years	257 (20.8%)	240 (20.8%)
29–34 years	313 (25.3%)	267 (23.1%)
35–49 years	457 (36.9%)	416 (36.0%)
50 years and above	209 (16.9%)	224 (19.4%)
Total	1238 (100%)	1156 (100%)
Educational status		
No formal education	4 (0.4%)	4 (0.4%)
Incomplete primary	114 (10.2%)	124 (11.0%)
Complete primary	271 (24.2%)	250 (22.3%)
Secondary	459 (41.1%)	506 (45.1%)
College/university	258 (23.1%)	233 (20.7%)
Total	1118 (100%)	1123 (100%)
Marital status		
Never married	216 (17.5%)	150 (13.0%)
Married/cohabiting	840 (68.0%)	841 (73.1%)
Divorced	36 (2.9%)	16 (1.4%)
Windowed	74 (6.0%)	61 (5.3%)
Separated	65 (5.3%)	68 (5.9%)
Total	1236 (100%)	1150 (100%)
Duration of stay		
<1 year	126 (10.2%)	105 (9.1%)
1–5 years	602 (48.7%)	456 (39.3%)
6–20 years	386 (31.2%)	420 (36.2%)
More than 20 years	123 (9.9%)	178 (15.4%)
Total	1237 (100%)	1159 (100%)
Family size		
1–2	488 (39.4%)	349 (30.2%)
3–6	673 (54.4%)	764 (66.1%)
7–10	71 (5.7%)	41 (3.5%)
>10	6 (0.5%)	2 (0.2%)
Total	1238 (100%)	1156 (100%)
Wealth index		
Poor	496 (40.1%)	307 (26.5%)
Middle	342 (27.6%)	455 (39.3%)
Rich	400 (32.3%)	397 (34.3%)
Total	1238 (100%)	1159 (100%)
Ownership of house		
Owns or co-owns	361 (29.2%)	173 (14.9%)
Rent	861 (69.5%)	974 (84.1%)
Others	16 (100%)	11 (100%)

Determinants of perceived risk (bivariate)

Bivariate analysis of the association between levels of perceived risk and basic background variables had shown that perceived risk is associated with location (city), age, duration of stay in the area, wealth index, family size, ownership of house, and experience of health issue related to poor SWM. However, this analysis has found non-significant association of levels of perceived risk with sex and educational status. The association between level of perceived risk and marital status was marginal. Further information about these associations is shown in Table 3.

Table 2. Perception of different risks associated with poor waste management.

	Mombasa	Nairobi
Types of perceived risks		
Health risks	1069 (98.4%)	959 (86.2%)
Dirty environment	751 (69.2%)	572 (51.4%)
Air pollution	578 (53.2%)	610 (54.9%)
Flooding	272 (25.0%)	204 (18.3%)
Pollution of water and rivers	227 (20.9%)	234 (21.0%)
Vermin	213 (16.9%)	280 (25.2%)
Fire risks	64 (5.9%)	38 (3.4%)
Others	7 (0.6%)	137 (12.3%)
Level of perceived risk		
No risk at all	155 (14.3%)	86 (7.7%)
Little risk	299 (27.6%)	214 (19.3%)
Moderate risk	324 (29.9%)	267 (24.0%)
High risk	233 (21.5%)	248 (22.3%)
Very high risk	74 (6.8%)	296 (26.6%)
Total	1085 (100%)	1111 (100%)
Ways of exposure to perceived risks		
Unpleasant smell	774 (83.1%)	750 (73.1%)
Smoke	372 (40.0%)	443 (43.2%)
Contamination of food	482 (51.8%)	350 (34.1%)
Contamination of water	120 (12.9%)	211 (20.6%)
Others	3 (0.3%)	186 (18.1%)
Perception of who is most at risk		
Children	1047 (97.6%)	1097 (98.8%)
Older person	7 (0.7%)	9 (0.8%)
Adult women	17 (1.6%)	4 (0.4%)
Adult men	2 (0.2%)	-
Total	1073 (100%)	1110 (100%)
Perception of ability to address the risk		
Yes, we can address the risk	396 (33.8%)	310 (28.5%)
No, we can't address the risk	776 (66.2%)	777 (71.5%)
Total	1072 (100%)	1087 (100%)
Experience of health issue related to waste		
Yes, experienced	176 (14.2%)	266 (23.0%)
No, didn't experience	1050 (84.8%)	883 (77.0%)
Total	1238 (100%)	1156 (100%)

Determinants of perceived risk (multivariate analysis)

After controlling for the effect of potential factors using an ordinal logistic regression model, study participants from Mombasa had lower levels of perceived risk as compared to those in Nairobi. With regard to the association between gender and levels of perceived risk, our analysis showed that although men had lower levels of perceived risk than women, this was not significant in the multivariate model. Lower family size negatively associated with levels of perceived risk. Wealth index was also positively associated with levels of perceived risk. This was statistically significant among those at lower (poor) categories of wealth index. On the other hand, shorter duration of stay (<1 year) in the study sites which was a significant factor in bivariate analysis was not associated with perceived risk in this model. Experience of a health issue related to poor state of SWM in the past seems to associate with the levels of perceived risk; however, the confidence intervals for this result were not statistically significant. The details of the outputs of the ordinal regression model are illustrated in Table 4.

Table 3. Distribution of levels of perceived risk by basic background variables.

	No risk	Little	Moderate	High	Very high	*p* value
Location (city)						
Mombasa	155 (64.3%)	299 (58.3%)	324 (54.8%)	233 (48.4%)	74 (20.0%)	0.001
Nairobi	86 (35.7%)	214 (41.7%)	267 (45.2%)	248 (51.6%)	296 (80.0%)	
Total	241 (100%)	513 (100%)	591 (100%)	481 (100%)	241 (100%)	
Sex						
Male	176 (73.0%)	363 (70.9%)	415 (70.3%)	345 (71.9%)	265 (71.6%)	0.944
Women	65 (27.0%)	149 (29.1%)	175 (29.7%)	135 (28.1%)	105 (28.4%)	
Total	241 (100%)	512 (100%)	590 (100%)	480 (100%)	370 (100%)	
Age						
<18	2 (0.8%)	-	1 (0.2%)	3 (0.6%)	1 (0.3%)	0.022
18–28 years	41 (17.0%)	112 (21.9%)	141 (23.9%)	98 (20.4%)	67 (18.1%)	
29–34 years	51 (21.2%)	146 (28.5%)	148 (25.1%)	112 (23.3%)	76 (20.5%)	
35–49 years	96 (39.8%)	164 (32.0%)	202 (34.2%)	170 (35.4%)	156 (42.2%)	
50 years and above	51 (21.2%)	90 (17.6%)	98 (16.6%)	97 (20.2%)	70 (18.9%)	
Total	241 (100%)	512 (100%)	590 (100%)	480 (100%)	370 (100%)	
Education						
No education	1 (0.5%)	6 (1.6%)	6 (1.3%)	6 (1.6%)	-	0.086
Incomplete primary	31 (16.6%)	57 (15.2%)	78 (17.1%)	64 (17.4%)	51 (16.3%)	
Complete primary	48 (25.7%)	89 (23.7%)	113 (24.8%)	110 (29.9%)	82 (26.2%)	
Secondary	77 (41.2%)	151 (40.2%)	182 (39.9%)	149 (40.5%)	128 (40.9%)	
College/university	30 (16.0%)	70 (18.6%)	77 (16.9%)	39 (10.6%)	52 (16.6%)	
Total	187 (100%)	376 (100%)	456 (100%)	368 (100%)	313 (100%)	
Marital status						
Never married	33 (17.2%)	71 (18.7%)	84 (19.0%)	50 (14.0%)	64 (20.9%)	0.049
Married/cohabiting	150 (78.1%)	298 (78.4%)	348 (78.9%)	299 (84.0%)	238 (77.8%)	
Divorced	2 (1.0%)	2 (0.5%)		2 (0.6%)	2 (0.7%)	
Windowed	1 (0.5%)	6 (1.6%)	1 (0.2%)	2 (0.6%)	1 (0.3%)	
Separated	6 (3.1%)	3 (0.8%)	6 (1.4%)	3 (0.8%)	1 (0.3%)	
Total	192 (100%)	380 (100%)	441 (100%)	356 (100%)	306 (100%)	
Duration of stay						
<1 year	19 (7.9%)	59 (11.5%)	54 (9.1%)	39 (8.1%)	28 (7.6%)	0.007
1–5 years	112 (46.7%)	229 (44.6%)	275 (46.5%)	206 (42.8%)	140 (37.8%)	
6–20 years	83 (34.6%)	164 (32.0%)	204 (34.5%)	169 (35.1%)	132 (35.7%)	
More than 20 years	26 (10.8%)	61 (11.9%)	58 (9.8%)	67 (13.9%)	70 (18.9%)	
Total	240 (100%)	513 (100%)	591 (100%)	481 (100%)	370 (100%)	
Family size						
1–2	85 (35.3%)	207 (40.4%)	200 (33.9%)	162 (33.8%)	81 (21.9%)	0.001
3–6	144 (59.8%)	281 (54.9%)	360 (61.0%)	289 (60.2%)	270 (73.0%)	
7–10	12 (5.0%)	21 (4.1%)	29 (4.9%)	27 (5.6%)	19 (5.1%)	
>10	-	3 (0.6%)	1 (0.2%)	2 (0.4%)	-	
Total	241 (100%)	512 (100%)	590 (100%)	480 (100%)	370 (100%)	
Wealth index						
Poor	80 (33.2%)	145 (28.3%)	199 (33.7%)	183 (38.0%)	113 (30.5%)	0.001
Middle	71 (29.5%)	164 (32.0%)	209 (35.4%)	176 (36.6%)	128 (34.6%)	
Rich	90 (37.3%)	204 (39.8%)	183 (31.0%)	122 (25.4%)	129 (34.9%)	
Total	241 (100%)	513 (100%)	591 (100%)	481 (100%)	370 (100%)	
Ownership of house						
Owns or co-owns	64 (26.6%)	130 (25.3%)	129 (21.9%)	101 (21.0%)	63 (17.0%)	0.002
Rent	170 (70.5%)	380 (74.1%)	459 (77.8%)	375 (78.0%)	303 (81.9%)	
Others	7 (2.9%)	3 (0.6%)	2 (0.3%)	5 (1.0%)	4 (1.1%)	
Total	241 (100%)	513 (100%)	590 (100%)	481 (100%)	370 (100%)	
Experienced health issue related to waste						
Yes	17 (7.1%)	64 (12.5%)	95 (16.1%)	131 (27.3%)	133 (35.9%)	0.001
No	224 (92.9%)	447 (87.3%)	491 (83.2%)	343 (71.5%)	231 (62.4%)	
Total	241 (100%)	512 (100%)	590 (100%)	480 (100%)	370 (100%)	

Discussion

This study sets out to investigate the levels and determinants of perceived health risks from SW among communities bordering dumpsites in Kenya. The results showed that generally, there is some level of awareness of the existence of risks associated with exposure to SW. Nevertheless, there

Table 4. Parameter estimates for predictors of levels of perceived risk.

						95% CI	
		Estimate	Std. Error	Wald	Sig.	Lower	Upper
Threshold	No risk at all	−2.955	0.274	116.224	0.001	−3.493	−2.418
	Little risk	−1.389	0.267	27.157	0.001	−1.911	−0.867
	Moderate risk	−0.181	0.265	0.466	0.495	−0.700	0.338
	High risk	1.060	0.266	15.816	0.001	0.738	1.582
City name	Mombasa	−0.746	0.085	76.224	0.001	−0.914	−0.579
	Nairobi	0[a]					
Gender	Male	−0.039	0.112	0.123	0.726	−0.258	0.180
	Female	0[a]					
Marital status	Never married	−0.057	0.176	0.104	0.747	−0.402	0.289
	Married or cohabited	−0.103	0.156	0.441	0.507	−0.408	0.202
	Had been married	0[a]					
Educational status	Primary	0.047	0.129	0.132	0.716	−0.205	0.299
	Secondary	−0.006	0.113	0.003	0.960	−0.228	0.217
	Tertiary	0[a]					
Family size	1–2	−0.590	0.209	7.945	0.005	−1.000	−0.180
	3–6	−0.172	0.196	0.769	0.381	−0.555	0.212
	7 and above	0[a]					
Duration of stay	<1 year	−0.151	0.153	0.983	0.321	−0.451	0.148
	1–5 years	−0.135	0.095	2.026	0.155	−0.321	0.051
	More than 5 years	0[a]					
Wealth index	Poor	0.262	0.117	5.053	0.025	0.034	0.491
	Middle	0.130	0.105	1.533	0.216	−0.076	0.337
	Rich	0[a]					
Age groups	Less than 28 years	−0.084	0.154	0.296	0.586	−0.386	0.218
	29–49 years	−0.081	0.122	0.439	0.508	−0.319	0.158
	50 and above	0[a]					
Ownership of house	Own or co-own	−0.242	0.112	4.629	0.031	−0.462	−0.022
	Rent	0[a]					
Experienced health issue	Yes	0.930	0.105	79.062	0.001	0.925	1.135
	No	0[a]					

was a sizable number of respondents who had low-risk perception of the effects of poor SWM on their health. This varied between the two cities, with communities in Mombasa having lower risk perception relative to Nairobi. These findings were confirmed in the multivariate analysis, where respondents in Mombasa tended to associate lower risks with poor SWM compared to Nairobi. The differences in risk perceptions among respondents in the two cities is not surprising as there is a huge difference between the dumpsites in Nairobi and Mombasa in terms of size, and consequently the level of exposure. For example, the Dandora dumpsite in Nairobi is the largest in the country and as a result a huge amount of pollution is emitted from it on a daily basis. Hence, the likelihood that communities bordering this dumpsite will consider it as a threat to their health is expected to be high. The same cannot be said of the dumpsites in Mombasa, which are relatively small and less likely to be seen by study participants as posing a threat to their health. Secondly, it could be that respondents in Mombasa have limited knowledge on the risks associated with poor SWM compared to respondents in Nairobi. This could be the case as there is evidence in the literature that shows that lack of knowledge can influence how people perceive the effect of poor SWM on their health (Singh et al. 2014; Awosan et al. 2017). For example, a research in India revealed that respondents of the communities studied lack knowledge on the harmful effects of waste heaps on the health of people living near these heaps or dumpsites (Singh et al. 2014). In the contrary, another study revealed that knowledge of hazards associated with improper waste disposal does not necessarily translate into risk perception (Awosan et al. 2017). In the Awosan et al.'s study (Awosan et al. 2017), respondents had good knowledge of the hazards of improper SW disposal, but suboptimal risk perception.

The three major perceived risks our analysis illuminated included disease risk, dirty environment and pollution. And children were considered by study participants to be the most affected by the hazards associated with exposure to poor SWM. This calls for deliberate policies and interventions to address the SWM menace in the two biggest cities in Kenya. Comparing these findings to previous research, one may observe some similarities. Collaborating our findings, a previous study found that participants perceived dumpsites to have a negative impact on physical health of people living close to them (Mosquera-Becerra et al. 2009). Results from several other studies showed that diarrhoea, intestinal worms, typhoid fever, respiratory infections and cancer were perceived as diseases resulting from the wastes at dumpsites (Yoada et al. 2014; Addo, Adei, and Acheampong 2015; Dea and Debnathb 2016). Boadi and Markku observed in their study a high incidence of diarrhoea among children living near waste dumps (Boadi and Markku). Further, the World Health Organization (2000) asserts that residents who live closer to exposed and unmanaged waste dumps are subjected to more bouts of cholera, acute intestinal infections, skin diseases, blood and eyes cancer and respiratory infections (World Health Organization 2000). These studies together with our study illuminated the potential health consequences of poor SWM.

Low household wealth index was positively associated with perceived health risks of SW from the dumpsites relative to the high wealth index. This is not unexpected as the communities very close to the dumpsites are likely to be inhabited by people belonging to the poor wealth index, and who also bear disproportionately the hazards associated with the dumpsites. This in effect may contribute to the risk perception of the respondents in poor households. Indeed, it is important to recognize that such perceptions may not necessarily be wrong or inaccurate. This is because if individuals of lower wealth index are exposed to a greater number of health risks associated with dumpsites, their perceptions are likely to reflect the consequences of the exposures (Unger et al. 1992; Lee et al. 2008). The issue of poor households bearing the largest effect of environmental health hazards and the possible consequential effects on their risk perception has been previously documented (Boadi and Kuitunen 2005b; Boadi and Markku 2005a; Yoada et al. 2014). The evidence is that poor households bear a higher burden of environmental health hazards than their wealthy counterparts, due to their particular vulnerability resulting from inadequate access to environmental health facilities and services (Boadi and Markku 2005a). However, the association between risk perception and the middle wealth index in our analysis though positive, did not reach statistical significance.

Related to wealth index is the educational level of the respondents, which unexpectedly did not show a significant relationship with perceived health risks of poor SWM. This finding is similar to other studies in the literature. For example, Njagi et al. (2013) observed in their study that education accounted for a non-significant 28% variation in respondents' attitude towards the health risks of dumpsites. However, in the same study, adequate education significantly accounted for 67% variation in respondents' health risk perception (Njagi et al. 2013). This is similar to a study in Nigeria, which showed that respondents with a higher level of education have a correct knowledge of the impact of improper waste management on health than those with a lower level of education (Jatau 2013). The differential effects of education suggest that education is not a constant predictor of perceive health risks as it relates to poor SWM.

The strength of this paper is the use of two city data, which help unmask differences and commonalities in the effects of the correlates on the risk perceptions of exposure to poor SWM, which would not have been possible with a single-city data. Another strength is that we used well trained field staff and rigorous quality checks in the data collection processes, and consequently, the data used in this paper are of very high quality. An important limitation of this study worth mentioning is the cross-sectional nature of the data, which does not lend itself to the establishment of causal relationships between predictor and outcome variables. The conclusions in the paper are therefore interpreted as associations between the predictor and outcome variables. The second limitation is that the paper is about perceptions, which may not reflect the reality on the ground. Further, the use of self-reports (questionnaires) to collect the data is a limitation in the context of issues such as inflated health risks, social desirability responses and recall bias among others (Ncube et al. 2017).

Conclusions

The study explored the levels and determinants of risk perceptions associated with exposure to poor SWM. The results showed that generally, there was some level of awareness of the existence of risks associated with exposure to SW and this varies between the two cities. The level of risk perception among the study participants living in communities in Nairobi was almost twice that of Mombasa. There were also a sizable number of respondents who had low-risk perception of poor SWM on their health. This calls for health promotion interventions to enhance risk awareness and perception in these communities. Respondents in the lower wealth index tended to have higher risk perception relative to those in the rich index. The significant statistical relationship between low wealth index and risk perception indicates the need to target poor households with health education interventions to reduce the effects of the SW on their health. In addition, the significantly low levels of risk perception suggest that the Kenyan Ministry of Health should educate urban communities on the dangers of poor SWM.

Acknowledgments

The authors acknowledge the Economic and Social Research Council (ESRC) and the UK Department for International Development (DFID) for their financial support through the Urban Africa: Risk Knowledge (ARK). The Urban ARK Programme was funded by ESRC and DFID Humanitarian Innovation and Evidence Programme, grant code: ES/L008777/1. The views expressed do not necessarily reflect those of the donors. Besides, the authors also extend their acknowledgement to the research team and field workers who made the implementation of the Urban ARK project and data collection for this study possible. We also wish to express our gratitude to the study participants for agreeing to participate in the study and providing us with this rich information.

Disclosure of interest

The authors report no conflict of interest

Funding

The authors acknowledge the Economic and Social Research Council (ESRC) and the UK Department for International Development (DFID) for their financial support through the Urban Africa: Risk Knowledge (ARK). The Urban ARK Programme was funded by ESRC and DFID Humanitarian Innovation and Evidence Programme, grant code: ES/L008777/1.

References

Addo IB, Adei D, Acheampong EO. 2015. Solid waste management and its health implications on the dwellers of Kumasi metropolis, Ghana. Curr Res J Social Sci. 7(3):81–93.

Al Yaqout AF. 2003. Assessment and analysis of industrial liquid waste and sludge disposal at unlined landfill sites in arid climate. Environ Manage. 23:817–824. doi:10.1016/S0956-053X(03)00036-9.

Aliaga A, Ren R. 2006. Optimal sample sizes for two-stage cluster sampling in demographic and health surveys.

Allison A, von Blottnitz H 2010. Solid waste management in Nairobi: a situation analysis. Technical Document accompanying the Integrated Solid Waste Management Plan Prepared by: Environmental & Process Systems Engineering Group University of Cape Town for the City Council of Nairobi on contract for the United Nations Environment Programme Draft.

Awosan JK, Oche MO, Yunusa EU, Raji MO, Isah BA. 2017. Knowledge, risk perception and practices regarding the hazards of unsanitary solid waste disposal among small-scale business operators in Sokoto, Nigeria. Int J Trop Dis Health. 26:1–10. doi:10.9734/IJTDH/2017/36491.

Boadi KO, Markku K. 2005a. Environment and health impacts of household solid waste handling and disposal practices in the third world cities: the case of accra metropolitan area, Ghana. J Environ Health. 68:34–36.
Boadi KO, Markku K. 2005b. Environment, wealth, inequality and the burden of disease in the Accra metropolitan area, Ghana. Int J Environ Health Res. 15:193–206. doi:10.1080/09603120500105935.
Dea S, Debnathb B. 2016. Prevalence of health hazards associated with solid waste disposal- a case study of Kolkata, India. Procedia Environ Sci. 35:201–208. doi:10.1016/j.proenv.2016.07.081.
Henry RK, Yongsheng Z, Jun D. 2006. Municipal solid waste management challenges in developing countries–kenyan case study. Environ Manage. 26:92–100. doi:10.1016/j.wasman.2005.03.007.
Jatau AA. 2013. Knowledge, attitudes and practices associated with waste management in Jos South Metropolis, plateau state Nigeria. Mediterr J Soc Sci. 4(5).
Jerie S. 2016. Occupational risks associated with solid waste management in the informal sector of Gweru, Zimbabwe. J Environ Public Health. 2016:9024160. doi:10.1155/2016/9024160.
Kithiia J, Dowling R. 2010. An integrated city-level planning process to address the impacts of climate change in Kenya: the case of Mombasa. Cities. 27:466–475. doi:10.1016/j.cities.2010.08.001.
Kubanza SN, Nzalalemba S, Danny S. 2016. Social and environmental injustices in solid waste management in sub-Saharan Africa: a study of Kinshasa, the Democratic Republic of Congo. Local Environ. 21:866–882. doi:10.1080/13549839.2015.1038985.
Lavrakas PJ. 2008. Encyclopedia of survey research methods. Thousand Oaks, CA: Sage Publications, Inc. doi:10.4135/9781412963947.
Lee JEC, Lemyre L, Turner MC. 2008. Health risk perceptions as mediators of socioeconomic differentials in health behaviour. J Health Psychol. 13:1082–1091. doi:10.1177/1359105308095962.
Mosquera-Becerra J, Gomez-Gutierrez OL, Mendez-Paz F. 2009. Impact perception on health, social and physical environments of the municipal solid waste disposal site in Cali. Revista de Salud Pública (Bogota). 11:549–558.
Mukama T, Ndejjo R, Musoke D, Musinguzi G, Halage AA, Carpenter DO, Ssempebwa JC. 2016. Practices, concerns, and willingness to participate in solid waste management in two urban slums in Central Uganda. J Environ Public Health. 2016:6830163. doi:10.1155/2016/6830163.
Ncube F, Ncube EJ, Voyi K. 2017. A systematic critical review of epidemiological studies on public health concerns of municipal solid waste handling. Perspect Public Health. 137(2). doi:10.1177/1757913916639077.
Njagi JM, Ireri AM, Njagi ENM, Akunga D, Afullo ATO, Ngugi MP, Mwanzo I, Karugu NI. 2013. Assessment of knowledge, attitude and perceptions of village residents on the health risks posed by Kadhodeki Dumpsite in Nairobi, Kenya. World Environ. 3(5):155–160.
Njoroge BNK, Kimani M, Ndunge D 2014. 'Review of municipal solid waste management: a case study of Nairobi, Kenya, [accessed 2018 Dec 20]. http://www.nswaienvis.nic.in/Waste_Portal/Case_Studies_30.10.14/Review%20of%20Municipal%20Solid%20Waste%20Management-A%20Case%20Study%20of%20Nairobi,%20Kenya.PDF.
Parrot L, Sotamenou J, Dia BK. 2009. Municipal solid waste management in Africa: strategies and livelihoods in Yaounde, Cameroon. Environ Manage. 29:986–995. doi:10.1016/j.wasman.2008.05.005.
Singh A, Zaidi J, Bajpai D, Sharma G, Yadav A, Chauhan DS, Ganesh S. 2014. Municipal solid waste management challenges and health risk problematic solutions at Agra city, U. P., India. Adv Appl Sci Res. 5:397–403.
The World Bank. 2018. Solid waste management. [accessed 2018 Dec 20]. http://www.worldbank.org/en/topic/urbandevelopment/brief/solid-waste-management
Troschinetz AM, Mihelcic JR. 2009. Sustainable recycling of municipal solid waste in developing countries. Environ Manage. 29:915–923. doi:10.1016/j.wasman.2008.04.016.
Unger DG, Wandersman A, Hallman W. 1992. Living near a hazardous waste facility: coping with individual and family distress. Am J Orthopsychiatry. 62:55–70. doi:10.1037/h0079317.
United Nations Environment Programme (UNEP). 2005. Solid waste management. [accessed 2018 Dec 20]. http://www.unep.org/ietc/Portals/136/SWM-Vol1-Part1-Chapters1to3.pdf.
WHO (World Health Organization). 2000. The world health report 2000: Health systems: improving performance. WHO, Geneva 27, Switzerland.
Yoada RM, Chirawurah D, Adongo BP. 2014. Domestic waste disposal practice and perceptions of private sector waste management in urban Accra. BMC Public Health. 14:697. doi:10.1186/1471-2458-14-697.
Ziraba AK, Haregu TN, Mberu M. 2016. A review and framework for understanding the potential impact of poor solid waste management on health in developing countries. Arch Public Health. 74:55. doi:10.1186/s13690-016-0166-4.