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ORIGINAL RESEARCH

Health Impact of Household Waste Burning in Khartoum State, Sudan

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Background: Waste disposal and management is a global concern affecting both high- and low-income countries. This research assessed the health impact of burning household waste in Khartoum State, Sudan.

Methods: An online community-based cross-sectional study was implemented on a sample of 844 participants selected through a stratified random sampling technique across Khartoum State. The data were collected through a standardized pre tested online questionnaire. The data file was georeferenced through Google Earth Pro and analysed with SPSS 23 and ArcGIS 10.3. The data were summarized numerically and graphically. The appropriate frequency tables were used in ArcGIS to generate geographical distribution maps of household waste burning and predictive health risk maps of waste burning in Khartoum State. Statistical tests performed for association carried out were Chi-square and ANOVA. A binary regression analysis established the relationship between burning of household waste and its associated factors. All statistical tests were considered significant when $p < 0.05$.

Results: The practice of burning household waste was performed by 74.5% (619/831) of the participants with 50.8% (311/612) who reported burning the waste weekly. The health conditions related to household waste burning were predominately asthma (57.0%) and respiratory manifestations (38.0%). Of the ten contributing factors of health risks related to burning household waste, the two statistically significant were the frequency of waste collection (OR = 0.720, 95% [CI: 0.593–0.875], $p = 0.001$) and the place of waste disposal (OR = 0.791, 95% [CI: 0.651–0.961], $p = 0.018$).

Conclusion: The practice of burning household waste in Khartoum State was a public health concern. Sociodemographic and managerial factors exposing residents to health risks appeal political, health authorities and communities to establish a partnership to manage household waste for public safety and good quality of life.

Keywords: burning waste, health risk, household waste, municipality waste collectors, open discharge, waste collection

Introduction

Waste management is a global concern affecting high- and low-income countries and its inappropriate handling can drastically impact human health. Waste disposal methods range from causally dumping on the streets to efficiently engineered waste disposal schemes including burying and burning.[1] The last one has been reported to increase in forthcoming years, leading to the degradation of the quality of air due to chemical atmospheric organic aerosols and a large number of compounds with carcinogenic and mutagenic potencies emitted in the atmosphere.[2,3] The practice of household waste burning, widely common in developing countries, is directly linked to the availability of waste collection services and the frequencies of waste collection regardless of the setting (urban, periurban and rural) and the quantity of waste generated.[4] Residents living close to waste burning sites are exposed to health hazards, such as cancers and psychological disturbances due to the burn fumes. Their quality of life is hindered when the burning is

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frequent and particularly when the waste is mixed with hazardous medical and industrial waste. This leads to a life-threatening relationship between air pollution, open burning and poor community health in particular where population density is high and the frequency of waste collection is low.[5,6]

Vast amount of environmental pollution is related to improper recycling, in particular with the most complex and the fastest growing municipal waste streams, which is electronic waste. Both formal and informal sectors are involved in management of municipal waste. These sectors employ waste pickers who target plastic and metal waste, which they attempt to recycle and sell to manufacturers. This practice is observed in high- and low-income countries but more evident in low incomes due to economic crises. The waste workers, either in formal or informal sectors, had high odds of experiencing fatigue, headaches, insomnia, gastrointestinal manifestations, including nausea, diarrhea and vomiting. Being exposed was also significantly associated with respiratory symptoms, which include dyspnea, sneezing, dry cough, sputum and rhinorrhea.[7–10]

Khartoum State, hosting the capital city of Sudan, is the home of an estimated total population of 7,351,331 people as of 2022. This population generated daily 5100 tons of garbage of which only 3570 tons were disposed per day in three landfills, which namely are Tayba, Hatab and Aby Wlidat. The remaining 1530 tons of garbage were daily left at the points of generation and in the streets.[11–13]

Generally, a greater number of people are aware that disease transmission is related to improper management of waste; however, most of them ignore that improper management of waste can also impact the environment because of the production of greenhouse gases.[14,15] In this framework, this research aimed to contribute in assessing the health impact of household waste burning in Khartoum State as at 2022.

Methods

An online community-based descriptive cross-sectional study was implemented from 10–26 April 2022. The study was conducted in Khartoum State subdivided in seven localities with a total population of 7,351,331 people distributed in 871,142 households of which 80.0% are urban and 20.0% rural. Of the total population of Sudan of 46,162,459 people, the Digital 2022 Global Overview Report published that 35.76 million cellular mobile connections in Sudan at start of 2022. A multistage sampling technique was used to select the study participants. Firstly, all the seven localities were included in the study. At second level, a stratified random sampling was used to distribute the households proportionally to size of each locality in using the formula $n=N/1+Nd^2$ where n was the estimated number of households in a given locality, N was the total households in the locality under consideration, and d was the degree of accuracy set at 0.05. This led to an estimated 2791 households to be included in the study, however, because of time constraint related to the deadline of the submission of our required MBBS thesis, the estimated sample size was adjusted by dividing it by three resulting to a targeted 930 households. Under the assumption, that in each of household, at least one member might have a smartphone, the sample size was estimated to be 930 participants. Of the 930 participants targeted, the study covered 844 participants representing 90.8% of the study targeted population. The data collected included the characteristics of the study participants (area of residence, type of residence, gender, age, marital status, occupation, education level, and household size), the types of waste management, the perceived health problems reported by the participants, the awareness of participants towards the risks related to household waste. The data collected through online google forms in Arabic were firstly converted in MS Excel and uploaded in the statistical package for social sciences (SPSS 23). The obtained SPSS data file was then translated in English and was geo-referenced by adding the geolocation (latitude and longitude) of the residence of the participants. The geographical coordinates were obtained through Google Earth Pro 7.3.6.9345 (64-bit). The geo-referenced data file was summarized numerically (mean, standard deviation and median). Their graphical summary enabled to generate frequency tables, which were used in the geographical information system (ArcGIS 10.3 for desktop version 10.3.043322) to generate geographical distribution and risk maps of household waste burning and its related health problems. The predictive risk map of burning household waste was elaborated by using the kriging method of data interpolation. A method based on the semivariogram, which captures the spatial dependence between samples by plotting the semi variance against the separation distance. The premise of any spatial interpolation is that close samples tend to be more similar than distant samples (this is also called spatial autocorrelation). This property of spatial data is implicitly used in inverse distance weighted (IDW) interpolation to determine cell values using a linearly weighted combination of a set of sample points. IDW is a method of interpolation

that estimates cell values by averaging the values of sample data points in the neighborhood of each processing cell. The closer a point is to the center of the cell being estimated, the more influence, or weight it has in the averaging process. The weight is a function of inverse distance. The surface being interpolated should be that of a location dependent variable. In kriging, one must model the spatial autocorrelation using a semivariogram instead of assuming a direct, linear relationship with separation distance.[16,17] Association between variables was also determined though Chi-square tests and analysis of variance. A binary regression analysis established the relationship between health impact of burning household waste and its associated factors. All the statistical tests were considered significant when p-value <0.05.

Results

Characteristics of the Participants

All the participants (n = 844) provided electronically their informed consent; they were 97.2% (792/815) aged between 18 years and 81 years and 2.8% (23/815) aged 14–17 years. During the data cleaning, this last age group was not excluded (14 years (n = 1, 0.1%), 15 years (n = 3, 0.4%), 16 years (n = 4, 0.5%) and 17 years (n = 15, 1.8%)). Under the assumption that if ≤17 years were able to participate the reason was that they are social media users and without parental approval they cannot own an electronic device (smartphone, iPhone, laptop) given the cost of this device in Sudan. The participants were from six of the seven localities of Khartoum State with 55.9% (463/829) living in Khartoum locality (Figure 1). 59.1% were females and 40.0% were males. They were aged 14–81 years with a median age of 23 years and 55.3% were 14–24 years old. Their family size ranged from 1 to 28 members with an average of 6 people, 61.5% of the participants (n = 811) reported living in families of 1–6 people. Table 1 displays the marital status, the education level and the status of ownership of the living place of the participants.

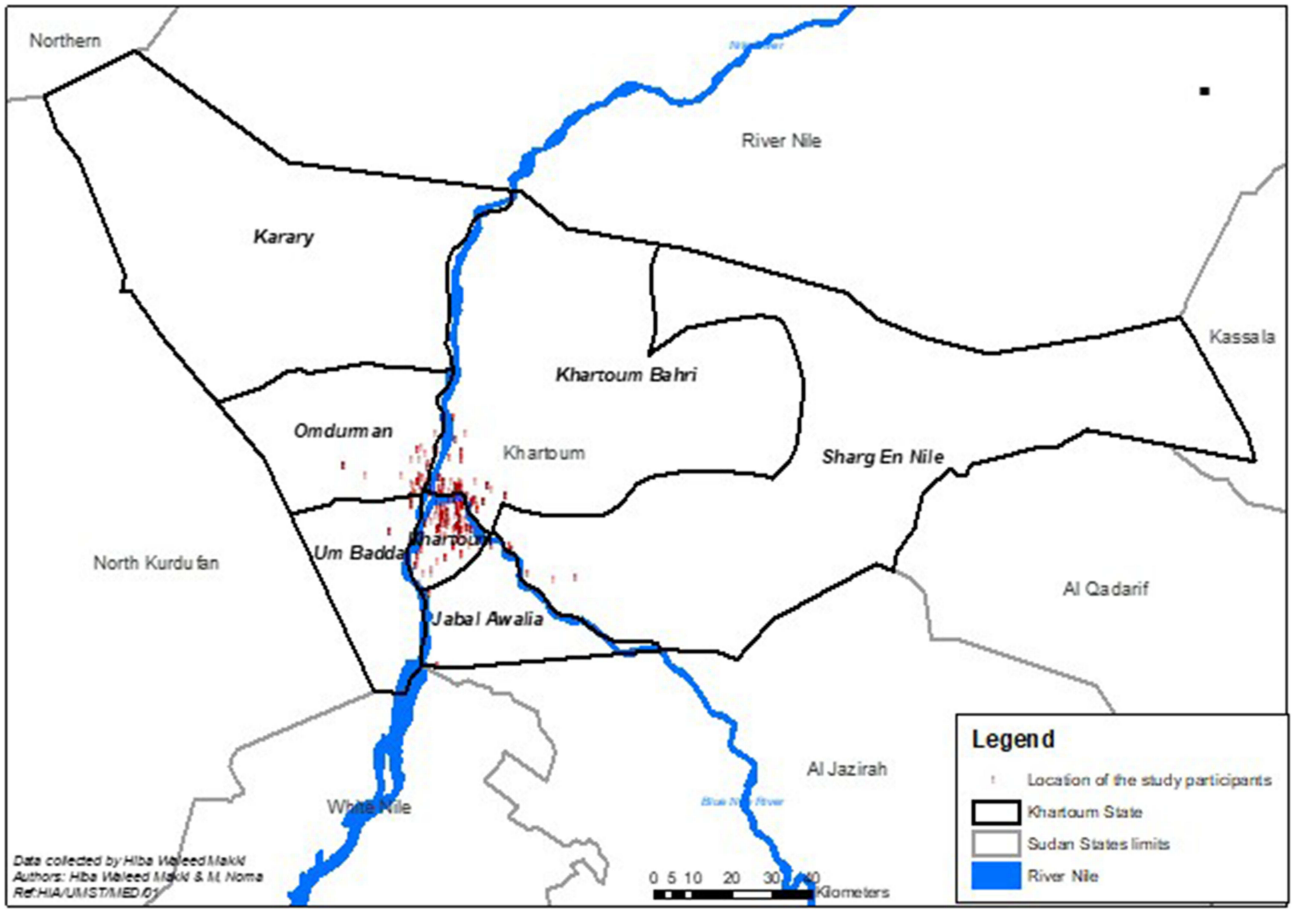

Figure 1 Geographical distribution of residence of study in Khartoum State.

Table 1 Characteristics of the Study Participants (n = 844)

Variable	Number	%	Variable	Number	%
Informed consent (n = 844)	844	100.0	**Marital Status (n=833)**		
Age in years (n = 815)			Single	567	68.1
Median	23		Married	242	29.1
Min - Max	14–81		Widowed	14	1.7
14–24 years	450	55.3	Divorced	10	1.1
25–49 years	297	36.4	**Education level (n=834)**		
≥50 years	68	8.3	University/postgraduate	750	89.9
Gender (n = 837)			Secondary	66	7.9
Male	342	40.9	Primary	15	1.8
Female	495	59.1	Khalwa (Quranic school)	3	0.4
Number of people living in the household (n = 811)			**Ownership of house in which participants lived (n=837)**		
Median	6		Yours/family house	594	71.0
Min - Max	1–28		Rented	220	26.3
1–6 people	499	61.5	Other	23	2.7
7–15 people	300	37.0	Dorm	6	
≥16 people	12	1.5	Governmental residence	5	
			Not live in Sudan/not own a house	1	

Household Waste Management in Khartoum State

Daily Quantity of Waste Produced and Its Disposal

The quantity of household waste produced daily was reported by 57.3% (479/836) of the participants out of which 20.1% (168/836) daily produced <500 g, 37.2% (311/836) generated ≥1000 g and 42.7% (357/838) could not quantify their daily household waste. For those who reported the daily quantity of household waste, their household size varied from 5 members to 7 members with a statistically significant association ($F_{2, 801}$= 17.324, p= 0.000) between quantity of waste daily produced and the household size. The household waste produced was disposed in the neighborhood common discharge (42.5%, 345/812), outside the house till removed by waste collectors (39.8%, 323/812), 11.6% (94/1812) discharged their waste both outside the house and in the common discharge and 6.2% (50/812) disposed in other places.

Collection of Household Waste Disposed in the Neighborhoods

The participants (n = 835) reported that in their neighborhood the household waste was collected by the municipality (44.6%), by caro (cart pulled by donkey, 10.9%), or left in the common discharge of the neighborhood (28.5%). 16.0% of the participants provided a combined removal of household waste involving municipality waste collectors, caro and left in common discharge.

More than half (55.7%, 461/827) of the participants reported irregular collection of household waste from their neighborhoods and they were 14.4% (119/827) who declared that the waste produced was never collected with a statistically significant association (Pearson Chi-Square=246.76, p=0.000) between the responsible of waste collection and the frequency of the collection.

Practice of Household Waste Burning and Perceived Health Hazards

Of 831 participants, 74.5% reported that in their neighborhood people burnt household waste with 50.8% (311/612) who declared that this practice occurred weekly. They were 25.5% (212/831) who did not have this practice in their neighborhood. Figure 2 displays the details of the opinions of the participants towards burning household waste.

The health risk related to the technique of burning household waste was assessed through a three level-scale (least harmful, may be harmful and most harmful) and compared to two other waste management techniques (collecting and burying household waste). The majority of participants (74.7%, 590/790) reported that burning waste was the most harmful risk for health. They were 55.3% (457/826) who lived in neighborhoods with burning waste places located in a radius ≤500 m from their individual residences. The majority of the participants (86.5%, 715/827) perceived burning household waste even at a distance of >500 m represented also a health risk. At the time of the data collection, the

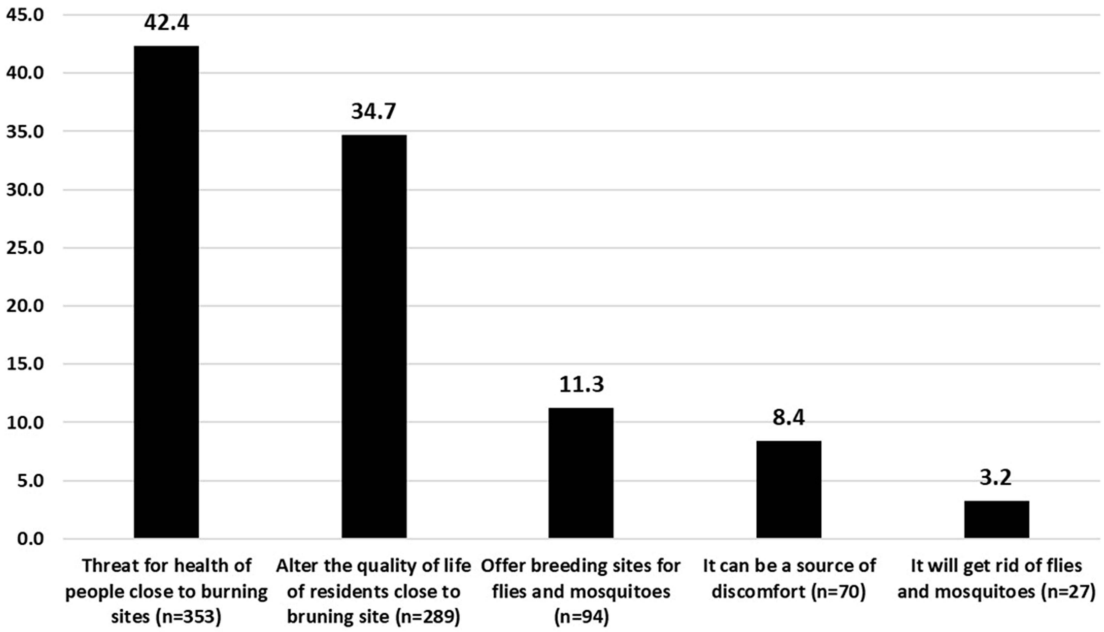

Figure 2 Distribution of the opinions of the study participants towards burning household waste.

participants were suffering from asthma (57.0%, 409.718), respiratory disease (38.0%, 273/718), ocular disease (2.2%, 16/718), headaches (1.4%, 10/718), skin lesions (1.1%,8/718), musculoskeletal pain (0/1%,1/781) and sleeping disturbance (0.1%, 1/718) which they associated to household waste burning.

Community Engagement in Household Waste Management

Most of the participants (85.6%) indicated that the responsibility of the collection of household waste in the neighborhoods engaged both the municipality and the households, 11.6% held the municipality as responsible (Table 2). At the time of the data collection, more than half of the participants (65,7%, 506/770) paid their contribution to the municipality, whereas 22.9% (176/770) paid private waste collectors to remove their household waste. However, only 40.3% (323/810) were willing to increase their financial contribution, for various reasons, 59.7% would not increase it if requested to do so as revealed by Table 2.

Relationship Between Burning Household Waste and Its Associate Factors

The Figures 3 and 4 reveal that burning household waste was a practice across six of the seven localities of Khartoum State.

A binary logistic regression analysis identified ten factors contributing to burning household waste in Khartoum State. These factors were gender, age, marital status, education level, household size, quantity of waste produced, place of waste disposal, person disposing the waste, responsible of collection of the waste and frequency of waste collection. The two statistically significant factors explaining the burning household waste were the frequency of waste collection (OR = 0.720, 95% [CI: 0.593–0.875], p = 0.001) and the place of waste disposal (OR = 0.791, 95% [CI: 0.651–0.961], p = 0.018). The negative coefficient of −0.328 of the frequency of waste collection indicated the household waste in neighborhoods was more likely to be burnt when the collection was “irregular”. The place of waste disposal had a negative coefficient of −0.235, which pointed out that burning of household waste happened more often when the place of discharge was the neighborhood discharge. Marital status (OR = 1.380, 95% [CI: 0.870–2.188], p = 0.171), responsible of the collection of house waste (OR = 1.165, 95% [CI: 0.982–1.381], p = 0.081) and the household size (OR = 1.027, 95% [CI: 0.967–1.090], p = 0.385) were contributing factors for ≥1 time. Table 3 reveals five contributing factors to the burning of household waste, each with a negative coefficient indicating an inverse. The coefficient of age of −0.020 indicated that younger participants were more kin to burn household waste, whereas the coefficient of the quantity of waste daily produced of −0.071 pointed out that when the household disposed daily <500 g of waste, the higher was

Table 2 Community Involvement in Collection and Financing of Household Waste

Variable	Number	%
Responsible of waste collection		
Municipality and household	713	85.6
Municipality	97	11.6
I do not know	23	2.8
Total	**833**	**100.0**
Contribute financially for the waste collection		
Payment to the municipality	506	65.7
Payment to private waste collectors	176	22.9
Others	88	11.4
Total	**770**	**100.0**
Payment to municipality in the last 6 months		
No	373	47.4
Yes	414	52.6
Total	**787**	**100.0**
Request for increasing financial contributions		
Willing to increase	323	40.3
No satisfied and decide stop contribution	190	23.7
Willingness maintain contribution at the same level	159	19.9
Willingness to stop and appeal for private waste collectors	129	16.1
Total	**801**	**100.0**

the likelihood that the waste discharged would be burned. The education level had a coefficient of −0.092 stressing that the participants with Quranic or primary school education were more prone to burn household waste. The coefficient of −0.128 of the person disposing waste suggested that the household waste would likely be burnt if it disposed by a household member (husband, spouse or children). Male gender was more keen to burn household waste with a coefficient of −0.258.

Estimated Population at Risk of Health Hazards Related to Burning Household Waste in Khartoum State

Table 4 reveals that the proportion of burning household waste varied from 64.3% (Sharg En Nile locality) to 86.5% (Omdurman locality) with median of 74.6%. Overall, of the total population 6,804,608 people distributed in the six localities surveyed, 5,046,899 persons were exposed to the health risk related to household waste burning. The predictive risk map (Figure 5) revealed that all the seven localities of Khartoum State were exposed to health risk related to burning household waste. The risk map revealed a very high risk belt (80.4–82.4%) localized in the western part of Karary locality with an extension in Omdurman. The lowest risk of 64.3–67.0% covered the eastern part of Sharg En Nile locality.

Discussion

In their study, Addo et al[18] reported a daily household waste production of 2000 g of which 36.6% was organic waste, 34.4% inorganic and 29.0% was combined organic and inorganic waste, while Fadhullah et al[15] indicated that 74.3% of household waste were food debris and 18.3% were plastic materials. This research performed online failed to identify the composition of household waste, nonetheless 57.3% knew the daily quantity of waste generated by their households which was <500 g as reported by 20.1% of the participants and ≥1000 g for 37.2% of the interviewees. The normally distributed household size was statistically associated ($F_{2,801}$= 17.324, p= 0.000) with the daily quantity of household waste generated which according to Elsarraf et al[13] in Khartoum State, residential solid waste was composed of food waste, paper, cardboard, plastic, textile, leather, yard waste, wood, glass, metals and ashes.

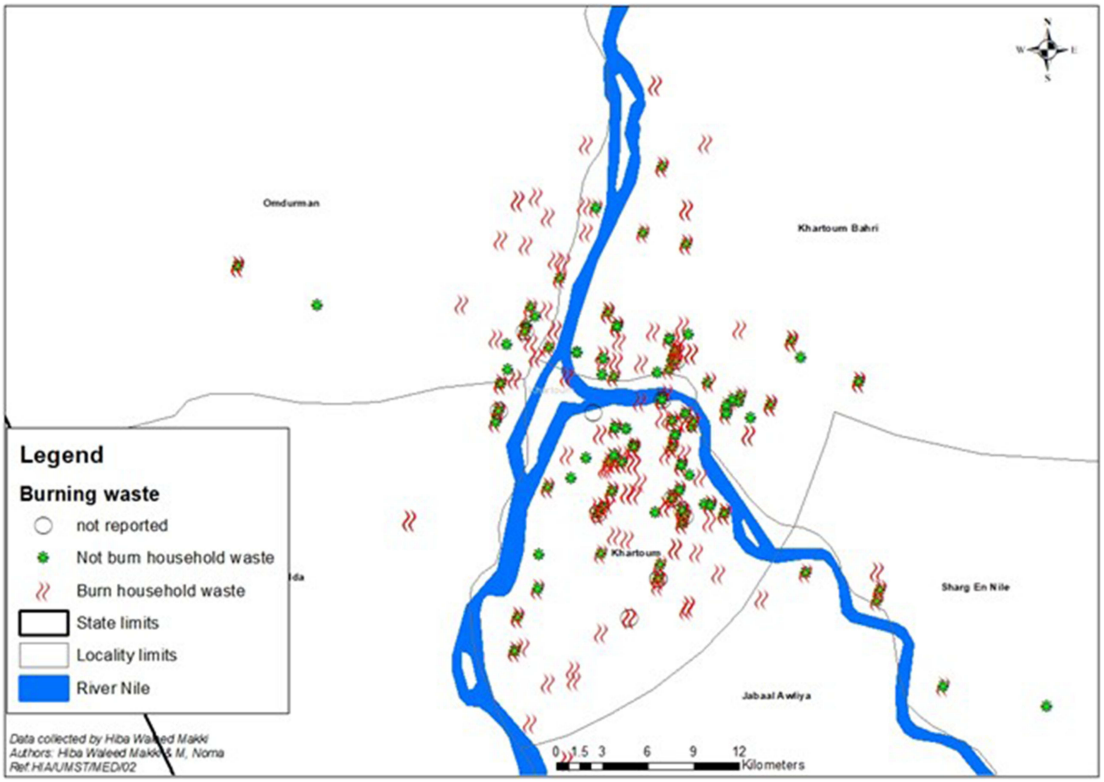

Figure 3 Status of household waste burning across six localities of Khartoum State.

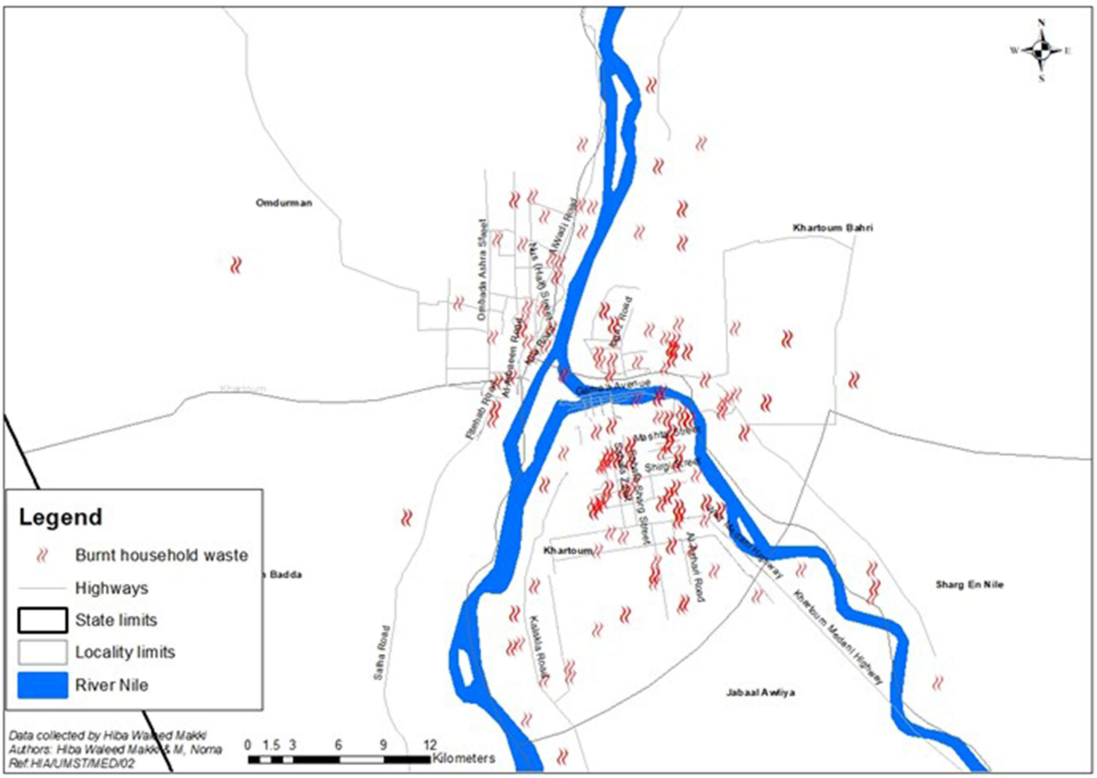

Figure 4 Geographical distribution of the residence practicing burning of household in Khartoum State.

Table 3 Binary Logistic Regression Assessing the Burning Household Waste Based on Ten Explanatory Variables

Factor	B	S.E.	Wald	df	*P*	OR	95% CI for OR	
							Lower	Upper
Gender	−0.258	0.192	1.796	1	0.180	0.773	0.530	1.126
Age	−0.020	0.012	2.831	1	0.092	0.981	0.959	1.003
Marital status	0.322	0.235	1.872	1	0.171	1.380	0.870	2.188
Education level	−0.092	0.232	0.158	1	0.691	0.912	0.579	1.436
Household size	0.026	0.030	0.756	1	0.385	1.027	0.967	1.090
Quantity of waste produced	−0.071	0.120	0.346	1	0.556	0.932	0.736	1.180
Place of waste disposal	−0.235	0.100	5.565	1	0.018	0.791	0.651	0.961
Person disposing waste	−0.128	0.108	1.392	1	0.238	0.880	0.711	1.088
Responsible of collection of waste	0.152	0.087	3.054	1	0.081	1.165	0.982	1.381
Frequency of waste collection	−0.328	0.100	10.870	1	0.001	0.720	0.593	0.875
Constant	2.981	1.168	6.513	1	0.011	19.703		

Table 4 Number of Participants Who Reported the Practice of Burning Household Waste in Their Neighborhood and Estimated Population Exposed to the Risk of Burning Household Waste

Locality	Sample[a]	Burning		% Practicing Burning[c]	Population	
		Yes[b]	No		Exposed[d]	Total[e]
Omdurman	74	64	10	86.5	662,148	765,609
Jabal Awliya	10	8	2	80.0	1,125,004	1,406,254
Khartoum Bahri	248	189	59	76.2	692,328	908,452
Khartoum	471	344	127	73.0	697,043	954,382
Um Badda	27	19	8	70.4	1,037,609	1,474,497
Sharg En Nile	14	9	5	64.3	832,766	1,295,414
Six localities	**844**	**633**	**211**	**74.6**	**5,046,899**	**6,804,608**

Notes: [a]Total number of participants per locality who address the question related to burning household waste. [b]Number of participants who reported that household waste was burnt in their respective neighborhood. [c]Percentage practicing waste burning obtained as 2/1 x 100. [d]Population exposed to the risks related to burning household waste. It was obtained as 5 x 3/100. [e]Total population of 2022 per locality obtained by projecting the 2008 census population of the concerned locality in using the formula Pop2008 x (1+2.9/100)[14] where 2.9/100 was Sudan population growth rate and 14 was the number of years between 2008 and 2022.

The findings of this research revealed 28.5% of the household waste was left in common discharge. Regarding the frequencies of the collection of household waste, more than half (55.7%) of the participants (n = 827) reported that the waste was collected in their neighborhood irregularly. The household waste removed periodically for 29.9% and never for 14.4% with a statistically significant association between frequency of household collection and responsible of waste collection. We assumed that the municipality waste collection offices might lack a monitoring system, adequate human and logistic resources to track all the common waste discharges across the state for timely removal and safe disposal of the waste in three designated landfills which totalized a capacity of 4,391,000 m^3 out of which only 24.0% are used.[13]

The majority (74.5%) of this study participants practiced household waste burning and 74.7% of them revealed that burning waste was the most harmful risk for health. The health risk they indicated by order of frequency were asthma, respiratory, ocular disease, headaches, skin lesions, musculoskeletal pain and sleeping disturbance. This study failed to identify the pollutants related waste burning, but in the literature authors published[14,19,20] as health risk related to waste burning potential irritant to skin, eyes and respiratory tract, cardiovascular diseases, cancer, fatigue (OR = 22.48; 95% [CI: 9.34–54.09]), headaches (OR = 16.88; 95% [CI:7.85–36.31]), insomnia (OR = 10.64; 95% [CI: 3.09–36.67]), nausea (OR = 9.72; 95% [CI: 4.74–19.92]), diarrhea (OR = 4.30; 95% [CI: 1.65–11.18]) and vomiting (OR = 4.74; 95% [CI: 1.53–14.68]), dyspnea (OR = 14.99; 95% [CI: 6.60–34.01]), sneezing (OR = 24.75; 95% [CI: 8.41–27.80]), dry cough

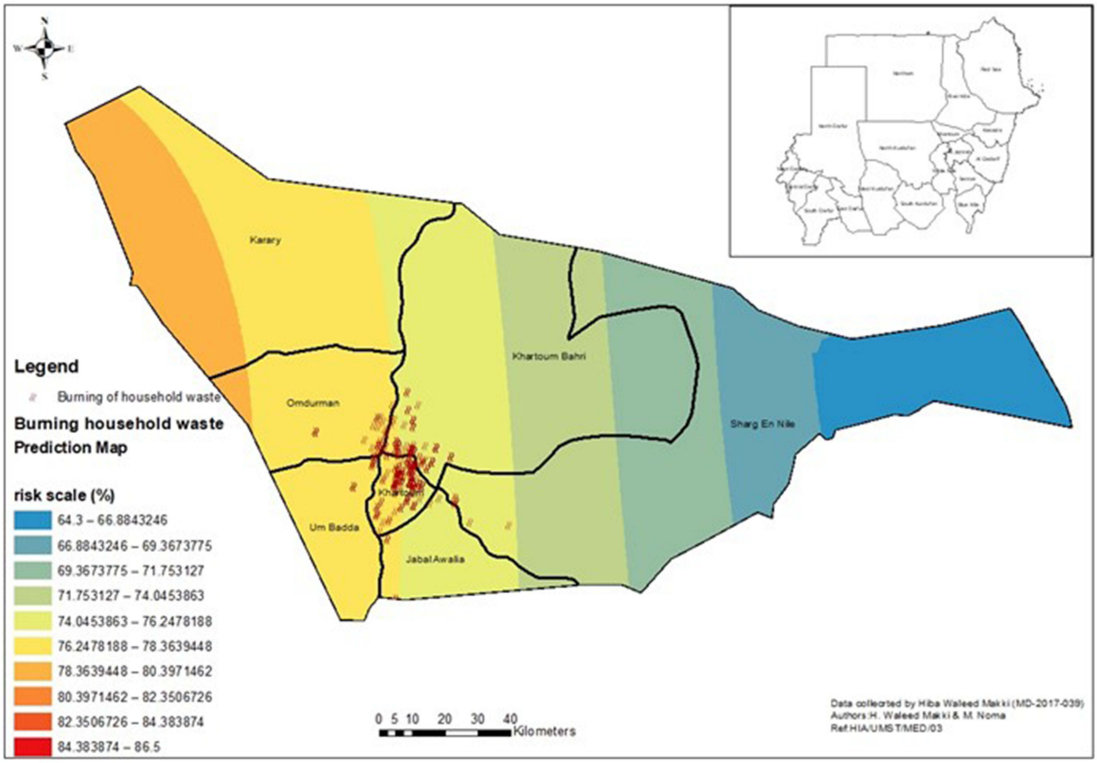

Figure 5 Predictive risk map of burning household waste in the seven localities of Khartoum State.

(OR = 9.57; 95% [CI: 4.03–22.70]), sputum (OR = 8.79; 95% [CI: 3.23–23.94]), and rhinorrhea (OR = 6.00; 95% [CI: 2.48–14.56]). Two statistically significant factors explained the burning of household waste in Khartoum State, the frequency of waste collection (OR = 0.720, 95% [CI: 0.593–0.875], p = 0.001) and the place of waste disposal (OR = 0.791, 95% [CI: 0.651–0.961], p= 0.018) with, respectively, negative coefficients (βs) of, respectively, −0.328 and −0.235 indicating when the frequency of the collection of the waste was irregular and the venue of disposable was in the neighborhood central point of waste collection the higher the probabilities that the household waste would be burned. Marital status (OR = 1.380, 95% [CI: 0.870–2.188], p = 0.171) was a contributing factor for burning household and it could be due to the higher generation of waste by the participants who were ever married (including widowed and divorced) than the singles who represented 61.8% of the study population as confirmed by its coefficient of contribution of 0.322. Another contributing factor of burning household waste was the household size (OR = 1.027, 95% [CI: 0.967–1.090], p= 0.385) as the higher the number of household members, the higher the quantity of household waste generated. The contribution of the person responsible of collection of waste (OR = 1.165, 95% [CI: 0.982–1.381], p = 0.081) could be explained when it was family members (husband, wife and children) rather than maids and other household residents. Other contributing factors were the age of participants, the quantity of waste daily produced the education level and the person disposing the waste. Elsewhere in the literature, a multiple logistic regression revealed that female gender (AOR = 0.45; 95% [Cl: 0.29, 0.79]), household size (AOR = 0.26; 95% [Cl: 0.09, 0.77]), practice of recycling (AOR = 0.03; 95% [Cl: 0.02, 0.08]) were contributing factors of waste management practice.[15]

The use of a geographic information system (GIS) to estimate human exposure to a variety of agents was published already by Fazzo et al[21] It emerged from the GIS analysis in this study that the health risks related to burning household waste concerned all the seven localities of Khartoum State with a very high risk belt (risk scale: 80.4–82.4%) localized in the western part of Karary locality extended downward in Omdurman. In the eastern part of the state, the locality of Sharg En Nile fell in the low risk belt of 64.3–67.0%. These risk areas might be explained by the satellite imagery (Supplement 1) revealing that the landscape tends to be more arid while moving from the eastern of the state (Sharg En Nile) to the north western part (Karary), hence the vegetation becomes rare and exposed to winds blows due to the absence of trees as discussed by Tahir et al.[22]

Some limitations of this research should be discussed. The types household waste managed was recorded; hence, the loss of ability to identify and quantify the biochemical risk for health related to the burning. Another limitation was the inability to estimate the daily production of household waste as this parameter was recorded as a categorical variable. This limited the possibility to correlate the quantity produced and the household size. The research failed to digitize the location of household waste discharge in each of the neighborhoods covered consequently the distance between the residence and the discharge place could not be estimated either through SPSS or ArcGIS. This limitation should be addressed in future studies. Nonetheless, these limitations were minimized by the binary logistic regression which enabled firstly to assess the validity and reliability of the online data collection with an overall representativeness of 74.9%.

Conclusion

The practice of burning household waste was common in this study exposing the participants to asthma, respiratory disease, ocular disease, headaches, skin lesions, musculoskeletal pain and sleeping disturbance. The identified factors associated to burning of household waste could be packaged in two groups socio-demographic (age, gender, marital status, education level, household size) and managerial (quantity of waste generated, person disposing the waste, frequency and body of removal of the waste) factors. This appeal the political and health authorities and the communities of Khartoum State to establish a win-win collaboration to manage household waste across the state to ensure public safety and good quality of life to all the residents of state.

Ethical Considerations

The research proposal was submitted to and approved by the Institutional Review Board (IRB) of the Faculty of Medicine of the University of Medical Science and Technology. The research was implemented as an online community-based survey, which did not require ethical approval from Khartoum State Ministry of Health. The research proposal reviewed by UMST Institutional Review Board included the research questionnaire which access required to an electronic signature to obtain the informed consent of each participant. Those who checked no were automatically denied access to the research tool. The UMST IRB was aware that in the socio-cultural environment of Sudan household management can be undertaken also by participants under ≤17 years. The graduation panel which reviewed the thesis (awarded the first price of the Faculty of Medicine) from which the current submitted manuscript endorsed the inclusion of 2.8% (23/815) of the participants aged 14–17 years. The confidentiality of the participants was ensured by the use of an anonymous questionnaire. The participants were also informed on the right to withdraw from the search at any time they might wish and they were free not to address a question they did not feel to do so.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors report no conflicts of interest in this work.

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