

## ORIGINAL ARTICLE

# Exploring Urban Residents' Understanding, Attitudes and Behaviors Towards Disaster Waste Management: A Survey-based Study

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## ABSTRACT

**Introduction:** Flood waste management is a global concern as significant number of wastes are frequently shifted and mud-washed makes waste recovery extremely a daunting task. Objectives: To assess the urban residents' understanding, attitudes, and behaviors towards disaster waste management. **Methods:** A cross-sectional study was conducted among 250 flood victims in Shah Alam, Selangor. The respondents were given a self-administered questionnaire to obtain sociodemographic characteristics, the post-flood waste management practice in the flood area, the victims knowledge and attitude in managing flood waste.

**Results:** The major flood debris was steel, wood, clay, household furnishings, tree, and branches. The flood waste were disposed at the side of the road (n = 103, 41.2%), by the disposal bins (n = 92, 36.8%) and at the empty space near their house (n = 51, 20.4%). The time taken to clean up the flood waste by most respondents was more than 5 days while the waste contractor took 4 to 5 days. Respondents in this study have good knowledge (n = 217, 86.8%), good attitude (n=202, 80.8%) and good practice (n = 222, 88.8%) regarding post-flood waste management. The knowledge were associated with gender, education level, and types of media. The attitude were associated with age, education level and attitude. Education level and residential location were significantly associated with practice. The relationship between knowledge, attitude and practice can be reaffirmed. **Conclusion:** This study emphasizes the importance of knowledge, attitude and practice to establish systematic post-flood waste management in the urbanized setting.

**Keywords:** Knowledge; Attitude; Practice; Post-flood waste; Disaster

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## INTRODUCTION

Solid waste can be defined as any garbage or refuse, sludge from a wastewater treatment plant, water supply treatment plant or air pollution control facility, and other abandoned material generated by industrial, commercial, mining, and agricultural activities, as well as community projects (1). The volume of solid waste is expected to increase each year due to the population growth and rapid development and it has become a challenge to the global economy (2). As for example, Malaysia population of 32.8 million is projected to generate

38,427 metric tonnes per day which is equivalent to 1.17 kg per capita and the collection reached 14 million metric tonnes per year of which, 17.5% is not disposed in landfills (2). Most Asian countries face problems in the management of solid waste generated in line with the planned rate of urbanization as well as rapid growth in population. This issue is getting worse following a natural disaster such as earthquake, landslide, drought, tsunami and flood.

The production of catastrophe waste has become one of the most significant issues following a disaster, because the volume and types of debris produced differ substantially from regular waste due to the nature and intensity of the disaster (3). In addition, post-disaster waste management becomes more challenging to be handled than ordinary waste as it is mixed and difficult to separate (4). A study

conducted by Karunasena et al., explained that catastrophe waste may be polluted with toxic or dangerous substances, resulting in environmental deterioration and health issues. Ismail et al., highlighted, the production of wastes after the disaster posed a threat as well as had a detrimental impact on health of human and increased environmental risk (5). Poor post-flood waste management encourages disease-carrying vectors like insects and rodents lead to the spread of diseases such as cholera and dengue fever (6).

Flood is the most prevalent natural and technological disasters, accounting for 40 to 50% of all disasters and disaster-related deaths around the world (7). The catastrophe resulted to many problems as it interferes the economy, destroys the infrastructure, disrupt the livelihoods as well as causes hygienic and health problems (8). The damage from this catastrophe leads to the tremendous amount of waste being produced that cause obstruction of entrance roads as well as drainage channels and obscure trapped people after the calamity (9). Debris disposal also will be a major challenge throughout an operation of disaster recovery as huge amount of solid waste produced and mixed up of waste make it difficult to be segregated and managed than the normal waste generation (5).

The flood event on December 2021 that heavily affected urban area of Shah Alam, Selangor was reported as the worst catastrophe happened with a total of 60 thousand victims were displaced in 430 evacuation centres in over 8 states all over Malaysia (10). The cause of floods and flash floods in several parts of the west coast Malaysia was due to the heavy rainfall coupled with the physical landscape. The large-scale floods are beyond the expectation as the monsoon season usually brought floods to the east coast not to the west coast (11). The flood disaster in Shah Alam, produced 31,374 metric tonnes of waste (12). The massive production of solid waste after the flood events have become the greatest concern among the community as it drastically changes in type and quantity (5). Poor disaster waste management from large amounts of debris and garbage can inflict damage on both the immediate and long-term recovery (9). It is impossible to reuse, recycle and recover the valuable materials from the flood waste as most of the items are severely damaged and covered with mud and may possess a serious effect to health and environment (13). Improper way of flood waste disposal during disaster may affect the community especially the children and workers that handle the waste (14). The risk of injury and infection will increase due to the increase of uncollected flood waste. De and Debnath emphasized, the improper waste disposal may cause severe health effects

like common cough and cold, frequent diarrhoea, infections (both skin and respiratory) parasitic infections like malaria (15). It also causes the people living in that area to suffer from hygienic and health problems due to the contamination of water supply from the waste dumping and leakage from the landfill sites (14).

To date there is no specific guideline on how to manage the disaster waste in Malaysia. In most occasion, it was controlled and managed in ad-hoc basis. Due to the absence of appropriate framework, the post-flood waste was randomly disposed of into the disposal site of the country (3). The existing catastrophe waste management practises frequently involve either taking no action and allowing the garbage to pile and deteriorate, or taking inappropriate action and dumping the waste in an uncontrolled manner (9). The only waste disposal method in Malaysia is landfilling which most of the landfill sites are open dumping areas and this situation may leads to significant environmental contamination and serious health effect.

As most of people in Shah Alam Selangor have never experienced flood before, they may have difficulties to manage and face the aftermath of the catastrophe. Thus, this study aims to assess the post-flood waste management among the flood victims in this area and how this associated with their knowledge and attitude. Result of this study filled in the gap on the significant determinants of the post-flood waste management and provide baseline data to the development of strategies for proper and systematic post-flood waste management in future. The finding can be used by the council and authorities to improve the system of post-flood waste management and may benefit the flood victims by enhancing their level of knowledge, attitude, and practice.

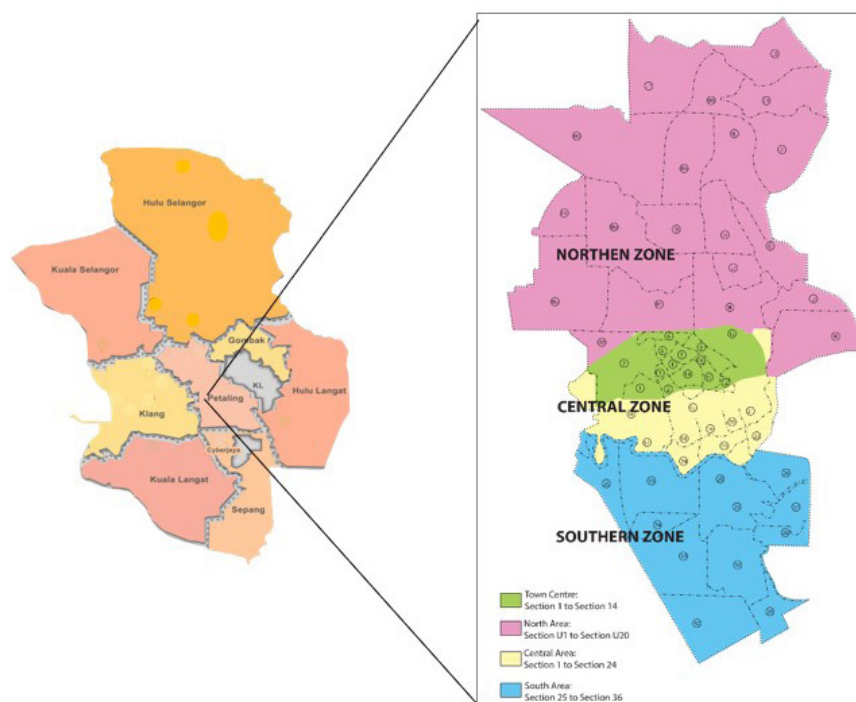
## **MATERIALS AND METHODS**

### **Study location**

This study was conducted in a flood affected area in Shah Alam, Selangor (Figure 1) the areas with the greatest suffering from the recent flood in December 2021. Shah Alam is the state capital of Selangor, Malaysia and situated within the Petaling District. As of 2010, the city has 541,306 population. The area are crowded, urbanised and lack of experience with extreme flooding condition (11). These areas can be a reference to address waste-related problems following flash floods and comprehend the procedure for improving urban environmental conditions.

### **Study design and sampling method**

This cross-sectional survey was conducted between



July to December 2022. The target population of this study is the flood victims within selected residential area. The exclusion criteria of respondents were flood victims who are age below 18 years old as they might lack of understanding on the aim of the research, foreigners due to their language barrier and respondent who is illiterate as they are unable to read and understand the objective of survey. There were six residential areas (sections) that heavily involved with the flood were selected in this study as (Section 13, Section 16, Section 17, Section 23, Section 24 and Section 25). Convenience sampling was employed to select the respondents based on their availability to answer the questionnaire (16). The questionnaire was distributed through an online platform which is Google form and physical approach which is from door-to-door.

### Sample size calculation

The maximum number of respondents from the calculation was 227 respondents. Considering 10% of drop out, the total number of samples that was included in this study were 250 respondents.

### Data collection

#### Questionnaire

The respondents were given a set of self-administered questionnaires which was adapted from previous studies (5, 9, 18) to assess the level of Knowledge, Attitude and Post-flood waste management practice.

The questionnaire comprised of four sections which includes:

- i. Section A : Sociodemographic Information (i.e. age, sex, race, marital status, education level,

- household income, location, and types of housing)
- ii. Section B : Knowledge of post-flood waste management. There were 10 questions concerning about the flood waste, the management, and the health risk due to improper flood waste management. True and false were used for the responses in this section. A score of 1 was given for a correct answer and 0 for a wrong answer.
- iii. Section C : Attitude of post-flood waste management. There were 17 questions in this section. The five-Likert scale responses of 5 to 1 were used from 'Strongly agree' to 'Strongly disagree'.
- iv. Section D : Practice of post-flood waste management. There were 7 questions in this section and were assessed using five-Likert scale of 5 to 1 represent 'Always', 'Very often', 'Sometimes', 'Rarely' and 'Never'.

The overall score for each respondent's knowledge, attitude, and practise of solid waste management was calculated by adding the scores from each of their responses. A scoring method developed from Bloom's cut-off points was used to determine the KAP level among the respondents (Table I) (19 – 21).

The questionnaire was establish in dual language; Malay and English version. The constructive test, was conducted on 10% of the sample size calculation. The Cronbach's Alpha's reliability test was found more than 0.7 for knowledge and attitude section which is acceptable (22). Improvement was made for the practice section since the value of Cronbach's alpha was below than 0.7. A validity test was conducted by an expert (academician from University Putra Malaysia) that has extensive experience in

Waste Management to ensure the questionnaire that was constructed following a rightly method to measure what it is supposed to measure.

**Statistical analysis**

The data obtained were analyzed using SPSS software (IBM Statistical Package for Social Sciences statistics, version 28.0 and Microsoft Excel 365. Descriptive analysis, Chi-square test and Spearman correlation were applied at a significance level of  $p < 0.05$ .

**Post-flood waste management**

The main debris found after the flood was steel, wood, clay, household furnishings, tree and branches. Other type of waste produced includes the potential infectious waste such as faeces and household waste, commercial and industrial waste (workshops, garage, banking, shops and malls and hazardous material such as oil, fuel, and paint (Table II). The majority respondents disposed the flood waste at the side of the road ( $n = 103, 41.2\%$ ) and in the disposal bins ( $n = 92, 36.8\%$ ). Few of

**Table I : System of scoring for level of knowledge, attitude and practice (Source: Badrum & Mapa, 2020; Abdullahi et al., 2016; Mahat et al.,2019)**

Knowledge		Attitude		Practice	
Score	Level	Mean score	Level	Mean score	Level
8-10	Good	3.67-5.00	Good	3.67-5.00	Good
6-7	Moderate	2.34-3.66	Moderate	2.34-3.66	Moderate
0-5	Poor	1.00-2.33	Poor	1.00-2.33	Poor

**Ethics statement**

The ethical approval was obtained from the Ethics Committee for Research Involving Human Subjects of University Putra Malaysia (JKEUPM) with the reference number of JKEUPM-2022-401. A written informed consents were sought from respondents before they participated in the study. Participation in this study was voluntary.

**RESULTS**

**The sociodemographic characteristics of the respondents**

Majority of the respondents aged between 18 to 24 years old ( $n=54, 21.6\%$ ), female ( $n = 128, 51.2\%$ ), and Malay ( $n = 233, 93.2\%$ ). The respondents are mostly married ( $n = 197, 78.8\%$ ) and live with five to six members per household ( $n = 113, 45.2\%$ ). The majority respondents have tertiary education either degree, master, or PhD ( $n = 131, 52.4\%$ ). They earned monthly income between RM5,000 to RM11,000 per household (34.8%). Number of respondents were distributed evenly across the residential area where majority of them lived in a medium-cost landed house (60.8%), followed by low-cost landed (36%), and medium cost high rise (1.6%) (Table II). The housing type was classified based on the selling ceiling price by the Ministry of Housing and Local Government where the low-cost housing was below RM 42,000 (based on location), low-medium cost was between RM 42,001 to RM 60,000, medium cost was between RM 60,001 to RM 100,000 and high cost was more than RM 100,001.

the respondents disposed the flood waste at the empty space near their house ( $n = 51, 20.4\%$ ). The time taken to clean up the flood waste by most respondents was more than 5 days ( $n = 145, 58\%$ ). Most respondents indicate that the contractor took 4 to 5 days to clean up the waste ( $n = 179, 71.6\%$ ). Majority of the respondents ( $n = 212, 84.8\%$ ) know about the post-flood waste management through media. The types of media that mainly assessed by the respondents were the social media like facebook ( $n = 127, 50.8\%$ ), followed by television ( $n = 85, 34\%$ ), radio and newspaper (2%). Majority of respondents had noticed the amount of flood waste accumulated in their community exceeds the amount of regular municipal waste ( $n=225, 90.0\%$ ). They also know the agency that is responsible for waste management and collection in their community ( $n = 191, 76.4\%$ ) as well as the risk associated with flood waste ( $n = 195, 78\%$ ). However, about two third of respondents in this study did not know how to handle flood waste ( $n = 168, 67\%$ ) and only 16 (6.4%) respondents noticed the existence of plan for flood waste management preparedness actions at their residential area.

**Knowledge, attitude and practice on post-flood waste management**

Respondents in this study have good knowledge regarding post-flood waste management with the mean  $\pm$  SD score of  $8.46 \pm 1.13$  ( $n = 217, 86.8\%$ ) (Table III). High knowledge score (mean  $\pm$  SD) was obtained for questions that indicate the dangers of

**Table II : The sociodemographic and post-flood waste characteristics of the respondents (N=250)**

Variables		Frequency (%)	Types of houses	Low-cost landed	90 (36.0)		
Age (Year)	18-24	54 (21.6)	Types of post-flood waste	Medium-cost landed	152 (60.8)		
	25-34	46 (18.4)		High-cost landed	1 (0.4)		
	35-44	42 (16.8)		Low-cost high rise	3 (1.2)		
	45-54	41 (16.4)		Medium-cost high rise	4 (1.6)		
	55-64	33 (13.2)		Disposal location of flood waste	Debris (Steel, wood, clay, household furnishings, tree, branches)	208 (83.2%)	
	65 and above	34 (13.6)			Hazardous materials (Oil, fuel, paint, varnishes, pesticide, fertilizer)	2 (0.8%)	
Gender	Male	122 (48.8)	Time taken by respondent to clean-up the flood waste		Commercial and industrial waste (Workshops, garage, banking, shops, malls)	9 (3.6%)	
	Female	128 (51.2)			Other potential infectious waste (feces that is openly disposed, household waste)	30 (12.0%)	
Race	Malay	233 (93.2)			Time taken by contractor to clean-up the flood waste	Others	1 (0.4%)
	Indian	17 (6.8)				Disposal bins	92 (36.8%)
Marital Status	Single	52 (20.8)		Side of the road		103 (41.2%)	
	Married	197 (78.8)		Empty space near house		51 (20.4%)	
	Divorce/Single Mother/Single Father	1 (0.4)	Inside house	1 (0.4%)			
				Don't know		3 (1.2%)	
Total number of households	1 to 2	7 (2.8)	Media awareness	Yes	212 (84.8%)		
	3 to 4	81 (32.4)		Types of media	No	38 (15.2%)	
	5 to 6	113 (45.2)			Radio	5 (2.0%)	
	7 to 8	37 (14.8)			Television	85 (34.0%)	
	Education level	No formal education			14 (5.6)	Newspaper	4 (1.6%)
UPSR		10 (4.0)			Social media	127 (50.8%)	
Household income	PT3/SPM	43 (17.2)	Don't know		29 (11.6%)		
	Diploma, STPM, Matriculation	52 (20.8)					
	Degree, Master, PhD	131 (52.4)					
	Residential area location	<RM2500	54 (21.6)				
		RM2500-RM5000	73 (29.2)				
RM5001-RM11000		87 (34.8)					
RM11001-RM15000		27 (10.8)					
>RM15000		9 (3.6)					

flood waste on the soil, air, and water pollution (n = 241, 96.4 %), respiratory disease (n = 240, 96%) and stress (n = 242, 96.8%). The respondents could correctly notice that breeding of vectors (n=222, 88.8 %) and skin disease (n=234, 93.6%) are the dangers that can be caused by the flood waste. Two third of respondents aware that the categorization of the waste produced after the flood is essential in order to promote proper waste management (n=200, 80%). They also aware the importance of safe handling, removal, and management of flood waste in disaster response and recovery (n=230, 92%).

Majority of the respondents have good attitude with the mean score ± SD of 4.19 ± 0.99 (n=202, 80.8 %). They have strongly agreed on the role of multiple media outlets such as television,

newspaper, and radio in dissemination of waste disposal information. They also agree that the severe resource shortage of enable flood waste collection is due to the insufficient preparation (n = 205, 82%) and post-disaster waste is one of the environmental problems that need immediate action and participating in flood waste management such as segregate the flood waste in their area is very valuable (n=198, 79.2%). They have a strong agreement also on if the flood information, together with tips for evacuation should be made to public early enough to enable good preparation (n=190, 76%). They agreed that the risk to health and environment will reduce if flood waste is managed immediately (n=188, 75.2%). The instructions



**Table III: The level of knowledge, attitude and practice of the flood victims on post-flood waste management (N = 250)**

	<b>Level (score)</b>	<b>Frequency (%)</b>	<b>Mean score ± SD</b>
Knowledge	Good (8-10)	217 (86.8 %)	8.46 ± 1.13
	Moderate (6-7)	26 (10.4 %)	
	Poor (0-5)	7 (2.8 %)	
Attitude	Good (3.67-5.00)	202 (80.8 %)	4.19 ± 0.99
	Moderate (2.34-3.66)	30 (12.0 %)	
	Poor (1.00-2.33)	18 (7.2 %)	
Practice	Good (3.67-5.00)	222 (88.8 %)	4.55 ± 0.73
	Moderate (2.34-3.66)	24 (9.6 %)	
	Poor (1.00-2.33)	4 (1.6 %)	

for appropriate in-house waste storage, collection plans including what, where and how flood waste will be collected also need to be announced during and after the flood events (n=131, 52.4%).

Only 36.4% of respondents (n=91) strongly agreed on a resilient waste management system of post-flood will not cause too much harm to society. They also less agreed on the importance to establish priorities between different types of waste (34%, n=85). Only 33.2% of respondents (n=83) were willing to participate in flood waste management in their neighbourhood and can spend money for waste disposal after flood disaster as they regard it as their responsibility. Very small number of respondents agreed that community play an important role in waste disposal after the flood (n=48, 19.2%) and willing to pay for the additional service and separate the recyclables of post-flood waste (n=28, 11.2%).

Our findings indicated that most of the respondents performed good post-flood waste management practice (n=222, 88.8 %) with the mean score ± SD of 4.55 ± 0.73. The majority respondents (n=191, 76.4%) get the information of the storage and disposal of flood waste locations. Most of them (n=166, 66.4%) also used a good storage to dispose the flood waste and get the trucks to enter the area to collect the flood waste (n=174, 69.6%). Many of them also dispose the disaster waste at the municipality dump area (n=197, 78.8%) and rent "Roll On Roll Off" (RORO) bins with the

neighbourhood to collect the flood waste (n=161, 64.4%). In addition, most of the respondents are the one who deal with the flood waste handling in their family (n=155, 62%) and they segregate the waste after the flood event to protect the environment (n=138, 55.2%).

**Association between Level of KAP and sociodemographic and post-flood waste management factors**

Our data shows elderly at the age of 55 to 64 have the highest knowledge scores (8.82 ± 0.77) compared to the rest of the group. Male respondents have a higher knowledge score (8.52 ± 1.22) compared to female (8.39 ± 1.03). The knowledge score for Indian respondents was 8.65 ± 0.61, followed by Malays at 8.45 ± 1.16. The knowledge score for married respondents (8.51 ± 1.01) not much difference to those who are single (8.42 ± 1.19). Respondents with 1-2 members in the household (8.57 ± 1.39), education of diploma/STPM/matriculation (8.79 ± 0.87) and the household income between RM 11,000 to RM 15,000 (8.78 ± 0.75) were among with the highest knowledge scores. (Table IV)

As for the residential location, respondents at Section 16 have the highest knowledge score of 8.79 ± 0.61 compared to the rest of the area. This probably due to frequent flood event in the area that make the residents more aware and prepared. Low cost landed house area have the highest knowledge scores (8.52 ± 1.03) compared to other type of houses. Respondents who are stick to media awareness have higher knowledge score (8.49 ± 1.11) compared to those who are not (8.29 ± 1.23). The highest knowledge score was from newspaper (9.00 ± 0.82). There were statistically significant associations between gender (p=0.006), education level (p<0.001) and type of media (p<0.001) with the knowledge level.

As for the attitude, respondents at the age of 45 to 54 (4.49 ± 0.75) and male has a better attitude score (4.26 ± 0.85). The attitude score for Malays was 4.20 ± 0.98 followed by Indian (4.06 ± 1.25). Respondents who are married (4.23 ± 0.99), with 1-2 members in the household (4.57 ± 0.79) and have tertiary education (4.31 ± 0.88) also have a better attitude score. Those with monthly income of RM 2500 to RM 5000 and RM 11,000 to RM 15,000 have a good attitude score (4.26 ± 0.93). The highest attitude score was observed among respondents in Section 23 (4.29 ± 0.89), followed by Section 16 (4.24 ± 1.05) and Section 24 (4.23 ± 1.12). Those who lives at the medium cost high rise house has a better attitude score (4.50 ± 0.58) compared to the rest of the group. The statistic shows only age (p<0.001) and education level (p=0.023) were associated with the attitude.

**Table IV : The association between level of knowledge, attitude and practice with sociodemographic factors (N=250)**

Sociodemographic Factors	Knowledge Mean ± SD	X <sup>2</sup> (p-value)	Attitude Mean ± SD	X <sup>2</sup> (p-value)	Practice Mean ± SD	X <sup>2</sup> (p-value)
Age (Year)						
18-24	8.37 ± 1.43	8.494	4.04 ± 0.98	33.872	4.67 ± 0.58	10.838
25-34	8.26 ± 1.23	(0.581)	4.15 ± 0.97	(<0.001*)	4.39 ± 0.77	(0.370)
35-44	8.48 ± 0.83		4.36 ± 0.73		4.52 ± 0.86	
45-54	8.41 ± 1.20		4.49 ± 0.75		4.59 ± 0.71	
55-64	8.82 ± 0.77		4.30 ± 1.01		4.64 ± 0.78	
65 and above	8.56 ± 0.89		3.82 ± 1.42		4.50 ± 0.71	
Gender						
Male	8.52 ± 1.22	0.194	4.26 ± 0.85	3.752	4.57 ± 0.75	1.596
Female	8.39 ± 1.03	(0.006*)	4.13 ± 1.12	(0.153)	4.54 ± 0.72	(0.450)
Race						
Malay	8.45 ± 1.16	0.981	4.20 ± 0.98	1.248	4.54 ± 0.75	2.301
Indian	8.65 ± 0.61	(0.232)	4.06 ± 1.25	(0.536)	4.76 ± 0.44	(0.317)
Marital Status						
Single	8.42 ± 1.19	35.384	4.06 ± 1.06	2.040	4.69 ± 0.54	12.867
Married	8.51 ± 1.01	(0.465)	4.23 ± 0.99	(0.728)	4.52 ± 0.77	(0.348)
Divorce/Single Mother/ Single Father	-	-	-	-	-	-
Total number of household						
1 to 2	8.57 ± 1.39	4.940	4.57 ± 0.79	4.562	4.86 ± 0.38	3.197
3 to 4	8.44 ± 1.46	(0.764)	4.19 ± 0.94	(0.803)	4.62 ± 0.73	(0.921)
5 to 6	8.46 ± 0.89		4.19 ± 1.04		4.51 ± 0.76	
7 to 8	8.49 ± 0.80		4.29 ± 0.80		4.49 ± 0.77	
9 and above	8.42 ± 1.38		3.67 ± 1.23		4.50 ± 0.52	
Education level						
No formal education	8.36 ± 1.39	7.681	4.07 ± 0.92	2.824	4.43 ± 1.02	8.938
UPSR	8.10 ± 0.99	(<0.001*)	3.90 ± 0.99	(0.023*)	4.80 ± 0.42	(0.012*)
PT3/SPM	8.33 ± 1.43		4.14 ± 1.01		4.49 ± 0.88	
Diploma / STPM / Matriculation	8.79 ± 0.87		4.31 ± 0.88		4.62 ± 0.63	
Degree / Master / PhD	8.41 ± 1.07		4.19 ± 1.06		4.54 ± 0.70	
Household income						
<RM2500	8.17 ± 1.34	14.002	4.22 ± 0.98	4.867	4.52 ± 0.77	6.991
RM2500-RM5000	8.47 ± 1.31	(0.082)	4.26 ± 0.93	(0.772)	4.62 ± 0.72	(0.538)
RM5001-RM11000	8.62 ± 0.73		4.15 ± 0.97		4.53 ± 0.71	
RM11001-RM15000	8.78 ± 0.75		4.26 ± 1.19		4.52 ± 0.80	
>RM15000	7.67 ± 1.58		3.67 ± 1.32		4.56 ± 0.73	
Location						
Section 13	8.49 ± 0.89	10.253	4.12 ± 1.08	4.575	4.24 ± 0.99	21.993
Section 16	8.79 ± 0.61	(0.419)	4.24 ± 1.05	(0.918)	4.59 ± 0.70	(0.015*)
Section 17	8.36 ± 1.14		4.07 ± 0.99		4.67 ± 0.61	
Section 23	8.52 ± 1.06		4.29 ± 0.89		4.50 ± 0.71	
Section 24	8.25 ± 1.63		4.23 ± 1.12		4.66 ± 0.61	
Section 25	8.36 ± 1.11		4.21 ± 0.86		4.64 ± 0.67	
Type of houses						
Low-cost landed	8.52 ± 1.03	10.174	4.14 ± 1.01	4.050	4.64 ± 0.64	5.821
Medium-cost landed	8.44 ± 1.05	(0.253)	4.22 ± 1.00	(0.853)	4.51 ± 0.77	(0.667)
High-cost landed	-	-	-	-	-	-
Low-cost high rise	8.00 ± 1.73		3.67 ± 0.58		4.00 ± 1.00	
Medium-cost high rise	7.75 ± 3.86		4.50 ± 0.58		4.50 ± 1.00	
Media awareness						
Yes	8.49 ± 1.11	1.439	4.18 ± 0.97	1.321	4.56 ± 0.73	2.612
No	8.29 ± 1.23	(0.487)	4.26 ± 1.16	(0.517)	4.53 ± 0.76	(0.271)
Types of media						
Radio	7.00 ± 2.12	29.153	3.80 ± 1.30	5.256	4.60 ± 0.55	2.681
Television	8.47 ± 0.95	(<0.001*)	4.16 ± 1.02	(0.730)	4.54 ± 0.75	(0.953)
Newspaper	9.00 ± 0.82		4.75 ± 0.50		4.75 ± 0.50	
Social media	8.48 ± 1.23		4.15 ± 0.98		4.54 ± 0.74	
Don't know	8.51 ± 0.78		4.45 ± 0.99		4.59 ± 0.73	

\*Significance level p &lt; 0.05

The education level ( $p=0.036$ ), and residential location of respondents ( $p=0.015$ ) were significantly associated with the practice. Respondents aged 18 to 24 have a better practice score ( $4.67 \pm 0.58$ ) compared to other age group. The practice score by gender shows not much difference. The highest practice score was observed among Indian ( $4.76 \pm 0.44$ ) followed by the Malays ( $4.54 \pm 0.75$ ). Respondents who are single ( $4.69 \pm 0.54$ ), with 1-2 house members have a better practice score ( $4.86 \pm 0.38$ ) compared to rest of the group. In contrast to knowledge and attitude, respondents with primary education (UPSR) in this study ( $4.80 \pm 0.42$ ) and monthly income between RM 2500 to RM 5000 have better practice score ( $4.62 \pm 0.72$ ). The highest practice score was observed among respondents in Section 17 ( $4.67 \pm 0.61$ ) followed by section 24 ( $4.66 \pm 0.61$ ) and Section 25 ( $4.64 \pm 0.67$ ). Those who lived at low cost landed house had a higher practice score ( $4.64 \pm 0.64$ ) compared to other house type.

Spearman rank correlation revealed significant positive correlations between knowledge with attitude ( $r=0.617$ ,  $p<0.01$ ) and knowledge with practice ( $r=0.815$ ,  $p<0.01$ ). This indicate that increase in the level of knowledge will improve the attitude and practice of respondents. There also a significant positive moderate correlation between attitude and practice ( $r=0.642$ ,  $p<0.01$ ) which defines that with the improvement of respondent attitude will encourage people to do good post-flood waste management practice.

## DISCUSSION

A total of 250 flood victims were involved in this study from six residential areas in Shah Alam. Majority of the respondents were females. Female also recorded the highest participation in the study conducted by Ismail et al., about disaster debris management in Kuala Krai, Kelantan (5). The majority respondents participated in this study were Malay which represents majority of the residents in Shah Alam. As of 2010, the city has a population of 541,306 consist of 65.5% Malay, 15.3% Chinese and 10.3% Indian. There were only 17 Indian respondents and none of the respondents was Chinese. This possibly due to the sampling method used for your survey may not have effectively reached or included a representative sample of the Chinese population.

Most of the flood victims were in the age of 18 to 24 years old, married with good education background either master, Phd or bachelor's degree. They can be categorized as middle-income group (M40) with the monthly income of RM 5,001 to RM11,000. Most of the respondents living in

medium cost-landed house with five to six households' members. They obtained the information and awareness regarding post-flood waste management through social media. Koser in a study highlighted the importance of mass media in disseminating knowledge and raise awareness regarding environmental and health risk issue in order to influence and develop good attitude and practice (23).

The most abundant flood waste produced in the study area mainly were debris category which includes steel, wood, clay, household furnishings, tree, and branches. In addition, other potential infectious waste reported as second high waste production that is produced after the flood in this study. The infectious waste can cause pollution to the flood water and cause harm to the community. Our study found that majority of the respondents disposed the flood waste at the side of the road. According to Guerrero et al., people will have higher likelihood to dump the waste in open spaces and along sides of the roads when there is an insufficient amount of waste containers and a greater distance to these containers (24). Mishra also reported a similar behavior among the community in Kerala, India as lack of space to collect and separate the waste were the main obstacle of solid waste management following the disaster (25).

In average, more than five days were taken by the flood victims to clean the house. This is consistent with a report by Ismail et al., that indicate 26.4% of respondents required less than a month to clean up the post-disaster waste. The waste operator took four to five days to clean up the flood waste from the road and public space after the flood waters receded. The duration of clean-up process may delay due to huge volume of flood waste produced in the affected area (5).

The waste contractor in the study area (i.e. Kumpulan Darul Ehsan Berhad (KDEB) Waste Management) collecting 31,000 tonnes of debris which equivalent to the weight of 25,000 adult elephants. Enormous amount of waste created after a calamity is one of the main obstacles to a community's recovery. The capability of the impacted area's waste management to handle the situation has been overwhelmed by the huge amounts of debris and rubbish (26). Amato et al., highlighted that flood waste presents the most challenges in terms of recycling and recovery activities due to diverse composition and the presence of mud (27). Traffic jams are typical in disaster affected locations, owing to debris that may affect the condition of the roads and resulted to the travel delays of waste transportation (28). Considering the massive volumes generated, an effective management stream is a high priority.



### **Knowledge, Attitude and Practice Level of Post-flood waste management**

The majority respondents in the study area had good knowledge about post-flood waste management. The high score obtained could be attributed to the information and awareness obtained from several media sources such as social media and television. Social media serve as a necessary tool to enlighten the public awareness with the recent information and the broadcast media can help promote community engagement in managing solid waste (29-30).

Respondents in this study have not been informed the correct way on how to handle waste after flood but they were able to accurately understand the impact of flood in waste production, benefit of waste categorization, role of individuals in flood waste management, importance of safe handling, removal and management of flood waste and the effects of flood waste towards human health and environment. According to Amato et al., the absence of helpful scientific evidence concerning catastrophe waste management, beneficial to provide support, frequently results in incorrect and inefficient management strategies, having detrimental effects on both the environmental and economic realms (27).

The respondents have lack of knowledge about the categorization of flood waste as the flood waste cannot be separated into recyclables and non-recyclables due to the abundant of waste produced were mixed with mud and hazardous material. Even though, the amount of waste to a landfill can be reduced to 20% by sorting manually (27) but, sorting the flood waste is more difficult especially when the waste is mixed with mud and other regular municipal solid waste (3).

The respondents aware that everyone has an important role to address issues that relates to flood waste management. They were not merely putting the burden on the government, rather, they acted together to solve the post-flood waste issue. However, the community in this study were not aware of methods on evacuation household goods before the water rises. There were no reinforcement measures undertaken by the local authority on waste management facilities prior to flood as a preparation as well. This is crucial particularly for the waste handling operator in conducting a rapid clean-up process. According to Yusof et al., the respective agencies should establish a platform or website to educate the public on waste management and recycling options, as well as strategies to reduce waste generation in homes and in the aftermath of catastrophes since they noticed the piled up of flood waste (9). The communities in this study

highlighted that there were no area or space to evacuate the household possessions after flood and lack of coordination with post-flood waste disposal in flood centres and at houses. Since this is the first time they are experienced the catastrophe, they were not well prepared to face such situation. This finding is consistent to Mohammad et al., which consequently had caused the flood waste being disposed to the side of the road (31).

In respect of health risk that resulted from the flood waste, most of the respondents in this study aware that the flood waste can pose health hazard. They are aware that improper management of flood waste can cause breeding of vectors, skin disease, pollution of soil, air and water, respiratory disease, and stress to the public. However, this may not interpret into action as the flood waste has been disposed indiscriminately at the side of the road. Mishra emphasized that due to the various waste types piled in public and private spaces, it is tough to prevent public health risks such as accidents, infections, disease transmission, virus spread, and vector transmitted diseases (25).

Generally, the more enthusiastically someone feels about a certain behaviour, the more likely it is that person will indulge in that behaviour, or vice versa. Therefore, when presented with a risk of flooding, individuals are more likely to act if they are more optimistic about taking action (32). Our finding proved that 80.8% respondents had good attitude towards post-flood waste management in which this result corresponds well with findings from previous studies in South West Ethiopia and Mogadishu Somalia (33-34).

Our result shows that people in this study willing to participate in managing the waste after the flood and showed good interest in getting information concerning post-flood waste management. However, they have neutral response toward spending their own money to ensure the waste is managed systematically. This finding is in line with a study conducted by Babaei et al., (35). The public is not expected to contribute to waste management, which is typically seen as being the primary obligation and duty of local authorities (24). However, in order to ensure the successful and effective post-flood waste management, both the authority and public must actively participate and play their role. Media also play important role to influence and alter audience attitudes, beliefs, and actions (23).

Our results also shows that majority of the respondents had good post-flood waste management practice where they were able to come with their own initiatives such as renting the RORO bin with the neighbourhood and get the trucks to collect the

flood waste. This result however is contradict with Omar et al., (34) study among the community in Mogadishu Somalia where waste management is a growing crisis that engulfs all urban centers within the country. The study reported more than half of the respondents had poor solid waste management practice (65.0%). Large proportion of the respondents (34.0%) buried the waste near to the house, 31.3% burn their garbage, and 28.0% dump the garbage outside their houses (34). The respondents mainly preferred buying packaged stuffs made of plastic which is not degradable and can causes harm to the environment (57.4%). In another study by Fetter & Rakes, in the United States the municipalities is highly depending on the independent contractors arranged by the authorities for debris removal operations in advance due to the overwhelming nature of disasters (36).

Even though it is challenging to segregate the flood waste by its type, but half respondents in this study (55.52%) performed good practice by segregating the flood waste before being disposed of with aim to protect the environment. This practice definitely will give a good impact to assure a rapid clean-up. Besides, the flood victims in the study area did not perform burning method to manage and dispose their waste. This revealed a good attitude as the production of smoke from the burning activities can pollute air and soil. This is possibly because the local government in urban areas managed solid waste in a more coordinated and structured manner, and as result, a more effective clean-up procedure was seen (5).

#### **The association of KAP with socio-demographic and post-flood waste management factors**

Our study determined the sociodemographic factors that commonly influence good knowledge, attitude and practice. According to Laor et al., and Ismail et al., education is one of the factor that influence the level of knowledge as well as the age (5, 17). Debrah et al., has reported that waste segregation was more common among elderly compared to the young one as this possibly associated to the better awareness level they gained across their experience aged (37). This is consistent with our findings, where half of respondents with good level of knowledge (52.4%) were holding either a bachelor's, master's, or doctoral degree and elderly aged 55 and above do more waste segregation compared to the rest of the group.

Our results also shows significant association between gender and type of media with knowledge. According to Babaei et al., gender can significantly influence the knowledge. For example, women's engagement in source separation and recycling program in Abadan,

Iran has been discovered as effective and consistent with their knowledge level (35). Cline et al., highlighted the media serve as a powerful tool for enhancing public knowledge and engagement as well as for numerous socio-psychological incentives and how people assess disaster risk (38). According to Koser, media has had a huge influence on how individuals perceive a variety of topics, especially environmental catastrophes (23). It can be seen that media reliance among people is sharply rising and important to raise public understanding about the environment and public health posed by improper waste management.

Our findings discovered that there were significant associations between education level and age with the attitude. Respondents in this study who have good attitude score were observed mainly have tertiary education with either Degree, Master or PhD. According to Laor et al., the education level and age were considered crucial factors in determining peoples attitude (17).

Our results shows that education level, and residential location were statistical significantly associated with practice. This is inconsistent with Laor et al., where variables that affect the practices were reported as age, marital status, source of waste management and education level (17). In most situation, good practice performed by individual is often associated with the education level. The statistical analysis in this study revealed that individual with no formal education had poor knowledge and practice towards post-flood waste management. According to Dinie et al., education is crucial to the success of waste management programme because it affects the participation and involvement of the public (39). It can be interpreted that being knowledgeable will increase the people attitude as compared to those who are not. This is most likely because highly educated people would be more likely to get access to various information that allows to increase their awareness and practice in disaster waste management. Guerrero et al., study reported the citizens are more likely to participate in recycling campaigns when they are informed about the advantages of recycling, how to sort waste, and how to organise programmes (24). The effectiveness of the technology and facilities, as well as participation levels from the public, are the key factors in recycling success. Our study also indicate an association between attitude and practice level. This finding was consistent with Kabito et al., (40). Thus, it makes sense that positive attitudes regarding the final destination of the post-flood waste produced by each resident could influence the correct post-flood waste management procedures.

**Study limitation**

This research has filled in the knowledge gap concerning post-flood waste management and its health risk to the flood victims especially in an urban area of Malaysia. There has been limited research found to demonstrate how post-flood waste affect the flood victims' health. Thus, this study provide a baseline information for future preparedness.

There are several limitations encountered in this study. Among them are sample of participants, and the representativeness of the sample. During a disaster and its aftermath, accessing and recruiting a representative sample can be challenging due to disruptions, population displacement, and other logistical constraints. This can introduce selection bias and limit the ability to generalize the findings to the broader population. The findings may not accurately reflect the entire population.

In addition, participants may be inclined to provide responses they perceive as socially desirable or acceptable, particularly when discussing waste management practices. This bias can affect the accuracy of self-reported data and potentially lead to an overestimation of positive waste management behaviors or an underestimation of negative practices.

Cross-sectional surveys provide data collected at a specific point in time. In the context of disaster waste management, this means that the survey captures a snapshot of the situation during a particular phase of the disaster or the post-disaster recovery period. However, it may not capture the full temporal dynamics of waste management efforts, such as changes over time or long-term effects. Researchers also may not be able to delve deeply into the reasons behind responses or fully explore complex relationships between variables. This may limit the depth of information that can be gathered about the complexities of disaster waste management. Researchers may not be able to explore the underlying reasons behind waste management practices or capture the nuances of local contexts and challenges.

However several strategies were employed to mitigate these limitations and enhance the quality and validity of the findings. This includes survey has been conducted as close to the event or relevant time frame as possible. Collecting data soon after the events or experiences being studied can enhance participants' ability to recall and report accurately. This study also has minimized the social desirability bias by ensuring survey questions are framed in a neutral and non-judgmental manner. Anonymity and confidentiality also emphasized to encourage participants to provide honest responses.

**CONCLUSION**

Based on the study conducted, it was observed that the major flood debris was steel, wood, clay, household furnishings, tree, and branches. Other type of waste produced includes the potential infectious waste such as faeces, the household waste, commercial and industrial waste. The majority respondents disposed the flood waste at the side of the road, and few respondents used disposal bins or disposed at the empty space near their house. The duration to clean up the flood waste by most respondents was more than 5 days while the waste contractor took 4 to 5 days. Overall, respondents in this study have good knowledge, attitude, and practice regarding the post-flood waste management. Education level was associated with the knowledge, attitude and practice of the respondents in this study. Other variables such as gender and type of media were associated with the level of knowledge. The age was significantly associated with attitude while the residential location were significantly associated with practice. There was a significant positive correlation between knowledge-attitude, knowledge-practice, and attitude-practice.

This research has filled in the research gap concerning post-flood waste management and its health risk to the flood victims in Malaysia. There has been limited research to demonstrate how the knowledge, attitude and practice of people involved in the disaster waste management. Thus, this study can provide a baseline data for the urban area. Results of this study may not be able to represent the condition of all disaster waste management as this study was only conducted in one affected area. Therefore, future study is recommended to involve more affected areas as to determine the variance that it may have. This may highlight more accurate level of KAP. The data collection facing great challenges as it is very time-consuming as some of the respondents were not willing to participate in this study. There was limited duration to obtain the data in which most of the respondents were working on weekdays and they are available only on weekend. Some of the respondents were elderly as they need full supervision to complete the questionnaire. Future study is recommended to take into consideration of this difficulty and give sample time for the data collection.

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