

ORIGINAL ARTICLE

Knowledge, Attitude, and Practices of Household Solid Waste Management Among Residents in Urban, Suburban, and Rural Zones of Kuantan, Pahang, Malaysia

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ABSTRACT

Introduction: Poor rural waste management poses environmental and health risks, making it crucial to understand residents' knowledge, attitude, and practice (KAP) for effective interventions. This study aims to assess the knowledge, attitude and practices (KAP) on household solid waste management among residents in urban, suburban and rural zones of Kuantan, Pahang. **Materials and Methods:** A cross-sectional study was carried out involving 210 respondents. Self-administered questionnaires were used to assess KAP, while household waste generation was self-recorded by respondents from 30 selected households for a week. **Results:** The waste generation rate was 0.23 ± 0.01 kg per person per day, with each house producing 1.10 ± 0.04 kg daily. The mean total waste generated across the three study sites was higher during weekends (43.41 ± 0.90 kg) compared to weekdays (28.93 ± 4.44 kg). Waste composition included plastic (31%, 72.11 kg), other materials (19%, 44.19 kg), and paper (17%, 39.54 kg). The community had a high level of knowledge of waste management (87.1%, $n = 183$), good knowledge of health risks (82.9%, $n = 174$), positive attitudes (81.9%, $n = 172$), and moderate practices (53.3%, $n = 112$). Significant associations were found between knowledge and practice ($p < 0.001$), and between practice and attitude ($p < 0.05$). **Conclusion:** The residents have a high knowledge of solid waste management that significantly influenced their attitude and moderate practice.

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waste can contribute to respiratory problems, further compounding the health risks associated with illegal dumping [1].

INTRODUCTION

Illegal dumping has become the major issue, posing substantial threats to both the environment and public health. It can result in significant environmental degradation, contaminating soil, water, and air. Toxic chemicals, hazardous materials, and other pollutants may seep into the soil and waterways, posing serious health risks to the ecosystems and communities [1]. Furthermore, illegal dumping sites present a public health hazard, especially when hazardous or infectious waste is involved. These sites can attract rodents, insects, and other pests, fostering the spread of disease. Additionally, the smoke and fumes emitted from burning

Effective management of household solid waste is therefore crucial to mitigating these environmental and public health risks. In Malaysia, household solid waste management is regulated under the Solid Waste and Public Cleansing Management Act 2007 (Act 672) and administered by the Solid Waste Management and Public Cleansing Corporation (SWCorp) under the Ministry of Housing and Local Government [2]. Waste collection, transportation, and disposal services in many states, including Pahang, are carried out by appointed concessionaire companies such as Alam Flora Sdn. Bhd., SWM Environment Sdn. Bhd., and E-Idaman Sdn. Bhd., while local authorities remain responsible for monitoring, supervision, and enforcement at the municipal level [3]. This institutional arrangement is

intended to ensure systematic waste collection and proper disposal; however, challenges in implementation persist in many communities. Previous studies have reported that ineffective enforcement, limited accessibility to waste collection services, inadequate infrastructure, and insufficient monitoring of dumping hotspots may contribute to improper waste disposal and illegal dumping practices in Malaysia and other developing regions [4,5]. In addition, low public compliance with waste management regulations and insufficient community participation in waste segregation and recycling programmes may further weaken the effectiveness of the existing waste management systems [4,5].

This issue is particularly evident in Kuantan, Pahang where inadequate waste management infrastructure and weak regulatory enforcement exacerbate the problem, making illegal dumping a major concern [6]. Over recent years, Kuantan has witnessed several notable instances of illegal dumping, ranging from the improper disposal of hazardous materials to construction debris in densely populated and public areas. Despite efforts to address the problem, some locals continue to dispose of waste in unauthorized areas due to limited access to suitable facilities or a lack of awareness regarding the environmental and health risks associated with illegal dumping. According to Sinar Harian [7], authorities identified and cleaned 58 illegal waste disposal sites in Kuantan; however, four locations remain active, serving as recurrent "hotspots" for garbage dumping. Furthermore, illegal disposal sites have also been identified in other areas, including Jerantut, Muadzam Shah, Bera, Raub, Pekan, Cameron Highlands, and Temerloh, highlighting the broader scope of the issue beyond Kuantan.

Understanding the dynamic between illegal dumping in Kuantan and residents' knowledge, attitudes and practices (KAP) towards waste management is essential for crafting effective intervention strategies. While legislative measures aim to control illegal dumping, their success depends heavily on the community's knowledge, attitudes, and behaviours. The KAP framework provides valuable insights into how community awareness and actions shape waste management practices and environmental sustainability. A study in Selangor revealed that 92% of respondents were aware of the harmful effects of improper waste disposal, yet only 52% practiced proper waste disposal methods [8]. Similarly, a study by Azmin et al. [9] indicated that respondents had a high level of knowledge on recycling, but more than half of the respondents demonstrated low levels of recycling practices. These findings align with global trends, as evidenced by a KAP survey in Gelemso town, Ethiopia, which indicated that households had a high level of knowledge on solid waste, and solid waste management as well as attitudes towards solid waste management [4]. However, most households were found to practice

improper solid waste disposal, and this behaviour was attributed to several key obstacles to effective waste management, including lack of awareness, inadequate infrastructure, and limited cooperation among locals [4]. These parallels underscore the importance of addressing knowledge gaps and fostering community engagement to improve waste management practices both in Kuantan and beyond.

To date, limited studies have been reported on the KAP of household solid waste management among residents in a rural area of the East Coast of Malaysia, particularly in Kuantan, Pahang. Therefore, this study aims to investigate these variables to improve the current practices and create an efficient waste management system. Understanding residents' KAP is crucial for authorities to identify gaps and implement targeted interventions that promote better waste segregation, storage, and disposal practices. The findings of this study will serve as a foundation for enhancing public awareness and fostering behavioural change among residents. Such efforts not only contribute to the development of a more sustainable waste management system but also align with the broader objectives of the United Nations Sustainable Development Goals (SDGs). Specifically, this initiative supports SDG 13: Good Health and Wellbeing, by reducing health risks associated with improper waste disposal, and SDG 13: Climate Action, by minimizing the environmental impact of waste through improved practices.

MATERIALS AND METHODS

Study Design and Location

This study is a cross-sectional study. Data collection was conducted from August to October 2023 among residents from three areas within the Kuantan region of Pahang, Malaysia: Bukit Setongkol (Site A), Sungai Isap (Site B), and Taman Tas (Site C) (**Figure 1**). Kuantan, a rapidly expanding area with a mix of urban, suburban, and rural zones, has a population of approximately 607,778. The demographic composition includes 57% Malays, 32% Chinese, 10% Indians, and 1% from other ethnic backgrounds. These residential areas were specifically selected for their proximity to illegal dumping sites, located within a 500-meter radius.

Sample Size and Sampling

This study employed a convenience sampling method to recruit respondents from three residential areas in Kuantan, Pahang, namely Bukit Setongkol, Sungai Isap, and Taman Tas. A total of 210 respondents were included, with 70 participants selected from each study site. Eligible households were approached through door-to-door visits, during which the objectives and procedures of the study were explained, and written informed consent was obtained prior to participation. The inclusion criteria comprised permanent residents aged 18 to 60 years, both male and female, residing

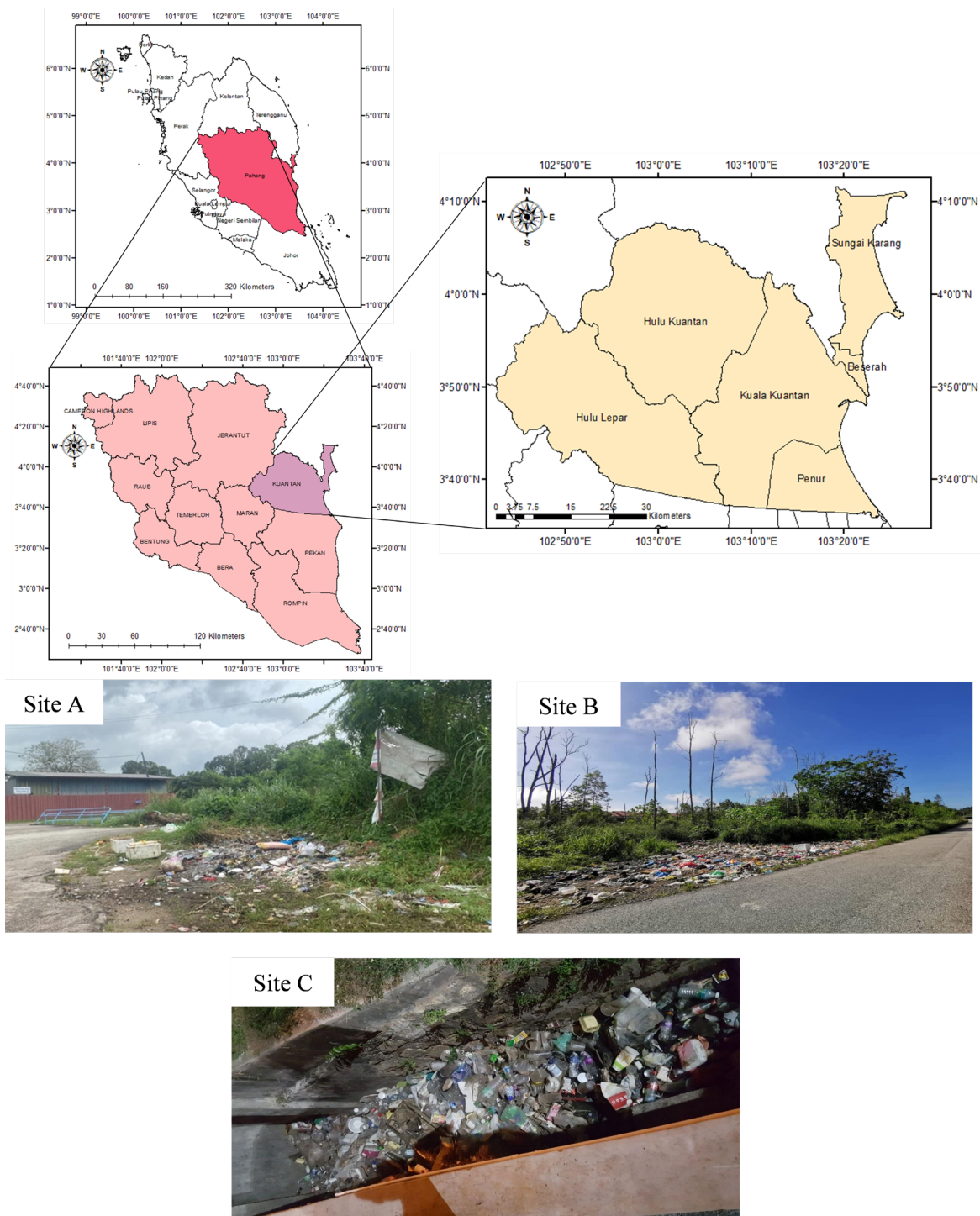


Fig. 1: Maps of Kuantan (Bukit Setongkol, Sungai Isap and Taman Tas) with the illegal dumping sites in Bukit Setongkol (Site A), Sungai Isap (Site B) and Taman Tas (Site C)

in the selected study areas and able to read and write to ensure comprehension of the self-administered questionnaire. Non-permanent residents, including tourists, visitors, and short-term renters, were excluded, as their temporary residence may not reflect long-term waste management practices within the community. Individuals who were unable to read or write were also excluded. This sampling approach was adopted to capture relevant information from residents who were more likely to influence household solid waste management behaviours in the study areas.

Study Instrument

The questionnaire was developed based on several studies for reference [10-12]. The questionnaire comprised five sections and was made available in both English and Malay. Section A collected socio-demographic information of the respondents. Section B assessed knowledge of solid waste management (SWM) and associated health risks, comprising 14 questions. Responses were categorized as correct (1), incorrect, or unsure (0). Knowledge levels were classified based on scores: 0-4 indicated poor knowledge, 5-9 moderate,

and 10–14 good. Section C evaluated respondents' attitudes towards SWM using 14 questions rated on a five-point Likert scale, from strongly disagree (1) to strongly agree (5). Similarly, Section D assessed SWM practices through 14 questions, rated from not at all (1) to everyday (5). For Section C and D, scores were categorized as low (1.00–2.33), moderate (2.34–3.67), or good (3.68–5.00) based on mean values.

The content validity of the questionnaire was reviewed by an expert panel from The Department of Environmental and Occupational Health, Universiti Putra Malaysia (UPM), Malaysia. The panel ensured the sufficiency and accuracy of each item, recommending revisions to improve clarity and minimize response bias. To evaluate reliability, a pre-test was conducted with 21 respondents (10% of the total sample size) to gauge their ability to provide appropriate responses and identify potential issues. Reliability analysis using SPSS software indicated strong internal consistency, with Cronbach's alpha values of 0.809 for section B (Knowledge), 0.954 for Section C (Attitude), and 0.817 for Section D (Practice), confirming the questionnaire's reliability for data collection.

Waste Volume Measurement

The waste measurement was conducted at 30 selected households, with 10 houses chosen from each study site, over a period of seven consecutive days. Respondents were instructed to separate their waste into two categories: general waste and recyclable waste. Measurements were taken daily at 7:00 am, prior to collection by the waste contractor. Each waste type was weighed using a kitchen scale, and the daily waste generation rate was calculated for each household. Waste was further categorized into paper, cans, and plastic, allowing for a detailed analysis of waste composition.

Data Analysis

The collected data were systematically recorded and organised using Microsoft Excel 2016 for initial data management and visualisation. Subsequent statistical analyses were conducted using SPSS software (Version 27.0, IBM). Descriptive statistics were applied to summarise sociodemographic characteristics of households, quantify the volume of waste generated, and assess residents' levels of knowledge, attitude, and practice (KAP) using frequencies and percentages. Fisher's Exact Test was employed to examine the associations between KAP and sociodemographic variables, as well as the interrelationships among knowledge, attitude, and practice, with statistical significance determined at $p < 0.05$.

Ethical Clearance

This study was carried out upon obtaining approval from the Ethical Committee for Research Involving Human Subjects at University Putra Malaysia (UPM) (JKEUPM-2023-533).

RESULTS

Respondents' Socio-Demographic Characteristics and Health and Environmental Impacts of Waste Disposal

The study included 210 respondents, the majority of whom were female (65.7%, $n = 138$). Most respondents were aged between 18 and 29 years (42.9%, $n = 90$) and had attained a degree-level education (58.6%, $n = 123$). A significant portion of respondents belonged to low- and middle-class income groups, with an average monthly income of MYR 1,500 (USD 315) (33.8%, $n = 71$). The largest employment category was government servants, accounting for 40.0% ($n = 84$) of respondents. In terms of housing, the majority lived in terrace houses (43.8%, $n = 92$), followed by Semi-D houses (42.4%, $n = 89$), bungalows (13.3%, $n = 28$), and traditional village houses (0.48%, $n = 1$). Most respondents resided more than 5 km from waste disposal sites (47.1%, $n = 99$), while 16.7% ($n = 35$) lived less than 100 m away. Additionally, 92.9% ($n = 195$) of respondents lived in areas with legal dumping sites (**Table I**).

Volume and Composition of Waste Generated Within Households

The weekly waste generation rate recorded from 30 selected households, representing 143 household members, totalled 231.45 kg, with an average of 33.06 ± 7.95 kg per day (**Table II**). Daily waste generation exhibited slight variations, peaking on Saturday at 44.04 kg and reaching its lowest on Tuesday at 24.91 kg. Over the weekdays (Monday to Friday), the total waste produced was 144.64 kg, and the weekend total of 86.81 kg. The mean daily waste generation during weekends was significantly higher at 43.41 ± 0.90 kg compared to 28.93 ± 4.44 kg on weekdays. The waste generation rate in the studied community was calculated at 0.23 ± 0.01 kg per person per day and 1.10 ± 0.04 kg per house per day.

Plastic constituted the highest type of waste generated (72.11 kg), representing 31% of the total weight. The second highest category was "other waste", which included electronic waste, expired medicines, cigarettes, diapers and masks, collectively accounting for 19% of the total waste, with a volume of 44.19 kg. Paper waste was generated at 39.54 kg (17%), followed by cans at 34.89 kg (15%), glass (27.91 kg, 12%) and garden waste at 13.98 kg (6%).

Knowledge, Attitude and Practice (KAP) Levels on Solid Waste Management

Table III shows the knowledge on solid waste management and knowledge on health risks associated with waste management among the residents. For knowledge on solid waste management, most respondents (91.0%, $n = 191$) correctly identified recycling as one of the elements in solid waste management. The process of waste segregation, which involves identifying, classifying, dividing, and sorting of

Table I: Sociodemographic characteristics of respondents (N = 210)

Description		Site A	Site B	Site C	Total, n (%)
		Frequency, n (%)			
Gender	Male	23 (33.3)	21 (29.6)	28 (40.0)	72 (34)
	Female	46 (66.7)	50 (70.4)	42 (60.0)	138 (65.7)
Age	18-29	28 (40.6)	32 (45.1)	30 (42.9)	90 (42.9)
	30-39	17 (24.6)	19 (26.8)	15 (21.4)	51 (24.3)
	40-49	13 (18.8)	11 (15.5)	14 (20.0)	38 (18.1)
	50-59	11 (15.9)	9 (12.7)	11 (15.7)	31 (14.8)
Educational level	Secondary	8 (11.6)	7 (9.9)	6 (8.6)	21 (10.0)
	Certificate/Diploma	19 (27.5)	18 (25.4)	24 (34.3)	61 (29.0)
	Degree	41 (59.4)	45 (63.4)	37 (52.9)	123 (58.7)
Monthly income (MYR)	Master/PhD	1 (1.4)	1 (1.4)	3 (4.3)	5 (2.4)
	<1500	19 (27.5)	24 (33.8)	28 (40.0)	71 (33.8)
	1501-2500	18 (26.1)	20 (28.6)	23 (32.9)	61 (29.0)
	2501-3500	18 (26.1)	16 (22.4)	11 (15.7)	45 (21.4)
	3501-4500	8 (11.6)	5 (7.6)	2 (2.9)	15 (7.1)
	4501-5500	6 (8.7)	5 (6.7)	4 (5.7)	15 (7.1)
Working status	>5500	0 (0.0)	1 (1.0)	2 (2.9)	3 (1.4)
	Unemployed	12 (17.4)	0 (0.0)	19 (27.1)	31 (14.8)
	Self-employed	2 (2.9)	8 (11.3)	1 (1.4)	11 (5.2)
	Government	25 (36.2)	28 (39.4)	31 (44.3)	84 (40)
	Private	19 (27.5)	18 (25.4)	16 (22.9)	53 (25.2)
	Retired	3 (4.3)	1 (1.4)	1 (1.4)	5 (2.4)
Types of houses	Students	8 (11.6)	16 (22.5)	2 (2.9)	26 (12.4)
	Bungalow	7 (10.1)	6 (8.5)	15 (21.4)	28 (13.3)
	Semi-D	17 (24.6)	18 (25.4)	54 (77.1)	89 (42.4)
	Terrace	44 (63.8)	47 (66.2)	1 (1.4)	92 (43.8)
	Traditional village house	1 (1.4)	0 (0.0)	0 (0.0)	1 (0.48)
Distance from house to the disposal sites	Less than 100 m	12 (17.4)	13 (18.3)	10 (14.3)	35 (16.7)
	100 m to 1 km	6 (8.7)	1 (1.4)	9 (12.9)	16 (7.6)
	1 km to 5 km	20 (29.0)	23 (32.4)	17 (24.3)	60 (28.6)
	More than 5 km	31 (44.9)	34 (47.9)	34 (48.6)	99 (47.1)
Type of disposal area	Illegal dumping area	4 (5.8)	6 (8.5)	5 (7.1)	15 (7.1)
	Legal dumping area	65 (94.2)	65 (91.5)	65 (92.9)	195 (92.9)

Table II: The volume of waste generated at 30 selected houses in the study areas

Site	No. of house-holds	Weekend				Weekdays							Total (7 days)	Mean±SD	Waste generation rate, kg/person/day	Mean ±SD	Waste generation rate, kg/house/day	Mean ±SD
		Day 1 (Sat)	Day 2 (Sun)	Total (2 days)	Mean ±SD	Day 3 (Mon)	Day 4 (Tues)	Day 5 (Wed)	Day 6 (Thurs)	Day 7 (Fri)	Total (5 days)	Mean±SD						
Site A (n = 10)	45	14.65	13.08	27.73	13.87±1.11	11.41	8.85	8.67	8.27	9.44	46.64	9.33 ±1.24	74.37	10.62±2.48	0.24		1.06	
Site B (n = 10)	47	14.76	14.73	29.49	14.75±0.02	11.44	7.38	8.45	9.56	10.58	47.41	9.48 ±1.62	76.90	10.99±2.89	0.23	0.23 ±0.01	1.09	1.10 ±0.04
Site C (n = 10)	51	14.63	14.96	29.59	14.80±0.23	12.81	8.68	7.90	10.87	10.33	50.59	10.12±1.92	80.18	11.45±2.77	0.22		1.14	
Total for 3 sites	143	44.04	42.77	86.81	43.41±0.90	35.66	24.91	25.02	28.70	30.35	144.64	28.93±4.44	231.45	33.06±7.95				

Table III: Knowledge on solid waste management and health associated with waste management among respondents (N = 210)

Knowledge on solid waste management					
No.	Statement	Correct answer		Wrong answer	
		Frequency, n	Percentage, %	Frequency, n	Percentage, (%)
1.	Recycling is one of the elements in solid waste management	191	91.0	20	9.0
2.	Waste segregation is a process of identifying, classifying, dividing, and sorting of garbage.	174	82.9	36	17.1
3.	5R refers to Refuse, Reduce, Reuse, Recycle and Recovery	170	81.0	40	19.0
4.	Poor solid waste disposal creates ideal conditions for pests	197	93.8	13	6.2
5.	Recycling reduces the amount of solid waste in a landfill.	190	90.5	20	9.5
6.	Open burning has negative consequences on the environment and health.	188	89.5	22	10.5
7.	Separating waste at the source helps reduce the amount of waste disposed in landfills.	180	85.7	30	14.3
8.	Plastic cannot be decomposed by microorganism other living things.	187	89.0	23	11.0
9.	Glass, paper, and plastic bottles are recyclable items.	175	83.3	35	16.7
10.	Plastic bags and polystyrene are non-recyclable items.	165	78.6	45	21.4
11.	Organic and food waste can be decomposed by microorganism or other living organisms.	148	70.5	62	29.5
Knowledge on health risk associated with waste management					
1.	Hazardous waste cause skin irritation, rashes, and allergic reactions when it comes into direct contact with the skin.	208	99.0	2	1.0
2.	Illegally dumped of hazardous waste can have long- term health effects such as the cancer and chronic disease.	205	97.6	5	2.5
3.	Hazardous waste contaminates the water supply, leading to water borne diseases (cholera, dysentery, and typhoid).	207	98.6	3	1.4
4.	Skin irritation, eye irritation, and respiratory problems are due to exposure of harmful materials from burning waste	197	93.8	13	6.2
5.	Consume contaminated food or water from illegal waste dumping sites can lead to gastrointestinal problems, including vomiting, diarrheal, and stomach pain.	197	93.8	13	6.2
6.	Residents near to waste disposal sites are prone to get respiratory disease.	184	87.6	26	12.4
7.	Hazardous waste affects the nervous system and lead to neurological disorders, including impaired cognitive function, developmental delays, and other neurological impairments.	186	88.6	24	11.4
8.	Stagnant water due to poor solid waste disposal create a breeding ground for mosquitoes.	182	86.7	28	13.3
9.	Improper waste disposal release toxic substances into the air. People living nearby may inhale these pollutants, which can result in respiratory problems, asthma, and other respiratory illnesses.	179	85.2	31	14.8
10.	Illegal waste dumping sites create breeding grounds for disease-carrying vectors and transmit diseases such as malaria and dengue.	175	83.3	35	16.7
11.	Illegal waste dumping sites create unpleasant odors that could disturb the community.	174	82.9	36	17.1
12.	Skin disease is associated with improper waste management.	172	81.9	38	18.1
13.	Pregnant women living near illegal waste dumping sites may be at a higher risk of exposing their unborn children to harmful substances, potentially leading to birth defects and developmental issues in infants.	172	81.9	38	18.1

garbage, was correctly understood by 82.9% (n = 174) of the respondents. Regarding the 5R concept (refuse, reduce, reuse, recycle, and recovery), 81.0% (n = 170) of respondents demonstrated awareness. Furthermore, most (93.8%, n = 197) of respondents acknowledged that poor solid waste disposal creates ideal conditions for pests. The role of recycling in reducing the amount of solid wastes in landfills was correctly recognized by 90.5% (n = 190) of the respondents, while 89.5% (n = 188) understood the environmental and health-related negative consequences of open burning. The practice of separating waste at the source to reduce landfill waste was acknowledged by 85.7% (n = 180) of respondents. Additionally, 89.0% (n = 187) correctly stated that plastic cannot be decomposed by microorganism or other living organisms, while 83.3% (n = 175) identifies glass, paper,

and plastic bottles as recyclable items. However, 78.6% (n = 165) recognized plastic bags and polystyrene as non-recyclable items, and 70.5% (n = 148) understood that organic and food waste can be decomposed by microorganisms or other living organisms.

For knowledge on health risks associated with waste management, a vast majority (99.0%, n = 208) knew that hazardous waste causes skin irritation, rashes, and allergic reactions when it comes into direct contact with the skin. Similarly, 97.6% (n = 205) acknowledged that the illegal dumping of hazardous waste can lead to long-term health effects, such as cancer and chronic diseases. Waterborne diseases, such as cholera, dysentery, and typhoid, caused by hazardous waste contaminating the water supply, were recognized by 98.6% (n = 207)

of respondents. Exposure to harmful materials from burning waste was identified as causing skin irritation, eye irritation, and respiratory problems by 93.8% (n = 197) of respondents, the same proportion that associated consuming contaminated food or water from illegal dumping sites with gastrointestinal problems.

A total of 87.6% (n = 184) of respondents acknowledged that residents near waste disposal sites are more prone to respiratory diseases, while 88.6% (n = 186) recognized the effects of hazardous waste on the nervous system, potentially leading to neurological disorders such as impaired cognitive function and developmental delays. Poor solid waste disposal leading to stagnant water, which serves as a breeding ground for mosquitoes, was acknowledged by 86.7 % (n = 182) of respondents. In addition, 85.2% (n = 179) knew that improper waste disposal releases toxic substances into the air, resulting in respiratory problems such as asthma. Furthermore, 83.3% (n = 175) of respondents were aware that illegal waste dumping sites create breeding grounds for disease-carrying vectors, transmitting disease like malaria and dengue. However, slightly fewer respondents identified illegal waste dumping sites as sources of unpleasant odours (82.9%, n = 174) or improper waste management as associated with skin diseases (81.9%, n = 172). Lastly, 81.9% (n = 172) are aware of the risks to pregnant women living near illegal dumping sites, including potential birth defects and developmental issues in infants.

The attitudes of respondents towards waste management are summarized in **Table IV**. The combined percentages for “Strongly Agree” and “Agree” demonstrate the overall positive attitudes of respondents towards waste management. A significant majority (72.4%, n = 152) agreed or strongly agreed that waste is one of the environmental issues in their residential area requiring immediate attention. Similarly, 85.3% (n = 179) believed that reusing plastic bags for shopping is

a good practice to reduce waste. The importance of the 5R concept in waste management was highlighted by 88.1% (n = 185) of respondents, and 89.0% (n = 187) agreed that community workshops on solid waste management increase awareness of proper disposal practices. Regarding waste segregation, 59.5% (n = 125) agreed that it can be time-consuming. Meanwhile, 89.0% (n = 187) of respondents expressed frustration when witnessing improper waste disposal and littering. A total of 84.8% (n = 178) of respondents agreed or strongly agreed that separating waste can extend landfill life, reducing its environmental and health impacts. Additionally, 81.9% (n = 172) recognized that improper disposal can lead to the occurrence of diseases. Finally, 85.2% (n = 179) of respondents indicated a strong commitment to responsibly disposing of waste and adhering to proper waste management guidelines.

The respondents’ practices regarding waste management and disposal are presented in **Table V**. The frequency of various waste management behaviours was analysed to identify the trends and areas needing improvement. For segregation of household garbage, only 10.0% (n = 21) of respondents segregated household waste daily, while 33.3% (n = 70) did so 2-3 times a week. A notable 52.2% reported not segregating their waste at all, indicating a gap in daily waste separation practices. For recommendation of proper waste management to others, a total of 11.4% (n = 24) of respondents reported commending proper waste management daily, and 24.3% (n = 51) did so 2-3 times a week. However, 32.4% (n = 29) did not encourage others at all, reflecting limited proactive efforts in promoting good waste practices.

For recycling at home, only 7.6% (n = 16) recycled every day, while 26.2% (n = 55) did so 2-3 times a week, and 24.8% (n = 52) recycled once a week. Alarming, 22.9% (n = 48) never recycled at home.

Table IV. Attitude on solid waste management among respondents (N = 210)

No.	Attitude	Strongly agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly disagree (%)
1.	Waste is one of the environmental issues in my residential area that requires immediate attention.	62 (29.5%)	90 (42.9%)	42 (20.0%)	2 (1.0%)	14 (6.7%)
2.	Reusing plastic bags for shopping is a good practice for reducing waste.	106 (50.5%)	73 (34.8%)	8 (3.8%)	3 (1.4%)	20 (9.5%)
3.	The 5R (Refuse, reduce, reuse, recycle and recovery) concept is important to waste management.	122 (58.1%)	63 (30.0%)	5 (2.4%)	8 (3.8%)	12 (5.7%)
4.	Community workshops on solid waste management help increase awareness on solid waste disposal practices of residents.	100 (47.6%)	87 (41.4%)	2 (1.0%)	5 (2.4%)	16 (7.6%)
5.	Waste segregation at home is time-consuming.	59 (28.1%)	66 (31.4%)	22 (10.5%)	33 (15.7%)	30 (14.3%)
6.	I feel frustrated when I see people litter or dispose of waste improperly.	112 (53.3%)	75 (35.7%)	1 (0.5%)	16 (7.6%)	6 (2.9%)
7.	Separating waste can increase the life span of landfill which can reduce the impact to the environment and human health.	152 (72.4%)	26 (12.4%)	10 (4.8%)	5 (2.4%)	17 (8.1%)
8.	Improper disposal can cause occurrence of disease.	103 (49.0%)	69 (32.9%)	13 (6.2%)	6 (2.9%)	19 (9.0%)
9.	I am committed to responsibly disposing of my waste and adhering to proper waste management guidelines.	116 (55.2%)	63 (30.0%)	12 (5.7%)	15 (7.1%)	4 (1.9%)

For use of reusable bags at grocery stores, daily use of reusable bags was reported by 13.3% (n = 28) of respondents, with 16.7% (n = 35) doing so 2-3 times a week. However, 32.9% (n = 69) did not bring reusable bags at all. For burying waste within the household compound, a significant proportion (41.0%, n = 86) of respondents buried their waste daily, while 40.0% (n = 84) reported never practicing this method. For burning waste in open spaces, a concerning 39.5% (n = 83) of respondents burned waste daily within their house compounds, while 21.0% (n = 44) did not engage in this activity at all. Although 63.8% reported observing illegal dumping 2–3 times a week only 0.5% (n = 1) did so daily. However, 23.3 (n = 49) never reported illegal dumping.

Level of Knowledge, Attitude and Practices of Respondents (N = 210)

The levels of knowledge, attitude and practices of respondents are summarized in **Table VI**. Most respondents demonstrated good knowledge regarding solid waste management (87.1%, n = 183), with a mean score of 11.92 (SD = 2.03). A smaller proportion had moderate knowledge (11.9%, n = 25), while only 1.0% (n = 2) were classified as having poor knowledge. Most respondents also displayed good knowledge of health risks related to waste management (82.9%, n = 174), with a mean score of 12.34 (SD = 2.20). Moderate

knowledge was reported by 16.2% (n = 34), and 1.0% (n = 2) had poor knowledge. For attitudes, respondents largely exhibit good attitudes toward waste management (81.9%, n = 172), with a mean score of 4.41 SD = 0.30). Meanwhile, 10.0% (n = 21) showed moderate attitudes, and 8.1% (n = 17) demonstrated poor attitudes. For level of practices, good practices in waste management were reported by 19.0% (n = 40) of respondents, with a mean score of 3.03 (SD = 0.26). The majority (53.3%, n = 112) exhibited moderate practices, and 27.6% (n = 58) had poor practices.

Associations Between Knowledge, Attitude and Practice of Solid Waste Management

There was no significant association between knowledge and attitude of solid waste management ($X^2 = 3.187$, $p = 0.543$). However, a significant association was observed between knowledge and practice ($X^2 = 16.585$, $p < 0.001$). In addition, practice was significantly associated with attitude towards solid waste management ($X^2 = 14.192$, $p < 0.05$).

DISCUSSION

Effective solid waste management is critical for safeguarding both environmental and public health, especially in rural and semi-urban settings where waste disposal infrastructure is often limited. The findings of

Table V: Practice on solid waste management among respondents (N = 210).

No.	Practice	Every day, n (%)	2-3 times a week, n (%)	Once a week, n (%)	Once a month, n (%)	Not at all, n (%)
1.	Frequency segregate household garbage wastes according to the types of waste	21 (10.0)	70 (33.3)	27 (12.9)	39 (18.6)	53 (52.2)
2.	Frequency recommends others to practice proper waste management?	24 (11.4)	51 (24.3)	38 (18.1)	29 (13.8)	29 (32.4)
3.	Frequency recycles at home	16 (7.6)	55 (26.2)	52 (24.8)	39 (18.6)	10 (22.9)
4.	Frequency brings reusable bags to grocery store.	28 (13.3)	35 (16.7)	68 (32.4)	10 (4.8)	25 (32.9)
5.	Frequency buries the waste within the house compound.	86 (41.0)	9 (4.3)	6 (2.9)	25 (11.9)	84 (40.0)
6.	Frequency burn waste in an open space within the house compound.	83 (39.5)	18 (8.6)	25 (11.9)	40 (19.0)	44 (21.0)
7.	Frequency report illegal dumping in the community	1 (0.5)	134 (63.8)	23 (11.0)	3 (1.4)	3 (23.3)

Table VI: The level of knowledge, attitude and practice among respondents in this study (N = 210)

Variables	Level	Frequency (n)	Percentage (%)	Mean (SD)
Knowledge on solid waste management	Good	183	87.1	11.92 (2.03)
	Moderate	25	11.9	
	Poor	2	1.0	
Knowledge on health risk associated with waste management	Good	174	82.9	12.34 (2.20)
	Moderate	34	16.2	
	Poor	2	1.0	
Attitude	Good	172	81.9	4.41 (0.30)
	Moderate	21	10.0	
	Poor	17	8.1	
Practices	Good	40	19.0	3.03 (0.26)
	Moderate	112	53.3	
	Poor	58	27.6	

Knowledge levels: poor (0–4), moderate (5–9), and good (10–14).

Attitude and practice level: low (1.00–2.33), moderate (2.34–3.67), or good (3.68–5.00) based on mean values.

this study provide insights into waste generation patterns, waste composition, and disposal practices, while also examining the knowledge, attitudes, and practices of the community towards waste management in Kuantan, Pahang. These findings are crucial for designing targeted interventions to improve waste handling and reduce environmental risks.

For waste generation, the weekly waste generation rate recorded from 30 houses, representing 143 households, totalled 231.45 kg, with a mean of 33.06 ± 7.95 kg per day. The waste generation rate in this study was closely aligned with the findings of a study by Darban Astane & Hajilo [13] conducted in a rural area in Iran with the rate of 0.178 kg/person/day. A comparable rate was also reported in a study by Syafrudin et al. [14] in rural Indonesia at a rate of 0.29 kg/person/day, indicating a comparable trend. However, the waste generation rate in this study was lower than the national average for Malaysia, at 1 kg/person/day.

The average daily waste disposed of on weekends in this study was significantly higher compared to weekdays. This is consistent with a study done by Letshwenyo & Kgetseymore [15] in developing country Botswana where the generation rate was between 0.02 to 0.17 kg/capita/day on weekdays and 0.21 to 0.38 kg/capita/day on weekends. This increase is likely due to social and domestic activities such as cooking, gathering, and celebrations. The results are also consistent with the average generation rate of 0.248 ± 0.18 kg/capita/day for 12 rural communities in Iran [16]. Other factors such as season of the year, and geographic location could have influenced generation rates in the study areas. Similar findings were reported by Miezech et al. [17] of 0.2 to 0.8 kg/person/day in Ghana.

The most common waste management methods among households in this study were landfilling and recycling. Open burning and burying the waste were utilized by an equivalent number of respondents. This is considered as the common practice of waste disposal as it was also reported in rural and remote areas such as Kelantan [9, 18]. About 34.9% of households in Bachok, 36.6% in Pasir Mas, and 38% in Pasir Puteh are without garbage collection facilities. This described the problem with household solid waste management in Kelantan. In urban or semi-urban areas, stationary waste storage containers are provided mainly at the sides of the main road within Kota Bharu districts by the local authority and the waste collection is done approximately three times a week in Bachok [19]. The major issues contributing to the problem are due to insufficient financial resources, lack of human labour, and transportation [20]. Lack of knowledge in proper waste handling is also one of the factors of poor waste handling at home especially on recycling behaviour [21].

Respondents in this study exhibited a good level of

knowledge regarding waste management and health risk. This finding is consistent with a study among highland residents in Northern Thailand indicating that the majority respondents (73.4%) exhibited a high level of knowledge [22]. Similarly, a survey conducted by Badrum & Mapa [23] in Penampang, Sabah, revealed that 96.2% of respondents were well-informed about solid waste management (SWM).

As for the attitude, most respondents have a good attitude towards SWM. This finding is similar to a study conducted among youths in the Klang Valley [24], where 61.3% of respondents demonstrated a positive attitude towards waste management. Similarly, research by Shahzadi et al. [25] among individuals in the rural community of Lahore revealed a high level of positive attitude among 95% of the respondents.

In this study, a significant portion of respondents ($n = 112$, 53.3%) demonstrated a moderate level of practice, with a mean (SD) score of 3.03 (0.26). Additionally, 58 respondents (27.6%) exhibited poor practice, while 40 respondents (19%) demonstrated a commendable level of good practice. This finding is consistent with research conducted in Thailand, where a majority (59%) of respondents exhibited moderate practice in SWM [22]. Similarly, a study among university students in Malaysia conducted by Ahamad & Ariffin [26] reported a moderate practice rate of 49.2%, aligning with our findings.

Although the relatively high levels of knowledge and positive attitudes observed among respondents, the persistence of illegal dumping indicates that awareness alone may not necessarily translate into consistent waste management behaviour. In this study, the overall level of waste management practices was only moderate, suggesting a gap between environmental awareness and the actual implementation of proper waste disposal practices. Similar discrepancies have been reported in previous studies, where individuals demonstrate adequate knowledge of environmental issues but do not consistently adopt appropriate waste management behaviours in their daily routines [19,26]. Practical constraints such as limited access to waste disposal facilities, inconsistent waste collection services, weak enforcement of regulations, and convenience-driven disposal behaviour may contribute to the continued occurrence of illegal dumping in residential areas [5]. Therefore, improving public awareness alone may not be sufficient to address improper waste disposal without parallel improvements in infrastructure, enforcement, and community engagement.

A significant association was observed between the level of knowledge and the level of practice in solid waste management ($p < 0.001$), indicating that respondents with good knowledge consistently demonstrated good waste management practices. This finding suggests

that adequate understanding plays an important role in shaping appropriate waste handling behaviours among households. A study by Ahamad and Ariffin [26] also reported a significant association between knowledge and practice ($p < 0.05$), further supporting the link between increased knowledge and improved waste management behaviours. Effective waste management practices are essential for promoting sustainable development, as they can reduce the volume of solid waste generated and minimise adverse impacts on public health and the environment [26]. However, this finding is inconsistent with Syed Ismail et al. [27], which reported no significant association between knowledge and practice, indicating that possessing good knowledge alone does not necessarily translate into good waste management practices.

In addition, attitude and practice on solid waste management also were significantly associated in this study ($p < 0.05$), with more than half of respondents (58.7%) who reported a good attitude demonstrating moderate levels of practice, indicating that while positive perceptions may not always translate into optimal practices, they still influence behaviour. Comparable research in Northern Thailand found a statistically significant positive relationship between attitude and practice regarding municipal solid waste management, where residents with favourable attitudes also tended to show better waste management practices, supporting the general linkage between these variables [22]. Additionally, programmes that raise environmental awareness have been shown to enhance both attitudes and practices related to waste management; for example, environmental education and awareness initiatives were associated with improved understanding of waste minimisation, segregation, and environmental impacts, which in turn can lead to more responsible waste handling behaviours among community members [28-30]. These findings suggest that efforts to strengthen waste management practices should not only aim to improve attitudes but also incorporate sustained education and engagement initiatives to support behaviour change and promote effective solid waste management outcomes.

This study has several limitations that should be considered when interpreting the findings. The use of data based on the frequency of waste types collected provides only a general overview of solid waste management and does not allow for accurate estimation of the actual quantity of waste generated by households. In addition, most respondents among the 30 selected households were housewives, which may affect data reliability and limit representation of diverse household routines and behaviours, particularly those of working individuals. The study was also confined to Bukit Setongkol, Sungai Isap, and Taman Tas, which may not reflect waste management practices across the wider Kuantan population. Furthermore, the non-probability sampling method employed may introduce

selection bias and restrict the generalisability of the findings to the broader community. Lastly, the absence of household income classification limits the ability to assess variations in waste management practices across different socioeconomic groups. Future studies may further explore the relationship between knowledge, attitudes, and practices and sociodemographic characteristics such as education level, employment status, and housing type. Such analysis could provide deeper insights into demographic factors influencing household waste management behaviour and assist policymakers in designing more targeted waste management interventions.

CONCLUSION

This study found that residents in the selected rural communities of Kuantan possess good knowledge and positive attitudes towards solid waste management, yet these strengths are not consistently reflected in daily practices. The persistence of moderate and poor practices despite awareness of health risks and the 5R concept highlights a gap between understanding and behaviour. Addressing this gap requires interventions that focus on practical application rather than awareness alone.

At the community level, authorities should implement household waste segregation programs supported by accessible disposal and recycling facilities. Programs should be tailored to the needs of the local population, including clear guidance on handling specific waste types such as plastic, electronic waste, and expired medicines. Community participation mechanisms, such as resident-led monitoring groups or volunteer committees, can further encourage consistent adoption of proper practices. Targeted education campaigns emphasizing behaviour change, rather than knowledge alone, can reinforce these efforts and enhance the effectiveness of waste management initiatives.

From a policy perspective, the findings support the integration of behavioural, infrastructural, and community engagement components into municipal waste management strategies. Coordinated efforts among local councils, public health agencies, and community leaders are necessary to facilitate compliance, provide incentives, and strengthen enforcement. Pilot projects, such as source segregation trials or localized recycling schemes, can be evaluated before wider implementation. These measures can help translate awareness into sustained practice, improve waste management outcomes, and inform future interventions at both regional and national levels.

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