

3R Practices and Solid Waste Composition among High Income Residence in Desa Pinggiran Putra, Kajang, Malaysia

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ABSTRACT

Due to the exponential growth in the human population over the last few years, waste has been accumulating rapidly. To lessen the amount of waste disposed in landfills, it is crucial to understand the importance of waste separation and recycling. This study examines 3R practices and solid waste composition among high-income households in Fasa 1 Desa Pinggiran Putra, Kajang, Malaysia, involving 12 sampled residences. The primary waste component was food waste (44%), followed by others (14%), sanitary pads and diapers (14%), plastics (11%), paper (7%), glass (7%), and metal waste (3%). Within the high-income household group studied, variations in waste composition were observed, reflecting differences in consumption patterns and household practices. Despite the presence of recyclable materials in the waste stream, most households reported infrequent use of formal recycling centres, indicating limited participation in organised recycling activities. Effective waste segregation practices were observed in some households, influencing waste composition. Socioeconomic factors were found to influence waste management behaviours, highlighting differences in waste segregation practices among households. Bridging the gap

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between awareness and behavioural change in waste management, particularly in relation to socioeconomic influences, remains a key challenge for improving waste management strategies in Malaysia.

1. INTRODUCTION

The Malaysian Investment Development Authority (MIDA) reported that the population produces 38,427 metric tonnes of solid waste daily, with 82.50% of it being disposed to landfills [1]. The Solid Waste Management and Public Cleansing Corporation (SWCorp) reported that Malaysia's national recycling rate increased to around 37.5% in 2024, approaching the government's 40% recyclables diversion target for 2025, although it still trails the higher rates observed in developed nations [2]. Lower-income households produce less food waste with the greatest number of recyclable products in their bins compared to middle-income and higher-income households, which indicates that socioeconomic levels may impact their waste production rates [3, 4]. Malaysia's waste production is expected to reach 15 million tonnes by 2022, with a compound annual growth rate of nearly 2% [2, 5]. Recycling waste is an efficient method to reduce landfill waste, adopting and maintaining 3R practices and solid waste separation from a young age is crucial for efficient waste management [6, 7]. However, public awareness and inactive participation make it difficult to make these practices habit among residents [8].

In Malaysia, reliance on landfills prevails as a cost-effective and convenient approach for solid waste management. However, the majority of landfills in the country are categorized as open dumping sites, with limited availability of sanitary landfills. Consequently, the lifespan of landfills has significantly shortened and reached critical levels, largely attributed to the escalating generation of solid waste [9, 10]. Hence, effective waste management incorporating 3R practices and waste segregation stands pivotal in curbing waste disposal.

This study encompasses three primary objectives: quantifying the volume and composition of solid waste generated by high-income households, evaluating the proportion of solid waste destined for landfills, and assessing the socioeconomic impact on 3R practices within these residences. The study aims to explore the relationships between solid waste generation, 3R practices, and socioeconomic factors. Its findings seek to provide insights into the solid waste production rates among affluent residents in Desa Pinggiran Putra, Kajang, shedding light on their attitudes and adherence to 3R practices, thereby contributing to statistical data in this domain.

2. EXPERIMENTAL METHODOLOGY

2.1 Study Location

The location of the study was first identified as shown in Fig. 1. The GPS coordinate of the selected study location is 2.9072°N, 101.7089°E. specifically, the study location was located at *Fasa 1* of the residential area, Persiaran Desa Pinggiran Putra 1. This study area was purposively chosen due to its classification as a high-income residential area, based on observable housing characteristics such as the predominance of semi-detached and bungalow-type houses, gated neighborhood layouts, and relatively large residential lot sizes. These physical and structural features are commonly associated with higher-income residential areas in suburban Malaysia. Therefore, the area was considered suitable for examining waste generation patterns and 3R practices among high-income households. Household income information was further obtained through the questionnaire survey to ensure that the selected households met the high-income criteria defined in this study.



Fig. 1. Location of study area at Desa Pinggiran Putra 1, Putrajaya

2.2 Solid Waste Collection

Residents from 12 selected households participated in the solid waste collection exercise. Each participating household was provided with plastic bags to segregate their solid waste during the collection period. Over a span of 7 consecutive days, the collected waste was measured daily using a mechanical kitchen weighing scale. The gathered solid waste was categorised based on its composition, following established methods reported in previous studies [11, 12]. Subsequently, the waste was sorted according to the categories outlined in Table 1. The weights of each waste category were recorded to determine the percentage of solid waste generated and the proportion of waste potentially disposed of at landfills.

Table 1. Solid Waste Category [9, 13]

Solid Waste Category	Description
Food Waste	Kitchen waste such as rice, vegetable and fruit peelings, eggshells, leftovers, tea or coffee bag, etc.
Plastic	Low-density polyethylene such as plastics bags, clear food containers, disposable packaging, etc. High-Density polyethylene such as thicker plastic bottles, toys, piping for water, etc. Polyethylene terephthalate such as food and beverage packaging
Paper	Books, newspaper, cardboards
Glass	Jars, medicine bottles, broken glass, sauce bottles
Metal	Aluminium cans, broken construction steel rods, old utensils
Others	Sanitary pads, diapers, batteries, textile, woods, gardening waste

The number of households was determined using purposive sampling, focusing on high-income residences that consented to participate in detailed daily waste collection. Due to the labour-intensive nature of household-level waste sorting and weighing, a relatively small sample size was adopted, consistent with similar exploratory solid waste composition studies. This approach allows for in-depth characterisation of waste composition while ensuring data accuracy and participant compliance.

2.3 Questionnaire and Demographic Information

A structured questionnaire was used as one of the primary data collection instruments in this study. The questionnaire consisted of two main components. Section A focused on sociodemographic information, including respondents' gender, age, education level, household income, and household size. These variables were included to characterise the background of the respondents and to support the assessment of socioeconomic influences on waste separation and 3R practices, as reported in previous studies [14, 15].

Sections B to E assessed household waste separation behaviour and 3R practices, covering aspects such as waste separation at source, waste reduction, reuse, recycling behaviour, attitudes towards 3R practices, and perceived social influence. All items were measured using a 5-point Likert scale ranging from 1 (Never) to 5 (Very Often). The questionnaire design allowed for the evaluation of both behavioural and perceptual factors influencing household solid waste management among high-income residents, thereby supporting the objectives of the study.

2.4 Waste Separation and 3R Practices

Waste separation and 3R practices are highly affected by psychological factors such as waste separation, recycling behaviours, attitudes, subjective norms, and perception towards waste separation and

the importance of 3R practices [15, 16]. These factors were important as they determined how it affected the residents' willingness to separate their waste and practice. The lack of knowledge and information about waste separation, such as the drawbacks of managing waste without separation, the potential advantages of waste separation, how to conduct waste separation, and which types of waste can be recycled, may be the reason why residents are unwilling or reluctant to separate waste in their daily lives [16, 17].

2.5 Data Analysis

For solid waste composition analysis, the collected waste was weighed according to its respective categories, and the percentage composition was calculated using Eq. (1) for each category [18].

$$\text{Percentage} = \frac{\text{Weight of Waste (by category)}}{\text{Total weight of solid waste produced}} \times 100\% \quad (1)$$

The waste generated by each household was recorded daily over a period of seven days, and the total waste produced during the sampling period was calculated using Eq. (2).

$$\text{Total Waste} = \Sigma \text{Weight of waste produced from day 1 until day 7} \quad (2)$$

The proportion of solid waste potentially disposed of at landfills was then estimated using Eq. (3).

$$\text{Percentage} = \text{Total Waste} \times 100\% \quad (3)$$

To examine the relationship between solid waste generation, 3R practices, and socioeconomic factors, a descriptive and exploratory analysis approach was adopted. Waste composition data were compared with respondents' sociodemographic characteristics and self-reported 3R practices obtained from the questionnaire. Associations were examined through comparative analysis and visual interpretation using bar charts and pie charts, rather than inferential statistical correlation tests, due to the limited sample size and the exploratory nature of the study.

3. RESULTS AND DISCUSSION

3.1 Solid Waste Collection

The data collection in Fasa 1 Desa Pinggiran Putra involved a sample of 12 houses. The highest waste composition was food waste at 44%, followed by others at 14%, sanitary pads & diapers at 14%, plastics at 11%, paper at 7%, glass at 7%, and metal waste at 3% as shown in Fig. 2.

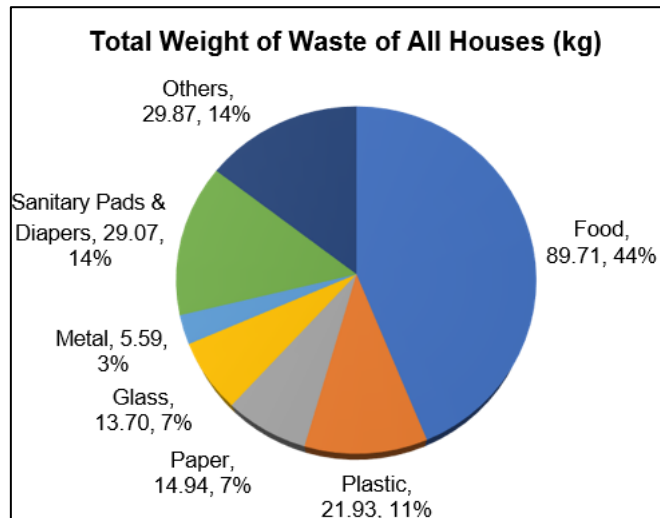


Fig. 2: Total weight of waste (kg) according to waste composition of 12 houses for 7 days

As income levels increase, variations in waste composition may occur, as higher-income households tend to consume a wider range of goods, leading to increased waste generation [19, 20]. Sanitary pads and diapers, as well as miscellaneous waste, were found to be the second highest waste components, which may be associated with lifestyle factors such as pet ownership and home gardening activities commonly observed among high-income households. Although recyclable materials such as plastic, paper, glass, and metal were present in the waste stream, this suggests that recycling practices were not consistently applied [8, 21]. Several households reported that recyclable materials were occasionally stored and transported to the Putrajaya recycling centre, which serves as the designated recycling facility for surrounding residential areas, including Desa Pinggiran Putra. However, the frequency of such practices was limited, resulting in recyclable materials still being disposed of as part of general household waste [4, 22].

Some households separated their waste into 2 or more plastic bags according to food waste, recyclable materials, sanitary waste, and other waste (cat litter, garden waste). Houses that generated miscellaneous combustibles and inert waste, such as cat litter, contributed to the higher percentage of "others, and sanitary pads & diapers" waste composition. Although the data indicate that higher-income households may tend to generate more diverse and larger quantities of waste, these findings should be interpreted as indicative rather than conclusive. The observed trend aligns with prior research suggesting that income levels influence consumption behaviour and waste output [23, 24]. However, given the small dataset, statistical validation was beyond the scope of this exploratory study.

3.2 Solid Waste Disposed at Landfills

The average percentage of waste produced was similar to Fig. 2, as shown in Fig. 3. Malaysia generally lacks knowledge and awareness about alternative method of food waste management, such as composting or bio-valorization using Black Soldier Fly (BSF) larvae contributes to a significant portion of organic waste being sent directly to landfills [25].

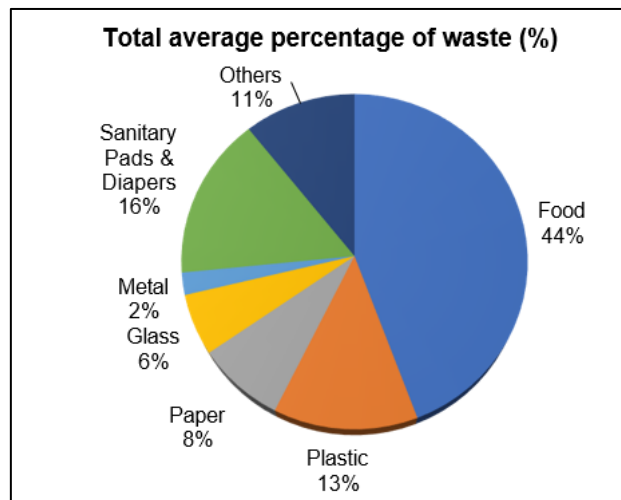


Fig. 3. Total average percentage of waste according to composition of all houses

Composting reduces the production of food waste and lowers the volume and amount of solid waste disposed at landfills [26]. Recycling recyclable materials can also help reduce waste volume and extend landfill lifespan. The large amount of food waste poses environmental issues, as the organic portion of solid waste results in leachate [3, 27]. Determining the composition of solid waste is crucial to limit waste transported to landfills. Minimizing waste sent to landfills can increase their lifespans, improve public health, conserve energy, and boost Malaysia's economy [28, 29]. Research in East Coast Malaysia shows little difference between individuals who segregate their waste and those who do not, suggesting that waste segregation practices should be implemented [22].

3.3 Socioeconomic Impact on 3R Practices

This study examines the influence of demographic and background factors on respondents' practices, perspectives, and attitudes towards household waste management. Observable differences in awareness and engagement in waste separation and recycling activities were noted across age groups, household characteristics, and educational levels. Fig. 4 shows that the largest proportion of respondents belonged to the 40–49 age group. Older respondents generally demonstrated lower awareness and engagement in waste separation and recycling activities compared to younger respondents, consistent with previous findings [4, 22, 30]. Educational background showed no clear pattern of influence on the effectiveness of solid waste management practices (Fig. 5). For instance, a male respondent with a PhD in the 60–69 age group did not practise waste separation at source or 3R practices at home. The data also indicated that respondents with lower levels of education were, in some cases, more inclined to segregate their waste compared to those with higher educational attainment, a trend similarly reported in earlier studies [4, 15, 18].

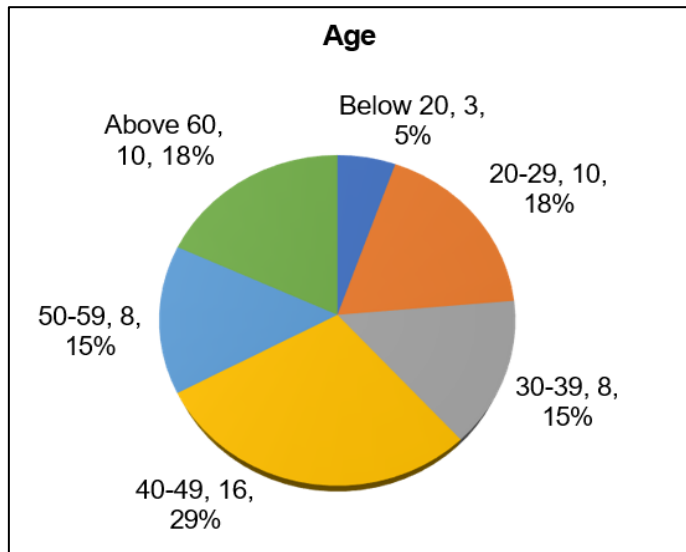


Fig.4. Respondents' age percentage involved in the survey

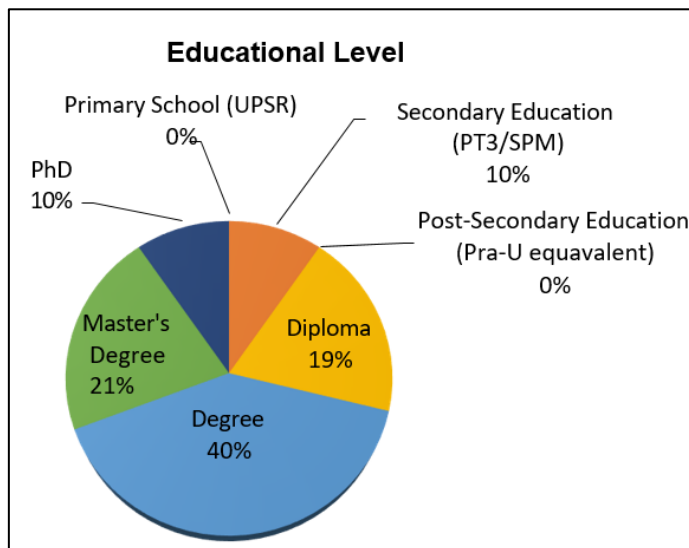


Fig. 5. Respondents' educational level percentage involved in the survey

The respondents' levels of engagement in various solid waste management and 3R practices is shown in Fig. 6. Overall, the findings indicate that respondents were more likely to practice waste reduction and simple reuse behaviours compared to recycling-related activities that require greater effort or external support. Practices related to waste reduction showed the highest levels of positive engagement. In particular, buying only what is needed to reduce food waste recorded a very high proportion of "Good" responses. Similarly, avoiding disposable food containers and using reusable products were commonly practised. These behaviours are closely linked to daily household routines and are often associated with

cost savings and convenience, making them easier to adopt consistently [4]. This suggests that respondents are more willing to engage in waste management practices that offer immediate personal benefits and require minimal behavioural change [31].

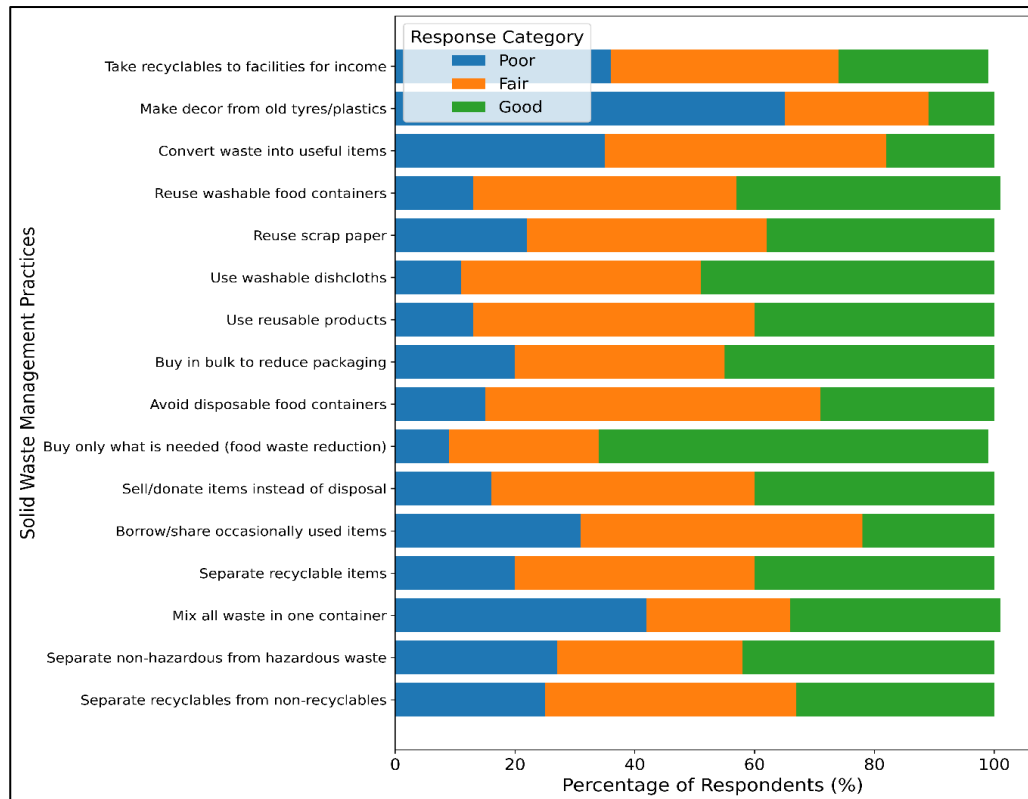


Fig. 6. Distribution of respondents' solid waste management and 3R practices based on a 5-point Likert scale, categorised as Poor (Never/Rare), Fair (Sometimes), and Good (Often/Very Often). Values represent the percentage of respondents (n = 55)

Reuse-related practices also demonstrated relatively strong participation. High levels of “Good” responses were observed for reusing washable food containers, using washable dishcloths instead of tissues, and reusing scrap paper. These practices require limited additional effort and are perceived as practical extensions of existing household habits. However, reuse activities that demand creativity or additional time investment, such as converting waste materials into useful items or making decorative products from old tyres and plastics, recorded a high proportion of “Poor” responses. This indicates that while respondents may support reuse conceptually, practical constraints such as time, skills, and perceived usefulness limit the adoption of such practices [8, 23].

In contrast, recycling-related practices exhibited lower and more inconsistent engagement. Although basic waste separation practices were reported, many respondents fell within the “Fair” category, indicating irregular or occasional practice. More demanding recycling behaviours, such as transporting recyclable materials to recycling facilities for income, showed a high proportion of “Poor” responses. This

finding highlights the presence of structural and behavioural barriers, including accessibility of recycling facilities, time constraints, and limited incentives, which may discourage consistent recycling behaviour even among high-income households [23, 32]. The respondents' recycling behaviour, attitudes towards 3R practices, and the influence of subjective norms is shown in Fig. 7. Overall, the findings indicate that positive attitudes towards 3R practices are more prevalent than actual recycling behaviour, highlighting a gap between awareness and practice. This observation is consistent with previous studies that suggest that motivation, moral responsibility, personal opinions, and socioeconomic characteristics influence household waste management behaviour [22].

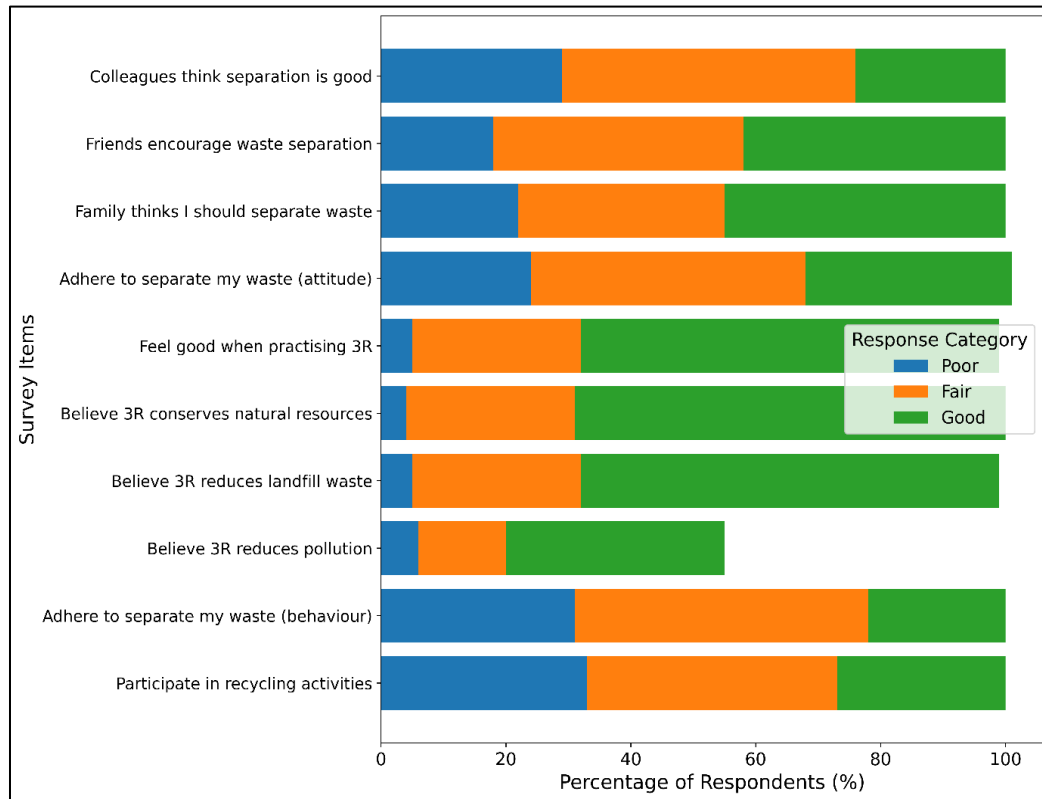


Fig. 7. Distribution of respondents' recycling behaviour, attitudes towards 3R practices, and subjective norms based on a 5-point Likert scale, categorised as Poor (Never/Rare), Fair (Sometimes), and Good (Often/Very Often). Values represent the percentage of respondents (n = 55)

In terms of recycling behaviour, a relatively small proportion of respondents demonstrated consistent engagement. As shown in Fig. 7, participation in recycling activities and adherence to waste separation at the behavioural level recorded a higher proportion of "Poor" and "Fair" responses compared to "Good". This indicates that although respondents are aware of recycling practices, many do not practise them regularly. Such findings suggest that practical constraints, including effort required, time availability, and accessibility to recycling facilities, may limit consistent recycling behaviour at the household level [14, 24]. Conversely, respondents exhibited strongly positive attitudes towards 3R practices. A high proportion of "Good" responses was observed for attitude-related items, including beliefs that 3R practices reduce pollution, reduce waste sent to landfills, conserve natural resources, and generate positive feelings

when practised. These results indicate that respondents largely recognise the environmental and personal benefits of 3R practices. However, the contrast between positive attitudes and lower behavioural engagement reinforces the presence of an attitude–behaviour gap, where favourable perceptions do not necessarily translate into sustained recycling actions [14, 15, 16].

The influence of subjective norms was also evident in Fig. 7. Support for waste separation was most strongly perceived from family members, followed by friends, while colleagues exerted comparatively less influence. This pattern suggests that close social relationships play a more important role in shaping household waste management behaviour than workplace or external social networks. Previous studies have highlighted that social pressure, cultural norms, and group beliefs can influence individuals' willingness to practise waste separation [14, 16, 23, 24]. When combined with positive personal attitudes, supportive subjective norms may further strengthen intentions to engage in recycling activities [9, 16, 21, 33].

3.4 Solid Waste Composition and Awareness

According to the present survey, the majority of residents who took part in the collection of waste consisted of food waste, sanitary products like pads and diapers, and miscellaneous waste. The remaining components were recyclables such as plastic, paper, glass, and metals. According to the surveys, respondents did have a reasonable amount of knowledge about waste separation and 3R practices. Taking into consideration respondents' awareness on waste separation and 3R practices and solid waste generated, it was observed that some participants had high knowledge in waste separation and applied in their daily life [34]. However more than half of the participants were not practicing waste separation and 3R practices although they are aware on the method and the advantages of managing waste properly. The study's findings are comparable to those of several earlier studies carried out in Putrajaya and Zimbabwe. However, both studies indicate that respondents' knowledge levels ranged from moderate to high but did not correspond to their behaviour while managing their solid waste [8, 24, 32].

4. CONCLUSIONS

This study examined solid waste generation, composition, and 3R practices among high-income households in Desa Pinggiran Putra, Kajang. The findings indicate that food waste is the dominant component of household solid waste, highlighting organic waste as the primary contributor to landfill disposal in the study area. Although recyclable materials such as plastic, paper, glass, and metal were present in the waste stream, a considerable proportion of these materials was still disposed of together with general waste, indicating untapped potential for improved waste segregation and recycling. The study further showed that waste reduction and reuse practices were more consistently adopted than recycling behaviours. While respondents generally demonstrated good awareness and positive attitudes towards 3R principles, this awareness did not fully translate into consistent recycling practices. This reflects a clear gap between knowledge and behaviour, particularly for recycling activities that require additional effort, time, or access to external facilities. Socioeconomic and behavioural factors, including lifestyle convenience and perceived effort, were found to influence household waste management practices even among high-income households. Conclusively, the findings suggest that improving household waste management requires more than awareness campaigns alone. Supportive infrastructure, accessible recycling

facilities, and targeted behavioural interventions are needed to encourage sustained participation in recycling activities. This study acknowledges that the limited sample size may restrict the representativeness of the findings. Future research should involve larger samples and explore food waste reduction strategies such as composting or bio-valorisation to support more sustainable waste management practices in Malaysia.

5. ACKNOWLEDGMENTS/FUNDING

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6. CONFLICT OF INTEREST STATEMENT

The authors declare that there are no conflicts of interest regarding the publication of this paper.

7. AUTHORS' CONTRIBUTIONS

Conceptualization, Formal Analysis and Supervision: Dzulaikha Khairuddin; Methodology: Nur Nabihah Azmi Azrin and Juliana Martin; Validation and Writing, Review & Editing: Dzulaikha Khairuddin and Juliana Martin; Investigation and Writing Original Draft Preparation: Nur Nabihah Azmi Azrin; Resources and Data Curation and Visualization: Dzulaikha Khairuddin and Nur Nabihah Azmi Azrin. All authors have read and agreed to the published version of the manuscript.

8. DECLARATION OF GENERATIVE AI IN THE WRITING PROCESS

During the preparation of this manuscript, the authors used ChatGPT (OpenAI) to assist with language refinement, grammar correction, and improvement of sentence clarity. After using this tool, the authors carefully reviewed and edited the content as necessary and take full responsibility for the final content of the publication.

9. DATA AVAILABILITY/SUPPLEMENTARY MATERIALS

All data generated or analysed during this study are included in this published article and its supplementary information files. To ensure transparency and reproducibility, detailed experimental procedures and supporting information are provided within the manuscript. No additional datasets were generated beyond those reported in this article.

10. ETHICS STATEMENT

This study was conducted in accordance with established ethical research standards. Informed consent was obtained from all participants prior to data collection. Participation was voluntary, and respondents were assured of confidentiality and anonymity. The data collected were used solely for academic purposes.

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