



INFLUENCE OF FOOD-RELATED ROUTINES ON FOOD WASTE BEHAVIOUR AMONG HOUSEHOLDS IN KUALA LUMPUR

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ABSTRACT

Food-related routines are integral parts of daily household activities, but can lead to the production of food waste. This study aims to investigate the relationship between food-related routines and food waste behaviour among households in Kuala Lumpur, Malaysia. A total of 302 households, comprising low-, medium- and high-income households, responded to the online questionnaire. The findings indicate that households rarely discard food. Meanwhile, Food Purchase Behaviour (FPB) in-store was the only food-related routine activity that correlated with household food waste and was the sole predictor of household food waste behaviour. However, when categorised according to income groups, FPB showed a significant correlation for food waste among low-income households. This study offers a novel contribution by positioning food waste as an outcome of everyday household routines rather than just individual behaviours. The income-stratified analysis approach employed in this study revealed that the relationship between food-related routines and waste varies across income groups within the same urban context. Thus, relevant bodies should conduct income-specific food waste reduction programmes tailored to each income group's specific challenges. Additionally, future studies can be conducted to investigate how community-based food-sharing networks can be implemented to minimise food waste, regardless of income group.

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Introduction

Waste management is intricately linked to the economy and lifestyle of a population. Generally, solid waste can be categorised into three main types: Municipal waste, hazardous waste, and industrial waste. Municipal Solid Waste (MSW) encompasses waste from residential areas, commercial spaces, and public areas such as streets, parks and playgrounds. MSW includes various categories, such as food waste, plastics, paper, cardboard, textiles, metals, diapers and more. Hazardous waste, on the other hand, poses significant immediate or long-term risks to human, plant and animal life. Some household

waste items, like unused medicines, solvents, paints and batteries, fall into the hazardous category (Environmental Protection Agency, 2016). Lastly, industrial waste originates from industrial processes other than mining (Jaafar *et al.*, 2018).

The rapid economic development and population growth in Malaysia, combined with insufficient infrastructure and limited land availability have made the management of municipal solid waste a pressing environmental concern (Abd Manaf *et al.*, 2009). According to the United States Environmental Protection

Agency (EPA, 2016), MSW — also known as trash or garbage — comprises everyday items that are disposed of after use. Alarminglly, a 2023 report by the United Nations Environment Programme (UNEP) (2024) revealed that Malaysians waste approximately 8.3 million metric tonnes of food annually, with everyone contributing an average of 259.82 kg to this total (Nizam, 2023). Mohd Pauze Taha, Chief Executive Officer (CEO) of the Solid Waste Corporation of Malaysia (SWCorp), noted that Malaysians discard around 39,078 tonnes of solid waste daily, with food making up the largest portion of household waste, accounting for about 30.6% (Choo, 2024). According to Yang *et al.* (2016), the amount of food wasted by Malaysians daily is higher than that of other countries in Southeast Asia by almost 33% and is sufficient to feed 12 million people.

Several factors and sources contribute to food waste in Malaysia. As illustrated in Table 1, households account for over 30% of the total food waste in the country (Jereme *et al.*, 2016). Bong *et al.* (2017) found that, on average, Malaysian households discard between 0.5 and 0.8 kg of uneaten food daily. Furthermore, the International Institute for Management Development (IMD) World Competitiveness

Yearbook (WCY) 2025 reported that Malaysia generated approximately 210 kg of food waste per capita annually (IMD, 2025). Despite uncertainty regarding the specific indicator used to measure per capita food waste, the report nevertheless positions Malaysia among the higher waste-generating countries (IMD, 2025). This figure encompasses waste from household, food service, and retail sectors. This issue is expected to persist over the coming years, in parallel with economic growth and urbanisation, as Malaysia’s population is projected to reach 37.4 million by 2030. Moreover, food waste in Malaysia has been rising annually, with the amount having doubled in recent years (Sulaiman & Ahmad, 2018). This situation is increasingly worrisome for the nation, as it not only involves the waste of edible food but also impacts the country’s economic development.

Several explanations and factors contribute to food waste, along with certain behaviours that exacerbate it. The Theory of Planned Behaviour (TPB) is used in many studies related to the perception of the consumer and the way of conduct concerning food waste (Chan *et al.*, 2023; Chun T’ing *et al.*, 2021). TPB explains that behavioural intention (i.e., willingness to behave in a certain way) is the main cause of

Table 1: Food waste generated in Malaysia

Estimated Food Waste Generated in Malaysia		Generation Rate	
Sources of Food	(Tonnes/day)	(Tonnes/year)	Percent (%)
Households	8,745	3,192,404	38.23
Wet and night markets	5,592	2,040,929	24.50
Food courts/restaurants	5,319	1,941,608	23.35
Hotels	1,568	572,284	6.87
Food and beverages industries	854	311,564	3.41
Shopping malls	298	108,678	1.30
Hypermarkets	291	106,288	1.28
Institutions	55	26,962	0.32
Schools	45	21,808	0.30
Fast food/chain shops	2521	808	0.26
Total	22,793	8,331,589	100

Source: Jereme *et al.* (2016)

the behaviour that leads to food waste (Ajzen, 1991; Aschemann-Witzel *et al.*, 2015). TPB, as proposed by Ajzen (1991), indicated that attitudes, subjective norms, and perceived behavioural control could predict intentions. Meanwhile, subjective norm refers to what is viewed as endorsed or objected to conduct in a particular circumstance. Moreover, perceived behavioural control relates to the degree to which consumers think decreasing food waste is within their domination (Tahir, 2023).

Unfortunately, consumers often remain unaware of the primary reasons for their food waste, as they become engrossed in daily routines (Wahlen, 2011; Stefan *et al.*, 2013; Stancu *et al.*, 2016; Wahlen & Winkel, 2016). Poor planning for shopping (Stefan *et al.*, 2013; Parizeau *et al.*, 2015), food storage (Schanes *et al.*, 2018), cooking (Shaw, 2021), and managing leftovers (Li *et al.*, 2023) often lead to increased food waste. Households of five in Malaysia spend an average of RM900.00 monthly on food, with about a quarter of it wasted during preparation, cooking and consumption. Unfortunately, this wasteful behaviour occurs across all socioeconomic brackets (Roodhuyzen *et al.*, 2017). Davenport *et al.* (2019) identified food-related routines as primary drivers of food waste at the household level. Examples include in-store purchasing behaviours, over-cooking, poor household management practices like inadequate food planning and storage issues, and various psycho-social factors such as personal choices, lifestyles, eating habits and lack of cooking skills (Dalilawati & Hassan, 2019; Janssens *et al.*, 2019).

Van de Werf *et al.* (2021) highlighted how families tend to keep stocks of food but later discard the unconsumed food. Additionally, poor knowledge and practices related to food storage resulted in food waste (Zahara *et al.*, 2021; Romani *et al.*, 2018). This is because at-home food supply is closely related to food purchase planning behaviour (O'Neill *et al.*, 2023) and food purchase behaviour (Aydin & Yildirim, 2021). Nevertheless, these behaviours have been shown to be associated with food waste (Ong *et al.*, 2023; Kymäläinen *et al.*,

2021). Moreover, cooking activities can also contribute to food being wasted. The amount of food cooked (Kymäläinen *et al.*, 2021), its quality (Karunasena *et al.*, 2021), and presentation (Richardson *et al.*, 2021) can influence the amount of food wasted; hence, it is important for the cook to properly plan their food preparation (Secondi *et al.*, 2015; Roe *et al.*, 2022). Therefore, the cook must have prior knowledge of reusing or repurposing leftovers to avoid discarding them (Knorr & Augustin, 2024). Consuming leftovers has been reported to reduce the amount of food wasted (Stancu *et al.*, 2016; Diekmann & Germelmann, 2021).

Additionally, research has shown that the amount of household food waste is influenced by factors such as household composition and size (van der Werf *et al.*, 2021), income level (Diana *et al.*, 2024), and cultural background (Smith & Landry, 2021). Income disparities also play a role, with higher food waste levels typically seen in urban areas compared to rural areas (Jereme *et al.*, 2016). Approximately 90% of people in low-income groups prefer purchasing less expensive food from cheaper locations (Yong & Norhasmah, 2016) and often buy discounted items at supermarkets (Aschemann-Witzel *et al.*, 2017; 2018). These discounted foods, however, are often close to their expiration dates or have minor quality defects (Roodhuyzen *et al.*, 2017; Aschemann-Witzel *et al.*, 2018). As a result, while supermarkets reduce waste by selling these items, households may end up with more waste at home (Aschemann-Witzel *et al.*, 2017, 2018; Rodgers *et al.*, 2021).

Food expenditure and income influence the amount of food waste (Diana *et al.*, 2024). This statement supports a past study by Badgie *et al.* (2011), who reported that the high-income groups waste an average of 30.84% of their food, middle-income groups waste 38.42%, and, surprisingly, low-income groups waste 54.04%. In other studies, high-income households tend to generate more avoidable food waste (Heng & House, 2022; Seng *et al.*, 2021) due to purchasing behaviour (van der Werf *et al.*, 2021; Campbell & Feldpausch, 2022), lifestyle preferences (Ananda *et al.*,

2022) and lower sensitivity to food costs (van der Werf *et al.*, 2021). In Malaysia, household income groups are categorised by the Malaysian Department of Statistics (DOSM, 2019). These categorisations are based on monthly household income levels, where households are categorised into B40 (bottom 40% income earners), M40 (middle 40%), and T20 (top 20%). According to the DOSM (2019), the low-income group (B40) comprised households earning less than RM3,860.00 per month, while the middle-income group (M40) earned between RM3,860.00 and RM8,319.00, and the high-income group (T20) earned above RM8,319.00. However, in addition to income level, other factors also play a significant role in influencing food waste generation within a household.

Studies similarly show that household size and composition (Edjabou *et al.*, 2016; Olowa & Olowa, 2017; Di Talia *et al.*, 2019; van der Werf *et al.*, 2021), age and culture (Olowa & Olowa, 2017; Di Talia *et al.*, 2019; Smith & Landry, 2021) are determinants of household food waste. Although the relationships between these factors and household solid waste have been explored internationally, they have received limited attention regarding food waste in Malaysian households. Given the aforementioned issues, it is crucial to conduct this study across households of varying socioeconomic backgrounds.

Therefore, this study aims to investigate the relationship between food-related routines and the household food waste behaviour. In addition, the study will examine the influence of income group towards household food waste behaviour. The findings will enable relevant stakeholders to promote more effective food waste awareness campaigns in Malaysia, particularly within the Klang Valley. Figure 1 illustrates the conceptual framework of the study.

Materials and Methods

This study employs a cross-sectional quantitative method through the cause-and-effect relationship study to determine the causality. Information was gathered from individuals aged 18 years and older who are responsible for providing food and other living essentials for their households.

Kuala Lumpur is a significant urban agglomeration with a population of approximately 350,000 households. The approximation of the number of households was based on a total population of 1.4 million and an average household size of four members per household. Accordingly, the minimum sample size needed was 92, calculated using G*Power 3.1.9.7 with an effect size of 0.15, a power of 0.80, an alpha error probability (α) of 0.05, and five predictors.

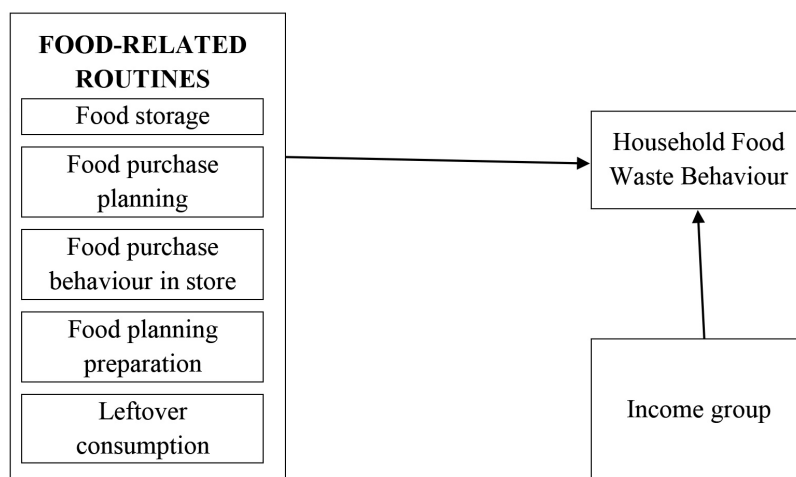


Figure 1: Conceptual framework
Source: Janssen *et al.* (2019)

An online questionnaire was adapted from past studies (Stefan *et al.*, 2013; Stancu *et al.*, 2016; Romani *et al.*, 2018; Schanes *et al.*, 2018) and was prepared in two languages, Malay and English, so that the respondents could fully understand the questionnaire. Additionally, the online survey was designed to permit only one submission per device to mitigate the likelihood of duplicate results. Compulsory fields ensured that participants completed all essential items prior to submission. Moreover, screening questions were incorporated at the beginning of the survey to confirm respondents' eligibility based on residential location.

A 5-point rating scale was used to gather respondents' responses related to their food-related routines and household food waste items. The food-related routine variable comprised five subvariables, namely food storage, food purchasing planning, in-store food purchase behaviour, food planning preparation, and leftover consumption. In this study, "food purchasing" is defined as the act of buying food items that can be influenced by price, availability and quality (Aschemann-Witzel *et al.*, 2017). Meanwhile, "food purchase behaviour" is defined as motivations, attitudes and patterns associated with the act of buying food (Aschemann-Witzel *et al.*, 2018).

All subvariables of the food-related routine response scale, ranging from "never" (Scale 1) to "always" (Scale 5), and "not at all" (Scale 1) to "more than half" (Scale 5), were used to determine the household food waste. The scale to measure household food waste was based on the respondent's reporting from Scale 1 (not at all) to Scale 5 (more than half) for the following food categories: Fresh fruits, vegetables, dairy products, meat, fish, bread and bakery, and can and tin products. Meanwhile, responses for reasons for food waste were either "yes" or "no" (dichotomous responses).

Before actual data collection, a pilot study involving 48 households at three locations in Selangor, namely Damansara, Shah Alam and

Sungai Buloh was conducted. The selection of locations was to ensure that respondents from three different income groups were involved. The number of respondents was proportionally divided into three income groups, with approximately 20% from low- and medium-income groups, respectively and another 10% from the high-income group category. Only eligible respondents were invited to respond to the questionnaire. The pilot study revealed that the questionnaire was valid and reliable, with an overall Cronbach's alpha value of 0.837, while each variable had a Cronbach's alpha value between 0.741 and 0.899 (Sekaran & Bougie, 2003).

Next, a stratified random sampling was used to divide the households into smaller subgroups known as strata. This sampling allows researchers to obtain a sample population that best represents all major income groups, specifically B40, M40, and T20, within Kuala Lumpur. Meanwhile, categorisation of residential areas in Kuala Lumpur is classified according to housing types, property values and socioeconomic profiles.

While the areas were delineated through stratified sampling, participants within these regions were recruited via online platforms using convenience sampling. Invitations were distributed through community WhatsApp groups and social media (such as Facebook and Instagram) for each residential area. The data was collected between August 2022 and December 2022. Completed data were then transferred to International Business Machines Statistical Package for the Social Sciences (IBM SPSS) software version 26 (SPSS Inc.) for data cleaning, followed by data analyses, in which descriptive analysis, Pearson Correlation analysis and one-way ANOVA were performed. During data cleaning, some negative worded statements were re-coded into positive statements.

While this method facilitated rapid and wide distribution among internet users, it may

have inadvertently excluded participation from individuals without regular internet access, such as older adults and low-income households. As a result, there is a potential for sampling bias, which may affect the generalisability of the findings. It is, therefore, recommended that future research incorporate alternative distribution methods, such as telephone or in-person surveys.

Results and Discussions

A total of 302 responses were gathered, which is approximately 220% more than the minimal sample size ($n = 92$). Table 2 summarises the background of the respondents. The largest cohort of the respondents were female (76.8%), Malay (94.7%), between 21 and 30 years old (50.3%), with a first-degree qualification (56%), and were single-person households (31.5%).

Table 2: Characteristics of the respondents ($n = 302$)

Respondents' Profile	n	%
Gender		
Female	232	76.8
Male	70	23.2
Race		
Malay	286	94.7
Chinese	5	1.7
Indian	3	1.0
Others	8	2.6
Age (years)		
< 21	45	14.9
21 to 30	152	50.3
31 to 40	77	25.5
41 to 50	12	4.0
51 to 60	6	2.0
> 60	10	3.3
Level of education		
Secondary school	26	8.6
Diploma	85	28.1
Degree	169	56.0
Master	18	6.0
PhD	4	1.3
Household income		
RM 3,860.00 and less	183	60.5
RM 3,861.00 to RM 8,319.00	77	25.5
More than RM 8,319.00	42	13.9
Household size		
Single person household	95	31.5
Households without kids	31	10.3
Household with 1 to 2 children	58	19.2
Household with 3 to 4 children	74	24.6
Households with five or more children	44	14.6

Descriptive Analysis for Food-related Routines

Table 3 summarises the mean and Standard Deviation (SD) for five subvariables of food-related routines for households in Kuala Lumpur, and also according to income groups. As shown in Table 3, households in Kuala

Lumpur had the lowest mean score for food purchase behaviour in-store (FPB) (3.111 ± 0.659), while food storage had the highest mean score (3.616 ± 0.607). However, when the food-related routines were categorised according to

Table 3: Mean and Standard Deviation (SD) of food-related routine subvariables for households and according to income group

Subvariable	Item Code*	Low-income (n = 183)		Medium-income (n = 77)		High-income (n = 42)		Overall (n = 302)	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
Food Storage (FS)	FS1	3.574	0.886	3.675	0.850	3.452	0.889	3.583	0.877
	FS2	3.842	0.962	3.961	0.768	3.643	1.144	3.844	0.947
	FS3	3.459	1.026	3.740	0.849	3.286	1.154	3.507	1.011
	FS4	3.120	1.057	3.390	0.975	3.167	0.935	3.195	1.024
	FS5	4.038	0.957	3.922	0.914	3.857	1.117	3.983	0.970
	FS6	3.590	0.990	3.662	0.837	3.429	0.966	3.586	0.949
Mean FS		3.604	0.619	3.725	0.495	3.472	0.712	3.616	0.607
Food Purchasing Planning (FP)	FP1	3.470	1.098	3.623	1.077	3.786	1.298	3.553	1.125
	FP2	3.725	1.003	3.792	0.894	4.024	0.924	3.784	0.968
	FP3	2.596	0.984	2.909	0.934	3.071	0.997	2.742	0.988
	FP4	4.049	1.012	4.130	0.923	4.024	1.047	4.066	0.993
	FP5	3.650	0.901	3.584	0.864	3.405	0.964	3.599	0.901
Mean FP		3.497	0.570	3.608	0.496	3.662	0.686	3.548	0.572
Food Purchase Behaviour In- store (FPB)	FPB1	2.771	0.933	2.805	0.974	3.119	1.109	2.828	0.973
	FPB2	3.120	0.912	3.247	0.920	3.238	0.878	3.169	0.908
	FPB3	3.317	0.913	3.312	0.950	3.286	0.864	3.311	0.913
	FPB4	2.907	1.057	2.948	0.930	3.024	1.047	2.934	1.022
	FPB5	3.268	1.109	3.429	1.141	3.286	1.132	3.311	1.119
Mean FPB		3.077	0.645	3.148	0.676	3.191	0.691	3.111	0.659
Food Planning Preparation (FPP)	FPP1	2.847	1.073	3.130	1.116	2.929	1.068	2.931	1.087
	FPP2	2.596	1.119	2.870	1.207	2.738	1.083	2.685	1.140
	FPP3	3.497	1.048	3.584	0.965	3.714	0.995	3.550	1.019
	FPP4	3.508	1.048	3.896	0.836	3.691	0.897	3.633	0.989
	FPP5	3.377	1.072	3.753	1.015	3.405	1.251	3.477	1.093
Mean FPP		3.165	0.710	3.447	0.661	3.295	0.636	3.255	0.696
Leftover Consumption (LoC)	LC1	3.514	0.882	3.429	0.802	3.643	1.078	3.510	0.892
	LC2	3.995	0.795	4.039	0.733	4.095	0.878	4.020	0.790
	LC3	3.262	0.948	3.338	0.788	3.048	0.987	3.252	0.917
	LC4	3.022	0.883	3.195	0.844	3.143	0.926	3.083	0.880
	LC5	3.301	0.956	3.364	0.887	3.500	1.018	3.344	0.947
Mean LoC		3.419	0.471	3.473	0.463	3.486	0.530	3.442	0.477

*Note: The explanation for each code is in the Appendix

income groups, the low-income group showed lower overall mean scores for all five food-related routines compared to the overall mean score for households in Kuala Lumpur. The low- and medium-income groups exhibited similar patterns to the overall households studied, whereas the high-income group did not. The high-income group had the lowest mean score (3.286 ± 1.132) for FPB but had the highest mean score (3.662 ± 0.686) for food purchasing (FP) activities.

Food Storage

As shown in Table 3, the statement “I always check the expiry date of food in the kitchen” (FS5) had the highest overall mean score ($M = 3.983$, $SD = 0.970$). When comparison was made based on income groups, the high-income group scored the lowest, while the low-income group scored the highest. Therefore, it can be said that most of the respondents, regardless of their income background, agree with this statement because they always check the expiry date of their food to prevent it from getting wasted. Meanwhile, the statement FS4 (I always use food that is more likely to expire in a short time compared to food that has a longer time to expire) had the lowest overall mean score ($M = 3.195$, $SD = 1.024$). Conversely, the low-income group had the lowest mean score for FS4 compared to other income groups. This behaviour indicates that the awareness about consuming food that will expire sooner may be lower among households in Kuala Lumpur, especially among the low-income group. However, a one-way ANOVA revealed that there was no statistically significant difference in mean food storage scores among the three income groups [$F(2,999) = 2.481$, $p = 0.082$].

The findings of this study support Barone and Aschemann-Witzel’s (2022) results, where consumers would inspect the expiry date of food when they are in the store or at their home. In addition, it is important to examine the condition of the food if it is past its expiry date to ensure the food is free from spoilage. Food spoilage is characterised by off-odour and off-flavour, as

well as colour and textural changes caused by pathogens, such as *Bacillus* sp. groups, *Bacillus cereus* and *Bacillus subtilis*, and *Escherichia coli* (Rawat, 2015). The presence of pathogenic bacteria in food can result in foodborne diseases with the most common symptoms being diarrhoea, fever, and abdominal cramps, and in the most severe cases where pathogens produce toxins lead to death (Bintsis, 2017)

Food Purchasing Planning

Item FP4 (I always check the expiry date of products when shopping) had the highest mean scores ($M = 4.066$, $SD = 0.993$), while item FP3 (I always buy things that I already have in the kitchen) had the lowest mean scores ($M = 2.742$, $SD = 0.988$). Similar trends were observed for all income groups. This can be supported by Li *et al.* (2020), who demonstrate that expiration dates significantly impact the perceived freshness of a food product, as they serve as indicators of a quality standard. Similarly, D’Amato *et al.* (2023) also stated that the expiry date affects consumers’ evaluation to purchase food items where they are more likely not to purchase foods that are close to the expiry date. In that case, the urge to check the expiry date of certain products might be important for them to have good food quality. Packaged food, including canned food, can spoil if the packaging is ruined, which may result in bloating or swelling packaging due to the anaerobic microbial growth within the package (Rawat, 2015). Similar to Barone and Aschemann-Witzel (2022), the findings also suggest that respondents were aware of the food items that were available in their kitchen. A one-way ANOVA also revealed that there was no statistically significant difference in mean food purchasing scores among the three income groups [$F(2,999) = 2.005$, $p = 0.137$].

Food Purchase Behaviour In-store

As shown in Table 3, statements FPB3, “I always buy larger amounts of food when shops are offering sales and discounts” (3.311 ± 0.913), and FPB5, “I always check the nutrition labels when shopping” (3.311 ± 1.119)

had the highest agreement compared to other statements. Meanwhile, the statement FPB1, “I always buy too many food products (more than needed) during shopping” had the lowest mean values (2.828 ± 0.973). A similar pattern of responses was observed for households in all three income groups. This was confirmed by the one-way ANOVA analysis, in which there was no statistically significant difference in mean food storage scores between at least two groups [$F(2,999) = 0.677, p = 0.509$]. Reading the nutrition labels and avoiding buying more than needed food is good behaviour (Aydin & Yildirim, 2021; Koca & Arkan, 2021), but their higher tendency to buy more food when it is on sale or offered at a discounted price may lead to food waste (Aydin & Yildirim, 2021). Due to the sales and discounts that supermarkets offer, the respondents had a high tendency to buy food items that were not on their shopping list (3.169 ± 0.908). Over-buying of food can lead to food waste (van der Werf *et al.*, 2021). In addition, the foods on sale or at a discounted price are normally close to their expiry date or are degrading in quality (Aschemann-Witzel *et al.*, 2017).

Food Planning Preparation

As can be seen from Table 3, item FPP4, “I always plan portions of meals according to household size” had the highest mean value (3.633 ± 0.989), followed by item FPP3, “I always follow the right method of cooking” (3.550 ± 1.019), and item FPP5, “I always cook for two or more people (including yourself) weekly” with a mean value of 3.477 (SD = 1.093). However, the respondents had the lowest agreement towards item FPP2, “I always follow a weekly menu” (2.685 ± 1.140). Although similar patterns were observed in all households in different income groups, a one-way ANOVA revealed that there was a statistically significant difference in mean food planning preparation scores between at least two groups [$F(2,999) = 4.624, p = 0.011 < 0.05$]. The results indicate that the respondents prepared food according to the household size and applied the correct

cooking method, but they did not properly plan for food preparation. They may simply cook food according to their desire, based on requests from family members, or use any resources available at home. As stated by Shaw (2021), cooking food without proper planning can result in waste as some family members may not want to eat food that they dislike.

Leftover Consumption

Item LC2, “I always store the leftovers in appropriate conditions so that they will last and be used adequately” has the highest agreement level among the respondents (4.020 ± 0.790), followed by item LC1, “I always eat leftovers cold or reheat them” (3.510 ± 0.892), and item LC5, “I always use the leftovers to make a new meal” (3.344 ± 0.947). Meanwhile, item LC4, “I always wasted food at home” scored the lowest (3.083 ± 0.880). Similar patterns of responses were observed in households of different income groups. A one-way ANOVA revealed that there was no statistically significant difference in mean leftover consumption scores between at least two groups [$F(2,999) = 0.555, p = 0.575$]. The results showed that the respondents have good knowledge about storing leftover food and would consume the leftovers later, either by eating the food as it is or repurposing it to prevent the food from being wasted. Furthermore, attitude has been shown to be associated with how one deals with leftover food (Talwar *et al.*, 2021). Meanwhile, it is important to ensure that leftover food is correctly reheated (Li *et al.*, 2023). The main purpose of reheating food is to destroy all foodborne pathogens, but foods that are reheated frequently may reduce their nutritional and functional quality (Nanje *et al.*, 2024).

Descriptive Analysis for Household Food Waste Behaviour and Reasons for Food Wasted

Table 4 summarises the amount of food wasted according to food categories. As shown in Table 4, the respondents reported discarding vegetables (2.507 ± 1.203), followed by the bread and bakery products (2.455 ± 1.159),

Table 4: Descriptive analyses of household food waste behaviour for overall households and according to income group

Code	Items	Low (n = 183)		Medium (n = 77)		High (n = 42)		Overall (n = 302)	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
HFWB1	Fresh fruits	2.142	1.159	2.195	1.039	2.000	1.249	2.136	1.140
HFWB2	Vegetables	2.503	1.185	2.623	1.225	2.310	1.239	2.507	1.203
HFWB3	Dairy product	2.180	1.151	2.260	1.174	2.286	1.235	2.215	1.166
HFWB4	Meat	2.006	1.277	1.701	1.159	1.810	1.330	1.901	1.259
HFWB5	Fish	2.060	1.241	1.714	1.202	1.691	1.220	1.921	1.236
HFWB6	Bread and bakery product	2.363	1.156	2.740	1.117	2.333	1.183	2.455	1.159
HFWB7	Canned and tinned products	2.077	1.165	1.896	1.033	2.071	1.068	2.030	1.119
Mean HFWB		2.190	0.953	2.161	0.855	2.071	0.999	2.166	0.934

and dairy products (2.215 ± 1.166) categories. Foods that were less discarded were meat (1.901 ± 1.259) and fish (1.921 ± 1.236). A similar trend was observed for low-income households. Medium- and high-income groups were shown to discard bread and bakery the most, followed by vegetables. Meat and fish were the least discarded. However, a one-way ANOVA revealed that there was no statistically significant difference in mean household food waste scores between at least two groups [$F(2,999) = 0.275$, $p = 0.760$]. Similar outcomes were reported by Li *et al.*, (2021) involving households in rural areas in China.

The findings of this study are supported by a study conducted by Ferro *et al.* (2022), Ganguly and Rob (2022), and Li *et al.* (2021), where vegetables were reported to be the most discarded by the consumers. According to Ferro *et al.* (2022), vegetables were the most thrown-away food items since they were easily destroyed. Ironically, the intake of vegetables in Malaysia is still below the recommendations for a healthy diet (Ramadas *et al.*, 2024), thus contributing to a deficiency in vitamins and minerals (Ja'afar *et al.*, 2024). The study also showed that meat, fish, and canned and tinned products are among the least discarded food items, indicating that

Malaysians commonly consume meat, fish, and canned and tinned products.

These findings exhibit a similar pattern to the households in rural China, where the amount of animal-based food waste was approximately one-tenth of the plant-based food waste (Li *et al.*, 2021). The intake of animal protein foods, especially meat in large quantities and taken frequently is not encouraged since meat contains high cholesterol and saturated fats, which may contribute to non-communicable diseases such as cardiovascular disease, hypertension, and obesity (Ramadas *et al.*, 2024). Similarly, the intake of canned and tinned products should be limited since they may contain hidden sugar and salt, preservatives, and other food additives such as flavouring agents, colourants, stabilisers, and emulsifiers (Dodd *et al.*, 2020; Saulais *et al.*, 2023).

Table 5 summarises the mean and Standard Deviations on reasons for food waste. The table shows that the most common reason that led food to be wasted was when it was expired and spoiled (1.106 ± 0.308), followed by food with mould (1.229 ± 0.421). Meanwhile, unlike the high-income group, food that did not have a good smell was the least to be discarded by low- and medium-income groups. Similarly, the

Table 5: Reasons for food being wasted for overall households and according to income group

Code	Items	Low (n = 183)		Medium (n = 77)		High (n = 42)		Overall (n = 302)	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
RWF1	Food is expired and spoiled	1.098	0.299	1.117	0.323	1.119	0.328	1.106	0.308
RWF2	Food has mold	1.224	0.418	1.221	0.417	1.262	0.445	1.229	0.421
RWF3	Food does not have a good smell	1.853	0.356	1.909	0.289	1.881	0.328	1.871	0.336
RWF4	Leftover food	1.448	0.499	1.364	0.484	1.429	0.501	1.424	0.495
RWF5	I did not like the food or ingredients	1.787	0.411	1.701	0.461	1.929	0.261	1.785	0.412
RWF6	The food does not meet my expectations	1.694	0.462	1.558	0.500	1.595	0.497	1.646	0.479

Note: The scale used was 1 for a “yes” and 2 for a “no”

findings also showed that households from all income groups did not simply throw away foods that they did not like (RWF5) or did not meet their expectations (RWF6). In general, almost similar patterns were observed for all household income groups with respect to reasons for food wasted. It is confirmed that a one-way ANOVA revealed no statistically significant difference in mean household food waste scores between at least two groups [$F(2,999) = 2.348$, $p = 0.097$]. According to Davenport *et al.* (2019), the characteristics of households such as their education and income levels, as well as household size, influence their food-related routine behaviour and decision to discard food. The findings of the current study were consistent with a study conducted by Aschemann-Witzel *et al.* (2019). Aschemann-Witzel *et al.* (2019) reported that the most frequent reason why consumers discard food is due to bad quality or visibly imperfect appearance, odour, or other characteristics.

The findings correspond with the findings presented in Table 3, where the respondents reported checking the expiration date of the food (FS5) and always checking that the fridge is free from any leftover food (FS1). Besides, all households in Kuala Lumpur, regardless of their income group, are more likely to discard the

leftover food (RWF4). It is important to expose household members to the skills to repurpose leftover food, which can help to reduce wastage (Jay, 2017) and transform the food into new and nutritious forms (Jay, 2017; Donato *et al.*, 2024). Donato *et al.* (2024) conducted an intervention study in transforming leftover food as a means to reduce food waste. Their study concluded that participants who engaged in this kind of activity had improved their psychological well-being. Hence, future research related to intervention studies can be conducted among households in Malaysia to further understand the factors contributing to food waste as well as to understand the implications of food waste behaviour towards their psychological well-being. A study conducted by Shaw (2021) revealed that through intervention studies, participants were also exposed to ways of managing food to avoid wastage.

Relationship between Food-related Routine and Household Food Waste Behaviour

As shown in Table 6, only FPB was significantly correlated to household food waste in Kuala Lumpur ($r = 0.188$, $p < 0.001$). A similar outcome was reported when the correlation analysis was conducted among the low-income group ($r = 0.231$, $p < 0.001$). Meanwhile, a

Table 6: Correlation between food-related routine and household food waste behaviour

Overall Households		1	2	3	4	5	6
1.	Food storage	1					
2.	Food purchasing planning	0.505 ^a	1				
3.	Food purchase behaviour in-store	0.175 ^a	0.318 ^a	1			
4.	Food planning preparation	0.431 ^a	0.532 ^a	0.450 ^a	1		
5.	Leftover consumption	0.325 ^a	0.357 ^a	0.366 ^a	0.376 ^a	1	
6.	Household food waste behaviour	0.005	-0.052	0.188 ^a	0.072	0.030	1
Low-income group							
1.	Food storage	1					
2.	Food purchasing planning	0.422 ^a	1				
3.	Food purchase behaviour in-store	0.151 ^b	0.383 ^a	1			
4.	Food planning preparation	0.372 ^a	0.521 ^a	0.485 ^a	1		
5.	Leftover consumption	0.35 ^a	0.361 ^a	0.316 ^a	0.371 ^a	1	
6.	Household food waste behaviour	-0.01	-0.099	0.231 ^a	0.086	0.023	1
Medium-income group							
1.	Food storage	1					
2.	Food purchasing planning	0.596 ^a	1				
3.	Food purchase behaviour in-store	0.247 ^b	0.304 ^b	1			
4.	Food planning preparation	0.538 ^a	0.526 ^a	0.461 ^a	1		
5.	Leftover consumption	0.365 ^a	0.353 ^a	0.452 ^a	0.429 ^a	1	
6.	Household food waste behaviour	-0.029	0.076 ^a	0.06	-0.004	-0.025	
High-income group							
1.	Food storage	1					
2.	Food purchasing planning	0.726 ^a	1				
3.	Food purchase behaviour in-store	0.193	0.092	1			
4.	Food planning preparation	0.545 ^a	0.583 ^a	0.264 ^a	1		
5.	Leftover consumption	0.213	0.328 ^b	0.401 ^a	0.296 ^b	1	
6.	Household food waste behaviour	0.081	-0.013	0.243	0.169	0.145	1

Note: ^a $p < 0.001$; ^b $p < 0.05$.

significant correlation was observed between food purchasing and household food waste among medium-income households ($r = 0.076$, $p < 0.001$). The high-income households did not exhibit any correlations between food-related routine activities and their household food waste.

As mentioned by Aydin and Yildirim (2021) and van der Werf *et al.* (2017), irrational food purchase behaviour can lead to wastage. In

addition, this behaviour can also result in post-purchase regrets, especially when the products purchased do not meet expectations (Cornish, 2020). Owusu *et al.* (2021) further stress that impulsive purchase behaviour can lead to financial problems and later risk of anxiety (Rudenstine *et al.*, 2021). This situation is mostly true for those with limited income (Hakulinen *et al.*, 2020; Rudenstine *et al.*, 2021). Hence, future research is proposed to examine relationships

between household financial knowledge and management, food-related routine behaviour and household food waste. The outcome of the proposed study can be utilised by respective agencies in providing suitable interventions to educate Malaysian consumers.

Conclusions

To conclude, this study provides valuable insights into food-related routines and household food waste behaviours across different income groups in Kuala Lumpur. The findings reveal that households in Kuala Lumpur prioritise food storage, particularly checking expiration dates, as a common practice to prevent waste. However, while they monitor expiration dates, they do not always prioritise consuming food close to expiry, particularly among low-income households. Food purchasing behaviour in-store, including a tendency to buy items on sale or at a discount, suggests a pattern that may inadvertently contribute to food waste, particularly if these discounted items are near expiry. Furthermore, while most households engage in planning food portions according to household size, there is less adherence to weekly meal planning, which could lead to excess food being prepared and subsequently wasted.

The analysis also shows that households frequently waste certain food types such as vegetables and bread, with minimal wastage of meat and fish. These patterns are consistent across income groups, though medium- and high-income groups are more inclined to discard bakery items. Reasons for food waste include spoilage and mold, with households generally avoiding discarding food simply due to dislike or unmet expectations. This study underscores the need for targeted awareness initiatives on food management practices across income levels, emphasising strategies like better meal planning, awareness of the nutritional value of perishable foods, and the impact of purchasing items close to expiry.

Finally, the correlation analysis highlights that food-related routines such as in-store food purchasing behaviour are associated with household food waste, particularly in low- and medium-income groups, suggesting potential areas for intervention. The findings of the study challenge assumptions that other routine activities such as storing and food preparation would be equally predictive. In addition, this study conceptualises food waste as an outcome of routine household practices, shifting the focus from individual behaviour to everyday domestic patterns. Efforts to improve food-related routines—such as promoting better storage practices, encouraging the consumption of items near their expiry, and offering education on balanced purchasing habits—could be enhanced by designing and testing differentiated intervention strategies tailored to each income group. Meanwhile, a community-based food sharing network can be initiated at the neighbourhood level that can interrupt the purchase-to-waste cycle, particularly across different socioeconomic areas of Kuala Lumpur. These strategies help mitigate food waste, ultimately contributing to environmental sustainability and resource efficiency in urban households in Kuala Lumpur.

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Conflict of Interest Statement

The authors declare that they have no conflict of interest.

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