PSYCHOMETRIC EVALUATION OF A QUESTIONNAIRE FOR MEASURING FOOD WASTE BEHAVIOUR AND FOOD SECURITY AT THE HOUSEHOLD LEVEL

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ABSTRACT

Introduction: Food waste and food security are two concepts that are often linked together. This study was performed for the psychometric evaluation of a developed questionnaire for measuring food waste behaviour and food security at the household level. Five expert panels conducted content validation for the relevance, clarity, simplicity, ambiguity of each item. **Methods:** A cross-sectional quantitative research approach was employed for the questionnaire testing in 10 villages in the Samarahan district of Sarawak state. A total of 168 households were interviewed using face-to-face interviews. Data entry and analysis was undertaken using Microsoft Excel version 2016 and the statistical package for social sciences (SPSS, version 27.0), **Result:** respectively. Four items were improved, and one item was added to the English questionnaire after receiving feedback from the expert panel and respondents. Further refinement was also performed for the Malay version. Cronbach's alpha value varied from 0.713 to 0.961, indicating the reliability of the questionnaire. **Conclusion:** Overall, the respondents were able to comprehend most of the questions effectively. No problem was raised for the flow and sequence of the questions. Conclusively, the developed questionnaire is unambiguous in its reliability and validity. Nevertheless, further refinement is required before being used in future studies.

Keywords: Food waste, Food security, Theory of Planned Behaviour

INTRODUCTION

Food waste is the reduction in the quantity or quality of food due to decisions and actions taken by retailers, food service providers, and consumers (Food and Agriculture Organization, 2019). Globally, approximately one billion tonnes of food are wasted every year, representing either one-third of the entire food production in mass or one-fourth if measured in calories (High-Level Panel of Experts, 2014). Lipinski et al. (2013) reported that developing and developed countries accounted for 44% and 56% of global food loss and waste, respectively. Developing countries lost more than two-thirds of their food in the post-harvest and processing stages. On the flip side, almost two-thirds of food loss and waste occurred in developed countries at the retailer and consumer levels. Thi et al. (2016) revealed that more affluent living standards lead to more food waste production. Better living quality in developed countries was associated with easy access to quality food controlled by better food product standards. Subsequently, improvement in food access led to higher demand, higher food purchase, and the creation of food waste.

On the contrary, food security occurs when every people have physical and economic access to adequate safe, and nutritious food at all times. This food also meets their dietary needs and food preferences for an active and healthy lifestyle (Food and Agriculture Organisation, 2008). The Food and Agriculture Organisation of the United Nations reported that moderate or severe food insecurity was experienced by more than one-fourth (25.9%) of the world population in 2019 (Food and Agriculture Organisation, 2020). This percentage is equivalent to two billion of the world population having food insecurity. Africa

recorded the highest food insecurity (51.6%), followed by Latin America (31.7%) and Asia (22.3%), whereas the regions with the least food insecurity were Oceania (13.9%) and Northern America and Europe (7.9%).

Both food waste and food security concepts are often interconnected. Food waste is often reported to cause food insecurity (Jereme et al., 2017). Nonetheless, this relationship is not well explored as there is no substantial evidence that food waste will directly lead to food insecurity. Despite the lack of evidence, food waste awareness campaigns still use food security data to educate the public regarding food waste (Tielens & Candel, 2014). The presenters will initially inform the audience regarding global food loss, food waste, and its related statistics. Next, the presenters will present the statistics on food insecurity around the world. Finally, they will suggest that some forms of action are needed to address these issues.

After an extensive literature review, a questionnaire assessing food waste behaviours, household food security, and their associated factors was developed to understand the relationship between food waste and food security. For food waste behaviour, few studies utilised the theory of planned behaviour to explain the consumers' behaviour (Graham-Rowe et al., 2015; Russell et al., 2017; Stancu et al., 2016; Stefan et al., 2013; Visschers et al., 2016; Werf et al., 2019). The factors associated with food waste behaviour included the intention to reduce food waste, personal attitude toward food waste, the subjective norm regarding food waste, and perceived behavioural control over food waste. For household food security, a few factors were identified which may affect the food security of a household. Consumers' food choice motives, financial attitudes, food planning routines, and social cohesion influenced food security (Aktas et al., 2018; Brisson, 2012; Denney et al., 2017; Franchi, 2012). This study was performed to examine the psychometric properties of

the developed questionnaire for food waste behaviour and food security. The psychometric properties of a questionnaire refer to the validity and reliability of the measurement tool (Portney & Watkins, 2009). A questionnaire with good psychometric properties must be evaluated extensively to be reliable and valid. To achieve this objective, content validation of the developed questionnaire was investigated, followed by examining the internal consistency.

METHODS
Study settings

This cross-sectional study was designed to collect information on food waste behaviour and food security among rural households in the Samarahan district of Sarawak. The study was conducted from October 2020 until June 2021. The inclusion criteria were mentally sound adults in charge of food in their respective households, irrespective of gender and living in Samarahan district. Non-Malaysians were excluded from the study. According to the Department of Statistics Malaysia, rural areas were defined as areas outside the gazetted local authority areas with a population of fewer than 10,000 persons (Department of Statistics Malaysia, 2010). There are a total of 50 rural villages from Samarahan district, and the list was obtained from Samarahan District Office.

Data collection instruments and procedure

A total of 10 rural villages from Samarahan district was randomly selected for this study. A total of 168 households were chosen from the selected villages for interview. Systematic sampling was used for household selection, whereby the 5th interval, starting from the village headman's house in each village, was approached. For every 5th house visited, the selected household adults who meet the inclusion criteria were interviewed. Data were collected via face-to-face interview using

an interviewer-administered questionnaire consisting of three parts: Sociodemographic; Part A: Food waste behaviour and its associated factors; and Part B: Food security and its associated factors (**Table 1**).

Table 1 Components of the questionnaire

Questionnaire component	No. of Item	Reference
Part A Food waste	**31**	
Food waste behaviour	10	Rahman et al.(2018)
Food waste quantification	4	Rahman et al.(2018)
Intention	4	Aktas et al.(2018)
Personal attitudes	4	Aktas et al.(2018)
Subjective norm	4	Aktas et al.(2018)
Perceived behavioural control	5	Werf et al. (2019)
Part B Food security	**32**	
Food security	18	Hamilton et al.(1997)
Food planning routines	3	Aktas et al.(2018)
Food choice motives	3	Aktas et al.(2018)
Financial attitudes	3	Aktas et al.(2018)
Social cohesion	5	Sampson et al.(1997)

Questionnaire translation and face validity

The questionnaire was initially developed in the English version. Next, it was translated into Malay version by two translators whose mother tongue is the Malay language. After combining both Malay versions, the questionnaire was back-translated into an English version. The finalised Malay version proceeded for testing. To examine the face validity of the questionnaire, two general factors of difficulty level and ambiguity were examined. In examining the difficulty level, respondents identified items with the words or phrases they considered to be difficult. For the examination of ambiguity, the respondents specified the items that were misunderstood or had ambiguous meanings. Other factors such as grammar and appropriate wording were also identified.

Household food waste behaviour

The household food waste behaviour section consisted of three domains: food waste behaviour, food waste quantification, and the associated factors. The food waste behaviour domain consisted of 10 questions adapted from the food waste questionnaire by Rahman et al. (2018). A five-point Likert scale ranging from (1) _"always"_ to five (5) _"never"_ was applied in recording the respondents' responses. The food waste quantification domain consisted of four items from the food waste questionnaire by Rahman et al. (2018). Participants' responses were stated based on the percentage of self-reported food waste. The choices were none, ¼ of the total amount, ½ of the total amount, ¾ of the total amount and whole. The last domain comprised 17 items assessing the factors associated with food waste behaviour. These factors included respondents' "intention" to reduce food waste, "personal attitudes" toward food waste, "subjective norm" toward food waste and "perceived behavioural control" toward food waste. Statements for intention, personal attitudes and subjective norms are adapted from the questionnaire developed by Aktas et al. (2018). Statements for perceived behavioural control were adapted from the

questionnaire developed by Werf et al. (2019). The respondents stated their agreement using a seven-point Likert scale, ranging from (1) "*strongly disagree"* to seven (7) *"strongly agree"*.

Household food security

The household food security section consisted of two domains: household food security and food security factors. Utilising 18 items adapted from the US Household Food Security Survey Module by Hamilton et al. (1997), the first domain assessed respondents' household food security for the past 12 months. The questionnaire comprised of two broad parts, adult food security and child food security. A household with children less than 18 years old was required to answer the child food security domain (eight items), whereas a household without children was exempted from answering the domain. Responses of "*yes*," "*often*," "*sometimes*," "*almost every month*," and "*some months but not every month*" were allocated the score of '1'; the remaining answers were allocated the score of '0'.

The second domain contained 14 items assessing the factors associated with food security. These factors included respondents' "food planning routines", "food choice motives", "financial attitudes", and "social cohesion". Statements for food planning routines, food choice motives, and financial attitudes were adapted from the questionnaire developed by Aktas et al. (2018) while those for social cohesion were adapted from the questionnaire developed by Sampson et al. (1997). Respondents stated their agreement using a seven-point Likert scale, ranging from (1) "*strongly disagree"* to seven (7) *"strongly agree"*.

Statistical analysis

Collected data were checked and verified manually. Next, the data were entered into Microsoft Excel sheet (Cooper, 2015) with a validation check. The raw data were imported to the analytic tool Statistical Package for Social Sciences (IBM SPSS), version 27 for Windows (IBM SPSS, 2020). Data screening, coding, and verification for duplication were performed before analysis. Cronbach's alpha reliability analysis and corrected item-total correlation were used to assess the reliability of the questionnaire. A reliability coefficient of 0.7 and above is considered a reliable instrument for survey research (Hair et al., 2019). A cut-off value of 0.3 for corrected item-total correlation was used to identify poor discrimination of items (Cooper, 2015; George & Mallery, 2020).

Ethical issues

Concerning the possible ethical issues related to this research, respondents' participation in this research was voluntary. The respondents' identity and personal information were kept confidential. The ethics approval was obtained from the Institutional Review Board of Universiti Malaysia Sarawak (Ref: FME/21/65).

RESULTS

The results of the study are described in two sections viz. (a) content validation, (b) reliability analysis.

Content validation

The questionnaire's content was validated by five experts (nutritionists and public health practitioners) who have expertise in the topic to be studied. Each item was evaluated by rating a) its relevance to the respective domains, b) its clarity, c) simplicity and d) ambiguity. The four attributes of every item were rated on a four-point scale (1 = not relevant/not clear/not simple/doubtful; 4 = very relevant/very clear/very simple/meaning is clear) (Lynn, 1986; Waltz et al., 2010; Yusoff, 2019). The experts were also encouraged to provide comments for each item when necessary.

A content validity index was calculated for all four attributes at two levels, namely the item-level content validity index (I-CVI) and scale level content validity index (S-CVI) (Lynn, 1986; Waltz et al., 2010; Yusoff, 2019). The I-CVI was calculated as the total experts scoring 3 or 4 divided by the total experts (Yusoff, 2019). With five experts, the recommended I-CVI was 1.00 (Lynn, 1986). For S-CVI, two indices were calculated: S-CVI/UA (Universal agreement) by experts and S-CVI/Ave (average agreement) by experts (Yusoff, 2019). S-CVI/Ave was obtained by averaging the I-CVI scores for all items for each scale. S-CVI/UA was obtained by dividing the sum of the universal agreement score by the total item. Each item can only gain a score of 1 if all the experts agree (rating 3 or 4). The recommended standard for the S-CVI/Ave and S-CVI/UA was 0.8 (Polit & Beck, 2006; Waltz et al., 2010).

The S-CVI was calculated for all 11 domains, and the S-CVI/Ave ranged from 0.60 to 1.00. On the other hand, S-CVI/UA ranged from 0.00 to 1.00. All domains had a perfect relevance score of 1.00 in S-CVI/Ave and S-CVI.UA. For clarity score, only the food waste quantification domain scored below 0.8 based on S-CVI/Ave (0.75 and 0.60, respectively). However, S-CVI/UA revealed food waste behaviour (0.40), food waste quantification (0.00), intention (0.25), and social cohesion (0.60) domains did not achieve the acceptable S-CVI. For simplicity score, all domains scored above 0.8 for S-CVI/Ave, but food waste quantification (0.00), intention (0.50), and perceived behavioural control (0.40) domains score below 0.8 for S-CVI/UA. For the ambiguity score, the food waste quantification domain had low S-CVI/Ave (0.60) and S-CVI/UA (0.00). Only intention (0.25) and perceived behavioural control (0.40) domains had low S-CVI/UA. Based on the S-CVI indices, all the items for each domain were kept as they were deemed relevant. Items with low I-CVI in clarity, simplicity or ambiguity were reassessed and modified for improvement. Table 2 illustrates the S-CVI/Ave and S-CVI/UA for each questionnaire domain (**Table 2**).

Table 2 S-CVI/Ave and S-CVI/UA of the questionnaire

Domains	Relevance		Clarity		Simplicity		Ambiguity	
	Ave	UA	Ave	UA	Ave	UA	Ave	UA
Food waste behaviour	1.00	1.00	0.84	0.40	1.00	1.00	0.96	0.80
Food waste quantification	1.00	1.00	0.75	0.00	0.80	0.00	0.60	0.00
Intention	1.00	1.00	0.80	0.25	0.85	0.50	0.80	0.25
Personal attitudes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Subjective norm	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Perceived behavioural control	1.00	1.00	1.00	1.00	0.88	0.40	1.00	0.40
Food security	1.00	1.00	0.99	0.94	0.99	0.94	0.99	0.94
Food planning routines	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Food choice motives	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Financial attitudes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Social cohesion	1.00	1.00	0.92	0.60	1.00	1.00	1.00	1.00

*Ave = average agreement; UA= Universal agreement

Reliability analysis

Reliability analysis allows examining the properties of measurement scales and the items that compose the scales. It calculates several commonly used scales that reliability measures and provides information. It also provides the relationships between individual items in the scale. In this study, we analysed and presented into two sub-sections viz. (i) Item analysis and (ii) Internal consistency.

Characteristics of respondents

A total of 168 households participated in this study. The respondents' mean age (SD) was 40.8 (13.3) years, with a minimum and maximum age of 20 and 68 years, respectively. A higher proportion of the respondents were females (69.6%) compared to male respondents (30.4%). The majority of the respondents were of Malay ethnicity and Islamic faith (Table 3). In total, 14 respondents (8.3%) were excluded from the final analysis due to missing data and incomplete responses to the questionnaire.

Table 3 Characteristics of the respondents (n = 168)

Characteristics	Frequency	%	Statistics
Age in years			Mean = 40.8 years
			SD = 13.3 years
			Min, Max = 20, 68 years
Gender			
Male	51	30.4	
Female	117	69.6	
Ethnicity			
Malay	70	41.7	
Iban	68	40.5	
Chinese	22	13.1	
Bidayuh	4	2.4	
Melanau	2	1.2	
Orang Ulu	2	1.2	
Religion			
Islam	76	45.2	
Christianity	70	41.7	
Buddhism	19	11.3	
Baha'i Faith	3	1.8	

Item analysis

Based on the feedback from experts and respondents, one additional item was added while 19 items were rephrased and refined. Overall, a total of 64 items were accepted compared to the previous or initial 63 items. Few items from the food waste quantification domain required question rephrase. Table 4 illustrates the summary of item analysis for each domain.

Table 4 Summary of item analysis

Domains	The initial number of Items	Edited Items					Total number of Items accepted
		Removed	Added Question	Added Answer	Rephrase	Rephrase Answer	
Food waste behaviour	10	0	0	0	0	0	10

Domains	The initial number of Items	Edited Items					Total number of Items accepted
		Removed	Added Question	Added Answer	Rephrase	Rephrase Answer	
Food waste quantification	4	0	1	0	4	0	5
Factors associated with food waste behaviour	17	0	0	0	0	0	17
Food security	18	0	0	0	0	0	18
Factors associated with food security	14	0	0	0	0	0	14
Total	63	0	0	0	4	0	64

Internal consistency

Initially, the food waste behaviour domain had a poor Cronbach's alpha of 0.525. After the removal of three negative items from analysis, Cronbach's alpha for the food waste behaviour domain improved to 0.781. The other domains reflected a good overall Cronbach's alpha ranging between 0.713 and 0.961. For corrected item-total correlation, one item in personal attitudes recorded a low value of less than 0.3 (Table 5). For the overall factors associated with food waste behaviour, one item in personal attitudes had a negative value of corrected item-total correlation. After deleting the item, the overall Cronbach's alpha improved to 0.776 while all the remaining items showed a positive corrected item-total correlation.

Table 5 Summary of reliability analysis

Parts	No. of items	Likert Scale	Cronbach's Alpha	Interpretation of Cronbach's Alpha	Corrected Item-Total Correlation
Food waste behaviour	7	1-5	0.781	Good	0.401 - 0.658
Food waste quantification	4	1-5	0.880	Good	0.638 - 0.827
Factors associated with food waste behaviour	17	1-7	0.749	Good	-0.136 – 0.756
Intention	4	1-7	0.731	Good	0.487 - 0.542
Personal attitudes	4	1-7	0.713	Good	0.126 - 0.749
Subjective norms	4	1-7	0.796	Good	0.503 - 0.714
Perceived behavioural control	5	1-7	0.863	Good	0.609 - 0.769
Food security – Adult	3	1-4	0.768	Good	0.451 – 0.763
Food security – Child	3	1-4	0.840	Good	0.570 - 0.822
Factors associated with food security	14	1-7	0.941	Excellent	0.541 – 0.790
Food planning routines	3	1-7	0.884	Good	0.732 – 0.812
Food choice motives	3	1-7	0.808	Good	0.602 – 0.694
Financial attitudes	3	1-7	0.905	Excellent	0.749 – 0.851
Social cohesion	5	1-7	0.961	Excellent	0.848 – 0.932

DISCUSSION

In this study, we reported on the questionnaire's psychometric properties (validity and reliability) for food waste behaviour and food security with samples of adults living in rural households. The final questionnaire retained 62 out of the 63 original items from the original articles and developed two new items (Aktas et al., 2018; Hamilton et al., 1997; Rahman et al., 2018; Sampson et al., 1997; Werf et al., 2019).

Food waste behaviour and quantification domains

The food waste behaviour domain achieved acceptable S-CVI/AVE in relevance, clarity, simplicity, and ambiguity score. Although the domain attained good reliability after deleting three negative items from the analysis, negative items in a scale are still important to help in reducing acquiescence bias. Solís Salazar (2015) reported that despite being able to reduce acquiescence bias, the negative item resulted in lower levels of consistency, evident by the improvement of Cronbach's alpha after the removal of negative items in this study. This situation might have occurred due to tiredness or fatigue when completing the questionnaire (Merritt, 2012). Nevertheless, the three negative items were retained for future studies as they are valuable in helping to reduce acquiescence bias.

Although the food waste quantification domain also achieved good relevance scores for validity and Cronbach's alpha for reliability, the clarity, simplicity, and ambiguity scores were poor (< 0.8 for each). In addition, the universal agreement was also 0 for the three scores. Items with poor clarity are difficult to understand, ambiguous and generate unnecessary burden to participants (Mercieca-Bebber et al., 2018). Some participants may become confused with the meaning of the item and not answer accordingly, whereas others may become

tired when answering these items. One item in this domain was also identified to be a double-barrelled question. A double-barrelled question could be dangerous as research has found that respondents understood such questions differently and independently compared to answering each component (Menold, 2020). Another observation noted by the experts regarding the items in food waste quantification in terms of the duration. The initial items assessed the respondents' total household food waste in the past one week in which the expert deemed too long. As such, each item in this domain was changed to quantify food waste for the past 24 hours. The estimation of food waste may be inaccurate, whereby respondents may be unable to remember the amount of food waste for the past one week as compared to the past one day (Resnicow et al., 2000).

In comparison, Gahamat (2019) used a similar scale adapted from Rahman et al. (2018) for food waste behaviour and reported an overall Cronbach's alpha value of 0.70. Two factors may explain the discrepancy with the current study. First, the present study separated the Cronbach's alpha value for food waste behaviour and quantification items. Gahamat (2019) on the other hand combined the Cronbach's alpha value of both domains, producing a good overall reliability value despite including the negative items. Second, the current study used a large sample size with 154 respondents. Appropriate sample size is important to obtain reliable, reproducible, and valid results. Results from a small sample size might lead to false results due to inadequate power and false-positive results due to biased samples (Blackford, 2017).

Factors associated with food waste behaviour

Personal attitudes and subjective norm domains had a good validity. The S-CVI/Ave and S-CVI/UA were 1.00 for all scores. For intention and perceived behavioural control domains, both had

good scores in relevance, clarity, simplicity, and ambiguity of more than 0.8 for S-CVI/Ave. However, the intention domain had poor clarity, simplicity, and ambiguity, while the perceived behavioural control domain had poor simplicity and ambiguity for their Universal Agreement. Few experts commented that certain items were not properly translated into the Malay version in the initial translation. These comments were discussed with the translators and the Malay version of the questionnaire was further refined for improvement.

The Cronbach's alpha for all of the domains was more than 0.7 which is good. However, the negative item in the personal attitude domain had a corrected item-total correlation of less than 0.3 (Cristobal et al., 2007). The same item also produced a negative corrected item-total correlation value for the overall factors associated with food waste behaviour. Low or negative corrected item-total correlation may suggest that the item is not related to the overall domain. However, the problematic item was kept since the item was deemed relevant by the expert panel. Moreover, the negative item can also help in reducing acquiescence bias in future studies (Solís Salazar, 2015). The overall Cronbach's alpha value for each factor was similar to the original questionnaires. Likewise, the adapted component from Aktas et al. (2018) and Werf et al. (2019) had Cronbach's alpha value greater than 0.7. The good reliability value from the current and original questionnaire indicate that these items are reliable in examining the individual factors associated with food waste behaviour.

Household food security

The content validity of the household food security domain was good, achieving a score of more than 0.8 in both S-CVI/Ave and S-CVI/UA for Relevance, Clarity, Simplicity, and Ambiguity. The reliability of this domain was also good with an overall Cronbach's alpha value higher than 0.7 and a corrected item-total

correlation of higher than 0.3 for each item. Hamilton et al. (1997) reported Cronbach's alpha values greater than 0.7 in adult and child domains for the household food security. The good Cronbach's alpha value obtained in both original and current studies indicates that the US Household Food Security Survey Module is reliable in assessing respondents' food security status.

Factors associated with household food security

Food planning routines, Food choice motives, and financial attitudes domains achieved good validity scores with the score of 1 in both S-CVI/Ave and S-CVI/UA for Relevance, Clarity, Simplicity, and Ambiguity. For Social cohesion, more than 0.8 scores in S-CVI/Ave was achieved for all four components but fell short on S-CVI/UA for Clarity. After reviewing all the experts' comments, the corrections needed were mainly from the translated Malay version. These comments were discussed with the translators and the Malay version of the items were further refined to improve the questionnaire.

The Cronbach's alpha for each domain in factors associated with household food security was higher than 0.7, indicating the consistency of each domain in measuring the respective domain. The corrected item-total correlation for each item was higher than 0.3, thus reflecting all the items were well-related to the overall scale (Cristobal et al., 2007). The overall Cronbach's alpha value for each factor in the current study was higher than the original study (Aktas et al., 2018). Specifically, Cronbach's alpha for food choice motives in the original study was 0.65, while the current study yielded 0.823. Despite the difference, the items in each domain were still reliable. In contrast, Financial Attitudes and Social Cohesion domains demonstrated Cronbach's alpha value higher than 0.9. High Cronbach's alpha value may suggest some redundancies in the domains (Tavakol & Dennick, 2011).

There were two limitations identified in this study. The results obtained are not generalisable since the study was conducted in one district of Sarawak. Respondents were also required to answer all the questions (64 items, thereby an in-depth response to the questionnaire might be lacking (Nederhof, 1985).

CONCLUSION

In conclusion, the current questionnaire has good validity and reliability in assessing food waste behaviour and household food security after refining unclear and ambiguous statements. As such, this questionnaire can be used to examine the relationship between food waste behaviour and household food security in future studies. Nevertheless, this study only focused on the rural population. Future research can include the urban population for comparison with the rural population.

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