ORIGINAL ARTICLE

The Effect of Consumers' Food Poisoning Prevention Knowledge, Attitude, Risk Perceptions and Environmental Assessment on Bought Cooked Food Using Partial Least Square Structural Equation Model (PLS-SEM)

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ABSTRACT

Introduction: This paper aims to investigate consumer knowledge, attitude, risk perceptions and environmental assessment of food safety and their direct effects on food poisoning preventive behaviour. Consumers play a crucial role in ensuring the safety of the food they consume, particularly when it comes to cooked food that is sold to them. Therefore, understanding consumers' knowledge, attitude, risk perceptions, and food safety environmental assessment is crucial in influencing their behaviour to prevent food poisoning. **Materials and methods:** We conducted a cross-sectional survey among 430 consumers aged 18 years and above around Ampang areas in Selangor using a validated Knowledge, Attitude, Practice, Perception and Environment (KAP2E) questionnaire. The questionnaires were self-administered among consumers and information on sociodemographic, food poisoning knowledge, attitude, risk perceptions and food safety environmental assessment were gathered. We used PLS-SEM to establish the relationship between the constructs under investigation. **Results:** The evaluation of the structural model indicates that knowledge, attitude, risk perceptions, and food safety environmental assessment account for 22.1% of preventive food poisoning preventive behaviour. Attitude was the strongest predictor (β= 0.381, $p< 0.05$) among other constructs. This study confirmed that food poisoning knowledge have positive impact on consumer's attitude (R^2 = 0.053).**Conclusion:** The present study highlights the importance of incorporating consumer risk perceptions and food safety environmental assessment into food safety education. By enhancing consumers' knowledge and attitude towards food poisoning prevention, we can ensure the effectiveness of these educational efforts.
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Keywords: Food poisoning preventive behaviour, Purchased food, Knowledge, Attitude, Risk perceptions, Food safety environmental assessment, PLS-SEM

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INTRODUCTION

Purchasing prepared meals from food premises or utilising online food delivery services has gained popularity because of the fast-paced nature of modern life and the growth of urban areas (1,2). Furthermore, the growing abundance of food outlets or restaurants could potentially put consumers at a higher risk of experiencing food poisoning (2). There is a concern that consumers' perceptions of food safety risks may not align with their intention to purchase food online (1). In addition, the behaviour of consumers who prioritise lower prices over cleanliness when choosing food premises can put their health at risk of food poisoning (3). There have been a few reported cases of food poisoning related to ready-to-eat foods. Improper handling of raw food and serving it at incorrect temperatures were among the causes of these cases.

Taking into account this issue, the Malaysian government has initiated several programmes aimed at food handlers to tackle it. This includes the food handler's training program, food premise grading system and food premise

recognition for hygiene and healthy food preparation or known as Bersih, Selamat dan Sihat (BeSS) (6-8).

Previous studies demonstrated that most outbreaks of food poisoning resulted from a lack of knowledge of food safety measures during food handling, including improper cooking, cross-contamination, contaminated ingredients and improper storage (9). For instance, a recent food poisoning outbreak in November 2023 involved 49 students in primary and secondary schools in Penang after consuming nasi lemak prepared in the same canteen (10). Thus, in most cases, the responsibility of ensuring food safety is not only under the scope of the food manufacturer or food handler, but also the consumers.

The World Health Organization (WHO) has prioritised consumers as the final link in food chain in order to guarantee the safety of the food they consume (11). It is the responsibility of consumers, especially Muslims, to ensure not only the nutrition of the food, but also the purity of the food consumed (12). In this context, purity refers to the handling and processing methods of food. Therefore, in addition to ensuring complete separation of food from any non – halal food or najs items, hygiene and sanitation play a vital role in the preparation of Halal food (13). It includes various aspects of personal hygiene, clothing, equipment, and the working premises for processing and preparation (12, 13). With this in mind, inculcating food safety knowledge and attitude in food safety education can minimize the risk of contracting food poisoning among consumers, especially in making an informed decision about getting safe food (14,15,17).

However, there have been numerous studies that have presented contradictory results when examining the relationship between knowledge, attitudes, and behavioural intentions (16,18,19,22, 27). Therefore, in recent years, scholars have emphasised the importance of investigating the discrepancies between existing food safety theories and the actual knowledge and intentions surrounding food safety (9, 22, 26). Understanding the performance of food safety behaviour involves examining one's beliefs about the behaviour, the possible consequences of following or not following it, and personal expectations about factors that may support or inhibit performance (21,23,24). We utilised the Health Belief Model (HBM) to examine two key factors influencing individuals' health behaviour: threat perception and behavioural evaluation (21,24). Establishing threat perception involves considering two crucial factors: an individual's perception of their susceptibility to health issues or illness, and their anticipation of the severity of the consequences that may result from these ailments (17, 20). Furthermore, it includes the evaluation of perceived benefits or efficacy of the suggested health behaviour, as well as the consideration of the consumer's environmental judgment about food safety risks that may hinder its implementation (23,24, 26, 48). Therefore, the present study used a KAP2E survey to investigate food poisoning prevention behaviour among consumers. The objective was to assess consumers' knowledge, attitude, preventive practices, environmental judgement, and risk perception regarding food poisoning and its prevention. We are intrigued by uncovering the direct impact within the latent constructs of knowledge, attitude, risk perceptions, and food safety environmental assessment on food poisoning preventive behaviour. Thus, the following hypotheses were formulated:

i. Hypothesis (H1): Knowledge of food poisoning is positively correlated with consumers' attitudes towards preventive food poisoning behavior and directly influences changes in their preventive behavior.
ii. Hypothesis (H2): Consumers' attitudes, shaped by their knowledge of food poisoning, directly affect changes in their preventive behavior.
iii. Hypothesis (H3): Consumers' risk perception directly influences their preventive behavior towards food poisoning.
iv. Hypothesis (H4): Environmental assessment of food safety directly impacts consumers' preventive behavior regarding food poisoning.

MATERIALS AND METHODS

Study design

The study utilised a cross-sectional design to gather data on consumers' sociodemographic factors, knowledge, attitudes, risk perceptions, and preventive behaviours related to food poisoning at a single point in time. We conducted a survey among a selected group of consumers to achieve this.

Study location

The research areas focused on the regions governed by Majlis Perbandaran Ampang Jaya (MPAJ), or Ampang Jaya Municipal Council, which include Ampang, Hulu Kelang, and a portion of Setapak districts. Estimates in 2007 placed the MPAJ population at approximately 600,000, representing approximately 12.7% of Selangor's total population (28). We chose the MPAJ areas for their extensive infrastructure development and their combination of urban and suburban location. The area surrounding Kuala Lumpur, often referred to as the 'Golden Triangle,' includes Taman Ampang Utama, Taman Putra Sulaiman, Ampang Point, Taman Tun Abdul Razak, and Ampang Jaya. Due to the influx of immigrants from neighbouring countries such as Indonesia, Myanmar, and Bangladesh, these residential areas have become colonised by these people. As a result, Asian-food restaurants and stalls have thrived in these areas (28).

Sample and Sampling Method

The study was carried out among adult consumers. Consumers were defined as individuals who purchased food from external sources on a monthly basis (29). We

included consumers who met the following criteria: (i) individuals over the age of 18 years and (ii) those who were fluent in either Bahasa Malaysia or English.

The study recruited 430 consumers, exceeding the calculated sample size of 422. We conducted the recruitment process in the MPAJ areas, following Krejcie and Morgan's (1970) formula. Here is the formula:

$$\text{Sample size} = \frac{Z_1 - \alpha/2^2}{d^2} P\ (1-p)$$

Where :
$Z_{1-\alpha/2}$: a standard normal variate (at 5% type I error (P<0.05) it is 1.96 and at 1% type 1 error (P< 0.01) it is 2.58). Majority of studies considered significance below 0.05, hence 1.96 is used
p : expected proportion in population based on previous studies or pilot study
d : absolute error or precision. In proportion of one; if 5%, d = 0.05

We sampled consumers using proportionate stratified random sampling. We employed stratified sampling, using the planning blocks of MPAJ areas as the strata from which we calculated the sample size based on the sampling fraction (31). There were three planning blocks in the MPAJ areas, including Ampang Indah, Ampang, and Taman Melawati (28). From each of the strata, residences were randomly selected and one resident of each selected residence (31).

Study administration
Consumers who met the criteria were provided with information and gave their consent before filling out the questionnaire. The consumers themselves filled out the questionnaire, with the researcher or the enumerators present to answer any questions and make sure everything was filled out completely. All questionnaires were collected the same day and thoroughly checked for completeness to ensure that there were no missing data if completed outside the research setting. The survey was conducted over a span of three months, starting from October 2019 until January 2020.

Research instrument
A KAP^{2}E questionnaire was developed to assess various factors, including sociodemographic factors, knowledge, attitudes, preventive behaviour, risk perceptions related to food poisoning and its prevention, and environmental risk assessment. The questions were adapted from previous studies (16,18,19,21,33). The initial questionnaire was composed in English and subsequently translated into Bahasa Malaysia using Brislin's back translation technique, employing the expertise of two external translators well-versed in linguistics and the specific subject matter (32). The assessment of food poisoning knowledge involved the evaluation of eight items that encompass various knowledge elements. These elements included an understanding of the etiologic agents responsible for food poisoning, knowledge of high-risk foods, recognition of signs and symptoms, awareness of potential complications, the ability to detect spoilt food, and familiarity with food poisoning prevention practices (26, 42). The survey questions permitted consumers to provide answers in the format of "Yes," "No," or "Unsure." Correct answers were assigned a mark of "1," while incorrect or "unsure" responses received a mark of "0." Evaluation of the difficulty and discriminant index of the constructed knowledge items yielded results that were deemed acceptable (33).

Consumers' attitudes were assessed on 10 items with respect to food poisoning prevention, treatment, and risk-related behaviours using a five-point Likert scale ("strongly disagree" to "strongly agree"), modified from Zahiruddin *et al.* (2018) (33). Negative items were reversed - scored and scores for each domain were summed to produce summary score for attitude.

Consumer psychosocial factors were assessed by measuring their perception of risk on a scale of 10 items, using the framework of the Health Belief Model (HBM). Four domains were included in the study, in line with previous research. These domains are perceived barriers, perceived benefits, perceived severity, and perceived susceptibility (21,24). The items in this study were adapted from previous research conducted by various authors (21, 24, 23). The assessment of all items was conducted using a five-point Likert scale, ranging from "strongly disagree" to "strongly agree". The reverse scoring technique was applied to negative items. A cumulative score was calculated by summing all the items, resulting in a comprehensive measure of risk perceptions.

The present study examines the construct of food poisoning behaviour, specifically focusing on the potential food safety practices adopted by consumers. Six items have been developed using prior consumer research (18, 36). The responses were evaluated according to the frequency of occurrences, ranging from Never to Always (21). Each behaviour item is assigned a value based on frequency: 4 for Always, 3 for Sometimes, 2 for Seldom, and 1 for Never. The collective data was aggregated to generate a comprehensive score for the practice.

Conversely, an evaluation of environmental factors was carried out on consumers. This evaluation encompassed 17 different aspects, such as the cleanliness of the premises and the personal hygiene of the food handlers. The items in the Food Premises Inspection Checklist were adapted from the original version developed by the Malaysian Ministry of Housing and Local Government in 2014 (8,34). Consumers were instructed to evaluate each item using a cleanliness scale ranging from 1 to 10, reflecting their most recent visit to a food premise.

A 10-point scale was utilised to provide consumers with greater autonomy in selecting their precise preference rather than being limited to choosing a close approximation (37). The term "food premise" refers to any location that is involved in activities related to the handling, processing, and distribution of food products. This includes activities such as preparation, preservation, packaging, storage, conveyance, distribution, sale, relabelling, reprocessing, or reconditioning of food (38).

The assessment of consumers' food poisoning knowledge involved assigning a score of 1 for correct 'answers' and 0 for 'incorrect' or 'unsure' responses. The cumulative score was calculated by adding all the individual scores. The scores for the knowledge domain were classified as 'good' for scores 60% and above and 'poor' for scores below 60% (16, 39). Consumers were classified as having a "good attitude" and a "positive perception" if their percentage was 70% or greater. Individuals with scores below 70% were classified as exhibiting a "poor attitude" or a "negative perception" (39). In the evaluation of environmental factors, consumers were classified as having a 'good assessment' if their percentage was 70% or above, or as having a 'poor assessment' if their percentage was 70% or below.

The validity and reliability of the items in the KAPE2 questionnaire was assessed and documented in a previous study (34). The Fornell–Larcker criterion provided evidence supporting the discriminant validity of three latent constructs: attitude, preventive behaviour, and risk perceptions (34,40). Cronbach's alpha values greater than 0.7 indicate that the reliability of all scaled items within each construct is satisfactory. Specifically, attitudes, preventive behaviour, and risk perception demonstrated high internal consistency, with alpha values of 0.820, 0.809, and 0.799, respectively (34).

Statistical Analysis

Data analysis was conducted using SPSS version 26.0 for Windows (SPSS, Chicago) and Smart PLS version 3.2.6 for Windows (SmartPLS GmbH, Germany). The study employed descriptive analyses to provide a comprehensive summary of sociodemographic profiles and various attributes, including knowledge level, attitude level, preventive behaviour, level of risk perception, and environmental factors. The data was presented in the form of frequencies (n) and percentages (%) for categorical variables.

The normality of the knowledge, attitude, preventive behaviour, risk perception, and environmental factor constructs was found to be nonnormal based on the results of the Kolmogorov-Smirnov test. Consequently, the data were displayed as median (quartile range).

Structural Analysis

To evaluate the correlation between various constructs such as knowledge, attitudes, perceptions of risk, preventive behaviour, and food safety environmental assessment, a Partial Least Square (PLS) analysis was conducted using the SmartPLS 3.2.8 (SmartPLS GmbH, Germany) software. The PLS-SEM method is a valuable tool for analysing measurement and structural relationships, regardless of data normality (40). The variables used in this study encompassed perceived susceptibility, perceived severity, perceived barriers, and perceived benefits. These variables were employed to assess the psychological factors that influence individuals' engagement in food poisoning preventive behaviour. Furthermore, this study investigated the impact of individuals' understanding of food poisoning on their attitudes and behaviours related to food safety measures. In their study, Hair et al. (2014) provided an explanation for the development of a model that incorporates multiple constructs. The construction of this model was grounded in established theoretical frameworks (40). There are two distinct types of theory that play a crucial role in the development of path models: measurement theory and structural theory. Structural theory specifies the measurement of each construct while also illuminating the relationships between the latent variables (40). We refer to the Al-Sakkaf study from 2013 (9) in order to identify and arrange the constructs. In a study conducted by Al-Sakkaf in 2013, we created a framework consisting of three key factors that influence consumer behaviour in relation to food safety. These factors encompass personal factors, environmental factors, and the nature of the perceived risk (9). We did not incorporate demographic and socioeconomic factors in the current study, as these characteristics are not amenable to modification through health intervention (15). The arrangement of the constructs in the structural model was determined based on the given premise, as illustrated in Figure 1.

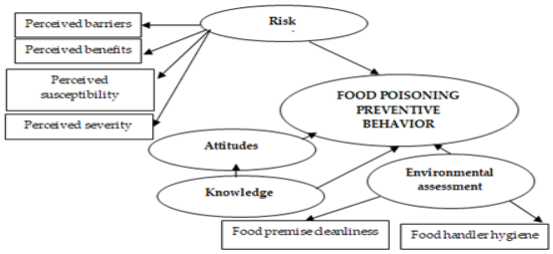

Figure 1: Structural food poisoning preventive behavior model.

Common-method Bias

Our study employed a self-administered survey. Evidence suggests that common method bias is likely to be a problem where a self-administered survey is conducted at a single point in time, although our enumerators were present during data completion in order to provide any clarification (41, 42). Common method bias is the variance that is accountable to systematic error rather than the study constructs, and it can introduce potential threat in behavioural research (41). Hair et al. (2014) suggested to find a common method bias, as

we can check the collinearity assessment using variance inflation factors (VIFs) for all the latent variables . VIF value of five and higher indicates a potential collinearity problem (40). The VIF assessment found that six items of the risk perception construct (Percept 6, Percept 7, Percept 10, Percept 11, Percept 12 and Percept 13) and one item from the environmental factor construct (Hyg 4) had a VIF value of more than five. Therefore, as proposed by Hair et al. (2014) and Kock (2015), items with high collinearity can be considered for removal or reassignment. In our case, we agreed that the items were to be removed from the construction (40, 42).

Ethical approval

Ethical approval for the conduct of this study was obtained from the Research Ethics Committee of the Islamic Science University of Malaysia (USIM/JKEP/2019-61) on 6 August 2019.

RESULTS

Consumer characteristics

Table I shows the sociodemographic characteristics of the consumers. The mean age of the consumers was 43.28 ± 15.05 years. More than half of the consumers were female, and most consumers were of Malay ethnicity. In addition, most of the consumers were married (69.1%) while 22.1% were single. A total of 44.4 % of the consumers obtained their education from secondary school, whilst 28% of them have a certificate or diploma. Almost half of the consumers were unemployed whilst the other half working in various sector (Table I).

Table I: Consumers' sociodemographic profile (n = 430).

Attributes		Mean (S.D)	
Age (years)		43.28 (15.05)	
		n	(%)
Gender	Male	181	42.1
	Female	249	57.9
Ethnicity	Malay	403	93.7
	Chinese	22	5.1
	Indian	2	0.5
	Others	3	0.7
Marital status	Single	95	22.1
	Married	297	69.1
	Separated/widowed	38	8.8
Education level	Informal	6	1.4
	Secondary	45	10.5
	Cert/STPM/Foundation	191	44.4
	Tertiary	45	57
Job sector	Self-employed	87	7.6
	Government	38	8.8
	Private	104	24.2
	Unemployed	201	46.7

Descriptive tests were used for the analysis. Data are presented as mean (S.D) for continues data and n (%) for categorical data.

Food poisoning knowledge, attitude, perceptions towards food poisoning prevention and food safety environmental assessment

Consumers underwent an evaluation of their knowledge, attitude, preventive behaviour, risk perceptions, and environmental factors regarding food poisoning. The scores were converted into percentages and organised according to previous research (10,49). A significant majority of consumers (77.2%) demonstrated a 'good knowledge'. The median score of 30.00(7.00) further supports this finding. Furthermore, the median attitude score was 63.00 (10.00), and an impressive 85.6% of consumers were classified as having 'good attitude'. The study found that most of the consumers were actively engaged in preventing food poisoning (Table II). However, a significant portion of consumers (36%) show a 'negative perception' toward the prevention of food poisoning. In Table II, it was found that 37.4 % of consumers rated their last visit to a food premise as 'poor environment' (Table II). Table II presents a concise summary of the scores and classifications assigned to the evaluated constructs.

Table II: Food poisoning knowledge, attitude, preventive behavior, risk perceptions and environmental factors scores.

Attribute	Median (QR)[a]	n (%)[b]
(A) Food poisoning knowledge		
Score	30.00 (26.00 – 33.00)	
Knowledge level		
Good (scores ≥ 60%)		332 (77.2%)
Poor (scores < 60%)		98 (22.8%)
(B) Attitude		
Score	63.00 (57.00 – 67.00)	
Attitude level		
Good (scores ≥ 70%)		368 (85.6%)
Poor (scores < 70%)		62 (14.4%)
(C) Preventive behavior		
Score	47.00 (43.00 – 51.00)	
Behavior level		
Good (scores ≥ 70%)		397 (92.3%)
Poor (scores < 70%)		33 (7.7%)

CONTINUE

Table II: Food poisoning knowledge, attitude, preventive behavior, risk perceptions and environmental factors scores. (CONT.)

Attribute	Median (QR)[a]	n (%)[b]
(D) Risk perceptions		
Score	56.00 (48.00 – 60.00)	
Perceptions level		
Positive (scores ≥ 70%)		275 (64.0%)
Negative (scores < 70%)		155 (36.0%)
(E) Environmental factors		
Score	129.50 (121.50 – 164.50)	
Environmental assessment level		
Satisfactory (scores ≥ 70%)		269 (62.6%)
Poor (scores < 70%)		161 (37.4%)

[a] Scores were exhibit as Median (QR) due to non-normally distributed data
[b] Attributes level were illustrated as n (%)

Model Measurements

The model measurement was evaluated based on three characteristics, namely factor loading, average variance extracted (AVE), and composite reliability. The initial number of preliminary items in knowledge, preventive behaviour, attitude, risk perception and environmental factor constructs were 42, 13, 15, 15 and 17 respectively. In order to meet the convergent validity, the items should undergo a unidimensionality process, in which the outer loading should be above 0.4 (40, 43). The unidimensionality process had identified few items due to their lower contribution to a construct (<0.4).

In this case, 34 items from knowledge, seven items from preventive behaviour, eight items from attitudes, four items from risk perceptions and one from environmental factor were deleted. We then performed a convergent analysis on the selected items, considering an AVE value of > 0.5 acceptable. Internal consistency of the model was measured using composite reliability whose values range between 0.70 to 0.90 and can be regarded as satisfactory (40). Table III summarizes the convergent validity for the model.

Table III: Assessment of measurement model.

Construct	Items	Outer loading[a]	AVE value[b]	Composite reliability [c]
Food poisoning knowledge	Spoilt food can be detected from physical change of food.	0.605	0.507	0.891
	Food is spoilt when it smells foul.	0.723		
	Spoilt food can be detected from the change of its taste.	0.685		
	Washing eggs before cooking can prevent from food poisoning.	00.645		
	Ones should wash using soaps each time after using toilet.	0.738		
	Raw food should be kept separated from cooked food.	0.699		
	Food premise should be kept free from pests such as rodents, cockroaches and flies.	0.787		
	Food handlers should practice good personal hygiene.	0.796		
Attitude	I will ensure the food premise hygiene grade when choosing a food premise.	0.728	0.581	0.903
	I will not buy food that is left at room temperature for a long period.	0.727		
	I will ensure the food premise that I visit is clean.	0.845		
	I will ensure to wash my hand with soap before eating.	0.718		
	I will lodge a report to relevant authorities if I witness any unhygienic food handling activities in a food premise.	0.783		
	I need to see doctor if I exhibit food poisoning symptoms.	0.738		
Preventive behavior	I reject food premise that harbor pests.	0.654	0.581	0.892
	I reject food premises from which the food handlers are smoking during food handling.	0.699		
	I look for food premise cleanliness grade before entering the premise.	0.733		
	I reject food premise of which the food handlers do not wear apron while handling food.	0.842		
	I will not buy food from food handlers who do not wear glove while handling food.	0.800		
	I will not buy food from food handlers who do not wear head cover.	0.654		
Risk perceptions	I feel that the risk of me getting food poisoning in Malaysia is low.	0.703	0.718	0.927
	I feel that my odds of getting food poisoning is low.	0.874		
	I feel that my risk of getting food poisoning is low because the food is prepared by food handler who practice a good personal hygiene.	0.842		
	I think safe-to-consume food usually sold at reasonable price.	0.871		
	I believe it easy to find food premise that sell safe and hygiene food.	0.887		
Environmental factor	The eating utensils were clean	0.746	0.613	0.962
	The air ventilation in the premise was good.	0.759		
	The food handlers wore clean apron.	0.754		
	The food handlers wore gloves while handling food.	0.747		
	Wall and ceiling were cleaned from webs or dust.	0.784		
	The premise floor was dry.	0.803		
	The premise did not use any floor mat.	0.716		

CONTINUE

Table III: Assessment of measurement model. (CONT.)

Construct	Items	Outer loading[a]	AVE value[b]	Composite reliability [c]
Environmental factor	There were no food debris on the floor.	0.790	0.613	0.962
	The washroom facilities were free from foul smell.	0.809		
	The toilet pump was functioned.	0.800		
	The washroom facilities had sufficient water.	0.817		
	The washroom's door did not facing to dining room.	0.809		
	The premise was equipped with liquid soap.	0.779		
	The hand washing facilities was equipped with tissue or hand blower.	0.795		
	There was no pest infestation in the premise.	0.809		
	The rubbish bins were covered.	0.804		

[a] Outer factor loading was accepted at ≥ 0.4
[b] Average variance extraction (AVE) was accepted at > 0.5
[c] Composite reliability was accepted at > 0.7

The researchers also measured the model discriminant validity using the Fornell - Larson criterion. Hair et al. (2014) described Fornell – Larcker as the square root of AVE values of the latent constructs (40). Table IV exhibits that the diagonal value in bold is higher than its row and column, and as such confirmed the discriminant validity (43).

Table IV: Discriminant validity for each latent construct.

Construct	Attitude	Environmental factor	Food poisoning knowledge	Preventive behavior	Risk perceptions
Attitude	0.756				
Environmental factors	0.168	0.783			
Food poisoning knowledge	0.230	0.002	0.712		
Preventive behavior	0.345	0.262	0.249	0.762	
Risk perceptions	0.080	-0.091	0.175	0.189	0.847

Structural Model Evaluation

The structural model relationships were determined using path coefficients that represent the hypothesized relationships among the constructs. The path coefficients standardized value range between -1 and +1, of which coefficient close to +1 represent strong positive relationships and vice versa for negative values (40). In order to identify whether the coefficient is significant, bootstrapping was conducted. The bootstrap standard error allows the calculation of the empirical t value. Hence, the four path analyses in the current study exhibit that knowledge (β= 0.257, p =0.004), attitude (β= 0.381, p< 0.001), risk perceptions (β= 0.242, p < 0.001), and environmental factors (β= 0.333, p < 0.001) have a significant positive relationship with food poisoning preventive behaviour. Similarly, food poisoning knowledge have significant positive relationship with consumer's attitude (β= 0.321, p <0.001). With this, we can conclude that Hypothesis 1 (H1), Hypothesis 2 (H2), Hypothesis 3 (H3), Hypothesis 4 (H4) and Hypothesis 5 (H5) are supported (Table V).

Table V: Structural model finding based on study hypotheses.

Hypotheses	β- value	t-value	R^2	Q^2	Hypotheses decision
Knowledge a Attitude	0.321	4.023[a]	0.053	0.028	Supported
Knowledge a Preventive behavior	0.257	2.892 [a]	0.221	0.115	Supported
Attitude a Preventive behavior	0.381	4.344 [a]			Supported
Risk perceptions a Preventive behavior	0.242	3.731 [a]			Supported
Environmental factors a Preventive behavior	0.333	4.265 [a]			Supported

[a] statistically significant at p< 0.05

Model predictive accuracy is identified by the coefficient of determination, or R2 value. The R2 value ranges from 0 to 1 indicating higher levels of predictive accuracy (40). The model exhibits 0.220 indicating that the construct explained 22.1% variances to preventive behaviour (Refer to Table V). Hair et al. (2014) and Rasoolimanesh et al. (2016) proposed that a R2 value of 0.20 is considered high in the discipline of consumer behaviour (40, 44). On the other hand, attitude towards food safety was 0.053, reflecting 0.053% of the variance explained in consumer's preventive behaviour. Furthermore, blindfolding was implemented to calculate the predictive relevance of the model, as indicated by Stone Geisser's Q2 value (40). A Q2 value greater than 0 suggests that the path model has predictive relevance for the specific construct being studied (40,44). The Q2 value for preventive behaviour was 0.115, indicating a significant level of predictive relevance. In contrast, the Q2 value for attitude was 0.028, suggesting a relatively low level of predictive relevance. Therefore, it is proposed that this particular structural model possesses the capability to make predictions regarding latent endogenous constructs (40,44). The model of food poisoning preventive behaviour is summarised as in Figure 2.

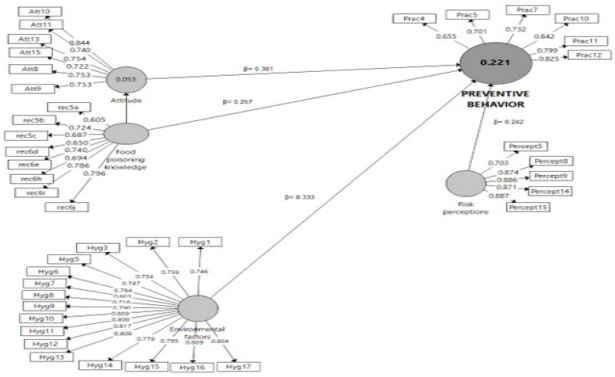

Figure 2: Evaluation of structural model.

DISCUSSION

This survey was conducted among consumers in Ampang areas, whereby the area was known for its population density in Selangor, with a total of 861,189 populations reported in 2010 (28). Its strategic location, that is near to Kuala Lumpur, has become an attraction to consumers, especially in the gastronomy sector (28). In addition, the availability of e- hailing services enables access to ready-to-eat food around Klang valley, which may expose to the risk of food poisoning due to time and temperature abuse and food malpractice (4,5). WHO emphasised consumers as the final gatekeepers in food safety assurance (11). Hence, good knowledge, attitude, and risk perception on food poisoning may promote the engagement of food safety behaviour (14, 16, 21).

The survey reveals more than 70% of the consumers around Ampang areas were regarded as 'Good' in food poisoning knowledge, attitude and preventive behaviour. The current finding is similar to Ruby et al. (2019 a) and Talaei et al. (2015), and these are more evident among those in the younger age group and those with higher levels of education (14, 39). It is explained that younger consumer within the age range of 30 to 49 years old were found to be significantly knowledgeable about food safety due to food safety information exposure via various sources of social media (39). Moreover, consumers with higher education were more aware of the risk of food poisoning and more concerned about the occurrence of contracting food poisoning. The risk perceptions, on the other hand, identified 64% of consumers who positively perceived that their risk of getting food poisoning was low. The low likelihood of consumers adopting food poisoning preventive behaviour is a cause for concern, as it indicates a sense of disempowerment in their ability to protect themselves from food poisoning (21, 35, 46). In a study conducted by Hanson et al. (2015), the authors observed a decrease in preventive behaviour regarding high-risk food consumption as individuals experienced heightened feelings of personal threat (21).

Consumers in our study evaluated the food safety environmental factors that influence the selections of food premise. In a study conducted by Ungku Zainal Abidin et al. (2011), the importance of understanding how consumers assess the risk factors associated with food safety on food premises was emphasised. The consumer's food safety concern stemmed from the observation of factors such as the personal hygiene of food handlers and the cleanliness of eating cutlery (25). Our study revealed that over 50% of consumers reported a satisfactory experience at the food premise during their most recent visit. The evaluation in our study encompasses the food handler's personal hygiene, the quality of washroom facilities, the cleanliness of eating utensils, the dining ambience, and the structure of the food premises. In line with previous research (25, 45), the findings of our study indicate that consumers assess the cleanliness of a food establishment by considering factors such as premise hygiene, ambient conditions, and the behaviour of food personnel. The impact of environmental factors, such as premise cleanliness and food handler personal hygiene, on consumer repurchase intention for the sold food was found to be inconclusive (45).

Furthermore, our study presented a model for preventing food poisoning that encompassed all the constructs previously discussed. In summary, the variables of the Health Belief Model (HBM) have effectively accounted for 22.1% of the variability in the positive impact of attitude, knowledge, and environmental factors. One of the constructs, attitude, had the most significant impact on food preventive behaviour ($\beta = 0.381$). These findings align with prior studies conducted by various researchers (16, 22, 27). In a recent study conducted by Soon et al. (2020), the authors highlight the significance of attitude as a pivotal factor that influences the relationship between knowledge and behaviour. The level of motivation required to practice food safety behaviour can be indicated by a positive attitude (27). However, a lack of awareness and failure to recognise the seriousness of food poisoning can result in an unwillingness to follow proper food safety practices (46). For instance, consumers may not find using a thermometer effective in reducing food poisoning as they perceive this method as a waste of money and time (46). Therefore, a positive attitude can be only instilled when a person believes specific behaviour can reduce the chance of food poisoning; then only good food handling behaviour can be exercised (27, 46).

Our study found that food safety environmental factors had a significant impact on food poisoning preventive behaviour ($\beta = 0.333$). According to a study by Ungku Zainal Abidin et al. (2011) and Vainio (2020), food premises hygiene has a significant impact on consumer decisions. Interestingly, their research revealed that food variety and convenient location were the top two factors considered by consumers, with food premise hygiene ranking third (25, 45). Our study found that the washing room facilities, including adequate water

supply, convenient location, and absence of unpleasant odours, were the most significant factors contributing to the overall construct. In a consumer's selection of food premises, the absence of pest infestation is considered an important factor. Our research findings are in direct contrast with the studies conducted by Ungku Zainal Abidin (2011) and Vainio (2020). These studies concluded that consumers do not consider the cleanliness of the lavatory and floor, as well as the grading of food premises, to be significant. One potential explanation for their discovery may be attributed to the fact that the maintenance of restaurant cleanliness fell within the purview of the foodservice staff (25).

The pathway evaluation exhibits that food poisoning knowledge positively affects food poisoning preventive behaviour ($\beta = 0.257$). The finding contradicts the previous studies, in which the knowledge did not affect food safety handling practices (16, 27). Nonetheless, it is demonstrated that consumers with good knowledge of food poisoning will not engage in any risky behaviours that include eating raw or partially cooked food, and they are more willing to improve their knowledge (14). This could be further explained by the finding that knowledge positively impacts attitude ($\beta = 0.321$), although it only explains 5% of the variance. Quick et al. (2013) agreed that although knowledge is an important factor that develops consumers' attitudes, it requires more enhancement to strengthen its position (47). This is necessary for consumers to be more positive about protecting themselves and more aware of what they consume. In addition, consumers with a positive attitude tend to handle food safely as a result of their concern towards preventing food poisoning (27, 47).

In our study, we found that risk perception had the lowest predictive value ($\beta = 0.242$). While risk perception was found to be the weakest factor among other variables, it still emerged as a significant predictor of individuals' adoption of preventive measures against food poisoning. With a variance percentage of less than 1%, McArthur's (2006) study found that the Health Belief Model (HBM) was not a reliable predictor of food handling practices. However, recent research has provided support for the idea that risk perception plays a significant role in promoting preventive behaviour (24, 25, and 45). As an illustration, customers who believed they were vulnerable to contracting food poisoning displayed a greater inclination to refrain from consuming or purchasing food from a restaurant that received a low grade (45). In addition, understanding consumers' risk perceptions can aid in developing a more targeted intervention method that is tailored to their specific perceptions (48).

Research findings clearly demonstrate that a person's knowledge and attitude play a pivotal role in determining their adherence to food poisoning prevention measures. Numerous studies have consistently supported the notion that enhancing consumer knowledge and fostering a positive attitude towards food safety can effectively promote safe food handling practices. Several studies focused on the preparation and safe handling of food in a home setting (16, 22, 27, 46). There has been limited exploration into the impact of these factors on consumers' behaviour regarding the safety of purchased cooked food. In addition, our study incorporates the examination of cross-contamination practices and the identification of contamination sources as crucial elements in the prevention of food poisoning, as suggested by Mihalache et al. (2021)(49).

Theoretical implications

Our study presents a comprehensive framework that explores the relationship between knowledge and attitude towards food poisoning prevention, consumer assessments of food safety environmental aspects, and risk perceptions, and how these factors contribute to the enhancement of preventive behaviour. The integration of emotional components of attitude and perceptions of risk seeks to enhance the adoption of preventive measures against food poisoning. The study incorporated a health belief model into the formation of the structural model. It is hypothesised that consumer behaviour may be influenced by the perceived level of threat and evaluations of potential actions. The use of the Health Belief Model (HBM) as the theoretical foundation in the examination of food safety was relatively limited in comparison to other established theories like the Theory of Planned Behaviour (TPB), Health Action Process Approach (HAPA), and Protection Motivation Theory. One study examined specific food handling intentions in accordance with the Health Belief Model (HBM) (23). In their study, Wang et al. (2021) focused exclusively on examining the various elements of the Health Belief Model (HBM). These elements included perceived susceptibility, perceived barriers, perceived severity, perceived benefits, perceived barriers, and self-efficacy (23). Our study contributes by incorporating attitudes and knowledge that can directly and indirectly influence consumers' food-preventive behaviour. Furthermore, the incorporation of HBM, knowledge, and attitude has accounted for 22.1% of the preventive behaviour, indicating that these factors possess significant predictive power in relation to food poisoning prevention. Therefore, the implementation of the HBM framework, along with the inclusion of knowledge and attitude, presents potential alternatives for food safety interventions aimed at promoting desired food preventive behaviour.

The application of PLS-SEM in assessing the direct impacts between the latent variables offers valuable insights into the extent to which these effects contribute to consumer behaviour (40). This information is valuable for community health educators who are tasked with developing food poisoning prevention interventions. By identifying the most significant factor

that can potentially alter consumer behaviour towards preventing food poisoning, educators can design more effective interventions (40,48).

Policy implications

The findings of our study have yielded essential insights, not only in terms of theory but also in terms of practical applications for policymakers and other stakeholders. These findings offer valuable opportunities to enhance existing food safety educational programmes. The discovery also suggests that the Health Ministry of Malaysia (MOH) should increase its efforts to educate consumers about food safety. This can be done by focusing on factors that enable food preventive behaviour, such as knowledge, attitude, risk perceptions, and food safety environmental assessment. The study's results highlight the importance of developing a targeted food safety intervention programme that effectively communicates the risk of food poisoning to consumers. Specifically, the data reveals a significant number of consumers who perceive themselves as less susceptible to food poisoning, suggesting the need for a strategic approach to address this perception (48). In addition, the findings of the food safety environmental factor assessment indicated that the cleanliness of the premises and the personal hygiene of food handlers were found to have less significance in the selection of food premises. The results of this study suggest that there is a clear necessity to promote the selection of clean food premises and the adoption of proper personal hygiene practices by food handlers to minimise the likelihood of food poisoning. The significance of a food safety program is just as crucial as a nutritional education program, given the prevalence of food poisoning cases. During the COVID-19 pandemic, there was a notable increase in high-risk food poisoning behaviour among consumers (50). Furthermore, the availability of online food purchasing options may expose consumers to the potential danger of food poisoning due to mishandling during the preparation and transportation of the food (4,5,50).

Limitations

Several limitations were identified in this study that require further consideration. The use of a survey method in our study poses limitations on our ability to establish causality. Therefore, it is suggested that an experimental or longitudinal study be conducted on various constructs for further investigation. This study also recognises that the inclusion of HBM may result in a limited ability to predict outcomes for existing HBM variables ($R2 < 0.21$). In this study, we suggest the use of an extended Health Belief Model (HBM) that incorporates four additional variables: self-identity, perceived importance, consideration for future consequences, and concern for appearance. These variables should be considered in future research on food safety (48). Ultimately, the assessment of food poisoning preventive behaviour relied on self-reported data rather than objective measures. There is a possibility that individuals may have a tendency to underreport their unsafe food handling practices. Therefore, it is imperative to conduct further research to examine the adoption of preventive behaviours among consumers when purchasing food from external sources.

CONCLUSION

This study provides evidence supporting the correlation between knowledge, attitude, risk perceptions, and food safety environmental assessment with food poisoning preventive behaviour. The present study demonstrates that attitude emerged as the most influential factor in predicting food poisoning preventive behaviour among consumers in the Ampang region. The relationship between knowledge about food poisoning, risk perceptions, and environmental factors has been found to account for 22.1% of the variance in food poisoning preventive behaviour. The results indicate that increasing knowledge about food poisoning may have a beneficial effect on consumer attitudes, despite accounting for only a small portion of the overall variability. Incorporating risk perceptions and conducting food safety environmental assessments have been found to impact consumer behaviour in preventing food poisoning. Therefore, this discovery suggests that the creation of an efficient food safety intervention should account for the psychological factors, knowledge, and environmental factors related to food safety.

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