ORIGINAL ARTICLE

Online Food Poisoning Educational Intervention: Can It Be an Effective Medium to Improve Consumer's Knowledge, Attitude and Risk Perception on Food Poisoning Prevention?

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ABSTRACT

Introduction: Food poisoning is a significant issue that has garnered attention in the realm of public health. Given the recent documentation of multiple outbreaks associated with food poisoning, it is imperative to prioritise the education surrounding this issue over other food and waterborne diseases. **Materials and methods:** The content for the food poisoning prevention educational module, 'See, Select, Tell', was developed through a comprehensive review of existing literature and careful analysis of relevant documents. The validation of both the face and content of the study was confirmed by experts in the field. The module was implemented using Google Classroom, an online platform for blended learning. The study aimed to assess the usability of the module through a pre- and post-experimental design to measure its effectiveness. Additionally, feedback from consumers was collected to evaluate the overall usefulness of the module. **Results:** The developed module elements were acceptable based on the experts' validation (coefficient validity > 0.7). The module efficiency was tested, and there was a significant increase in knowledge scores in both the intervention and control group after 4 weeks' intervention (t (29) = 9.95, p= <0.001, d = 1.82 and t (29) = 20.76, p = <0.001, d = 3.79 respectively). The attitude scores increased significantly from 57.47 (9.28) to 61.97 (10.0) in the intervention group after 4 weeks of module implementation (p= 0.019). **Conclusion:** The module could potentially serve as a valuable tool for health educators, enabling them to effectively educate and inspire the public to make informed decisions regarding healthy food choices and maintaining clean food preparation areas. This, in turn, has the potential to contribute to the prevention of food poisoning outbreaks in Malaysia.
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Keywords: Food poisoning prevention educational module, Consumer, Knowledge, Attitude, Risk perceptions

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INTRODUCTION

Previous studies have shown that a significant number of cases of food poisoning can be attributed to a lack of understanding regarding proper food safety practices. These practices encompass various aspects of food handling, such as inadequate cooking techniques, cross-contamination, the use of contaminated ingredients, and improper storage methods (1 – 3). Although knowledge plays a crucial role in influencing individuals' food preventive behaviour, it is worth noting that around 50% of the studies conducted on food handlers have found that knowledge alone does not always result in practical application (2,4). An incident occurred in November 2023 where 49 students from primary and secondary schools in Penang experienced food poisoning after consuming *nasi lemak* from the same canteen (5). Furthermore, there were two fatalities reported in the preceding month that involved personnel from Perhilitan. These individuals were suspected to have contracted food poisoning in Dungun, Terengganu (6). Hence, the guarantee of food safety extends beyond the purview of food manufacturers and handlers to encompass the role of consumers as well.

The World Health Organisation (WHO) has highlighted the crucial role of consumers in the food chain to ensure the safety of the food they consume (7). It has been suggested that incorporating food safety knowledge and attitude into food safety education could potentially reduce the likelihood of consumers

contracting food poisoning (8–10). In a recent study by Ruby et al. (2019 a), it was found that there is a correlation between consumer knowledge and food safety practices (8). Previous research has shown that knowledge is a significant factor in predicting food poisoning behaviour. Several studies have indicated that enhancing consumers' knowledge and attitudes can lead to improved food safety behaviours among consumers (8, 11). The food preventive behaviours of individuals can be influenced by their attitudes, which, when combined with knowledge, can enhance the likelihood of consumers engaging in food safety protective behaviours (9). However, individuals who have a lower inclination towards practicing food safety measures tend to show less concern for factors such as food quality, food safety, and even food integrity when making food purchases (10). In 2017, Wahida et al. conducted a study that discovered that consumers who are optimistic about choosing food premises, even in the presence of unsanitary conditions, are more likely to be at risk of food poisoning (11).

In addition to attitude, the risk perceptions of consumers also play a role in their limited engagement with preventive measures against food poisoning. As demonstrated in previous studies (12,13), there is a correlation between individuals who perceive themselves as less susceptible to food poisoning and their tendency to engage in risky behaviour related to food safety. Furthermore, it was noted that individuals exhibiting an optimism bias tended to make suboptimal selections in terms of their dietary preferences (12). The selection of food options was primarily influenced by heuristics associated with the consumer's knowledge, the cost of the product, and their previous experience with the product (14,15). Consequently, this heuristic feeling may impart a heightened sense of assurance in the choice of food, leading to a diminished perception of risk (14). Understanding the risk perception of consumers is crucial for developing effective interventions to enhance their awareness and perception of food poisoning prevention. As an illustration, employing a personal kitchen audit to evaluate the safe food handling behaviour of consumers has the potential to be a promising approach to enhancing their understanding and conduct regarding food safety (16).

In Malaysia, there is a strong commitment to safeguarding the public's access to clean, safe food. This is achieved through the implementation of various preventive measures aimed at reducing the risk of food poisoning. These measures include a comprehensive training programme for food handlers, a grading system for food premises, and the recognition of facilities that adhere to strict standards of hygiene and healthy food preparation. This initiative, known as *Bersih, Selamat,* and *Sihat* (BeSS), plays a crucial role in ensuring the well-being of the community (17, 11). However, most of the initiatives focused primarily on food vendors. Past research has shown that the knowledge, attitude, and risk perceptions of consumers can influence their adoption of food poisoning preventive behaviour (8–10, 12). Therefore, the implementation of a food safety programme is considered crucial for consumers due to the occurrence of food poisoning incidents. Prior research has suggested that consumers have the potential to play a crucial role in the food supply chain as catalysts for change. By fostering a strong desire for a positive food safety culture, consumers can effectively influence both food handlers and food vendors (18–20). The efforts and procedures of vendors have an impact on consumers' perceptions of food safety, which in turn fosters a sense of ongoing confidence in the vendors' capacity to safeguard their products against any potential contamination. In a comprehensive meta-analytic review conducted by Nardi et al. (2020), it was discovered that trust plays a crucial role as the main antecedent in shaping individuals' perceptions of food safety risks. Consumers who have trust in their suppliers tend to rely less on additional information to determine the safety of a particular food supplier or food product (21).

Existing research has established a clear link between cognitive and psychosocial factors and consumer behaviour to prevent food poisoning. This highlights the importance of empowering consumers in these areas to make informed choices when selecting food vendors that prioritise cleanliness and safety (20). Furthermore, harnessing the desire of consumers to enhance the safety practices of vendors shows great potential. Therefore, implementing an educational intervention aimed at consumers has the potential to enhance their knowledge, attitude, and risk perceptions regarding the prevention of food poisoning.

In the age of borderless learning, the integration of multimedia in the Moodle Learning Management System (LMS) presents a novel approach to enhancing food safety knowledge. According to a recent study by Alberts and Stevenson (2017), the incorporation of multimedia components into the Learning Management System (LMS), such as videos and interactive games, had a positive effect on students' understanding of Hazard Analysis and Critical Control Point (HACCP) and Good Manufacturing Practice (GMP). Additionally, this approach also influenced students' behavioural intentions (Alberts & Stevenson, 2017, p. 22). The incorporation of video as a tool in this study has proven to be instrumental in enhancing students' comprehension of complex concepts (22). However, the validity of this study's findings may be subject to scrutiny due to the absence of a control group for comparison (23). The single-group pre-post design has several limitations in providing conclusive evidence, yet some researchers may choose to utilise this design for the sake of practicality and feasibility (24). The study aimed to create an online educational module called

'See, Select, Tell' for preventing food poisoning. The effectiveness of this module in enhancing consumers' knowledge, attitude, and risk perceptions regarding food poisoning prevention was evaluated using a quasi-experimental design.

MATERIALS AND METHODS

'See, Select, Tell' module design

To facilitate module design, a Sequential Iterative Model (SIM) was employed. In accordance with the SIM model, it is imperative for an educational module to commence by establishing the aim and objectives, with a specific emphasis on the desired training outcomes. Subsequently, it is imperative to ascertain the pivotal subjects that necessitate the curation of content pertaining to the prevention of food poisoning. The content is arranged in a specific sequence, prioritised by experts in the field. The incorporation of the training material into the model aims to optimise the efficiency of the training process. As part of the evaluation process, an assessment of the module's content is conducted for each component. This assessment aims to gauge the module's usability among consumers (25).

Document and literature analysis

A document analysis was conducted to identify the components for food poisoning prevention to be included in the module. The research technique of document analysis involves the examination of written texts, including books, book chapters, essays, interview findings, discussions, news articles, historical documents, advertisements, and theatre materials, among others, which are used as means of communication (26). The objective of document analysis is to identify the essential components of food poisoning prevention that should be integrated into the module and proposed intervention activities. The analysis incorporates guidelines from the Centre for Communicable Disease Control and Prevention (CDC) and the Malaysian Ministry of Health (MOH), as well as relevant literature on dining out and ensuring the consumption of clean and safe food. An analysis was conducted on several factors pertaining to the purchase or consumption of food from external sources. The CDC and MOH placed significant emphasis on several key elements, including the evaluation of food premise cleanliness grades or scores, the importance of food handlers' personal hygiene, safe food handling practices, proper cooking techniques, ensuring food safety while dining out or eating away from home, preventing time-temperature abuse of food, and addressing food poisoning or mishandling complaints.

In this regard, the elements have been categorised into four groups to be incorporated as the module unit or scope. The following sections are included in this study: (i) Introduction to the occurrence of food poisoning; (ii) Selecting food that is safe for consumption; (iii) Establishing a channel for reporting cases of food poisoning and mishandling; and (iv) Ensuring timely treatment for food poisoning cases.

Module content and activities

The module scopes were carefully designed to align with the specific domain of interest. These scopes included: (i) knowledge about food poisoning prevention; (ii) attitude towards food safety; and (iii) risk perception. This approach was taken to ensure that the content of the module could effectively measure the desired outcomes related to food poisoning preventive behaviour (27). Subsequently, the fundamental subjects pertaining to each module's scope were incorporated. In order to accomplish this, we carefully selected relevant topics from existing literature research that aligned with the scope of each module. The summarised information can be found in Table I. The delivery strategies for online module activities were developed with a focus on achieving the desired outcome of the module scope activities, including online and video demonstrations, online interactive games, short- films, and web applications. The online delivery strategies for each activity are depicted in Table II.

Table I: 'See, Select, Tell' module domain, scope and related key topics.

No	Module outcome/ domain	Module scope / unit	Key topics
1	Knowledge, risk perceptions (perceived severity, perceived benefits)	Introduction to food poisoning	i.Food poisoning signs and symptoms ii.Food poisoning complications and effect to individual and country iii.Food contamination source iv.Cross- contamination
2	Attitude, risk perceptions (perceived barriers)	Choosing safe-to eat food	i.High-risk and low-risk food to contamination ii.Spoilt food identification iii.Food premise cleanliness assessment
3	Knowledge, attitude	Lodging food mishandling and insanitary food premise complaint	i.Type of food mishandling ii.Food premise insanitary example iii.Available lodging complaint medium and how to use them
4	Attitude, Risk perceptions (perceived severity, perceived barriers, perceived benefits, self-efficacy)	Getting prompt treatment for food poisoning	i.Treatment involved in food poisoning ii.Food poisoning complication iii.The role of family members and community in getting prompt treatment for food poisoning.

Table II: Deliveries strategies for online module activities.

No	Activity	Modified delivery strategy
1	Mix and match	Online interactive game for food poisoning signs and symptoms.
2	*Euww… apa tu?*	Separation of food contamination source using Google drawing
3	*Rantaian beracun*	Video demonstration on food cross-contamination
4	*Mak pergi pasar*	Identification of high-risk food using Google slide
5	*Detektif Along*	Video on food premise cleanliness; Google form
6	*Elok lagi ke tak?*	Video demonstration on spoilt food detection; Google slide
7	Complaint medium for food mishandling and insanitary premises	Online demonstration; Google drawing
8	Understand the community roles: *Adik muntah - muntah*	Short film projection *Kerana rasa, badan binasa*; Google doc

Module validation and pre- testing

The module underwent a rigorous validation process, involving the assessment of seven experts from various backgrounds, including two experts from community health, two local authority personnel, two food hygienists, and one health practitioner respectively. These experts were carefully selected based on their experience and involvement in the field of food safety or educational modules, with representation from both government and non-government agencies. The selection process involved choosing experts with a minimum of 10 years of experience in the fields of food safety and food safety education (27). According to Adler and Ziglio (1996), enough experts for a study can range from 7 to 15, as long as there is a high level of consistency among them (28). The module underwent validation using a Sidek and Jamaludin (2005) checklist modification (27). The validation components consisted of the module objective, module scope, delivery strategy, resources, module scope evaluation, module scope arrangement, and time allocation. The items were developed using a 5-point Likert scale.

Scores given by the experts from the Likert scale were calculated based on the formula (27):

$$\text{Validit acheivement} = \frac{[\text{Total experts' score (x)}]}{[\text{Maximum score}]} \text{ X } 100\%$$

When the percentage obtained for each module component exceeds 70%, it can be considered acceptable, whereas a percentage below 70% is regarded as indicative of low module validity (27). The percentage was then converted into a correlation coefficient. Therefore, a content validity value of 75% can be interpreted as having a correlation coefficient of 0.75 (27).

A pre-test of the module was conducted among 25 consumers residing in Kajang, Selangor, Malaysia. The consumers were required to meet certain criteria, including being 18 years of age or older, having proficiency in both Bahasa Malaysia and English, and regularly purchasing or consuming meals outside of their homes at least once to three times a month. The pre-test was carried out to identify potential language inconsistencies and ambiguities in the wording. Feedback on the module implementation was collected through a survey that utilised a 5-point Likert scale, ranging from "strongly agree" to "strongly disagree." Modifications were made in response to the feedback provided.

Module implementation – respondent recruitment and instruments

The deployment of the module aims to evaluate its effectiveness and utility. A pre- and post-quasi-experimental study was conducted to evaluate the effectiveness of the "See, Select, Tell" module. The selection of respondents took place in two distinct areas in Negeri Sembilan, specifically KTMB Gemas (the intervention group) and Dangi, Kuala Pilah (the control group). The study was carried out with the assumption that assigning respondents randomly from a comparable sample pool to either the treatment or control groups might result in the occurrence of the 'Hawthorne effect' (29). The study recruited respondents who agreed and consented to participate. The respondents were Malaysian, had IT literacy, and reported buying or eating away from home at least one to three times a month.

The sample size for the interventional study was determined using the methodology proposed by Chan (2003). The formula considered the standardised effect size for the intended outcome of knowledge, attitude, and behaviour (30). The sample size was determined through a calculation that considered the highest values obtained from the attitude domain and adjusted for a 20% attrition rate (29). Therefore, a sample size of 30 participants was assigned to both the control and intervention groups. To address the absence of randomization in a quasi-experimental design, the participants were carefully matched based on their baseline scores for food poisoning knowledge (29). In order to mitigate the potential bias caused by respondents' pre-existing knowledge and experience of food poisoning, participants from both the intervention and control groups were carefully chosen. Specifically, only individuals with a baseline knowledge score below 60 were included, as suggested by Talaei et al. (2016) and Ruby et al. (2019b) (8, 31).

An evaluation was conducted to assess the effectiveness of the module in enhancing knowledge attainment, food poisoning prevention attitudes, and risk perceptions. The outcomes were assessed one week prior to the module intervention and one week following the intervention (pre and post). An assessment was conducted to evaluate

individuals' understanding, beliefs, and perceptions regarding food poisoning. This was done through a questionnaire that respondents completed voluntarily. The questionnaire used was KAP2E, which was developed based on previous research (32). The validity and reliability of all items in KAP2E were assessed (32). The scores from the items were aggregated to generate a summary score.

Three module trainers were selected from the health inspectors of the Tampin Health District Office, Negeri Sembilan. The trainers chosen for this study were individuals who possessed a deep understanding of the subject matter covered in the module (27). The trainers underwent comprehensive training during the "train-the-trainer" sessions, which focused on the module content.

Module implementation – administration

The module activities were carried out using the Google Classroom platform. The respondents were allocated to three different break rooms, each supervised by a designated trainer responsible for overseeing the activities. The module activities were carried out over a span of four sessions, with each session consisting of three hours of dedicated activities. The sessions were conducted over the course of the weekend.

In contrast, the control group received a collection of infographics on food safety sourced from the Malaysian Ministry of Health. The infographics were disseminated to the participants through the WhatsApp platform. In line with the intervention group (module), all participants were provided with informed consent and given a brief overview of the study by WhatsApp platform. Four infographics were presented, encompassing the subjects of time and temperature control, cross-contamination, selecting sanitary food premises, and hand hygiene.

Respondents in both the control and intervention groups were administered a series of questionnaires to evaluate their knowledge, attitude, preventive behaviour, and risk perceptions regarding food poisoning and its prevention one week prior to the intervention. The survey was conducted using an online platform provided by Google. A follow-up assessment was carried out one week after the intervention, utilising the identical questionnaire. The study process flow is illustrated in Figure 1.

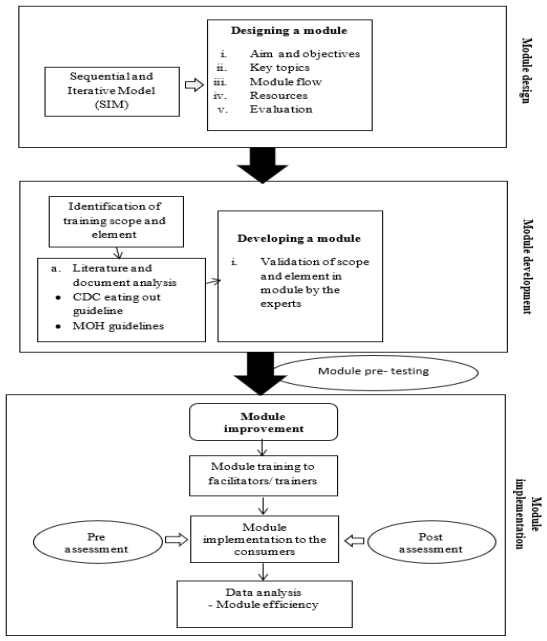

Figure 1: Flowchart of the study process.

Data analysis

Data on respondents' knowledge regarding food poisoning prevention, their attitudes, and perceptions of risk were entered into the Statistical Package for Social Sciences (SPSS) version 21 (Chicago, USA). To assess respondents' understanding of food poisoning, a scoring system was implemented. A correct answer was awarded 1 point, while an incorrect or uncertain response received 0 points. The cumulative score was calculated by summing all the individual scores.

Conversely, when evaluating items employed in assessing attitudes towards food poisoning prevention and risk perception, negative items were initially scored in the opposite direction. The scores for each construct were then combined to generate a comprehensive summary score. An analysis was performed to examine the percentage of module pre-testing feedback, focusing on consumer satisfaction with module language clarity and comprehension.

The normality of all knowledge, attitude, and risk perception domains was confirmed using the Kolmogorov-Smirnov test, indicating a normal distribution. As a result, parametric tests were employed

for further analysis. A statistical analysis technique known as the independent t-test was employed to assess and compare the average scores of both the control and intervention groups. A paired t-test was conducted to compare the mean scores of two sets of findings within the same group, specifically before and after the intervention. A significance level of P value < 0.05 was deemed significant for all statistical tests performed.

Ethical approval

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

RESULTS

Module validation score

The validation score of the 'See, Select, Tell' module was determined by calculating the percentage obtained from the sum of each component of the module, as evaluated on the Likert scale, relative to the maximum possible score. The assessment of the module components encompasses various aspects, including the module objective, the content covered within each module scope, the delivery strategy employed, the resources utilised, the evaluation of topics, the arrangement of the module, and the allocation of time for each activity. When evaluating the module's validity, a percentage above 70% was deemed indicative of high validity. The percentage was subsequently converted into a validity correlation coefficient. The correlation coefficient and validity attainment are presented in Table III. With a validity coefficient of 0.9071, all experts deemed the module scope objectives to be appropriate. The content embedded in the four module scopes demonstrates suitability, with a validity coefficient exceeding 0.70. The consensus among experts is that the delivery strategies, resources allocated to each activity, and the evaluation of topics are all deemed suitable. The experts found the module scope arrangement and time allocation for each activity to be acceptable, with a validity coefficient of > 0.7).

Table III: Module validation attainment scores for each component.

No	Validation component	Validity percentage (%)	Validity coefficient	Validity attainment
1	The suitability of learning objectives for every module scope	90.71	0.9071	Attained
2	The suitability of the content in each module scope			
	i.Introduction to food poisoning	90.48	0.9048	Attained
	ii.Choosing a- safe to eat food	90.48	0.9048	Attained
	iii.Lodging food mishandling and insanitary food premise complaint	89.52	0.8952	Attained
	iv.Getting prompt treatment for food poisoning	79.52	0.7952	Attained
3	Delivery methods	90.61	0.9061	Attained
4	Learning resources	89.29	0.8929	Attained
5	Content evaluation	87.62	0.8762	Attained
6	Module scope arrangement	87.35	0.8735	Attained
7	Time allocation for each activity	90.65	0.9065	Attained

The feedback from the pre-testing of the module was documented and can be found in Table IV. The feedback was collected using a 5-point Likert scale, ranging from "strongly agree" to "strongly disagree." The consensus among all respondents was that the language employed in the module delivery was highly comprehensible, with the instructions being clear. Interestingly, a small but notable portion of the respondents, approximately 12%, expressed varying levels of agreement or disagreement regarding the utilisation of scientific terminology throughout the delivery of the module. Several enhancements were implemented, specifically in the language and substance, as demonstrated in Table IV.

Table IV: "See, Select, Tell' module pilot feedback and improvement

No	Feedback	Improvement
1	100% of respondents agreed that the wording used in module delivering was easy to understand.	-
2	12% of respondents either agreed or disagreed that there were jargons/scientific terms that were used during module activity.	*i.Bakteria Salmonella* was changed to *Kuman Salmonella* ii.Simpler explanation on cross-contamination
3	100% of respondents agreed that instructions given during activity conduct were clear	i.The cockroach model was replaced with pebbles/stone for physical contamination. This is to avoid confusion since cockroaches can be a source of biological contamination.

Module effectiveness - food poisoning and prevention knowledge

The mean scores for food poisoning and prevention in the pre-test were 21.20 (2.61) for the intervention group and 20.93 (3.09) for the control group. The analysis of the independent T-test indicates that there is no significant difference in the mean scores between the intervention and control groups (df = 58, t = -0.361, p = 0.719) (Table V).

Table V: Mean scores for food poisoning knowledge, attitude and risk perceptions between control and intervention group before intervention (pre-test) and after intervention (post – test) (n = 60).

Variables	Control mean (SD)	Intervention mean (SD)	df	t	*p*-value
Food poisoning knowledge (pre-test)	21.20 (2.61)	20.93 (3.09)	58.0	-0.361	0.719
Food poisoning knowledge (post – test)	30.17 (3.87)	36.53 (2.29)	58.0	7.76	<0.001*
Food poisoning attitude (pre- test)	55.57 (13.07)	57.47 (9.28)	58.0	0.649	0.519
Food poisoning attitude (post – test)	58.9 (8.62)	61.97 (10.0)	58.0	1.272	0.208
Food poisoning risk perceptions (pre – test)	56.73 (7.27)	56.67 (8.37)	58.0	0.033	0.974
Food poisoning risk perceptions (post – test)	56.15 (6.65)	55.27 (11.08)	58.0	0.805	0.424

Independent T-test was used (2-tailed)
*significant at p< 0.05 *(2-tailed)

In contrast, the mean scores for the intervention and control groups in the post-test were 36.53 (2.29) and 30.17 (3.87), respectively. The post-test food poisoning knowledge scores from the independent T-test showed a significant difference between the intervention and control groups. The results indicated strong statistical significance (df = 58, t = 7.76, p < 0.001) (Table V).

Table VI presents the analysis of mean comparisons for both the intervention and control groups after 4 weeks of intervention. Notable disparities in knowledge scores were observed in the pre- and post-intervention in these two groups. The mean knowledge scores among the control group members showed a significant increase from 21.20 (2.61) to 30.17 (3.87) after 4 weeks of intervention (t (29) = 9.95, p = <0.001, d = 1.82). There was a similar trend in the intervention group, where the score significantly increased from 20.93 (3.09) to 36.53 (2.29) (t (29) = 20.76, p = <0.001, d = 3.79). The knowledge gained by the intervention group was significantly higher than that of the control group, indicating that the 'See, Select, Tell' module effectively improved respondents' understanding of food poisoning and how to prevent it.

Module effectiveness - food poisoning prevention attitude

The pre-test mean scores for the attitude towards food poisoning prevention were 57.47 (9.28) for the intervention group and 55.57 (13.07) for the control group. The results of an independent T-test showed that the mean scores for this construct were slightly higher in the intervention group compared to the control group. However, this difference was not found to be statistically significant (df = 58, t = 0.649, p = 0.519) (see Table V). After 4 weeks of intervention, the attitude towards food poisoning prevention showed contrasting results. The post-scores for the intervention group were 61.97 (10.0), while the control group had post-scores of 55.27 (11.08). There was a slight difference in the mean score between the intervention group and the control group (df = 58, t = 1.272, p =0.208) (see Table V).

An analysis was conducted to compare the mean scores of attitudes before and after a 4-week intervention period for both the intervention and control groups. The aim was to determine if there were any significant differences. There were significant differences in attitude scores pre- and post-intervention in the module intervention group. The mean scores of attitudes among the members of the intervention group showed a significant increase from 57.47 (9.28) to 61.97 (10.0) after 4 weeks of intervention (t (29) = 2.475, p = <0.001, d = 0.45). However, there were no significant differences in the mean attitude scores for the control group in the pre- and post-intervention periods (t (29) = 1.139, p = <0.264, d = 0.21) (Table VI). The intervention group showed a small effect size for attitude (d = 0.45), which was slightly larger compared to the control group that did not implement the module (d = 0.2). The difference in effect size indicates that the module's implementation may have influenced respondents' attitudes towards food poisoning prevention as compared to the control group (33).

Table VI: Comparison of pre and post food poisoning knowledge mean scores for control and intervention groups (n = 60).

Variables	Group	Pre score mean (SD)	Post score mean (SD)	df	t	*p*-value	Effect size (d)
Food poisoning knowledge	Control	21.20 (2.61)	30.17 (3.87)	29	9.95	<0.001*	1.82
	Intervention	20.93 (3.09)	36.53 (2.29)	29	20.76	<0.001*	3.79
Food poisoning attitude	Control	55.57 (13.07)	58.90 (8.62)	29	1.139	0.264	0.21
	Intervention	57.47 (9.28)	61.97 (10.0)	29	2.475	0.019*	0.45
Food poisoning risk perceptions	Control	56.67 (8.37)	55.27 (11.08)	29	0.471	0.641	0.09
	Intervention	56.73 (7.27)	57.17 (6.65)	29	0.273	0.787	0.05

Paired t-test was used.
* significant at p<0.05 (2-tailed)

Module effectiveness - food poisoning prevention risk perceptions

The mean pre-test scores for the risk perceptions towards food poisoning prevention in the intervention and control groups were 56.73 (7.27) and 56.67 (8.37), respectively. Independent T-test analysis shows that the mean risk perception scores in both groups were not statistically different (df = 58, t = 0.033, p = 0.974) (Table V).

After four weeks of intervention, the risk perception ratings were 57.15 (6.65) and 55.27 (11.08) for the intervention and control groups, respectively. The mean score was marginally higher in the intervention group compared to the control group. However, an independent T-test shows that the score difference was not significant (df = 58, t = 0.805, p = 0.424) (Table V).

Paired T-test analysis was used to evaluate the mean risk perception score before and after a four-week intervention for both intervention and control groups. There were no significant differences in risk perception scores in the pre- and post-intervention groups in either the intervention or control group (t (29) = 0.471, p = 0.641, d = 0.09, and t (29) = 0.273, p = 0.787, d = 0.05, respectively). The effect size of risk perception in both the intervention and control groups was relatively small and negligible. However, Piaw (2014) argued that a negligible impact size should not be interpreted strictly, and that the data should be compared to other effects in previous literature (29).

DISCUSSION

The module known as 'See, Select, Tell' was developed using the Sequential Iterative Model (SIM) framework. It comprises five distinct components: (i) aim and objectives; (ii) key topics; (iii) training flow; (iv) training resources; and (v) training evaluation. Following the initial phase, a thorough examination of the documents was carried out to ascertain the essential subjects that would be incorporated into the module. References were consulted, including previous literature and guidelines from MOH and CDC, to identify five main topics: (i) an overview of food poisoning; (ii) selecting safe-to-consume food; (iii) reporting food poisoning and mishandling incidents; (iv) seeking timely treatment for food poisoning. The selected topics revolve around the examination of food safety practices when purchasing food outside of one's home, whether it be from street vendors or other food premises.

Past studies have extensively examined various food safety interventions, including the importance of thorough handwashing (34, 35), appropriate food storage (36, 37), proper cooking techniques (36, 38), and the significance of maintaining cleanliness and preventing cross-contamination (37). In our study, we identified significant differences from the previous research, in which we focused on two main areas: (i) the handling of food and the channels for addressing complaints, and (ii) the importance of receiving timely treatment for food poisoning. There is a growing assumption that the number of food poisoning cases in Malaysia is on the rise, potentially due to a significant underreporting of cases (11). According to a study conducted by Chan et al. (2014), many consumer complaints about product-related failures in restaurants were related to the sensory quality of the food rather than its safety (39). Ensuring proper hygiene procedures are followed is of utmost importance in the food industry, spanning from food production to preparation and serving (39). Therefore, in addition to providing education to food vendors regarding food safety practices, it is recommended that empowering consumers to file complaints about food mishandling and unhygienic premises could potentially enhance the promotion of food safety practices among food vendors (19).

Incorporating the topic of 'Getting prompt treatment for food poisoning' into the 'See, Select, Tell' module offers a distinctive approach to educating consumers about the importance of seeking immediate treatment for food poisoning. Improved documentation of incidents of food poisoning and the implementation of efficient therapeutic interventions and medical care will ultimately yield positive outcomes, particularly within vulnerable populations such as children, the elderly, and individuals with compromised immune systems (40). The perception of food poisoning as a transient discomfort rather than a disease itself often leads to a delay in seeking prompt medical attention, thereby hindering early treatment (8). In a study conducted by Lamine et al. (2020), it was noted that over 60% of adolescents did not seek treatment before experiencing food intoxication, indicating a similar trend. In addition, many individuals sought medical advice upon experiencing clinical manifestations such as bloody diarrhoea, abdominal pain, and the presence of red spots (40, 41). According to previous studies, it has been observed that individuals tend to be more motivated to seek treatment when they perceive their condition to be more severe (40, 41).

According to the findings of the study, the average scores of knowledge in the group that received the module intervention showed a significant increase after 4 weeks of intervention. Based on Cohen's convention, the effect size of the knowledge improvement was found to be larger than what is conventionally considered a large effect (d = 3.79). From the observed larger size effect, it can be inferred that the SST module has the potential to enhance consumers' understanding of food poisoning and its prevention. Furthermore, the mean scores of knowledge in the control group exhibited significant improvement, with a substantial effect size of d = 1.82. The results indicate that the inclusion of food safety infographics in the control group had a discernible

impact on the knowledge levels of the control group members, albeit to a lesser extent compared to the module intervention group. The present study utilised food safety infographics provided by the Malaysian Ministry of Health as a standard intervention, commonly referred to as a placebo. Respondents were given the opportunity to examine the infographics, and the knowledge they gained may be restricted to the information provided in the pamphlets. To minimise potential interactive effects, the researchers decided to administer food safety infographics as a placebo to the control group instead of not implementing any intervention at all (29). The fact that there is an interactive effect means that there is a chance that the study could be biased. This could make it harder to find a link between the independent variable (pre and post) and the changes seen in the dependent variables (knowledge, attitude, and risk perceptions) (29).

Recent studies have demonstrated that the use of video demonstrations and online worksheet activities in lieu of traditional face-to-face activities and field visits can significantly enhance consumers' understanding and attitudes towards food poisoning prevention practices. According to previous research conducted by Yeung et al. (2019), it was discovered that online food safety modules have the potential to be just as effective as in-person programmes (42). Moreover, this study reveals that the implementation of a virtual food safety programme effectively improved the understanding of food safety and resulted in a shift in attitudes and perceptions among low-income families in the United States. This study presents a potential avenue for the development and validation of additional online food safety programmes, particularly targeting specific niche groups (43).

However, advocates asserted that in-person programmes offered greater chances for facilitators to thoroughly discuss and explore specific topics, thereby generating increased curiosity among respondents to further investigate the information (42).

Research has shown that the primary aim of food safety education is to increase individuals' knowledge about food safety, leading to a positive change in their attitudes and ultimately reducing the risk of food poisoning (9, 23). Our study aligns with prior research indicating that educational modules on food poisoning prevention have effectively enhanced consumers' knowledge (22, 23, 43).

In contrast, the module intervention group demonstrated a significant improvement in attitude scores, with an average improvement of 4.5 points ($t(29) = 2.475$, $p = <0.001$, $d = 0.45$). Conversely, the control group did not exhibit any significant improvement in attitude scores ($t(29) = 1.139$, $p = <0.264$, $d = 0.21$). The Cohen's convention determined that the attitude score in the module intervention group had a small effect, suggesting that the module intervention could potentially influence consumers' attitudes. As indicated by previous research, attitude plays a crucial role in mediating the relationship between knowledge and food safety behaviour (8, 44). It is hypothesised that the significant increase in knowledge scores observed in the intervention group after a 4-week intervention may be attributed to the positive attitudes exhibited by the respondents who received module training. It is worth noting that the results of our study align with previous research, which has shown that maintaining a positive attitude can play a role in influencing food safety behaviour (44). Furthermore, in-depth knowledge and adherence to proper food safety practices can lead to a favourable outlook on food safety (10).

An assessment was conducted to gauge consumers' perceptions of risk in relation to the prevention of food poisoning. This assessment focused on four key constructs: perceived barriers, perceived susceptibility, perceived severity, and perceived benefit. It has been hypothesised that the perception of risk has the potential to influence an individual's behaviour regarding food safety. Nevertheless, the intervention of the module did not yield a significant improvement in the respondents' risk perceptions ($t(29) = 0.471$, $p = 0.641$, $d = 0.09$). In comparison to the control group, no statistically significant difference was observed. In a study conducted by Slovic et al. (2005), it was suggested that individuals' perceptions of the risk of food poisoning can be heightened when they perceive a lack of control over the situation (45). Furthermore, to enhance this sensation, robust messaging strategies and suitable risk communication strategies can be implemented. As demonstrated in a recent study, the presentation of a message that triggers an emotional response or elicits feelings of disgust has been shown to have a significant impact on individuals' intentions and actions related to food safety (46). In addition, it was found that consumers tended to select food vendors who emphasised the importance of reducing the risk of food poisoning through their food safety certification or by highlighting their food safety attributes (19).

The study focused on the integration of perceived risk of food poisoning prevention into two distinct module scopes: (i) the selection of safe-to-eat food, and (ii) the prompt treatment of food poisoning. The utilisation of pre-recorded video demonstrations and short films in this context may not effectively elicit respondents' perception of risk regarding food poisoning, as it may lack the necessary emotional and disgust-inducing elements. Initial delivery strategies, such as role-play and experimental demonstration, have been shown to enhance respondents' risk perception. However, it should be noted that these activities necessitate face-to-face interactions. It is suggested that if the module is conducted online, the delivery strategies should include

elements that elicit emotional and disgust responses. This is believed to enhance risk perceptions and ultimately promote behavioural change.

Limitations

Although this study has presented numerous strong and promising findings regarding the efficacy of the module, it is important to acknowledge and address certain limitations. Initially, the quasi-experimental design employed in this study may introduce a certain level of selection bias. The absence of a randomization process in this design could potentially impede the generalizability of the study. A randomized controlled trial (RCT) can be employed to mitigate this bias and subsequently eliminate the possibility of drawing a causal-effect conclusion from the intervention.

In addition, the present study exclusively examined the factors that facilitate attitudes and risk perceptions related to the prevention of food poisoning. However, it is important to note that these findings may not necessarily align with individuals' actual behaviours. Therefore, it is possible to utilise objective methods such as observation or behaviour checklists to mitigate any potential bias.

Ultimately, the results of the study were assessed solely at two specific time points (pre and post), which may not accurately capture the true changes in behavioural enablers. Prior research indicates that a longitudinal study can be used to observe the consistency of behavioural changes.

CONCLUSION

The present study provides tangible proof supporting the efficacy of the 'See, Select, Tell' online module in enhancing consumers' knowledge, attitude, and risk perception pertaining to food poisoning and its prevention. An evaluation was carried out to determine the effectiveness of the module using a quasi-experimental design. The respondents' knowledge, attitude, and risk perceptions regarding food poisoning were measured through pre- and post-tests. The results of the quantitative analysis demonstrated a significant impact of implementing the module on both knowledge and attitude when compared to the control group that utilised infographics.

The design and development of the 'See, Select, Tell' online module carefully consider psychosocial aspects and incorporate a relevant theoretical framework. The positive discovery made in this module adds to the existing body of knowledge, with a focus on providing consumers with relevant information about food poisoning and the necessary skills to prevent it. This will ultimately empower them to make informed decisions when choosing safe and hygienic food.

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