Structural modelling of food allergen knowledge, attitude and practices among consumers in Malaysia

Abstract

The aim of this study was to assess food allergen knowledge, attitude and self-reported practices among consumers in Malaysia. An online survey was conducted and data were analysed using descriptive statistics and exploratory factor analysis. A model linking food allergen knowledge and attitude and their direct effects on practices were confirmed using structural equation modelling (SEM). Consumers demonstrated moderate food allergen knowledge in this study but scored highly in their attitude towards food allergens. Although participants scored moderately in food allergen knowledge, this does not necessarily translate into practices. There is a possibility that an increase in food allergen knowledge can increase optimistic bias or a sense of over-confidence to manage allergen risks. Consumers' attitude towards food allergens have a positive and significant influence on practices. A positive attitude represents personal beliefs and reflects the level of motivation and care required to manage food allergens effectively. There was insignificant relationship between food allergen knowledge and attitude. This demonstrates a need to tailor targeted risk communication and learning strategies to influence consumers' practices.

Highlights

- Consumers have moderate level of food allergen knowledge but rank highly in attitude scores.
- Food allergen knowledge has a negative relationship with food allergen handling practices.
- Attitude has a positive and significant relationship with food allergen handling practices.
- Attitude and knowledge independently influenced practices.

Keywords: cross contamination; food allergens; hygiene; structural equation modelling

Introduction

The prevalence of food allergy is increasing in a number of developed nations. Meanwhile, data from developing and less developed countries are scarce hence creating a perception of lower prevalence in food allergy (Boye, 2012; Yadav & Naidu, 2015). In fact, some developing nations in Asia has reported cow's milk allergy (Ngamphaiboon, Chatchatee, & Thongkaew, 2008) and shrimp allergy (Lao-araya & Trakultivakorn, 2012) in Thailand, shellfish (Shek et al., 2010) and fish allergy in Philippines (Connett *et al.*, 2012), egg, cow's milk, shrimp and fish allergy in China (Chen, Hu, Allen, Ho, & Li, 2011; Chen *et al.*, 2012). In other more affluent Asian countries, Chiang *et al.* (2007) reported egg, shellfish and peanut as among the most common sensitising food allergen in young atopic children in Singapore, whilst hen's eggs, cow's milk and wheat were the most frequent causative foods in Japan (Ebisawa *et al.*, 2017). Similarly, hen's eggs, cow's milk and peanuts/nuts

were the leading cause of food allergic reactions among Korean infants (Kim, Chang, Han, Ahn, & Lee, 2011). Wu *et al*. (2012) reported seafood (i.e. shrimp, crab, mollusc and fish) as the most common food allergen in Taiwan.

In Malaysia, food and food ingredients such as cereal containing gluten (including wheat, rye, barley and oat), nut and nut products including peanut, soybean, fish and fish products, milk and milk products (including lactose) and egg and egg products are known to cause hypersensitivity and must be declared on labels (MOH, n.d.). Yadav and Naidu (2015) reported a higher sensitisation towards egg white and cow's milk in children less than 2 years in Malaysia. Prawn was the most common food allergen in children up to 12 years (Gendeh, Mujahid, Murad, & Rizal, 2004) and in adults with allergic rhinitis in Malaysia (Wan Majdiah, Nurul Khaiza, Suzina, Che Maraina, & Norr Suryani, 2016). Other studies related to food allergens involved the survey of knowledge and practices of food allergen management. For example, Ajala *et al.* (2010) evaluated food handlers' knowledge on food allergy management while Ahuja and Sicherer (2007) investigated the factors that affect the provision of allergen-safe meals. Similarly, Dupuis *et al.* (2017) and Lee and Sozen (2016) assessed restaurant workers' and food handlers' knowledge, attitude, and training in food allergy management. Awareness and understanding of food allergen management in Thai food companies were conducted by Waisarayutt et al. (2014) whilst Dzwolak (2017) evaluated compliance of food allergen management in small food facilities in Poland. In Malaysia, similar studies among food handlers (Shafie & Azman, 2015), hospitality students (Din, Rashid, & Ramli, 2015), medical science students (Redhwan, Low, Mustafa, Robert, & Ali, 2011) had been carried out. A nationwide survey carried out by the Malaysian Society of Allergy and Immunology (MSAI) and Universiti Putra Malaysia reported that there is still a big gap between awareness of food allergies and its implications on health (Murugappan, 2016).

A number of food safety knowledge, attitudes and practices (KAP) of food handlers' studies had been carried out in developing countries (Zanin, da Cunha, de Rosso, Capriles, & Stedefeldt, 2017) including Malaysia (Abdul Mutalib et al., 2012; Abdullah Sani & Siow, 2014; Siow & Abdullah Sani, 2011; Tan, Bakar, Karim, Lee, & Mahyuddin, 2013). Structural equation modelling is used as a confirmatory technique to determine model validity and had been used in a number of food safety studies (Baser, Ture, Abubakirova, Sanlier, & Cil, 2017; Chen, 2017; Lagerkvist & Okello, 2016; Lim, Chye, Sulaiman, Mohd Suki, & Lee, 2016), HACCP practices (Ko, 2013), eliminating pesticide residues (Wang, Tao, Yang, Chu, & Lam, 2017) and checking expiry dates (Shah & Hall-Phillips, 2017). There is currently lack of food allergen KAP studies among consumers that utilise the SEM technique. Based on the literature and the limited study on consumers' knowledge, attitude and practices towards food allergen it is crucial to explore the current understanding of food allergen handling among general consumers. In this study, the author postulates Figure 1 based on the relationship as suggested by

Baser *et al.* (2017), Lim *et al.* (2016), Schwartz (1975) and Shafie and Azman (2015). Figure 1 represents the following hypotheses:

H1: Food allergen knowledge directly affects food allergen handling practices
H2: Attitude towards food allergen directly affects food allergen handling practices
H3: Food allergen knowledge and attitude are correlated.

Insert Figure 1 here

A number of studies on food allergen management among food handlers had been conducted. Although it is crucial to understand the implementation of food allergen management among food handlers, consumers too have the responsibility to ensure food safety and safe food allergen management. Hence, this study utilises structural equation modelling (SEM) to examine the relationship between knowledge, attitude and the self-reported practices of food allergen handling among consumers in a developing country.

Materials and Methods

Questionnaire development

The questionnaire was constructed and divided into 5 sections: (i) demographics (6 questions); (ii) purchasing habits (4 questions); (iii) knowledge (10 questions); (iv) attitudes (10 questions); and (v) practices (10 questions). The questions were developed based on Choi and Choi (2016), Marchisotto *et al.* (2016) and Shafie and Azman (2015). In the food allergen knowledge section, participants were provided with optional answers of "yes", "no" or "uncertain" to prevent participants from selecting the correct answer by chance. Each correct answer received 1 point, while incorrect or uncertain answers were not allocated any points. The attitude and practices sections allow participants to rate on a 5-point Likert scale of strongly disagree/never to strongly agree/always. Participants were invited to complete all sections. The questionnaire was provided in both English and Malay languages. A pilot study was conducted among 20 participants who were not included in the actual study to evaluate the language, clarity and suitability of wording.

Data collection

The questionnaire was uploaded onto an online survey system (Survey Monkey) and sent to 560 consumers (adults) all around Malaysia between June – August 2017. The subjects were targeted based on the author's personal contacts where they were invited through email and social media that contain the link to direct the consumers to the survey. Participants experiencing food allergies or are caring for family members with food allergies were encouraged to post the link in their own social media page to generate more responses via the snowballing technique. Snowball sampling is particularly useful in identifying potential hidden subjects (e.g. food allergic subjects) where subjects

are hard to locate (Ali, Guo, Sherwani, & Ali, 2017). Although food allergic subjects can be invited to participate from support groups, currently, there is no allergy support group in Malaysia. The Malaysian Society of Allergy and Immunology is hoping to initiate such groups (Lim, 2012). Survey is a useful tool to obtain a high volume of information from a large number of people in a short period of time (MacLeod 2014). A total of 325 questionnaires were returned. Of this, 285 surveys were valid resulting in a successful response rate of 50.89%. This is similar to other studies carried out by New *et al.* (2017) and Lee and Lee (2005), but lower than the food safety survey in Saudi Arabia (66.08%) (Al-Shabib, Husain, & Khan 2017) and Republic of Ireland (76.8%) (Moreb, Priyardashini, & Jaiswal, 2017).

Statistical analysis

Descriptive and Exploratory Factor Analysis (EFA) was conducted using Statistical Package for Social Science (SPSS) 22.0 software. EFA was performed to extract valid items for knowledge, attitude and practices. This is based on factor loadings of the scale items greater than 0.40 (Baser *et al.*, 2017). Confirmatory Factor Analysis (CFA) was performed using Analysis of Moment Structures (AMOS) and confidence level was set at 95%.

Results and Discussion

Female makes up three quarter of the respondents. Almost 90% of the respondents are within the 18 – 25 and 26 -35 years group and exposed to higher education. This is similar to other research that found a larger proportion of respondents were female (Achon, Serrano, Garcia-Gonzalez, Alonso-Aperte, & Varela-Moreiras, 2017; Lake *et al.*, 2006) and more educated people are more likely to participate in surveys (Curtin, Presser, & Singer, 2000). This is largely attributable to the survey subject matter. It is highly likely that females dominate the food purchasing and preparation role (Lake et al., 2006). Although more than half of the respondents had not experienced food allergic reactions before, a large proportion of them (60%) reported that their family members have had experienced the symptoms of food allergies or potentially intolerances. Crustaceans (n=150) were reported as the most common causative agent of food allergies, followed by peanuts (n=38) and tree nuts (n=30) (Table 1).

Insert Table 1 here

This coincides with other studies that shellfish is a major sensitising food source in Asian children (Chiang *et al.*, 2007; Shek *et al.*, 2010; Wu *et al.*, 2012). The abundance of seafood in this region (Boye, 2012; Lee, Thalayasningam, & Lee, 2013) and exposure to insects (e.g. cockroaches, dust mite) also increases the likelihood of shellfish sensitisation (Chiang *et al.*, 2007). Respondents also reported reactions to other type of food products such as alcohol, bird's nest, pineapple, turmeric, monosodium glutamate, mango, chicken, *rambutan* (tropical, hairy fruit native to Southeast Asia),

coconut, coconut milk and kiwifruit. Anaphylactic reactions to exotic food such as sago worms (Yew & Kok (2012) and bird's nest from swiftlets (de Bruyne & Lee, 2004) had been reported. Participants who had experienced food allergic reactions (including those with family members who experienced food allergies) were more likely to look for food allergen information on the labelling ($t[282] = 2.14$, $p < 0.05$). Both groups rated that they seldom purchase food products that are labelled in a language they are not familiar with and even less so if the label contains precautionary statements (Table 2). This is in contrast with Hefle *et al*. (2007), Marchisotto *et al*. (2017) and Mills, Wang and Kattan (2016) who reported that consumers choose to ignore precautionary statements and purchased food products bearing advisory statements.

Insert Table 2

More than 90% of the respondents were aware that food allergies are not common but can be serious and the only way to prevent food allergic reactions is to avoid the food allergen (Table 3). More than half did not know that food allergens are protein-based and hands that had been in contact with food allergens can cross contaminate other surfaces. When it comes to cleaning effectively before meal preparation, more than 80% consumers were aware that effective cleaning could help to prevent cross contamination. However, when probed further, there is a possibility that consumers were not aware of the correct procedures in cleaning as only 30% disagreed that rinsing utensils with water alone are sufficient to remove food allergens. However, consumers scored highly on the question about using separate cooking oil for allergen-free meals to prevent cross contamination. According to MOH (n.d.), monosodium glutamate (MSG) is not considered as food causing hypersensitivity of which slightly more than 60% of the respondents were correct. However, in some populations particularly among those with asthma or atopy, MSG can cause 'Chinese Restaurant Syndrome' characterised by palpitations, general weakness and numbness (Geha *et al*., 2000; Rangan & Barcelouz, 2009). According to Murugappan (2016) Malaysians were aware of common food allergens such as seafood (89.9%), tree nuts (47%) and soy (44.3%). There was also lower awareness among Malaysians about cow's milk as a food allergen (8.3%). No comparison was made between different age groups due to the high number of participants categorised as millennials (i.e. born in 1996 and onwards). According to Leal, Ruth, Rumble, and Simonne (2017), the millennials or younger generation were identified as having the least amount of food safety knowledge and mostly learned about food safety from their parents.

Insert Table 3 here

Respondents mostly agreed with the statements in Table 4. With the exception of A9, the mean scores ranged positively from 4.00 – 4.56. A9 scored lowest among the statements and represented a general disagreement among the respondents in diluting the food allergen with water. Table 5

suggested a good level of self-reported food allergen handling practices. This is evident in P4 where the consumers seldom use the same dish cloth for all purposes. Having separate dish cloth for different activities (e.g. cleaning, drying) and for different meals (e.g. conventional and allergen meals) can help to prevent cross contamination. This is similar to the principle of utilising different utensils for raw or cooked meat and fresh produce. Similarly, in P9, consumers often wash their hands prior to preparing allergen free meals. Although consumers strongly agreed that if a person is suffering from food allergic reactions, he or she should get immediate treatments, however, a majority of the respondents were not confident when it comes to handling an emergency situation (due to food allergic reactions) at home or when eating out.

Insert Tables 4 and 5 here

EFA was applied in factor analysis to extract the items for knowledge, attitude and practices. The score of > 0.40 is used to select items (Baser *et al.* 2017). A total of one item each from attitude and practices were removed. The Kaiser-Meyer-Olkin (KMO) measure of sampling value for food allergen knowledge, attitude and practices were 0.647, 0.886 and 0.874 respectively. These values fulfil Hair, Black, Babin, Anderson, and Tatham (2010) who stated that the criterion of validity should be > 0.60.

Insert Figure 2 here

Insert Table 6 here

The relationship between food allergen knowledge, attitude towards food allergens and food allergen handling practices is shown in Figure 2. In order to evaluate the model fit, Hair, Anderson, Tatham and Black (1998) recommended observing more than one indicator. The indices such as Comparative Fit Index (CFI) was estimated at 0.905 and indicates a good fit (Table 6). CFI is commonly used as a fit index as it is least affected by sample size (Fan, Thompson, & Wang, 1999). Both the Goodness of Fit (GFI) and Normed Fit Index (NFI) measured slightly below the accepted values but were comparable to Baser *et al.* (2017) and Wang *et al.* (2017). The Root Mean Square Error of Approximation (RMSEA) was measured below 0.10 (MacCallum, Browne, & Sugawara, 1996) and is considered a good fit if below 0.06 (Hu & Bentler, 1999). Based on the indices and comparison with other studies, the hypothesised model had an acceptable fit.

Insert Table 7 here

Figure 2 and Table 7 demonstrate the magnitude and direction of relationship of the model. Food allergen knowledge has a negative relationship ($\beta 1 = -0.271$, $p<0.05$) with food allergen handling practices hence supporting H1. One could draw the theoretical interpretation from Figure 2 that food

allergen handling practices will decrease 0.27 unit with each incremental unit in knowledge. This does not indicate a direct linear relationship between knowledge and practices but the possibility that having good food allergen knowledge does not translate into good practices. Previous studies indicated similar results where Baser *et al.* (2017) and Ko (2013) revealed that food safety knowledge has a negative relationship with food safety behaviour. Vo, Le, Le, Minh and Nuorti (2015) reported that although there were positive effects of training on knowledge, however, knowledge alone was insufficient to change food safety practices. Studies of trained food handlers (Rahman, Arif, Bakar, & Tambi, 2012) and insufficiently trained food handlers (Garayoa, Vitas, Diez-Leturia, & Garcia-Jalon, 2011) found that knowledge was not translated into good practices. There is a possibility that increasing knowledge can increase optimistic bias (OB) (Miles, Braxton, & Frewer, 1999). OB occurs when individuals felt shielded against risks or negative effects or 'why it won't happen to me' perception (Weinstein, 1984). Training or education based only on scientific communication may not encourage changes in behaviour or practices (Green *et al.*, 2005; Park, Kwak, & Chang, 2012). According to Bandura (2001), people are able to learn new knowledge, skills, rules, beliefs and attitudes in social systems. Although food safety education on allergens can be provided – this does not necessarily translate into practices. Hence, one way to approach food allergen education is through the social cognitive theory which emphasises enactive or vicarious learning from the social environment (Schunk, 2012a; Schunk and Usher, 2012). Enactive learning occurs through the consequences of performing actions e.g. accidental cross contamination of utensils with food allergen may result in allergic reactions hence leading to increased awareness in future food preparation. Enactive learning is useful as an informative indicator to repeat or not repeat a behaviour (Schunk, 2012a). Meanwhile, vicarious learning occurs by observing other people, non-human characters, electronic or print (Schunk 2012b).

The second hypothesis postulates that attitude affects practices and H2 is sustained based on Table 7. Attitude has a positive and significant relationship with food allergen practices ($\beta 1 = 0.43$, $p<0.05$). Figure 2 indicates that good practice increases by 0.43 unit with each unit increase in attitude. A positive attitude reflects the level of motivation and care required to manage food allergens effectively. Lim *et al.* (2016) also found food safety attitude as the most important factor in influencing consumers' food safety behaviour. Attitude represents beliefs and can serve as a mediator between knowledge and practices. Dudeja, Singh, Sahni, Kaur and Goel (2017) found that food handlers in hospital settings with positive attitude helped to improve food safety practices whilst Abdul-Mutalib et al. (2012) reported that positive attitude among food handlers resulted in safe food storage practices. In addition to knowledge and attitudes, other factors such as experience, values and emotions can influence individuals' thinking and judgement about the severity and acceptability of risks. Risk perceptions can motivate consumers to take action to avoid, prevent, adapt to or even ignore the risks (Wachinger, Renn, Begg, & Kuhlicke, 2013). Studies of risk perceptions towards food safety had been conducted. Parra, Kim, Shapiro, Gravani, & Bradley (2014) found that home food

safety practices among Mexican-Americans were associated with perceptions and awareness of risks whilst Tiozzo, Mari, Ruzza, Crovato and Ravarotto (2017) reported that there was a sense of incomplete control due to lack of information on recognising and preventing food risks among consumers in northeast Italy. This highlights the paradox of risk perceptions as different personal (e.g. age, gender, education level, profession, personal experience) and contextual factors (e.g. area of living, economy, country) can be important determinants of risk perceptions.

There is an insignificant relationship between food allergen knowledge and attitude in this study. In other words, knowledge and attitude independently influenced practices. Zanin and Stedefeldt (2017) provided an excellent review of past KAP studies and how knowledge and attitude influenced food safety practices. However, most studies were focused on food handlers. As food handlers, they are likely to be in contact with food or food contact surfaces and may be involved in preparation of raw materials, cooking, serving and cleaning (Dudeja & Singh, 2017), hence it is crucial to understand how training, education and personal beliefs affect food handlers' practices. Other studies involving food safety KAP among consumers were also conducted. For example, Samapundo, Cam Thanh, Xhaferi and Devlieghere (2017) conducted a study among consumers in Vietnam and found adequate attitude levels whilst consumers of street food in Haiti exhibited average attitude levels towards food safety (Samapundo, Climat, Xhaferi, & Devlieghere, 2017). Tan *et al.* (2013) found weak correlations between knowledge and hand hygiene attitudes among food handlers in Malaysia including practices. KAP of food allergens among consumers are scarce in comparison. KAP can be combined with the Theory of Planned Behaviour to further understand how attitude, perceived behavioural control and social norms affect food allergen management practices. The current food allergen knowledge – attitudes – practices model can be expanded to include trust particularly if one is studying consumers' behaviour while eating out (Begen *et al.*, 2016; Begen *et al.*, 2018). Furthermore, it is worth categorising and studying the specific measured variable in detail i.e. purchasing and understanding food labels, meal preparation and prevention of cross contamination and whilst eating out.

The only current method to prevent food allergy is complete avoidance of the trigger food. This requires vigilance from both consumers and food business operations. Food businesses are encouraged to provide clear written or verbal allergen information to consumers. In the UK, signposting of allergen information helps to ensure customers know where to find the information (FSA, 2015). Begen *et al.* (2017) also recommended that food allergic individuals should make allergen enquiries when eating out. This is particularly important in Malaysia as the provision of food allergen information is currently not a legal requirement. Food handlers in Malaysia are required to attend the Food Handlers Training programme as specified in Food Hygiene Regulations (2009). The topics focused on food safety topics such as personal hygiene, good hygiene/manufacturing practices, risk of food poisoning and food laws and regulations. Although some food safety training providers voluntarily incorporate food allergen management in the module, it is strongly recommended that all

food handlers should be made aware of the importance of food allergen management and the risk of food allergic reactions.

Conclusion

In general, the consumers in this study demonstrates moderate knowledge of food allergen and highly positive attitudes and self-reported practices. Within SEM, it is found that although the consumers are moderately knowledgeable, this does not translate into practices. However, an increase in personal beliefs can help to boost good practices. Understanding consumers' risk perceptions towards food allergen – particularly among consumers with food allergic reactions or those caring for individuals with food allergic reactions can narrow the attitudinal – good food allergen practices (GAP). A number of food safety research had been conducted but food allergen studies remain sparse in Malaysia. The main limitations of this study were the small sample size and the findings cannot be generalised outside the study sample. Although the present study was conducted with a small sample size, this can be considered a pilot study to understand consumers' knowledge, attitude and practices in managing food allergens. Understanding how consumers think about and respond to risks (i.e. respond to food allergens and impact of cross contamination) will aid risk mitigation strategies. Food allergy creates a significant health burden and can further impact upon consumer's social and quality of life. National and international efforts should focus on food safety and appropriate food allergen management practices. More importantly, correct food allergen labelling is crucial to inform consumers of the presence of allergens.

References

Abdul-Mutalib, N. A., Abdul-Rashid, N. A., Mustafa, S., Amin-Nordin, S., Hamat, R. A., & Osmana, M. (2012). Knowledge, attitude and practices regarding food hygiene and sanitation of food handlers in Kuala Pilah, Malaysia. *Food Control, 27*(2), 289-293.

Abdullah Sani, N., & Siow, O. N. (2014). Knowledge, attitudes and practices of food handlers on food safety in food service operations at the Universiti Kebangsaan Malaysia. *Food Control, 37*, 210-217.

Achon, M. Serrano, M., Garcia-Gonzalez, A., Alonso-Aperte, E., & Varela-Moreiras, G. (2017). Present food shopping habits in the Spanish adult population: A cross-sectional study. *Nutrients, 9*(5): 508.

Ahuja, R., & Sicherer, S. H. (2007). Food allergy management from the perspective of restaurant and food establishment personnel. *Annals of Allergy, Asthma and Immunology, 98*(4), 344-348.

Ajala, A. R., Cruz, A. G., Faria, J. A. F., Walter, E. H. M., Granato, D., & Sant' Ana, A. S. (2010). Food allergens: Knowledge and practices of food handlers in restaurants. *Food Control, 21*(10), 1318-1321.

Al-Shabib, N. A., Husain, F. M., & Khan, J. M. (2017). Study on food safety concerns, knowledge and practices among university students in Saudi Arabia. *Food Control 73*(B), 202-208.

Ali, A., Guo, X., Sherwani, M., & Ali, A. (2017). Factors affecting Halal meat purchase intention: Evidence from international Muslim students in China. *British Food Journal 119*(3), 527-541.

Bandura, A. (2001). Social cognitive theory of mass communication. *Media Psychology, 3*(3), 265-299.

Baser, F., Ture, H., Abubakirova, A., Sanlier, N., & Cil, B. (2017). Structural modelling of the relationship among food safety knowledge, attitude and behaviour of hotel staff in Turkey. *Food Control, 73*(B), 438-444.

Begen, F. M., Barnett, J., Payne, R., Roy, D., Gowland, H. M., & Lucas, J. S. (2016). Consumer preferences for written and oral information about allergens when eating out. *PLoS ONE, 11*(5), e0156073.

Begen, F. M., Barnett, J., Payne, R., Gowland, M. H., DunnGalvin, A., & Lucas, J. S. (2017). Eating out with a food allergy in the UK: Change in the eating out practices of consumers with food allergy following introduction of allergen information legislation. *Clinical & Experimental Allergy*, doi: 10.1111/cea.13072

Begen, F. M., Barnett, J., Barber, M., Payne, R., Gowland, M. H., & Lucas, J. S. (2018). Parents' and caregivers' experiences and behaviours when eating out with children with a food hypersensitivity. *BMC Public Health, 18*, 38.

Bentler, P. M., & Bonnet, D. C. (1980). Significance tests and goodness of fit in the analysis of covariance structures. *Psychological Bulletin, 88*(3), 588-606.

Boye, J. I. (2012). Food allergies in developing and emerging economies: need for comprehensive data on prevalence rates. *Clinical and Translational Allergy, 2*(1), 25.

Chen, J., Hu, Y., Allen, K. J., Ho, M. H., & Li, H. (2011). The prevalence of food allergy in infants in Chongqing, China. *Pediatric Allergy and Immunology, 22*(4), 356-360.

Chen, J., Liao, Y., Zhang, H. Z., Zhao, H., Chen, J., & Li, H. Q. (2012). Prevalence of food allergy in children under 2 years of age in three cities in China. *Chinese Journal of Pediatrics, 50*(1), 5-9.

Chen, M.-F. (2017). Modeling an extended theory of planned behavior model to predict intention to take precautions to avoid consuming food with additives. *Food Quality and Preference, 58*, 24-33.

Chiang, W. C., Kidon, M. I., Liew, W. K., Goh, A., Tang, J. P., & Chay, O. M. (2007). The changing face of food hypersensitivity in an Asian community. *Clinical and Experimental Allergy: Journal for the British Society of Allergy and Clinical Immunology, 37*(7), 1055-1061.

Choi, J., & Choi, A. (2016). Perceptions of food labelling about allergens in food products in South Korea. *British Food Journal, 118*(12), 2842-2854.

Connett, G. J., Cabrera-Morales, E. A., Yuenyongviwat, A., Ngamphaiboon, J., Chatchatee, P., Sangsupawanich, P., Soh, S.-E., Yap, G.-C., Shek, L. P.-C., & Lee, B. W. (2012). A population-based study of fish allergy in the Philippines, Singapore and Thailand. *International Archives of Allergy and Immunology, 159*(4), 384-390.

Curtin, R., Presser, S. and Singer, E. (2000). The effects of response rate changes on the index of consumer sentiment. *Public Opinion Quarterly, 64*(4): 413-428.

De Bruyne, J. A., & Lee, B. W. (2004). Anaphylaxis in the Asia Pacific. *Allergy and Clinical Immunology International, 16*(4), 137-141.

Din. N., Rashid, B., & Ramli, K. I. (2015). Gauging food allergy knowledge among hospitality students. *Journal of Management Research, 7*(2), 252-265.

Dudeja, P., & Singh, A. (2017). Chapter 21 – Food handlers. In, R. K. Gupta, P. Dudeja and A. S. Minhas (Eds.). *Food Safety in the 21st Century*. Public Health Perspective. Amsterdam: Academic Press

Dudeja, L. C. P., Singh, A., Sahni, N., Kaur, S., & Goel, S. (2017). Effectiveness of an intervention package on knowledge, attitude and practices of food handlers in a tertiary care hospital of north India: A before and after comparison study. *Medical Journal of Armed Forces India, 73*, 49-53.

Dupuis, R., Meisei, Z., Grande, D., Strupp, E., Kounaves, S., Graves, A., Frasso, R., &Cannuscio, C. C. (2016). Food allergy management among restaurant workers in a large U.S. city. *Food Control 63,* 147-157.

Dzwolak, W. (2017). Assessment of food allergen management in small food facilities. *Food Control 73*, 323-331.

Ebisawa, M., Ito, K., Fujisawa, T., Committee for Japanese Pediatric Guideline for Food Allergy, The Japanese Society of Pediatric Allergy, & Clinical Immunology and the Japanese Society of Allergology (2017). Japanese guidelines for food allergy 2017. *Allergology International, 66*(2), 248-264.

Fan, X., Thompson, B., & Wang, L. (1999). Effects of sample size, estimation methods and model specification on structural equation modelling fit indexes. *Structural Equation Modeling, 6*(1), 56-83.

Food Hygiene Regulations (2009). Malaysia Food Hygiene Regulations 2009 PU(A) 095/2009. Available at: http://www.fao.org/faolex/results/details/en/c/LEX-FAOC091581 [Accessed 2 March 2018]

FSA (2015). Food allergen labelling and information requirements under the EU Food Information for Consumers Regulation No. 1169/2011: Technical guidance. Food Standards Agency. Available at: https://www.food.gov.uk/sites/default/files/food-allergen-labelling-technical-guidance.pdf [Accessed 2 March 2018].

Garayoa, R., Vitas, A. I., Diez-Leturia, M., & Garcia-Jalon, I. (2011). Food safety and the contract catering companies: Food handlers, facilities and HACCP evaluation. *Food Control, 22*(12), 2006-2012.

Geha, R. S., Beiser, A., Ren, C., Patterson, R., Greenberger, P. A., Grammer, L. C. *et al.* (2000). Review of alleged reaction to monosodium glutamate and outcome of a multicentre double-blind placebo-controlled study. *Journal of Nutrition, 130*(4), 1058S- 1062S.

Gendeh, B. S., Mujahid, S. H., Murad, S., & Rizal, M. (2004). Atopic sensitization of children with rhinitis in Malaysia. *The Medical Journal of Malaysia, 59*(4), 522-529.

Green, L., Selman, C., Banerjee, A., Marcus, R., Medus, C., Angulo, F. J., Radke, V., Buchanan, S., & EHS-Net Working Group (2005). Food service workers' self-reported food preparation practices: an EHS-Net study. *International Journal of Hygiene and Environmental Health, 208*(102), 27-35.

Hair, J. R. Jr., Anderson, R. E., Tatham, R. L., & Black, W. C. (1998). *Multivariate data analysis.* 5th Ed. New Jersey: Prentice-Hall.

Hair, J. F., Black, B., Babin, B., Anderson, R. E., & Tatham, R. I. (2010). *Multivariate analysis: A global perspective.* New Jersey: Person Education Inc, Upper Saddle River.

Hefle, S. L., Furlong, T. J., Niemann, L., Lemon-Mule, H., Sicherer, S., & Taylor, S. L. (2007). Consumer attitudes and risks associated with packaged foods having advisory labelling regarding the presence of peanuts. *Journal of Allergy and Clinical Immunology* 120(1): 171-176.

Hooper, D., Coughlan, J., & Mullen, M. (2008). Structural equation modelling: Guidelines for determining model fit. *Electronic Journal of Business Research Methods, 6*(1), 53-60.

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling 6*(1), 1-55.

Kim, J., Chang, E., Han, Y., Ahn, K., & Lee, S. I. (2011). The incidence and risk factors of immediate type food allergy during the first year of life in Korean infants: a birth cohort study. *Pediatric Allergy and Immunology, 22*(7), 715-719.

Kline, R. B. (1998). *Principles and practice of structural equation modelling.* Guilford Press, New York.

Ko, W.-H. (2013). The relationship among food safety knowledge, attitudes and self-reported HACCP practices in restaurant employees. *Food Control, 29*, 192-197.

Lagerkvist, C. J., & Okello, J. (2016). Using the integrative model of behavioural prediction and censored quantile regression to explain consumers' revealed preferences for food safety: Evidence from a field experiment in Kenya. *Food Quality and Preference, 49*, 75-86.

Lake, A. M., Hyland, R. M., Mathers, J. C., Rugg-Gunn, A. J., Wood, C. E. and Adamson, A. J. (2006). Food shopping and preparation among the 30-somethings: whose job is it? (The ASH30 study). *British Food Journal* 108(6): 475-486.

Lao-araya, M., & Trakultivakorn, M. (2012). Prevalence of food allergy among preschool children in northern Thailand. *Pediatrics International, 54*(2), 238-243.

Leal, A., Ruth, T. K., Rumble, J. N., & Simonne, A. H. (2017). Exploring Florida residents' food safety knowledge and behaviors: A generational comparison. *Food Control, 73*(B), 1195-1202.

Lee, A. J., Thalayasingam, M., & Lee, B. W. (2013). Food allergy in Asia: how does it compare? *Asia Pacific Allergy, 3*(1), 3-14.

Lee, K. E., & Lee, H. S. (2005). Influences of school food service dietitians' job satisfaction and perception of barriers to HACCP implementation on food sanitation/safety management performance in Gyeongbuk province. *Journal of the Korean Dietetic Association, 11*(2), 179-189.

Lee, Y. M., & Sozen, E. (2016). Food allergy knowledge and training among restaurant employees. *International Journal of Hospitality Management, 57*, 52-59.

Lim, C. Y. (2012). Allergy sufferers beware. The Star Online, 19 August. Available at: https://www.thestar.com.my/lifestyle/health/2012/08/19/allergy-sufferers-beware/ [Accessed 2 March 2018].

Lim, T.-P., Chye, F. Y., Sulaiman, M. R., Mohd Suki, N., & Lee, J. S. (2016). A structural modelling on food safety knowledge, attitude, and behaviour among Bum Bum Island community of Semporna, Sabah. *Food Control, 60*, 241-246.

MacCallum, R. C., Browne, M. W., & Sugawara, H. M. (1996). Power analysis and determination of sample size for covariance structure modelling. *Psychological Methods, 1*(2), 130-149.

McLeod, S. (2014). Questionnaires. *Simply Psychology*. https://www.simplypsychology.org/questionnaires.html Accessed 14 September 2017.

Marchisotto, M. J., Harada, L., Kamdar, O., Smith, B. M., Waserman, S., Sicherer, S., Allen, K., Muraro, A., Taylor, S., & Gupta, R. S. (2016). Food allergen labeling and purchasing habits in the United States and Canada. *Journal of Allergy and Clinical Immunology: In Practice, 5*(2), 345-351.

Mills, C. A., Wang, J. and Kattan. J. D. (2016). Consumer attitudes towards packaged foods having food allergen advisory labelling. *Journal of Allergy and Clinical Immunology* 137(2): AB127.

Miles, S., Braxton D. S., & Frewer, L. J. (1999). Public perceptions about microbiological hazards in food. *British Food Journal, 101*(10), 744-762.

MOH (nd). Guidelines on labelling of foods and food ingredients obtained through modern biotechnology. Ministry of Health Malaysia. http://www.fao.org/fileadmin/user_upload/gmfp/docs/GUIDELINES%20ON%20LABELLING%20OF%20FOODS%20AND%20FOOD%20INGREDIENTS%20PRODUCED%20FROM%20MODERN%20BIOTECHNOLOGY.pdf Accessed 24 April 2017.

Moreb, N. A., Priyadarshini, A., & Jaiswal, A. K. (2017). Knowledge of food safety and food handling practices among food handlers in the Republic of Ireland. *Food Control, 80*, 341-349.

Murugappan, R. (2016). Managing allergies. A survey reveals Malaysians lack awareness on allergies. The Star Malaysia 17 July 2017, Press Reader. https://www.pressreader.com/malaysia/the-star-malaysia/20160717/282776355881807 Accessed 5 September 2017.

New, C. Y., Thung, T. Y., Premarathne, J. M. K. J. K., Russly, A. R., Abdulkarim, S. M., & Son, R. (2017). Microwave oven safety: A food safety consumer survey in Malaysia. *Food Control, 80*, 420-427.

Ngamphaiboon, J., Chatchatee, P., & Thongkaew, T. (2008). Cow's milk allergy in Thai children. *Asian Pacific Journal of Allergy and Immunology, 26*(4), 199-204.

Park, S. H., Kwak, T. K., & Chang, H. J. (2012). Evaluation of the food safety training for food handlers in restaurants operations. *Nutrition Practice and Research, 4*(1), 58-68.

Parra, P. A., Kim, H., Shapiro, M. A., Gravani, R. B., & Bradley, S. D. (2014). Home food safety knowledge, risk perception, and practices among Mexican-Americans. *Food Control, 37*, 115-125.

Rahman, M. M., Arif, M. T., Bakar, K., & Tambi, Z. B. (2012). Food safety knowledge, attitude and hygiene practices among the street food vendors in northern Kuching city, Sarawak. *Borneo Science, 31*, 95-103.

Rangan, C., & Barceloux, D. G. (2009). Food additives and sensitivities. *Disease-Month, 55*(5), 292-311.

Redhwan, A. A., Low, W. Y., Mustafa, F. M., Robert, C., & Ali, A. (2011). Perceptions about food allergy among medical science students in a university in Shah Alam, Selangor, Malaysia. *International Food Research Journal, 18*, 451-458.

Samapundo, S., Cam Thanh, T. N., Xhaferi, R., & Devlieghere, F. (2016). Food safety knowledge, attitudes and practices of street food vendors and consumers in Ho Chi Minh city, Vietnam. *Food Control, 70*, 79-89.

Samapundo, S., Climat, R., Xhaferi, R., & Develieghere, F. (2015). Food safety knowledge, attitudes and practices of street food vendors and consumers in Port-au-Prince, Haiti. *Food Control, 50*, 457-466.

Schunk, D. H. (2012a). Social cognitive theory. In, K. R. Harris, S. Graham, T. Urdan, C. B. McCormick, G. M. Sinatra, and J. Sweller (Eds.). *APA Educational Psychology Handbook*, Vol. 1. Theories, constructs and critical issues, pp. 101-123.

Schunk, D. H. (2012b). *Learning theories. An educational perspective*. 6th Edition. Pearson Education, Inc.

Schunk, D. H., & Usher, E. L. (2012). Social cognitive theory and motivation. In R. M. Ryan (Ed.). *The Oxford Handbook of Human Motivation.* Oxford: Oxford University Press.

Schwartz, N. E. (1975). Nutritional knowledge, attitudes, and practices of high school graduates. *Journal of the American Dietetic Association, 66*(1), 28-31.

Shafie, A. A., & Azman, A. W. (2015). Assessment of knowledge, attitude and practice of food allergies among food handlers in the state of Penang, Malaysia. *Public Health, 129*(9), 1278-1284.

Shah, P., & Hall-Phillips, A. (2017). Antecedents and implications of expiration date search effort. *Journal of Consumer Affairs.* DOI: 10.1111/joca.12141

Shek, L. P.-C., Cabrera-Morales, E. A., Soh, S. E., Gerez, I., Ng. P. Z., Yi, F. C., Ma, S., & Lee, B. W. (2010). A population-based questionnaire survey on the prevalence of peanut, tree nut, and shellfish allergy in 2 Asian populations. *Journal of Allergy and Clinical Immunology, 126*(2), 324-331.

Siow, O. N., & Abdullah Sani, N. (2011). Assessment of knowledge, attitude and practices (KAP) among food handlers at residential colleges and canteen regarding food safety. *Sains Malaysiana, 40*(4), 403-410.

Tan, L. T., Bakar, F. A., Karim, M. S. A., Lee. H. Y., & Mahyuddin, H. Y. (2013). Hand hygiene knowledge, attitudes and practices among food handlers at primary schools in Hulu Langat district, Selangor (Malaysia). *Food Control, 34*, 428-435.

Tiozzo, B., Mari, S., Ruzza, M., Crovato, S., & Ravarotto, L. (2017). Consumers' perceptions of food risks: A snapshot of the Italian Triveneto area. *Appetite, 111*, 105-115.

Vo, T. H., Le, N. H., Le, A. T. N., Minh, N. N. T., & Nuorti, J. P. (2015). Knowledge, attitudes, practices and training needs of food handlers in large canteens in Southern Vietnam. *Food Control, 57*, 190-194.

Wachinger, G., Renn, O., Begg, C., & Kuhlicke, C. (2013). The risk perception paradox – Implications for governance and communication of natural hazards. *Risk Analysis, 33*(6), 1049-1064.

Waisarayutt, C., Surojanametakul, V., Kaewpradub, S., Shoji, M., Ito, T., & Tamura, H. (2014). Investigation on the understanding and implementation of food allergen management among Thai food manufacturers. *Food Control, 46*, 182-188.

Wan Majdiah, W. M., Nurul Khaiza, Y., Suzina, S. A. H., Che Maraina, C. H., & Noor Suryani, M. A. (2016). Food allergen sensitization among Malaysian rhinitis patients. *International Medical Journal, 23*(2), 252-256.

Wang, J., Tao, J., Yang, C., Chu, M., & Lam, H. (2017). A general framework incorporating knowledge, risk perception and practices to eliminate pesticide residues in food: A structural equation modelling analysis based on survey data of 986 Chinese farmers. *Food Control, 80*, 143-150.

Weinstein, N. D. (1984). Why it won't happen to me – perceptions of risk-factors and susceptibility. *Health Psychology, 3*(5), 431-457.

Wu, T. C., Tsai, T. C., Huang, C. F., Chang, F. Y., Lin, C. C., Huang, I. F., Chu, C. H., Lau, B. W., Wu, L., Peng, H. J., & Tang, R. B. (2012). Prevalence of food allergy in Taiwan: a questionnaire-based survey. *Internal Medicine Journal, 42*(12), 1310-1315.

Yadav, A., & Naidu, R. (2015). Clinical manifestation and sensitization of allergic children from Malaysia. *Asia Pacific Allergy, 5*(2), 78-83.

Yew, K. L., & Kok, V. S. L. (2012). Exotic food anaphylaxis and the broken heart: sago worm and Takotsubo cardiomyopathy. *Medical Journal of Malaysia, 67*(5), 540-541.

Zanin, L. M., da Cunha, D. T., de Rosso, V. V., Capriles, V. D., & Stedefeldt, E. (2017). Knowledge, attitudes and practices of food handlers in food safety: An integrative review. *Food Research International, 100*(1), 53-62.