1 **Food allergen knowledge, attitude and practices among UK consumers: A structural**
2 **modelling approach**

3 Jan Mei Soon[1]

4 Faculty of Health and Wellbeing, University of Central Lancashire, Preston PR1 2HE, UK

5 **Abstract**

6 Food allergies are becoming more prevalent and affect up to 1 – 2% of adults and 5- 8% of children

7 in the UK. This study investigated the food allergen knowledge, attitude towards food allergens and

8 food allergy management practices among food allergic and intolerant consumers and / or their

9 family members and carers. Questionnaires were distributed at three major Free From events in the

10 UK in 2017 and 2018. Structural Equation Modelling (SEM) was used as a confirmatory technique to

11 determine the model's validity. Cereals containing gluten, milk and eggs were the most common

12 triggers reported by the consumers. Other trigger foods such as chocolate, garlic, maize, onions, red

13 and white meat, spices, and fruits such as apples and cherries were also reported. Consumers

14 demonstrated very good understanding on the severity of allergic reactions, prevention method and

15 hidden egg ingredients. Overall, consumers were relatively good in the knowledge section. The

16 participants were motivated in their personal allergen avoidance towards food allergens especially in

17 checking food labels, preference for more free from product choices and handwashing. Consumers

18 did not rely on dietary apps or social media to find out about allergen-free food products. Both

19 knowledge and attitude did not translate into food allergy management practices. Significant

20 correlation between knowledge and attitude was identified suggesting that as knowledge decreases,

21 so will their attitude scores. This study suggests that targeted and systematic food allergy

22 management topics and peer support could be used to improve consumers' knowledge and attitude

23 to positively impact food allergen handling practices.

24

25 **Highlights**
26 Consumers demonsrate relatively good knowledge in food allergens
27 Food allergen knowledge and attitude did not directly affect food allergen handling practices
28 A significant relationship between knowledge and attitude was identified
29

30 **Keywords:** food allergy; intolerance; prevention; Structural Equation Modelling
31

32 **Introduction**
33 The prevalence of food allergy in infancy has increased to 10% particularly in westernised regions
34 and is more common among children compared to adults (Osborne et al., 2011; Sicherer & Sampson,
35 2018). Food allergy is an adverse immune reaction that occurs upon exposure to specific food
36 (Moore, Stewart, & de Shazo, 2017) and symptoms range from mild skin reactions to severe

---

[1]Corresponding author: Jan Mei Soon; Email: jmsoon@uclan.ac.uk; Tel: +44(0)1772 89 4567

37 anaphylactic reactions. At the global level, Codex stated that the eight common food allergens

38 (cereals containing gluten, egg, milk, soy, peanuts, tree nuts, fish and shellfish) shall be declared

39 (Codex, 1985). These eight main food allergens contribute 90% of food allergic reactions (Bush &

40 Hefle, 1996). In the UK, food businesses are regulated by the EU Food Information for Consumer

41 Regulation No. 1169/2011 (EU FIC). Food businesses are required to present allergen information

42 clearly (emphasis by font, style or background colour) for prepacked foods in the list of ingredients.

43 Food businesses such as food services providing and selling non-prepacked foods are required to

44 provide allergen information for the inclusion of any of the 14 specified food allergens (celery, cereals

45 containing gluten, crustaceans, egg, fish, lupin, milk, molluscs, mustard, peanuts, sesame seeds,

46 soya, sulphur dioxide and tree nuts) (Regulation EU No. 1169/2011).

47

48 Peanuts, tree nuts and fish are the most common cause of food allergic reactions among adults in the

49 UK while children are commonly affected by milk, eggs and peanuts (NHS, 2016). Strict avoidance of

50 food allergens is the main preventative and management of food allergic reactions. However,

51 adherence to an allergen-free diet could be challenging particularly when consumers are dining out or

52 purchasing ready meals (Begen et al., 2018). According to Versluis et al. (2014), between 21 – 31%

53 of accidental consumption of allergens occurred while eating in restaurants and 13 – 23% occurred at

54 workplace or school canteens. Each year in the UK, 10 patients die from food-induced anaphylaxis

55 due to undeclared allergenic ingredients (FSA, n.d.). Recent fatalities due to presence of food

56 allergens in takeaway meals and sandwiches underscore the importance of food allergen

57 management, food allergen labelling and allergy awareness among catering staff (BBC News, 2018a,

58 b; Soon, 2018a).

59

60 A number of food allergen management studies had been carried out among food service workers

61 (Ajala et al., 2010; Dupuis et al., 2016; Soon, 2018a; Wham & Sharma, 2014). Food service staff

62 often receive food allergy training and such training had proven positive in Bailey, Kindratt, Smith, &

63 Reading (2014) where restaurant employees were able to answer food allergy questions, better

64 management of food allergens (e.g. review ingredient lists) and improved communication with

65 customers. Food service staff are provided with the essential training and knowledge of food allergen

66 management (Lee & Sozen, 2016). On the other hand, individuals with food allergic reactions and/or

67 intolerance often rely on their own initiatives to learn and manage their conditions and associated

68 risks. Children and vulnerable individuals manage their conditions with support from family members,

69 carers or healthcare providers. A number of consumer studies are associated with eating out practices

70 (Begen et al., 2018; Leftiwch et al., 2011) and food allergen labelling and purchasing habits (Barnett

71 et al., 2011; Marchisotto et al., 2017). Food allergy management deals with food allergen avoidance,

72 managing symptoms, treatment of allergic reactions as a result of accidental exposure and

73 communicating food allergic consumers' needs (Davis & Kelso, 2018; Venter, Sicherer, & Greenhawt,

74 2019). There remain limited studies on knowledge of food allergic consumers and/or their family

75 members and carers', their attitude and practices towards food allergens. This study investigates the
76 food allergen knowledge, attitude towards food allergens and food allergy management practices
77 among food allergic and/or intolerant consumers and / or their family members and carers. Food
78 allergen knowledge refers to the understanding of or information about food allergen acquired
79 through experience or education while attitude is a feeling or opinion about food allergies and
80 practice refers to the action or application of food allergy management (Cambridge Dictionary, 2019a,
81 b, c). Structural equation modelling (SEM) method was used as a confirmatory technique to
82 determine the proposed model validity. SEM had been used in a number of food safety studies
83 (Baser, Ture, Abubakirova, Sanlier, & Cil, 2017; Chen, 2017; Lim, Chye, Sulaiman, Mohd Suki & Lee,
84 2016) and only one study had utilised SEM in food allergy study (Soon, 2018b). In this study, the
85 author postulates the following hypotheses based on Baser et al. (2017), Lim et al. (2017), Schwartz
86 (1975), Shafie and Azman (2015) and Soon (2018b). The following hypotheses are proposed:
87
88   H1: Food allergen knowledge does not directly affect food allergen handling practices
89   H2: Attitude towards food allergen directly affects food allergen handling practices
90   H3: Food allergen knowledge and attitude are correlated
91

92 **Methodology**
93 **Questionnaire development**
94 The questionnaire was constructed and divided into five sections: (i) demographics; (ii) epidemiology;
95 (iii) knowledge (10 questions); (iv) attitude (10 questions); and (v) practices (10 questions). The
96 questions were developed based on previous studies (Choi & Choi, 2016; Marchisotto et al., 2016;
97 Shafie & Azman, 2015; Soon, 2018b). In the food allergen knowledge section, participants were
98 given options e.g. "yes", "no" or "uncertain" to prevent participants from selecting the correct answer
99 by chance. In the attitude and practices section, participants were asked to rate based on a Likert
100 scale of 1 (strongly disagree / never) to 5 (strongly agree / always). A pilot study was conducted
101 among 20 participants (excluded from the actual study) to ensure the clarity and suitability of
102 wordings.
103

104 **Data collection**
105 The author visited two main Free From events in Liverpool (3 – 4 Nov 2017 and 3 – 4 2018) and
106 London (7 – 9 July 2017). Another Free From event scheduled in Glasgow in 3 – 4 March 2018 was
107 cancelled. The Free From event caters to consumers with allergies and intolerance needs and exhibits
108 a number of free from food, cosmetics and household items. It draws 12,000 number of visitors in
109 2017 (ACC Liverpool Group, 2018). Consumers experiencing food allergies or intolerance, or those
110 who are carers to individuals with food allergies / intolerance and those interested in free from food
111 products were invited to participate in the study. The reason why family members were included in
112 the survey was because third party allergen avoidance is also practiced by family members and carers

113 and they require the skills and experience to manage food allergens at home and interpret food

114 allergen information (Gowland, 2015). The study was explained to them using an information sheet

115 and consent was obtained prior to completing the survey. The author utilised a face to face approach

116 during such events as it returns a higher response rate as consumers are interested in the topic.

117

118 **Statistical analysis**

119 Descriptive and Exploratory Factor Analysis (EFA) was conducted using SPSS 24.0. EFA was

120 performed to extract items from knowledge, attitude and practices based on factor loadings greater

121 than 0.4 (Baser et al., 2017; Soon, 2018b). Based on the extracted items, SEM was conducted using

122 Analysis of Moment Structures (AMOS) and confidence level was set at 95%.

123

124 **Results and Discussion**

125 A total of 254 questionnaires were returned of which 252 were valid. All the consumers approached

126 and invited by the author agreed to participate in the study, resulting in a 100% response rate. Most

127 of the respondents were females, with the highest representative from the 45 – 54 and 55 – 64 year

128 old categories. This is similar to previous surveys in the UK where female respondents dominated the

129 samples (Cole, Peek, & Cowe, 2018; Gadema & Oglethorpe, 2011). Females also tend to be the main

130 decision maker in food purchasing decisions (Cole et al., 2018) and main caregivers (DunnGalvin et

131 al., 2006; Swinkels, van Tilburg, VerbakeL, & van Groenou, 2017). Almost 40% of the respondents

132 graduated with a degree and about 10% have a postgraduate degree reflecting a highly educated

133 group of consumers. More than 45% of the consumers and about 37% of the consumers' family

134 members have had not experienced food allergic reactions before but this could be due to the fact

135 that consumers with food intolerance, coeliac disease (CD) patients or those with personal lifestyle

136 choices also participated in the study. Participants were mostly diagnosed by general practitioners,

137 allergists and other healthcare practitioners (e.g. consultants, gastroenterologists and dietitians). It is

138 interesting to note that 30 respondents self-diagnosed their food allergies / intolerance. Cereals

139 containing gluten (35%), milk (17.8%), eggs (6.9%) and peanuts (6.4%) were the most common

140 causative agents reported by the participants (Table 1). Cow's milk, wheat, egg, soy, peanut, tree

141 nuts, fish and shellfish results in the majority of food allergic reactions in Europe (Nwaru et al., 2014).

142 In the UK, food allergy affects about 1 – 2% of adults and 5- 8% of children (Buck, Hattersley, &

143 Kimber, 2010). Coeliac disease patients selected cereals containing gluten as the main causative

144 ingredients that aggravate their autoimmune disease. About 1 – 2% of the global population are

145 affected by CD (Collin, Vilppula, Luostarinen, Holmes, & Kaukinen, 2018). The incidence rate of CD

146 was 19.1 per 100,000 person in the UK (West, Fleming, Tata, Card, & Crooks, 2014).

147

148 Insert Table 1 here

149

150　More than 90% of the respondents were aware of the danger of food allergens and the best way to

151　avoid an allergic reaction is to avoid the causative agent. There was less certainty when it comes to

152　the potential for cross contact of allergens via hands as 15.9% and 16.7% answered incorrectly or

153　were uncertain about the statement. 38.1% believed that tree nuts are similar to peanuts while 48%

154　were uncertain about this statement. A third of the respondents knew that high temperature cooking

155　does not destroy food allergen and more than half recognised that rinsing cooking utensils with water

156　only is insufficient. 46.4% were uncertain that most food allergens are protein-based products. More

157　than half of the respondents knew that buckwheat is not listed as a food allergen in UK/EU and up to

158　89% of the respondents are aware of potential hidden egg ingredients in food products (Table 2).

159　Most of the respondents have good understanding of hidden allergenic ingredients in food products

160　and knew that consuming even a small amount of food allergen will cause an allergic reaction and in

161　severe cases, it can be fatal. Respondents scored 67% in the overall knowledge section and were

162　relatively good. This demonstrates that the respondents understood what is needed to control and

163　manage their food allergies and/or intolerance.

164

165　In Soon (2018a), one third of takeaway staff did not know that allergens can be transferred by

166　hands. Food allergens can be transferred from hands during food preparation (Sheehan et al., 2018).

167　Brough et al. (2013) revealed that peanut protein persisted on hands 3 hours after peanut

168　consumption. Thermal processing can influence allergenicity by modifying the allergenic protein via

169　protein denaturation, restructuring of disulfide bonds or formation of new intra/inter molecular bonds

170　(Ekezie, Cheng, & Sun, 2018). The changes that occur may influence allergenicity positively,

171　negatively or indifferently, e.g. the modified structure of proteins may introduce new allergy

172　generating sites or loses the original allergenicity (Vanga & Raghavan, 2017). It is true that most food

173　allergens are glycoproteins (oligosaccharide + protein) (Ekezie et al., 2018) but respondents may

174　associate food allergenicity with the type of food product rather than the composition and structure of

175　the food allergens. Foods with hidden allergens can be dangerous for food allergic patients. Anibarro,

176　Seoane and Mugica (2007) reported that 22.4% of 530 food reactions were considered to be due to

177　hidden allergens. Food allergy knowledge and awareness are critical to the safety of consumers with

178　food allergy. This is particularly important to family members and/or carers of food allergic individuals

179　as they are faced with the expectation to manage food allergies, recognise symptoms and treat food

180　allergic reactions and anaphylaxis. Equipped with food allergy knowledge can boost confidence and

181　improve food allergy prevention strategies and preparedness for anaphylaxis (Gupta et al., 2009;

182　Tsuang et al., 2019).

183

184　Insert Table 2 here

185

186　There were strong agreement among respondents concerning checking of food labels, preference for

187　more free from choices and that one should wash their hands after coming into contact with food

188 allergens. Respondents also felt that there should be more information provided about allergen-free

189 food when ordering food online and agreed that it is their responsibility to inform staff of their food

190 allergies if ordering via telephone. Consumers were less certain about purchasing of food with

191 allergenic ingredients even if other household members can consume the product with no adverse

192 health effects. Neither were consumers confident in being able to handle a food allergy emergency

193 situation (Table 3).

194

195 Studies had been conducted among food allergic consumers who disregard food labels especially

196 those bearing food allergen advisory statements (Robertson et al., 2013). Consumers are confused

197 with Precautionary Allergen Labelling (PAL) and the use of PAL often frustrate and restrict consumers'

198 food choices (Ong, 2008; Sharma, Pereira, & Williams, 2015). There's a higher level of risk taking

199 among consumers because of 'label fatigue' among consumers which increase the tendency to

200 disregard advisory labels (Robertson et al., 2013). In Sheth et al. (2008) and Sheth et al. (2010), the

201 authors found 6.3% and 8.3% (n=695) of allergic individuals who ignored PAL went on to have a

202 resultant allergic reaction to material that was present in the food through cross contamination.

203 Edwards and Thomas (2018) recommended the triple check of food labels i.e. read the label at the

204 store, when unpacking the groceries and before serving. It is encouraging to note that respondents

205 felt very strongly about checking of food labels. Handwashing is key to prevent cross contact of food

206 allergens and Perry, Conover-Walker, Pomes, Chapman and Wood (2004) recommended that hands

207 should be washed with soap to remove protein residue. Perry et al. (2004) found that using plain

208 water and antibacterial hand sanitiser left detectable peanut on hands. When ordering food online in

209 the UK, consumers with food allergens are directed to contact the restaurants / takeaways directly to

210 determine if allergen-free meals could be prepared and delivered. At the moment, there are limited

211 information and studies in this area, and is definitely worth exploring. The uncertainty in dealing with

212 a food allergy emergency demonstrates the importance of competence in using an auto-injector and

213 calling the emergency helpline if someone is suffering from a food allergic reaction.

214

215 Insert Table 3 here

216

217 Consumers frequently read the food labels to check for allergenic ingredients and wash their hands

218 before preparing allergen-free meals. When dining out, consumers frequently inform staff about their

219 food allergies and would verify that their meals are indeed allergen-free when served. On the

220 contrary, the respondents seldom use dietary apps or Quick Response (QR) codes to find out if food

221 products contain any allergens. There were also less reliance on social media to find suitable eateries

222 when dining out. Not all respondents find the advisory labelling helpful though (Table 4).

223

224 Insert Table 4 here

225

226 According to Begen et al. (2016), consumers with food allergies / intolerances preferred to rely on

227 written information before and during their eating out experiences. This can be done by checking the

228 venue websites, checking the recipes on the internet and menus displayed in the restaurant window.

229 Verbal information from knowledgeable and perceptive staff increased consumers' confidence in the

230 safety of their meals. Potentially, the reliance on written and verbal information provided by the

231 restaurants enable consumers to be confident in their meals. Most consumers did not use food allergy

232 apps to determine if a product is suitable or to find out more information about the ingredients. There

233 are multiple dietary apps provided to food allergy and intolerant users today such as the Foodmaestro

234 food app which helps to validate if a product is suitable and to look for alternative products across

235 major retailers in the UK (Foodmaestro, 2017). The Biteappy (2018) app helps to search for allergy

236 friendly restuarants worldwide. It is worth exploring the type and source of information used by food

237 allergic individuals (e.g. advice from healthcare practitioners, online allergy support group, media,

238 restaurant reviews) to make their decisions in food choices and allergy management. Precautionary

239 allergen labelling (PAL) remains an area of confusion. Walker, Hazel and Points (2018) proposed that

240 a target should be agreed on between government and retailers for a reduction in the variants of PAL

241 wordings within the next three years.

242

243 EFA was applied in factor analysis to extract the items for knowledge, attitude and practices. The

244 score of < 0.40 is used to select items (Baser et al. 2017). A total of four items from knowledge,

245 three items from attitude and one item from practices were removed. The Kaiser-Meyer-Olkin (KMO)

246 measure of sampling value for food allergen knowledge, attitude and practices were 0.614, 0.603 and

247 0.696 respectively. These values fulfil Hair, Black, Babin, Anderson, and Tatham (2010) who stated

248 that the criterion of validity should be > 0.60. Hair, Anderson, Tatham and Black (1998) also

249 recommended observing more than one indicator to evaluate the model fit (Table 5).

250

251 Insert Table 5 here

252

253 CFI measured 0.90 indicating a good model fit. GFI and NFI were slightly below the cut off value but

254 were comparable to Baser et al. (2017) and Wang et al. (2017). The RMSEA and RMR measured

255 below 0.08 (Hu & Bentler, 1999; MacCallum et al., 1996). Based on the indices and comparison with

256 other similar studies, the hypothesised model had an acceptable fit.

257

258 Insert Figure 1 here

259

260 Insert Table 6 here

261

262 Figure 1 and Table 6 explains the magnitude and relationship between food allergen knowledge,

263 attitude towards food allergen and food allergy management practices. Food allergen knowledge has

264   a negative and insignificant relationship ($\beta 1 = -0.02$, $p > 0.05$) with food allergy management practices

265   hence supporting H1. The theoretical interpretation from Figure 1 is that food allergy management

266   practices will decrease 0.02 unit with each incremental unit in knowledge. Although this does not

267   indicate a direct, linear relationship between knowledge and practices, but this finding reiterates that

268   having good food allergen knowledge may not translate into good practices. Previous studies by

269   Baser et al. (2017), Soon (2018b) and Ko (2013) support this finding.

270

271   Attitude towards food allergens were found to have a positive and insignificant relationship with

272   practices ($\beta 1 = 0.05$, $p > 0.05$) hence rejecting H2. $\beta 1$ indicates that food allergy management

273   practices increase by 0.05 unit with each unit increase in attitude. This contradicts previous findings

274   where Baser et al. (2017), Soon (2018) and Lim et al. (2016) reported significant relationship

275   between food safety attitude and practices. Although the respondents scored highly in most of the

276   attitude mean items, this does not translate into food allergy management practices. This could be

277   due to the fact that consumers seldom rely on apps or social media to check out suitable products or

278   restaurants. Okumus, Ali, Billgihan, & Ozturk (2018) suggested that consumers' intention to use and

279   adoption of dietary apps can be increased by increasing the apps' performance, ease of usage, social

280   inflluence and degree of user innovativeness. The consumers in this study also did not often

281   purchase, whole unprocessed ingredients to prepare their meals from scratch. In fact, they would like

282   to have more free-from choices, indicating that consumers would prefer to purchase ready meals or

283   semi-finished ingredients that do not contain the allergenic materials. Time saving in meal

284   preparation was identified as a key driver in food choices (Casini et al., 2019). The two key strategies

285   employed by the respondents in this study are handwashing before preparing allergen-free meal and

286   communicating their needs to food service staff when eating out. There is a significant and negative

287   relationship between food allergen knowledge and attitude in this study ($\beta 1 = -0.20$, $p < 0.05$),

288   supporting H3. This indicates that knowledge and attitude dependently affect practices. As knowledge

289   decreases, so will their attitude towards food allergens. Tan et al. (2013) found weak correlations

290   between knowledge and attitude among food handlers while Soon (2018b) found insignificant

291   relationship between both attributes among consumers.

292

293   The current best method to prevent food allergic reactions would be to adhere to a strict free-from

294   diet. However, researchers are working on oral immunotherapies to build up tolerance for food

295   allergens (Blumchem et al., 2018; Wasserman et al., 2018). The PALISADE Group of Clinical

296   Investigators (2018) revealed encouraging results where peanut oral immunotherapy resulted in

297   desensitisation among children and adolescents who were highly allergic to peanuts. Such trials can

298   potentially prevent food allergic reactions and life-threatening circumstances as consumers' tolerance

299   levels are increased and could tolerate accidental consumption of food allergens. This coupled with

300   vigilant safe food handling and food allergy management practices can help to ensure the safety of

301   consumers with food allergies. Food safety is not synonymous with the total absence of risk (FAO,

302 WHO, 1997). Similarly, zero risk for food allergic individuals is not a realistic option. Consumers,

303 regulators, clinical researchers and food industry are working towards defining a tolerable level of risk

304 (Madsen et al., 2010). Madsen et al. (2012) reported that the guiding principle in defining acceptable

305 risk is the concept of minimising the overall risk and hence, the burden of disease caused by food

306 allergy. Begen et al. (2016, 2018) carried out in-depth interviews to gain understanding of

307 consumers' preferences for food allergy and intolerance (FAI) information and impact of such

308 information when eating out while Begen et al. (2017) reported on the experiences of family

309 members and carers' who eat out with children with FAI. In addition to quantitative surveys, it is

310 recommended that in-depth interviews be carried out with the consumers to explore their views and

311 food allergen handling practices especially the adoption of dietary apps in managing FAI.

312

313 **Conclusion**

314 Consumers demonstrated relatively good knowledge in food allergens and are motivated in their

315 personal allergen avoidance towards food allergy management. Most respondents however did not

316 resort to using dietary apps or social media to find out more information about food products.

317 Consumers also prefer to have more free-from choices and may not have time to prepare meals from

318 scratch. The structural equation modelling showed an acceptable fit on food allergen knowledge,

319 attitude and practices. Although knowledge and attitude did not directly affect their food allergy

320 management practices, a significant relationship was identified between knowledge and attitude. A

321 combination of knowledge and attitude can potentially modify food allergen handling practices. It is

322 suggested that targeted and specific food allergy management topics and online or peer group

323 support are provided to improve the knowledge-attitude relationships to positively influence their food

324 allergen handling practices.

325

326 **References**

327 ACC Liverpool Group (2018). Free from show winter. Available at:
328 https://www.exhibitioncentreliverpool.com/whats-on/the-allergy-free-from-show-north/ [Accessed 16
329 November 2018]
330
331 Ajala, A. R., Cruz, A. G., Faria, J. A., Walter, E. H., Granato, D., & Sant, A. S. (2010). Food allergens:
332 Knowledge and practices of food handlers in restaurants. *Food Control, 21*(10), 1318-1321.
333
334 Anibarro, B., Seoane, F. J., & Mugica, M. V. (2007). Involvement of hidden allergens in food allergic
335 reactions. *Journal of Investigational Allergology and Clinical Immunology, 17*(3), 168.
336
337 Bailey, S., Kindratt, T. B., Smith, H., Reading, D. (2014). Food allergy training event for restaurant
338 staff; a pilot evaluation. *Clinical and Translational Allergy, 4*, 26.
339
340 Barnett, J., Leftwich, J., Muncer, K., Grimshaw, K., Shepherd, R., Raats, M. M. et al. (2011). How do
341 peanut and nut-allergic consumers use information on the packaging to avoid allergens. *Allergy,
342 66*(7), 969-978.
343
344 Baser, F., Ture, H., Abubakirova, A., Sanlier, N., & Cil, B. (2017). Structural modelling of the
345 relationship among food safety knowledge, attitude and behaviour of hotel staff in Turkey. *Food
346 Control, 73*(B), 438-444.

347

348 BBC News (2018a). Pret a Manger to label products after allergy death. BBC News, 3 October 2018.
349 Available at: https://www.bbc.co.uk/news/business-45731201 [Accessed 10 November 2018]
350

351 BBC News (2018b). Megan Lee: Takeaway bosses jailed over allergy death. BBC News, 7 November
352 2018. Available at: https://www.bbc.co.uk/news/uk-england-lancashire-46123858 [Accessed 10
353 November 2018]
354

355 Begen, F. M., Barnett, J., Payne, R., Roy, D., Gowland, M. H., & Lucas, J. S. (2016). Consumer
356 preferences for written and oral information about allergens when eating out. *PLOS One, 11*(5),
357 e0156073.
358

359 Begen, F. M., Barnett, J., Barber, M., Payne, R., Gowland, M. H., Lucas, J. S. (2017). Parents' and
360 caregivers' experiences and behaviours when eating out with children with a food hypersensitivity.
361 *BMC Public Health, 18*, 38
362

363 Begen, F. M., Barnett, J., Payne, R., Gowland, H., DunnGalvin, A., & Lucas, J. S. (2018). Eating out
364 with a food allergy in the UK: Change in the eating out practices of consumers with food allergy
365 following introduction of allergen information legislation. *Clinical & Experimental Allergy, 48*(3), 317-
366 324.
367

368 Bentler, P. M., & Bonnet, D. C. (1980). Significance tests and goodness of fit in the analysis of
369 covariance structures. *Psychological Bulletin, 88*(3), 588-606.
370

371 Biteappy (2018). Biteappy. Available at: https://www.biteappy.com/#!/home [Accessed 20 November
372 2018]
373

374 Blumchen, K., Trendelenburg, V., Ahrens, F., Gruebl, A., Hamelmann, E., Hansen, G. et al. (2018).
375 Efficacy, safety, and quality of life in a multi-center, randomized, placebo-controlled trial of low-dose
376 peanut oral immunotherapy in peanut allergic children. *Journal of Allergy and Clinical Immunology: In
377 Practice*, doi: 10.1016/j.jaip.2018.10.048
378

379 Brough, H. A., Makinson, K., Penagos, M., Maleki, S. J., Cheng, H., Douiri, A., Stephens, A. C.,
380 Turcanu, V., & Lack, G. (2013). Distribution of peanut protein in the home environment. *Journal of
381 Allergy and Clinical Immunology, 132*(3), 623-629.
382

383 Buck, J., Hattersley, S., & Kimber, I. (2010). Food allergy – science and policy needs – The UK Food
384 Standards Agency Research Programme. *Toxicology, 278*(3), 319-325.
385

386 Bush, R. K., & Hefle, S. L. (1996). Food allergens. *Critical Reviews in Food Science and Nutrition, 36*,
387 S119-S163.
388

389 Cambridge Dictionary (2019a). Knowledge. Cambridge University Press. Available at:
390 https://dictionary.cambridge.org/dictionary/english/knowledge [Accessed 17 December 2019]
391

392 Cambridge Dictionary (2019b). Attitude. Cambridge University Press. Available at:
393 https://dictionary.cambridge.org/dictionary/english/attitude [Accessed 17 December 2019]
394

395 Cambridge Dictionary (2019c). Practice. Cambridge University Press. Available at:
396 https://dictionary.cambridge.org/dictionary/english/practice [Accessed 17 December 2019]
397

398 Casini, L., Boncinelli, F., Contini, C., Gerini, F., Scozzafava, G., & Alfnes, F. (2019). Heterogenous
399 preferences with respect to food preparation time: Foodies and quickies. *Food Quality and
400 Preference, 71,* 233-241.
401

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

404

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

407

408   Codex (1985). Codex General Standard for the Labelling of Prepackaged Foods. CODEX STAN 1-1985
409   (Rev 1-1991). Available at: http://www.fao.org/docrep/005/Y2770E/y2770e02.htm#fn4 [Accessed 10
410   November 2018]

411

412   Cole, M., Peek, H. and Cowen, D. (2018). UK consumer perceptions of a novel till-receipt 'traffic-light'
413   nutrition system. *Health Promotion International*, doi.org/10.1093/heapro/day007

414

415   Collin, P., Vilppula, A., Luostarinen, L., Holmes, G. K. T., & Kaukinen, K. (2018). Review article:
416   Coeliac disease in later life must not be missed. *Alimentary Pharmacology and Therapeutics, 47*, 563-
417   572.

418

419   Davis, C. M., & Kelso, J. M. (2018). Food allergy management. *Immunology and Allergy Clinics of*
420   *North America, 38*(1), 53-64.

421

422   DunnGalvin, A., Hourihane, J. O'B., Frewer, L., Knibb, R. C., Elberink, J. N. G. O., & Klinge, I. (2006).
423   Incorporating a gender dimension in food allergy research: a review. *European Journal of Allergy and*
424   *Clinical Immunology, 61*(11), 1336-1343.

425

426   Dupuis, R., Meisel, Z., Grande, D., Strupp, E., Kounaves, S., Graves, A. et al. (2016). Food allergy
427   management among restaurant workers in a large U.S. city. *Food Control, 63*, 147-157.

428

429   Edwards, J. B. E., & Thomas, B. F. (2018). Putting THOUGHT into food allergens. *2018 Annual*
430   *Virginia Head Start Conference*, 10 – 12 April 2018, Virgina. Available at:
431   https://www.headstartva.org/assets/Annual-Conference/2018-Conference/Workshop-
432   Handouts/Putting%20Thought%20into%20Food%20Allergens_faedadal.pdf [Accessed 19 November
433   2018]

434

435   Ekezie, F.-G. C., Cheng, J.-H., & Sun, D.-W. (2018). Effects of nonthermal food processing
436   technologies on food allergens: A review of recent research advances. *Trends in Food Science &*
437   *Technology, 74,* 12-25.

438

439   FAO.WHO (1997). Risk management and food safety. Report of a Joint FAO.WHO consultation. Rome,
440   Italy, 27 to 31 January. *FAO Food and Nutrition Paper*, number 65. Available at:
441   http://www.fao.org/3/a-w4982e.pdf [Accessed 17 February 2019]

442

443   Foodmaestro (2018). Foodmaestro Food App. Available at:
444   http://www.foodmaestro.me/consumer.html [Accessed 20 November 2018]

445

446   FSA, Food Standards Agency (n.d.). Food allergy facts. Available at:
447   http://allergytraining.food.gov.uk/english/food-allergy-facts.aspx [Accessed 23 November 2018]

448

449   Gadema, Z., & Oglethorpe, D. (2011). The use and usefulness of carbon labelling food: A policy
450   perspective from a survey of UK supermarket shoppers. *Food Policy, 36*(6), 815-822.

451

452   Gowland, M. H. (2015). Chapter 7. Consumer attitudes to allergens in foods. *Handbook of Food*
453   *Allergen Detection and Control*. Woodhead Publishing Series in Food Science, Technology and
454   Nutrition, 133-160.

455

456   Gupta, R. S., Kim, J. S., Springston, E. E., Smith, B., Pongracic, J. A., Wang, X., & Holl, J. (2009).
457   Food allergy knowledge, attitudes, and beliefs in the United States. *Annals of Allergy, Asthma &*
458   *Immunology, 103*(1), 43-50.

459

460 Hair, J. R. Jr., Anderson, R. E., Tatham, R. L., & Black, W. C. (1998). *Multivariate data analysis.* 5th
461 Ed. New Jersey: Prentice-Hall.
462
463 Hair, J. F., Black, B., Babin, B., Anderson, R. E., & Tatham, R. I. (2010). *Multivariate analysis: A*
464 *global perspective.* New Jersey: Person Education Inc, Upper Saddle River.
465
466 Hooper, D., Coughlan, J., & Mullen, M. (2008). Structural equation modelling: Guidelines for
467 determining model fit. *Electronic Journal of Business Research Methods, 6*(1), 53-60.
468
469 Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis:
470 Conventional criteria versus new alternatives. *Structural Equation Modeling 6*(1), 1-55.
471
472 Kline, R. B. (1998). *Principles and practice of structural equation modelling.* Guilford Press, New York.
473
474 Ko, W.-H. (2013). The relationship among food safety knowledge, attitudes and self-reported HACCP
475 practices in restaurant employees. *Food Control, 29*, 192-197.
476
477 Lee, Y. M., & Sozen, E. (2016). Food allergy knowledge and training among restaurant employees.
478 *International Journal of Hospitality Management, 57*, 52-59.
479
480 Leftwich, J., Barnett, J., Muncer, K., Shepherd, R., Raats, M., Gowland, M. H. et al. (2011). The
481 challenges for nut-allergic consumers of eating out. *Clinical & Experimental Allergy*, 41(2), 243-249.
482
483 Lim, T.-P., Chye, F. Y., Sulaiman, M. R., Mohd Suki, N., & Lee, J. S. (2016). A structural modelling on
484 food safety knowledge, attitude, and behaviour among Bum Bum Island community of Semporna,
485 Sabah. *Food Control, 60*, 241-246.
486
487 MacCallum, R. C., Browne, M. W., & Sugawara, H. M. (1996). Power analysis and determination of
488 sample size for covariance structure modelling. *Psychological Methods, 1*(2), 130-149.
489
490 Madsen, C. B., Crevel, R., Chan, H. C., Dubois, A. E. J., DunnGalvin, A., Flokstra-de Blok, B. M. J. ET
491 AL. (2010). Food allergy: Stakeholder perspectives on acceptable risk. *Regulatory Toxicology and*
492 *Pharmacology, 57*(2-3), 256-265.
493
494 Madsen, C. B., Hattersley, S., Allen, K. J., Beyer, K., Chan, C. H., Godefroy, S. B. et al. (2012). Can
495 we define a tolerable level of risk in food allergy? Report from a Euro Prevall/UK Food Standards
496 Agency workshop. *Clinical & Experimental Allergy 42*(1), 30-37.
497
498 Marchisotto, M. J., Harada, L., Kamdar, O., Smith, B. M., aserman, S., Sicherer, S. et al. (2017). Food
499 allergen labelling and purchasing habits in the United States and Canada. *Journal of Allergy and*
500 *Clinical Immunology: In Practice*, 5(2), 345-351.
501
502 Moore, L. E., Stewart, P. H., & de Shazo, R. D. (2017). Food allergy: What we know now. *The*
503 *American Journal of Medical Sciences, 353*(4), 353-366.
504
505 NHS (2016). Food allergy. Available at: https://www.nhs.uk/conditions/food-allergy/ [Accessed 10
506 November 2018]
507
508 Nwaru, B. I., Hickstein, L., Panesar, S. S., Muraro, A., Werferl, T., Cardona, V. et al. (2014). The
509 epidemiology of food allergy in Europe: a systematic review and meta-analysis. *European Journal of*
510 *Allergy and Clinical Immunology, 69*(1), 62-75.
511
512 Okumus, B., Ali, F., Bilgihan, A., & Ozturk, A. B. (2018). Psychological factors influencing customers'
513 acceptance of smartphone diet apps when ordering food at restaurants. *International Journal of*
514 *Hospitality Management, 72*, 67-77.
515

Ong, P. Y. (2008). Are allergy advisory statements helpful to patients with food allergy? *Journal of Allergy and Clinical Immunology, 121*(2), 536-537.

Osborne, N. J., Koplin, J. J., Martin, P. E., Gurrin, L. C., Lowe, A. J., Matheson, M. C. et al. (2011). Prevalence of challenge-proven IgE-mediated food allergy using population-based sampling and predetermined challenge criteria in infants. *Journal of Allergy and Clinical Immunology, 127*(3), 668-676.

Perry, T. T., Conover-Walker, M. K., Pomes, A., Chapman, M. D., & Wood, R. A. (2004). Distribution of peanut allergen in the environment. *Journal of Allergy and Clinical Immunology, 113*(5), 973-976.

Regulation (EU) No. 1169/2011. Regulation EU No. 1169.2011 of the European parliament and of the council of 25 October 2011. Official Journal of the European Union, L 304/18. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32011R1169&from=en [Accessed 10 Nov 2018]

Robertson, O. N., Hourihane, J. O'B., Remington, B. C., Baumert, J. L., & Taylor, S. L. (2013). Survey of peanut levels in selected Irish food products bearing peanut allergen advisory labels. *Food Additives and Contaminants: Part A, 30*(9), 1467-1472.

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.

Sharma G. M., Pereira, M., & Williams, K. M. (2015). Gluten detection in foods available in the United States – A market survey. *Food Chemistry, 169*, 120-126.

Sheehan, W. J., Taylor, S. L., Phipatanakul, W., & Brough, H. A. (2018). Environmental food exposure: What is the risk of clinical reactivity from cross-contact and what is the risk of sensitization. *Journal of Allergy and Clinical Immunology: In Practice, 6*(6), 1825-1832.

Sheth, S. S., Waserman, S., Kagan. R. Alizadehfar, R., Primeau, M.-N., Elliot, S. et al. (2010). Role of food labels in accidental exposures in food-allergic individuals in Canada. *Annals of Allergy, Asthma & Immunology, 104*(1), 60-65.

Sheth, S. S., Waserman, S., Kagan, R., Alizadehfar, R., Primeau, M. et al. (2008). Improving food labelling for the allergic consumer. *Journal of Allergy and Clinical Immunology, 121*(2), S183

Sicherer, S. H., & Sampson, H. A. (2018). Food allergy: A review and update on epidemiology, pathogenesis, diagnosis, prevention, and management. *Journal of Allergy and Clinical Immunology, 141*(1), 41-58.

Soon, J. M. (2018a). 'No nuts please': Food allergen management in takeaways. *Food Control, 91*, 349-356.

Soon, J. M. (2018b). Structural modelling of food allergen knowledge, attitude and practices among consumers in Malaysia. *Food Research International, 111*, 674-681.

Swinkels, J., van Tilburg, T., Verbakel, E., & van Groenou, M. B. (2017). Explaining the gender gap in the caregiving burden of partner caregivers. *Journal of Gerontology: Social Sciences,* doi.org/10.1093/geronb/gbx036

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.

573
574 The PALISADE Group of Clinical Investigators (2018). AR101 oral immunotherapy for peanut allergy.
575 *New England Journal of Medicine*, doi: 10.1056/NEJMoa1812856
576
577 Tsuang, A., Atal, Z., Demain, H., Patrick, K., Pistiner, M., & Wang, J. (2019). Benefits of school nurse
578 training sessions for food allergy and anaphylaxis management. *Journal of Allergy and Clinical*
579 *Immunology: In Practice, 7*(1), 309-311.
580
581 Vanga, S. K., & Ranghavan, V. (2017). Processing effects on tree nut allergens: A review. Critical
582 Reviews in Food Science and Nutrition, 57(17), 3794-3806.
583
584 Venter, C., Sicherer, S. H., & Greenhawt, M. (2019). Management of peanut allergy. *Journal of Allergy*
585 *and Clinical Immunology: In Practice, 7*(2), 345-355.
586
587 Versluis, A., Knulst, A. C., Kruizinga, A. G., Michelsen, A., Houben, G. F., & Baumert, J. L. (2014).
588 Frequency, severity and causes of unexpected allergic reactions to food: a systematic literature
589 review. *Clinical & Experimental Allergy, 45*(2), 347-367.
590
591 Walker, M. J., Gowland, M. H. & Points, J. (2018). Managing food allergens in the U.K. Retail Supply
592 Chain. *Journal of AOAC International, 101*(1), 45-55.
593
594 Wang, J., Tao, J., Yang, C., Chu, M., & Lam, H. (2017). A general framework incorporating
595 knowledge, risk perception and practices to eliminate pesticide residues in food: A structural equation
596 modelling analysis based on survey data of 986 Chinese farmers. *Food Control, 80*, 143-150.
597
598 Wasserman, R. L., Hague, A. R., Pence, D. M., Sugerman, R. W., Silvers, S. K., Rolen, J. G., &
599 Herbert, M. (2018). Real-world experience with peanut oral immunotherapy: Lessons learned from
600 270 patients. *Journal of Allergy and Clinical Immunology: In practice*, doi: 10.1016/j.jaip.2018.05.023
601
602 West, J., Fleming, K. M., Tatam L. J., Card, T. R., & Crooks, C. J. (2014). Incidence and prevalence of
603 celiac disease and dermatitis herpetiformis in the UK over two decades: Population-based study.
604 *Americal Journal of Gastroenterology, 109*, 757-768.
605
606 Wham, C. A. and Sharma, K. M. (2014). Knowledge of café and restaurant managers to provide a
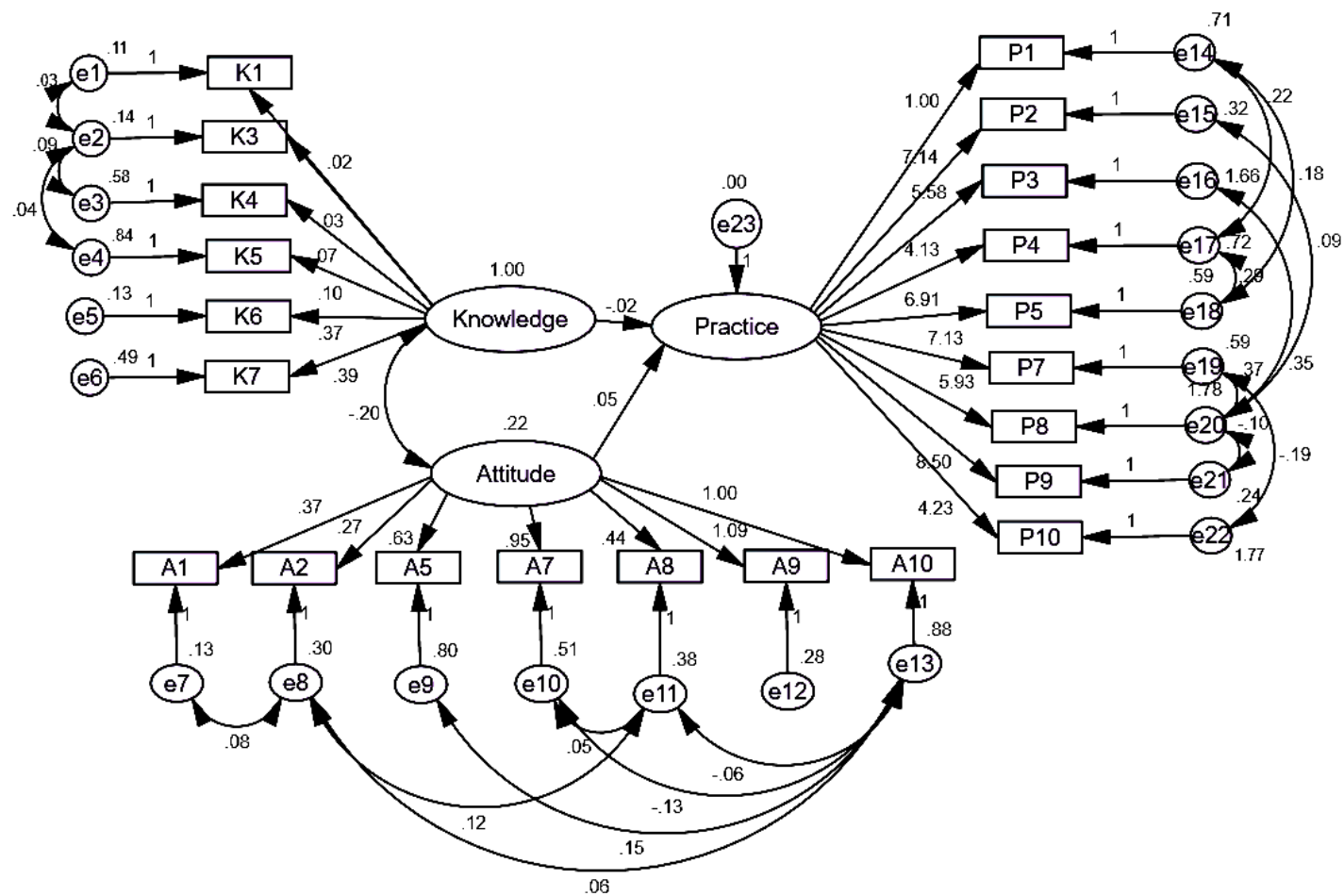607 safe meal to food allergic consumers. *Nutrition & Dietetics, 71*(4), 265-269.
608
609

Figure 1 Structural Equation Modelling of food allergen knowledge, attitude and practices among UK consumers

612

Table 1 Demographic characteristics of participants (n=252)

Variable	Items	Frequency (%)
Gender	Male	57 (23.0)
	Female	195 (77.0)
Age	18-24	22 (8.7)
	25-34	36 (14.3)
	35-44	44 (17.5)
	45-54	55 (21.8)
	55-64	50 (19.8)
	65 years and above	36 (14.3)
	Prefer not to say	12 (4.8)
Education	Primary education	2 (0.8)
	Secondary education	89 (35.3)
	HNC or Foundation degree	37 (14.7)
	Degree	99 (39.3)
	Masters	22 (8.7)
	Doctorate	3 (1.2)
Have you experienced food allergic reactions before (such as tingling or itching in mouth, swelling of lips, tongue, face or throat, dizziness, difficulty in breathing or fainting)?	Yes	108 (42.9)
	No	117 (46.4)
	Uncertain	27 (10.7)
Have your family member(s) experienced food allergic reactions before?	Yes	136 (54.0)
	No	92 (36.5)
	Uncertain	24 (9.5)
The food allergies and/or intolerance experienced by you or your family were diagnosed by:	Allergist	62 (24.6)
	General practitioner	77 (31.0)
	Paediatrician	21 (8.3)
	Emergency physician	2 (0.8)
	Dermatologist	0
	Self-diagnosis	30 (11.9)
	Other	32 (11.9)
	Not applicable	28 (10.3)
Please select the foods you or your family member(s) are allergic to. Check all that apply*:	Milk	92
	Molluscs (e.g. mussels, oysters)	4
	Peanuts	33
	Tree nuts (e.g. almonds, cashews, hazelnuts)	29
	Soybeans	22
	Eggs	36
	Fish	12
	Cereal containing gluten (wheat, rye, barley, oats)	181
	Lupin (a common garden plant and seeds from some varieties are used to make flour)	6
	Sulphites	20
	Celery	0
	Crustaceans (prawns, crabs, lobsters)	9

	Mustard	9
	Sesame seed	8
	Others (e.g. anything high in histamine, chocolate, fermentable oligo-, di-, monosaccahrides and polyols (FODMAP), fruits such as apples, cherries, garlic, maize, onions, red meat, spices, white meat)	32
	Not applicable	25

614 Note: *Participants can select more than one food allergens

615

616 **Table 2** Food allergen knowledge (n=252)

No.	Questions	Correct answers Frequency (%)	Standard loadings
K1	Allergen can be serious and in severe cases result in death	True 240 (95.2)	0.80
K2	Ingesting a small amount of food allergen will cause an allergic reaction	True 225 (89.3)	<0.40
K3	The best way to prevent food allergic reaction is to avoid the allergen	True 238 (94.4)	0.71
K4	Allergens can be transferred by hands	True 170 (67.5)	0.89
K5	Tree nuts (e.g. almonds, cashew nuts, Brazil nuts) are similar to peanuts	False 35 (13.9)	<0.40
K6	High temperature cooking such as roasting, baking and deep frying can destroy food allergen	False 191 (75.8)	0.82
K7	Allergen cross contamination of cooking utensils can be prevented by rinsing with tap water	False 135 (53.6)	0.81
K8	Which of the following causes food allergic reaction?		<0.40
	Protein*	**103 (40.9%)**	
	Salt	0	
	Sugar	9	
	Lipid	7	
	Unknown substance	16	
	Uncertain	117	
K9	Which of the following is not categorised as food allergen in UK/EU?		<0.40
	Buckwheat	128 (50.8%)	
	Almonds	7	
	Fish	20	
	Milk	5	
	Mustard	23	
	Uncertain	69	
K10	If an individual is allergic to eggs, which of the following food should be avoided?		<0.40
	Mayonnaise	21	
	Pancakes	0	
	Meringues	0	
	Quiches	0	
	All of the above	**224 (88.9)**	
	Uncertain	7	

617 *Bold letters indicate correct answers in K8 – K10

618
619
620

621

622 **Table 3** Mean scores of items in attitude towards food allergens (1: Strongly disagree to 5: Strongly

623 agree) (n=252)

Items	Description	Mean	Standard deviation	Standard loadings
A1	When purchasing food, labels should be checked if it contains any ingredients that can cause food allergic reaction	4.82	0.41	0.67
A2	There should be more free from choices to choose from	4.64	0.57	0.87
A3	I will not purchase food containing the food allergen (where I or a family member is allergic to) even though other household members are not allergic to it	3.25	1.32	<0.40
A4	Kitchen surfaces and cooking equipment are washed with hot soapy water and rinse to remove allergens	4.33	0.71	<0.40
A5	It is easy to prepare allergen-free meals by substituting with other types of ingredients (e.g. wheat can be substituted with quinoa)	4.06	0.95	0.71
A6	Hands should be washed thoroughly after coming into contact with allergenic products to avoid cross contact	4.64	0.49	<0.40
A7	It is my responsibility to inform food services if I have any food allergies	4.46	0.84	0.61
A8	When ordering food online, there should be more information provided about allergen free food	4.48	0.65	0.67
A9	When ordering food via telephone, it is my responsibility to ask for allergen free food	4.49	0.74	0.66
A10	I believe I can handle a food allergy emergency situation at home or when eating out	3.62	1.05	0.61

624

625

626 **Table 4** Mean scores of items food allergen management practices (1: Never to 5: Always) (n=252)

Items	Description	Mean	Standard deviation	Standard loadings
P1	I purchase whole, unprocessed foods	3.67	0.85	0.65
P2	During shopping, I read the food labelling to check for allergenic ingredients	4.59	0.77	0.69
P3	I use apps or scan the QR code to find out if the ingredients contain any allergens	2.29	1.35	0.46
P4	I prepare my meals from scratch	3.93	0.90	0.59
P5	I look for alternative ingredients to use in my meal preparation or as food substitutes	3.90	0.92	0.74
P6	I wash my hands before preparing allergen-free meal	4.60	0.75	<0.40
P7	When eating out, I frequent restaurants that cater allergen-free meals	4.10	0.93	0.68
P8	I check social media to identify suitable restaurants	3.22	1.41	0.49
P9	I would inform the staff of my food allergies and seek confirmation that my meal is allergen-free when served	4.56	0.79	0.71
P10	I find the precautionary allergen labelling 'May contain' helpful	3.63	1.37	0.85

627

628
629 **Table 5** Goodness of fit indices

Fit indices	Model value	Accepted value
x^2/df	1.98	< 3[1]
Comparative Fit Index (CFI)	0.90	> 0.90[2]
Goodness of Fit Index (GFI)	0.82	>0.90[3]
Root Mean Square Error of Approximation (RMSEA)	0.06	<0.08[4]
Normed Fit Index (NFI)	0.70	> 0.90[5]
Root Mean Square Residual (RMR)	0.05	< 0.08[2]

630 [1]Kline (1998)
631 [2]Hu and Bentler (1999)
632 [3]Hooper, Coughlan and Mullen (2008)
633 [4]MacCallum et al. (1996)
634 [5]Bentler and Bonnet (1980)

635

636 **Table 6** Estimates of hypothesis paths for food allergen knowledge, attitude and practice

Hypothesis	Paths	Estimate	C.R.	P value
H1	Knowledge → Practice	-0.02	-1.09	0.28
H2	Attitude → Practice	0.05	1.11	0.27
H3	Knowledge <--> Attitude	-0.20	-3.40	< 0.05

637

638