Diet Diversity of University Students with Food Allergies and Food Allergen Knowledge and Practices of Catering Staff

By

Zainab Laheri

A thesis submitted in partial fulfilment for the requirements for the degree of MSc (by Research), at the University of Central Lancashire

September 2019

Student Declaration Form

Type of Award: ***MSC (by Research)***

School: ***Faculty of Health and Wellbeing***

1. Concurrent registration for two or more academic awards

I declare that while registered as a candidate for the research degree, I have not been a registered candidate or enrolled student for another award of the University or other academic or professional institution

2. Material submitted for another award

I declare that no material contained in the thesis has been used in any other submission for an academic award and is solely my own work

3. Collaboration

Where a candidate's research programme is part of a collaborative project, the thesis must indicate in addition clearly the candidate's individual contribution and the extent of the collaboration. Please state below:

This research was not part of a collaborative project.

4. Use of a Proof-reader

No proof-reading service was used in the compilation of this thesis.

Signature of Candidate: Z. LAHERI

Print name: ZAINAB LAHERI

Abstract

The incidence of food allergies is becoming extremely prevalent amongst young adults. This period of adolescence is often characterised as a challenging developmental stage. It is one whereby individuals will undergo a period of transition from parental supervision to self-management of their allergy. Firstly, students are more likely to be risk-takers in the realm of food and hence, poor food selection behaviour is a common practice amongst these individuals. Secondly, whilst avoidance of the offending food is the cornerstone of management for those with food allergies, this can often lead to an excessive consumption of foods rich in fat, salt and sugar. Finally, with the responsibility of the food allergy now on the adolescent, these students will also be reliant upon catering staff to provide them with safe, allergen free food. Additionally, individuals in late adolescence are also reliant on catering staff to prevent and aid the incidence of any food allergic reactions. However, many institutions are not currently equipped to support the needs of students with food allergies.

Thus, the purpose of this research was to understand which factors can influence food choice behaviour, assess the nutritional status of individuals in late adolescence with food allergies, as a means of establishing key nutrients that are lacking and to explore the knowledge and practices of catering staff at a university, to identify any potential gaps.

For the initial phase of the study, student participants were asked to rate on a scale of 1-5 how influential a total of 5 factors (cost, taste, convenience, health and labelling) were, in terms of their food selection behaviour. Statistical analyses in the form of descriptive statistics along with Chi-Squared (χ^2) analysis (to determine gender differences) was used on the demographic results from this study. Additionally, the Mann Whitney U test was used to determine which of the 5 factors were the most influential, along with any gender differences. The second study utilised a widely established food frequency questionnaire to measure student participant's dietary intake. The software FETA was used to analyse the food frequency questionnaire data. For the final study, participant's knowledge and perceived practices of catering staff were assessed through means of a questionnaire. Both independent t-tests and one-way ANOVA were used to examine any significant differences on data generated from this questionnaire. Additionally, to quantitatively assess the current food allergen practices of catering staff, food contact surfaces were swabbed for protein residue.

The results indicated that taste and cost were amongst the most influential determinants of food selection for adolescents. Significant differences ($p > 0.05$) were found between genders for both of these factors. Females were more likely than males to be influenced by cost, whilst for males taste was a greater determinant of food choice. Labelling was found to be the least influential factor, with regards to food choice. Moreover, the overall

dietary diversity of adolescents (19-24) was found to be particularly poor, with individuals consuming high amounts of saturated fat, salt and sugar, and lacking in dietary fibre and key vitamins and minerals. Furthermore, catering staff possessed good knowledge and perceived practices of food allergens. No significant differences ($p > 0.05$) were found in knowledge and perceived practices between gender, age and education level. Interestingly, it was found that although all catering staff had received level 2 food safety training, their current food allergen practices could be further improved.

Table of Contents

List of Tables

List of Figures

Abbreviations

DRV – Dietary Reference Value

FDA – Food and Drug Administration

FFQ – Food Frequency Questionnaire

FSA – Foods Standard Agency

GFD – Gluten Free Diet

HACCP – Hazard Analysis and Critical Control Point

OFC's – Oral Food Challenges

PAL – Precautionary Allergen Labelling

SCRAN – Students Creating Resources Around Nutrition

SPT's - Skin Prick Tests

SSIgE – Serum Specific IgE

UCLan – University of Central Lancashire

UL – Tolerable Upper Intake Level

Acknowledgements

I would like to take this opportunity, to thank all those who have helped me through the process of my research.

First and foremost, I would like to thank my supervisory team, Dr Jan Mei Soon and Dr Stephanie Dillon for their continued guidance, encouragement, and advice throughout this journey.

Second, I would like to offer my appreciation to all those who participated in my studies, without whom this research would not have been possible.

Thirdly, I would like to show gratitude to all those who helped in the recruitment of participants - Amy and the team at SCRAN, the Anaphylaxis Campaign and the FreeFrom Food Awards all deserve a special mention here.

Finally, I would also like to thank the catering team at UCLan, in particular Elizabeth Cleminson, who provided me with a great deal of assistance in data collection.

1. Literature Review

1.1. What is a Food Allergy?

In recent years, there has been a considerable increase in the number of individuals diagnosed with food allergies (Tang and Mullins. 2017). With more and more people falling victim to this life changing phenomenon, the need to self-educate and understand what truly qualifies as a food allergy is not only beneficial, but absolutely necessary (Hahn et al., 2017). According to the World Allergy Organisation (2017), food allergies have been characterised as a "hypersensitivity reaction initiated by proven or strongly suspected immunologic mechanisms." Food allergies consist of both Immunoglobulins E (IgE) mediated reactions, as well as non-IgE mediated reactions. IgE mediated reactions typically involve the 14 major food allergens (celery, gluten, crustaceans, eggs, fish, lupin, milk, molluscs, mustard, nuts, peanuts, sesame seeds, soya and sulphites). They can be characterised by a rapid onset of symptoms, whereby adverse reactions, typically hives, vomiting and anaphylaxis, occur within minutes of ingesting the offending food (Valenta et al., 2015). In comparison, non-IgE mediated reactions, though not fully understood, are thought to be concerned with different parts of the immune system and are not associated with IgE antibodies. Adverse effects following non-IgE mediated reactions are generally delayed, following ingestion of the offending food, with abdominal discomfort, vomiting and diarrhoea, the most severe of symptoms. A classic example for this type of reaction would be coeliac disease (Nowak-Wegrzyn et al., 2015). It is understood that both IgE and non-IgE mediated reactions, can both cause adverse immune responses to certain foods. However, with IgE mediated reactions responsible for a staggering 90% of all food allergies worldwide, it is clear that this particular type of reaction, with its potentially life-threatening properties, is perhaps the most feared (Manea et al., 2016).

1.2. Prevalence

Over the past 20 years, there has been an increased prevalence of food allergies, predominantly in western countries, affecting both children and adults alike (Rachid and Keet, 2018). Currently, in the UK alone, 200 million people are living with a food allergy (FSA, 2017) and thus, it is no surprise why this widespread hypersensitivity, continues to place an increased burden on the health care systems (Tang and Mullins, 2017). It is estimated, that the cost to the National Health Service (NHS) for all allergic diseases is an average of £900 million each year (Venter, 2009). Further research highlights that the burden is far more substantial, with costs exceeding £1 billion (Diwakar et al., 2017). In the case of cow's milk allergy, research indicates that management of this particular food allergy alone, will cost the

NHS a staggering £25.6 million per annum (Sladkevicius et al., 2010). With food allergies expected to rise, the cost required for management will only continue to increase, further straining the burden that already exists on the health care systems (Tang and Mullins, 2017).

Current research indicates that food allergies affect up to 5% of all adults, compared to 8% of all children worldwide (Iweala et al., 2018). Though it was previously thought to be a rare occurrence in the developing world, food allergies have now become extremely common in many different countries. Much research highlights the varied prevalence of food allergies (Tables 1 and 2). It is clear from this data that the frequency of food allergies is extremely wide-ranging. The literature shows that children in Australia have the highest prevalence of food allergies, whilst for adults, the greatest prevalence was in the USA. It should also be noted that those studies which are based on self-reported practices, have a higher reported prevalence than both *in-vivo* and *in-vitro* tests. Self-reported food allergies often lead to misdiagnosis and thus, it can be said that the prevalence rates in these cases are likely to have been overestimated (Ali, 2017). Although there is no clear cause for the development of food allergies, the large geographical variation can be attributed to factors such as environment, genetics, dietary practices, exposure to certain foods and the gut microbiota (Benede et al., 2016). Whilst it is clear that disparities do exist with regards to prevalence worldwide, what remains true is that the incidence of food allergies is undoubtedly increasing (Loh and Tang, 2018).

Whilst the increased prevalence amongst children is most definitely noteworthy, it is important to understand that for this particular group, most allergies are often outgrown during early adolescence (Anagnostou et al., 2015). By the age of 16, 79% of children can outgrow a cow's milk allergy, 68% of children can outgrow an egg allergy and 20% of children can outgrow a peanut or tree nut allergy (Iweala et al., 2018). Therefore, it can be said that allergies during childhood, with their ability of being resolved, are perhaps less alarming than those developed during adulthood. In fact, much literature exists regarding the various aspects of food allergies in children and thus, many individuals often associate food allergy incidence only with childhood (Acker et al., 2017; Lee, 2017; Rachid and Keet, 2018). However, recent research highlights that 45% of all food allergies in adults are developed during adulthood, thus contradicting this popular, yet obsolete belief (Gupta et al., 2017). Though somewhat insignificant in terms of overall prevalence, the numbers of adults with food allergies has most definitely increased over the years and are gradually becoming a greater cause for concern (Tang and Mullins, 2017). In fact, food allergies developed during adulthood can appear at any moment and are more likely to persist, making them both unpredictable and life-threatening (Kamdar et al., 2015). Globally, fish, shellfish, peanut and tree-nut allergy are four of the major food allergens that are prevalent amongst adults. All four are known to be the

leading cause of food induced anaphylaxis, further reinforcing the severity of possessing a food allergy during adulthood (Cianferoni and Muraro, 2012; Loh and Tang, 2018).

It is clear that food allergies are increasing in popularity and placing an increased burden on many individuals. Whilst children, more often than not, are able to outgrow their food allergy, the same unfortunately cannot be said for adults. This coupled with the fact that food allergies developed during adulthood are life-threatening and constantly overlooked, suggests that this group of individuals are perhaps more vulnerable than previously thought.

Table 1: Food Allergy Prevalence of Children in Different Countries

Country	Year of Study	Method of Diagnosis	Age	Prevalence of Food Allergy (%)	References
USA	2011	Self-Reported	< 18 years	8	Gupta et al. (2011)
Canada	2010	Self-Reported	< 18 years	7.1	Soller et al. (2012)
U.K.	2002	Medical History and Skin Prick Testing	12 months	4	Venter et al. (2006)
Australia	2007-2010	Skin Prick Tests and Oral Food Challenge	12 months	> 10	Osborne et al. (2011)
Denmark	1998-1999	Skin Prick Tests, Serum Specific IgE and Oral Food Challenges	18 months	3.6	Eller et al. (2009)
China	2009	Oral Food Challenge	0-24 months	7.7	Hu et al. (2010)
South Africa	2013-2014	Skin Prick Tests and Oral Food Challenges	12 -36 months	2.5	Basera et al. (2015)
Hong Kong	2005-2006	Self-Reported	0-14 years	4.8	Ho et al. (2012)

Table 2: Food Allergy Prevalence of Adolescents and Adults in Different Countries

Country	Year of Study	Method of Diagnosis	Age	Prevalence of Food Allergy (%)	References
USA	2015-2016	Self-Reported	> 18 years	10.8	Gupta et al. (2019)
Canada	2010	Self-Reported	> 18 years	6.6	Soller et al. (2012)
U.K.	2002-2003	Skin Prick Tests and Oral Food Challenges	11-15 years	2.3	Pereira et al. (2005)
Australia	2002	Medical History and Skin Prick Testing	20-45 years	1.3	Woods et al. (2002)
India	2005-2010	Serum Specific IgE	20-54 years	1.2	Mahesh et al. (2016)
Kuwait	2015-2016	Self-Reported	17-30 years	12	Ali (2017)

1.3. Diagnosis

1.3.1. Importance of Correct Diagnosis

The incidence of food allergies is at an unprecedented high and with prevalence expected to increase, there is a growing demand on the health care systems to provide both efficient and reliable care (Diwakar et al., 2017). Diagnosis of food allergies is an extremely complex process, with positive diagnosis apparent in less than 50% of cases (Roberts, 2005). Multiple factors can explain the difficulty experienced in correctly diagnosing food allergies. Firstly, diagnosis is largely reliant on patient medical history, which is often inaccurate (Begin and Nadeau, 2014; Sicherer and Sampson, 2018). Secondly, foods are rarely eaten independently and are often consumed as a complete meal, making it more difficult to identify the specific allergen responsible (Lange, 2014). Finally, many manifestations of food allergies exist, all with different severities. This coupled with the fact that numerous symptoms often masquerade as a food allergy, makes accurate diagnosis complicated (Sicherer and Sampson, 2018).

Misdiagnosis of food allergies places an unwarranted economic burden on the health care systems, with patients needlessly being referred to specialists and physicians conducting irrelevant additional tests, as well as prescribing unnecessary medications (Bird, 2015). More importantly, misdiagnosis of food allergies can lead to dietary restrictions, which can dramatically impact the nutritional profile of individuals (Kattan and Sicherer, 2015). For example, common food allergies in children often include, cow's milk, egg, wheat and soy. Hence, misdiagnosis of a food allergy in children, whereby the first five years of life are crucial to growth, could lead to a diet lacking in essential nutrients, leaving children with the risk of developing growth impairment (Kajornrattana et al., 2018). This is further reinforced by Alvares et al. (2013), who found that misdiagnosis of food allergy can lead to severe malnutrition, particularly in infants. Furthermore, dietary restrictions as a result of misdiagnosis can also negatively impact quality of life (Kattan and Sicherer, 2015). For instance, individuals will spend extra time preparing allergen free meals. Also, the additional time spent scrutinising labels to ensure safe consumption, will make the simple task of shopping, extremely arduous.

Limited participation in any social activities involving food will also occur, as a result of misdiagnosis (Kajornrattana et al., 2018). All of these consequences will increase unwarranted anxiety in both patients and caregivers, dramatically impacting their overall quality of life (Bird et al., 2015). Therefore, reliable methods of diagnosis are not only beneficial, but are absolutely necessary. In fact, improved methods of diagnosis can dramatically reduce the existing burden on the health care systems, save NHS resources, preserve nutrient status and improve overall quality of life of both patients and caregivers (Diwakar et al., 2017).

1.3.2. Methods of Diagnosis

Once an individual is suspected of a food allergy, conducting a detailed medical history and undertaking a thorough physical examination are the initial steps, which must be taken to enable accurate diagnosis (Begin and Nadeau, 2014). The clinical history considers any symptoms that suggest an allergic reaction to a particular food, whilst also taking into account the quantity ingested, the duration of the reaction and any facilitating factors (e.g. exercise and illness) that could induce a possible reaction (Kattan and Sicherer, 2015). On the other hand, the physical examination will instantly expose any signs of an acute reaction, which will help to determine a likely cause of the allergic symptoms (Manea et al., 2016). Although both the medical history and the physical examination are important tools to guide the physician in choosing an appropriate test, independently they cannot provide enough precision and sensitivity to conclusively diagnose a patient with a food allergy (Kattan and Sicherer, 2015). Currently, multiple methods exist that can be utilised in order to assist in establishing a suspected food allergy (see Table 3).

Table 3: Different Methods of Food Allergy Diagnosis

Method of Diagnosis	Procedure	Advantages	Disadvantages
Skin Prick Tests (SPT's)	- Involves an extract of the food allergen being placed on the forearm of the patient after which, the skin is pricked using a lancet. - Prick to prick testing (pricking the food followed by pricking the patient), can also be completed as a means of testing fresh food. - A positive response is indicated by the formation of a wheal, accompanied by red, swollen skin. - The larger the size of the wheal, the more likely the patient will possess a food allergy. (O'Keefe et al., 2014).	- Rapidly and effectively determines if the patient possesses an IgE mediated food allergy (Kattan and Sicherer, 2015). - Can be conducted with convenience and causes minimal patient discomfort (Manea et al., 2016). - Results can be produced within 15 minutes (Heinzerling et al., 2013). - SPT's are highly sensitive (greater than 90%), non-invasive and cheap, making them extremely reproducible and consequently, both reliable and accurate (Heinzerling et al., 2013).	- Cannot be utilised on patients using antihistamines and/or those suffering from atopic eczema, as both interfere with the results, leading to false positives (Begin and Nadeau, 2014). - Possibility of severe reactions, which could potentially lead to anaphylaxis and consequently death (Roberts et al., 2016). - This method is unable to predict the severity of a food allergic reaction (Kattan and Sicherer, 2015). - Determines sensitisation of an allergen through the indication of a positive test, but does not necessarily mean that an individual can now be diagnosed with a specific food allergy (Kattan and Sicherer, 2015).
Serum specific IgE (SSIgE)	- An alternative method to SPT's and used to determine the presence of a food allergy, when SPT's are deemed ineffective (Manea et al., 2016). - Involves measuring the amount of IgE present in the blood that is able to bind to specific food allergens (O'Keefe et al., 2014). - An increased concentration of IgE in the blood is linked to an increased likelihood of possessing a food allergy (Kattan and Sicherer, 2015).	- Allows all allergens to be tested and are not restricted to IgE mediated allergies alone (Klinieken, 2007). - Can be used in patients with multiple severe allergies, without discontinuing the ingestion of antihistamines (Begin and Nadeau, 2014).	- Delay in obtaining results following the blood test, with procurement ranging from days to weeks. - Discomfort experienced by patients due to venepuncture and high costs to conduct the method (Klinieken, 2007; Brown et al., 2016). - This method is unable to predict the severity of a food allergic reaction (Kattan and Sicherer, 2015) - Determines sensitisation of an allergen through the indication of a positive test, but does not necessarily mean that an individual can now be diagnosed with a specific food allergy (Kattan and Sicherer, 2015).
Oral Food Challenges (OFC's)	- Involve gradually increasing the suspected food allergen in small doses, under medical supervision. - Any symptoms are considered to be indicative of a positive result, confirming the patient has a food allergy. - If during this period no symptoms occur, the results are deemed negative and the patient is considered to not possess a food allergy (Anagnostou, 2018).	- Can fully confirm diagnosis of a food allergy (O'Keefe et al., 2014). - OFC's are important to determine when foods can be safely reintroduced into the diet (Perry et al., 2004).	- Expensive and time-consuming, making it a burdensome process for both the patient and the clinician (Klinieken, 2007). - The primary objective of this method is to progressively introduce the offending allergen into the diet, which can pose the risk of an allergic reaction, causing both stress and anxiety in the patient (Kattan and Sicherer, 2015). - OFC's have the capability to produce false negatives due to the effect of facilitating factors, such as drug use, exercise, alcohol and viral infections (Ballmer-Weber and Beyer, 2018).

1.3.3. Summary

Diagnosis of food allergies is a complex, lengthy and time consuming process. In order to make a correct prognosis and to ensure misdiagnosis does not occur, accurate clinical history is paramount (Begin and Nadeau, 2014). Whilst SPT's and SSIgE tests can determine sensitisation, OFC's remain the only method through which confirmation of a food allergy can truly be achieved (Kattan and Sicherer, 2015). However, enduring each process can prove to be burdensome for all those involved. Additionally, though each method is essential in enabling accurate diagnosis, individually they are unfortunately accompanied by various limitations (O'Keefe et al., 2014). Therefore, the need to establish sound methods that are able to minimise patient discomfort, whist at the same time allow reliable, accurate diagnosis for clinicians, is crucial (Kattan and Sicherer, 2015). Currently, many alternative methods of food allergy diagnosis exist (applied kinesiology, Vega testing, hair analysis, component resolved diagnosis and molecular based diagnosis). Despite this, most of these are controversial and have not yet been validated. In their current form, they should not be used in a clinical setting. However, with further evaluation these techniques could prove to be somewhat promising (Begin and Nadeau, 2014; Kattan and Sicherer, 2015). Perhaps further research into the pathophysiology of food allergies can assist in the development of more accurate and reliable methods of diagnosis (Waserman et al., 2018). The improvement of existing diagnostic methods, as well as the formation of new validated procedures are an absolute necessity and will most certainly revolutionise the lives of all food allergic individuals, whilst at the same time assuage the current burden that exists between physicians (O'Keefe et al., 2014).

1.4. Treatment

Currently, the only proven treatment for food allergies is complete avoidance of the offending food (Rachid and Keet, 2018). Whilst adherence to this strict diet is the only effective way of managing a food allergy, complete compliance requires constant vigilance and as such, can prove to be extremely challenging. Recent advances in research have allowed for the development of certain therapeutic strategies, that could provide an alternative means of treatment for those with food allergies (Feuille and Nowak-Wegrzyn, 2018). Food immunotherapy is considered to be one of the most popular forms of this treatment and can be administered orally (via ingestion), sublingually (application under the tongue) or epicutaneously (application on the skin) (Anvari and Anagnostou, 2018). This type of therapy aims to increase the individuals threshold of reactivity to the offending food, by administering either a gradual increasing dose (for oral and sublingual therapy) or a fixed dose (for

epicutaneous therapy) of the relevant allergen (Sampath et al., 2018). However, at present these approaches are accompanied with significant risks.

Firstly, most of these therapies are still in their research phase and thus, due to their experimental nature, the efficacy and long term safety of these methods is somewhat questionable. Secondly, desensitisation for most individuals is only temporary, with a high possibility of relapse following discontinuation of therapy. Finally, in order for successful treatment to occur maintenance is key, with the process requiring regular administration of the allergen. This may prove to be particularly onerous for the affected individual (Anvari and Anagnostou, 2018; Feuille and Nowak-Wegrzyn, 2018). Despite these many drawbacks, food allergies are undoubtedly increasing in prevalence and as the traditional treatment of avoidance is extremely burdensome for the individual, the need for alternative therapies like food immunotherapy is essential. With the help of further research, these new emerging therapies will most definitely provide a promising form of treatment in the near future (Anvari and Anagnostou, 2018; Feuille and Nowak-Wegrzyn, 2018; Sampath et al., 2018).

1.5. Labelling Regulations

In order to achieve effective allergen avoidance extensive education is required for all those affected (Sicherer and Sampson, 2018). All individuals with food allergies must have the proper knowledge to correctly read and interpret all labelling on food (Marra et al., 2017). Different countries across the world, are each governed by their own labelling regulations and guidelines (Allen et al., 2014). In the UK, all food labels must highlight the 14 major food allergens. The European Union Food Information for Consumers (EU FIC) Regulation No. 1169/2011 outlines the specific requirements, which must be enforced by all food business operators. This law dictates that all allergenic ingredients must be clearly identified on all pre-packaged foods. Thus, food establishments are required to emphasise the food allergen by means of font, style or background colour (FSA, 2015). Furthermore, this new legislation directly impacts the catering industry, as well as retail businesses, such as delicatessens and bakeries. For these particular establishments (whereby non-prepacked foods make up a large proportion of what is sold), clear, obvious signposting must be utilised, such as menus or chalkboards, to highlight the presence of any food allergens. Alternatively, clear oral communication is another means of conveying the existence of any of the 14 major food allergens, for loose foods (FSA, 2017). The EU FIC Regulation No. 1169/2011 is designed to provide a higher level of security for food allergic individuals. Therefore, all catering staff must be adept at identifying the 14 allergens in all food items, or at the very least be able to direct the consumer to where this particular information can be found (Fransvea et al., 2014). To further strengthen allergen labelling, under the new ‘Natasha’s law’, foods which are pre-

packed for sale are now required to carry a full list of ingredients. This new legislation, named after Natasha Ednan-Laperouse (the teenager who died after suffering an allergic reaction to a Pret A Manger baguette), will allow the millions of allergy sufferers with greater trust and confidence in the food they buy (BBC News, 2019). It is also important to note, that whilst the food industry implements this compulsory food labelling, more and more food establishments are also including the use of precautionary allergen labelling (PAL). PAL is utilised to warn individuals of any trace amounts of the allergen, as well as the possibility of cross contamination. Hence the use of PAL, acts as an additional means of ensuring food safety amongst food allergic consumers (Rachid and Keet, 2018).

1.6. PAL – A Benefit or Burden?

The use of PAL may prove to be counterproductive, for the many sufferers of food allergies. PAL consists of various statements all of which are interchangeably used. For example, 'may contain (an allergen)', 'packed in an environment where (an allergen) may be present' or 'made in a facility that also processes (an allergen)' are common phrases featured on countless food packaging (Allen et al., 2014). The use of these many different PAL statements often causes unwarranted confusion and anxiety amongst food allergic individuals, ultimately overwhelming them. As a result, consumers with food allergies will mistakenly purchase food products containing these statements, increasing their risk of a food allergic reaction DunnGalvin et al., 2019). This is further reinforced by Sheth et al. (2010) who found that food allergic individuals would purchase food items with the presence of PAL, due to their inability to clearly identify the food allergen. Thus, individuals were subject to accidental exposures. Additionally, research has found that an increased use of PAL is the primary cause of label fatigue (Robertson et al., 2013). This label fatigue could also cause individuals to disregard the advisory labelling and still purchase the food which contains trace amounts of the allergen, regrettably placing themselves at risk (Soon and Manning, 2017).

On the other hand, research also dictates that the ambiguity of PAL would also cause the avoidance of such foods (Sicherer and Sampson, 2018; Blom et al., 2018). Hefle et al. (2007), found that food packaging that specifically utilised the statements 'may contain (an allergen)' and 'may contain traces of (an allergen)', were never purchased and completely disregarded by more than 90% of those with food allergies. Moreover, Noimark et al. (2009), found that 80% of individuals would not purchase food items whereby statements such as 'may contain (an allergen)' or 'not suitable for someone with (X allergy)' were used. In some instances the more ambiguous the warning, the less likely individuals were to purchase the food item. Additionally, this also highlights that from the many different advisory statements,

‘may contain (an allergen)’, along with slight variations of this statement, heavily influence the purchase habits of those with food allergies.

Furthermore, much literature exists regarding the wrongful overuse of PAL statements. Whilst conducting research into the prevalence of PAL Zurzola et al. (2013), found that from a total of 1355 food products, 65% used PAL, when no allergen was actually present in the food item. In addition to this, the inappropriate use of PAL can further be reinforced by the Foods Standards Agency (FSA), who found that in a basket of 232 every day food items, 69% of cereals and 56% of confectionary items all possessed some form of PAL, to indicate that each food product contained some form of nuts. However, when analysed, all food items were found to contain no traces of peanut or tree nuts, thus falsely informing the consumer (Allen et al., 2014). Whilst PAL has been designed to inform the consumer of any possible cross-contact, its’ abundance and ambiguity is causing label fatigue and consequently ignorance, amongst food allergic individuals, ultimately proving to be a burden rather than a benefit (Zurzola et al., 2013).

PAL is meant to offer clarity to individuals with food allergies and should be used with the sole purpose of minimising risk to consumers. However, many continue to be confused by this voluntary form of labelling. With PAL constantly being wrongly used, it seems more often than not, as though food manufacturers are only concerned with protecting themselves as well as those involved in the supply chain, from product liability claims. Hence, it is no surprise why many are against this widespread, yet overused form of labelling (Soon and Manning, 2017). Perhaps acknowledging, addressing and standardising inconsistencies with regards to labelling legislation and/or eradicating the use of PAL completely (as in Japan), can prove useful. Firstly, as a means of improving the status of PAL and secondly, as a potential possibility of mitigating the confusion that currently exists amongst the food allergic community, consequently improving their overall food safety (Allen et al., 2014). Furthermore, DunnGalvin et al. (2019) suggests that providing more directive information, through the use of a quantitative risk assessment, allows for consumers to make more informed choices when purchasing foods, consequently reducing the risk of an allergic reaction.

1.7. Hidden Allergens

Whilst both mandatory food labelling and PAL can act as a means of protection for food allergic individuals, accidental exposure to hidden allergens may still occur. Hidden allergens are unexpected ways in which an individual is exposed to food allergens (Zurzola et al., 2012). Anibarro et al. (2007) found that a quarter of all food allergic reactions, were the result of individuals unintentionally coming into contact with hidden allergens. Thus, this highlights the

severity that hidden allergens pose, for those who possess a food allergy. Allergic reactions elicited by any hidden food allergens, can be characterised by three key components.

1.7.1. Undeclared Ingredients

Firstly, many food items consist of undeclared ingredients that may possess a food allergen, which are sometimes left off the ingredients list (Sicherer, 2014). As previously discussed, it is mandatory for food products to adhere to the appropriate labelling guidelines, which in effect, if implemented properly, should expose any major food allergens (Allen et al., 2014). Errors in labelling due to the incompetency of any stakeholders in the food manufacturing and supply chain, leads not only to the accidental ingestion of allergenic foods, but is also one of the leading causes of food recall (Khuda et al., 2016). According to a report published by Reynolds Porter Chamberlain (RPC) (2017), food recalls have increased by a staggering 62% in 2015/16 in the UK, with 144 food and drink items being recalled due to improper labelling of food allergens. Moreover, in 2018 alone, many of the UK's top food manufacturers (Marks and Spencers, Tesco, Morrisons, Asda, Walkers and Boots), have all been required to recall some of their food products, as a result of undeclared food allergens (FSA, 2018).

In addition to this, the slightest incompetence of the food manufacturer and those in the supply chain (such as neglecting to disclose a certain food allergen in the correct manner, or not providing this information by using the correct terminology or language), may consequently lead to incorrect information being placed on food labels (Sicherer, 2014). In recent years, the fast food industry has been placed under major scrutiny regarding this very aspect. The Royal Society for Public Health (RSPH) discovered that 70% of takeaways were found to violate labelling legislation, by providing information in the wrong way. Moreover, it was found that four out of five takeaways (80%) did not possess a suitable system, to ensure that their allergen information was both accurate and verified (RSPH, 2015). Therefore, it seems that although the new labelling legislation enforced in 2014 (EU FIC Regulation No. 1169/2011), places greater emphasis on loose foods, many fast food outlets are unable to meet current guidelines. This failure to comply with current labelling legislation can only result in tragic consequences for all those involved. This is clearly highlighted when in 2016, Natasha Ednan-Laperouse died as a result of consuming a Pret a Manger baguette, which failed to identify its inclusion of sesame – an allergen to which she was severely allergic (Ward, 2019). This fatal incident caused uproar in the food allergic community, again further reinforcing the significance of incompetency. Whilst new regulations for allergic consumers have in many ways improved the quality of available information, it seems that many fast food outlets are prioritising profit over safety (Telegraph, 2019). Despite this, research conducted by the FreeFrom Awards indicates that 'access to clear, reliable and transparent information' is of

greater importance than an increase in availability, ultimately confirming the need for more stringent legislative change (RSPH, 2015).

Furthermore, clarity in communication is also of vital importance when a food allergic individual is eating out or purchasing food without any distinct labels. For instance, the communication between and amongst restaurant and takeaway staff (including delivery services) is key, considering the large number of staff typically involved in daily restaurant operations (In both restaurants and other food service establishments, there may be many occasions whereby the chef utilises different food allergens to enhance taste and texture. For instance, the addition of peanut flour is a common technique of thickening up both soups and sauces, thus providing a creamier texture. In this case, if such information is not appropriately conveyed to the food allergic individual, even the most diligent consumer can remain ignorant of that particular food allergen, until ultimately provoked by an allergic response (Sicherer, 2014; Wen and Kwon, 2018). Whilst it is mandatory for the retailers of non-prepacked foods, to provide sufficient information regarding food allergens and to also ensure clarity in verbal communication (in accordance with EU FIC Regulation No. 1169/2011), takeaways continue to pose an alarming risk for those with food allergies (FSA, 2017). Research indicates that the level of allergen awareness in fast food outlets is particularly low, with 54% of takeaways unable to identify the presence of any major food allergens, in their food items. Additionally, it was found that takeaways specialising in fried chicken performed the worst. 100% of these establishments did not have the appropriate notices to inform consumers of potential food allergens, as well as failed to keep records of which dishes contained major allergens and which dishes were allergen free (RSPH, 2015).

In 2014, Paul Wilson died after eating a takeaway meal containing peanuts, after having been assured that it was ‘nut free’ (BBC News, 2017). Similarly, in 2017, Chloe Gilbert died following a severe allergic reaction to dairy, after eating a kebab, which did not indicate its inclusion of yoghurt (Wood, 2018). Hence, this lack of knowledge and cavalier attitude displayed by staff, further highlights how those working in the fast food industry, are unable to comprehend the magnitude of their actions. Furthermore, with the fast food industry growing in popularity, the use of gateways such as Just Eat, Hungry House and Deliveroo are becoming increasingly prevalent. However, whilst these services provide a means of convenience for consumers, they also pose an unnecessary threat for those with food allergies (BBC News, 2018). In 2017, Megan Lee became the latest casualty of gross negligence, after she placed an online order from a takeaway, despite stressing her nut allergy (Ward, 2019). The EU FIC Regulation No. 1169/2011 which came into force on December 2014, mandates both restaurants and takeaways to provide consumers with accurate and accessible information regarding food allergies (FSA, 2017). Therefore, this incident emphasises that

although guidelines are present, food outlets continue to be negligent, which will most certainly allow for the possibility of mistakes that could ultimately prove fatal. Begen et al. (2016), highlights that perhaps identifying the best manner in which information pertaining to food allergies can be efficiently conveyed to the consumer, is vital in improving their safety. It was found that food allergic individuals favoured written information, which would thereafter lead to implicit trust in any following verbal communication. Regarding online orders, it was found that food allergic individuals were found to have an expectation to receive sufficient information on the website, whilst for telephone orders, it was expected that an informed response from staff was available. Therefore, it is hopes that understanding these preferences will encourage food outlets to provide clearer written and verbal communication, as well as strengthen the training of staff, allowing them to be more proactive and allergen aware.

Whilst omission is not always intentional, the food industry must do better in terms of clarity, to explicitly convey to food allergic consumers the presence of any hidden allergens. Although food labelling has considerably improved over the years and ignorance is no longer acceptable as an excuse, it seems that many are still failing to meet current regulations. Individuals with food allergies are dependent on food labels and if improper labelling and improper food information from staff continues to occur, choosing a safe allergen free food will most certainly prove to be problematic.

1.7.2. Cross Contact

Secondly, cross contact can also lead to the exposure of hidden food allergens and as such, proves to provide an additional challenge for food allergic individuals. Cross contact may occur via transport, storage or processing of the food item, due to the ubiquitous nature of food allergens (Blom et al., 2018). More specifically, cross contact of food allergens will occur when facilities are utilising and sharing the same equipment and utensils, without thorough cleaning between preparations (Sicherer, 2014).

Hazard Analysis and Critical Control Points (HACCP), is a preventative mechanism utilised to minimise this very risk. HACCP is a quality assurance system that is used to identify, assess, control and prevent, any potential food safety hazards. This internationally agreed approach is all inclusive, in that it works by controlling each critical point of the production process – from raw production, procurement and handling, to manufacturing, distribution and consumption of the final product (Citraresmi and Wahyuni, 2018). This, coupled with the fact that the HACCP method can be tailored and adapted to suit each individual business, highlights that it is both an efficient and dynamic method of food screening (Agyei-Baffour et al., 2013). Since January 2006, a new food hygiene regulation (EU FIC Regulation No. 852/2004) was passed concerning food safety management. The legislation dictates, that all

UK food businesses must greatly emphasise the use of HACCP, to allow more effective control throughout the food chain (Osimani et al., 2013). Therefore, this mandatory implementation of HACCP by all food businesses is a sure way to achieve good manufacturing practices – a vital aspect of reducing the cross contact of food allergens (Agyei-Baffour et al., 2013). Food Safety Management Systems (FSMS) that are based on the principles of HACCP have also been introduced in the UK. Safer Food Better Business (SFBB0) has been introduced in both England and Wales and is one example of a FSMS that is specific to the catering sector. This practical and easy to use approach complies with food safety regulations, allowing small businesses to implement effective food safety management procedures. Additionally, the SFBB pack also takes into account the management of food allergens, in accordance with EU FIC Regulation No. 1169/2011. For instance, guidance on how to correctly and easily convey food allergen information to consumers is included within the SFBB pack, as well as visual aids that can be used to assist in staff training. These explicit guidelines will prove to provide an additional means of safety for those with food allergies (FSA, 2020).

Despite the incorporation of allergen control plans within the HACCP procedure, many food establishments continue to be prone to high levels of cross contact. Restaurants are known to contribute to a significant proportion of adverse food allergic reactions, through cross contact (Radke et al., 2016), with up to 31% of accidental allergen ingestions occurring at restaurants (Barnett et al., 2018). A study conducted by Wanich et al. (2008), highlighted that of the 294 respondents recruited, 34% experienced at least one food allergic reaction at a restaurant. Likewise, in another study conducted by Weiss and Munoz-Furlong (2008), it was further highlighted that almost 50% of fatal food allergic reactions over a 13-year period, were caused by foods consumed at multiple different restaurants. Additionally, the likelihood of cross contact at takeaways is at an unprecedented high and poses a serious threat to individuals with food allergies, often resulting in multiple fatalities (Morgan, 2018; Marsh, 2019; Middleton, 2019; Ward, 2019). Whilst they often provide a means of convenience for consumers, takeaways possess limited kitchen space and have a high incidence of sharing both cooking equipment and utensils. This coupled with the fact that employees are required to order and construct a meal within a matter of minutes, truly highlights the ease through which cross contact of food allergens can take place (Soon, 2018).

Furthermore, consuming food at educational settings can prove to be a challenging environment for food allergic individuals. Research indicates that up to 23% of accidental allergic ingestions occur at school canteens, through cross contact (Barnett et al., 2018). In fact, a study conducted by Ortiz et al. (2018), highlights the significance of cross contact and due to its prevalent nature, the difficulty it poses for those with food allergies. They found that from a total of 50 school canteen kitchens, 30% to some extent were contaminated with protein

residue. This was despite the fact that all food contact surfaces had been cleaned with wet cleaning using both detergents and disinfectants. Surprisingly, large proportions of these food contact surfaces, had also been dedicated solely to the preparation of allergen-free meals, yet were still predisposed to allergens. Hence, this research firstly highlights how the current cleaning methods present in school canteens are far from adequate. In this case, validation and verification of these cleaning procedures will prove a vital component of reducing this incidence of cross contact (Jackson et al., 2008; Galan-Malo et al., 2017). Secondly, much to the dismay of those with food allergies, this research also sheds light on the extra care and vigilance needed by those suffering, as the utilisation of allergen-free surfaces, does not necessarily guarantee a safe allergen free meal.

Furthermore, it was found that 36% of schools that were involved in this study had actually reported a minimum of at least one food allergic reaction between 2014 and 2015 (Ortiz et al., 2016). Therefore, it is clear that this particular piece of research exposes the harsh reality of both ineffective cleaning procedures and cross contact, for those with food allergies. Much research supports the increased likelihood of being exposed to food allergens when eating outside of the home (Radke et al., 2016; Ortiz et al., 2016; Barnett et al, 2018; Ortiz et al., 2018; Soon, 2018). Whilst the media is gradually coming to terms with the significance of food related deaths, it must also be noted that many incidents are unlikely to have been reported. This is often the case with fast food outlets where food is frequently delivered and consumed at home. Hence, with the food industry likely to be unaware of the occurrence of many reactions, this only makes their already difficult task of reducing cross contact, even more challenging (Marsh, 2019; Middleton, 2019).

Whilst the notion of eating out is gradually gaining popularity and has become an essential social norm that is important to psychological wellbeing, for those with food allergies it can prove detrimental (Rachid and Keet, 2018). Therefore, prior to eating out, planning and preparation are considered paramount for food allergic individuals. Those with food allergies often take a number of steps, in order to reduce the possibility of being exposed to a food allergen. For example, utilising a chef card as a means of communicating a food allergy to members of staff, or avoiding restaurants that frequently use foods containing high levels of food allergens (such as Asian restaurants for peanut or tree nut allergy and seafood restaurants for shellfish allergies), avoiding complex soups and sauces and avoiding buffet or salad bars, due to the possibility of cross contact (Anaphylaxis Campaign, 2017). Despite the various prevention strategies adopted by food allergic consumers prior to eating out, cross contact of food allergens due to shared equipment and cleaning practices is solely dependent on the knowledge of all personnel. Hence, this is something, which those with food allergies cannot control (Wen and Kwon, 2018).

In the UK, all employees are required to obtain sufficient training with regards to food hygiene. The EU FIC Regulation No. 1169/2011 requires all catering staff to be well-versed in knowledge pertaining to the 14 food allergens (FSA, 2017). Whilst food allergy courses are also available in many food service establishments, this training is not mandatory (Bailey et al., 2014). With participation being voluntary, it is no surprise why much literature exists regarding the extremely poor food allergen knowledge and practices, of restaurant staff (Radke et al., 2016; Wen and Kwon, 2018; Young and Thaivalappil, 2018; Lee and Sozen, 2018) (see Table 4). This data highlighted that staff were aware of the severity of food allergies and placed great importance in minimising cross contact. However, their knowledge of major food allergens was limited. Additionally, it was found that responding to food allergy emergencies was a common difficulty that was experienced by most staff. The studies also revealed that food allergen training was a key area that was found to be inadequate in many individuals. The data from these studies help to provide an insight into the specific areas which staff were lacking in. This information can then be used to improve their knowledge and practices concerning food allergens, ultimately providing greater safety for those who suffer from food allergies.

Furthermore, additional research indicates, that many misconceptions concerning food allergen knowledge and practices, exist amongst restaurant employees. For example, many believed that cooking at high temperatures was enough to destroy food allergens or picking off an allergen from a final dish (e.g. peanuts), would prevent an allergic reaction (Sicherer, 2014). These many common misunderstandings which frequently exist amongst restaurant personnel, indicates both their ignorance and incompetence. These gaps in knowledge are acting as somewhat of a hindrance for restaurant staff, to truly realise the severity of their actions, which can negatively impact food allergic consumers and possibly lead to fatal consequences. It is essential that all restaurant employees play an active role in food allergy prevention and management (Lee and Sozen, 2018). Despite this, many are lacking in basic training and as such don't possess adequate knowledge, consequently placing many food allergic consumers at risk. Therefore, it is no wonder why 60% of young people with food allergies were found to avoid eating out, due to the possibility of being accidentally exposed to a food allergen (FSA, 2018). Research by Bailey et al. (2014), highlights that something as simple as attending a training session on food allergen management and practices, is sufficient to ensure satisfactory knowledge of food allergens amongst all staff. Moreover, McAdams et al. (2018), further reiterates the importance of utilising food allergy training sessions, as a means of increasing employee awareness and confidence, ultimately reducing the possibility of cross contact.

Cross contact of food allergens poses a serious threat to individuals with food allergies. Research indicates that control of these allergens, is an exceedingly difficult task for those in the catering industry (Radke et al., 2016; Ortiz et al., 2016; Barnett et al., 2018; Ortiz et al., 2018; Soon, 2018). For the many sufferers of food allergies, dining out remains a daunting experience. In order to successfully reduce the impact that food allergens can have on susceptible individuals, the catering world must implement and adhere to certain procedures. HACCP is a crucial aspect of achieving good manufacturing practices and provides the first line of defence against allergen cross contact. Careful and conscious planning of HACCP, which has been effectively planned and designed, can most certainly prove to be successful (Wallace, 2014). It is also important to note, that simply certifying HACCP will by no means guarantee optimal food safety. Rather, the need to be able to clearly demonstrate in a transparent manner how food safety has been planned and implemented via HACCP is the most basic requirement, for all food institutes (Kafetzopoulos et al., 2013). Whilst the integration of HACCP into daily operations will prove successful, in isolation it is just not enough. Hence, the second phase of managing the potential risks from allergenic foods is efficient education. The education and training level of all employees, along with employee competency level will greatly influence the effectiveness of the HACCP (Agyei-Baffour et al., 2013). Appropriate food allergen knowledge and practices of all employees is an absolutely crucial step for the implementation of adequate cleaning protocols – the third and final stage of minimising the danger that is cross contact (Ortiz et al., 2018). Protection of food allergic consumers must be prioritised by the food industry, in order to come to terms with the countless food safety issues of the changing world. Effective implementation of HACCP, sufficient education and knowledge of all employees and the application of adequate cleaning protocols are three essential aspects that will surely reduce the risk of cross contact, consequently providing a comfortable and more importantly safe environment, for the many sufferers of food allergies.

1.7.3. Non-Food Items

Finally, everyday non-food items can also contain hidden food allergens, which can prove fatal for those with food allergies. Food allergens can be present in a range of different everyday items such as, toothpaste, cosmetics, postage stamps, toys, as well as skin and hair products (Sicherer, 2014; Bracho-Sanchez, 2019). In addition to this, both vaccines and medications are also known to contain food proteins that are utilised for their pharmaceutical properties, which could put food allergic individuals at risk. For example, egg proteins are commonly used in influenza and yellow fever vaccines, whilst glucosamine, which is derived from shellfish, is a form of medication used to treat arthritis (Kelso, 2014). Moreover, latex gloves are a ubiquitous raw material, used in many different industries. When used during food handling,

latex gloves can elicit unexpected reactions, when handled foods are ingested by latex allergic individuals (Sicherer, 2014). Hence, it is clear that food allergens are overwhelmingly ubiquitous in a range of non-food items, causing additional anxiety amongst those with food allergies. Therefore, food allergic individuals must take extra caution when purchasing and handling these products. Despite this, it seems that identifying potential sources of allergens in everyday items is challenging, due to the fact that labelling laws are not applicable to non-food items (King, 2013). Without clear identification of allergens present in non-food items, how can it possible for those with food allergies, to avoid these dangerous products and ultimately guarantee their overall safety?

1.7.4. Summary

For those with food allergies, the absence of a cure means that avoidance is the only means of effective management. In order to survive, extreme diligence is a requirement and is the best and only means of ensuring safety, amongst food allergic individuals (Sicherer and Sampson, 2018). Hidden allergens encompass undeclared allergens, cross contact of allergens and allergens present in non-food items. These types of allergens are inconspicuous by nature and are omnipresent in a variety of different industries. Hence, without sufficient education food allergen avoidance will not always be effective (Sicherer, 2014). Individuals must be proficient enough to correctly read and interpret labels, have heightened awareness in order to mitigate cross contact and possess enough knowledge to clearly identify hidden allergens in the form of non-food items. With the labelling industry lacking in various different aspects, it seems that reliance on individual knowledge is more important than ever (Rachid and Keet, 2018). This increased awareness that every individual with a food allergy must demonstrate, is a legitimate source of anxiety. Thus, it is no wonder why a reduced quality of life, is heavily associated with food allergic individuals (Antolin-Amerigo et al., 2016).

Table 4: Food Allergen Knowledge and Practices – Key Findings from Previous Studies

Country	Method	Location	Key Findings	Study
USA	Interviews	Restaurants	- Data from 278 randomly selected restaurants was collected through interviews with restaurant managers, food workers and servers. - Gaps in knowledge and attitudes were found regarding food allergens e.g. staff were less likely to be able to identify major allergens and staff incorrectly believed that ingesting a small amount of an allergen was considered safe. - Managers and staff had low confidence in accommodating for food allergy emergencies.	Radke et al. (2016)
USA	Interviews	Restaurants	- 16 managers from various different restaurants were interviewed. - Most managers (11) were aware of the severity of food allergy reactions and knew of the importance of minimising cross-contact. - Some managers (5) believed that customers had more responsibility of communicating allergen free meals. - Managers did not have sufficient food allergy training and also provided little training to staff. - Some felt that food allergen training was not important for a restaurant setting. - Stand-alone restaurants did not have adequate risk management policies in place to address food allergy reactions, however chain restaurants did.	Wen and Kwon, (2016)
USA and U.K.	Systematic Review	Restaurants and Food Service Establishments (e.g. Cafes and Delis)	- A systematic review was utilised and a total of thirty-eight relevant studies were identified. Participants included managers, chefs and servers. - It was found that knowledge, practices and training was highly variable across all studies. - In general, it was found that participants had higher knowledge and self-efficacy, when it came to preparing and serving allergen free meals, as opposed to responding to food allergy emergencies. - Many participants were unaware of anaphylaxis as a symptom of a food allergy reaction. - Across all studies, it was found that the use of risk prevention and response practices was low. Establishments were more concerned with risk communication and avoidance of cross-contact, as opposed to being able to quickly and effectively recognise symptoms and respond to food allergy reactions. - Whilst many studies were interested in receiving food allergy training, it was found that few participants had actually received adequate training.	Young and Thaivalappil, (2018)
USA	Questionnaires	Restaurants	- 110 managerial staff and 229 restaurant employees completed an online questionnaire, regarding their knowledge, attitudes and training of food allergies. - Most restaurants were willing to modify recipes for customers with food allergies. - A lack of knowledge of allergen-handling practices was identified with differences found amongst managerial staff and employees on how to respond to food allergy reactions. - Less than half of all employees had received food allergy training.	Lee and Sozen, (2018)

1.8. Nutritional impact

1.8.1. Nutritional Deficiencies

Strict avoidance of food allergens is the primary strategy implemented by all those with food allergies (O'Keefe et al., 2014). Whilst literature suggests that this is a proven technique, complete avoidance can lead to a restrictive diet (Kim et al., 2013). Restrictive diets, whereby all foods associated with the offending allergen is eliminated, is an effective means of dietary management of the food allergy. It is well known, that food allergies are heavily linked with the manifestation of atopic dermatitis (a chronic form of eczema, common in children, which causes the skin to become inflamed). Symptoms which appear on the skin of affected individuals of atopic dermatitis can be significantly reduced, by the implementation of a restrictive diet. Hence, this further reiterates its beneficial qualities (Kim et al., 2013; Lim et al., 2013). Additionally, asthma (a chronic respiratory disease) has been commonly shown to coexist with food allergies (Foong et al., 2017), with research indicating that food allergy is an important risk factor for the development of asthma (Hill et al., 2016). Despite there being little understanding in how food allergies and asthma interact and influence each other, restrictive dieting (often implemented by those with food allergies) can also have a positive impact on the control of asthma (Guilleminault et al., 2017). Therefore, it seems that restrictive diets are somewhat of a beneficial tool for food allergic individuals, providing a necessary means of safety (Lim et al., 2013).

Despite this, a restrictive diet can be classified as a diet that is severely lacking in both macro and micro nutrients and consequently, many individuals with food allergies, have an extremely poor nutritional status (Steinman, 2010). It should also be noted that the type of restrictive diet employed is dependent on which food allergen and/or allergens are being eliminated, which in turn will determine the nutritional status of food allergic individuals. For instance, milk, egg and soy allergy are extremely prevalent in children (Lee, 2017). All three are important sources of protein and fat and thus, those individuals who eliminate food products containing these particular food allergens from their diet, are at risk of stunted growth (Steinman, 2010). In addition to this, protein deficiency disorders such as Kwashiorkor (a severe form of protein malnutrition), is common in children who engage in allergen elimination diets (Mehta et al., 2013). Furthermore, research suggests that children who possess multiple food allergies are not only at an increased risk of poor growth, but will also be deficient in multiple vitamins and minerals, in particular calcium, vitamin D and vitamin E (Steinman, 2010). It is clear that nutritional deficiencies in children with food allergies are prevalent. However, children more often than not are placed on a supervised elimination diet and though deficiencies can occur, the situation is controlled and the impact minimal. In fact, children with

food allergies, (particularly those who are allergic to egg, milk, fruits, vegetables, wheat and soy), who implement an elimination diet will eventually develop a tolerance for that particular food allergen. Whilst the re-introduction of certain foods can reduce stress and anxiety, improving overall quality of life, the true benefit is perhaps the attainment of increased adequate nutrition (Turnbull et al., 2014).

In contrast, adults often exhibit an increased anxiety regarding trace exposures of food allergens and so commonly self-administer their restrictive diet, which can rapidly result in nutritional decline (Skypala and McKenzie, 2018). Unlike many allergies in childhood, which are likely to be outgrown, allergies during adulthood continue to persist. This persistence ensures that all adults with food allergies will experience a lifetime of dietary avoidance, of certain types of foods. Research indicates that if prolonged dietary elimination has already occurred in adults (as is the case with restrictive diets), then re-introduction of a food allergen can result in a loss of oral tolerance, leading to severe anaphylactic reactions (Gangakhedkar et al., 2017). Hence, this highlights the problematic nature of pursuing a restrictive diet that excludes any essential food groups. Furthermore, coeliac disease is a prevalent autoimmune disorder and is increasingly being diagnosed in adults (Parzanese et al., 2017). Individuals with this particular non IgE mediated food hypersensitivity must adhere to a strict gluten free diet (GFD). Whilst this is the only proven treatment for coeliac disease, the diet itself is repeatedly associated with nutritional complications. Saturni et al. (2010), reports that 41% of individuals with coeliac disease are deficient in vitamin B12, whilst a staggering 69% of coeliacs have been found to have insufficient iron levels, following a long-term GFD. Likewise, Miranda et al. (2014) found that individuals with coeliac disease, who adhered to a strict GFD were found to have micronutrient deficiencies, specifically vitamins B and D, calcium, zinc, magnesium and iron. Therefore, this highlights the severity and damaging consequences of restrictive diets during adulthood.

Table 5 (see below), highlights the nutritional impact of restrictive diets for specific food allergies. The data shows how eliminating a single food allergen can lead to the development of nutritional deficiencies, with multiple food allergies placing individuals at greater risk of malnutrition. Subsequently, these nutritional deficiencies will lead to the development of disease, which will undoubtedly prove damaging to health. For instance, in the case of cow's milk allergy, the data reveals that both rickets and anaemia are a common consequence of restrictive dieting. Therefore, it seems that strict adherence to an elimination diet, can lead to an abundance of nutritional deficiencies in both children and adults, subsequently outweighing its advantages. Whilst adhering to a restrictive diet is necessary, perhaps the extent of the restriction is something which can provide some level of control for those with food allergies

and help to manage their nutritional deficiencies. For instance, research suggests that lack of education coupled with fear (particularly maternal fears of increasing the risk of further allergic reactions) is the primary cause for the implementation of extreme elimination diets (Noimark and Cox, 2008). Therefore, restrictive diets that are supervised by dieticians along with an alternative means of increasing nutrient consumption, is possibly the only manner in which to improve overall dietary status (Skypala and McKenzie, 2018).

Table 5: Nutritional Impact of Restrictive Diets in Those with Food Allergies – Key Findings from Previous Studies

Sample Size	Age	Food Allergy	Nutrient Deficiencies	References
1 (case study)	14-month-old child	Cow's Milk	Vitamin D Deficiency Rickets	Fox, et al. (2004)
1 (Case Study)	10-Month-Old	Cow's Milk	Hypocalcemia, Fe Deficiency Anemia and Rickets	Noimark and Cox (2008)
134 Children	1-36 Months	Cow's Milk and Egg	Low concentrations of Se and Zn and therefore weakened oxidative barrier	Kamer et al. (2012)
39 Infants	14 Weeks	Cow's Milk	Vitamin D deficiency	Maslin et al. (2016)
225	1-65 Years	Cow's Milk Egg Wheat Soybean Beef Pork Chicken	**Cow's Milk** – Ca, Zn and Vitamin B_2 deficiency **Egg** – Vitamin A, Vitamin B_1, Vitamin B_2, Niacin and Cholesterol deficiency **Wheat and Soybean** – Ca, P, Fe, K, Zn, Vitamin B_2, Vitamin B_6 and Niacin deficiency **Beef, Pork and Chicken** – Fe deficiency and an excess of Ca, K Vitamin A and Vitamin B_2	Kim et al. (2013)

1.8.2. Alternative Food Sources and Supplementation

In order to combat the undesirable consequences of poor nutritional status, research suggests that acquiring nutritional support from alternative allergen free sources is of great importance (Skypala and McKenzie, 2018). 'Free from' foods are a rapidly growing industry, with more food manufacturers increasing the availability of tailored allergen free foods. In fact, market research highlights an increase of sales by 40% in 2017 alone (North and Brown, 2017). Although accessibility of 'free from' foods has undeniably improved, the issue remains that the nutritional composition of these particular foods is somewhat questionable (Moreno et al., 2014). In fact, Missbach et al. (2015), found that gluten free foods possess little health benefits, with key nutrients such as protein, significantly lacking. This is further reinforced by Hosseini et al. (2018), who highlights how specific nutrients such as fibre, iron, vitamin D and Vitamin B_{12} are notably deficient in those consuming gluten free foods. Additionally, Suri et al. (2019), stresses that lactose-free foods possess low nutritional quality, with lifetime adherence causing nutritional imbalance. Furthermore, when compared to their allergen containing counterparts, 'free from' foods lack palatability and so, food industries often increase the use of fat, salt and sugar in order to make them more pleasant to eat, thus compromising their nutritional integrity (Saturni et al., 2010). Therefore, the process of replacing lost nutrients via replacement foods and supplements is an essential practice, necessary for all food allergic individuals (Turnbull et al., 2014). If appropriate supplementation is not acquired, then individuals are at risk of malnutrition.

For instance, children with cow's milk allergy, who are unable to receive sufficient nutrients in the form of supplements, or are consuming allergy free foods that have not been fortified, have been increasingly associated with both vitamin D deficient rickets and calcium deficient rickets (Steinman, 2010). However, research also highlights the proven benefit associated with suitable allergen free replacements, which can supplement the diet. For example, if these same individuals, who were allergic to cow's milk allergy were to consume a fortified soy beverage, then 91% of the time they would be able to meet their daily nutritional requirements. In addition to this, the use of alternative grains is a proven and tolerable alternative to 'free from' foods. Alternative whole grains are naturally rich in a variety of nutrients and minerals, as well as phytochemicals and dietary fibre. Consequently, their consumption can prove essential in increasing the quality of diet amongst the food allergic community (Li et al., 2016). Therefore, this truly illustrates the importance, value and necessity of acquiring suitable replacements, which are both safe and although not completely comparable in terms of nutritional profile, are most definitely a sure way of enhancing dietary status (Mehta et al., 2013; Skypala and McKenzie, 2018).

1.8.3. Cross Reactivity

For an individual that has a single food allergy, simply avoiding that particular food may not be enough. Cross-reactivity exists amongst various food items and as such, those with food allergies may also need to avoid related foods. For example, an individual who is allergic to shellfish, will most likely need to avoid the entire food group, due to high rates of cross reactivity (Abrams and Sicherer, 2016). Likewise, both cow's milk and goat's milk contain a similar protein structure, which forces the immune system to associate them with each other. Hence, those who are diagnosed with a cow's milk allergy, will 90% of the time also be allergic to goat's milk (Caffarelli et al., 2010). Therefore, high levels of cross-reactivity forces food allergic individuals to adhere to a restrictive diet. Approximately, 22% of individuals with food allergies implement some form of an elimination diet, through fear of cross-reactivity (Steinman, 2010). However, the issue is that whilst for some food allergic individuals the need to avoid related food groups is a prerequisite of safety, for others, inappropriate dietary restrictions are unnecessary and will definitively provoke a nutritional imbalance.

Many misconceptions seemingly exist amongst the food allergic community. For instance, individuals with a tree nut allergy are frequently advised to avoid coconut products, due to the fact that coconuts and tree nuts, share similar protein sequences (Anaphylaxis Campaign, 2016). For this particular reason and for the purpose of labelling legislation, the Food and Drug Administration (FDA) categorises the coconut as a tree nut (FDA, 2018). However, it should be noted that firstly, the coconut is a member of the palm family and therefore is only distantly related to the tree nut (Anaphylaxis Campaign, 2016). Secondly, cross-reactivity between a coconut and a tree nut is rare, with previous research highlighting only a handful of occurrences (Teuber and Peterson, 1999; Nguyen et al., 2004). In actual fact, more recent research is indicating that coconut is incorrectly considered as a tree nut. Research conducted by Stutius et al. (2010), found that there was no significant risk of allergy to the coconut, in children with peanut and tree nut allergy. Additionally, Anagnostou (2017) highlights, that the coconut is a fruit not a nut and therefore, can be safely consumed for all those suffering from a nut allergy. Furthermore, Weinberger and Sicherer (2018), suggest that the coconut is an exceedingly rare allergen and having a coconut allergy does not necessarily mean that you will develop a tree nut allergy and vice versa. Hence, the general recommendation is that those with a tree nut allergy, do not necessarily need to avoid foods containing coconuts (Anaphylaxis Campaign, 2016).

It is also important to note, that many health care professionals often incorrectly diagnose an individual with a food allergy and a restrictive diet continued unnecessarily, due to incorrect diagnosis, is particularly damaging to health (Lim et al., 2013). Whilst safety is a

number one priority for the food allergic community, when it comes to excluding any food item due to the risk of cross-reactivity, considering both dietary status and the possibility of reducing the risk of allergy through consumption is absolutely essential (Weinberger and Sicherer, 2018).

1.8.4. Food Selection Behaviour

Food selection behaviour plays a crucial role, in determining nutritional status of food allergic individuals. Though it is common knowledge that those who possess food allergies have difficulty in choosing safe food to eat, one group of individuals is perhaps more at risk than others. Whilst children are solely reliant upon their parents/caregivers and adults are naturally more cautious individuals, adolescents between the ages of 18 and 24, with their innate qualities of risk-taking and carelessness are perhaps the most vulnerable (Warren et al., 2017). University is a critical period for adolescents with food allergies. It is a time of physical, cognitive, psychological and social development (Monks et al., 2010). This coupled with the responsibility of self-management of their allergy, makes it an extremely stressful and significant period in their educational lives (Warren et al., 2017). Students between the ages of 18-24 will be in a state of transition from late adolescence to adulthood (Jaworska and Macqueen, 2015; Sawyer et al., 2018) and thus, poor food selection behaviour is becoming increasingly prevalent amongst this particular group of individuals (Deliens et al., 2014). Students are more likely to be risk-takers in the realm of food and hence, it is no surprise why weight gain is more pronounced during the first year of university (deVos, 2015). The negative impact on health is further emphasised by Hebden et al. (2015), who found that students are frequently surrounded by cheap, nutrient deprived, processed foods, inevitably leading to a diet rich in salt and saturated fat. It seems that food allergic adolescents between the ages of 18 and 24 are constantly surrounded by a poor nutritional environment, during their time at university. This is problematic, as research indicates that a high-quality diet, enriched with a variety of nutrients is essential, in optimising academic performance in students (Abraham et al., 2018).

1.8.5. Summary

There are various factors that can compromise the nutritional intake of many individuals. Whilst cultural, religious and ethical reasons can lead to the aversion of numerous foods, for the food allergic individual, fear of contamination is perhaps the most significant (Skypala and McKenzie, 2018). This coupled with lack of education are perhaps the two most important factors, that lead to food allergic individuals poorly managing their condition and consequently will result in them compromising their diet, in order to stay safe (Steinman, 2010). It seems individuals with food allergies will always be at a loss. Although a restrictive diet acts as a

means of safety for food allergic individuals, this exact protective mechanism when exercised excessively is a detriment, negatively impacting their nutritional status (Kim et al., 2013).

Whilst the food industry has significantly improved over the years to accommodate for food allergies, the nutritional status of foods tailored for these particular individuals is somewhat questionable. More must be done, to ultimately accommodate for the many sufferers of food allergies (Moreno et al., 2014). Additionally, food selection behaviour is an important aspect for determining nutritional status. However, during their time at university, adolescents, whilst attempting to navigate the new and unfamiliar environment and the stress of self-management of their food allergy, will frequently find themselves in close proximity to foods with a low nutritional content. Thus, poor food selection behaviour and consequently poor dietary status, is a typical aspect of university life (Deliens et al., 2014).

When it comes to the nutritional management of the pervasive food allergy, collective responsibility is perhaps the only way forward. Firstly, for the food allergic individuals themselves, careful management of exclusion diets, as well as incorporating suitable alternative foods to improve their nutritional status is crucial. Secondly, for the health care practitioners, correct diagnosis and providing clear, sufficient information to those who are suffering, is of vital importance. Thirdly, for the food industry, clarity in labelling along with dramatic improvements in the nutritional status of 'free from' products is not only beneficial, but rather an essential requirement (Kim et al., 2013). Finally, for the many universities who accommodate for food allergic individuals, perhaps an increase in the availability of nutritionally sound food that is safe to consume, along with implementing strategies to reduce the burden that comes with self-management of the chronic food allergy.

1.9. Food Allergies at University

With regards to vulnerability, it is clear that food allergic adolescents, who are studying at university, are the most susceptible group of individuals (Greenhawt, 2016; Warren et al., 2017). Individuals experiencing late adolescence who possess food allergies have been associated with a number of different vulnerabilities, consequently leading to a reduced quality of life. Social isolation, depression and performance anxiety are merely a few of the negative effects reported by food allergic adolescents (Antolin-Amerigo et al., 2016). In addition to this, a staggering 43% of adolescents and young adults were subject to some form of bullying, due to the nature of their food allergy (Warren et al., 2017). Furthermore, individuals in late adolescence often avoid social venues, due to the fear of being exposed to a food allergen. This consequently leads to social vulnerabilities and as such can rapidly reduce their quality of life (Walkner et al., 2015; Warren et al., 2016).

A child with a food allergy is likely to experience fewer adverse reactions, due to the fact that any contact with a food allergen is managed by their extremely vigilant parents or caregivers. On the other hand, adolescents between the ages of 18 and 24 (particularly those living on), with their care-free attitude will interpret and have a different idea of what it means to manage their condition. Thus, it is no surprise why those experiencing late adolescence are subject to an increased number of food allergic reactions (Sampson et al., 2006; Warren et al., 2017). Adolescence is a challenging developmental stage, particularly for those between the ages of 18 and 24 who are likely responsible for self-management of their allergy. During this critical period of their lives, individuals are attempting to navigate their surroundings and achieve independence. Therefore, individuals in late adolescence often experiment and are naturally thought to be risk takers. Whilst this risk taking is somewhat of a necessity in order to gain peer acceptance, as well as autonomy from their parents, it can also prove detrimental (Warren et al., 2017). Numerous studies have found that adolescents and young adults with food allergies participate in risky behaviour, such as knowingly ingesting 'may contain' foods that could potentially increase their risk of anaphylaxis (Sampson, 2006; Monks et al., 2010; Greenhawt, 2016). Likewise, research also indicates that when in a peer social situation, those in late adolescence are often poorly equipped to deal with any reactions. They frequently feel hesitant to inform others about their food allergy and may refuse to continuously carry epinephrine auto-injectors with them. The need to conform to certain situations dominates self-preservation and as such, is one of the leading causes of food induced anaphylaxis in adolescents (Warren et al., 2017).

Whilst living on campus, individuals in late adolescence that possess a chronic food allergy are placed in a somewhat precarious position. These individuals will most likely for the first time, be experiencing self-management of their food allergy and thus, will be responsible for a number of crucial aspects. Firstly, ensuring that prescriptions are regularly filled and up to date is vital. Secondly, ensuring that they are well versed in which particular foods are safe to consume and which must be avoided, is also essential. Finally, ensuring they are well equipped in how to deal with any emergencies that may accidentally occur, due to food induced anaphylaxis, is especially important (Greenhawt et al., 2009). Whilst it is clear that during this critical period in their lives, the onus of the food allergy is now on the adolescent, they more often than not, will also be reliant upon the catering staff at the particular university, to provide them with safe, allergen free food (Choi and Rajagopal, 2013). Additionally, it is well known, that risky behaviour is an ingrained quality of all adolescents between the ages of 18 and 24 and subsequently, universities must also have the appropriate measures in place, to prevent and aid the incidence of any food allergic reactions (Greenhawt, 2016). Hence, the

need for all university catering staff to be well versed in adequate food allergen knowledge, management and practices, is absolutely essential.

Unfortunately, many universities are unable to provide safe dining establishments within campus and thus many institutes are poorly equipped to deal with the growing needs of those with food allergies (Greenhawt et al., 2009; Choi and Rajagopal, 2013). In fact, a study conducted by Bock et al. (2007), illustrated that over a 10-year period, 63 individuals experienced some form of an allergic reaction, with 16 fatalities occurring specifically in adolescent students with food allergies, whilst at university. The research further mentions that 50% of all fatalities occurred on campus. Therefore, this stresses the lack of sufficient policies and procedures, with regards to food allergen management and practices, available at universities. In addition to this, research conducted by Choi and Rajagopal (2013) further reinforces the poor food allergen knowledge that exists amongst foodservice employees. They found that although university catering staff had sound knowledge of what defines a food allergy and how to prevent food allergic reactions, they severely lacked knowledge in two key aspects, concerning food allergies. Firstly, a total of 46.4% of catering staff were lacking in knowledge regarding the eight top food allergens, whilst secondly, 58% were unable to identify the best treatment for controlling a severe food allergic reaction. This lack of knowledge is detrimental as it could lead to cross contact, inevitably causing an unwarranted reaction, at which point the outcome would prove fatal.

Moreover, universities often hire part-time or student employees, who often possess little or no knowledge and experience of dealing with food allergies (Choi and Rajagopal, 2013). In fact, research conducted by Lin and Sneed (2005) found that part-time student employees had reduced awareness of food allergies and were less concerned with the many principles of food safety, when compared to full-time non-student employees. Choi and Rajagopal (2013), further supports this piece of research, as they found that non-student employees had increased knowledge, attitudes and practices, as opposed to student employees. Therefore, this indicates that the recruitment of student or part-time employees, although beneficial for the university foodservice department in allowing flexibility regarding staffing, is perhaps a poor choice with regards to safety.

Furthermore, the need for sufficient training for every foodservice employee is absolutely critical. There is a considerable amount of research that explicitly highlights the importance of food allergen training firstly, as part of the process of recruiting new employees and secondly, as part of enriching employees' development through ongoing training, during the period of employment (Bailey et al., 2014; Lessa et al., 2016; Radke et al., 2016; Radke et al., 2017; Wen and Kwon, 2017; Lee and Sozen, 2018; McAdams et al., 2018; Padua et al.,

2018). Despite this, much literature also suggests that many institutions are failing to meet the necessary requirements of food allergen training, which is contributing to the poor knowledge and practices that are clearly present in many foodservice employees (Bailey et al., 2014; Lessa et al., 2016; Radke et al., 2016; Radke et al., 2017; Wen and Kwon, 2017; Lee and Sozen, 2018). In addition to this, adequate food allergen training of foodservice employees at the university level is perhaps of greater importance, with students reliant upon catering staff on a daily basis. However, research conducted by Choi and Rajagopal (2013), found that a staggering 78.8% of all employees at a particular university did not possess any training regarding food allergies. This is particularly concerning as adolescents between the ages of 18 and 24, who often exhibit careless and risky behaviour, are extremely reliant upon university catering staff. Without acquiring the necessary training, foodservice employees at universities are unlikely able to confidently provide food allergic students with safe, allergen free food and provide assistance in the event of an allergic reaction.

For the many sufferers of food allergies who are reliant upon university foodservice employees, the need for educated and experienced catering staff is a basic requirement. However, the considerable amount of research which highlights the poor food allergen knowledge, attitudes, practices and training of employees in the university foodservice department, is far from reassuring for those with food allergies. Whilst universities cannot completely guarantee an allergen free environment, they can and should, assist in minimising the risk of exposure, encourage self-responsibility and plan for effective response.

2. Aims of Research

This study aimed to look at two key areas regarding both nutrition and food allergies. Firstly, the dietary diversity of first year university students who possessed food allergies was explored, as a means of establishing their nutritional status. It is well known that living with food allergies is both a challenging and stressful task and whilst avoidance of the offending food is the cornerstone of management, research suggests that this can lead to the overconsumption of high fat, high salt and high sugar foods. Additionally, as individuals with food allergies enter into higher education, they experience a period of transition from parental supervision to self-management of their allergy, which not only provides an additional challenge, but can continue to negatively impact their already poor diet. Whilst sufficient literature exists, regarding the poor dietary diversity of first year university students, little research is available that specifically examines this aspect for those individuals with food allergies. **Therefore, this particular piece of research assessed the nutritional status of university students with food allergies, in an attempt to establish key nutrients that are lacking.** Furthermore, this piece of research recommended several different concepts that all affected individuals should adhere to, in order to allow individuals to self-manage their food allergy, whilst at the same time ultimately eat a nutritionally balanced diet.

Secondly, the reasons behind these students' current eating habits was also analysed, in order to determine the underlying causes of their poor nutritional behaviour. It is well known that the transition from late adolescence to adulthood presents many challenges for each individual. In actual fact, this period of transition into a new and unfamiliar environment is a primary cause of poor food selection behaviour amongst many university students. **Therefore, understanding the true motives behind why students eat what they eat can prove useful, in improving dietary status.** More specifically, it can lead to the implementation of tailored intervention programmes that promote positive lifestyle changes and ultimately lead to a varied diet, rich in essential nutrients.

Finally, whilst food service employees bear the huge responsibility of providing safe food for all consumers, it is clear that extra attention must be paid to those individuals who possess a food allergy. Adequate food allergen management practices of catering staff, is an essential component of ensuring safety for all consumers with food allergies. Though it is assumed that catering staff possess satisfactory knowledge and practices of food allergens, there is insufficient literature investigating this very aspect. **Hence, this particular piece of research assessed the food allergen management knowledge and practices of catering staff.** This area of research is crucial in identifying any potential gaps in both knowledge and

practices of the catering staff, which can lead to the development of additional training sessions, as well as more robust policies and procedures.

When assessing nutritional status and food selection behaviour of university students, a comparison will be made between genders. For the food allergen knowledge and practices of catering staff, comparisons will be made between gender, age, education level and food safety certification.

This particular piece of research has a novel approach, as it further researched two areas (diet diversity of food allergic university students and food allergen management practices of university catering staff) that are often investigated independently, whilst at the same time, shed some much-needed light on the relationship that exists between the two. Therefore, it is anticipated that this study will firstly, build upon existing research. Secondly, this study will identify any gaps that can prove advantageous in implementing specific interventions. This will help to improve both the nutritional status of university students with food allergies, as well as improve the training and implementation of foodservice employees, thus ensuring maximum safety of all individuals.

3. Methodology

3.1. Subjects

This particular piece of research targeted two sets of participants. The first set of participants involved students who met 3 specific criteria. Firstly, both male and female individuals, who were enrolled on a foundation entry course or a first-year undergraduate course were recruited. Data collection initially took place at UCLan. The place of data collection was easily accessible, as the lead researcher is currently a student at this particular institution. This proved beneficial in managing time restraints. Over the course of the investigation, recruitment of participants took place beyond UCLan, as a means of maximising data (see section 3.3. Recruitment). The inclusion of only foundation entry students and first-year undergraduate students, was for the purpose of ensuring that all participants were in the state of late adolescence and would also be experiencing self-management of their allergy for the first time. It was assumed that all participants were in fact self-managing their food allergy, although this was not explicitly asked in the questionnaires themselves. The assumption was made on the basis that all prospective participants were shown the recruitment flyer (see Appendix – Attachment 2), which clearly indicated that participation required this specific criterion to be met. Secondly, all student participants recruited were between the ages of 18 and 24, as research suggests that it is this age range, which signifies late adolescence (Jaworska and MacQueen, 2015; Sawyer et al., 2018). Finally, all student participants were required to be diagnosed with a food allergy.

The second set of participants consisted of catering staff at UCLan. Again, the place of data collection was easily accessible, as the lead researcher is currently a student at this university and so this assisted in managing time restraints. A convenience sample of food service employees at UCLan was recruited.

3.2. Ethics Approval

Prior to collecting actual data, ethical approval was sought from the University of Central Lancashire's (UCLan) Science, Technology Engineering, Medicine and Health (STEMH) ethics committee. Once approval was granted (see Appendix – Attachment 1), participant information sheets were presented to each prospective participant, to provide them with sufficient knowledge regarding the study. This allowed them to make an informed decision, on whether or not they would truly like to participate. Consent was then obtained from all those participating, to ensure that all individuals fully agreed with their involvement in the study.

3.3. Recruitment

Student participants were recruited using flyers, which were placed around the UCLan campus. Specifically, flyers were placed on the students' union notice boards, as well as in various places in the library. The flyer was also uploaded on the Blackboard site of different school hubs. Additionally, social media (in this case Facebook and Twitter), was also used to assist in recruiting participants. To further recruit participants, a student led social enterprise known as SCRAN (Students Creating Resources Around Nutrition), which is based at UCLan was also utilised. The Anaphylaxis Campaign also assisted student recruitment, by placing an advertisement on both their website and dedicated young person's Facebook page. Students from any background were able to take part, ensuring that they met the subject criteria.

When recruiting catering staff, face to face invitation along with communication via email with the catering services manager/supervisor, was used. Supervisory employees, in this case then provided access to all catering staff. All participant recruitment took place over a period of 10 weeks, between 07/03/19 and 16/05/19.

3.4. Questionnaire Development

A total of 3 questionnaires were used in this particular research study, each evaluating a different component. Firstly, the food selection behaviour of students with food allergies was determined. Secondly, the dietary diversity of food allergic students was assessed via a food frequency questionnaire (FFQ). Finally, the food allergen knowledge and practices of catering staff at UCLan was also examined. Prior to collecting main data, a pilot test was also conducted for all questionnaires utilised, in order to assess the clarity and time taken to complete them. Following pilot testing, changes were made to two of the three questionnaires. Firstly, for the food selection behaviour questionnaire revisions were made to enhance clarity. Most participants were confused as to the definitions of mild, moderate and severe allergy and thus, for each type an explanation was provided. Secondly, it was initially assumed that the FFQ would take approximately 30 minutes to complete. However, upon completion of the pilot testing, it was determined that the FFQ would take longer to complete. Participants were informed of the estimated time taken to complete this questionnaire (45 minutes), in the participant information sheet, allowing them to decide whether or not they wanted to take part.

3.4.1. Food Selection Behaviour

This particular questionnaire (see Appendix – Attachment 9) was utilised to deduce participants' motives regarding food selection behaviour and was adapted from similar studies

conducted by Share and Stewart-Knox (2012) and Warren et al. (2017). Smart Survey (smartsurvey.co.uk) was used to create this particular questionnaire. The questions were split into two sections. The first section covered participant demographics and information regarding the participants' food allergy/allergies. For this particular section, multiple choice questions were utilised. The second section covered questions relating to the food selection behaviour of participants of which 5 factors (cost, taste, convenience, clear labelling and health) were used. Participants had to rate which of the factors were the most influential, in terms of their food selection behaviour. The factors were quantified on a scale using the numbers 1 – 5, with 1 being the least influential and 5 being the most influential.

3.4.2. Epic Norfolk Food Frequency Questionnaire

Individuals, who completed the food selection behaviour questionnaire, were then asked if they were interested in taking part in the FFQ (see Appendix – Attachment 10). The FFQ used in this study was based on the EPIC Norfolk FFQ (Mulligan et al., 2014). This FFQ is widely established and contains an extensive variety of foods (130 in total). The addition of UK specific brand names, helped to provide participants with a clearer understanding of each individual food item. Therefore, this particular FFQ is a comprehensive way of assessing participant's food intake. Additionally, the EPIC Norfolk FFQ is a semi-quantitative FFQ and as such, portion sizes were used to accurately assess the frequency of consumption of each particular food item, during the previous year. The frequency of food consumption over the previous year refers to the 12 months, prior to data collection. A period of a year was used as this is more representative of habitual food intake, in comparison to shorter periods of time (Kowalkowska et al. 2013). Furthermore, the software FETA was also utilised to analyse the EPIC Norfolk FFQ data. This helped to provide the existing diet diversity of participants, consequently leading to a general overview of their nutritional status.

The questionnaire itself consisted of two key parts. Part 1 contained a list of 130 food items (representing all food groups) accompanied by a portion size – medium serving, standard unit or household measures. Participants were required to select an appropriate frequency of consumption, for each particular food item, from a choice of nine different frequency categories. Part 2 contained a series of further questions, where participants were required to provide specific details regarding their consumption of milk, cereals and cooking fats.

Upon completion of the FFQ's, all data from part one of the questionnaires was manually coded into a spreadsheet using numeric values, ranging from 1 to 9. For instance, a code of '1' was used to indicate 'never or less than once a month,' whilst a code of 9, was used to indicate 'more than 6 times per day.' Where participants failed to provide a frequency

on the FFQ, a code of -9 was used. As for part 2 of the questionnaire, participants were required to provide specific details regarding their consumption of milk, cereals and cooking fats. Food codes were used to match participant responses to a reference list of food items containing varieties of milk, breakfast cereals and cooking fats. This coded data was then run through the software FETA. This particular software converted the information from the FFQ into the average daily nutrient and food group intake, for each individual participant. All nutrient data for each of the FFQ foods came from McCance and Widdowson's, 'The Composition of Foods' and its associated supplements (Holland et al., 1988; Holland et al., 1989; Holland et al., 1991a; Holland et al., 1991b; Holland et al., 1992a; Holland et al., 1992b; Chan et al., 1994; Chan et al., 1995; Chan et al., 1996). The software provided comprehensive nutritional information highlighting the 14 food groups (Alcoholic Beverages, Cereals and Cereal Products, Eggs and Egg Dishes, Fats and Oils, Fish and Fish Products, Fruit, Meat and Meat Products, Milk and Milk Products, Non-Alcoholic Beverages, Nuts and Seeds, Potatoes, Soups and Sauces, Sugars, preserves and Snacks, Vegetables), as well as an additional 46 nutrients (including Macronutrients, Vitamins and Minerals). However, this particular research focused on only a selection of nutrients, in this case a total of 29 nutrients.

Once processing of the FFQ data was completed by FETA, all information was then input into SPSS for further analysis. Nutrient intake for males and females was compared to the dietary reference values (DRV's) for individuals between the ages of 19 and 24. This was to assess whether or not each individual was meeting their recommended daily nutrient requirements. The dietary reference values (DRV's) was based on multiple different sources. DRV's produced by the Committee on Medical Aspects of Food Policy (COMA) (2016), the Scientific Advisory Committee on Nutrition (SACN) (2016) as well as the DRV's from the FDA (2016) were all utilised as a means of comparison.

Tables 7 and 10 highlight the average daily intake for each of these nutrients, for both men and women respectively. FETA also provided data regarding the 14 different food groups. Information from the 14 food groups was then combined to highlight the 6 basic food groups, to mirror that of the Eatwell guide. The Eatwell guide is the most up to date healthy eating model, established by Public Health England. This model provides the proportion of food groups to be consumed on a daily basis (British Nutrition Foundation, 2018). Therefore, it was used as a means of comparison, to evaluate the dietary diversity of participants in this study.

3.4.3. Food Allergen Knowledge and Practices

In order to assess UCLan catering staffs' knowledge and consequently current practices, of food allergens, a questionnaire was utilised. Development of this questionnaire was based on others used in similar studies (Choi and Rajagopal, 2013; Lessa et al., 2016; Radke et al.,

2017 and Radke et al., 2017). The questions covered areas such as knowledge related to food allergies, the prevention of cross-contact, emergency food allergy treatment procedures, as well as food allergen practices of catering staff. To further assess the food allergen practices of UCLan catering staff and increase the validity and reliability of this study, the presence of food allergens was determined, via a specialised rapid test kit. For this particular study, the AllerSnap™ (Hygiena USA) protein residue test was used. This specific test is one of the most suitable in detecting both the presence and absence of any protein-based food allergens. Additionally, the AllerSnap test is able to detect 3 micrograms of protein and so allows for more sensitive surface hygiene monitoring. This, along with its quick (results in 15 minutes) and easy to use nature, makes it a favourable asset (Hygiena, 2018).

Samples were collected on the university campus, specifically in both Harrington (Kitchen A) and Foster kitchen (Kitchen B). A total of 100 cleaned surfaces were swabbed in each kitchen, including food contact surfaces (e.g. table tops, utensils and chopping boards), non-food contact surfaces (e.g. stove tops and exterior of fridge/freezer) and transfer points (e.g. taps). In order to allow comparison, the same surfaces were swabbed in each kitchen. Consent was obtained from managerial staff prior to data collection. When obtaining all samples, the protocol issued by Hygiena (2018) (see below) was followed.

3.4.3.a. Hygiena Swabbing Protocol:

When each individual sample was collected, the swab itself was not touched, to avoid contamination. For regular surfaces, such as the chopping board, a 10cm by 10cm area was swabbed (see Fig.1). During the swabbing procedure, the swab was rotated (horizontally, vertically and diagonally) to ensure maximum sample collection. For irregular surfaces, such as the microwave button, an area that was large enough to obtain a representative sample was swabbed. During swabbing, sufficient pressure (enough to create a flex in the tube) was applied. To activate the device, both the thumb and forefinger were used to hold the swab tube firmly and the Snap-Valve was then broken by bending the bulb forwards and backwards. To ensure all liquid was expelled into the swab, the bulb was squeezed twice. After this, the swab tube was gently shook for 5-10 seconds, to ensure the liquid had enough time to immerse into the swab. Following on from this, the sample was then incubated to further intensify the reaction, at 37ºC for 30 minutes. After incubation, the colour of the reagent was compared with the colour chart provided on the label, to determine the presence of any allergens. Whilst green signifies a pass i.e. no presence of any protein, purple indicates contamination. The deeper and darker the purple becomes, the greater the presence of the protein in the sample.

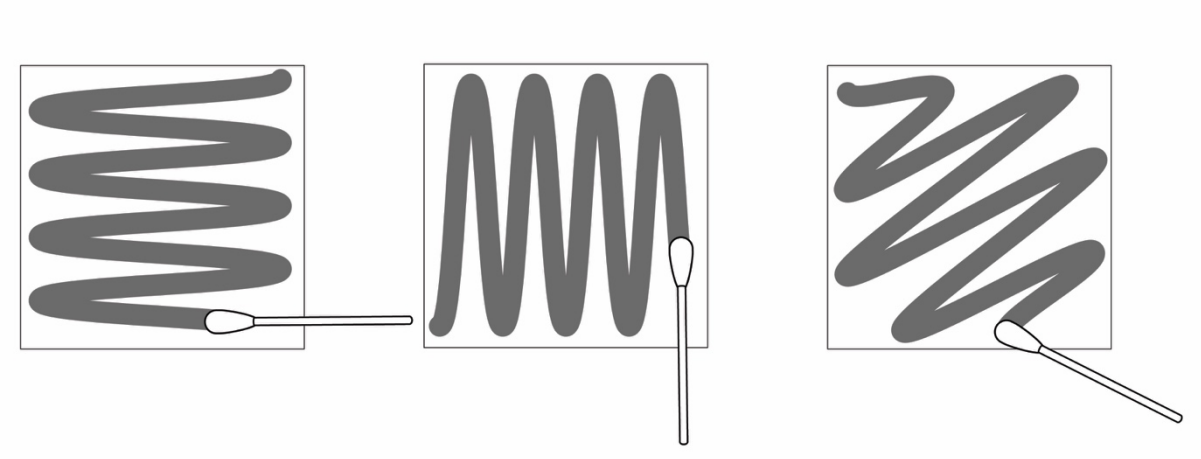


Figure 1. 10cm by 10cm Swabbing Protocol

3.5. Statistical Analysis

All statistical analyses were performed using IBM SPSS Statistics Version 24.0. Statistical analyses in the form of descriptive statistics, was conducted on all FFQ data that had been processed by FETA. Additionally, descriptive statistics, was also conducted on participant demographic information from section one of the food selection behaviour questionnaire, as well as participant demographic characteristics from the food allergen knowledge and practices questionnaire. In order to determine gender differences with regards to prevalence of the different types of food allergies, a Chi-Squared (χ^2) analysis was also utilised. For section two of the food selection behaviour questionnaire, a Mann Whitney U test analysis was conducted. This was firstly to determine which of the 5 factors (cost, taste, convenience, labelling and health) were the most influential in terms of food selection, as well as if any significant differences existed between genders. Additionally, one-way ANOVA and independent t-tests were also employed, to examine any significant differences on data generated from the food allergen knowledge and practices questionnaire. For all tests the significance level was set at 0.05.

4. Results and Discussion

4.1. Food Selection Behaviour Questionnaire

4.1.1. Participant Demographics

A total of 219 participants (83 males and 136 females) took part in this questionnaire. The mean age of the participants was 20.2 ± 1.8 years. The large gender difference regarding participant recruitment, could be attributed to the fact that females, on average, are more likely than males to participate in surveys (Porter and Whitcomb, 2005; Smith, 2008; Lobato et al., 2014). Regarding participant recruitment, this could potentially have been affected by the time of data collection. All participant recruitment took place between March and May. The month of May is typically associated with university examinations for most individuals. Thus, with this being a stressful time for students, this could potentially have impacted the number of participants who took part.

In order to ensure that all participants were experiencing self-management of their allergy for the first time, only those individuals who were undertaking a foundation entry course, or were enrolled on a first-year undergraduate course were included within the study. Of the 219 participants, 72 (33%) were undertaking a foundation entry course, whilst 147 (67%) were enrolled on a first-year undergraduate course (see Table 6).

All participants who took part in this study had been diagnosed with a food allergy. It was found that a total of 172 participants (79%) had been clinically diagnosed with their food allergy. Table 6 (see below) shows the different methods and frequencies, through which participants were clinically diagnosed with a food allergy. SPT's were the most popular choice amongst participants, with 66 participants (30%) using this particular method to confirm their food allergy. This is consistent with previous research, which indicates that SPT's are a prevalent diagnostic technique in adolescents, due to their cheap, quick and convenient ability of determining food allergies (Kattan and Sicherer, 2015). In contrast, a total of 47 participants (21%) were found to have confirmed their food allergy though self-diagnosis. However, self-reported food allergies often lead to misdiagnosis, consequently resulting in the unnecessary avoidance of foods (Ali, 2017).

To assess their preparedness in managing food allergy reactions, participants were asked whether or not they carried an epinephrine auto-injector with them, on campus. It was found that 201 participants (92%) did not carry an epinephrine auto-injector with them (see Table 6). Whilst the reasons behind this behaviour were not established in this study, it can

be firstly assumed that the care-free nature often displayed by adolescents, is one of the primary causes of participants not choosing to carry the epinephrine auto-injector (Sampson et al., 2006; Greenhawt, 2016; Warren et al., 2017). Secondly, peer acceptance is a major influencer in the major developmental stage that is adolescence. Therefore, the need to conform to certain social situations often precedes safety, further explaining these results (Warren et al., 2017). Finally, a large proportion of participants had been diagnosed with coeliac disease (see Table 7). Individuals with this autoimmune disorder will not go into a state of anaphylaxis when gluten is consumed, with damage to the villi of the small intestine being the primary consequence, rendering the epinephrine auto-injector useless (Jiminez et al., 2015). Thus, this could provide an alternate explanation for why only a small number of participants chose to carry the epinephrine auto-injector.

Table 6: Participant demographics from the Food Selection Behaviour Questionnaire for Males (n = 83) and Females (n = 136)

		Males	Females	Total
Age	*18y*	25	21	46
	19y	25	29	54
	20y	0	28	28
	21y	17	23	40
	22y	6	10	16
	23y	5	13	18
	24y	5	12	17
Year of Study	*Foundation Entry*	33	39	72
	First Year Undergraduate	50	97	147
Diagnosis of Food Allergy	*Skin Prick Test*	19	47	66
	Blood Test	19	33	52
	Food Elimination Diet	27	27	54
	Self-Diagnosis	18	29	47
Do you Carry an Epinephrine Auto-injector	*Yes*	14	4	18
	No	69	132	201

The prevalence of food allergy for all participants was also determined. Overall, it was found that 147 participants (67%) were intolerant to gluten and had been diagnosed with coeliac disease (see Table 7). This particular autoimmune disorder was found to be the most widespread amongst participants. This is consistent with research, which indicates that coeliac disease has developed into an extremely common autoimmune disease, affecting approximately 1% of the UK population (Ciacci et al., 2015). In particular, research highlights that this disease is becoming increasingly prevalent amongst adolescents (Arnone and Fitzsimons, 2012). More specifically, the results highlighted that coeliac disease was more common in female participants (38%) than male participants (29%). This gender difference is plausible, as research reveals that coeliac disease is more prevalent in females, with 60-70% of individuals diagnosed with coeliac disease being women (Shah and Leffler, 2010; Arnone and Fitzsimons, 2012). Additionally, the fact that women, on average, are more likely to use healthcare services than men, can further explain this (Pinkhasov et al., 2010).

Following coeliac disease, the results indicated that allergies to peanuts (57%), crustaceans (51%) and fish (50%) were the next most common food allergies in participants (see Table 7). These findings reflect results from previous research, which also suggest that allergies to peanuts, shellfish and fish are extremely popular in both adolescents and adults (Cianferoni and Muraro, 2012; Loh and Tang, 2018). In contrast, allergies to both mustard and sesame were non-existent in participants, whilst only a small number of individuals were found to be allergic to egg, (11%), lupin (9%), celery (6%), milk (4%), sulphur dioxide (3%) and soya (1%) (see Table 7). Previous research indicates that these particular food allergens are less common in adolescents (Lee 2017; (Iweala et al., 2018), which explains why so few had been diagnosed with these types of food allergies. Furthermore, Chi-Squared (χ^2) analysis was utilised to determine if there were any significant differences between genders, with regards to prevalence of food allergy. Statistical analysis highlighted that a significant difference ($p < 0.05$) did exist between males and females, in six of the fourteen food allergies (celery, gluten, egg, lupin, milk and sulphur dioxide (see Table 7).

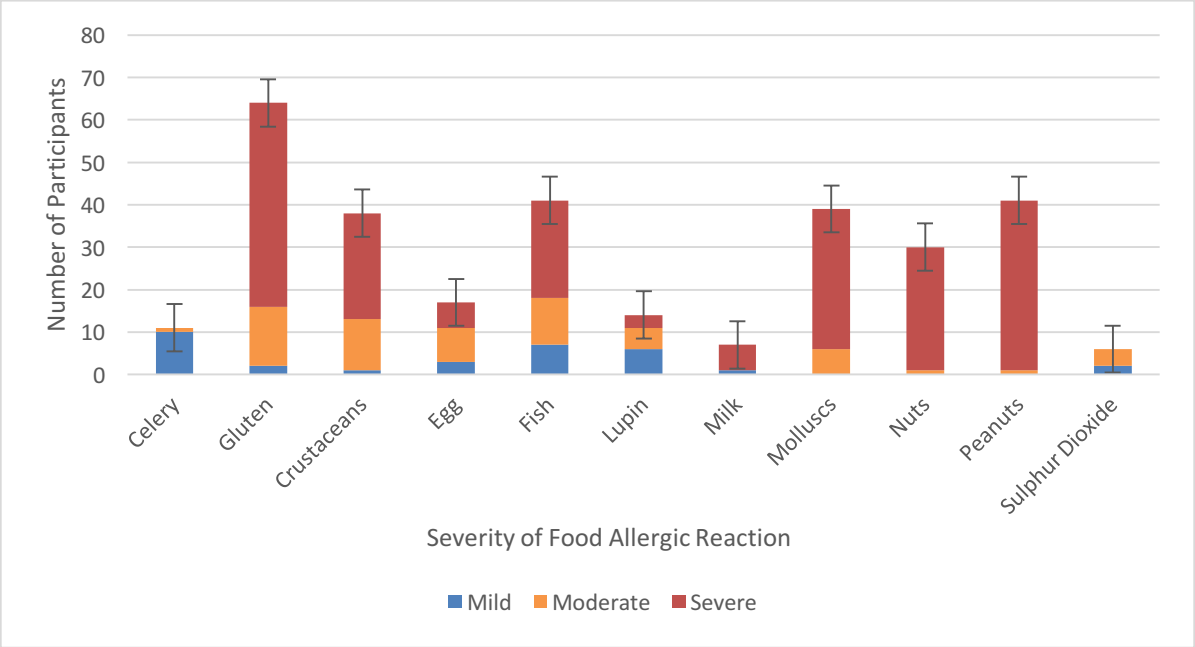
Table 7: Prevalence of Food Allergy.

Food Allergy	Male	Female	Total	χ^2	*p*
Celery	11	2	13	12.82	< 0.001
Gluten	64	83	147	6.04	0.01
Crustaceans	38	73	111	1.29	0.26
Egg	17	8	25	10.87	< 0.001
Fish	41	68	109	0.01	0.93
Lupin	14	5	19	11.3	< 0.001
Milk	7	1	8	8.70	< 0.001
Molluscs	39	54	93	1.12	0.30
Mustard *	-	-	-	-	-
Nuts	30	66	96	3.2	0.10
Peanuts	41	84	125	3.2	0.10
Sulphur Dioxide	6	0	6	10.12	< 0.001
Soya	0	3	3	1.86	0.18
Sesame *	-	-	-	-	-

* *No statistics were computed as no participants were found to be allergic to these particular food items.*

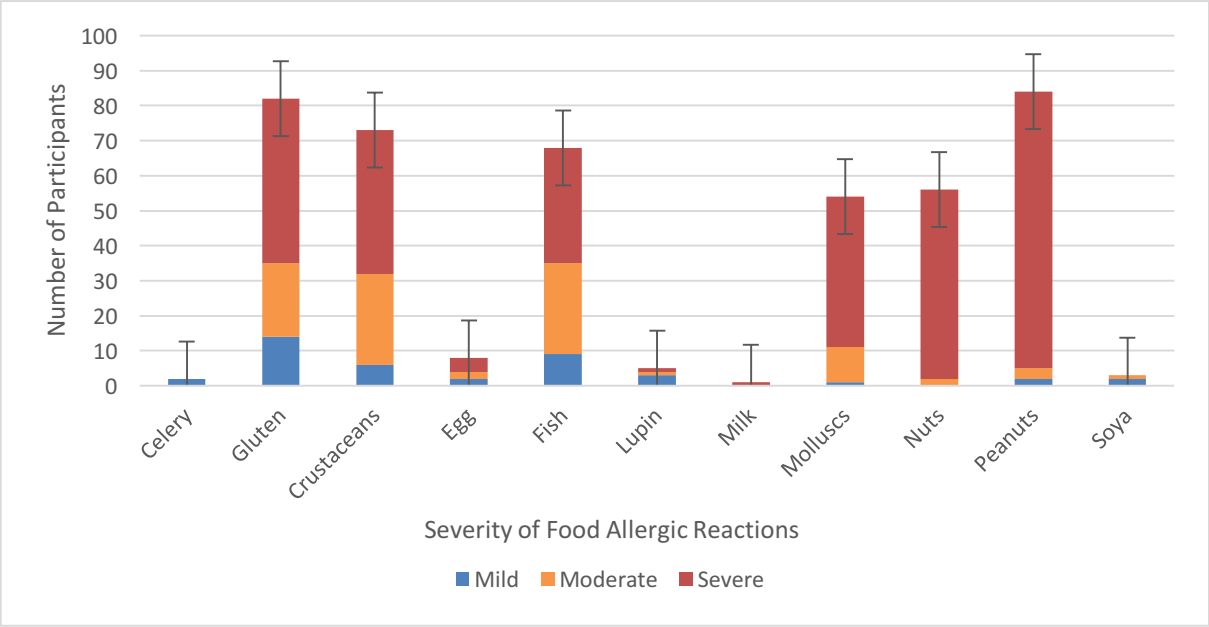
Further analysis regarding the severity of the food allergic reaction, was also determined through means of this questionnaire. Three severity levels (mild, moderate and severe), were used to describe the symptoms associated with each individual's most severe food allergic reaction. Most participants described their food allergy reactions as being severe (see Fig 2. and 3). It has already been established that a large proportion of participants in this study displayed risky behaviour, due to their lack of carrying an epinephrine auto-injector. This coupled with the fact that many participants were subject to severe food allergic reactions, indicates that this particular group of individuals are at risk of fatal reactions. Therefore, the need to educate participants on the importance of preparedness, is a vital aspect of managing future food allergy reactions.

For male participants, it was found that individuals with a gluten intolerance, followed by those with a peanut allergy, experienced the most severe reactions. Similarly, for females, those with a peanut and nut allergy reported to have had the most severe of reactions (see fig 2. and 3). Although severity of food allergic reactions are extremely unpredictable and will likely differ from one person to the next (Yue et al., 2018), research does dictate that individuals with a peanut or tree nut allergy will likely experience the most severe of reactions (Weinberger and Sicherer, 2018). Therefore, these findings mirror that of previous research.



**Mustard, soya and sesame are not included, as no male participants were allergic to these food allergens.*

Figure 2. Severity of Food Allergic Reaction for Males for each of the 14 Food Allergens



**Mustard, sesame and sulphur dioxide are not included, as no female participants were allergic to these food allergens.*

Figure 3. Severity of Food Allergic Reaction for Females for each of the 14 Food Allergens

4.1.2. Food Selection

The final question of the food selection behaviour questionnaire, assessed participants buying habits with regards to food. Participants were asked to rate how 5 different factors - cost, taste, convenience, labelling and health, influenced their food choices. Descriptive statistics revealed that of the 5 variables, taste was the most influential (2.86 ± 0.99) for participants, followed by cost (2.27 ± 1.00), convenience (2.18 ± 0.70), health (2.07 ± 0.76) and finally labelling (1.87 ± 0.80) (see Table 8).

A Mann-Whitney U test was also used to determine any gender differences in relation to food selection. The test revealed that there was a significant difference between genders for two factors, cost ($U = 3149$ ($Z = -5.706$), $p < 0.001$) and taste ($U = 4488$ ($Z = -2.700$), $p = 0.007$). Effect size was also calculated to determine how significant this difference was. A small difference between genders was found for both cost ($r = -0.39$) and taste ($r = -0.18$). Additionally, no significant difference was found between genders for convenience, labelling and health (see Table 8). These findings contradict previous research which suggest differences in food preferences between males and females. Specifically, research has found that females were more concerned with weight gain and this fuelled their desire to eat more healthily (Wardle et al., 2004; Yeung, 2010; Manippa et al., 2017). Therefore, the importance of considering a gender specific approach towards healthy eating may prove more beneficial. However, further research needs to be done to further identify why these differences exist.

Table 8. Influence of 5 Factors by Gender in Relation to Buying Habits

Variable	Mean	SD	Males (n = 83) Mean Rank	Females (n = 136) Mean Rank	u-value	z-value	p-value
Cost	2.27	1.00	80	128	3149	-5.706	0.000
Taste	2.86	0.99	124	102	4488	-2.700	0.007
Convenience	2.18	0.70	110	110	5608	-0.089	0.929
Labelling	1.87	0.80	116	106	5142	-1.176	0.240
Health	2.07	0.76	107	112	5367	-0.661	0.509

Taste

Previous studies have also found similar findings to this study, with regards to adolescent food selection behaviour. Contento et al. (2006), Verstraeten et al. (2014) and Ensaff et al. (2015) all found that taste was a significant food choice parameter amongst adolescents. More specifically, it was found that foods high in fat, salt and sugar, were considered by students to be 'tastier.' This belief will undoubtedly lead to an increased consumption of low quality foods by students, negatively impacting their health.

Cost

The second most influential factor of food selection in participants was considered to be price. Multiple studies also reinforce how the cost of a food item is a decisive factor for adolescent students (Verstraeten et al., 2014; Ensaff et al., 2015; Vilaro et al., 2018). Although price is clearly an influential determinant of food selection, Ensaff et al. (2015), suggests that the importance of price is dependent on the eating occasion. In particular, the research highlights that adolescent students are more cautious about price when eating out. Whereas in the university environment, students were aware of the price being within certain limits and so were not as concerned with the cost. Therefore, this could potentially explain why cost, though influential, was not the most significant determinant of food selection for participants. Additionally, research indicates that campus foods which are cheap and affordable for students, are often those which are low in fibre and rich in fat, salt and sugar. Thus, as price increased, students were likely to consume fewer fruits and vegetables and more sugar sweetened beverages and added sugars (Guyton, 2012; Vilaro et al., 2018). Verstraeten et al. (2014), found that adolescent students were more willing to purchase nutrient rich foods such as fruits and vegetables, if they were sold at more reasonable prices. Therefore, universities should consider making healthier foods more affordable for students, in an attempt to improve their health status.

Convenience

Additionally, previous research, has found that adolescent students select foods based on convenience i.e. ease of preparation and portability of the food item ('grab and go') (Verstraeten et al., 2014). Although convenience was not the most significant predictor for participants in this study, it was of greater importance than both health and clear labelling. Whilst students attempt to balance the stressful university lifestyle, opting for convenience foods seems like a smart choice (Warren et al., 2017). However, the consumption of convenience foods which are abundant in added sugar, have often been associated with poor

dietary intake, consequently leading to nutritional decline (Lachat et al., 2012; Vilaro et al., 2018).

Health

Also, health was found to be one of the least influential factors of food choice for participants. This is surprising, as previous research indicates that food choice in adolescents is driven by a healthy aesthetic (Ensaff et al., 2015; Vilaro et al., 2018). For participants in this study, the most influential determinants (taste, cost and convenience) all led to poor dietary intake, therefore contradicting this research. It is well known that a high-quality diet, enriched with a variety of nutrients is essential, in optimising academic performance in students (Abraham et al., 2018). Therefore, the need to address barriers to healthy eating is of vital importance.

Labelling

Furthermore, results of this study revealed that clear labelling was the least influential factor of food selection. This is particularly worrying as all participants in this study were diagnosed with a food allergy and for this particular group of individuals, clarity in labelling is the only means of achieving safety (Rachid and Keet, 2018). It has already been established that adolescents often display a risky, care free attitude, as they attempt to navigate the unfamiliar surroundings of university life (Greenhawt, 2016). Therefore, it seems that as individuals attempt to adapt to a life of independency, their food selection will be determined by the components of a university lifestyle, consequently leading to carelessness with regards to their food allergy.

Interventions

It is clear that understanding food preferences, due to its multi-factorial nature, is highly complex. Although only 5 such factors were addressed, many different variables that were not investigated in this study, could also influence university students eating habits. For instance, peer influence, social norms, appearance, habit, state of mind, student life and social media are also known to contribute to students eating habits (Deliens et al., 2014; Verstraeten et al., 2014; Ensaff et al., 2015; Hebden et al., 2015; Tanton et al., 2015; Vadeboncoeur et al., 2015; Vilaro et al., 2018). Thus, further research into these areas should be conducted in an effort to understand the reasons behind participants' food selection behaviour, which can enable universities to foster healthier eating habits.

This particular study is one of the few pieces of research which investigated food selection behaviour in food allergic individuals. Participants in this study (individuals with food allergies) were found to be influenced by the same factors as those without food allergies

(Contento et al., 2006; Verstraeten et al., 2014; Ensaff et al., 2015; Vilaro et al., 2018). Therefore, the results suggest that possessing a food allergy in a university setting, does not necessarily impact food choice. Furthermore, the results of this study further confirm that all university students engage in health risking behaviours. Thus, the high prevalence of unhealthy eating warrants the need for interventions to promote healthy eating behaviour.

Eating behaviours established during adolescence are likely to persist into adulthood and so, promoting positive change during this life stage is critical (Vilaro et al., 2018). Quite simply, strategies to promote the uptake of healthy foods will evolve from food preferences of adolescents outlined in this study. Hence, providing students with a variety of healthy foods that are tasty, affordable and convenient will prove beneficial in improving health status. Additionally, a better understanding between diet and health amongst university students is needed to further develop strategies that promote positive behavioural change. Consequently, this will improve the lifestyle of students and reduce the incidence of diet related diseases such as, obesity, type 2 diabetes and cancer (Sogari et al., 2018; Vilaro et al., 2018). Also, Vilaro et al. (2018) suggests that consulting university students prior to the implementation of healthy eating behaviours, is an important factor. Therefore, universities should involve students when creating interventions to maximise the potential of healthy eating. For example, UCLan is home to a student led social enterprise known as SCRAN, which is part of the healthy, safe and sustainable food policy at the university. This organisation is currently involved in encouraging the consumption of healthy, safe and sustainable food, through student recruitment and 'cook and eat sessions'. Whilst in the past their work has proven inspirational for both students and staff, perhaps allowing groups like SCRAN a more integral role within the university (such as collaborating with catering staff to influence the current menu and snack options, along with portion size and methods of cooking), could greatly benefit the overall health and wellbeing of all those at the institution (Healthy University Plan, 2018). Though this example showcases only one organisation at one particular university, the initiative can easily be applied to different universities and can form the basis of positive change. Moreover, universities should provide food education and food preparation classes to all students. This will assist in increasing their nutritional knowledge and allow them to better plan their meals. This is vital, as research suggests that increasing the knowledge of university students with respect to healthy eating, can allow them to make more informed choices throughout their life (Stok et al., 2018). Furthermore, additional research should be conducted on evaluating the effectiveness of these intervention programmes, in promoting students' behaviours towards healthy eating (Sogari et al., 2018). It is clear that universities have a responsibility to their students and acknowledging this crucial role can undoubtedly help in creating a long-lasting healthy environment.

It is important to note that whilst promoting healthy, affordable and convenient foods utilising the above strategies may prove to be a straightforward principle, in reality it is a far more complicated process – one which extends far greater than the confines of the university setting (Lang and Heasman, 2015). The global food system is responsible for ensuring that there is an abundance of nutritious foods, that are both accessible and affordable for all individuals. Food policies are built on the foundation of good health and are an integral part of shaping the food system (Green et al., 2018). Despite this, food culture is divided and many dichotomies continue to exist amongst consumers, all of which can impact the food system. For instance, whilst reducing costs may benefit the consumers, businesses will often operate at a loss and so, will it be plausible for individuals to constantly pursue cheap foods? Additionally, whilst convenience foods are becoming a large part of consumer culture, is the quality of these foods being compromised. If so, then how will the food system address these issues? (Lang and Heasman, 2015). Thus, it is clear that future food systems will face many challenges, whilst attempting to meet the needs of the growing population (Green et al., 2018). Therefore, the university environment cannot be solely to blame for the eating habits of university students. Rather, achieving food security for all individuals is a complex and multifactorial issue (Cole et al., 2018).

4.2. Food Frequency Questionnaire

In order to assess the dietary status of university students with food allergies, a FFQ was utilised. A total of 83 participants from a possible 219 took part in the FFQ, reflecting a response rate of 38%. Of the 83 participants, 27 were male and 56 were female. The most prevalent food allergies for these particular participants, was peanut allergy (71%) and nut allergy (64%). Additionally, a large proportion of participants were also found to be intolerant to gluten and possessed coeliac disease (63%) (see Table 9).

Table 9: Prevalence of Food Allergy for Males (n = 27) and Females (n = 56) who participated in the FFQ

Food Allergy	Male	Female	Total
Celery	7	0	7
Gluten	19	33	52
Crustaceans	10	36	46
Egg	2	0	2
Fish	9	31	40
Lupin	8	3	11
Milk *	0	0	0
Molluscs	9	19	28
Mustard *	0	0	0
Nuts	14	39	53
Peanuts	17	42	59
Sulphur Dioxide	0	0	0
Soya	0	3	3
Sesame *	0	0	0

** No participants who took part in the FFQ, were found to be allergic to these food allergens*.

4.2.1. Nutritional Analysis from the FETA programme

The results of this study highlight the average daily consumption of both macro and micronutrients, for both males and females. It is hoped that by exploring these results, the nutritional status of the participants will be determined.

4.3. Macronutrients

A total of 4 macronutrients were considered in this particular study – carbohydrate, fat, protein and fibre.

4.3.1. Carbohydrate and Dietary Fibre

Regarding carbohydrate consumption, male participants had a daily average intake of 247 ± 86g compared to the DRV of 333g, indicating a deficiency of 26%. On the other hand, females had a daily average intake of 242 ± 58g compared to a DRV of 267g, indicating a deficiency of only 9% (see Table 10). Therefore, whilst both genders were deficient, males were lacking more in this particular macronutrient.

This deficiency in carbohydrate experienced by both genders, could potentially be attributed to the type of food allergy that participants possessed. A large proportion of individuals who took part in the FFQ were diagnosed with coeliac disease (63%). It is common knowledge that adhering to a strict GFD is a proven way of treating this autoimmune disorder (Parzanese et al., 2017). Many foods that contain gluten also contain carbohydrates and so, those individuals who abide by this diet, will naturally be reducing their carbohydrate consumption. In fact, previous research has found that men and women who followed a GFD, consumed significantly lower amounts of carbohydrates (Devlin, 2013). It should also be noted that whilst 63% of participants were diagnosed with coeliac disease, the rest possessed a different allergy, indicating an alternative reason for their reduced carbohydrate consumption. Perhaps the availability and affordability of certain food items could also have influenced the carbohydrate intake for these adolescents (Guyton, 2012).

Carbohydrates are present in a wide variety of foods and so increasing carbohydrate intake is relatively easy to do (Slavin and Carlson, 2014). However, whilst this may prove a simple task, individuals should be concerned with the different types of carbohydrates. Carbohydrates are loosely categorised as simple and complex. Whilst simple carbohydrates are refined, highly processed foods with added sugar, complex carbohydrates are whole, unprocessed foods (Ferretti and Mariani, 2017). It has been well established that the consumption of simple carbohydrates, which typically possess a high glycemic index, are a major contributor to metabolic syndrome, which will most certainly increase the risk of non-

communicable diseases (Whitney et al., 2015; Stanhope, 2016; Mazidi et al., 2017; Lee et al., 2019). Conversely, a high intake of complex carbohydrates, which typically possess a low glycemic index, will provide protective effects, consequently reducing the risk of these non-communicable diseases (Ferretti and Mariani, 2017). Therefore, the quality of the carbohydrate consumed is an important dietary factor, that will ultimately help to determine future health status (Ludwig et al., 2018).

The results of this study indicate that participants had a higher consumption of simple carbohydrates. This can be assumed, based on two facts. Firstly, it has already been well established that university students are often surrounded by cheap energy dense, but nutrient low foods (Deliens et al., 2014; de Vos, 2015; Hebden et al., 2015; Vadeboncoeur et al., 2015; do Amaral e Melo et al., 2017). Therefore, it can be expected that the diet for participants in this study, is largely based on foods that are refined and highly processed.

Secondly, both genders were severely deficient in their consumption of dietary fibre. On average, male participants consumed 17 ± 9g of fibre, whilst females consumed an average of 13 ± 3.5g, compared to the DRV of 30g (see Table 10). Thus, this indicates that males were almost 45% deficient, whereas females were found to be 57% deficient. This is worrying, as dietary fibre is an important source of complex carbohydrates, which is an essential component for a healthy diet. More specifically, research highlights that sufficient consumption of dietary fibre will increase HDL (High Density Lipoprotein) cholesterol, lowering the risk of heart disease (Zhou et al., 2015). Additionally, increased dietary fibre will lead to a lower risk of developing stroke (Zhang et al., 2013), cardiovascular diseases (Threapleton et al., 2013) and type 2 diabetes (Slavin and Carlson, 2014; Yao et al., 2014). Furthermore, improvement in immune function, is a recognised benefit associated with increased fibre consumption (Simpson and Campbell 2015; Dong et al., 2016).

Guyton (2012) found that campus foods which were high in dietary fibre, were more expensive than foods containing sodium and fat. Results from this study have already established that cost is a primary factor, that influences the food selection behaviour of university students (see section 4.1). Therefore, the reduced consumption of dietary fibre by participants in this study, could be due to the nature of their cost. Additionally, the consumption of fruits and vegetables could provide a further explanation as to why participants were deficient in their dietary fibre, as fruits and vegetables are high in this particular macronutrient (Ludwig et al., 2018). Female participants had a reduced consumption of fruits and vegetables, which justifies why they had a poor intake of dietary fibre. In the case of males, whilst consumption of fruits and vegetables was adequate, dietary fibre was still deficient. Perhaps the types of fruits and vegetables consumed could have influenced these results. For instance,

male participants may have been consuming an abundance of low-fibre fruits and vegetables, which could potentially have impacted their dietary fibre intake.

It is clear that participants in this study were lacking in both carbohydrates and dietary fibre. Whilst recommendations dictate that 38% of a healthy diet should be based on starchy carbohydrates, it seem that quality over quantity is crucial (Public Health England, 2016). Therefore, increasing dietary fibre can help to increase the consumption of complex carbohydrates. Therefore, individuals should strive to achieve the daily recommendations of 30g, by consuming a variety of high fibre foods such as fruits, vegetables, legumes and grains (Ludwig et al., 2018). Especially if there is any hope of improving overall dietary status and ultimately reducing the risk of chronic diseases.

Table 10: Average Daily Nutrient Intake from the FETA Programme and DRV's for Men (n = 27) and Women (n = 56) with a Food Allergy, aged 19-24.

	Nutrient	DRV's	Mean	SD	Minimum	Maximum
Men	Energy (kcal)	2500	2059	436	1168	3120
	Carbohydrate (g)	333	247	86	164	526
	Protein (g)	55.5	91	44	36	233
	Fat (g)	<97	106	65	44	389
	Monounsaturated (g)	36	40	26	18	155
	Polyunsaturated (g)	18	17	12	7	60
	Saturated (g)	<31	39	24	14	141
	Cholesterol (mg)	300	307	84	126	427
	Dietary Fibre (g)	30	17	9	10	57
Women	Energy (kcal)	2000	1952	379	1023	2646
	Carbohydrate (g)	267	242	58	112	380
	Protein (g)	45	72	15	35	110

Table 10: Continued

Nutrient	DRV's	Mean	SD	Minimum	Maximum
Fat (g)	<78	83	18	34	122
Monounsaturated (g)	29	31	7.3	13	47
Polyunsaturated (g)	14	11	3.0	5.9	23
Saturated (g)	<24	34	8	12	51
Cholesterol (mg)	300	302	89	108	466
Dietary Fibre (g)	30	13	3.5	5.9	25

4.3.2. Fat

Regarding overall fat consumption, males had a daily average intake of 106 ± 65g, compared to the DRV of <97g, whilst females had a daily average intake of <83 ± 18g, compared to the DRV of <78g (see Table 10). Therefore, this indicates that both genders had a higher intake of this macronutrient, with males consuming an excess of 9% and females an excess of 6%.

The results of this study looked at three different types of fat – monounsaturated, polyunsaturated and saturated fat. Whilst both monounsaturated and polyunsaturated fats are termed the 'good fats', due to their ability to promote insulin resistance, inflammation and obesity, saturated fats are characterised as the 'bad fats', due to the negative impact they have on cardiovascular health (Liu et al., 2017; Forouhi et al., 2018). The findings suggest that both genders had a higher intake of saturated fat. For this particular group of participants, a maximum of 32% of saturated fat should contribute to the overall daily fat intake of males and a maximum of 31% for females. However, results indicated that all participants exceeded these guidelines, with males consuming a daily average of 37% of saturated fat and females a daily average of 41% (see Table 10). This is particularly worrying, as research indicates that elevated saturated fat levels are associated with an increase in Low Density Lipoprotein (LDL), which leads to a build-up of cholesterol in the arteries (Morenga and Montez, 2017). This is turn will lead to the development of cardiovascular disease – a major contributor of mortality worldwide (Houston, 2018; Lordan et al., 2018; Nettleton et al., 2018). The current study found that cholesterol levels for both genders, were only very slightly above the DRV, with males consuming only 2% more than the recommended levels and females only 1% (see Table 9).

Whilst this may seem acceptable, individuals should be striving to consume less of this nutrient, due to its many adverse health effects, as opposed to aiming to meet the guidelines.

Possessing a food allergy, as is the case for all individuals who took part in this study, could explain why participants were found to have increased levels of saturated fat and cholesterol. 63% of participants who had their diet analysed were diagnosed with coeliac disease, all of whom are likely to be observing a strict GFD. Gluten itself is known to provide elasticity, viscosity, taste and texture, consequently proving to be an essential component of many foods (Padaliino et al., 2016). Thus, removal of this component will affect the palatability (a key determinant of food choice), of gluten free foods (Zingone et al., 2010). This poor palatability leads to food industries increasing the use of saturated fat, to make gluten free foods more pleasing for the consumer. Hence, excessive consumption of gluten free foods by coeliacs, will naturally lead to an increase in saturated fat and cholesterol (Saturni et al., 2010). In order for participants to overcome this situation, the incorporation of alternative grains into the diet will prove essential. Grains such as amaranth, quinoa and buckwheat, are rich in fibre, protein and a variety of vitamins and minerals, whilst at the same time, are lacking in both gluten and saturated fat, making them a necessary means of improving the nutritional status of participants (Comino et al., 2013).

Additionally, this particular group of participants also had an excessive consumption of dairy products (see Fig 4. and 5), which could also explain the results concerning saturated fat and cholesterol. Research indicates that dairy products possess a high saturated fat content, which will lead to increased levels of LDL cholesterol and therefore, cardiovascular disease (Lordan et al., 2018). It would seem appropriate therefore, that in order to resolve cholesterol levels, a low dairy diet should be administered by all participants. However, it is important to note that dairy products are nutrient dense, providing a multitude of vitamins and minerals, that would prove difficult to obtain, without the incorporation of dairy into the diet (Wade et al., 2017). It should also be noted that all participants in this study were adolescents, who are in need of nutrients that can aid growth and development. Dairy products are rich in these types of nutrients and so a low dairy diet may not be suitable. Certain dietary guidelines dictate that complete avoidance of full-fat dairy products is the best means of reducing saturated fat, with a greater focus being placed on the consumption of low-fat dairy products (National Health and Medical Research Council, 2013). Despite this, research indicates that full-fat dairy products possess a higher bioavailability of certain nutrients (namely vitamin D and vitamin K) and so may be more beneficial than low-fat dairy products (Spence et al., 2011; Vanderhout et al., 2016). Therefore, the key is for individuals to be able to moderately consume full-fat dairy products, as part of a healthy and balanced lifestyle.

Furthermore, much literature has found that most foods on campus are high in saturated fat and are relatively cheaper than their healthier alternatives (Guyton, 2012; Deliens et al., 2014; de Vos, 2015; Hebden et al., 2015; Vadeboncoeur et al., 2015; do Amaral e Melo et al., 2017). The cost of these foods makes it more tempting for students to purchase them. Therefore, the responsibility of the university to provide more affordable healthier food is of great significance. In addition to consuming alternative grains and controlling their intake of dairy products, participants should increase their fibre intake, as research suggests that high fibre foods removes cholesterol from the body (Morenga and Montez, 2017). Moreover, substituting foods which are high in saturated fat with those that are rich in mono and polyunsaturated fats, can also help to regulate cholesterol levels (Astrup et al., 2011).

4.3.3. Protein

Regarding protein consumption, males had an average daily intake of 91 ± 44g, compared to a DRV of 55.5g, whilst females had a daily average intake of 72 ± 15g, compared to a DRV of 45g (see table 10). Therefore, both genders were consuming more than needed of this nutrient, with males consuming an excess of 39% and females an excess of 60%. The tolerable upper intake level (UL) refers to the daily maximum consumption of a particular nutrient, that is unlikely to pose any adverse health effects (Otten et al., 2006). Based on the average daily energy intake, it was determined that the UL for males was 94g and for females was 75g. Therefore, this indicates that on average, neither gender, though consumed a very high amount of protein, did not reach the UL.

Research suggests that a high protein diet has no adverse effects for healthy individuals (Cuenca-Sanchez et al., 2015; Antonio et al., 2016). In fact, high protein diets are often encouraged due to their ability to produce increased satiety, therefore promoting weight loss and reducing the risk of cardiovascular disease (Cuenca-Sanchez et al., 2015; Campos-Nonato et al., 2017). However, the evidence from this study indicates that this particular group of participants, had a high consumption of simple carbohydrates and saturated fat and were severely lacking in dietary fibre. Therefore, this unhealthy, poor diet, coupled with the high protein intake, indicates that these participants are at risk of metabolic complications such as renal dysfunction, kidney damage and an increased risk of cancer (Delimaris et al., 2013).

One explanation of the high protein intake in both genders, could be attributed to protein supplements. Research highlights that the overuse of protein supplements is quite common in adolescents (Whitehouse and Lawlis, 2017; Samal and Samal, 2018). In particular, young male adolescents are known to have an increased use of protein supplements, as a means of increasing their muscle mass (Eisenberg et al., 2012; Herriman et al., 2017). The

results from this study found that a total of 16 individuals (19%), all of whom were male, were in fact taking some form of protein supplements. This data may suggest that protein supplementation for this group of participants is perhaps an uncommon practice. Additionally, it has already been established that participants in this study had an excessive intake of dairy, with individuals consuming more than double the required amount (see Fig 2. and 3). Dairy foods are a good source of proteins and so a high dairy diet will naturally lead to a diet high in protein (Josse et al. 2012). Furthermore, Guyton (2012), found that foods rich in protein are both cheap and readily available around campus, making them an appealing form of sustenance for students. Therefore, both of these reasons can further explain the high intake of protein, found in participants.

Whilst the quantity of protein consumed by participants is significant in determining the nutritional status, it is also important to consider the quality of the protein. Protein is of two types – animal protein and plant protein. Animal protein is more nutritionally complete and is considered to be of higher quality than plant proteins, which often lack one or more essential amino acids (Lin et al., 2015). However, animal protein is also higher in saturated fat and therefore cholesterol, whilst plant protein is higher in fibre and complex carbohydrates (Xu and Xue, 2016). Whilst data regarding the type of protein consumed by participants was not determined in this particular study, it can be assumed (due to the high levels of saturated fat, cholesterol and dairy), that a large proportion of the protein consumed was animal protein. Therefore, the abundance of protein consumed by both genders in this study, is likely to be that of animal protein, undoubtedly leaving participants at risk of multiple health issues.

Protein is a critical macronutrient needed in adolescence, for the development of bone and muscle mass, therefore it is no surprise why an increased protein intake is common amongst adolescents (Lin et al., 2015). An extremely high consumption of protein can cause nutritional imbalance, placing individuals at risk of disease (Delimaris, 2013). Strategies to reduce protein intake for this group of participants include controlling the use of protein supplements through supervision of a medical professional. Additionally, consuming animal proteins in moderation, along with an increase in the consumption of plant proteins (such as grains, legumes and vegetables) can also help to regulate protein levels.

4.4. Micronutrients

It has long been established that consuming both a balanced and varied diet, is a sure means of acquiring all essential vitamins and minerals (Ward, 2014). In fact, adequate consumption of vitamins and minerals is of great significance, as it can lead to improved health and therefore, prevention of disease (Verkaik-Kloosterman et al., 2012). The daily mean vitamin and mineral intake for all participants, was also determined through the software FETA. A total of 20 vitamins and minerals (9 vitamins and 11 minerals), were included within the results of this study.

4.4.1. Vitamins

It was found that for most vitamins participants were able to meet the DRV's. In fact, for certain nutrients both genders exceeded the recommended levels. Adolescent males and females had a higher dietary intake for 7 of the 9 vitamins (Tables 11 and 12). Therefore, this suggests that males had an overall higher mean daily intake of vitamins and minerals, when compared to females.

Table 11: Average Daily Vitamin Intake from the FETA Programme and DRV's for Men (n = 27) with a Food Allergy, aged 19-24.

Nutrient	DRV's	Mean	SD	Minimum	Maximum
Folate (mcg)	200	239	66	162	419
Niacin (mg)	16.5	23	10	10	54
Vitamin A (mcg)	700	443	197	191	983
Vitamin B2 (mg)	1.3	1.7	0.7	1.0	4.2
Vitamin B1 (mg)	1.0	1.5	0.7	0.9	4.0
Vitamin B12 (mcg)	1.5	5.3	3.1	2.2	17
Vitamin B6 (mg)	1.4	2.4	0.8	1.5	5.3
Vitamin C (mg)	40	114	90	51	512
Vitamin D (mcg)	10	3.2	3.1	0.7	17.5

Table 12: Average Daily Vitamin Intake from the FETA Programme and DRV's for Women (n = 56) with a Food Allergy, aged 19-24.

Nutrient	DRV's	Mean	SD	Minimum	Maximum
Folate (mcg)	200	218	55	85	372
Niacin (mg)	13.2	18	4.5	9.4	30
Vitamin A (mcg)	600	395	126	64	678
Vitamin B2 (mg)	1.1	1.5	0.3	0.7	2.4
Vitamin B1 (mg)	0.8	1.2	0.3	0.7	2.0
Vitamin B12 (mcg)	1.5	4.7	1.4	1.1	7.8
Vitamin B6 (mg)	1.2	2.1	0.5	1.0	3.4
Vitamin C (mg)	40	93	38	36	306
Vitamin D (mcg)	10	2.7	1.0	0.5	5.1

4.4.2. Excessive Consumption

It is also important to note, that on average, of the vitamins that were consumed in excess amounts, the UL was not reached (see Table 13). Therefore, this suggests that based on the current daily mean intakes for vitamins neither gender is at risk of negatively affecting their health. However, when looking at the maximum consumption of vitamins, the UL for one particular nutrient was exceeded.

a) Niacin

It was found that a maximum of 54mg was consumed by certain male individuals (see Table 11), surpassing the UL of 35mg (see Table 13). Research highlights that an increased consumption of this particular nutrient, can lead to flushing (redness of the skin accompanied with a burning sensation), nausea and vomiting and in more severe cases, liver toxicity (Otten et al., 2006; Meyer-Ficca and Kirkland, 2016). Therefore, an excess of this particular B vitamin can prove to be problematic. It is important to note that adverse effects due to an increased niacin consumption, are typically as a result of dietary supplements, as opposed to naturally occurring niacin from foods. (Otten et al., 2006; Meyer-Ficca and Kirkland, 2016).

Table 13: Tolerable Upper Intake Levels (UL) for Vitamins, for Males and Females aged 19-24.

Vitamins	UL*
Folate (mcg)	1000
Niacin (mg)	35
Vitamin A (mcg)	3000
Vitamin B2 (mg)	ND**
Vitamin B1 (mg)	ND
Vitamin B12 (mcg)	ND
Vitamin B6 (mg)	100
Vitamin C (mg)	2000

**Sourced from Otten et al. (2006).*
***ND indicates 'Not Determined.' Perhaps due to lack of data, or absence of adverse effects even at high intakes (Verkaik-Kloosterman et al., 2012).*

The final question of the EPIC Norfolk FFQ looked at supplement intake for each participant. When looking at the raw FFQ data, it was determined that of the 49 individuals (59%) who were taking some form of supplements, 6 (7%) were consuming niacin supplements. Thus, this justifies how they exceeded the UL. The use of dietary supplements is globally on the rise, with a recent report by Grand View Research projecting a market worth of 214 billion pounds for this industry, by 2024 (Grand View Research, 2019). Despite their popular nature, there is limited evidence to support the claim that dietary supplements can prevent disease and improve overall health (Kamangar and Emadi, 2012; Moyer, 2014; Ronis et al., 2017; Chen et al., 2019). This is somewhat surprising, as research indicates that 45% of individuals use supplements to 'improve overall health' and 33% use supplements to 'maintain health' (Bailey et al., 2013). With supplements increasingly being used by many individuals, research dictates that they should not replace complete meals (Chen et al., 2019). Whilst to a certain extent dietary supplements may provide a concentrated form of nutrients, excess consumption may have an opposite effect, posing adverse health risks (Lentjes, 2019).

Obtaining nutrients from foods can provide added benefits that are not seen with supplements (Chen et al., 2019). Therefore, increasing consumption of nutrients through the diet should be a primary strategy, along with monitoring the use of supplements by health care professionals to ensure a healthy balance (Chen et al., 2019; Lentjes 2019). More importantly, in order to ensure that the UL is not exceeded, regulating intake via constant supervision is

vital for the medical community, in order to prevent any further risk (Sirico et al., 2018). It is also important to note, that for this particular study all participants had been diagnosed with a food allergy. For this group of individuals, the use of supplements is a common practice, without which malnutrition is inevitable (Turnbull et al., 2014). Whilst this remains true, only 59% of participants in this study were actually taking some form of supplements, suggesting this notion to be somewhat unpopular. However, it should be noted that a mere 83 individuals participated in diet analysis for this study, which is a relatively small sample size, making it difficult to generalise.

4.4.3. Deficiencies

Certain vitamins were also lacking from the diet. Deficiencies existed in vitamin A and D for both males and females (see tables 11 and 12).

a) Vitamin A

When looking at the daily fruit and vegetable consumption for both genders, male participants had adequate consumption compared to females (see fig 4. and 5.). This would suggest that males should also have a sufficient intake of vitamin A. Whilst males did have adequate consumption of fruits and vegetables, they were severely deficient in their dietary fibre, which can lead to vitamin A deficiency. This could be due to their low intake of complex carbohydrates and perhaps the consumption of low fibre fruits and vegetables. Additionally, the results indicate that whilst males do have a higher vitamin A status than females, the intake of this particular nutrient for both genders continues to be deficient. In fact, males are consuming only 63% of their recommended daily allowance of vitamin A from their diet, compared to 56% consumed by females (see tables 11 and 12).

Furthermore, whilst an increased intake of fruits and vegetables is a proven way of allowing sufficient micronutrient consumption, the key is ensuring that consumption of this food group is varied. Eating behaviours are often based on habit and will rarely fluctuate. Particularly for this group of adolescents who are potentially for the first time in their lives, responsible for their own diet, whilst trying to also navigate the unfamiliar environment of university (van't Riet et al., 2011). This is an issue, as it will lead to individuals consuming the same types of foods and thus, the same types of nutrients on a daily basis. Consequently, this will lead to an exclusion of certain micronutrients. Research highlights that consuming a variety of different fruits and vegetables are more beneficial, than simply increasing the consumption of a single fruit or a single vegetable, over a long period of time (Dhandevi and Jeewon et al., 2015). Therefore, in order for participants to not only improve vitamin A levels, but also to

ensure sufficient consumption of all micronutrients, eating a variety of fruits and vegetables is vital.

b) Vitamin D

Both genders were also severely deficient in vitamin D. Vitamin D is an important micronutrient, involved in the regulation of serum calcium and phosphorus levels. Low levels of vitamin D will reduce the guts ability to absorb both calcium and phosphorus (Gani et al., 2015). This is an issue, as calcium and phosphorus are crucial minerals needed for bone mineralisation (Shaker and Deftos, 2018). When looking at the results of this study, calcium and phosphorus intake for both genders were in fact adequate. Whilst this may seem acceptable, due to the insufficient vitamin D levels, only a very low level of these nutrients will actually be absorbed. In the case of calcium, research highlights that approximately only between 10 and 15% of calcium is likely to be absorbed, compared to 40% when vitamin D levels are adequate (Soliman et al., 2014). What is more concerning, is that maximising bone health in adulthood, is dependent on the bone density acquired during adolescence (Levine, 2012). Therefore, as this particular group of participants (who are all adolescents) have a low absorption rate of calcium and phosphorus, bone mineral density will also be reduced, ultimately leading to consequences in later life. In fact, research highlights that there will be an occurrence of osteomalacia (a condition whereby softening of the bones occurs). If left untreated this disorder can progress, leading to the development of osteoporosis (a condition which results in the bones becoming extremely porous and fragile), inevitably increasing the risk of fracture (Soliman et al., 2014; Beto, 2015; Zadka et al., 2018). Thus, this highlights the importance of ensuring that all individuals possess adequate levels of vitamin D. Intervention during early adolescence is key, to ensure the possibility of maximum skeletal growth in adulthood (Levine, 2012).

Only certain foods (oily fish and eggs) naturally contain vitamin D and therefore, relying exclusively on these types of foods, will make it difficult for individuals to meet their recommended daily allowance. Therefore, three primary strategies exist which if implemented, will allow participants to acquire sufficient vitamin D levels. Firstly, individuals should be encouraged to consume foods fortified with vitamin D. Secondly, greater exposure to sunlight can help to increase vitamin D levels. Finally, the use of vitamin D supplementation is a proven and effective way of treating and preventing vitamin D deficiency (Pilz et al., 2018). Whilst these different approaches can assist in increasing vitamin D intake, it is important to consider the limitations associated with sunlight exposure and supplementation. Firstly, whilst increased exposure to sunlight can increase serum concentrations of vitamin D, too much can lead to skin damage and skin cancer (Holick, 2014). Secondly, any form of supplementation,

including that of vitamin D, is dependent on adherence by each individual. This is concerning as adherence rates in adolescents have been found to be particularly low, with the primary reason being attitude and lack of knowledge regarding the significance of the disease (Al Adawi et al., 2017). Additionally, the risk of potential overdose can provide an additional danger when using supplements. In particular, research has found that an increased consumption amongst individuals, (exceeding the recommended dietary allowance of 100mcg) can lead to recurrent vomiting, dehydration, abdominal pain and kidney failure (Rooney et al., 2017; Marcinowska-Suchowierska et al., 2018).

Whilst sunlight exposure and supplementation are accompanied with certain difficulties, it cannot be denied that these strategies can improve vitamin D status, so long as additional care is taken. Regarding fortification of foods, this is perhaps the best means of individuals increasing their vitamin D intake, with multiple advantages linked with this particular strategy. The ease through which foods can be fortified, allows individuals to be exposed to a wide variety of different foods, appealing to even the fussiest of eaters (Pilz et al., 2018). This will be crucial as individuals with food allergies, who often implement restrictive diets, will still be able to consume allergy free foods, that have the ability to be fortified (Rajasekaran and Kalaivani, 2013). Hence, allowing them to improve their nutritional status.

Improving and maintaining vitamin D status is crucial for the general population, specifically for this group of participants who were found to be severely deficient. In order to reach the recommended daily target of 10mcg, individuals should be educated on the severity of consequences associated with vitamin D deficiency. Thereafter, promoting sensible exposure to sunlight, controlled vitamin D supplementation and the increased consumption of fortified foods, will most certainly assist in improving vitamin D levels, consequently reducing the risk of disease.

4.4.4. Minerals

It was found that for most minerals, participants were able to meet the DRV's (Tables 13 and 14). In fact, for certain nutrients both genders exceeded the recommended levels. Adolescent males had a higher dietary intake for 10 of the 11 minerals (see Table 14). In comparison, adolescent females possessed an increased consumption for only 5 of the 11 minerals (see Table 15). Therefore, this suggests that males had an overall higher mean daily intake of minerals, when compared to females.

Table 14: Average Daily Mineral Intake from the FETA Programme and DRV's for Men (n = 27) with a Food Allergy, aged 19-24.

Nutrient	DRV's	Mean	SD	Minimum	Maximum
Calcium (mg)	700	848	391	444	2140
Chloride (mg)	2300	3624	1000	1971	6326
Copper (mg)	1.2	1.3	0.4	0.8	2.7
Iron (mg)	8.7	10.6	4.7	5.8	27
Iodine (mcg)	140	143	51	80	289
Potassium (mg)	3500	3617	1307	2506	8911
Magnesium (mg)	300	315	101	214	728
Sodium (mg)	1500	2925	1895	1351	9986
Phosphorus (mg)	550	1454	634	710	3612
Selenium (mcg)	75	60	31	31	180
Zinc (mg)	9.5	10.3	4.5	4.1	25

Table 15: Average Daily Mineral Intake from the FETA Programme and DRV's for Women (n = 56) with a Food Allergy, aged 19-24.

Nutrient	DRV's	Mean	SD	Minimum	Maximum
Calcium (mg)	700	762	163	314	1096
Chloride (mg)	2300	3394	841	1477	5561
Copper (mg)	1.2	1.0	0.2	0.5	1.8
Iron (mg)	14.8	9.3	2.2	4.4	14.5
Iodine (mcg)	140	123	33	51	187
Potassium (mg)	3500	3079	673	1436	4525
Magnesium (mg)	270	256	53	129	408
Sodium (mg)	1500	2249	534	1005	3493
Phosphorus (mg)	550	1189	217	630	1603
Selenium (mcg)	60	50	12	27	74
Zinc (mg)	7	8.4	1.9	3.5	12.9

The above difference can be explained when looking at the data for daily food group intake. Fig 4. and 5. highlight the average daily intake for each of the 6 food groups, for males and females respectively. Results indicate that for each of the food groups, males had a higher daily intake than females. In particular, the daily consumption for fruits (excluding juices) and vegetables for males was 417g, compared to 367g for females. Government guidelines indicate that five portions of fruits and vegetables, each weighing 80g should be consumed on a daily basis (NHS, 2018). Additionally, research highlights that this particular food group (fruits and vegetables) compared to all other food groups, provides higher concentrations of vitamins and minerals (Pem and Jeewon, 2015). Therefore, it can be said that the ability to meet the recommendations for 'five a day,' enabled male participants to increase their overall mineral consumption.

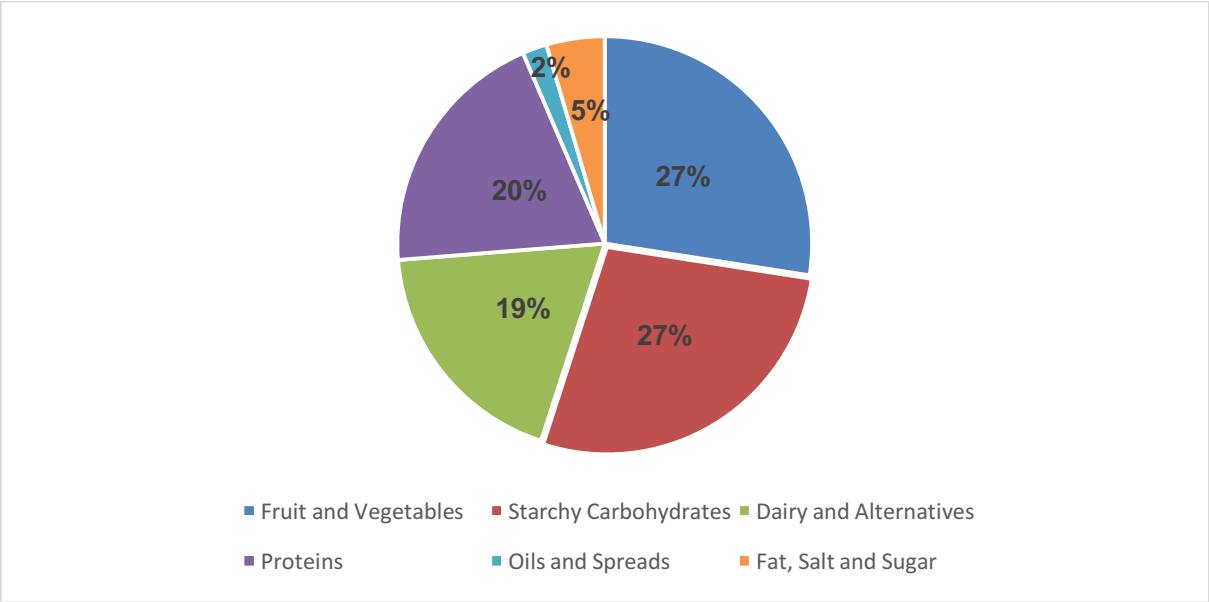


Figure 4. Chart to Show the Mean Daily Intake (%) for Males (n = 27) for each of the 6 Basic Food Groups.

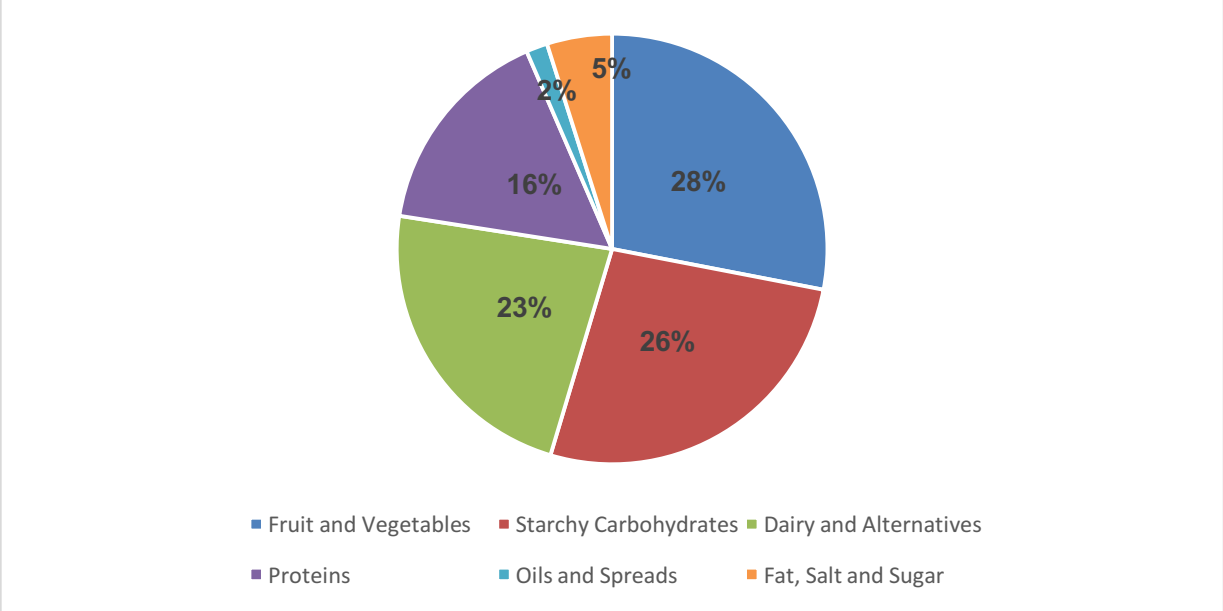


Figure 5. Chart to Show the Mean Daily Intake (%) for Females (n = 56) for each of the 6 Basic Food Groups.

Note: Individuals should be consuming approximately 38% carbohydrates, 40% fruits and vegetables, 8% dairy and alternatives, 12% protein, 1% oils and spreads and 1% of the fat, salt and sugar category (Public Health England, 2018).

4.4.5. Excessive Consumption

It is also important to note, that on average, of the minerals that were consumed in excess amounts, the UL was not reached (see Table 16). Therefore, this suggests that based on the current daily mean intakes for minerals, neither gender is at risk of negatively affecting their health. However, when looking at the maximum consumption of minerals, the UL for certain nutrients was exceeded.

a) Magnesium

The maximum consumption of magnesium was 728mg for males and 408mg for females (Tables 14 and 15), compared to the UL of 350mg (see Table 16). Effects of increased magnesium consumption primarily include bowel discomfort and reduced kidney function, with higher concentrations potentially leading to neuromuscular dysfunction (Jahnene-Dechent and Ketteler, 2012; Al Alawi, 2018). It is important to note that adverse effects due to an increased magnesium consumption, are typically as a result of dietary supplements, as opposed to naturally occurring magnesium from foods. (Otten et al., 2006; Meyer-Ficca and Kirkland, 2016).

Table 16: Tolerable Upper Intake Levels (UL) for Minerals, for Males and Females aged 19-24.

Minerals	UL*
Calcium (mg)	2500
Chloride (mg)	3600
Copper (mg)	10
Iron (mg)	45
Iodine (mcg)	1100
Potassium (mg)	ND**
Magnesium (mg)	350
Sodium (mg)	2300
Phosphorus (mg)	4000
Selenium (mcg)	400
Zinc (mg)	40

**Sourced from Otten et al. (2006).*
***ND indicates 'Not Determined.' Perhaps due to lack of data, or absence of adverse effects even at high intakes (Verkaik-Kloosterman et al., 2012).*

As previously mentioned, the final question of the EPIC Norfolk FFQ looked at supplement intake for each participant. When looking at the raw FFQ data, it was determined that of the 49 individuals (59%) who were taking some form of supplements, 10 individuals (12%) were consuming magnesium supplements. Thus, this suggests how they exceeded the UL. The effects of dietary supplements has been previously discussed in the section regarding vitamins (see section 4.4.2).

b) Sodium and Chloride

Furthermore, the maximum consumption for both sodium and chloride for both genders was considerably high. The maximum consumption of chloride was 6326mg and 5561mg, for males and females respectively (Tables 14 and 15). When compared to the UL of 3600mg, it can be seen that chloride levels for both genders was exceeded by certain individuals (see Table 15). Additionally, the maximum consumption of sodium was 9986mg and 3493mg, for males and females respectively (Tables 14 and 15). The UL for sodium is 2300mg, indicating that some individuals consumed an excess of this nutrient (see Table 16).

Sodium and chloride typically appear together in most foods and is more commonly referred to as table salt. In order to further emphasise the extent to which sodium and chloride were consumed by participants, both the daily mean and maximum salt intake in g, was calculated. This was done by converting the amount of sodium consumed, by multiplying by 2.542 and then dividing by 1000 (Vasara et el., 2017). Following conversion, the data indicated that on average, men consumed 7.4g of salt, whilst women consumed 5.7g of salt. The maximum consumption of salt by men was 25.4g compared to women who consumed a maximum of 8.9g of salt. Recommendations for salt intake for all individuals 11 years and above, is 6g (British Nutrition Foundation, 2017; NHS, 2018). It should be noted, that these recommendations whilst practical, are most certainly not ideal. In fact, the UK National Institute for Health and Care Excellence (NICE) targets a daily consumption of no more than 3g per day by 2025 (NICE, 2013). When comparing the results of this study to these recommended guidelines, it is clear that all individuals had an extremely high consumption of salt. In both cases (mean intake and maximum intake), women had a lower intake of salt than men. This is concurrent with research conducted by Teramoto et al. (2011) and Zhang et al. (2014), who also found higher intakes of salt in men than women. The maximum consumption of sodium levels in males is particularly alarming, with participants consuming over 4 times greater than the recommended amount.

Few foods contain naturally occurring salt, with most added during the period of processing (Otten et al., 2006). In fact, 70% of sodium from the diet comes from processed foods (Farquhar et al., 2015). Research emphasises that individuals in late adolescence are

amongst those who consume the highest amounts of processed foods (Baraldi et al., 2018). This is worrying as all participants in this study were in the stages of late adolescence, hence this could have potentially explained why the UL for sodium and chloride was exceeded. Additionally, Tanton et al. (2015), indicates that university students were frequent consumers of heavily processed convenience foods and takeaway meals, that were integrated within the campus environment. Again, this is particularly worrying as Jaworska et al. (2012), highlights that an average takeaway meal possesses a high percentage of sodium, contributing to more than half of the recommended daily salt intake. Whilst both sodium and chloride are necessary to maintain extracellular fluid volume and plasma osmolality, high concentrations in the body can prove detrimental to overall health (Otten et al., 2006; Farquhar et al., 2015). Much research has established that excessive consumption of sodium chloride is primarily linked to an increase in blood pressure. Consequently, this increase in blood pressure is a risk factor for cardiovascular disease, kidney disease and diabetes (Otten et al., 2006; Jaworska et al., 2012; Aaron and Sanders, 2013; Farquhar et al., 2015). It is clear that from all micronutrients included within this study, sodium and chloride were consumed in higher concentrations by most participants - a finding which seems to mirror that of the general population (Thout et al., 2019).

Reducing salt intake via the reduction of dietary sodium is a fundamental principle, to ensure any improvement in overall health (Farquhar et al., 2015). In fact, research conducted by Ha (2014), found that reducing levels of sodium can most certainly lower blood pressure, inevitably reducing the risk of cardiovascular disease. Both the UK and Finland have proven successful in reducing sodium levels (Laatikainen et al., 2006; Reinivuo et al., 2006; Sadler et al. 2012). Therefore, this indicates that despite the high prevalence of salt intake, reduction is possible.

There are many ways in which dietary sodium can be decreased. Firstly, the food industry can assist by reducing the sodium content of foods, by improving both their accessibility and availability (Megavero et al., 2014). This can potentially be achieved, by using low sodium substitutes, modifying recipes, enhancing the flavours of other components within the foods and changing cooking techniques (Ha, 2014; Losby et al., 2014; Taylor et al., 2014; Farquhar et al., 2015). Secondly, individuals themselves should select low sodium foods and also attempt to reduce their intake of processed foods. Informing consumers of the many health risks associated with high consumptions of salt, is a proven technique that can motivate individuals to choose healthier options (Johnston et al., 2014). Due to the increased number of people suffering from chronic diseases, such as strokes and heart disease, the need to reduce sodium is a vital step. It should also be noted, that barriers will exist for both the food industry and consumers when it comes to reducing the sodium content of foods. Whilst the

food industry will face difficulties concerning flavour, cost and time, individuals themselves will most certainly find it difficult to adhere to a low sodium diet, due its ubiquitous nature (Mugavero et al., 2014; Farquhar et al., 2015). It is hoped that by following these strategies, the overall consumption of salt will be reduced, to achieve the recommended guidelines of no more than 6g of salt per day, consequently decreasing the risk of non-communicable diseases (British Nutrition Foundation, 2017; NHS, 2018).

4.4.6. Deficiencies

a) Iron

Iron levels were found to be extremely insufficient in females. Adolescent individuals undergo a period of rapid growth. Specifically, the period of adolescence is a time where 45% of skeletal growth takes place, between 15 and 25% of height is achieved and 37% of bone mass is accumulated (Mulugeta et al., 2015). Therefore, it is no surprise why iron requirements in this particular group of individuals is greater. More specifically, iron needs in adolescent women, due to menstrual loss, are much greater than men, which could potentially explain why women in this study, had a lower iron intake than men (Kumari et al., 2017). A further explanation that could explain the difference in iron intake between genders, can be linked to vitamin C intake. It has been well established that vitamin C plays a crucial role in maximising iron absorption (Lane et al., 2016). Despite both genders obtaining sufficient vitamin C from their diet, women on average consumed less of this micronutrient (see table 12), consequently reducing their absorption rates.

Improving iron status is crucial, with deficiencies leading to physical impairment, reduced cognitive function, reduced neural function and iron deficiency anemia (Otten et al., 2006; Miller, 2013). Whilst oral iron supplementation is both a proven and cheap way of improving iron status, this method is accompanied by many side effects. Abdominal pain, nausea, diarrhoea and constipation, are only some of the disadvantages which occur upon the use of iron supplementation (Mulugeta et al., 2015; Keshav and Stevens, 2017). Additionally, in order for this particular method to be successful, intestinal uptake needs to be intact. It should be noted that many participants who took part in this study were diagnosed with coeliac disease and thus, the uptake through the gut for these specific individuals would be diminished, making oral iron supplementation an ineffective method (Jiminez et al., 2015). In this case, intravenous iron supplementation could prove beneficial in quickly restoring and maintaining iron stores. However, this technique is perhaps more burdensome for the individual, as it is costlier and requires administration by a health care professional (Auerbach and Macdougall, 2014).

Consequently, the importance of consuming food sources which are high in iron bear great significance, as they can provide an alternative way of improving iron status, which is free of discomfort and cheaper (Miller, 2013). Individuals should also consider the bioavailability of the iron which they are consuming. As heme iron (animal based protein) compared to non heme iron (plant based protein) is more readily absorbed, consuming foods high in this type of iron, such as red meat, poultry and fish, are more beneficial. In addition to this, as iron deficiency anemia has now become a worldwide health issue, the food industry is using both fortification and bio-fortification as a means of improving iron status (Prentice et al. 2016). Whilst this may prove beneficial for the many sufferers of iron deficiency anemia, fortified foods often contain low levels of iron and so, individuals should not solely be reliant on fortified foods as their iron source. (Abukhader, 2018). In fact, research has found that the bioavailability of iron can range from as little as 5% to as much as 20%, due to the presence of either polyphenols and phytates (which inhibit absorption) and vitamin C and calcium (which enhance absorption) (Armah et al., 2015).

4.5. Dietary Habits and Interventions

From the studied population, it is clear that individual participants, due to both an excessive consumption of certain nutrients and deficiencies of others, are at risk of multiple health issues. Overall, when looking at their daily average food group consumption for each of the 6 main food groups, the eatwell guide dictates that individuals should be consuming approximately 38% carbohydrates, 40% fruits and vegetables, 8% dairy and alternatives, 12% protein, 1% oils and spreads and 1% of the fat, salt and sugar category. These government recommendations indicate that those who follow these guidelines will undoubtedly consume a healthy diet that is rich in all necessary nutrients, therefore lowering the risk of any disease (Public Health England, 2016). However, when comparing this to the daily consumption of the 6 food groups for participants from this study, there seems to be an imbalance. Participants were found to be over consuming foods from 4 of the 6 food groups. Dairy and alternatives, protein, oils and spreads and fat, salt and sugar, were of the four food groups where excessive consumption for both genders was taking place. On the other hand, participants were found to be under consuming foods from the carbohydrates and fruits and vegetables group (see Fig 4. and 5.).

Therefore, it can be said that the nutritional status of these individuals is lacking in many areas and is most definitely in need of improvement. It should be noted that much research has previously looked at the nutritional status of first year university students, with all literature concluding, that individuals in this particular age group possess a poor nutritional status, with pronounced weight gain being a common outcome (Deliens et al., 2014; de Vos,

2015; Hebden et al., 2015; Vadeboncoeur et al., 2015; do Amaral e Melo et al., 2017). Therefore, the findings of this study seem to mirror that of the general adolescent population, who were in their first year at university.

The dietary habits of the adolescents in this study, could potentially provide an explanation of their poor nutritional behaviour. Firstly, it was found that participants were more concerned with 'taste' and 'cost' as opposed to consuming foods beneficial for their 'health' (see Table 8). Secondly, the university food environment itself can also negatively influence dietary habits. Whilst this particular aspect was not determined for this group of participants, previous research informs us that universities are plagued with an 'obesogenic environment' that will most certainly lead to weight gain (Vadeboncoeur et al., 2015; Shi et al., 2018). Adolescents at university are continuously faced with energy dense foods high in fat, salt and sugar (Guyton, 2012).

It is also important to note, that other factors excluding those mentioned above, could also impact the nutritional status of the studied population. For instance, stress and anxiety due to an increased vigilance for food allergic individuals and/or stress and anxiety due to the nature of educational studies at a university level. Also, certain beliefs of students could also lead to limited variation in the diet. It is important to consider these, as they could lead to the development of intervention strategies, that could potentially improve the health of the students. However, more research must ultimately be done on these areas, to truly identify their influence on students eating habits (Weiss et al., 2010).

In order to improve the nutritional status of adolescents, dietary intervention is a necessity. Specifically, for this group of individuals (based on results from this study), increasing the consumption of fibre and certain vitamins and minerals, along with the reduction of saturated fat and salt, is crucial. There are many established methods that can potentially be used. Educating participants regarding the significance of consuming a variety of foods is of great importance. Many universities are encouraging healthy eating on campus, in a bid to improve the overall health and wellbeing of students. For example, UCLan - one of the institutions whereby students were recruited from, have established a student led social enterprise known as SCRAN that advocates healthy, safe and sustainable food. Similarly, Manchester Metropolitan University have also recently developed a student led social enterprise, called MetMunch. This new enterprise also focuses on promoting sustainable, healthy and nutritious food. Capitalising on enterprises like these can prove to be beneficial for universities, in helping to educate the students, which could ultimately influence their future food selection habits.

Moreover, generally improving the availability and accessibility of healthier foods that are safe to consume for those with food allergies, can potentially combat the nutritional status of first year university students (Tseng et al., 2016; Pelletier and Laska, 2013) In fact, Shi et al. (2018), found that there was an increased consumption of sugary drinks (a known contributor to obesity), due to vending machines being made readily available across campus. Thus, reducing the availability of these sugary drinks and/or replacing them with healthier alternatives could assist in improving the overall health of adolescents. Further exploring which specific unhealthy foods are consumed in excess at the university setting, can help to create more targeted intervention plans. Likewise, research indicates that energy dense foods that are nutritionally poor, are much cheaper than healthier alternatives (Guyton, 2012).

The food selection behaviour results from the initial part of this study, highlight that cost is the second most influential predictor in participants (see Table 8). Hence, reducing the price of healthier foods and making them more affordable, will surely encourage adolescents to increase their purchase of these types of foods. (Pelletier and Laska, 2013). Furthermore, many individuals find it difficult to choose healthier options, as they are unable to understand the nutritional jargon that dominates food packaging. Therefore, explaining terms, statements and symbols that appear on nutrition labels has been shown to improve the diet quality of adolescents (Buyuktuncer et al., 2018). Research has found that utilising technology to nutritionally educate adolescents, has been particularly effective (do Amaral e Melo et al., 2017). As individuals who live at university will consume most meals on campus, the university itself has a responsibility to ensure adequate nutrition is available, in order to create a food environment that is more conducive to healthy eating (Tseng et al., 2016). Whilst this may be true, it should be noted that students are significantly exposed to fast food outlets surrounding the campus environment. Research has already highlighted that individuals in late adolescence are more inclined to consume processed foods (Tanton et al., 2015) and thus, may not necessarily purchase or consume foods from the university canteens. Despite this, some university canteens will often compete with these fast food outlets for student's patronage and will consequently provide energy dense but nutrient poor foods (Pelletier and Laska, 2013). Although it was not determined from where participants in this study were purchasing and consuming foods and whether they were living on campus or not, what can be said is that all students who decide to eat on or around campus, will continuously be exposed to a nutritionally poor environment, which will almost certainly deter healthy eating. Therefore, it is hoped that by implementing even some of these strategies, the diet quality and consequently the nutritional status of adolescents with food allergies will improve.

4.6. Summary

The findings from this study indicate that participants possessed a poor diet rich in saturated fat, salt and sugar, with deficiencies existing in multiple vitamins and minerals. It seems that the university environment is greatly responsible for contributing to the dietary habits of the participants. Therefore, the need for universities to be able to provide convenience foods that are affordable and nutritionally sound is of great importance. Additionally, educating adolescents through the development of university policies, can also help to establish healthy food preferences, which will prove beneficial.

4.7. Food Allergen Knowledge and Practices

A total of 14 staff, (including chefs, production supervisors, managers and cleaning staff), took part in this questionnaire. Table 17 (see below) highlights the demographic characteristics for all participants. Females accounted for 86% of all participants, whilst only 14% of the participants were male. It has already been established that females are more likely than males to participate in questionnaires (Porter and Whitcomb, 2005; Smith, 2008; Lobato et al., 2014), thus justifying this large gender difference. Majority of the participants (57%) were between the ages of 35-54. With regards to education level, the data revealed that most participants had completed a high school education (64%), with the remainder of individuals (36%) having also obtained a college level education. Additionally, it was found that only 50% of participants possessed food safety certification. It should be acknowledged here, that the institution utilised for the purposes of this study provides all staff with level 2 food safety training. Whilst all staff will have this qualification, they may not necessarily possess the certificate itself, as this is often safeguarded by the managerial staff. Thus, this could potentially explain why half of participants responded as to not having a food safety certificate.

Table 17: Participant Demographics from the Food Allergen, Knowledge and Practices Questionnaire for Males (n = 2) and Females (n = 12)

Variable	Items	Frequency (%)
Gender	*Male*	*2 (14)*
	Female	*12 (86)*
Age	*< 18*	*0 (0)*
	18-24	*2 (14)*
	25-34	*3 (21)*
	35-54	*8 (57)*
	55+	*1 (7)*
Education Level	*High School*	*9 (64)*
	College	*5 (36)*

Table 17: Continued

Variable	Items	Frequency (%)
	Bachelor's Degree	*0 (0)*
Food Safety Certification	*Yes*	*7 (50)*
	No	*7 (50)*

4.7.1. Knowledge

Table 18 (see below) highlights the food allergen knowledge of all participants. Overall, participants had very good knowledge regarding food allergens. 100% of participants were correctly able to identify how tap water alone, is not enough to remove cross contamination. Similarly, 100% of participants were also able to identify the fatality associated with eating any food containing the offending allergen. Participants were also highly knowledgeable when asked questions regarding the prevention of cross-contact and emergency food allergy treatment procedures. In fact, for 10 of the 12 possible statements, participants had a minimum correct response rate of 86%. Participants were less knowledgeable for the following two statements, '*Tree nuts, for example – almonds, Brazil nuts and cashew nuts, are similar to peanut allergy' and 'A fever and headache are common symptoms experienced by individuals who are having a food allergy reaction***.'** In relation to the statement concerning the similarity of peanut and tree nut allergy, only 36% of participants were able to correctly respond. In the case of a fever and headache being common symptoms of a food allergy, 64% of participants were able to correctly respond. Therefore, a higher percentage of respondents scored incorrectly on these two statements, as opposed to all other statements.

With regards to the statement surrounding peanut and tree nut allergy, the reason for a greater number of incorrect responses, could potentially be due to misconceptions surrounding these allergies. Individuals often confuse peanut and tree nut allergy as the same allergy, when in fact they are different (Anaphylaxis, 2018). Despite both peanuts and tree nuts being similarly named, on a botanical level, they are distantly related. Peanuts are a member of the legume family and are closely related to beans, lentils and peas. In contrast, tree nuts refer to any nut coming from a tree, which is encased in a hard shell (Weinberger and Sicherer, 2018). Also, the FSA (2017) classifies both tree nuts and peanuts as separate allergens. However, it is easy to understand why participants may have become confused.

There are many reasons for the association between peanut and tree nut allergy. Both peanuts and tree nuts are considered to be of the eight most common food allergens (Bublin and Breiteneder, 2014). In fact, peanut and tree nut allergy are extremely severe, with both accounting for approximately 70-90% of fatal anaphylactic reactions (Weinberger and Sicherer, 2018). Additionally, research highlights that a significant proportion of individuals who are allergic to peanuts, will also be allergic to tree nuts (Yang et al., 2015). Maloney et al. (2008), found that in a large study consisting of 324 peanut allergic individuals, 86% were also sensitised to tree nuts. Similarly, Glaspole et al. (2011), found that up to 60% of patients who possessed a peanut allergy, were also allergic to one or more tree nuts. Therefore, this indicates that tree nut allergy is similar to peanut allergy. Clearly, there is much controversy surrounding both peanut and tree nut allergy. This could have led to confusion amongst participants, ultimately impacting their knowledge of these food allergies.

In the same way, participants may also have misconceptions regarding fever and headache being common symptoms of food allergies. Whilst a food allergy reaction can lead to both a fever and headache, the food allergy itself is not a direct result of these symptoms. In actual fact, these symptoms could be as a result of a secondary infection, such as sinusitis. Therefore, many symptoms are often mistaken for food allergy reactions, when the true cause is likely to be unrelated (Rodriguez, 2018). Consequently, this could have caused confusion amongst participants, explaining the frequency of incorrect responses.

Whilst this study reveals that participants possessed good knowledge of food allergies, there still remains to be some misunderstanding and confusion amongst catering staff. Choi and Rajagopal (2013) argues that regular food safety training can help to improve knowledge of staff. All staff who took part in this study are required to renew their food safety certificate every two years, to ensure they are up to date with current legislation. Research conducted by Adesokan et al. (2015), highlighted the importance of food safety refresher courses. Their results indicated that those who participated in such courses demonstrated significantly higher knowledge than those who did not. Therefore, participants should be encouraged to undergo a refresher food safety course prior to the 2-year renewal period. Furthermore, following the training course, all staff should be assessed before they are issued with a food safety certificate, to evaluate knowledge retained (Gaungoo and Jeewon, 2013). Hence, both of these practices will help to reduce the gaps in knowledge exhibited by participants.

Table 18: Knowledge of Food Allergens for Catering Staff Participants (n = 14)

Knowledge Items	**Frequency (%)**	
	True	***False***
A food allergy reaction occurs 24 hours after ingesting one of the 14 major food allergens	1 (7)	**13 (93)***
Individuals with food allergies can safely consume foods containing the offending allergen, as long as only a small amount is consumed	2 (14)	**12 (86)***
High temperatures, for example – deep frying, roasting and baking, can destroy the food allergen	2 (14)	**12 (86)***
Tree nuts, for example – almonds, Brazil nuts and cashew nuts, are similar to peanut allergy	9 (64)	**5 (36)***
Oil that has been previously used to cook foods containing nuts, eggs or fish can be used to cook food for food allergic individuals	1 (7)	**13 (93)***
If someone has an allergic reaction, it is correct to first offer water in order to dilute the allergen and stop the reaction	1 (7)	**13 (93)***
Allergen cross contamination of cooking utensils, can be prevented by rinsing with tap water	0 (0)	**14 (100)***
Removing allergenic food items (e.g. walnuts or peanuts) from a finished dish, will prevent the individual from having an allergic reaction	1 (7)	**13 (93)***
Cooking in unrefined oils, will not leave any traces of nut protein in the food	2 (14)	**12 (86)***
Bendryl, Sudafed and Pseudoephedrine are commonly used to treat severe food allergy reactions	1 (7)	**13 (93)***
Someone with a food allergy can die from eating any food containing the offending food allergen	**14 (100)***	0 (0)
A fever and headache are common symptoms experienced by individuals who are having a food allergy reaction	5 (36)	**9 (64)***

**bold indicates correct response*

4.7.2. Practices

A 5-point Likert scale was used to assess participants believed practices towards food allergies. The results are shown in table 19 (see below). The mean practice rating for all 13 items ranged from 3.57 to 5.00. Overall, it was found that participants scored highly (4.20 ± 0.81) and were found to have good practices towards food allergen management.

The results indicated that 100% of participants, when preparing food for a food allergic customer, would remake the food if a mistake had been made. This highlights the willingness of the university staff to accommodate for those with food allergies. These findings are consistent with previous research, which also found that other foodservice establishments are willing to accommodate for individuals suffering from food allergies (Choi and Rajagopal, 2013; Radke et al., 2016; Wen and Kwon, 2016).

Additionally, 100% of participants would clean and sanitise both equipment and utensils, to prevent cross-contact between allergens. This practice is particularly important, as appliances which regularly come into contact with food, are often contaminated with food allergens. This contamination can lead to cross-contact, thus increasing the potential for food allergic reactions (Lessa et al., 2016). It was also found that 93% of participants would use separate equipment when handling allergen containing foods. Similarly, 93% of participants always washed hands with soap and water, following contact with food allergens. Watson et al. (2015), highlights that effective handwashing is a proven technique of removing food allergens and thus, this practice will prove essential in reducing the risk of allergic reactions. It is clear that this particular group of staff possessed extremely positive practices, with regards to cross contact. It should be noted here, that these findings differ from that of previous research. Certain studies reveal that preventing cross contact of food allergens proved difficult for many foodservice employees, with the main reason being failure to distinguish between cross-contact and cross-contamination (Choi and Rajagopal, 2013; Lessa et al., 2016; Soon 2018).

The study also revealed, that 86% of staff would take care in listening to and understanding customers' questions relating to food allergies, before answering. Furthermore, 93% of staff were able to clearly communicate food allergen information from customer to chef. It has already been established that clarity in communication, between both staff and customer, is of great importance to minimise and prevent the possibility of any food allergy reactions (Khuda et al., 2016; Wen and Kwon, 2016). Therefore, participants in this study, with their increased awareness of risk communication are in a good position to prevent food allergy reactions.

On the other hand, it was found that participants had varied responses when it came to identifying common food allergens in foods, with only 56% of participants having confidence to do so. This is particularly worrying, as not being able to clearly identify food allergens in foods can lead to unintentional cross-contact, which could prove fatal for those suffering with a food allergy (Choi and Rajagopal, 2013; Morgan, 2018; Marsh, 2019; Middleton, 2019; Ward, 2019). The reduced capability of identifying common food allergens, could be associated with the time between training sessions. Participants involved in this study are required to renew their food safety certification every 2 years. The large gap between training courses could lead participants to forget previously learnt information (Choi and Rajagopal, 2013). In fact, Worsfold et al. (2004), suggests that the more opportunities staff have to rehearse their skills, the greater the likelihood that these skills will be maintained, ultimately leading to increased knowledge and improved practices. Therefore, universities should encourage their foodservice employees to regularly partake in refresher courses. Additionally, focusing specifically on the needs of individual staff (which are likely to vary considerably), as opposed to subjecting all individuals to general food safety training, will help to improve overall performance (Adesokan et al., 2015). In this case, educating employees on the eight common food allergens (which account for 90% of all food-based allergic reactions) is particularly important (Lessa et al., 2016).

Furthermore, when asked the following '*If I am unsure about the ingredients in a menu item, I still assure the customer that the food does not contain any allergens*', participants' responses ranged from one extreme to the other, with 64% never assuring the customer and 36% always assuring the customer. This particular statement also produced the lowest mean rating (3.57). The fact that more than a third of participants were willing to falsely comfort customers, showcases how the nature of food allergies was not taken seriously by some participants. This is rather worrying, as research dictates that food allergic reactions are in fact very severe, often leading to anaphylaxis and consequently death (Valenta et al., 2015; Loh and Tang, 2018). These findings also contradict previous research (Choi and Rajagopal, 2013; Radke et al., 2016; Wen and Kwon, 2016), as well as the results from this study, which suggests that foodservice employees are extremely willing to accommodate for those with food allergies.

A key component of reducing food allergic reactions on university campus, is to understand the practices of the catering staff, regarding food allergen management. Generally, participants displayed positive practices with regards to managing food allergies. However, certain practices were found to be poor amongst participants, which could prove dangerous for students with food allergies. Therefore, regular refresher courses along with a greater focus on individual needs of employees, in relation to food safety, will prove beneficial.

Table 19: Food Allergy Practices of Catering Staff Participants (n = 14)

Practice Items	Mean	SD	Frequency (%)				
			Never	Seldom	Sometimes	Often	Always
I check the ingredients list of food items, to see if they contain any food allergens.	4.43	1.16	0 (0)	2 (14)	1 (7)	0 (0)	11 (79)
I am able to quickly identify if any ingredients in foods from the menu, contain any common food allergens, upon customer request	4.29	1.00	0 (0)	1 (7)	2 (14)	3 (21)	8 (57)
If a mistake is made when preparing a meal for a food allergic customer, I remake the food	5.00	0.00	0 (0)	0 (0)	0 (0)	0 (0)	14 (100)
I try to listen carefully, understand, and then answer customers' questions about food allergies or allergens in the food	4.86	0.36	0 (0)	0 (0)	0 (0)	2 (14)	12 (86)
If a student has a food allergy, I communicate the allergen information to the chef to ensure that the food is prepared safely and is allergen-free	4.79	0.80	0 (0)	1 (7)	0 (0)	0 (0)	13 (93)
While serving foods to customers with a food allergy, I separately handle allergen-containing plates and allergen-free plates to prevent cross-contact	4.71	1.10	1 (7)	0 (0)	0 (0)	0 (0)	13 (93)

Table 19: (Continued)

Practice Items	Mean	SD	Frequency (%)				
			Never	Seldom	Sometimes	Often	Always
If I am unsure about the ingredients in a menu item, I still assure the customer that the food does not contain any allergens*	3.57	1.99	9 (64)	0 (0)	0 (0)	0 (0)	5 (36)
When preparing food for a customer with food allergies, I pay more attention to safe food handling practices than when preparing food for a student without food allergies	4.00	1.71	3 (21)	0 (0)	1 (7)	0 (0)	10 (71)
When preparing fried food for students with a food allergy, I make sure that I change the oil in the deep fryer to prevent cross contact	4.21	1.58	2 (14)	1 (7)	0 (0)	0 (0)	11 (79)
I wash my hands thoroughly with soap and water after coming into contact with any food allergens	4.93	0.30	0 (0)	0 (0)	0 (0)	1 (7)	13 (93)
I use clean and sanitized equipment and utensils to prevent cross-contact between allergens	5.00	0.00	0 (0)	0 (0)	0 (0)	0 (0)	14 (100)
I use separate equipment for handling allergen-containing foods	4.86	0.54	0 (0)	0 (0)	1 (7)	0 (0)	13 (93)

**Item was reversely coded*

4.7.3. Differences in Knowledge and Practices between Gender, Age and Education Level of Catering Staff

Any differences in participants' knowledge and practices between gender, age andeducation level among catering staff, was also determined through statistical analyses. Independent t-tests were used to assess differences in knowledge and practices between gender and education level. It should be noted here, that although education level had 3 groups (high school, college and bachelor's degree), no participants had completed education beyond college. Thus, independent t-tests were also used to assess differences in this variable. One-way Analysis of Variance (ANOVA) was also conducted to compare any differences in knowledge and practices between age groups.

Gender

No significant differences were found ($p > 0.05$) between males and females, with regards to knowledge ($t(12) = -0.30$, $p = 0.769$) and practices ($t(12) = 0.90$, $p = 0.385$) (see Table 20). Overall, both genders possessed good food allergy knowledge and practices. However, females did have a slightly higher knowledge score (1.77 ± 0.09) than males (1.75 ± 0.00). With regards to food allergen management practices, males were found to possess more positive practices (4.69 ± 0.12) than females (4.47 ± 0.34).

Table 20: Knowledge and Practices of Food Allergies between Males vs. Females

Variable	Males (n = 2)		Females (n = 12)		t-value	p-value
	Mean	SD	Mean	SD		
Knowledge	1.75	0.00	1.77	0.09	-0.30	0.769
Practices*	4.69	0.12	4.47	0.34	0.90	0.385

**Likert Scale: 1 = Never; 2 = Seldom; 3 = Sometimes; 4 = Often; 5 = Always*

Education Level

No significant differences were found ($p > 0.05$) in knowledge ($t(12) = -0.50$, $p = 0.641$) and practices ($t(12) = -1.98$, $p = 0.071$) between participants who possessed a high school education and those who possessed a college education (see Table 21). Whilst the difference was not significant, those with a college level education did perform marginally better in their knowledge (1.78 ± 0.13 compared to 1.76 ± 0.07) and practices (4.71 ± 0.17 compared to 4.38 ± 0.34) of food allergies. This is consistent with research conducted by Goossens et al. (2013) and Radke et al. (2016), who both found that individuals with at least some college level education had higher food allergy knowledge and practice scores. These findings can be explained by the fact that a higher level of education is associated with better skills, allowing individuals to fully understand information relating to food allergies (Loerbroks et al., 2019). Therefore, promoting education through the implementation of continuous training strategies, can help to create a safer environment for university students with food allergies (Lessa et al., 2015; Canon et al., 2019).

Table 21: Knowledge and Attitudes of Food Allergies by Education Level

Variable	High School (n = 9)		College (n = 5)		t-value	p-value
	Mean	SD	Mean	SD		
Knowledge	1.76	0.07	1.78	0.13	-0.50	0.641
Practices	4.38	0.34	4.71	0.17	-1.98	0.071

Age

No significant differences were found ($p > 0.05$) between age groups in both knowledge ($F(3, 10) = 0.34$, $p = 0.800$) and practices ($F(3, 10) = 0.37$, $p = 0.776$) (see Table 22). When looking at the mean knowledge scores, it was found that that younger staff (18-24 year olds) did not perform as well as those in the older age categories (1.71 ± 0.06). Staff between the ages of 25-34 and 35-54 performed the best on questions relating to knowledge of food allergies, with both groups producing the highest mean score (1.78 ± 0.05 and 1.78 ± 0.12 respectively). The results also show that staff over the age of 55, had the most positive practices towards food allergies, producing a high mean score of 4.69.

Table 22: Knowledge and Practices of Food Allergies by Age Group

	18-24 (n = 2)		25-34 (n = 3)		35-54 (n = 8)		55+ (n = 1)			
Variable	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD***	**f-value**	**p-value**
Knowledge	1.71	0.06	1.78	0.05	1.78	0.12	1.75	-	0.34	0.800
Practices	4.46	0.22	4.64	0.12	4.43	0.40	4.69	-	0.37	0.776

**Standard deviation is not shown, as there is only one participant in this group*

4.7.4. Cleaning Practices

To further assess the food allergen practices of catering staff at UClan, the presence of food allergens was detected using the AllerSnap protein residue test. The particular institution (UCLan) that was used in this study included two kitchens. 100 surfaces in each of the two kitchens was analysed for the presence of any protein residue.

Results indicated that cleaning practices could be further improved, with a large number of surfaces being contaminated with protein in both kitchens (see Fig 6). Of the 100 surfaces that were swabbed, 43% of surfaces were found to be free of protein residue in Kitchen A, compared to only 26% in Kitchen B. Therefore, cleaning practices in Kitchen B required significant improvement to minimise cross contact of food allergens.

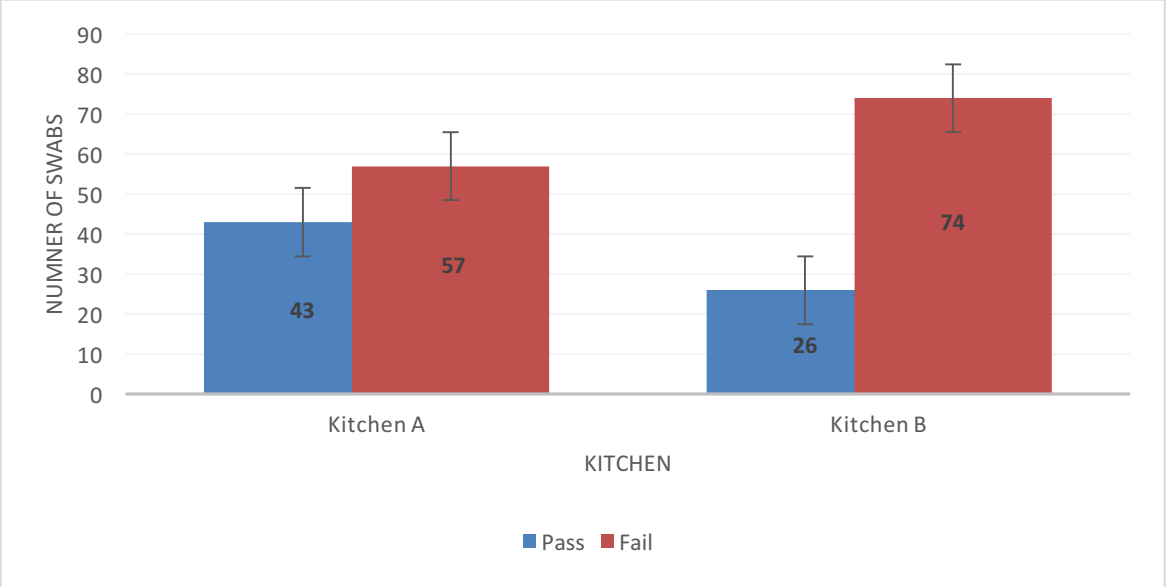


Figure 6. Presence and Absence of Protein Residue in Kitchen A and Kitchen B

Moreover, the AllerSnap protein residue test was also able to detect the strength of the food allergen present, through means of colour change. The colour purple was used to indicate contamination, with a lighter shade of purple indicating a slight presence of protein and a deeper shade of purple indicating the presence of a large amount of protein. Figure 7 (see below) highlights the 4 different stages of contamination (caution, first fail, second fail and third fail) in both Kitchen A and Kitchen B. Of the surfaces that had been contaminated with protein residue, 12% produced a caution, highlighting the presence of a small amount of protein residue. Similarly, 12% of surfaces produced a first fail, whilst 19% of surfaces produced a

second fail. A total of 24% of surfaces produced a third fail, indicating the greatest concentration of protein residue. Therefore, these results further stress the inadequate cleaning practices of catering staff.

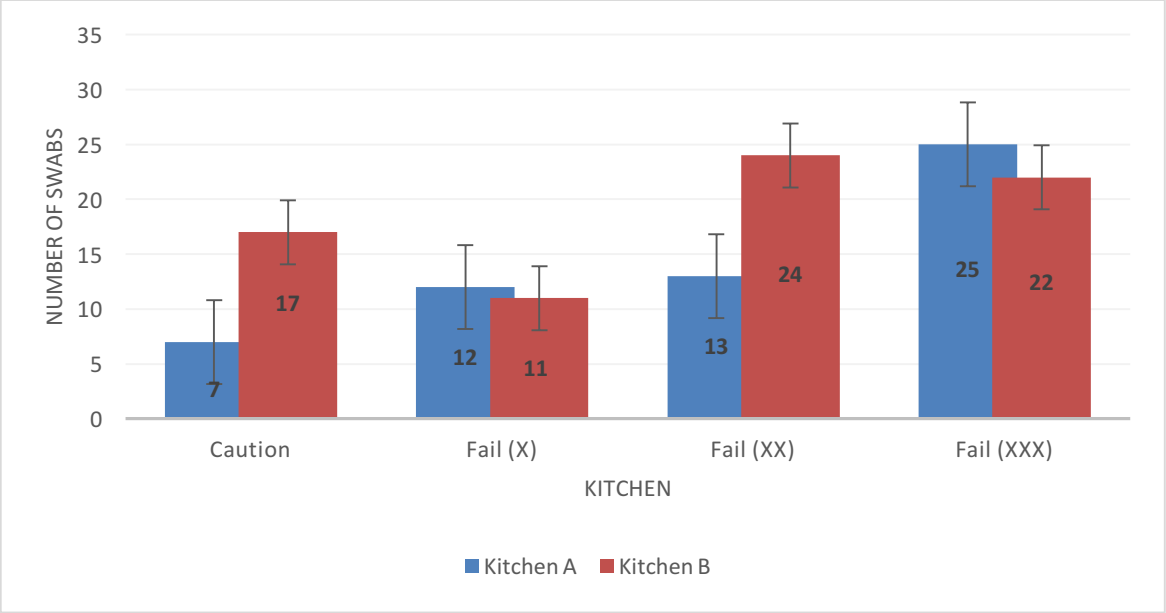


Figure 7. Levels of Contamination in Kitchen A and Kitchen B

Furthermore, the results also revealed the types of surfaces, which possessed the largest amount of protein residue. Figure 8 and 9 (see below) highlight these results. A total of 49 food contact surfaces, 23 non-food contact surfaces and 28 transfer points (see Appendix – Attachment 13) were used for swabbing purposes, in each kitchen. It was found that 33% of food contact surfaces, 74% of non-food contact surfaces and 86% of transfer points were all contaminated with protein residue, in Kitchen A. In contrast, 63% of food contact surfaces, 78% of non-food contact surfaces and 89% of transfer points were found to be contaminated with protein residue, in Kitchen B. Thus, this suggests that with regards to cleaning, transfer points were the most neglected type of surface, with greater attention being placed on food contact surfaces.

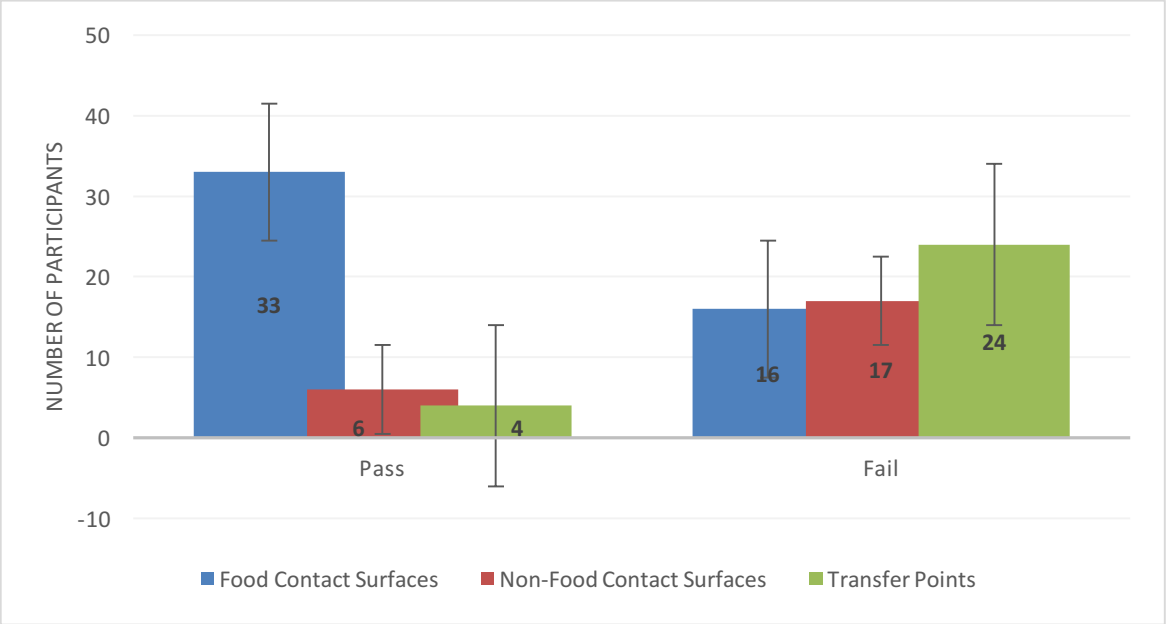


Figure 8. Presence of Protein Residue for each of the Different Surfaces in Kitchen A

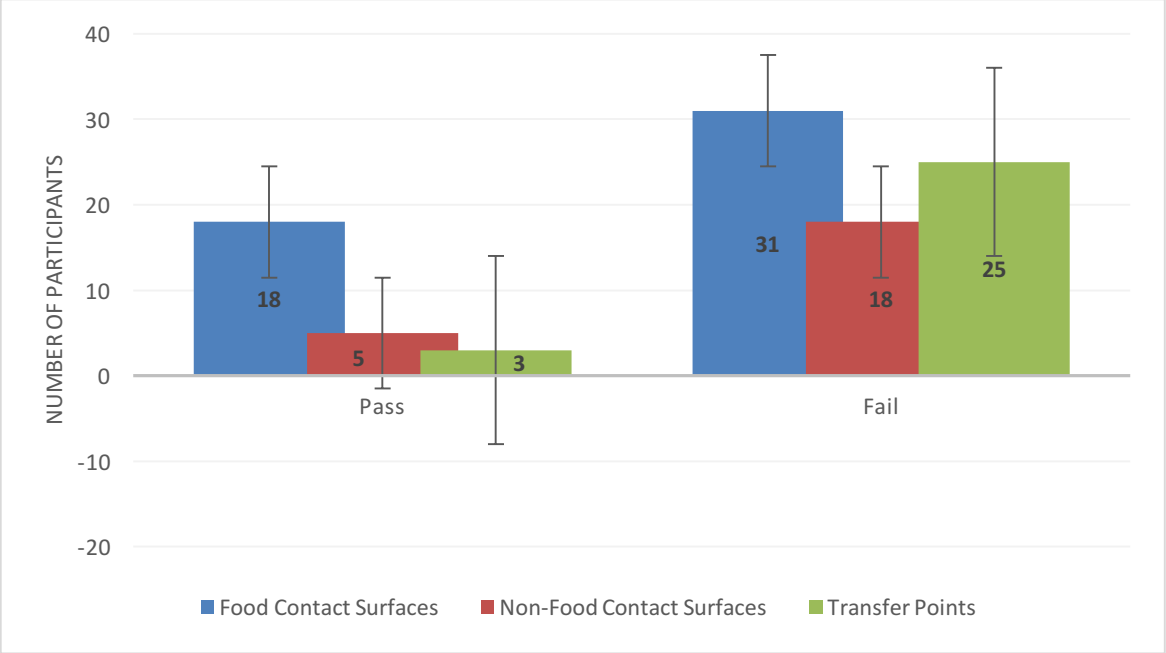


Figure 9. Presence of Protein Residue for each of the Different Surfaces in Kitchen B

Overall, the results from this study allowed insight into the food allergen knowledge and practices of catering staff at UCLan. Participants possessed a good understanding regarding knowledge of food allergens, prevention of cross-contact and emergency food allergy treatment procedures. Additionally, participants scored highly on their self-reported practices. However, with such a large proportion of surfaces having 'failed' the protein residue test, it is clear that the current cleaning practices of staff is inadequate. This is worrying as university students with food allergies, who are without direct parental supervision and are more likely to take risks with their food allergies, are reliant upon catering staff to provide a safe dining establishment, should they choose to consume food on campus (Lessa et al., 2015; Greenhawt, 2016; Canon et al., 2019).

The findings from this study are supported by Jackson et al. (2008) and Galan-Malo et al. (2017), who also found that cleaning practices implemented by catering staff in an educational environment, were ineffective. These results are somewhat surprising, as according to participant responses, individuals were found to possess high knowledge and perceived practices of food allergens (see sections 4.3.1. and 4.3.2). Therefore, this firstly highlights that an increased knowledge of food allergens does not necessarily equal good food allergy practices – a finding which is reinforced by Choi and Rajagopal, (2013). Secondly, whilst participants may possess the adequate knowledge on how to manage food allergies, the incompetency of staff could have led to poor enforcement of cleaning practices. Finally, the large presence of allergen residues indicates that perhaps the current cleaning protocol issued by the university is not effective. However, when looking at the university cleaning procedures (see Appendix – Attachment 12), emphasis has been placed on regular cleaning using 'hot soapy water' along with 'sanitiser spray' or 'washing liquid,' as well as ensuring the use of designated safe sponges. Much research supports the use of these specific cleaning procedures, as a means of removing the presence of any food allergens (Jackson et al., 2008; Brough et al., 2013; Bird et al., 2015; Watson et al., 2015; Galan-Malo et al., 2017). Therefore, perhaps the high rate of protein residue could be due to post cleaning contamination from unknown cross-contact sources. Further research would therefore need to be done on this aspect, in order to truly determine the source of contamination.

5. Conclusion

The purpose of the current study, was to firstly determine the food selection behaviour of university students with food allergies. The results of this investigation show that taste and cost were the most influential factors of food selection, whilst clear labelling was found to be the least significant. Moreover, significant differences were found between genders for both cost and taste, with females more likely than to be influenced by cost, whilst for males taste was a greater determinant of food choice. This piece of research is one of the few, which explored food selection behaviour in food allergic individuals. The present study confirms previous findings in relation to behavioural eating habits of adolescents. Additionally, it further verifies that all university students engage in health risking behaviours. Furthermore, the study contributes further evidence that suggests that individuals with and without food allergies are influenced by the same determinants of food selection.

Secondly, the nutritional status of these students was also established. The findings from this study highlight that the diet of university students was rich in saturated fat, salt and sugar, with deficiencies existing in multiple vitamins and minerals. These results are consistent with previous findings and thus, enhance our understanding of the current dietary diversity of university students with food allergies.

Finally, the food allergen knowledge and practices of catering staff at a chosen institution was also assessed. These findings suggest that in general, catering staff were knowledgeable in the management of food allergies. Gender, age, education level and training of catering staff did not significantly impact the knowledge and perceived practices of catering staff. A more significant finding to emerge from this study would be the poor cleaning practices with regards to food allergens, observed in staff. These results are particularly surprising, as all staff had received a minimum of level 2 food safety training.

In conclusion, in its entirety, the present study provides a greater understanding of the food selection behaviour and nutritional status, of adolescent university students with food allergies. Additionally, the study also provides insight into the food allergen knowledge and practices of the catering staff at one particular university. The incidence of food allergies is undoubtedly increasing in adolescents. As these individuals enter into higher education, the period of transition from parental supervision to self-management of their allergy, will make them nutritionally and emotionally vulnerable. Therefore, taken together these results emphasise the obligation of the university environment. Firstly, in creating a setting that positively promotes healthy eating and secondly, in ensuring that staff are able to provide a safe dining experience and administer aid in the event of an allergic reaction.

5.1. Limitations

It should be acknowledged that the present study is subject to some limitations. All data collected using the FFQ was solely reliant on the participant's memory. Individuals are more often than not unable to accurately remember frequency of food intake and portion size information, especially for prolonged periods of time (such as a year), thus affecting the validity of the results (Naska et al., 2017). Also, when using FFQ's, participants may not be entirely truthful when assessing their own diet. Individuals could intentionally misreport the consumption of certain foods and supplements, particularly those which could portray them in a negative light (e.g. foods which could implicate obesity) (Healey et al., 2016; Maffeisa et al., 2017; Walker et al., 2018). Moreover, a total of 83 participants took part in the FFQ. This small sample size suggests that perhaps the data regarding the nutritional status of participants, is not truly representative of the larger adolescent population. Likewise, for the food allergen knowledge and practices of catering staff, a total of 14 staff participated and so, this reduced response rate also serves as a major limitation of this study. Additionally, for this section the study utilised a convenience sample from only one university (UCLan). Also, catering staff's perceived practices were based on self-reported data. This could have impacted the results of the study, as firstly participants are likely to have been influenced by social desirability and secondly, statements may be interpreted differently by different participants, reducing the reliability of the results. Furthermore, it was not identified if student participants were solely reliant on university canteens for food. Therefore, it is difficult to say that the cleaning practices of catering staff is directly responsible for the occurrence of any food allergic reactions. Therefore, the generalisability of these results to other foodservice operations is somewhat questionable and so, the findings of this study should be interpreted with caution.

5.2. Recommendations for Further Studies

Given that multiple factors outside those tested in this study are known to contribute to eating behaviours of adolescents (Deliens et al., 2014; Verstraeten et al., 2014; Ensaff et al., 2015; Hebden et al., 2015; Tanton et al., 2015; Vadeboncoeur et al., 2015; Vilaro et al., 2018), further research into these areas will prove beneficial in understanding food selection amongst these individuals. Consequently, allowing for the development of effective interventions.

Future studies should also compare the dietary status of first year adolescents, with students towards the end of their time at university. This can be useful to see if the transition period which first year university students undergo, is a key factor in influencing their dietary status. Similarly, research should also compare the dietary status of food allergic individuals with those without food allergies, to see if the presence of an allergy is an influential factor. A

greater focus on investigating which specific unhealthy foods are consumed in excess at the university setting, will also prove beneficial in creating more targeted intervention plans.

It would be beneficial if further studies identified any specific dietary regimes that were implemented by participants. The types of diet that were being observed e.g. a vegetarian/ vegan diet, along with adherence rates could also potentially have influenced the dietary status of participants, irrespective of their food allergy.

Obtaining further information with regards to participants' home life (e.g. if they were living on campus or in halls or alone or with a partner/roommate) along with frequent places of food consumption, could have proven beneficial, in providing an insight into the purchasing and eating habits of participants. This information could also help to pinpoint the source of potential food allergic reactions. This could then allow for specific interventions, as not all individuals with a food allergy will be reliant upon university canteens for food, with multiple outside vendors made easily accessible to students.

Additionally, it would be interesting to conduct further research at different universities, to develop a more holistic view of the knowledge and practices of catering staff. Moreover, focus groups should also be utilised to obtain detailed information regarding barriers to practicing food allergy behaviours. It is also recommended, that further research be undertaken to determine the possibility of post cleaning contamination from unknown cross-contact sources. Alongside this, conducting interviews to determine the barriers that exist as a means of achieving effective food allergen management practices, will also prove beneficial.

References

Aaron, K.J. and Sanders, P.W. (2013). Role of Dietary Salt and Potassium Intake in Cardiovascular Health and Disease: A Review of the Evidence. *Mayo Clinic Proceedings*. 88 (9), pp1-17.

Abraham, S., Noriega, B.R. and Young-Shin, J. (2018). College students eating habits and knowledge of nutritional requirements. *Journal of Nutrition and Human Health*. 2 (1), pp1-5.

Abrams, E.M., and Sicherer, S.H. (2016). Diagnosis and Management of Food Allergy. *The Canadian Medical Association Journal*. 188 (15), pp1087-1093.

Abukhader, M.M. (2018). Comparative assessment and suitability of iron and the nutritional composition of fortified foods for young children. *Nutrition and Health*. 24 (2), pp103-109.

Acker, W.W., Plasek, J.M., Blumenthal, K.G., Lai, K.H., Topaz, M., Seger, D.L., Goss, F.R., Slight, S.P., Bates, D.W. and Zhou, L. (2017). Prevalence of food allergies and intolerances documented in electronic health records. *The Journal of Allergy and Clinical Immunology*. 140 (6), pp1587-1591.

Adesokan, H.A., Akinseye, V.O. and Adesokan, G.A. (2015). Food Safety Training Is Associated with Improved Knowledge and Behaviours among Foodservice Establishments' Workers. *International Journal of Food Science*, pp1-8.

Agyei-Baffour, P., Sekyere, K.B. and Addy, E.A. (2013). Policy on Hazard Analysis and Critical Control Point (HACCP) and adherence to food preparation guidelines: a cross sectional survey of stakeholders in food service in Kumasi, Ghana. *BMC Research Notes*. 6 (442), pp1-12.

Al Adawi, R., Jassim, Z., Khanjar, I., Abdelgelil, M. and Abdallah, I. (2017). Assessment of Medication Adherence and Factors Contributing to Non-Adherence to Calcium and Vitamin D as Mainstay in Treatment and Prophylaxis of Osteoporosis. *PULSUS Journals*. 8, pp125-128.

Al Alawi, A.M., Majoni, S.W. and Falhammar, H. (2018). Magnesium and Human Health: Perspectives and Research Directions. *International Journal of Endocrinology*, pp1-17.

Ali, F. (2017). A Survey of Self-Reported Food Allergy and Food-Related Anaphylaxis among Young Adult Students at Kuwait University, Kuwait. *Medical Principles and Practice*. 26 (3), 229-234.

Allen, K.J., Turner, P.J., Pawankar, R., Taylor, S., Sicherer, S., Lack, G., Rosario, N., Ebisawa, M., Wong, G., Clare-Mills, E.N., Beyer, K., Fiocchi, A. and Sampson, H.A. (2014).

Precautionary labelling of foods for allergen content: are we ready for a global framework. *World Allergy Organisation Journal*. 7 (10), pp1-14.

Alvares, M., Kao, L., Mittal, V., Wuu, A., Clark, A. and Bird, J.A. (2013). Misdiagnosed food allergy resulting in severe malnutrition in an infant. *The Journal of Pediatrics*. 132 (1), pp229-232.

Anagnostou, K., Meyer, R., Fox, A. and Shah, N. (2015). The rapidly changing world of food allergy in children. *F1000 Prime Reports*. 7 (35), pp1-8.

Anagnostou, K. (2017). Coconut Allergy Revisited. *Children: An Open Access Journal.* 4 (10), pp85-87.

Anagnostou, K. (2018). Safety of Oral Food Challenges in Early Life. *Children - Open Access Journal*. 5 (6), pp65-70.

Anaphylaxis Campaign. (2016). *Coconut Allergy.* Available: https://www.anaphylaxis.org.uk/knowledgebase/coconut/.Last accessed 14th Jun 2019.

Anaphylaxis Campaign. (2017). *Young People - A Guide to Eating Out.* Available: https://www.anaphylaxis.org.uk/young-people-help-a-guide-to-eating-out/. Last accessed 24th Nov 2018.

Anaphylaxis Campaign. (2018). *Peanut Allergy and Tree Nut Allergy – The Facts.* Available: https://www.anaphylaxis.org.uk/wp-content/uploads/2019/07/Peanut-2018.pdf. Last accessed 15th Sep 2019.

Anibarro, B., Seoane, F.J. and Mugica, M.V. (2007). Involvement of Hidden Allergens in Food. *Journal of Investigational Allergology and Clinical Immunology*. 17 (3), PP168-172.

Antolin-Amerigo, D., Manso, L., Caminati, M., de La Hoz Caballer, B., Cerecedo, I., Muriel, A., Rodriguez-Rodriguez, M., Barbarroja-Escudero, J., Sanchez-Gonzalez, M.J., Huertas-Barbudo, B. and Alvarez-Mon, M. (2016). Quality of life in patients with food allergy. *Journal of Clinical and Molecular Allergy*. 14 (4), pp1-10.

Antonio, J., Ellenbroek, A., Silver, T., Vargas, L., Tamayo, A., Buehn, R. and Peacock, C.A. (2016). A High Protein Diet Has No Harmful Effects: A One-Year Crossover Study in Resistance-Trained Males. *Journal of Nutrition and Metabolism*. pp1-5.

Anvari, S. and Anagnostou, K. (2018). The Nuts and Bolts of Food Immunotherapy: The Future of Food Allergy. *Children: An Open Access Journal*. 5 (4), pp47-56.

Armah, S., Carriquiry, A. and Reddy, M. (2015). Total iron bioavailability from the US diet is lower than the current estimate. *The Journal of Nutrition*. 145 (11), pp2617-2621.

Arnone, J. and Fitzsimons, V. (2012). Adolescents with Celiac Disease. *Gastroenterology Nursing*. 35 (4), pp248-254.

Astrup, A., Dyrberg, J., Elwood, P., Hermansen, K., Hu, F.B., Jakobsen, M.U., Kok, F.J., Krauss, R.M., Lecerf, J.M., LeGrand, P., Nestel, P., Riserus, U., Sanders, T., Sinclair, A., Stender, S., Tholstrup, T. and Willett, W.C. (2011). The role of reducing intakes of saturated fat in the prevention of cardiovascular disease: where does the evidence stand in 2010?. *The American Journal of Clinical Nutrition* . 93 (4), pp684-688.

Auerbach, M. and Macdougall, I.C. (2014). Safety of intravenous iron formulations: facts and folklore. *Blood Transfusions*. 12 (3), pp296-300.

Bailey, S., Albardiaz, R., Frew, A.J. and Smith, H. (2011). Restaurant staff's knowledge of anaphylaxis and dietary care of people with allergies. *Clinical and Experimental Allergy: Journal of the British Society for Allergy and Clinical Immunology*. 41 (5), pp713-717.

Bailey, R.L., Gauche, J.J., Miller, P.E, Thomas, P.R. and Dwyer, J.T. (2013). Why US Adults Use Dietary Supplements. *JAMA Internal Medicine.* 173 (5), pp355-361.

Bailey, S., Kindratt, T.B., Smith, H. and Reading, D. (2014). Food allergy training event for restaurant staff; a pilot evaluation. *Clinical anjd Translational Allergy*. 4 (26), pp1-4.

Ballmer-Weber, B.K. and Beyer, K. (2018). Food challenges. *Journal of Allergy and Clinical Immunology*. 141 (1), pp69-71.

Barnett, J., Begen, F.M., Gowland, F.H. and Lucas, J.S. (2018). Comparing the eating out experiences of consumers seeking to avoid different food allergens. *BMC: Public Health*. 18, pp1263-1275.

Basera, W., Botha, M., Gray, C.L., Lunjani, N., Watkins, A.S., Venter, C., Allen, K.J., Hlela, C., Zar, H.J., Levin, M.E. (2015). The South African Food Sensitisation and Food Allergy population-based study of IgE-mediated food allergy: validity, safety, and acceptability. *Annals of Allergy, Asthma and Immunology*. 115 (2), pp113-119.

Brandi, L.G., Steele, E.M., Canella, D.S., Monteiro, C.A. (2018). Consumption of ultra-processed foods and associated sociodemographic factors in the USA between 2007 and 2012: evidence from a nationally representative cross-sectional study. *British Medical Journal*. 8 (3), pp1-9.

BBC News. (2017). *Peanut curry death: Mohammed Zaman fails in appeal bid.* Available: https://www.bbc.co.uk/news/uk-england-york-north-yorkshire-41926399. Last accessed 4th May 2017.

BBC News. (2018). *Deliveroo to display allergy information.* Available: https://www.bbc.co.uk/news/business-45962920. Last accessed 4th May 2019.

BBC News. (2019). *Pret allergy death: Parents 'delighted' by 'Natasha's law' plan.* Available: https://www.bbc.co.uk/news/uk-politics-48752388. Last accessed 28th Sep 2019.

Begen, F.M., Barnett, J., Payne, R., Roy, D., Gowland, M.H. and Lucas, J.S. (2016). Consumer Preferences for Written and Oral Information about Allergens When Eating Out. *PLOS one*. 11 (5), pp1-12.

Begin, P. and Nadeau, K.C. (2014). Epigenetic regulation of asthma and allergic disease. *Allergy, Asthma and Clinical Immunology*. 10 (27), pp1-12.

Benede, S., Blazquez, A.B., Chiang, D., Tordesillas, L. and Berin, M. (2016). The rise of food allergy: Environmental factors and emerging treatments. *EBioMedicine*. 7, pp27-34.

Beto, J.A. (2015). The role of calcium in human aging. *Clinical Nutrition Research*. 4 (1), pp1-8.

Biban, B. and Lichiardopol, C. (2017). Iodine Deficiency, Still a Global Problem? *Current Health Sciences Journal*. 43 (2), pp103-111.

Bird, A.J., Crain, M. and Varshney, P. (2015). Food Allergen Panel Testing Often Results in Misdiagnosis of Food Allergy. *The Journal of Pediatrics*. 166 (1), pp97-100.

Birdi, G., Cooke, R. and Knibb, R. (2016). Quality of Life, Stress, and Mental Health in Parents of. *Journal of Allergy*, pp1-7.

Blom, W.M., Michelsen-Huisman, A.D., van Os-Medendorp, H., van Duijn, G., de Zeeuw-Brouwer, M., Versluis, A., Castenmiller, J.J.M., Noteborn, H., Kruzinga, A.G., Knulst, A.C. and Houben, G.F. (2018). Accidental Food Allergy Reactions: Products and Undeclared Ingredients. *Journal of Allergy and Clinical Immunology*. 142 (3), pp865-875.

Bock, S.A., Munoz-Furlong, A. and Sampson, H.A. (2007). Further fatalities caused by anaphylactic reactions to food, 2001-2006. *The Journal of Allergy and Clinical Immunology*. 119 (4), pp1016-1018.

Bollinger, M.E., Dahlquist, L.M., Mudd, K., Sonntag, C., Dillinger, L., McKenna, K. (2006). The impact of food allergy on the daily activities of children and their families. *Annals of Allergy, Asthma and Immunology*. 96 (3), pp415-421.

Bracho-Sanchez, E. (2019). *Girl's deadly reaction to toothpaste is extremely rare, allergist reminds parents.* Available: https://edition.cnn.com/2019/04/22/health/toothpaste-deadly-allergic-reaction-perspective/index.html. Last accessed 18th May 2019.

British Nutrition Foundation. (2017). *Nutrition Requirements.* Available: https://www.nutrition.org.uk/attachments/article/907/Nutrition%20Requirements_Revised%20Oct%202017.pdf. Last accessed 12th Jul 2019.

British Nutrition Foundation. (2018). *The eatwell guide - A revised healthy eating model.* Available: https://www.nutrition.org.uk/healthyliving/healthydiet/eatwell.html. Last accessed 8th July 2019.

Brough, H.A., Makinson, K., Penagos, M., Maleki, S.J., Cheng, H., Douiri, A., Stephens, A.C., Turcanu, V. and Lack, G. (2013). Distribution of peanut protein in the home environment. *The Journal of Allergy and Clinical Immunology*. 132 (3), pp623-629.

Brown, C.E., Jones, C.J., Stuttaford, L., Robertson, A., Rashid, R.S. and Smith, H.E. (2016). A qualitative study of the allergy testing experiences, views and preferences of adult patients. *Clinical and Translational Allergy*. 6 (1), pp34-40.

Bublin, M. and Breiteneder, H. (2014). Cross-Reactivity of Peanut Allergens. *Current Allergy and Asthma Reports*. 14 (426), pp1-12.

Buyuktuncer, Z., Ayaz, A., Dedebayraktar, D., Inan-Eroglu, E., Ellahi, B. and Tanju Besler, H. (2018). Promoting a Healthy Diet in Young Adults: The Role of Nutrition Labelling. *Nutrients - Open Access Journal*. 10 (10), pp1335-1447.

Caffarelli, C., Baldi, F., Bendandi, B., Calzone, L., Marani, M. and Pasquinelli, P. (2010). Cow's milk protein allergy in children: a practical guide. *Italian Journal of Pediatrics*. 36 (5), pp1-7.

Campos-Nonato, I., Hernandez, L. and Barquera, S. (2017). Effect of a High-Protein Diet versus Standard- Protein Diet on Weight Loss and Biomarkers of Metabolic Syndrome: A Randomized Clinical Trial. *The European Journal of Obesity: Obesity Facts*. 10, pp238-251.

Canon, N., Gharfeh, M., Duffey, D., Anvari, S. and Davis, C.M. (2019). Role of Food Allergy Education: Measuring Teacher Knowledge, Attitudes, and Beliefs. *Allergy and Rhinology*. 10, pp1-7.

Cianferoni, A. and Muraro, A. (2012). Food Induced Anaphylaxis. *Immunology and Allergy Clinics of North America*. 32 (1), pp165-195.

Ciacci, C., Ciclitira, P., Hadjivassiliou, M., Kaukinen, K., Ludvigsson, J.F., McGough, N., Sanders, D.S. Woodward, J., Leonard, J.N. and Swift, G.L. (2015). The gluten-free diet and its current application in coeliac disease and dermatitis herpetiformis. United Europeans Gastroenterology Journal. 3 (2), pp121-13.

Citraresmi, A.D.P. and Wahyuni, E.E. (2018). Implementation of hazard analysis and critical control point (HACCP) in dried anchovy production process. *International Conference Series: Earth and Environmental Science*. 131, pp1-7.

Chan W, Brown JB, Buss DH (1994). Miscellaneous foods. Fourth supplement to McCance and Widdowson's The Composition of Foods, 5th ed. Cambridge: Royal Society of Chemistry.

Chan W, Brown J, Lee SM, Buss DH (1995). Meat, poultry and game. Fifth supplement to McCance and Widdowson's The Composition of Foods, 5th ed. Cambridge: Royal Society of Chemistry.

Chan W, Brown J, Church SM, Buss DH (1996). Meat products and dishes. Sixth supplement to McCance and Widdowson's The Composition of Foods, 5th ed. Cambridge: Royal Society of Chemistry.

Chen, F., Du, M., Blumberg, J.B., Chui, K., Ruan, M., Rogers, G., Shan, Z., Zeng, L. and Zhang, F.F. (2018). Association Among Dietary Supplement Use, Nutrient Intake, and Mortality Among U.S. Adults: A Cohort Study. *Annals of Internal Medicine*. 170, pp604-613.

Choi, J.H. and Rajagopal, L. (2013). Food allergy knowledge, attitudes, practices, and training of foodservice workers. *Food Control*. 31, pp474-481.

Cole, M.B., Augustin, M.A., Robertson, M.J. and Manners, J.M. (2018). The science of food security. *npj: Science of Food*. 2 (14), pp1-8.

Comino, I., Moreno, M., Real, A., Rodrigues-Herrera. A., Barro, F. and Sousa, C. (2013). The Gluten-Free Diet: Testing Alternative Cereals Tolerated by Celiac Patients. Journal of Human Nutrition. 5 (10), pp4250-4268.

Contento, I.R., Williams, S.S., Michela, J.L. and Franklin, A.B. (2006). Understanding the food choice process of adolescents in the context of family and friends. *The Journal of Adolescent Health*. 38 (5), pp575-582.

Cuenca-Sanchez, M., Navas-Carrillo, D. and Orenes-Pinero, E. (2015). Controversies Surrounding High-Protein Diet Intake: Satiating Effect and Kidney and Bone Health. *Advances in Nutrition: An International Review Journal*. 6 (3), pp260-266.

Deliens, T., Clarys, P., De Bourdeaudhuij, I. and Deforche, B. (2014). Determinants of eating behaviour in university students: a qualitative study using focus group discussions. *BMC Public Health*. 14 (53).

Delimaris, A. (2013). Adverse Effects Associated with Protein Intake above the Recommended Dietary Allowance for Adults. *ISRN Nutrition: Hindawi Publishing Corporation*. pp1-6.

deVos, P., Hanck, C., Neisingh, M., Prak, D., Groen, H. and Faas, M. M. (2015). Weight gain in freshman college students and perceived health. *Preventive Medicine Reports*. 1 (2), pp229-234.

Devlin, J. (2013). Nutrient intakes of healthy adults on a gluten-free diet (Master's Thesis). *School of Health Sciences Dietetics and Human Nutrition Program Eastern Michigan University*.

Dhandevi, P.E.M. and Jeewon, R. (2015). Fruit and Vegetable Intake: Benefits and Progress of Nutrition Education Interventions - Narrative Review Article. *Iranian Journal of Public Health*. 44 (10), pp1309-1321.

DiNicolantonio, J, J., Mangan, D. and O'Keefe, J, H. (2018). Copper deficiency may be a leading cause of ischaemic heart disease. *Open Heart*. 5 (2), pp1-8.

Diwakar, L., Cummins, C., Lilford, R. and Roberts, T. (2017). Systematic review of pathways for the delivery of allergy services. *British Medical Journal*. 7, pp1-19.

do Amaral e Melo, G.R., de Carvalho Silva Vargas, F. and dos Santos Chagas, C.M. (2017). Nutritional interventions for adolescents using information and communication technologies (ICTs): A systematic review. *Nutritional interventions for adolescents using information and communication technologies (ICTs): A systematic review*. 12 (9), pp1-12.

Dong, H., Sargent, L.J., Chatzidiakou, Y., Saunders, C., Harkness, L., Bordenave, N., Rowland, I., Spencer, J.P.E. and Lovegrove, J.A. (2016). Orange pomace fibre increases a composite scoring of subjective ratings of hunger and fullness in healthy adults. *Appetite*. 107, pp478-485.

DunnGalvin, A., Roberts, G., Austin, M.M., Schadt, S., Hernandez, P., Hjorth, B., Fernandez-Rivas, M., Taylor, S., Baumert, J., Sheikh, A., Astley, S., Crevel, R. and Mills, E.N.C. (2019). Understanding how consumers with food allergies make decisions based on precautionary labelling. *Clinical and Experimental Allergy*, pp1-20.

Eisenberg, M.E., Wall, M. and Neumark-Sztainer. (2012). Muscle-enhancing Behaviors Among Adolescent Girls and Boys. *Journal of Pediatrics*. 130 (6), pp1019-1026.

Eller, E., Kjaer, H.F., Host, A., Anderson, K.E. and Bindslev-Jensenn, C. (2009). Food allergy and food sensitization in early childhood: results from the DARC cohort. *European Journal of Allergy and Clinical Immunology*. 64 (7), pp1023-1029.

Ensaff, H., Coan, S., Sahota, P., Braybrook, D. Akter, H. and McLeod, H. (2015). Adolescents' Food Choice and the Place of Plant-Based Foods. *Nutrients - Open Access Journal*. 7, pp4619-4637.

Farquhar, W.B., Edwards, D.G., Jurkovitz, C.T. and Weintraub, W.S. (2015). Dietary Sodium and Health: More Than Just Blood Pressure. *Journal of the American College of Cardiology*. 65 (10), pp1042-1050.

Ferretti, F. and Mariani, M. (2017). Simple vs. Complex Carbohydrate Dietary Patterns and the Global Overweight and Obesity Pandemic. *International Journal of Environmental Research and Public Health*. 14 (10), pp1174-1186.

Feuille, E. and Nowak-Wegrzyn, A. (2018). Allergen-Specific Immunotherapies for Food Allergy. *Allergy, Asthma and Immunology Research*. 10 (3), pp189-206.

Food and Drug Administration. (2016). *Revision of the Nutrition and Supplement Facts Labels.* Available: https://s3.amazonaws.com/public-inspection.federalregister.gov/2016-11867.pdf. Last accessed 27th June 2019.

Food and Drug Administration. (2018). *Guidance for Industry: Questions and Answers Regarding Food Allergens (Edition 4).* Available: https://www.fda.gov/regulatory-information/search-fda-guidance-documents/guidance-industry-questions-and-answers-regarding-food-allergens-edition-4.Last accessed 14th Jun 2019.

Foods Standards Agency. (2017). *Allergen Guidance for Industry.* Available: https://www.food.gov.uk/business-guidance/allergen-guidance-for-industry. Last accessed 05 Nov 2018.

Foods Standards Agency. (2017). *Food Allergy and Intolerance Programme.* Available: https://www.food.gov.uk/sites/default/files/media/document/fsa170306.pdf. Last accessed 30th Oct 2018.

Foods Standards Agency. (2018). *Allergy Alerts.* Available: https://www.food.gov.uk/news-alerts/search?keywords=. Last accessed 14th Nov 2018.

Foods Standards Agency. (2018). *Young people and Food Allergies and Intolerances.* Available: https://www.food.gov.uk/sites/default/files/media/document/young-people-and-food-allergies-2018.pdf. Last accessed 16th Nov 2018.

Foods Standards Agency. (2020). *Safer food, better business.* Available: https:// www.food.gov.uk/business-guidance/safer-food-better-business. Last accessed 01 Feb 2020.

Foong, R., du Toit, G. and Fox, A.T. (2017). Asthma, Food Allergy, and How They Relate to Each Other. *Frontiers in Pediatrics*. 5 (89), pp1-6.

Forouhi, N.G., Krauss, R.M., Taubes, G. and Willst, W. (2018). Dietary fat and cardiometabolic health: evidence, controversies, and consensus for guidance. *The British Medical Journal*. 361 (k2139), pp1-8.

Fox, A.T., Du Toit, G., Lang, A. and Lack, G. (2004). Food allergy as a risk factor for nutritional rickets. Journal of Pediatric Allergy and Immunology. 15 (6), pp566-569.

Fransvea, A., Celano, G., Pagliarone, C.N., Disanto, C., Balzaretti, C., Milano, G.V. and Bonerba, E. (2014). Food Labelling: A Brief Analysis of European Regulation 1169/2011. *Italian Journal of Food Safety*. 3 (3), pp151-153.

Galan-Malo, P., Lopez, M., Ortiz, J.C., Perez, M.D., Sanchez, L., Razquin, P. and Mata, L. (2017). Detection of egg and milk residues on working surfaces by ELISA and lateral flow immunoassay tests. *Journal of Food Control*. 74, pp45-53.

Gangakhedkar, A., Somerville, R. and Jelleyman, T. (2017). Carotenemia and hepatomegaly in an atopic child on an exclusion diet for a food allergy. *Australasian Journal of Dermatology*. 58 (1), pp42-44.

Gani, L.U. and How, C.H. (2015). Vitamin D deficiency. *Singapore Medical Journal*. 56 (6), pp433-437.

Gaungoo, Y. and Jeewon, R. (2013). Effectiveness of training among food handlers: A review on the Mauritian Framework. *Current Research in Nutrition and food Science*. 1 (1), pp1-9.

Glaspole, I.N., de Leon, M.P., Prickett, S.R., O'Hehir, R.E. and Rolland J.M. (2011) Clinical allergy to hazelnut and peanut: identification of T cell cross-reactive allergens. *International Archives of Allergy and Immunology.* 155(4), pp345–54.

Goossens, N.J., Flokstra-de Blok, B.M., van der Meulen, G.N., Botjes, E., Burgerhof, H.G., Gupta, R.S., Springston, E.E., Smith, B., Duivermann, E.J. and Dubois, A.E. (2013). Food allergy knowledge of parents - is ignorance bliss? *Paediatric Allergy and Immunology*. 24 (6), pp567-573.

Grand View Research. (2019). *Dietary Supplements Market Size Analysis Report by Ingredient (Botanicals, Vitamins), By Form, By Application (Immunity, Cardiac Health), By End User, By Distribution Channel, And Segment Forecasts, 2.* Available: https://www.grandviewresearch.com/industry-analysis/dietary-supplements-market. Last accessed 9th Jul 2019.

Green, H., Broun, P., Cook, D., Cooper, K., Drewnowski, A., Pollard, D., Sweeney, G. and Roulin, A. (2018). Healthy and sustainable diets for future generations. *Journal of the Science of Food and Agriculture*. 98 (9), pp3219-3224.

Greenhawt, M.J., Singer, A.M. and Baptist, A.P. (2009). Food allergy and food allergy attitudes among college students. *The Journal of Allergy and Clinical Immunology*. 124 (2), pp323-327.

Greenhawt, M. (2016). Food allergy quality of life and living with food allergy. *Current Opinion in Allergy and Clinical Immunology*. 16 (3), pp284-290.

Guilleminault, L., Williams, E.J., Scott, H.A., Berthon, B.S., Jensen, M. and Wood, L.G. (2017). Diet and Asthma: Is It Time to Adapt Our Message? *Nutrients - Open Access Journal*. 9 (11), pp1227-1252.

Gupta, R.S., Springston, E.E., Warrier, M.R., Smith, B., Kumar, R, Pongracic, J. and Holl, J.L. (2011). The prevalence, severity, and distribution of childhood food allergy in the United States. *Journal of Pediatrics*. 128 (1), pp9-17.

Gupta, R. (2017). *Many food allergic adults develop a new food allergy in adulthood.* Available:https://www.healio.com/internal-medicine/allergy-asthma-immunology/news/online/%7B0fb00b5a-fc15-4cf0-9d63-eb8c45976387%7D/many-food-allergic-adults-develop-a-new-food-allergy-in-adulthood. Last accessed 31st October 2018.

Gupta, R.S., Warren, C.M., Smith, B.M., Jiang, J., Blumenstock, J.A., Davis, M.M., Schleimer, R.P. and Nadeau, K.C. (2019). Prevalence and Severity of Food Allergies Among US Adults. *The Journal of the American Medical Association*. 2 (1), pp1-14.

Guyton, J.L. (2012). Evaluation of the Nutritional Content of Food on Campus. *Journal of Undergraduate Research*. 13 (3), pp1-5.

Ha, S.K. (2014). Dietary Salt Intake and Hypertension. *Electrolytes and Blood Pressure*. 12 (1), pp7-18.

Hahn, A.L., Dahlquist, L.M., Hoehn, J.L. and Bollinger, M.E. (2017). Development of a Food Allergy Knowledge Test for Parents. *Journal of Pediatric Psychology*. 42 (5), pp598-609.

Healthy University Plan. (2018). *Healthy University Plan.* Available: https://www.uclan.ac.uk/corporate_information/assets/healthy-university-action-plan-2018-20.pdf. Last accessed 7th Feb 2020.

Hebden, L., Chan, H. N., Louie, J. C., Rangan, A. and Allman-Farinelli, M. (2015). You are what you choose to eat: Factors influencing young adults' food selection behaviour. *Journal of Human Nutrition and Dietetics*. 28 (4), pp401-408.

Hefle, S.L., Furlong, T.J., Lemon-Mule, H., Sicherer, S. and 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), pp171-176.

Heinzerling, L., Mari, A., Bergmann, K.C., Bresciani, M., Burbach, G., Darsow, U., Durham, S., Fokkens, W., Gjomarkaj, M., Haahtela, T., Bom, A.T., Wohrl, S., Maibach, H. and Lockey, R. (2013). The skin prick test – European standards. *Clinical and Translational Allergy*. 3 (3), pp1-10.

Herbert, L., Shemesh, E. and Bender, B. (2016). Clinical Management of Psychosocial Concerns Related to Food Allergy. *The Journal of Allergy and Clinical Immunology in Practice*. 4 (2), pp205-213.

Herman, M., Fletcher, L., Tchaconas, A., Adesman, A. and Milanaik, R. (2017). Dietary Supplements and Young Teens: Misinformation and Access Provided by Retailers. *American Academy of Pediatrics*. 139 (2), pp1-7.

Hill, D.A., Grundmeier, R.W., Ram, G. and Spergel, J.M. (2016). The epidemiologic characteristics of healthcare provider-diagnosed eczema, asthma, allergic rhinitis, and food allergy in children: a retrospective cohort study. *BMC Pediatrics*. 16 (133), pp1-8.

Ho, M., Lee, L.S., Wong, W., IP, P., Lau., Y.L. (2012). Prevalence of self-reported food allergy in Hong Kong. *Asian Pacific Journal of Allergy and Immunology*. 30, pp275-284.

Hoehn, J.L., Dahlquist, L.M., Hahn, A.L. and Bollinger, M.E. (2017). Parents of Children with Food Allergy: Gender Differences in Perceived Impact and Perceived Food Allergy Severity. *Journal of Pediatric Psychology*. 42 (2), pp186-197.

Holick, M.F. (2014). Cancer, sunlight and vitamin D*. *Journal of Clinical and Translational Endocrinology*. 1 (4), pp179-186.

Holland B, Unwin ID, Buss DH (1988). Cereals and cereal products. Third supplement to McCance and Widdowson's The Composition of Foods, 4th ed. Cambridge: Royal Society of Chemistry.

Holland B, Unwin ID, Buss DH (1989). Milk products and eggs. Fourth supplement to McCance and Widdowson's The Composition of Foods, 4th ed. Cambridge: Royal Society of Chemistry.

Holland B, Welch AA, Unwin ID, Buss DH, Paul AA, Southgate DAT (1991a). McCance and Widdowson's The Composition of Foods, 5th ed. Cambridge: Royal Society of Chemistry.

Holland B, Unwin ID, Buss DH (1991b). Vegetables, herbs and spices. Fifth supplement to McCance and Widdowson's The Composition of Foods, 4th ed. Cambridge: Royal Society of Chemistry.

Holland B, Unwin ID, Buss DH (1992a). Fruit and nuts. First supplement to McCance and Widdowson's The Composition of Foods, 5th ed. Cambridge: Royal Society of Chemistry.

Holland B, Welch AA, Buss DH (1992b). Vegetable dishes. Second supplement to McCance and Widdowson's The Composition of Foods, 5th ed. Cambridge: Royal Society of Chemistry.

Holland B, Brown JB, Buss DH (1993). Fish and fish products. Third supplement to McCance and Widdowson's The Composition of Foods, 5th ed. Cambridge: Royal Society of Chemistry.

Hosseini, S.M., Soltanizadeh, N., Mirmoghtadaee, P., Banavand, P., Mirmoghtadaie, L. and Shojaee-Aliabadee, S. (2018). Gluten-free products in celiac disease: Nutritional and technological challenges and solutions. *Journal of Research in Medical Sciences*. 23, pp109-123.

Houston, M. (2018). The relationship of saturated fats and coronary heart disease: fact or fiction? A commentary. *Therapeutic Advances in Cardiovascular Disease*. 12 (2), pp33-37.

Hu, Y., Chen, J. and Li, H. (2010). Comparison of food allergy prevalence among Chinese infants in. *Pediatrics International*. 52, pp820-824.

Hygiena. (2018). *AllerSnap: Rapid Protein Residue Test.* Available: https://www.hygiena.com/allersnap-food-and-beverage.html. Last accessed 2nd Dec 2018.

Ito, K. (2013). Diagnosis of food allergies: the impact of oral food challenge testing. *Asia Pacific Allergy*. 3 (1), pp59-69.

Iweala, O.I., Choudhary, S.K. and Commins, S.P. (2018). Food Allergy. *Current Gastroenterology Reports.* 20 (5), pp1-11.

Jackson, L.S., Al-Taher, F.M., Moorman, M., DeWries, J.W., Tippett, R., Swanson, K.M.J., Fu, T.J., Salter, R., Dunaif, G., Estes, S., Albillos, S. and Gendel, S.M. (2008). Cleaning and Other Control and Validation Strategies to Prevent Allergen Cross Contact in Food Processing Operations. *Journal of Food Protection*. 71 (2), pp445-458.

Jahnen-Dechent, W. and Ketteler, M. (2012). Magnesium Basics. *Clinical Kidney Journal*. 5, pp3-14.

Jaworowska, A., Blackham, T., Stevenson, L. and Davies, I.G. (2012). Determination of salt content in hot takeaway meals in the United Kingdom. *Appetite*. 59 (2), pp517-522.

Jaworska, N. and MacQueen, G. (2015). Adolescence as a unique developmental period. *Journal of Psychiatry and Neuroscience*. 40 (5), pp291-293.

Johnston, Y.A., McFadden, M., Lamphere, M., Buch, K., Stark, B. and Salton, J.L. (2014). Working with grocers to reduce dietary sodium: lessons learned from the Broome County Sodium Reduction in Communities pilot project. *Journal of Public Health Management and Practice*. 20 (1), pp54-58.

Josse, A.R., Atkinson, S.A., Tarnopolsky, M.A. and Phillips, S.M. (2012). Diets Higher in Dairy Foods and Dietary Protein Support Bone Health during Diet- and Exercise-Induced Weight Loss in Overweight and Obese Premenopausal Women. *The Journal of Clinical Endocrinology and Metabolism*. 97 (1), pp251-260.

Jimenez, k., Kulnigg-Dabsch, S. and Gasche, C. (2015). Management of Iron Deficiency Anemia. *Gastroenterology and Hepatology*. 11 (4), pp241-250.

Kafetzopoulos, P., Psomas, E.L., Kafetzopoulos, P.D. (2013). Measuring the effectiveness of the HACCP Food Safety Management System. *Journal of Food Control*. 33 (2), pp505-513.

Kajornrattana, T., Sangsupawanich, P. and Yuenyongviwat, A. (2018). Quality of life among caregivers and growth in children with parent-reported food allergy. *Asian Pacific Journal of Allergy and Immunology*. 36 (1), pp22-26.

Kamangar, F. and Emadi, A. (2012). Vitamin and Mineral Supplements: Do We Really Need Them? *International Journal of Preventive Medicine*. 3 (3), pp221-226.

Kamdar, T.A., Peterson, S., Lau, C.H., Saltoun, C.A., Gupta, R.S. and Bryce, P.J. (2015). Prevalence and Characteristics of Adult-Onset Food Allergy. *The Journal of Allergy and Clinical Immunology*. 3 (1), pp114-120.

Kamer, B., Wasowicz, W., Pyziak, K., Kamer-Bartosinska, A., Gromadzinska, J. and Pasowska, R. (2012). Role of selenium and zinc in the pathogenesis of food allergy in infants and young children. Archives of Medical Science. 8 (6), pp1083-1088.

Kardalas, E., Paschou, S.A., Anagnostis, P., Muscogiuri, G., Siasos, G. and Vryonidou, A. (2018). Hypokalemia: a clinical update. *Endocrine Connections*. 7 (4), pp135-146.

Kattan, J.D. and Sicherer, S.H. (2015). Optimizing the Diagnosis of Food allergy. *Immunology and Allergy Clinics of North America*. 35 (1), pp61-76.

Kelso, J.M. (2014). Potential Food Allergens in Medications. *Journal of Allergy and Clinical Immunology*. 133 (6), pp1509-1518.

Keshav, S. and Stevens, R. (2017). New concepts in iron deficiency anaemia. *British Journal of General Practice*. 67 (654), pp10-11.

Khuda, S.E., Sharma, G.M., Gaines, D., Do, A.B., Pereira, M., Chang, M., Ferguson, M. and Williams, K.M. (2016). Survey of undeclared egg allergen levels in the most frequently recalled food types (including products bearing precautionary labelling). *Food Additives and Contaminants: Part A*. 33 (8), pp1265-1273.

Kim, J., Kwon, J., Noh, G. and Lee, S.S. (2013). The effects of elimination diet on nutritional status in subjects with atopic dermatitis. *Nutrition Research and Practice*. 7 (6), pp488-494.

King, A.R. (2013). Gluten Content of the Top 200 Medications: Follow-Up to the Influence of Gluten on a Patient's Medication Choices. Hospital Pharmacy. 48 (9), pp736-743.

Klinieken, I. (2007). Allergy diagnosis: pros and cons of different tests, indications and limitations. *Breathe: European Respiratory Society*. 3 (4), pp345-349.

Kowalkowska, J., Slowinska, M.A., Slowinski, D., Dlugosz., A., Niedzwiedzka., E. and Wadolowska, L. (2013). Comparison of a Full Food-Frequency Questionnaire with the Three-Day Unweighted Food Records in Young Polish Adult Women: Implications for Dietary Assessment. *Nutrients - Open Access Journal*. 5 (7), pp2747-2776.

Kumari, R., Bharti, R.K., Singh, K., Sinha, A., Kumar, S., Saran, A. and Kumar, U. (2017). Prevalence of Iron Deficiency and Iron Deficiency Anaemia in Adolescent Girls in a Tertiary Care Hospital. *Journal of clinical and Diagnostic Research*. 11 (8), pp1-6.

Lachat, C., Nago, E., Verstraeten, R., Roberfroid, D., Van Camp, J. and Kolsteren, P. (2012). Eating out of home and its association with dietary intake: a systematic review of the evidence. *Obesity Reviews*. 13 (4), pp329-346.

Latinainen, T., Pietinen, P., Valsta, L., Sundvall, J., Reinivuo, H. Tuomilehto, J. (2006). Sodium in the Finnish diet: 20-year trends in urinary sodium excretion among the adult population. *European Journal of Clinical Nutrition*. 60 (8), pp965-970.

Lane, D.J.R., Jansson, P.J. and Richardson, D.R. (2016). Bonnie and Clyde: Vitamin C and iron are partners in crime in iron deficiency anaemia and its potential role in the elderly. *Open Access Impact Journal on Ageing*. 8 (5), pp1150-1152.

Lang, T. and Heasman, M. (2015). In: Lang, T. and Heasman, M. *Food Wars: The global battle for mouths, minds and markets*. 2nd ed. London: Routledge: Taylor and Francis Group.

Lange, L. (2014). Quality of life in the setting of anaphylaxis and food allergy. *Allergo Journal International*. 23 (7), pp252-260.

Lee, Y.M. and Xu, H.M. (2015). Food Allergy Knowledge, Attitudes, and Preparedness Among Restaurant Managerial Staff. *Journal of Foodservice Business Research*. 18 (5), pp454-469.

Lee, S. (2017). IgE-mediated food allergies in children: prevalence, triggers, and management. *Korean Journal of Pediatrics*. 60 (4), pp99-105.

Lee, Y.M. and Sozen, E. (2018). Who knows more about food allergies – restaurant managerial staff or employees? *British Food Journal*. 120 (4), pp876-890.

Lee, K.W., Lyu, J., Park, J., Jo, C. and Kim, S.S. (2019). Dietary carbohydrate quality and quantity in relation to the incidence of type 2 diabetes: A prospective cohort study of middle-aged and older Korean adults. *Nutrition - Open Access Journal*. 57, pp245-251.

Lentjes, M.A.H. (2019). The balance between food and dietary supplements in the general population. *Proceedings of the Nutrition Society*. 78 (1), pp97-109.

Lessa, K., Lozano, M., Esteve, M.J. and Frigola, A. (2016). Food Allergy Knowledge, Attitudes and Practices: A *European Journal of Nutrition and Food Safety*. 6 (2), pp58-64.

Levine, M.A. (2012). Assessing bone health in children and adolescents. *Indian Journal of Endocrinology and Metabolism*. 16 (2), pp205-212.

Li, B., Zhang, G., Tan, M., Zhao, L., Jin, L., Tang, X., Jiang, G. and Zhong, K. (2016). Consumption of whole grains in relation to mortality from all causes, cardiovascular disease, and diabetes. The Journal of Medicine - Baltimore. 95 (33), pp1-9.

Lim, H., Song, K., Kim, R., Sim, J., Park, E., Ahn, K., Kim, J. and Han, Y. (2013). Nutrient Intake and Food Restriction in Children with Atopic Dermatitis. *Clinical Nutrition Research*. 2 (1), pp52-58.

Lin, S. Y., & Sneed, J. (2005). University foodservice employees' food safety knowledge, attitudes, practices, and training. Retrieved from of service and size. *Journal of Culinary Science & Technology,* 4(2/3), 63e77. http://dx.doi.org/10.1300/J385v04n02_05.

Lin, Y., Mouratididou, T., Vereecken, C., Kersting, M., Bolca, S., Moraes, A., Cuenca-Garcia, M., Moreno, L.A., Gonzalez-Gross, M., Valtunea, J., Labayen, I., Grammatikaki, E., Hallström, L., Leckercq, C., Ferrari, M., Gottrand, F., Beghin, L., Manios, Y., Ottevaere, C., Van Oyen, H., Molnar, D., Kafatos, A., Widhalm, K., Gomez-Martinez, S., Prieto, L. and De Henauw, S., Huybrechts, I. (2015). Dietary animal and plant protein intakes and their associations with obesity and cardio-metabolic indicators in European adolescents: the HELENA cross-sectional study. *Nutrition Journal*. 14 (10), pp1-11.

Liu, A.G., Ford, N.A., Hu, F.B., Zelman, K.M., Mozaffarian, D. and Kris-Etherton, P.M. (2017). A healthy approach to dietary fats: understanding the science and taking action to reduce consumer confusion. *Nutrition Journal*. 16 (53), pp1-15.

Lobato, L., Bethony, J.M., Pereira, F.B., Grahek, S.L., Demerit, D. and Gazzinelli, M.F. (2014). Impact of gender on the decision to participate in a clinical trial: a cross-sectional study. *BMC Public Health*. 14 (1156), pp1-9.

Loerbroks, A., Tolksdorf, S.J., Wagenmann, M. and Smith, H. (2019). Food allergy knowledge, attitudes and their determinants among restaurant staff: A cross-sectional study. *PLOS One*. 14 (4), pp1-13.

Loh, W. and Tang, M.L.K. (2018). The Epidemiology of Food Allergy in the. *International Journal of Environmental Research and Public Health*. 15 (9), pp2043-2050.

Lordan, R., Tsoupras, A., Mitra, B. and Zabetakis, I. (2018). Dairy Fats and Cardiovascular Disease: Do We Really Need to Be Concerned? *Foods - An Open Access Journal from MDPI*. 7 (29), pp1-34.

Losby, J.L., Patel, D., Schuldt, J., Hunt, G.S., Stracuzzi, J.C. and Johnston, Y. (2014). Sodium-reduction strategies for meals prepared for older adults. *Journal of Public Health Management and Practice*. 20 (1), pp23-30.

Ludwig, D.S., Hu, F.B., Tappy, L. and Brand-Miller, J. (2018). Dietary carbohydrates: role of quality and quantity in chronic disease. *The British Medical Journal*. 361 (2340), pp1-6.

Maffeisa, C., Schutz, Y., Fornari, E., Marigliano, M., Thomaselli, F., Tommassi, M., Chini, V. and Morandi, A. (2017). Bias in food intake reporting in children and adolescents with type 1 diabetes: the role of body size, age and gender. *Pediatric Diabetes*. 18 (3), pp213-221.

Mahesh, P.A., Wong, G.W.K., Ogorodova, L., Potts, J., Leung, T.F., Fedorova, O., Holla, A.D., Fernandez-Rivas, M., Clare-Mills, E.N., Kummeling, I., Versteeg, S.A., van Ree, R., Yazdanbakhsh, M. and Burney, P. (2016). Prevalence of food sensitization and probable food allergy among adults in India: the EuroPrevall INCO study. *European Journal of Allergy and Clinical Immunology*. 71 (7), pp1010-1019.

Maloney, J.M., Rudengren, M., Ahlstedt, S. and Bock S.A, Sampson, H.A. (2008). The use of serum-specific IgE measurements for the diagnosis of peanut, tree nut, and seed allergy. *J Allergy Clin Immunol.* 122(1), pp145–51.

Manea, I., Ailenei. E. and Deleanu, D. (2016). Overview of food allergy diagnosis. *Clujul Medical*. 89 (1), pp5-10.
Manila, V., Padulo, C., van der Laan, L.N. and Brancucci, A. (2017). Gender Differences in Food Choice: Effects of Superior Temporal Sulcus Stimulation. *Frontiers in Human Neuroscience*. 11 (596), pp1-9.

Marcinowska-Suchowierska, E., Kupisz-Urbańska, M., Łukaszkiewicz, J., Pludowski, P and Jones, G. (2018). Vitamin D Toxicity–A Clinical Perspective. *Frontiers in Endocrinology*. 9 (550), pp1-7.

Marra, C.A., Harvard, S., Grubisic, M., Galo, J., Clarke, A., Elliott, S. and Lynd, L.D. (2017). Counsumer Preferences for Food Allergen Labelling. *Journal of Allergy, Asthma and Clinical Immunology*. 13 (19), pp1-11.

Marsh, S. (2019). *Just Eat under fire over allergens found in takeaway meals.* Available: https://www.theguardian.com/business/2019/jan/14/just-eat-under-fire-over-allergens-found-in-takeaway-meals. Last accessed 18th may 2019.

Maslin, K., Oliver, E.M., Scally, K.S., Atkinson, J., Foote, K., Venter, C., Roberts, G. and Grimshaw, K.E.C. (2016). Nutritional adequacy of a cows' milk exclusion diet in infancy. *Clinical and Translational Allergy*. 6 (20), pp1-8.

Mazidi, M., Pennathur, S. and Afshinia, F. (2017). Link of dietary patterns with metabolic syndrome: analysis of the National Health and Nutrition Examination Survey. *Nutrition and Diabetes*. 7 (3), pp255-263.

McAdams, B., Deng, A. and MacLaurin, T. (2018). Food allergy knowledge, attitudes, and resources of restaurant employees. *British Food Journal*. 120 (11), pp2681-2694.

Mehta, H., Groetch, M. and Wang, J. (2013). Growth and Nutritional Concerns in Children with Food Allergy. *Current Opinion in Allergy and Clinical Immunology*. 13 (3), pp275-279.

Meyer-Ficca, M. and Kirkland, J.B. (2016). Niacin. *Advances in Nutrition: An international Review Journal*. 7 (3), pp556-558.

Middleton, L. (2019). *Parents' desperate plea to Just Eat over allergy death of daughter, 15.* Available:https://metro.co.uk/2019/04/29/parents-desperate-plea-just-eat-allergy-death-daughter-15-9333638/.Last accessed 18th May 2019.

Miller, J.L. (2013). Iron Deficiency Anemia: A Common and Curable Disease. *Cold Spring Harbor: Perspectives in Medicine*. 3 (7), pp1-13.

Miranda, J., Lasa, A., Bustamante, M.A., Churruca, I. and Simon, E. (2014). Nutritional differences between a gluten-free diet and a diet containing equivalent products with gluten. The Journal of Plant Foods for Human Nutrition. 69 (2), pp182-187.

Missbach, B., Schwingshackl, L., Billmann, A., Mystek, A., Hickelsberger, M., Bauer, G. and Konig, J. (2015). Gluten-free food database: the nutritional quality and cost of packaged gluten-free foods. *Peer Journal: Peer Review and Open Access*. 3. pp1-18.

Monks, H., Gowland, M.H., MacKenzie, H., Erlewyn-Lajeunesse, M., King, R., Lucas, J.S. and Roberts, G. (2010). How do teenagers manage their food allergies? *Clinical and Experimental Allergy*. 40, pp1533-1540.

Moreno, M.L., Comino, I and Sousa, C. (2014). Alternative Grains as Potential Raw Material for Gluten-. Austin Journal of Nutrition and Food Sciences. 2 (3), pp1-9.

Moraga, L.T. and Montez, J.M. (2017). Health effects of saturated and trans-fatty acid intake in children and adolescents: Systematic review and meta-analysis. *PLOS One*. 12 (11), pp1-20.

Morgan, E. (2018). *Exclusive: Huge spike in severe allergic reactions to food and drinks bought in UK restaurants and takeaways.* Available: https://www.itv.com/news/2018-11-20/exclusive-huge-spike-in-severe-allergic-reactions-to-food-and-drinks-bought-in-uk-restaurants-and-takeaways/. Last accessed 9th May 2019

Moyer, M.W. (2014). Nutrition: vitamins on trial. *Nature*. 510 (7506), pp462-464.

Mugavero, K.L., Gunn, J.P., Dunet, D.O. and Bowman, B.A. (2014). Sodium Reduction: An Important Public Health Strategy for Heart Health. *Journal of Public Health Management and Practice*. 20 (101), pp1-5.

Mulligan, A.A., Luben, R.N., Parry-Smith, D.J., O'Connor, L., Khawaja, A.P., Forouhi, N.G., Khaw, K.T. (2014). A new tool for converting food frequency questionnaire data into nutrient and food group values: FETA research methods and availability. *Journal of Epidemiology and Community Health*. 4, pp1-11.

Mulugeta, A., Tessema, M., Hsellasie, K., Seid, O., Kidane, G. and Kebede, A. (2015). Examining Means of Reaching Adolescent Girls for Iron Supplementation in Tigray, Northern Ethiopia. *Nutrients - Open Access Journal*. 7 (11), pp9033-9045.

Naska, A., Lagiou, A. and Lagiou, P. (2017). Dietary assessment methods in epidemiological research: current state of the art and future prospects. *F1000 Research*. 6 (926), pp1-8.

National Health and Medical Research Council. (2013). *Australian Dietary Guidelines.* Available: https://www.nhmrc.gov.au/about-us/publications/australian-dietary-guidelines. Last accessed 4th Sep 2019.

National Institute for Health and Care Excellence. (2013). *Salt reduction strategy could prevent thousands of deaths from CVD, says NICE.* Available: https://www.nice.org.uk/news/article/salt-reduction-strategy-could-prevent-thousands-of-deaths-from-cvd-says-nice. Last accessed 15th July 2019.

Nettleton, J.A., Brouwer, I.A., Mensink, R.P., Diekman, C. and Hornstra, G. (2018). Fats in Foods: Current Evidence for Dietary Advice. *Annals of Nutrition and Metabolism.* 72 (3), pp248-254.

Nguyen, S.A., More, D.R., Whisman, B.A. and Hagan, L.L. (2004). Cross-reactivity between coconut and hazelnut proteins in a patient with coconut anaphylaxis. *Annals of Allergy Asthma and Immunology*. 92 (2), pp281-284.

NHS. (2018). *5 A Day: what counts?* Available: https://www.nhs.uk/live-well/eat-well/5-a-day-what-counts/. Last accessed 07 Jul 2019.

NHS. (2018). *Salt: the facts.* Available: https://www.nhs.uk/live-well/eat-well/salt-nutrition/. Last accessed 14TH July 2019.

Noimark, L. and Cox, H.E. (2008). Nutritional problems related to food allergy in childhood. Journal of Pediatric Allergy and Immunology. 19, pp188-195.

Noimark, L., Gardner, J. and Warner, J.O. (2009). Parents' attitudes when purchasing products for children with nut allergy: a UK perspective. *The Journal of Pediatric Allergy and Immunology*. 20 (5), pp500-504.

North, A. and Brown, R. (2017). *Revealed: How free-from sales surged by a whopping £230m.* Available: https://www.thegrocer.co.uk/reports/digital-features/free-from-report-2017/revealed-how-free-from-sales-surged-by-a-whopping-230m/556516.article. Last accessed 8th Dec 2018.

Nowak-Wegrzyn, A., Katz, Y., Mehr, S.S. and Koletzko, S. (2015). Non–IgE-mediated gastrointestinal food allergy. *The Journal of Allergy and Clinical Immunology*. 135 (5), pp1114-1124.

O' Keefe, A.W., De Schryver. S., Mill, J., Mill, C., Dery, A. and Ben-Shoshan, M. (2014). Diagnosis and Management of Food Allergies: new and emerging options: a systematic review. *Journal of Asthma and Allergy*. 7, pp141-164.

Otten, J.J., Hellwig, J.P. and Meyers, L.D. (2006). Part 3: Vitamins and Minerals, In: Otten, J.J., Hellwig, J.P. and Meyers, L.D. *Dietary Reference Intakes: The Essential Guide to Nutrient Requirements*. USA: National Academies Press. pp167-422.

Ortiz, J.C., Cabrera, M., Mateos-Alonso, A., Garcia-Gálvez, M., Ortiz-Ramos, M., Grazón, B. Seguridad alimentaria en los comedores escolares del distrito de Hortaleza de Madrid. Control de dietas especiales. Presented at the 12ª Reunión de la Sociedad Española de Seguridad Alimentaria, Compartir nuevas propuestas para viejos retos, Antequera, Andalucía (2016)

Ortiz, J.C., Galan-Malo, P., Garcia-Galvez, M., Mateos, A., Ortiz-Ramos, M., Razquin, P. and Mata, L. (2018). Survey on the occurrence of allergens on food-contact surfaces from school canteen kitchens. *Journal of Food Control*. 84, pp449-454.

Osborne, M.J., Koplin, J.J., Martin, P.E., Gurrin, L.C., Lowe, A.J., Matheson, M.C., Ponsonby, A.L., Wake, M., Tang, M.L.K., Dharmage, S.C. and Allen, K.J. (2011). Prevalence of challenge-proven IgE-mediated food allergy using population-based sampling and predetermined challenge criteria in infants. *The Journal of Allergy and Clinical Immunology*. 127 (3), pp668-676.

Osimani, A., Aquilanti, L., Tavoletti, S. and Clementi, F. (2013). Evaluation of the HACCP System in a University Canteen: Microbiological Monitoring and Internal Auditing as Verification Tools. *International Journal of Environmental Research and Public Health*. 10 (4), pp1572-1585.

Padalino, L., Conte, A. and Del Nobile, M.A. (2016). Overview on the General Approaches to Improve. Food Science Journal. 5 (87), pp1-18.

Padua, I., Moreira, A., Moreira, P. and Barros, R. (2018). Food Allergy Training for Schools and Restaurants (The Food Allergy Community Program): Protocol to Evaluate the Effectiveness of a Web-Based Program. *Journal of Multidisciplinary Research Protocols*. 7 (6), pp1-9.

Pelletier, J.E. and Laska, M.N. (2013). Campus food and beverage purchases are associated with indicators of diet quality in college students. *American Journal of Health Promotion*. 28 (2), pp80-87.

Pem, D. and Jeewon, R. (2015). Fruit and Vegetable Intake: Benefits and Progress of Nutrition Education Interventions- Narrative Review Article. *Iranian Journal of Public Health*. 44 (10), pp1309-1321.

Pereira, B., Venter, C., Grundy, J., Clayton, B., Arshad, H. and Dean, T. (2005). Prevalence of sensitization to food allergens, reported adverse reaction to foods, food avoidance, and food hypersensitivity among teenagers. *Journal of Allergy and Clinical Immunology*. 116 (4), pp884-892.

Parzanese, I., Qehajaj, D., Patrinicola, F., Aralica, M., Chiriva-Internati, M., Stifter, S., Elli, L. and Grizzi, F. (2017). Celiac Disease: From Pathophysiology to Treatment. *World Journal of Gastrointestinal Pathophysiology*. 8 (2), pp27-38.

Perry, T.T., Matsui, E.C., Conover-Walker, M.K. and Wood, R.A. (2004). Risk of oral food challenges. *The Journal of Allergy and Clinical Immunology*. 114 (5), pp1164-1168.

Pettersson, M.E., Koppelman, G.H, Flokstra-de Blok, B.M.J., Kollen, B.J. and Dubois, A.E.J. (2019). Prediction of the severity of allergic reactions to foods. *European Academy of Allergy and Clinical Immunology*. 73 (7), pp1532-1540.

Pilz, S., März, W., Cashman, K.D., Kiely, M.E., Whiting, S.J., Holick, M.F., Grant, W.B., Pludowski, P., Hiligsmann, M., Trummer, C., Schwetz, V., Lerchbaum, E., Pandis, M., Tomaschitz, A., Grubler, M. R., Gaksch, M., Verheyen, N., Hollis, B.W., Rejnmark, L., Karras, S.N., Hahn, A., Bischoff-Ferrari, H.A., Reichrath, J., Jorde, R., Elmadfa, I., Vieth, R., Scragg, R., Calvo, M.S., van Schoor, N.M., Bouillon, R., Lips, P., Itkonen, S.T., Martineau, A.R., Lamberg-Allardt, C. and Zittermann, A. (2018). Rationale and Plan for Vitamin D Food Fortification: A Review and Guidance Paper. *Frontiers in Endocrinology*. 9 (373), pp1-16.

Pinkhasov, R.M., Wong, J., Kashanian, J., Lee, M., Samadi, D.B., Pinkhasov, M.M. and Shabsigh, R. (2010). Are men short-changed on health? Perspective on health care utilization and health risk behaviour in men and women in the United States. The International Journal of Clinical Practice. 64 (4), pp475-487.

Porter, S.R. and Whitcomb, M.E. (2005). Non-response in student surveys: The Role of Demographics, Engagement and Personality. *Research in Higher Education*. 46 (2), pp127-152.

Prentice, A.M., Mendoza, Y.A., Pereira, D., Cerami, C., Wegmuller, R., Constable, A. and Spieldenner, J. (2017). Dietary strategies for improving iron status: balancing safety and efficacy. *Nutrition Reviews*. 75 (1), pp49-60.

Prescott, S.L., Pawankar, R., Allen, K.J., Campbell, D.E., Sinn, J.K.H., Fiocchi, A., Ebisawa, M., Sampson, H.A., Beyer, K. and Lee, B. (2013). A global survey of changing patterns of food allergy burden in children. *World Allergy Organisation Journal*. 6 (1), pp21-32.

Public Health England. (2016). *Government Dietary Recommendations.* Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/618167/government_dietary_recommendations.pdf. Last accessed 26th Jun 2019.

Public Health England. (2018). *The Eatwell Guide: how to use in promotional material.* Available: https://www.gov.uk/government/publications/the-eatwell-guide/the-eatwell-guide-how-to-use-in-promotional-material. Last accessed 25th Jul 2019.

Rachid, R. and Keet, C.A. (2018). Food Allergy: Whats on the menu in 2018? *The Journal of Allergy and Clinical Immunology*. 6 (2), pp419-420.

Radke, T.J., Brown, L.G., Rickamer-Hoover, E., Faw, B.V., Reimann, D., Wong, M.R., Nicholas, D., Barkley, J. and Ripley, D. (2016). Food Allergy Knowledge and Attitudes of Restaurant Managers and Staff: An EHS-Net Study. *Journal of Food Protection*. 79 (9), pp1588-1598.

Radke, T.J., Brown, L.J., Faw, B., Hedeen, N., Matis, B., Perez, P., Viveiros, B., Ripley, D. (2017). Restaurant Food Allergy Practices — Six Selected Sites, United States, 2014. *Morbidity and Mortality Weekly Report*. 66 (15), pp404-407.

Rajasekaran, A. and Kalaivani, M. (2013). Designer foods and their benefits: A review. *Journal of Food Science and Technology.* 50 (1), pp1-16.

Reinivuo, H., Valsta, L.M., Laatikainen, T., Tuomilehto, J. and Pietinen, P. (2006). Sodium in the Finnish diet: II trends in dietary sodium intake and comparison between intake and 24-h excretion of sodium. *European Journal of Clinical Nutrition*. 60 (10), pp1160-1167.

Ribeiro-Silva, R., Nunes, I.L. and Assis, A.M.O. (2014). Prevalence and factors associated with vitamin A deficiency in children and adolescents. *Journal de Pediatria*. 90 (5), pp486-492.

Roberts, S. (2005). Challenging times for food allergy tests. *Archives Disease Child*. 90, pp564-566.

Roberts, G., Ollert, M., Aalberse, R., Austin, M., Custovic, A., DunnGalvin, A., Eigenmann, P.A., Fassio, F., Grattan, C., Hellings, P., Hourihane, J., Knol, E., Muraro, A, Papadopoulos, N., Santos, A. F., Schnadt, S. and Tzeli, K. (2016). A new framework for the interpretation of IgE sensitization tests. *European Journal of Allergy and Clinical Immunology*. 71 (11), pp1540-1551.

Robertson, ON., Hourihane, J.O., Remington, B.C., Baumert, J.L. and Taylor, S.L. (2013). Survey of peanut levels in selected Irish food products bearing peanut allergen advisory labels. *Food Additives and Contaminants. Part A: Chemistry, Analysis, Control, Exposure and Risk Assessment*. 30 (9), pp1467-1472.

Rodriguez, M. (2018). *Why Does Food Allergy Cause Fever?* Available: https://genolevures.org/why-does-food-allergy-cause-fever/. Last accessed 15th Sep 2019.

Ronis, M.J.J., Pederson, K.B. and Watt, J. (2018). Adverse Effects of Nutraceuticals and Dietary Supplements. *Annual Review of Pharmacology and Toxicology*. 58, pp583-601.

Rooney, M.R., Harnack, L., Michos, E.D., Ogilvie, R.P., Sempos, C.T. and Lutsey, P.L. (2017). rends in Use of High Dose Vitamin D Supplements Exceeding 1,000 or 4,000 International Units Daily, 1999-2014. *The Journal of the American Medical Association*. 317 (23), pp2448-2450.

Royal Society for Public Health. (2015). *Allergy Information and Fast Food Takeaways: Reducing the risk to allergic consumers from takeaways breaking the law.* Available: https://www.rsph.org.uk/uploads/assets/uploaded/f1249152-3bd0-4bf4-b8ca860c281f725a.pdf. Last accessed 4th May 2019.

RPC. (2017). *UK product recalls reach new high - up 48% in a year.* Available: https://www.rpc.co.uk/press-and-media/uk-product-recalls-reach-new-high-up-48-percent-in-a-year/. Last accessed 14th Nov 2018.

Sadler, K., Nicholson, S., Steer, T., Gill, V., Bates, B., Tipping, S., Cox, L., Lennox, A. and Prentice, A. (2012). *National Diet and Nutrition Survey - Assessment of dietary sodium in adults (aged 19 to 64 years) in England, 2011.*Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/213420/Sodium-Survey-England-2011_Text_to-DH_FINAL1.pdf. Last accessed 12th Jul 2019.

Samal, J.R.K. and Samal, I.R. (2018). Protein Supplements: Pros and Cons. *Journal of Dietary Supplements*. 15 (3), pp365-371.

Sampath, V., Sindher, S.B., Zhang, W. and Nadeau, K.C. (2018). New treatment directions in food allergy. *Annals of Allergy, Asthma and Immunology*. 120 (3), pp254-262.

Sampson, M.A., Munoz-Furlong, A. and Sicherer, S.H. (2006). Risk-taking and coping strategies of adolescents and young adults with food allergy. *The Journal of Allergy and Clinical Immunology*. 11 (6), pp1440-1445.

Saturni, L., Ferretti, G. and Bacchetti, T. (2010). The Gluten-Free Diet: Safety and Nutritional Quality. Human Nutrition Journal. 2 (1), pp16-34. 5.

Sawyer, S.M., Azzopardi, P.S., Wickremarathne, D. and Patton, G.C. (2018). The Age of Adolescence. *The Lancet - Child and Adolescent Health*. 2 (3), pp223-228.

Schwalfenberg, G.K. and Genius, S.J. (2017). The Importance of Magnesium in Clinical Healthcare. *Scientifica*, pp1-14.

Shi, Y., Wang, Q., Norman, C., Allman-Farinelli, M. and Colaaiuri, S. (2018). It Is Time to Make Policy for Healthier Food Environments in Australian Universities. *Nutrients - Open Access Journal*. 10 (12), pp1909-1921.

Shaker, J.L. and Deftos, L. (2018). Diseases of Bone and Mineral Metabolism: Calcium and Phosphate Homeostatis. In: Feingold, K.R., Anawalt, B., Boyce, A., Chrousos, G., Duncan, K., Grossman, A., Hershman, J.M., Kaltass, G., Koch, C., Kopp, P., Karbonits, M., McLachlan, R., Morley, J.E., New, M., Perreault, L., Purnell, J., Rebar, R., Singer, F., Trence, D.L., Vinik, A. and Wilson, D.P. *Endotext: Clinical Endocrinology*. UK.

Shah, S. and Leffler, D. (2010). Celiac disease: an underappreciated issue in women's health. Women's Health (London, England). 6 (5), pp753-766.

Share, M. and Stewart-Knox, B. (2012). Determinants of food choice in Irish adolescents. *Food Quality and Preference*. 25, pp57-62.

Shemesh, E., Annunziato, R.A., Ambrose, M.A., Ravid, N.L., Mullarkey, C., Rubes, M., Chuang, K., Sicherer, M. and Sicherer, S.H. (2013). Child and parental reports of bullying in a consecutive sample of children with food allergy. *Journal of the American Academy of Pediatrics*. 131 (1), pp10-17.

Sheth, S.S., Waserman, S., Kagan, R., Alizadehfar, R., Primeau, M.N., Elliot, S., Pierre, Y.S., Wickett, R., Joseph, L., Harada, L., Dufresne, C., Allen, M., Allen, M., Godefroy, S.B. and Clarke, A.E. (2010). Role of food labels in accidental exposures in food-allergic individuals in Canada. *Annals of Allergy, Asthma and Immunology*. 104 (1), pp60-65.

Sicherer, S.H. (2014). Chapter 25: Hidden and Cross-Reacting Food Allergens. In: Metcalfe, D.D., Sampson H.A., Simon, R.A. and Lack G. *Food Allerg7y: Adverse Reactions to Foods and Food Additives*. 5th ed. U.S.A: John Wiley and Sons, Incorporated. PP316-320.

Sicherer, S.H. and Sampson, H.A. (2018). Food Allergy: A review and update epidemiology, pathogenesis, diagnosis, prevention and management. *The Journal of Allergy and Clinical Immunology*. 141 (1), pp41-58.

Sirico, F., Miressi, F., Castaldo, C., Spera, R., Montagnana, S., Meglio, F.D. and Nurzynska, D. (2018). Habits and beliefs related to food supplements: Results of a survey among Italian students of different education fields and levels. *PLOS One*. 13 (1), pp1-11.

Simpson, H. L. and Campbell, B. J. (2015). Review article: dietary fiber-microbiota interactions. *Alimentary Pharmacology & Therapeutics*, 42, pp158-179.

Skypala, I. and McKenzie, R. (2018). Nutritional Issues in Food Allergy. *Clinical Reviews in Allergy and Immunology*. 55 (158), pp1-13.

Sladkevicius, E., Nagy, E., Lack, G. and Guest, J.F. (2010). Resource implications and budget impact of managing cow milk allergy in the UK. *Journal of Medical Economics*. 13 (1), pp119-128.

Slavin, J. and Carlson, J. (2014). Carbohydrates. *Advances in Nutrition*. 5 (6), pp760-761.

Smith, W.G. (2008). Does Gender Influence Online Survey Participation? A Record-linkage Analysis of University Faculty Online Survey Response Behavior. *BePress*. pp1-22.

Sogari, G., Velez-Argumedo, C., Gomez, M.I. and Mora, C. (2018). College Students and Eating Habits: A Study Using an Ecological Model for Healthy Behavior. *Nutrients - Open Access Journal*. 10, pp1-16.

Solomon, A.T., De Sanctis, V., Elalaily, R., Bedair, S. and Kassem, I. (2014). Vitamin D deficiency in adolescents. *Indian Journal of Endocrinology and Metabolism*. 18 (1), pp9-16.

Soon, J.M. and Manning, L. (2017). 'May Contain' Allergen Statements: Facilitating or Frustrating Consumers. *Journal of Consumer Policy*. 40 (4), pp447-472.

Soon, J.M. (2018). 'No nuts please': Food allergen management in takeaways. *Journal of Food Control*. 91, pp349-356.

Soller, L., Ben-Shoshan, M., Harrington, D.W., Fragapane, J., Joseph, L., St. Pierre, Y., Godefroy, S.B., La Vieille, S., Elliott, S.J. and Clarke, A.E. (2012). Overall prevalence of self-reported food allergy in Canada. *The Journal of Allergy and Clinical Immunology*. 130 (4), pp986-988.

Spence, L.A., Cifelli, C.J. and Miller, G.D. (2011). The Role of Dairy Products in Healthy Weight and Body Composition in Children and Adolescents. *Current Nutrition and Food Science*. 7 (1), pp40-49.

Stanhope, K.L. (2016). Sugar consumption, metabolic disease and obesity: The state of the controversy. *Critical Reviews in Clinical Laboratory Sciences*. 53 (1), pp52-67.

Steinman, H. (2010). Nutritional Implications of Food Allergies. *South African Journal of Clinical Nutrition*. 23 (1), pp37-41.

Stensgaard, A., Bindslev-Jensen, C., Nielsen, D., Munch, M. and DunnGalvin, A. (2016). Quality of life in childhood, adolescence and adult food allergy: Patient and parent perspectives. *Clinical and Experimental Allergy*. 47, pp530-539.

Stok, F.M., Renner, B., Clarys, P., Lien, N., Lakerveld, J. and Deliens, T. (2018). Understanding Eating Behavior during the Transition from Adolescence to Young Adulthood: A Literature Review and Perspective on Future Research Directions. *Nutrients - Open Access Journal*. 10 (6), pp1-16.

Stutius, L.M., Sheehan, W.J., Rangsithienchai, P., Bharmanee, A., Scott, J.E., Young, M.C., Dioun, A.F., Schneider, L.C. and Phipatanakul, W. (2010). Characterizing the relationship between sesame, coconut, and nut allergy in children. *Journal of Pediatric Allergy and Immunology*. 21 (8), pp1114-1118.

Suri, S., Kumar, V., Prasad, R., Tanwar, B., Goyal, A., Kaur, S., Gat, Y., Kumar, A., Kaur, J. and Singh, D. (2019). Considerations for development of lactose-free food. *Journal of Nutrition and Intermediary Metabolism*. 15, pp27-34.

Tang, M.L.K. and Mullins, R.J. (2017). Food allergy: is prevalence increasing? *International Medicine Journal*. 47 (3), pp256-261.

Tanton, J., Dodd, L.J., Woodfield, L. and Mabhala, M. (2018). Eating Behaviours of British University Students: A Cluster Analysis on a Neglected Issue. *Advances in Preventive Medicine*, pp1-8.

Taylor, S., Tibet, T., Patel, D. and Bishop, E. (2014). Use of environmental change strategies to facilitate sodium reduction: a case study in a rural California school district. *Journal of Public Health Management and Practice*. 20 (1), pp38-42.

Telegraph Reporters. (2019). *Tougher food labelling proposed to prevent allergy deaths.* Available: https://www.telegraph.co.uk/news/2019/01/25/tougher-food-labelling-proposed-prevent-allergy-deaths/. Last accessed 4th May 2019.

Teuber, S.S. and Peterson W.R. (1999). Systemic allergic reaction to coconut (Cocos nucifera) in 2 subjects with hypersensitivity to tree nut and demonstration of cross-reactivity to legumin-like seed storage proteins: new coconut and walnut food allergens. *Journal of Allergy and Clinical Immunology*. 103 (6), pp1180-1185.

Thout, S.R., Santos, J.A., McKenzie, B., Trieu, K., Johnson, C., McLearn, R., Arcand, J., Campbell, N.R.C. and Webster, J. (2019). The Science of Salt: Updating the evidence on global estimates of salt intake. *The Journal of Clinical Hypertension*. 21 (6), pp710-721.

Threapleton, D.E., Greenwood, D.C., Evans, C.E., Leghorn, C.L., Nykjaer, C., Woodhead, C., Cade, J.E., Gale, C.P. and Burley, V.J. . (2013). Dietary fibre intake and risk of cardiovascular disease: systematic review and meta-analysis. *The British Medical Journal*. 347, pp1-12.

Tseng, M., DeGreef, K., Fishler, M., Gipson, R., Koyano, K. and Neill, D.B. (2016). Assessment of a University Campus Food Environment, California, 2015. *Preventing Chronic Disease*. 13 (18), pp1-10.

Turnbull, J.L., Adams, H.M. and Gorard, D.A. (2015). Review article: the diagnosis and management of food allergy and food intolerances. *Alimentary Pharmacology and Therapeutics.* 41 (1), pp3-25.

Vadeboncoeur, C., Townsend, N. and Foster, C. (2015). A meta-analysis of weight gain in first year university students: is freshman 15 a myth? *BMC Obesity*. 2 (22), pp1-9.

Valenta, R., Hochwallner, H., Linhart, B. and Pahr, S. (2015). Food Allergies: The Basics. *The Journal of Gastroenterology*. 148 (6), pp1120-1131.

Vanderhout, S.M., Birken C.S., Parkin, P.C., Lebovic, G., Chen, Y., O'Connor, D.L. and Maguire, J.L. (2016). Relation between milk-fat percentage, vitamin D, and BMI z score in early childhood. *The American Journal of Clinical Nutrition.* 104 (6), pp1657-1664.

van't Riet, J., Sietsema, S.J., Dagevos, H. and De Bruijn, G.J. (2011). The importance of habits in eating behavior. An overview and recommendations for future research. *Journal of Appetite*. 57 (3), pp585-596.

van Zon, S.K.R., Reijneveld, S.A., Mendes de Leon, C.F. and Bultmann, U. (2017). The impact of low education and poor health on unemployment varies by work life stage. *International Journal of Public Health*. 62 (9), pp997-1006.

Vargas, P., Sicherer, S.H., Christie, L., Keaveny, M., Noone, S., Watkins, D., Carlisle, S.K. and Jones, S.M. (2011). Developing a food allergy curriculum for parents. *Pediatric Allergy and Immunology*. 22 (6), pp575-582.

Vasara, E., Marakis, G., Breda, J., Skepastinos, P., Hassapidou, M., Kafatos, A., Rodopaios, N., Koulouri, A.A. and Cappuccio, F.P. (2017). Sodium and Potassium Intake in Healthy Adults in Thessaloniki Greater Metropolitan Area—The Salt Intake in Northern Greece (SING) Study. *Nutrients - Open Access Journal*. 9 (4), pp417-428.

Venter, C., Pereira, B., Grundy, J., Clayton, C.B., Roberts, G., Higgins, B. and Dean, T. (2006). Incidence of parentally reported and clinically diagnosed food hypersensitivity in the first year of life. *Journal of Allergy and Clinical Immunology*. 117 (5), 1118-1124.

Venter, C. (2009). Cow's milk protein allergy and other food hypersensitivities in infants. *Journal of Family Health Care*. 19 (4), pp128-134.

Verkaik-Kloosterman, J., McCann, M.T., Hoekstra, J. and Verhagen, H. (2012). Vitamins and minerals: issues associated with too low and too high population intakes. *Food and nutrition Research*. 56 (5728), pp1-8.

Verstraeten, R., Van Royen, K., Ochoa-Aviles, A., Penafiel, D., Holdsworth, M., Donoso, S., Maes, L. and Kolesteren, P. (2014). A conceptual framework for healthy eating behavior in ecuadorian adolescents: a qualitative study.. *PLOS One*. 9 (1), pp1-7.

Wade, A.T., Davis, C.R., Dyer, K.A., Hodgson, J.M., Woodman, R.J., Keage, H.A. and Murphy, K.J. (2017). A Mediterranean Diet to Improve Cardiovascular and Cognitive Health: Protocol for a Randomised Controlled Intervention Study. *Nutrients - Open Access Journal*. 9 (2), pp145-174.

Walker, S.O., Mao, G., Caruso, D., Hong, X., Pongracic, J.A. and Wang, X. (2016). Cardiovascular Risk Factors in Parents of Food-Allergic Children. *The Journal of Medicine (Baltimore)*. 95 (15), pp3156-3166.

Walker, J.L., Ardouin, S. and Burrows, T. (2018). The validity of dietary assessment methods to accurately measure energy intake in children and adolescents who are overweight or obese: a systematic review. *European Journal of Clinical Nutrition*. 72, pp185-197.

Walkner, M., Warren, C. and Gupta, R.S. (2016). Quality of Life in Food Allergy Patients and Their Families. *Pediatric Clinics of North America*. 62 (6), pp1453-1461.

Wallace, C.A. (2014). HACCP-based food safety management systems: great in theory but can we really make them work in practice? *Perspectives in Public Health*. 134 (4), pp188-190.

Wanich, N., Weiss, C., Furlong, T.J. and Sicherer, S.H. (2008). Food Allergic Consumer (FAC) Experience in Restaurants and Food Establishments. *The Journal of Allergy and Clinical Immunology*. 121 (2), p182.

Ward, E. (2014). Addressing nutritional gaps with multivitamin and mineral supplements. *Nutrition Journal*. 13 (72), pp1-10.

Ward, V. (2019). *Takeaways failing to provide correct information about allergens are 'playing fast and loose' with lives.* Available: https://www.telegraph.co.uk/news/2019/01/14/takeaways-failing-provide-correct-information-allergens-playing/. Last accessed 4th May 2019.

Wardle, J., Haase, A.M., Steptoe, A., Nilapun, M., Jonwutiwes, K. and Bellisie, F. (2004). Gender differences in food choice: The contribution of health beliefs and dieting. *Annals of Behavioural Medicine.* 27 (2), pp107-116.

Warren, C.M., Dyer, A.A., Otto, A.K., Smith, B.M., Kauke, K., Dinakar, C. and Gupta, R.S. (2017). Food Allergy - Related Risk Taking and Management Behaviours Among Adolescents and Young Adults. *The Journal of Allergy and Clinical Immunology in Practice*. 5 (2), pp381-390.

Warren, C.M., Otto, A.K., Walkner, M.M. and Gupta, R.S. (2016). Quality of Life Among Food Allergic Patients and Their Caregivers. *Current Allergy and Asthma Reports*. 16 (38), pp1-8.

Waserman, S., Begin, P. and Watson, W. (2018). IgE-mediated food allergy. *Allergy, Asthma and Clinical Immunology*. 14 (55), pp71-81.

Watson, W.T.A., Woodrow, A.M. and Stadnyk, A.W. (2015). Removal of peanut allergen Ara h 1 from common hospital surfaces, toys and books using standard cleaning methods. *Allergy, Asthma and Clinical Immunology*. 11 (4), pp1-4.

Weinberger, T and Sicherer, S. (2018). Current perspectives on tree nut allergy: a review. *Journal of Asthma and Allergy*. 11, pp41-51.

Weiss, C. and Munoz-Furlong, A. (2008). Fatal food allergy reactions in restaurants and food-service establishments: strategies for prevention. *Journal of Food Protection*. 28, pp657-661.

Weiss, J. W., Weiss, D. J., and Edwards, W. (2010). A descriptive Multi-Attribute Utility model for everyday decisions. *Theory and Decision*. doi: 10.1007/s11238-009-9155-1.

Wen, H. and Kwon, J. (2016). Food Allergy Risk Communication in Restaurants. *Food Protection Trends*. 36 (5), pp372-383.

Whitehouse, G. and Lawlis, T. (2018). Protein supplements and adolescent athletes: A pilot study investigating the risk knowledge, motivations and prevalence of use. *Journal of the Dietitians Association of Australia: Nutrition and Dietetics*. 74 (5), pp509-515.

Whitney, E.N. and Rolfes, S.R. (2015). *Understanding Nutrition*. 15th ed. USA: Wadsworth Publishing.

Woods, R.K., Thien, F., Raven, J., Walters, H. and Abramson, M. (2002). Prevalence of food allergies in young adults and their relationship to asthma, nasal allergies, and eczema. *Annals of Allergy, Asthma and Immunology*. 88 (2), pp183-189.

Wood, J. (2018). *Bath takeaway boss fined after death of 15-year-old schoolgirl Chloe Gilbert who suffered allergic reaction.* Available: https://www.somersetlive.co.uk/news/somerset-news/bath-takeaway-boss-fined-after-1717178.Last accessed 6th May 2019.

World Allergy Organisation. (2017). *Food Allergy.* Available: http://www.worldallergy.org/education-and-programs/education/allergic-disease-resource-center/professionals/food-allergy. Last accessed 23rd October 2018.

Worsfold, D., Griffith, C. and Worsfold, P. (2004). A survey of environmental health officers' views of food hygiene training. *British Food Journal*. 106 (1), pp51-64.
Xie, D., Liao, Y., Yue, J., Zhang, C., Wang, Y., Deng, C. and Chen, L. (2018). Effects of five types of selenium supplementation for treatment of Kashin-Beck disease in children: a systematic review and network meta-analysis. *The British Medical Journal*. 8, pp1-10.

Xu, S., and Xue, Y. (2016). Protein intake and obesity in young adolescents. *Experimental and Therapeutic Medicine*. 11, pp1545-1549.

Yang, L., Clements S. and Joks, R. (2015). A retrospective study of peanut and tree nut allergy: Sensitization and correlations with clinical manifestations. *Allergy and Rhinology*. 6 (1), pp39-43.

Yao, B., Fang, H. and Xu, W. (2014), Dietary fiber intake and risk of type 2 diabetes: a dose response analysis of prospective studies. *European Journal of Epidemiology*. 29. pp79- 88.

Yeung, W.T.L. (2010). Gender Perspectives on Adolescent Eating Behaviors: A Study on the Eating Attitudes and Behaviors of Junior Secondary Students in Hong Kong. *Journal of Nutrition, Education and Behaviour*. 42 (4), pp250-258.

Young, I. and Thaivalappil, A. (2018). A systematic review and meta-regression of the knowledge, practices, and training of restaurant and food service personnel toward food allergies and Celiac disease. *PLOS One*. 13 (9), pp1-18.
Yue, D., Ciccolini, A., Avilla, E. and Waserman, S. (2018). Food allergy and anaphylaxis REVIEW. *Journal of Asthma and Allergy*. 11, pp111-120.

Zhang, A., Xu, G., Liu, D., Zhu, W., Fan, X. and Liu, X. (2013). Dietary fiber consumption and risk of stroke. *European Journal of Epidemiology*, 28. Pp119-130.

Zhang, J., Yan, L., Tang, J., Ma, J., Guo, X., Zhao, W., Zhang, X., Li, J., Chu, J. and Bi, Z. (2014). Estimating daily salt intake based on 24 h urinary sodium excretion in adults aged 18–69 years in Shandong, China. *British Medical Journal*. 4 (7), pp1-6.

Zadka, K., Palkowska-Gozdzik, E. and Rosolowska-Huszcz, D. (2018). The State of Knowledge about Nutrition Sources of Vitamin D, Its Role in the Human Body, and Necessity of Supplementation among Parents in Central Poland. *International Journal of Environmental Research and Public Health*. 15 (7), pp1489-1499.

Zhou, Q., Wu, J., Tang, J., Wang, J.J., Lu, C.H. and Wang, P.X. (2015). Beneficial Effect of Higher Dietary Fiber Intake on Plasma HDL-C and TC/HDL-C Ratio among Chinese Rural-to-Urban Migrant Workers. *International Journal of Environmental Research and Public Health*. 12 (5), pp4726-4738.

Zingone, F., Capone, P. and Ciacci, C. (2010). Celiac Disease: Alternatives to a Gluten Free Diet. World Journal of Gastrointestinal Pharmacology and Therapeutics. 1 (1), pp36-39.

Zurzola, G.A., Mathai, M.L., Koplin, J.J. and Allen, K.J. (2012). Hidden Allergens in Foods and Implications for Labelling and Clinical Care of Food Allergic Patients. *Current Allergy and Asthma Reports*. 12 (4), pp292-296.

Zurzola, G.A., Mathai, M.L., Koplin, J.J. and Allen, K.J. (2013). Precautionary allergen labelling following new labelling practice in Australia. *Journal of Paediatrics and Child Health*. 49 (4), pp306-310.

Appendix

Attachments

Attachment 1: Ethics Approval

07 March 2019

Jan Mei Soon / Zainab Laheri
School of Sport and Wellbeing
University of Central Lancashire

Dear Jan / Zainab

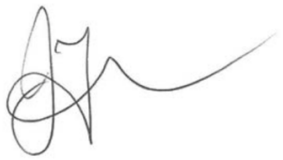
Re: STEMH Ethics Committee Application Unique
Reference Number: **STEMH 980**

The STEMH ethics committee has granted approval of your proposal application 'Dietary Diversity of University Students with Food Allergies and Food Allergen Knowledge and Practices of Catering Staff'. Approval is granted up to the end of project date*.

It is your responsibility to ensure that

- the project is carried out in line with the information provided in the forms you have submitted
- you regularly re-consider the ethical issues that may be raised in generating and analysing your data
- any proposed amendments/changes to the project are raised with, and approved, by Committee
- you notify EthicsInfo@uclan.ac.uk if the end date changes or the project does not start
- serious adverse events that occur from the project are reported to Committee
- a closure report is submitted to complete the ethics governance procedures (Existing paperwork can be used for this purposes e.g. funder's end of grant report; abstract for student award or NRES final report. If none of these are available use e-Ethics Closure Report Proforma).

Yours sincerely Jane Fitzgerald Deputy Vice Chair **STEMH Ethics Committee**



Jane Fitzgerald

Deputy Vice Chair
STEMH Ethics Committee

* for research degree students this will be the final lapse date

NB - Ethical approval is contingent on any health and safety checklists having been completed and necessary approvals gained as a result.

Attachment 2: Research Poster

Food Selection Behaviour and Diet Diversity of University Students with Food Allergies

PARTICIPANTS NEEDED

- Are you **18-24** years of age?
- Do you have a **food allergy**?
- Are you responsible for **self-management** of your food allergy?

Taking part in this study will involve completing two questionnaires

- Food Selection Behaviour Questionnaire
- Food Frequency Questionnaire

If you are interested, please contact zlaheri@uclan.ac.uk

View PDF

Attachment 3: Participant Information Sheet - Students

Participant Information Sheet - Students

Dietary Diversity of University Students with Food Allergies and Food Allergen Knowledge and Practices of Catering Staff

Project Background

You have been selected to take part in this research study. Prior to taking part, it is important for you to understand both the purpose of this research and what it will involve. Please take your time to read all the following information carefully. If there is something you do not understand, or you require more information, please do not hesitate to ask (Contact information can be found below).

Living with food allergies is both a challenging and stressful task and whilst avoidance of the offending food is the cornerstone of management, research suggests that this leads to the overconsumption of high fat, high salt and high sugar foods. Whilst sufficient literature exists, regarding the poor dietary diversity of first year university students, little research is available that examines this aspect for those with food allergies. Additionally, as individuals with food allergies enter into higher education, they experience a period of transition from parental supervision to self-management of their allergy, which provides an additional challenge and can continue to negatively impact their already poor diet. Understanding the true motives behind why students eat what they eat can prove useful, in improving overall dietary status.

Aim:

This particular piece of research will look at key areas regarding both nutrition and food allergies. The dietary diversity of foundation entry or first year university students with food allergies will be determined, to establish their nutritional status. Additionally, the reasons behind these students' current eating habits will also be analysed, to determine the causes of their poor nutritional behaviour.

Participant Criteria:

You have been invited to take part in this particular study because you fulfill the following participant inclusion criteria:

- Between the ages of 18 and 24
- Diagnosed with a food allergy
- Responsible for self-management of this allergy

What will happen to me if I take part?

If you decide to take part, then you will have to complete two short questionnaires. The first questionnaire will be used to assess your food selection behaviour. There are two sections in this questionnaire, with the first section looking at participant demographics and information regarding food allergies. The second section will look at questions related to participants' food selection behaviour. It will take approximately a total of 5 minutes to complete this questionnaire. The second questionnaire is a food frequency questionnaire, which will assess your food intake for the previous year. Again this questionnaire will be split into two sections. The first section will require you to select an appropriate frequency consumption for a total of 130 different food items. The second section will contain a series

of further questions, which will require more detailed information regarding breakfast cereals and cooking fats. It will take approximately 45 minutes to complete this questionnaire.

Potential Benefits and Risks:

There are no risks associated with taking part in this study. Additionally, there are no direct benefits to be obtained from taking part in this study. However, it is hoped that knowledge gained from this research will prove beneficial for students, as well as the university.

All data collected will be confidential and utilised purely for the purpose of this study. It is entirely up to you whether you decide to take part. Please note, you have the right to withdraw at any time during the study and do not need to provide any reason for doing so. Once the data collection is completed, you will not be able to withdraw your results, as the data will be anonymised.

Contact information of researcher:

If you would like more information, or would be interested in the results of this study, then please use the contact details below.

Name: Zainab Laheri
School: School of Health and Wellbeing
Email: zlaheri@uclan.ac.uk

If you have decided to take part, please read and sign the attached consent form.

Attachment 4: Participant Information Sheet – Catering Staff

Participant Information Sheet – Catering Staff

Dietary Diversity of University Students with Food Allergies and Food Allergen Knowledge and Practices of Catering Staff

Project Background

You have been selected to take part in this research study. Prior to taking part, it is important for you to understand both the purpose of this research and what it will involve. Please take your time to read all the following information carefully. If there is something you do not understand, or you require more information, please do not hesitate to ask (Contact information can be found below).

Food service employees bear the huge responsibility of providing safe food for all consumers. Extra attention must be paid to those individuals who possess a food allergy. Adequate food allergen management practices of catering staff, is essential to ensure safety for all students with food allergies. Though it is assumed that catering staff possess satisfactory knowledge and practices of food allergens, there is insufficient literature investigating this very aspect.

Aim:

This particular piece of research will assess both the food allergen knowledge and practices of catering staff, to identify any gaps in their current habits.

Participant Criteria:

You have been invited to take part in this particular study because you fulfill the following participant inclusion criteria.

- Catering staff at UCLan

What will happen to me if I take part?

If you decide to take part, then you will have to complete one short questionnaire, which will assess both your food allergen knowledge and practices. There are a total of three sections in this questionnaire. The first section will look at participant demographic characteristics. The second section will assess your knowledge with regards to food allergies. There are a total of twelve statements. You will be required to read each statement and then select either true or false, based on your knowledge. The third section will assess your food allergen practices. There are a total of 13 statements in this section. For each statement you will have to select the appropriate frequency, which indicates how often you complete each particular action. It will take approximately 10 minutes to complete this questionnaire.

Potential Benefits and Risks:

There are no risks associated with taking part in this study. Additionally, there are no direct benefits to be obtained from taking part in this study. However, it is hoped that knowledge gained from this research will prove beneficial for catering staff, as well as the university.

All data collected will be confidential and utilised purely for the purpose of this study. It is entirely up to you whether you decide to take part. Please note, you have the right to withdraw at any time during the

study and do not need to provide any reason for doing so. Once the data collection is completed, you will not be able to withdraw your results, as the data will be anonymised. Contact information of the researcher can be found below.

Contact information of researcher:

Name: Zainab Laheri
School: School of Health and Wellbeing
Email: zlaheri@uclan.ac.uk

If you have decided to take part, please read and sign the attached consent form.

Attachment 5: Participant Consent Form – Students and Catering Staff

Participant Consent Form

Dietary Diversity of University Students with Food Allergies and Food Allergen Knowledge and Practices of Catering Staff

By signing this consent form I agree, that:

1. I have read and understood the participant information sheet,
2. I have had the opportunity to ask any questions, which I was unsure about,
3. I have been provided with enough information
4. I have the right to withdraw at any time during the study (If you wish to withdraw from the research , please speak to the researcher or email them at zlaheri@uclan.ac.uk),
5. I do not have to provide any reason for withdrawing from the study,
6. I am aware of any risks associated with the study,
7. I am aware of any benefits associated with the study.

Name of Participant: ……

Signed: ……..…… Date: ……

Name of Researcher: ……

Signed: ……... Date: ……

Attachment 6: Participant Information Sheet – Swabbing:

Participant Information Sheet – Swabbing

Dietary Diversity of University Students with Food Allergies and Food Allergen Knowledge and Practices of Catering Staff

Project Background

Prior to agreeing permission to conduct AllerSnap protein residue swab tests, it is important for you to understand both the purpose of this research and what it will involve. Please take your time to read all the following information carefully. If there is something you do not understand, or you require more information, please do not hesitate to ask (Contact information can be found below).

Food service employees bear the huge responsibility of providing safe food for all consumers. Extra attention must be paid to those individuals who possess a food allergy. Adequate food allergen management practices of catering staff, is an essential component to ensure safety for all students with food allergies. Though it is assumed that catering staff possess satisfactory practices of food allergens, there is insufficient literature investigating this very aspect.

Aim:

This particular piece of research will assess the food allergen practices of catering staff in both Foster and Harrington kitchens, via a specialised rapid test kit (AllerSnap protein residue test).

What will the researcher need to do?

The researcher will swab various food contact surfaces (table tops, utensils and chopping boards), non-food contact surfaces (stove tops and exterior of fridge/freezer) and transfer points (light switch and taps) in both Foster and Harrington kitchens. The swabs will be incubated and then activated, to validate hygiene in both kitchens.

Potential Benefits and Risks:

There are no risks associated with taking part in this study. Additionally, there are no direct benefits to be obtained from taking part in this study. However, it is hoped that knowledge gained from this research will prove beneficial for catering staff, as well as the university, with regards to improving overall food allergen management and practices.

All data collected will be confidential and utilised purely for the purpose of this study. Please note, all participants taking part have the right to withdraw at any time during the study and do not need to provide any reason for doing so. Once the data collection is completed, all participants taking part will not be able to withdraw their results, as the data will be anonymised. Contact information of the researcher can be found below.

Contact information of researcher:

Name: Zainab Laheri
School: School of Health and Wellbeing
Email: zlaheri@uclan.ac.uk

If you have decided to allow the researcher to conduct the swabbing, please read and sign the attached consent form.

Attachment 7: Participant Consent Form – Swabbing:

Participant Consent Form - Swabbing

Dietary Diversity of University Students with Food Allergies and Food Allergen Knowledge and Practices of Catering Staff

By signing this consent form I agree, that:

1. I have read and understood the participant information sheet,
2. I have had the opportunity to ask any questions, which I was unsure about,
3. I have been provided with enough information
4. I am aware that all participants have the right to withdraw at any time during the study (If they wish to withdraw from the research , please speak to the researcher or email them at zlaheri@uclan.ac.uk),
5. I am aware that all participants do not have to provide any reason for withdrawing from the study,
6. I am aware of any risks associated with the study,
7. I am aware of any benefits associated with the study.

Name of Manager ……

Signed: ……..…… Date: ……

Name of Researcher: ……

Signed: …….. Date: ……

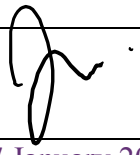
Attachment 8: Risk Assessment Form

SENS RISK ASSESSMENT FORM
(for Projects, Research, Consultancy & Testing)

Use this form to risk-assess:

- ***Off-campus work (research, fieldwork, educational visits etc)***
- ***All lab / classroom / sports-hall based activities involving medium/high risk procedures or use of specialist equipment***
- ***All project work, research, consultancy and testing of athletes or equipment***

This form should be completed by the investigator and verified by a member of SENS staff, in conjunction with a qualified or otherwise competent person (normally a technician or Faculty HSE officer). Completed forms must be countersigned by the Head of School or the Chair of the School Health & Safety Committee.

Assessment Undertaken By: (Investigator)	**Assessment Verified By: (Technician or other competent person)**
Name: Zainab Laheri	Name: Jan Mei Soon
Signed: Z.Laheri	Signed: 
Date: 01/01/19	Date*: 17 January 2019
Note: Risk Assessment is valid for **one year from the date given above. Risk Assessments for activities lasting longer than one year should be reviewed annually.*	
Countersigned by Head of School or Chair of H&S Committee:	
Date:	

Risk Assessment For:
Activity: *All activities will take place at UClan* (i) Swabbing in the kitchen (ii) Incubation of swabs
Location of Activity: (i) Swabbing in the kitchen – Foster and Harrington kitchens (ii) Incubation of swabs – Nutrition and Health Suite (Darwin Building)

List significant / potential hazards	List groups of people who are at risk	Level of Risk (high, medium, low)	List the action / safety precautions needed.
General safety issues at locations being visited *Injury resulting from safety failings of activity provider e.g. lack of competency, unsafe equipment, premises, persons not following safety instructions, etc*	Student Investigator	Low	
Personal safety (general) *Physical and/or verbal assault, leisure time activities, fire hazards*	Student Investigator	Low	Research area of swabbing and incubation if unfamiliar. Carry a mobile phone to raise the alarm if necessary. Wear protective clothing when conducting swabbing (lab coat and gloves). Be aware of all fire exits in both Foster and Harrington kitchens and the nutrition and health suite, be aware of protocol in the case of a fire or upon hearing potential fire alarms.
Slips trips and falls	Student Investigator	Low	Wear footwear suitable for the activities. Contact supervisor in the case of any accidents. Be aware of who to contact if first aid is needed.

Attachment 9: Food Selection Behaviour Questionnaire

1. Section 1:

This section will determine eligibility and will assess food allergy history

1. Gender *

- [ ] Male
- [ ] Female
- [ ] Prefer not to say

2. Are you currently a foundation entry or first year undergraduate student? *

- [ ] Yes
- [ ] No

3. Are you currently between the ages of 18 and 24? *

- [ ] Yes
- [ ] No (If you have selected this option, we thank you for your interest, but you are not eligible for this survey)

4. What is your current age? *

- [ ] 18
- [ ] 19

- [ ] 20
- [ ] 21
- [ ] 22
- [ ] 23
- [ ] 24

5. Do you have a food allergy? *

- [ ] Yes
- [ ] No (If you have selected this option, we thank you for your interest, but you are not eligible for this survey)

6. How have you been diagnosed with your food allergy? Select all that apply *

- [ ] Skin Prick Test
- [ ] Blood Test
- [ ] Food Elimination Diet
- [ ] Other (please specify):

7. Which food/s are you allergic to? Select all that apply *

- [ ] Celery
- [ ] Gluten
- [ ] Crustaceans

- [ ] Egg
- [ ] Fish
- [ ] Lupin
- [ ] Milk
- [ ] Molluscs
- [ ] Mustard
- [ ] Nuts
- [ ] Peanuts
- [ ] Sulphur Dioxide
- [ ] Soya
- [ ] Sesame Seeds
- [ ] Other (please specify):

For each food allergen selected in question 6, rate the severity as either mild/moderate or severe/life-threatening, for that particular food allergy. Please use the definitions below, when answering this question.

Mild:

This may include one or more of the following – redness of the skin, runny nose/sneezing, slight cough

Moderate:

This may include one or more of the following symptoms - hives, eczema, itchy mouth, stomach pain, odd taste in the mouth.

Severe:

This may include one or more of the following symptoms - obstructive swelling of the lips, tongue, and/or throat, trouble swallowing, shortness of breath, turning blue, drop in blood pressure, loss of consciousness, chest pain, weak pulse.

Name of food allergen

Severity level

Name of Food Allergen

Severity level

Name of food allergen

Severity level

If more space is required, then complete your answer here:

8. Do you carry an epinephrine auto-injector with you? *

- [ ] Yes
- [ ] No
- [ ] Sometimes

2. Section 2:

This particular section will determine which factors will influence your food selection behaviour. The following predictor variables will be included within the questionnaire: cost, taste, convenience and clear labelling. Explanations of these measures are listed below. (1) Cost – The cost of each food item. (2) Taste – The taste of each food item. (3)Convenience – Buying certain foods, because they are easily accessible and require little effort to prepare. (4) Clear Labelling – Buying certain foods, as they provide maximum clarity in terms of labelling i.e. clear identification of affecting allergen and little/no use of precautionary allergen labelling. (5) Health - Buying foods based on their nutritional content or the impact they have on your health.

9. On a scale of 1-5, with 1 being the most influential and 5 the least influential, rate how each predictor variable influences your food selection behaviour *

	1	2	3	4	5
Cost	☐	☐	☐	☐	☐
Taste	☐	☐	☐	☐	☐
Convenience	☐	☐	☐	☐	☐
Clear Labelling	☐	☐	☐	☐	☐
Health	☐	☐	☐	☐	☐

Attachment 10: Food Frequency Questionnaire

This questionnaire asks for some background information about you, especially about what you eat.

If you have any problems with the questions please email zlaheri@uclan.ac.uk.

Your answers will be treated as strictly confidential and will be used only for research.

PLEASE COMPLETE THE FOLLOWING

Date of birth: ☐

Please enter M if you are Male or F if you are Female ☐

Please answer every question. If you are uncertain about how to answer a question then do the best you can, but please do not leave a question blank.

YOUR DIET LAST YEAR

For each food there is an amount shown, either a "medium serving" or a common household unit such as a slice or teaspoon. Please put a tick, or write yes in the box to indicate how often, **on average,** you have eaten the specified amount of each food **during the past year.**

EXAMPLES:

For white bread the amount is one slice, so if you ate 4 or 5 slices a day, you should put a tick or write yes in the column headed "4-5 per

day".

FOODS AND AMOUNTS	AVERAGE USE LAST YEAR								
BREAD AND SAVOURY BISCUITS (one slice or biscuit)	Never or less than once/month	1-3 per month	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day
White bread and rolls								YES	

For chips, the amount is a "medium serving", so if you had a helping of chips twice a week you should put a tick or write yes in the column headed "2-4 per week".

FOODS AND AMOUNTS	AVERAGE USE LAST YEAR								
POTATOES, RICE AND PASTA (medium serving)	Never or less than once/month	1-3 per month	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day
Chips				YES					

For very seasonal fruits such as strawberries and raspberries you should estimate your average use when the fruits are in season, so if you ate strawberries or raspberries about once a week when they were in season you should put a tick or write yes in the column headed "once a week"

FOODS AND AMOUNTS	AVERAGE USE LAST YEAR								
FRUIT (1 fruit or medium serving)	Never or less than once/month	1-3 per month	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day
Strawberries, raspberries, kiwi fruit			YES						

Please estimate your average food use as best you can, and please answer every question

Do not leave ANY lines blank. PLEASE PUT A TICK OR WRITE YES ON EVERY LINE

FOODS AND AMOUNTS	AVERAGE USE LAST YEAR								
MEAT AND FISH (medium serving)	Never or less than once/month	1-3 per month	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day
Beef: roast, steak, mince, stew or casserole									
Beef burgers									
Pork: roast, chops, stew or slices									
Lamb: roast, chops or stew									
Chicken or other poultry eg. turkey									
Bacon									
Ham									
Corned beef, Spam, luncheon meats									
Sausages									
Savoury pies, eg. meat pie, pork pie, pasties, steak & kidney pie, sausage rolls									
Liver, liver pate, liver sausage									
Fried fish in batter, as in fish and chips									
Fish fingers, fish cakes									
Other white fish, fresh or frozen, eg. cod, haddock, plaice, sole, halibut									
Oily fish, fresh or canned, eg. mackerel, kippers, tuna, salmon, sardines, herring									
Shellfish, eg. crab, prawns, mussels									
Fish roe, taramasalata									
	Never or less than once/month	1-3 per month	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day

Please check that you have a tick or a yes on EVERY line

PLEASE PUT A TICK OR A YES ON EVERY LINE

FOODS AND AMOUNTS	**AVERAGE USE LAST YEAR**								
BREAD AND SAVOURY BISCUITS (one slice or biscuit)	Never or less than once/month	1-3 per month	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day
White bread and rolls									
Brown bread and rolls									
Wholemeal bread and rolls									
Cream crackers, cheese biscuits									
Crispbread, eg. Ryvita									
CEREALS (one bowl)									
Porridge, Readybrek									
Breakfast cereal such as cornflakes, muesli etc.									
POTATOES, RICE AND PASTA (medium serving)									
Boiled, mashed, instant or jacket potatoes									
Chips									
Roast potatoes									
Potato salad									
White rice									
Brown rice									
White or green pasta, eg. spaghetti, macaroni, noodles									
Wholemeal pasta									
Lasagne, moussaka									
Pizza									
	Never or less than once/month	**1-3** per month	Once a week	**2-4** per week	**5-6** per week	Once a day	**2-3** per day	**4-5** per day	6+ per day

Please check that you have a tick or a yes on EVERY line

PLEASE PUT A TICK OR A YES ON EVERY LINE

FOODS AND AMOUNTS	AVERAGE USE LAST YEAR								
DAIRY PRODUCTS AND FATS	Never or less than once/month	1-3 per month	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day
Single or sour cream (tablespoon)									
Double or clotted cream (tablespoon)									
Low fat yogurt, fromage frais (125g carton)									
Full fat or Greek yogurt (125g carton)									
Dairy desserts (125g carton)									
Cheese, eg. Cheddar, Brie, Edam (medium serving)									
Cottage cheese, low fat soft cheese (medium serving)									
Eggs as boiled, fried, scrambled, etc. (one)									
Quiche (medium serving)									
Low calorie, low fat salad cream(tablespoon)									
Salad cream, mayonnaise (tablespoon)									
French dressing (tablespoon)									
Other salad dressing (tablespoon)									
The following on bread or vegetables									
Butter (teaspoon)									
Block or hard margarine, eg. Stork, Krona (teaspoon)									
Polyunsaturated margarine, eg. Flora, sunflower,soya spreads (teaspoon)									
Soft margarines,including olive oil based and dairy spreads, eg. Blue Band, Olivio/ Bertolli, Clover (teaspoon)									
Low fat spreads (less than 60% fat), eg. Outline, Gold (teaspoon)									
Very low fat spread (less than 30% fat) (teaspoon)									
	Never or less than once/month	1-3 per month	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day

Please check that you have a tick or a yes on EVERY line

PLEASE PUT A TICK OR A YES ON EVERY LINE

FOODS AND AMOUNTS	AVERAGE USE LAST YEAR								
SWEETS AND SNACKS (medium serving)	Never or less than once/month	1-3 per month	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day
Sweet biscuits, chocolate, eg. digestive (one)									
Sweet biscuits, plain, eg. Nice, ginger (one)									
Cakes eg. fruit, sponge, home baked									
Cakes eg. fruit, sponge, ready made									
Buns, pastries eg. scones, flapjacks, home baked									
Buns, pastries eg. croissants, doughnuts, ready made									
Fruit pies, tarts, crumbles, home baked									
Fruit pies, tarts, crumbles, ready made									
Sponge puddings, home baked									
Sponge puddings, ready made									
Milk puddings, eg. rice, custard, trifle									
Ice cream, choc ices									
Chocolates, single or squares									
Chocolate snack bars eg. Mars, Crunchie									
Sweets, toffees , mints									
Sugar added to tea, coffee, cereal (teaspoon)									
Crisps or other packet snacks, eg. Wotsits									
Peanuts or other nuts									
SOUPS, SAUCES, AND SPREADS									
Vegetable soups (bowl)									
Meat soups (bowl)									
Sauces, eg. white sauce, cheese sauce, gravy (tablespoon)									
Tomato ketchup (tablespoon)									
Pickles, chutney (tablespoon)									
Marmite, Bovril (teaspoon)									
Jam, marmalade, honey (teaspoon)									
Peanut butter (teaspoon)									
	Never or less than once/month	1-3 per month	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day

Please check that you have a tick or a yes on EVERY line

PLEASE PUT A TICK OR A YES ON EVERY LINE

FOODS AND AMOUNTS	AVERAGE USE LAST YEAR								
DRINKS	Never or less than once/month	1-3 per month	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day
Tea (cup)									
Coffee, instant or ground (cup)									
Coffee, decaffeinated (cup)									
Coffee whitener, eg. Coffee-mate (teaspoon)									
Cocoa, hot chocolate (cup)									
Horlicks, Ovaltine (cup)									
Wine (glass)									
Beer, lager or cider (half pint)									
Port, sherry, vermouth, liqueurs(glass)									
Spirits, eg. gin, brandy, whisky, vodka (single)									
Low calorie or diet fizzy soft drinks (glass)									
Fizzy soft drinks, eg. Coca cola, lemonade (glass)									
Pure fruit juice (100%) eg. orange,									
apple juice (glass)									
Fruit squash or cordial (glass)									
FRUIT **For seasonal fruits marked*, please estimate your average use when the fruit is in season**									
Apples (1 fruit)									
Pears (1 fruit)									
Oranges, satsumas, mandarins (1 fruit)									
Grapefruit (half)									
Bananas (1 fruit)									
Grapes (medium serving)									
Melon (1 slice)									
* Peaches, plums, apricots (1 fruit)									
* Strawberries , raspberries,kiwi fruit (medium serving)									
Tinned fruit (medium serving)									
Dried fruit, eg. raisins, prunes (medium serving)									
	Never or less than once/month	1-3 per month	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day

Please check that you have a tick or a yes on EVERY line

PLEASE PUT A TICK OR A YES ON EVERY LINE

FOODS AND AMOUNTS	AVERAGE USE LAST YEAR								
VEGETABLES Fresh, frozen or tinned (medium serving)	Never or less than once/month	1-3 per month	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day
Carrots									
Spinach									
Broccoli, spring greens, kale									
Brussels sprouts									
Cabbage									
Peas									
Green beans, broad beans, runner beans									
Marrow, courgettes									
Cauliflower									
Parsnips, turnips, swedes									
Leeks									
Onions									
Garlic									
Mushrooms									
Sweet peppers									
Beansprouts									
Green salad, lettuce, cucumber, celery									
Watercress									
Tomatoes									
Sweetcorn									
Beetroot									
Coleslaw									
Avocado									
Baked beans									
Dried lentils, beans, peas									
Tofu , soya meat, TVP, Vegeburger									
	Never or less than once/month	1-3 per month	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day

Please check that you have a tick or a yes on EVERY line

YOUR DIET LAST YEAR, continued

1. Are there any **OTHER** foods which you ate more than once a week? Yes ☐ No ☐
   Put an X in the box.

If **YES,** please list below

Food	Usual Serving Size	Number of times eaten each week

2. What type of milk did you most often use?
   Put an X in the box.

   ☐

   Select one only

   Full cream/whole ☐
   Skimmed ☐
   Dried milk ☐
   Other, specify ☐
   Semi-skimmed ☐
   Channel Islands, gold ☐
   Soya ☐
   None ☐

3. How much milk did you drink each day, including milk with tea, coffee, cereals etc? Put an X in the box.

   None ☐
   Quarter of a pint ☐
   Half a pint ☐
   Three quarters of a pint ☐
   One pint ☐
   More than one pint ☐

4. Did you usually eat breakfast cereal (excluding porridge and Ready Brek mentioned earlier)? Put an X in the box.

   Yes ☐ No ☐

   If **YES,** which brand and type of breakfast cereal, including muesli, did you usually eat?

   List the one or two types most often used

Brand e.g. Kellogg's	Type e.g. Cornflakes

5. What kind of fat did you most often use for frying, roasting, grilling etc? Put an X in the box.

Select one only

Butter ☐ Solid vegetable fat ☐

Lard/dripping ☐ Margarine ☐

Vegetable oil ☐ None ☐

If you used vegetable oil, please give type eg. corn, sunflower ☐

6. What kind of fat did you most often use for baking cakes etc?
Put an X in the box.

Select one only

Butter ☐ Solid vegetable fat ☐

Lard/dripping ☐ Margarine ☐

Vegetable oil ☐ None ☐

If you used margarine, please give name or type eg. Flora, Stork

☐

7. How often did you eat food that was fried at home? Put an X in the box.

Daily ☐ Less than once a week ☐

1-3 times a week ☐ Never ☐

4-6 times a week ☐

8. How often did you eat fried food away from home? Put an X in the box.

Daily ☐ Less than once a week ☐

1-3 times a week ☐ Never ☐

4-6 times a week ☐

9. What did you do with the visible fat on your meat? Put an X in the box.

Ate most of the fat ☐

Ate as little as possible ☐

Ate some of the fat ☐

Did not eat the meat ☐

10. How often did you eat grilled or roast meat? Write the number of times per week.

☐ times a week

11. How well cooked did you usually have grilled or roast meat? Put an X in the box.

Well done /dark brown ☐ Lightly cooked/rare ☐

Medium ☐ Did not eat meat ☐

12. How often did you add to food while cooking? Put an X in the box.

Always ☐
Usually ☐
Sometimes ☐
Rarely ☐
Never ☐

13. How often did you add salt to any food at the table? Put an X in the box.

Always ☐
Never ☐

14. Did you regularly use a salt substitute e.g. LoSalt? Put an X in the box. Yes ☐ No ☐

If **YES,** which brand? ☐

15. During the course of last year, on average, how many times a week did you eat the following foods?

Food Type	Portion Size	Times Per Week
Vegetables (not including potatoes)	Medium Serving	
Salads	Medium Serving	
Fruit and Fruit Products (not including fruit juice)	Medium Serving or 1 Fruit	
Fish and Fish Products	Medium Serving	
Meat, Meat Products and Meat Dishes (including bacon, ham and chicken)	Medium Serving	

16. Have you taken any vitamins, minerals, fish oils, fibre or other food supplements during the past year? Put an X in the box.

Yes ☐

No ☐

Don't know ☐

If **YES,** please complete the table below.

If you have taken more than 5 types of supplement please put the most frequently consumed brands first.

Example: If you take one tablet of vitamin C two times a day, please write '2' in the amount- column and tick or write yes in the 'once a day' box. Most supplements mention a strength value (in our example 500mg), please write this information in the table.

Supplements				**Average frequency for the past year Tick or write yes in ONE box per line to show how often on average you took the amount consumed as mentioned in 'amount' column.**					
Brand	Name	Strength (strength of the supple-ment for each tablet or capsule)	Amount (number of tablets, capsules or teaspoons taken in one day)	Never or less than once a month	1-3 per month	Once a week	2-4 per week	5-6 per week	Once a day
EXAMPLE Boots	**High strength vitamin C**	**500mg**	**2 tablets**			**Yes**			

Thank you for your help

Attachment 11: Food Allergen Knowledge and Practices Questionnaire

Food Allergen Knowledge and Practices

1. Section 1

Demographic Characteristics

1. Gender *

- [ ] Male
- [ ] Female
- [ ] Prefer not to say

2. Age *

- [ ] under 18
- [ ] 18-24
- [ ] 25-34
- [ ] 35-54
- [ ] 55+

3. Education Level *

- [ ] High School
- [ ] College
- [ ] Bachelors Degree

4. Food Safety Certification *

- [ ] Yes
- [ ] No

2. Section 2:

This section will assess your knowledge, with regards to food allergies.

5. For each of the following statements, select true or false *

	True	False
(a) A food allergy reaction occurs 24 hours after ingesting one of the 14 major food allergens	☐	☐
(b) Individuals with food allergies can safely consume foods containing the offending allergen, as long as only a small amount is consumed	☐	☐
(c) High temperatures, for example – deep frying, roasting and baking, can destroy the food allergen	☐	☐

	True	False
(d) Tree nuts, for example – almonds, Brazil nuts and cashew nuts, are similar to peanut allergy	☐	☐
(e) Oil that has been previously used to cook foods containing nuts, eggs or fish can be used to cook food for food allergic individuals	☐	☐
(f) If someone has an allergic reaction, it is correct to first offer water in order to dilute the allergen and stop the reaction	☐	☐
(g) Allergen cross contamination of cooking utensils, can be prevented by rinsing with tap water	☐	☐
(h) Removing allergenic food items (e.g. walnuts or peanuts) from a finished dish, will prevent the individual from having an allergic reaction	☐	☐
(i) Cooking in unrefined oils, will not leave any traces of nut	☐	☐

	True	False
protein in the food		
(j) Bendryl, Sudafed and Pseudoephedrine are commonly used to treat severe food allergy reactions	☐	☐
(k) Someone with a food allergy can die from eating any food containing the offending food allergen	☐	☐
(l) A fever and headache are common symptoms experienced by individuals who are having a food allergy reaction	☐	☐

3. Section 3:

This section will assess your food allergen practices

6. For each of the following statements, choose the appropriate rating *

	Never	Seldom	Sometimes	Often	Always
(a) I check the ingredients list of food items, to see if they contain any food allergens.	☐	☐	☐	☐	☐

	Never	Seldom	Sometimes	Often	Always
(b) I am able to quickly identify if any ingredients in foods from the menu, contain any common food allergens, upon customer request?	☐	☐	☐	☐	☐
(c) If a mistake is made when preparing a meal for a food allergic customer, I remake the food	☐	☐	☐	☐	☐
(d) I try to listen carefully, understand, and then answer customers' questions about food allergies or allergens in the food	☐	☐	☐	☐	☐
(e) If a student has a food allergy, I communicate the allergen information to the chef to ensure that the food is prepared safely and is allergen-free	☐	☐	☐	☐	☐
(f) While serving foods to customers with a food allergy, I separately handle allergen-containing plates and allergen-free plates to prevent cross-contact	☐	☐	☐	☐	☐

	Never	Seldom	Sometimes	Often	Always
(g) If I am unsure about the ingredients in a menu item, I still assure the customer that the food does not contain any allergens	☐	☐	☐	☐	☐
(h) When preparing food for a customer with food allergies, I pay more attention to safe food handling practices than when preparing food for a student without food allergies	☐	☐	☐	☐	☐
(i) When preparing fried food for students with a food allergy, I make sure that I change the oil in the deep fryer to prevent cross contact	☐	☐	☐	☐	☐
(j) I wash my hands thoroughly with soap and water after coming into contact with any food allergens	☐	☐	☐	☐	☐
(k) I use clean and sanitized equipment and utensils to prevent cross-contact between allergens	☐	☐	☐	☐	☐

	Never	Seldom	Sometimes	Often	Always
(l) I use separate equipment for handling allergen-containing foods	☐	☐	☐	☐	☐
(m) I wear a fresh pair of gloves before preparing an allergen free meal	☐	☐	☐	☐	☐

Attachment 12: University Cleaning Procedures

OUTLETS
CLEANING PROCEEDURES: PLEASE ENSURE THAT PROTECTIVE CLOTHING IS WORN
AND THE CORRECT MATERIALS AND EQUIPMENT ARE USED

APPLIANCE WHERE APPLICABLE	TASK	WORK INSTRUCTIONS	APPROVED CLEANING MATERIAL	Frequency of cleaning
SANDWICH FRIDGE	Switch all electric off at the mains. Wipe shelves inside and outside of the fridge	Remove all food debris. Wipe the fridge, shelves, inside and outside of the fridge. Polish any glass areas.	Rubber gloves Hot water with approved washing liquid. Sanitiser Spray Blue cloth Glass spray	Daily
COLD DRINKS FRIDGE	Switch all electric off at the mains. Wipe shelves inside and outside of the fridge	Remove all food debris. Wipe the fridge, shelves, inside and outside of the fridge. Polish any glass areas.	Rubber gloves Hot water with approved washing liquid. Sanitiser Spray Blue cloth Glass spray	When required
COFFEE MACHINE	Switch all electric off at the mains. Wipe and clean inside and outside including drip tray	Clean as instructed by the manufactures handbook/guidance.	Rubber gloves Hot water with approved washing liquid. Sanitiser Spray Blue cloth Glass spray	Clean daily and when required. Strip and deep clean weekly
TOASTER	Switch all electric off at the mains.	Wipe down with damp cloth and empty crumb tray	Slightly damp cloth to be used on the outside of toaster only.	Daily

APPLIANCE WHERE APPLICABLE	TASK	WORK INSTRUTIONS	APPROVED CLEANING MATERIAL	Frequency of cleaning
COUNTERS/ DISPLAY UNITS	Make sure all stock is covered and/or wrapped, any waste recorded and all food is secure.	Wipe the counter ensuring that all food debris has been removed. Clean all stains and marks	Rubber gloves Hot water with approved washing liquid. Sanitiser Spray Blue cloth Glass spray	Daily
SINK	Clear all food debris from the sink.	Clean sink and sink surround. For stubborn stains, use a green scourers	Rubber gloves Hot water with approved washing liquid. Sanitiser Spray Blue cloth Glass spray	Daily
FLOORS	Sweep all food debris off the floor.	Mop floor area with clean hot water	Rubber gloves EHO Recommended floor cleaner	Daily
BINS	Empty all rubbish bags out of bins.	Wipe the bin inside and outside.	Rubber gloves Hot water with approved washing liquid. Sanitiser Spray Blue cloth Glass spray	Daily
CHAIRS & TABLES	Clear all debris off tables.	Wipe tables and chairs.	Rubber gloves	Daily deep clean monthly legs

			Hot water with approved washing liquid. Sanitiser Spray Blue cloth Glass spray	and underneath
COFFEE TABLE AREA	Clear all debris off table	Wipe coffee table area down	Rubber gloves Hot water with approved washing liquid. Sanitiser Spray Blue cloth Glass spray	Daily
STOREROOM	All items to be off floor, on suitable racking.	Floor to be swept and mopped daily and any spillages mopped straight away	Rubber gloves EHO Recommended floor cleaner	Daily and when required
MICROWAVE	Switch off at mains	Wipe any spillages inside including top & plate. Damp cloth to wipe the outside.	Rubber gloves Hot soppy water with approved washing liquid. Grooved scraper EHO recommended oven cleaner	Daily and when required.
ROLL OVER HOT DOG UNIT	Switch off at mains	Empty water and wipe all shelves and glass down	Rubber gloves Hot soppy water with approved washing liquid.	Daily
KNOCK OUT BOX	Empty coffee grinds into bin, making sure not to lose the bar	Rinse out and dry both boxes	Rubber gloves Hot soapy water with approved washing up liquid.	Daily
Grinders	Switch off at mains	When empty wipe with dry cloth to take off any residue.	Rubber gloves Hot soapy water with approved washing up liquid.	Daily/ termly for deep clean.

		Release plastic container having turned off the power and rinse unit.		
SOUP URN	Switch off at mains	Wipe with damp cloth inside when cool & out	Rubber gloves Hot soapy water with approved washing up liquid.	Daily

TRAINING REMINDERS TEMPLATE

1. ALL CLEANING TASKS MUST BE CARRIED OUT AS DOCUMENTED AND IN ACCORDANCE WITH TRAINING.

2. ALL CLEANING TASKS MUST BE CARRIED OUT USING APPROVED CHEMICALS ONLY.

3. ALL CLEANING TASKS MUST BE CARRIED OUT IN ACCORDANCE WITH THE SCHEDULE OUTLINED ON THE MONITORING PAPERWORK (DOCCATSERS0009)

4. ANY NON CONFORMITIES MUST BE REPORTED BELOW IN WRITING FOLLOWING VERBAL COMMUNICATION TO OUTLET SUPERVISOR OR IN THEIR ABSENCE CATERING SERVICES MANAGER.

NON CONFORMITIES

SIGNED……..

Attachment 13: Different Types of Surfaces for Swabbing

a) Food Contact Surfaces (49)

- Chopping Board x6
- Work Surface x4
- Knives x3
- Food Gastronorm Tray x3
- Food Tray x6
- Plates x6
- Dining Table x6
- Utensils x3
- Salad Bar Compartment x3
- Electric Mixer (Inside) x1
- Spatula (Inside) x1
- Ladle (Inside) x1
- Whisks (Inside) x1
- Tongs (Inside) x1
- Pots (Inside) x2
- Soup Pot (Inside) x1
- Soup Ladle (Inside) x1

b) Non-Food Contact Surfaces (23)

- Fridge Door x2
- Freezer Door x1
- Grill Door x3
- Oven Door x1
- Microwave Door x2
- Fryer Door x3
- Sink (Inside) x2
- Hand Soap Dispenser x1
- Hand Dryer x1
- Utensil Tray x2
- Exit Door x2
- Cleaning Cloths x3

c) Transfer Points (28)

- Fridge Handle x2
- Freezer Handle x1
- Grill Handle x3
- Oven Knob x3
- Microwave Button x2
- Microwave Handle x2
- Electric Mixer Handle x1
- Fryer Knob x3
- Sink Tap x2
- Exit Door Handle x2
- Spatula Handle x1
- Ladle Handle x1
- Whisk Handle x1
- Tong Handle x1
- Pot Handle x2
- Soup Ladle Handle x1

SPSS Outputs

Food Selection Behaviour Questionnaire

Section 1 - Demographics:

Statistics

Age

N	Valid	219
	Missing	2
Mean		20.22
Std. Deviation		1.874

Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	18	46	20.8	21.0	21.0
	19	54	24.4	24.7	45.7
	20	28	12.7	12.8	58.4
	21	40	18.1	18.3	76.7
	22	16	7.2	7.3	84.0
	23	18	8.1	8.2	92.2
	24	17	7.7	7.8	100.0
	Total	219	99.1	100.0	
Missing	System	2	.9		
Total		221	100.0		

Crosstabs

Gender * Year_of_Study Cross tabulation

Count

		Year_of_Study		
		Foundation Entry	First Year Undergraduate	
Gender	Male	33	50	83
	Female	39	97	136
Total		72	147	219

Gender * Age Cross tabulation

Count

		Age							
		18	19	20	21	22	23	24	
Gender	Male	25	25	0	17	6	5	5	83
	Female	21	29	28	23	10	13	12	136
Total		46	54	28	40	16	18	17	219

Gender * Diagnosis_of_Food_Allergy Cross tabulation

Count

		Diagnosis_of_Food_Allergy				
		Skin Prick Test	Blood Test	Food Elimination Diet	Self-Diagnosis	Total
Gender	Male	19	19	27	18	83
	Female	47	33	27	29	136
Total		66	52	54	47	219

Gender * Do_you_carry_an_epinephrine_autoinjector_with_you Cross tabulation

Count

		Do_you_carry_an_epinephrine_autoinjector_with_you		
		Yes	No	Total
Gender	Male	14	69	83
	Female	4	132	136
Total		18	201	219

Gender * Severity_level_of_celery_allergy Cross tabulation

Count

		Severity_level_of_celery_allergy		
		Mild	Moderate	Total
Gender	Male	10	1	11
	Female	2	0	2
Total		12	1	13

Gender * Severity_level_of_gluten_allergy Cross tabulation

Count

		Severity_level_of_gluten_allergy			
		Mild	Moderate	Severe	Total
Gender	Male	2	14	48	64
	Female	14	21	47	82
Total		16	35	95	146

Gender * Severity_level_of_crustacean_allergy Cross tabulation

Count

		Severity_level_of_crustacean_allergy			
		Mild	Moderate	Severe	Total
Gender	Male	1	12	25	38
	Female	6	26	41	73
Total		7	38	66	111

Gender * Severity_level_of_egg_allergy Cross tabulation

Count

		Severity_level_of_egg_allergy			
		Mild	Moderate	Severe	Total
Gender	Male	3	8	6	17
	Female	2	2	4	8
Total		5	10	10	25

Gender * Severity_level_of_fish_allergy Cross tabulation

Count

		Severity_level_of_fish_allergy			
		Mild	Moderate	Severe	Total
Gender	Male	7	11	23	41
	Female	9	26	33	68
Total		16	37	56	109

Gender * Severity_level_of_lupin_allergy Crosstabulation

Count

		Severity_level_of_lupin_allergy			
		Mild	Moderate	Severe	Total
Gender	Male	6	5	3	14
	Female	3	1	1	5
Total		9	6	4	19

Gender * Severity_level_of_milk_allergy Crosstabulation

Count

		Severity_level_of_milk_allergy		
		Mild	Severe	Total
Gender	Male	1	6	7
	Female	0	1	1
Total		1	7	8

Gender * Severity_level_of_mollusc_allergy Crosstabulation

Count

		Severity_level_of_mollusc_allergy			
		Mild	Moderate	Severe	Total
Gender	Male	0	6	33	39
	Female	1	10	43	54
Total		1	16	76	93

Gender * Severity_level_of_nut_allergy Crosstabulation

Count

		Severity_level_of_nut_allergy		
		Moderate	Severe	Total
Gender	Male	1	29	30
	Female	12	54	66
Total		13	83	96

Gender * Severity_level_of_peanut_allergy Crosstabulation

Count

		Severity_level_of_peanut_allergy			
		Mild	Moderate	Severe	Total
Gender	Male	0	1	40	41
	Female	2	3	79	84
Total		2	4	119	125

Gender * Severity_level_of_sulphur_dioxide_allergy Crosstabulation

Count

		Severity_level_of_sulphur_dioxide_allergy		
		Mild	Moderate	Total
Gender	Male	2	4	6
Total		2	4	6

Crosstabs

Gender * Are_you_allergic_to_celery

Crosstab

Count

		Are_you_allergic_to_celery		
		Yes	No	Total
Gender	Male	11	72	83
	Female	2	134	136
Total		13	206	219

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	12.815[a]	1	.000		
Continuity Correction[b]	10.792	1	.001		
Likelihood Ratio	12.857	1	.000		
Fisher's Exact Test				.001	.001
Linear-by-Linear Association	12.757	1	.000		
N of Valid Cases	219				

a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 4.93.

b. Computed only for a 2x2 table

Gender * Are_you_allergic_to_gluten

Crosstab

Count

		Are_you_allergic_to_gluten		
		Yes	No	Total
Gender	Male	64	19	83
	Female	83	53	136
Total		147	72	219

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	6.039[a]	1	.014		
Continuity Correction[b]	5.332	1	.021		
Likelihood Ratio	6.221	1	.013		
Fisher's Exact Test				.017	.010
Linear-by-Linear Association	6.011	1	.014		
N of Valid Cases	219				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 27.29.

b. Computed only for a 2x2 table

Gender * Are_you_allergic_to_crustaceans

Crosstab

Count

		Are_you_allergic_to_crustaceans		
		Yes	No	Total
Gender	Male	38	45	83
	Female	73	63	136
Total		111	108	219

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.285[a]	1	.257		
Continuity Correction[b]	.988	1	.320		
Likelihood Ratio	1.286	1	.257		
Fisher's Exact Test				.268	.160
Linear-by-Linear Association	1.279	1	.258		
N of Valid Cases	219				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 40.93.

b. Computed only for a 2x2 table

Gender * Are_you_allergic_to_egg

Crosstab

Count

		Are_you_allergic_to_egg		
		Yes	No	Total
Gender	Male	17	66	83
	Female	8	128	136
Total		25	194	219

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	10.864[a]	1	.001		
Continuity Correction[b]	9.468	1	.002		
Likelihood Ratio	10.525	1	.001		
Fisher's Exact Test				.002	.001
Linear-by-Linear Association	10.815	1	.001		
N of Valid Cases	219				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 9.47.

b. Computed only for a 2x2 table

Gender * Are_you_allergic_to_fish

Crosstab

Count

		Are_you_allergic_to_fish		
		Yes	No	Total
Gender	Male	41	42	83
	Female	68	68	136
Total		109	110	219

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.007[a]	1	.931		
Continuity Correction[b]	.000	1	1.000		
Likelihood Ratio	.007	1	.931		
Fisher's Exact Test				1.000	.521
Linear-by-Linear Association	.007	1	.931		
N of Valid Cases	219				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 41.31.

b. Computed only for a 2x2 table

Gender * Are_you_allergic_to_lupin

Crosstab

Count

		Are_you_allergic_to_lupin		
		Yes	No	Total
Gender	Male	14	69	83
	Female	5	131	136
Total		19	200	219

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	11.320[a]	1	.001		
Continuity Correction[b]	9.716	1	.002		
Likelihood Ratio	11.025	1	.001		
Fisher's Exact Test				.001	.001
Linear-by-Linear Association	11.268	1	.001		
N of Valid Cases	219				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 7.20.

b. Computed only for a 2x2 table

Gender * Are_you_allergic_to_milk

Crosstab

Count

		Are_you_allergic_to_milk		
		Yes	No	Total
Gender	Male	7	76	83
	Female	1	135	136
Total		8	211	219

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	8.679[a]	1	.003		
Continuity Correction[b]	6.630	1	.010		
Likelihood Ratio	8.827	1	.003		
Fisher's Exact Test				.005	.005
Linear-by-Linear Association	8.640	1	.003		
N of Valid Cases	219				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 3.03.

b. Computed only for a 2x2 table

Gender * Are_you_allergic_to_molluscs

Crosstab

Count

		Are_you_allergic_to_molluscs		
		Yes	No	Total
Gender	Male	39	44	83
	Female	54	82	136
Total		93	126	219

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.119[a]	1	.290		
Continuity Correction[b]	.841	1	.359		
Likelihood Ratio	1.116	1	.291		
Fisher's Exact Test				.325	.180
Linear-by-Linear Association	1.114	1	.291		
N of Valid Cases	219				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 35.25.

b. Computed only for a 2x2 table

Gender * Are_you_allergic_to_mustard

Crosstab

Count

		Are_you_allergic_to_mustard	
		No	Total
Gender	Male	83	83
	Female	136	136
Total		219	219

Chi-Square Tests

	Value
Pearson Chi-Square	.[a]
N of Valid Cases	219

a. No statistics are computed because Are_you_allergic_to_mustard is a constant.

Gender * Are_you_allergic_to_nuts

Crosstab

Count

		Are_you_allergic_to_nuts		
		Yes	No	Total
Gender	Male	30	53	83
	Female	66	70	136
Total		96	123	219

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	3.211[a]	1	.073		
Continuity Correction[b]	2.728	1	.099		
Likelihood Ratio	3.238	1	.072		
Fisher's Exact Test				.092	.049
Linear-by-Linear Association	3.197	1	.074		
N of Valid Cases	219				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 36.38.

b. Computed only for a 2x2 table

Gender * Are_you_allergic_to_peanuts

Crosstab

Count

		Are_you_allergic_to_peanuts		
		Yes	No	Total
Gender	Male	41	42	83
	Female	84	52	136
Total		125	94	219

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	3.218[a]	1	.073		
Continuity Correction[b]	2.733	1	.098		
Likelihood Ratio	3.210	1	.073		
Fisher's Exact Test				.091	.049
Linear-by-Linear Association	3.203	1	.073		
N of Valid Cases	219				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 35.63.

b. Computed only for a 2x2 table

Gender * Are_you_allergic_to_sulphur_dioxide

Crosstab

Count

		Are_you_allergic_to_sulphur_dioxide		
		Yes	No	Total
Gender	Male	6	77	83
	Female	0	136	136
Total		6	213	219

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	10.108[a]	1	.001		
Continuity Correction[b]	7.577	1	.006		
Likelihood Ratio	11.921	1	.001		
Fisher's Exact Test				.003	.003
Linear-by-Linear Association	10.062	1	.002		
N of Valid Cases	219				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 2.27.

b. Computed only for a 2x2 table

Gender * Are_you_allergic_to_soya

Crosstab

Count

		Are_you_allergic_to_soya		
		Yes	No	Total
Gender	Male	0	83	83
	Female	3	133	136
Total		3	216	219

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.856[a]	1	.173		
Continuity Correction[b]	.583	1	.445		
Likelihood Ratio	2.884	1	.089		
Fisher's Exact Test				.291	.237
Linear-by-Linear Association	1.848	1	.174		
N of Valid Cases	219				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 1.14.

b. Computed only for a 2x2 table

Gender * Are_you_allergic_to_sesame_seeds

Crosstab

Count

		Are_you_allergic_to_sesame_seeds	
		No	Total
Gender	Male	83	83
	Female	136	136
Total		219	219

Chi-Square Tests

	Value
Pearson Chi-Square	.[a]
N of Valid Cases	219

a. No statistics are computed because Are_you_allergic_to_sesame_seeds is a constant.

Section 2 – Food Selection:

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
How influential is cost when choosing selecting food?	219	2.2740	1.00358	1.00	4.00
How influential is taste when choosing selecting food?	219	2.8584	.98756	1.00	5.00
How influential is convenience when choosing selecting food?	219	2.1826	.69959	1.00	4.00
How influential is labelling when choosing selecting food?	219	1.8721	.79684	1.00	3.00
How influential is health when choosing selecting food?	219	2.0731	.76275	1.00	4.00
Gender	219	1.6210	.48625	1.00	2.00

Mann-Whitney Test

Ranks

	Gender	N	Mean Rank	Sum of Ranks
How influential is cost when choosing selecting food?	Male	83	79.94	6635.00
	Female	136	128.35	17455.00
	Total	219		
How influential is taste when choosing selecting food?	Male	83	123.93	10286.00
	Female	136	101.50	13804.00
	Total	219		
	Male	83	110.43	9166.00

How influential is convenience when choosing selecting food?	Female	136	109.74	14924.00
	Total	219		
How influential is labelling when choosing selecting food?	Male	83	116.05	9632.00
	Female	136	106.31	14458.00
	Total	219		
How influential is health when choosing selecting food?	Male	83	106.66	8853.00
	Female	136	112.04	15237.00
	Total	219		

Test Statistics[a]

	How influential is cost when choosing selecting food?	How influential is taste when choosing selecting food?	How influential is convenience when choosing selecting food?	How influential is labelling when choosing selecting food?	How influential is health when choosing selecting food?
Mann-Whitney U	3149.000	4488.000	5608.000	5142.000	5367.000
Wilcoxon W	6635.000	13804.000	14924.000	14458.000	8853.000
Z	-5.706	-2.700	-.089	-1.176	-.661
Asymp. Sig. (2-tailed)	.000	.007	.929	.240	.509

a. Grouping Variable: Gender

```
NPAR TESTS
 /M-W= Cost Taste Convenience Clear_Labelling Health BY Gender(1 2)
 /STATISTICS=DESCRIPTIVES QUARTILES
 /MISSING ANALYSIS.
```

Food Frequency Questionnaire

Section 1 – Food Allergy Frequencies:

Gender * Are_you_allergic_to_gluten Crosstabulation

Count

		Are_you_allergic_to_gluten		
		Yes	No	Total
Gender	Male	19	8	27
	Female	33	23	56
Total		52	31	83

Gender * Are_you_allergic_to_celery Crosstabulation

Count

		Are_you_allergic_to_celery		
		Yes	No	Total
Gender	Male	7	20	27
	Female	0	56	56
Total		7	76	83

Gender * Are_you_allergic_to_crustaceans Crosstabulation

Count

		Are_you_allergic_to_crustaceans		
		Yes	No	Total
Gender	Male	10	17	27
	Female	36	20	56
Total		46	37	83

Gender * Are_you_allergic_to_egg Crosstabulation

Count

		Are_you_allergic_to_egg		
		Yes	No	Total
Gender	Male	2	25	27
	Female	0	56	56
Total		2	81	83

Gender * Are_you_allergic_to_fish Crosstabulation

Count

		Are_you_allergic_to_fish		
		Yes	No	Total
Gender	Male	9	18	27
	Female	31	25	56
Total		40	43	83

Gender * Are_you_allergic_to_lupin Crosstabulation

Count

		Are_you_allergic_to_lupin		
		Yes	No	Total
Gender	Male	8	19	27
	Female	3	53	56
Total		11	72	83

Gender * Are_you_allergic_to_milk Crosstabulation

Count

		Are_you_allergic_to_milk	
		No	Total
Gender	Male	27	27
	Female	56	56
Total		83	83

Gender * Are_you_allergic_to_molluscs Crosstabulation

Count

		Are_you_allergic_to_molluscs		
		Yes	No	Total
Gender	Male	9	18	27
	Female	19	37	56
Total		28	55	83

Gender * Are_you_allergic_to_mustard Crosstabulation

Count

		Are_you_allergic_to_mustard	
		No	Total
Gender	Male	27	27
	Female	56	56
Total		83	83

Gender * Are_you_allergic_to_nuts Crosstabulation

Count

		Are_you_allergic_to_nuts		
		Yes	No	Total
Gender	Male	14	13	27
	Female	39	17	56
Total		53	30	83

Gender * Are_you_allergic_to_peanuts Crosstabulation

Count

		Are_you_allergic_to_peanuts		
		Yes	No	Total
Gender	Male	17	10	27
	Female	42	14	56
Total		59	24	83

Gender * Are_you_allergic_to_sulphur_dioxide Crosstabulation

Count

		Are_you_allergic_to_sulphur_dioxide	
		No	Total
Gender	Male	27	27
	Female	56	56
Total		83	83

Gender * Are_you_allergic_to_soya Crosstabulation

Count

		Are_you_allergic_to_soya		
		Yes	No	Total
Gender	Male	0	27	27
	Female	3	53	56
Total		3	80	83

Gender * Are_you_allergic_to_sesame_seeds Crosstabulation

Count

		Are_you_allergic_to_sesame_seeds	
		No	Total
Gender	Male	27	27
	Female	56	56
Total		83	83

Gender * Diagnosis_of_Food_Allergy Crosstabulation

		Diagnosis_of_Food_Allergy				
		Skin Prick Test	Blood Test	Food Elimination Diet	Self Diagnosis	
Gender	Male	9	7	11	0	27
	Female	24	13	4	15	56
Total		33	20	15	15	83

Section 2 - Nutrients:

Gender = Male

Descriptive Statistics[a]

	N	Minimum	Maximum	Mean	Std. Deviation
Age	27	19.00	24.00	21.1481	1.56165
Energy_kcal	27	1168.31	3120.18	2058.7048	435.65758
Carbohydrate_total_g	27	163.65	526.39	247.3578	85.52584
Protein_g	27	36.12	233.26	90.6430	43.95237
Fat_g	27	44.22	388.57	105.8815	65.17464
Monounsaturated_Fat_g	27	18.28	155.08	40.4707	25.50957
Polyunsaturated_Fat_g	27	7.26	59.74	16.8593	11.51336
Saturated_Fat_g	27	14.12	141.05	39.4444	23.51133
Cholesterol_mg	27	125.93	427.15	306.8585	84.29440
Non_Starch_Polysaccharides_g	27	9.60	56.74	16.6174	8.87273
Folate_mcg	27	162.13	419.32	238.7470	65.60735
Niacin_mg	27	9.99	54.17	22.6615	9.60174
Vitamin_A_mcg	27	191.19	982.96	443.0448	196.62893
Vitamin_B2_mg	27	1.03	4.23	1.7089	.73294
Vitamin_B1_mg	27	.86	4.00	1.5474	.71065
Vitamin_B12_mcg	27	2.15	17.00	5.3096	3.09200
Vitamin_B6_mg	27	1.49	5.34	2.4152	.75204
Vitamin_C_mg	27	50.61	512.16	114.1659	89.87905
Vitamin_D_mcg	27	.72	17.53	3.1907	3.12319
Calcium_mg	27	444.09	2139.89	847.6874	390.64263
Chloride_mg	27	1971.33	6326.46	3624.4448	1000.22001
Copper_mg	27	.75	2.69	1.2785	.42850
Iron_mg	27	5.82	27.04	10.6281	4.73683
Iodine_mcg	27	80.34	289.22	142.5726	51.17499
Potassium_mg	27	2506.30	8910.97	3616.8274	1306.80066
Magnesium_mg	27	214.15	727.95	315.0700	100.59879
Sodium_mg	27	1350.86	9985.96	2925.2622	1895.37951
Phosphorus_mg	27	710.35	3611.60	1454.3119	634.21344
Selenium_mcg	27	31.46	179.88	60.1263	30.90783

Zinc_mg	27	4.08	24.99	10.3033	4.50575
Alcoholic_Beverages_g	27	.00	230.74	32.1611	51.87605
Ceraels_and_Cereal_Products_g	27	71.91	1008.62	286.8130	196.50040
Eggs_and_Egg_Dishes_g	27	3.50	71.50	30.2407	19.88059
Fats_an_Oils_g	27	10.32	177.67	29.2500	31.89313
Fish_and_Fish_Products_g	27	.00	477.73	53.0130	90.14607
Fruit_g	27	55.15	896.10	249.4148	183.50879
Meat_and_Meat_Products_g	27	14.70	478.36	126.8167	84.92425
Mlik_and_Mlik_Products_g	27	170.92	604.98	285.0130	109.91327
Non_Alcoholic_Beverages_g	27	18.46	767.80	269.4511	155.48869
Nuts_and_Seeds_g	27	2.10	60.40	23.4756	14.60761
Potatoes_g	27	32.69	259.82	130.7244	63.39168
Soups_and_Sauces_g	27	5.25	408.80	68.1800	104.96745
Sugars_Preserves_and_Snacks_g	27	12.30	417.36	68.5230	78.78084
Vegetables_g	27	45.99	1032.16	168.4163	189.86927
Valid N (listwise)	27				

Gender = Female

Descriptive Statistics[a]

	N	Minimum	Maximum	Mean	Std. Deviation
Age	56	19.00	24.00	21.3214	1.34984
Energy_kcal	56	1022.54	2645.79	1951.6832	379.15220
Carbohydrate_total_g	56	111.72	380.33	242.4079	58.26058
Protein_g	56	35.23	110.00	71.6114	14.96783
Fat_g	56	34.29	121.92	82.9359	18.30830
Monounsaturated_Fat_g	56	13.36	47.12	30.7132	7.26152
Polyunsaturated_Fat_g	56	5.93	22.55	11.3659	2.97660
Saturated_Fat_g	56	11.81	51.25	33.6366	7.82487
Cholesterol_mg	56	108.04	466.24	302.0861	88.74375
Non_Starch_Polysaccharides_g	56	5.89	25.35	13.1764	3.50863
Folate_mcg	56	84.69	372.40	217.9207	54.78692
Niacin_mg	56	9.40	29.71	18.1200	4.46753
Vitamin_A_mcg	56	64.04	678.44	394.5984	126.12688
Vitamin_B2_mg	56	.73	2.35	1.5268	.33614
Vitamin_B1_mg	56	.65	1.95	1.2102	.28209
Vitamin_B12_mcg	56	1.05	7.83	4.7113	1.44112
Vitamin_B6_mg	56	.99	3.44	2.0813	.52838
Vitamin_C_mg	56	35.51	306.28	93.2673	37.74032
Vitamin_D_mcg	56	.45	5.05	2.7121	1.01536
Calcium_mg	56	314.14	1095.68	761.6848	163.32010
Chloride_mg	56	1477.23	5561.48	3394.1913	840.75107
Copper_mg	56	.52	1.83	1.0375	.24138
Iron_mg	56	4.35	14.54	9.3298	2.23377
Iodine_mcg	56	50.62	186.90	122.7036	32.59512
Potassium_mg	56	1435.67	4524.80	3079.0184	672.59305
Magnesium_mg	56	128.91	407.86	256.0436	53.42678
Sodium_mg	56	1004.57	3493.06	2249.1952	534.46802
Phosphorus_mg	56	629.65	1603.29	1189.1325	216.76376
Selenium_mcg	56	26.74	73.80	49.9671	11.58721
Zinc_mg	56	3.53	12.92	8.3864	1.94475
Alcoholic_Beverages_g	56	.00	237.88	29.2325	49.47659
Ceraels_and_Cereal_Products_g	56	70.98	475.35	244.1082	98.38973
Eggs_and_Egg_Dishes_g	56	.00	60.50	23.4821	18.69758
Fats_an_Oils_g	56	6.72	51.74	20.9373	9.07790

Fish_and_Fish_Products_g	56	.00	92.85	33.4239	20.44736
Fruit_g	56	14.70	957.80	245.3045	148.86316
Meat_and_Meat_Products_g	56	34.30	262.07	111.6827	47.62962
Mlik_and_Mlik_Products_g	56	146.00	600.70	298.8568	104.72239
Non_Alcoholic_Beverages_g	56	30.80	778.28	358.0029	154.22186
Nuts_and_Seeds_g	56	.00	31.90	9.7493	8.62428
Potatoes_g	56	26.32	353.69	104.1520	64.85013
Soups_and_Sauces_g	56	2.10	223.73	31.8175	32.19825
Sugars_Preserves_and_Snacks_g	56	8.82	129.67	63.8784	24.83472
Vegetables_g	56	56.25	289.00	122.3234	47.39352
Valid N (listwise)	56				

a. Gender = Female

Food Allergy Knowledge, Attitudes and Practice

Section 1 - Demographics:

Statistics

		Age	Gender	Education_Level	Do you have a food safety certification?
N	Valid	14	14	14	14
	Missing	0	0	0	0
Mean		3.57	1.86	1.36	1.50
Std. Deviation		.852	.363	.497	.519

Frequency Table

Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	18-24	2	14.3	14.3	14.3
	25-34	3	21.4	21.4	35.7
	35-54	8	57.1	57.1	92.9
	55+	1	7.1	7.1	100.0
	Total	14	100.0	100.0	

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	2	14.3	14.3	14.3
	Female	12	85.7	85.7	100.0
	Total	14	100.0	100.0	

Education_Level

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	High School	9	64.3	64.3	64.3
	College	5	35.7	35.7	100.0
	Total	14	100.0	100.0	

Do you have a food safety certification?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	7	50.0	50.0	50.0
	No	7	50.0	50.0	100.0
	Total	14	100.0	100.0	

Section 2 - Knowledge:

Frequency Table

A food allergy reaction occurs 24 hours after ingesting one of the 14 major food allergens

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	True	1	7.1	7.1	7.1
	False	13	92.9	92.9	100.0
	Total	14	100.0	100.0	

Individuals with food allergies can safely consume foods containing the offending allergen, as long as only a small amount is consumed

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	True	2	14.3	14.3	14.3
	False	12	85.7	85.7	100.0
	Total	14	100.0	100.0	

High temperatures, for example – deep frying, roasting and baking, can destroy the food allergen

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	True	2	14.3	14.3	14.3
	False	12	85.7	85.7	100.0
	Total	14	100.0	100.0	

Tree nuts, for example – almonds, Brazil nuts and cashew nuts, are similar to peanut allergy

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	True	9	64.3	64.3	64.3
	False	5	35.7	35.7	100.0
	Total	14	100.0	100.0	

Oil that has been previously used to cook foods containing nuts, eggs or fish can be used to cook food for food allergic individuals

		Frequency	Percent	Valid Percent	Cumulative Percent

Valid	True	1	7.1	7.1	7.1
	False	13	92.9	92.9	100.0
	Total	14	100.0	100.0	

If someone has an allergic reaction, it is correct to first offer water in order to dilute the allergen and stop the reaction

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	True	1	7.1	7.1	7.1
	False	13	92.9	92.9	100.0
	Total	14	100.0	100.0	

Allergen cross contamination of cooking utensils, can be prevented by rinsing with tap water

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	False	14	100.0	100.0	100.0

Removing allergenic food items (e.g. walnuts or peanuts) from a finished dish, will prevent the individual from having an allergic reaction

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	True	1	7.1	7.1	7.1
	False	13	92.9	92.9	100.0
	Total	14	100.0	100.0	

Cooking in unrefined oils, will not leave any traces of nut protein in the food

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	True	2	14.3	14.3	14.3
	False	12	85.7	85.7	100.0
	Total	14	100.0	100.0	

Bendryl, Sudafed and Pseudoephedrine are commonly used to treat severe food allergy reactions

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	True	1	7.1	7.1	7.1
	False	13	92.9	92.9	100.0
	Total	14	100.0	100.0	

Someone with a food allergy can die from eating any food containing the offending food allergen

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	True	14	100.0	100.0	100.0

A fever and headache are common symptoms experienced by individuals who are having a food allergy reaction

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	True	5	35.7	35.7	35.7
	False	9	64.3	64.3	100.0
	Total	14	100.0	100.0	

Section 3 - Practices:

Frequency Table

I check the ingredients list of food items, to see if they contain any food allergens.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Seldom	2	14.3	14.3	14.3
	Sometimes	1	7.1	7.1	21.4
	Always	11	78.6	78.6	100.0
	Total	14	100.0	100.0	

I am able to quickly identify if any ingredients in foods from the menu, contain any common food allergens, upon customer request?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Seldom	1	7.1	7.1	7.1
	Sometimes	2	14.3	14.3	21.4
	Often	3	21.4	21.4	42.9
	Always	8	57.1	57.1	100.0
	Total	14	100.0	100.0	

If a mistake is made when preparing a meal for a food allergic customer, I remake the food

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Always	14	100.0	100.0	100.0

I try to listen carefully, understand, and then answer customers' questions about food allergies or allergens in the food

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Often	2	14.3	14.3	14.3
	Always	12	85.7	85.7	100.0
	Total	14	100.0	100.0	

If a student has a food allergy, I communicate the allergen information to the chef to ensure that the food is prepared safely and is allergen-free

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Seldom	1	7.1	7.1	7.1
	Always	13	92.9	92.9	100.0
	Total	14	100.0	100.0	

While serving foods to customers with a food allergy, I separately handle allergen-containing plates and allergen-free plates to prevent cross-contact

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	1	7.1	7.1	7.1
	Always	13	92.9	92.9	100.0
	Total	14	100.0	100.0	

If I am unsure about the ingredients in a menu item, I still assure the customer that the food does not contain any allergens

		Frequency	Percent	Valid Percent	Cumulative Percent

Valid	Never	9	64.3	64.3	64.3
	Always	5	35.7	35.7	100.0
	Total	14	100.0	100.0	

When preparing food for a customer with food allergies, I pay more attention to safe food handling practices than when preparing food for a student without food allergies

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	3	21.4	21.4	21.4
	Sometimes	1	7.1	7.1	28.6
	Always	10	71.4	71.4	100.0
	Total	14	100.0	100.0	

When preparing fried food for students with a food allergy, I make sure that I change the oil in the deep fryer to prevent cross contact

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	2	14.3	14.3	14.3
	Seldom	1	7.1	7.1	21.4
	Always	11	78.6	78.6	100.0
	Total	14	100.0	100.0	

I wash my hands thoroughly with soap and water after coming into contact with any food allergens

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Often	1	7.1	7.1	7.1
	Always	13	92.9	92.9	100.0

	Total	14	100.0	100.0	

I use clean and sanitized equipment and utensils to prevent cross-contact between allergens

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Always	14	100.0	100.0	100.0

I use separate equipment for handling allergen-containing foods

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Sometimes	1	7.1	7.1	7.1
	Always	13	92.9	92.9	100.0
	Total	14	100.0	100.0	

I wear a fresh pair of gloves before preparing an allergen free meal

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Always	14	100.0	100.0	100.0

Section 4 - Differences:

Group Statistics

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Mean_Q5	Male	2	1.7500	.00000	.00000
	Female	12	1.7708	.09485	.02738

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
Mean_Q5	Equal variances assumed	2.414	.146	-.300	12	.769
	Equal variances not assumed			-.761	11.000	.463

```
T-TEST GROUPS=Gender(1 2)
 /MISSING=ANALYSIS
 /VARIABLES=Mean_Q6
 /CRITERIA=CI(.95)
```

Group Statistics

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Mean_Q6	Male	2	4.6923	.10879	.07692
	Female	12	4.4679	.33843	.09770

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
Mean_Q6	Equal variances assumed	.882	.366	.902	12	.385

	Equal variances not assumed			1.804	5.522	.125

/CRITERIA=CI(.95).

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
Mean_Q6	Equal variances assumed	.941	.351	.816	12	.430
	Equal variances not assumed			.816	9.974	.433

```
T-TEST GROUPS=Education_Level(1 2)
 /MISSING=ANALYSIS
 /VARIABLES=Mean_Q5
 /CRITERIA=CI(.95).
```

Group Statistics

	Education_Level	N	Mean	Std. Deviation	Std. Error Mean
Mean_Q5	High School	9	1.7593	.06514	.02171
	College	5	1.7833	.12638	.05652

Independent Samples Test

	Levene's Test for Equality of Variances	t-test for Equality of Means

		F	Sig.	t	df	Sig. (2-tailed)
Mean_Q5	Equal variances assumed	3.035	.107	-.478	12	.641
	Equal variances not assumed			-.398	5.211	.707

```
T-TEST GROUPS=Education_Level(1 2)
 /MISSING=ANALYSIS
 /VARIABLES=Mean_Q6
 /CRITERIA=CI(.95).
```

Group Statistics

	Education_Level	N	Mean	Std. Deviation	Std. Error Mean
Mean_Q6	High School	9	4.3846	.33750	.11250
	College	5	4.7077	.16677	.07458

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
Mean_Q6	Equal variances assumed	.839	.378	-1.984	12	.071
	Equal variances not assumed			-2.394	11.958	.034

```
ONEWAY Mean_Q5 BY Age
```

/STATISTICS DESCRIPTIVES

/MISSING ANALYSIS

/POSTHOC=TUKEY ALPHA(0.05).

Oneway ANOVA

Warnings

Post hoc tests are not performed for Mean_Q5 because at least one group has fewer than two cases.

Descriptives

Mean_Q5

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean			
					Lower Bound	Upper Bound		
18-24	2	1.7083	.05893	.04167	1.1789	2.2378	1.67	1.75
25-34	3	1.7778	.04811	.02778	1.6583	1.8973	1.75	1.83
35-54	8	1.7813	.10854	.03837	1.6905	1.8720	1.58	1.92
55+	1	1.7500	.	.	.	.	1.75	1.75
Total	14	1.7679	.08758	.02341	1.7173	1.8184	1.58	1.92

ANOVA

Mean_Q5

	Sum of Squares	df	Mean Square	F	Sig.

Between Groups	.009	3	.003	.336	.800
Within Groups	.091	10	.009		
Total	.100	13			

```
ONEWAY Mean_Q6 BY Age
 /STATISTICS DESCRIPTIVES
 /MISSING ANALYSIS
 /POSTHOC=TUKEY ALPHA(0.05).
```

Warnings

Post hoc tests are not performed for Mean_Q6 because at least one group has fewer than two cases.

Descriptives

Mean_Q6

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean			
					Lower Bound	Upper Bound		
18-24	2	4.4615	.21757	.15385	2.5067	6.4163	4.31	4.62
25-34	3	4.6410	.11750	.06784	4.3491	4.9329	4.54	4.77
35-54	8	4.4327	.40483	.14313	4.0942	4.7711	3.62	5.00
55+	1	4.6923	.	.	.	.	4.69	4.69
Total	14	4.5000	.32320	.08638	4.3134	4.6866	3.62	5.00

ANOVA

Mean_Q6

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.136	3	.045	.371	.776
Within Groups	1.222	10	.122		
Total	1.358	13			