The impact of the Royal Prince Alfred Hospital Elimination Diet on diet quality and nutritional adequacy

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The research presented in this report was conducted by the candidate under the guidance of the supervisors above. I Imogen Hooper (the candidate) contributed to assessment form design and the development of recruitment and data collection protocols. I also recruited participants, and collected and entered data with assistance from Anna-Jane Debenham; and independently undertook data analysis.

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Declaration

1. I, *Imogen Hooper*, hereby declare than no work presented in this report has been submitted to any other University or Institution for a higher degree and that to the best of my knowledge contains no materials written or published by another person, except where due reference is made in text.
2. The studies described in this report were approved by the Ethics Review Committee (RPAH Zone) of the Sydney Local Health District, and all subjects gave informed consent before participating.

Signature

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The aim of this study was to assess and compare dietary intake and nutritional adequacy of patients at the RPAH Allergy Unit before their initial appointment and during their time on the RPAH elimination diet.

Patients were called one week prior to their initial appointment at the RPAH Allergy Unit to ascertain suitability and interest for the study. A suitable candidate was one who was suffering from symptoms suspected to be food intolerance related, over the age of 16, and had never undertaken the RPAH elimination diet before. 4-day weighed food records were used to record candidates' dietary intake, which included supplement use, both before and on the elimination diet. Data was combined with early 2014 and 2013 data for analysis. Dietary intake was analysed in FoodWorks7 and compared to the Australian and New Zealand Nutrient Reference Values (NRV) and the Australian Guide to Healthy Eating (AGHE) recommendations.

116 before elimination diet WFRs were analysed and 31 on-elimination diet WFRs were analysed. The study showed an improvement in the average consumption of the recommended serves of core food groups for the on elimination diet group from 61% to 82%. There was a marked decrease in the average consumption of discretionary items by those on the elimination diet from 130% of maximum serves allowed to 90%. Micronutrient intake exceeded the Recommended Dietary Intake and Estimated Average Requirement values for both before and on elimination diet groups for most micronutrients but there were inadequate intakes of folate and calcium, which improved on the elimination diet.

The study shows those on the elimination diet do not face adverse nutritional implications overall. In fact, their diets demonstrate a more closely aligned intake to the AGHE recommendations and NRVs

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Imogen Hooper was the primary author involved in recruitment, data collection, entry and analysis, and writing the manuscript. Anna-Jane Debenham and Kristy-Lee Raso contributed to recruitment, data collection and data entry. Dr Robert Loblay, Dr Anne Swain, Brooke McKinnon, Carling Chan and Kirsty Le Ray were responsible for the study design and supervision.

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Abstract

Aim: The aim of this study was to assess and compare dietary intake and nutritional adequacy of patients at the RPAH Allergy Unit before their initial appointment and during their time on the RPAH elimination diet.

Method: Patients were called one week prior to their initial appointment at the RPAH Allergy Unit to ascertain suitability and interest for the study. A suitable candidate was one who was suffering from symptoms suspected to be food intolerance related, over the age of 16, and had never undertaken the RPAH elimination diet before. 4-day weighed food records were used to record candidates' dietary intake, which included supplement use, both before and on the elimination diet. Data was combined with early 2014 and 2013 data for analysis. Dietary intake was analysed in FoodWorks7 and compared to the Australian and New Zealand Nutrient Reference Values (NRV) and the Australian Guide to Healthy Eating (AGHE) recommendations.

Results: 116 before elimination diet WFRs were analysed and 31 on-elimination diet WFRs were analysed. The study showed an improvement in the average consumption of the recommended serves of core food groups for the on elimination diet group from 61% to 82%. There was a marked decrease in the average consumption of discretionary items by those on the elimination diet from 130% of maximum serves allowed to 90%. Micronutrient intake exceeded the Recommended Dietary Intake and Estimated Average Requirement values for both before and on elimination diet groups for most micronutrients but there were inadequate intakes of folate and calcium, which improved on the elimination diet.

Conclusion: The study shows those on the elimination diet do not face adverse nutritional implications overall. In fact, their diets demonstrate a more closely aligned intake to the AGHE recommendations and NRVs.

Introduction

Key words: Food chemical intolerance, nutritional adequacy, dietary intake

Introduction

Food chemical intolerance is a non-immune reaction to specific chemicals within food[1]. The symptoms of food intolerance manifest in the GI tract, skin respiratory tract and/ or the central nervous system[1,2]; giving rise to symptoms which include angioedema, rashes, hives, vomiting, swelling, asthma, migraines and headaches[1-3.] The chemicals responsible for these reactions can be naturally occurring (e.g. salicylates, amines and glutamates), additives from the manufacturing process (e.g. colours, flavours and preservatives) and from foods containing soy, gluten and dairy[1-5]. Individuals present with reactions that are idiosyncratic in severity, onset and frequency[1,3]. As chemical intolerance symptoms and triggers manifest in such individualised patterns, patients undertake the RPAH elimination diet and challenge protocol (RPAH ED&CP) to identify their individual dietary triggers. An elimination diet and challenge protocol is considered to be the gold standard in detecting food chemical intolerances[6]. The RPAH ED&CP, has three levels of restriction; strict, moderate and simple, which eliminate sources of naturally occurring and added chemicals to varying degrees[5]. Some patients, particularly those with GI symptoms, may also be required to eliminate dairy, soy and gluten from the diet.

For any condition requiring dietary restriction, the nutritional adequacy of the diet should be considered. While diagnostic diets such as the RPAH ED&CP are generally only used in their strictest form for a short period, ensuring nutritional adequacy of micro and macro nutrients is nevertheless important, whilst undertaking the elimination diet, and also in the long term for those who identify food intolerances and will need to follow a limited diet over the longer term to control their symptoms[8,9].

In Australia, nutritional adequacy is most frequently measured by comparing nutrient intakes with the Australian and New Zealand Nutritional Reference Value (NRV) recommendations, which assess whether macronutrient intake is within Acceptable Macronutrient Distribution

Ranges (AMDR) for protein, fat and carbohydrates; and whether micronutrient intake is meeting the Recommended Dietary Intake (RDI), Estimated Average Requirements (EAR) and/or Adequate Intake (AI) and Upper Level (UL) intake for the correct age and gender category[10]. Diet quality may be assessed by comparing food and drink intake to the Australian Guide to Healthy Eating food group recommendations[11-14]. By examining nutritional adequacy and diet quality, this study aims to provide information which will better equip clinicians to advise and ensure nutritional adequacy for patients undertaking the RPAH ED&CP.

The results from this current research can be combined with previous research undertaken in 2014 which examined the nutritional adequacy of patient's 'usual' diet prior to their first appointment at the RPAH Allergy Unit, using the same data collection method and analysis techniques. However, this study extends the scope of previous research by examining the nutritional adequacy of patients' dietary intake both prior to their first appointment as well as during the period in which they are undertaking the elimination diet. The comparison of dietary adequacy at two time points will provide information on the nutritional adequacy of the elimination diet.

Method

This study was carried out at the RPAH Allergy Unit using prospective observational data collected by the University of Sydney student research dietitians. The study was approved by the Ethics Review Committee (RPAH Zone) of the Sydney Local Health District, protocol no: X13-0208 & LNR/13/RPAH/249. Data collected by previous student researchers Neubauer[15] and Dynana & McGirr[16] was combined with data from this study period for analysis.

The recruitment stage of the study was carried out by research dietitians, who called prospective patients one week prior to their initial appointment date to ascertain suitability and interest to participate in the study. A copy of the inclusion criteria and exclusion criteria is

included in appendix 1. Those identified as suitable for the study were sent an information pack via email or post which included a 4-day weighed food record (WFR) template to be completed prior to their initial appointment. The patient could choose to complete this in hard copy, or using the Australian Calorie Counter – Easy Diet Diary (Xyris software, Brisbane, Australia) app on their iOs device to record their food intake. The WFR asked for quantities, brands and cooking methods of the foods and drink the patient consumed over a 4 day period. Upon presentation to the unit patients had their weight and height recorded using floor scales and a stadiometer. Completed WFRs were collected, checked for missing data and/or clarified as required.

The patient was then assessed by the doctor and if suitable, proceeded to the dietitian for instructions on the elimination diet. For those that were prescribed the elimination diet, a second WFR was collected 3 weeks after starting the elimination diet. Food Works (Professional Version7, Xyris software, Brisbane, Australia. Databases AUSNUT 2007, NUTTAB 2010, AUSFOODS 2012, and AUSBRANDS 2012) were used to analyse the completed food diaries. The overall nutritional adequacy of their diet was assessed by comparing the Estimated Energy Intake (EEI) against the Estimated Energy Requirements (EER), and macro and micronutrient intakes to the NRVs suitable for the individual's age and gender. The EAR, RDI, AI and/or UL of intake values of nutrients were used to benchmark adequate nutritional intake. The energy contributions from protein, fat and carbohydrates were compared to the AMDR values to assess the overall macronutrient distribution of the patients' diets. Microsoft Excel spread sheet format (Appendix 2) was used to code all dietary intake into a core food group (fruit, vegetables, grains and cereals, meat and alternatives, dairy and alternatives) or a non-core food group (discretionary foods and excess unsaturated fats and oils) as stipulated by the AGHE. The number of serves consumed within each food group was compared to the AGHE serve recommendations for the appropriate age and gender category. As per the AGHE guidelines, only one serve of fruit juice was coded as ; fruit' per day; excess

fruit juice consumed was coded as discretionary. The same was applied for excess intake of unsaturated oils and spreads. Legume intake was added either to the total vegetable group intake, or to the total meat and alternatives intake, being allocated to the group with the lowest total intake, or, if both groups were equal, the amount was distributed across both groups. While the AGHE was used as a guide to code foods into their appropriate food group, clinical judgement was used if there was uncertainty about a particular food item. For example, mixed dishes that were not considered discretionary foods were coded by ingredients as per the recipe provided by the patient, and when not available a standardised recipe created by the researchers was used.

Results

Between May and September 2014, a total of 538 patients were called. Of this number, 130 were un-contactable after 3 call attempts, 184 met inclusion criteria and accepted further information on the study, 191 declined to take part in the study and 33 were unsuitable, cancelled or rescheduled their appointments. A total of 83 WFRs were collected from patients who agreed to take part in the study over this time period. There was a total of 147 WFR used for analysis in this study after data was combined with the earlier 2014 and 2013 research. 116 of these were before elimination diet WFRs and 31 of these were on-elimination diet WFRs (Appendix 3).

Of those who gave a WFR whilst on the elimination diet, 74% were following the strict elimination diet and 45% were avoiding dairy, soy and gluten. Any vitamin and mineral supplements consumed were included in the analysis of dietary intake. In the before elimination diet group 22% of patients supplemented their diet with a vitamin and mineral supplement, 52% supplemented their diet on the elimination diet.

Patients' initial diet before presenting to the RPAH Allergy Unit

Estimated Energy Intake

On average, patients were meeting 77% of EER before commencing the elimination diet (data not shown). 41% of patients had an EEI <70% of EER and 11% had an EEI of >100% EER.

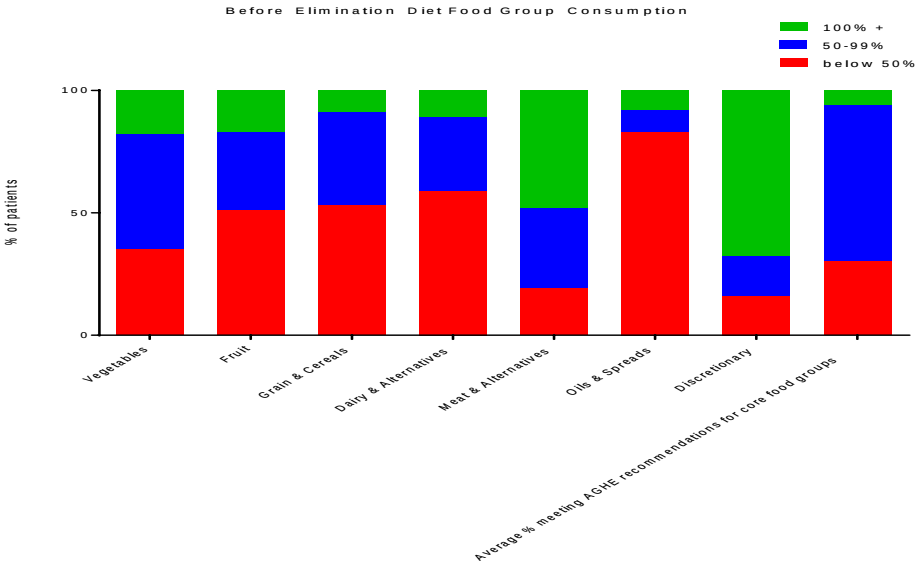
Food Groups

Graph 1a (Figure 1) shows the percentage of patients consuming below 50%, within 50-99% and 100% or greater of the AGHE recommendations. The average recommended serves consumed for vegetables, fruit and grains and cereals, dairy and alternatives and meat and alternatives consumed were 65%, 55%, 51%, 48% and 91% respectively. Average unsaturated oils and spreads consumption was 26% of the maximum serve allowance. Average discretionary food consumption was 144% of the maximum serve allowance. The majority of patients (69%) consumed >100% of the maximum serve allowance of discretionary foods. 30% of patients were consuming below 50% of the recommended number of serves for all core food groups.

Nutrients

Graph 1b (Figure 1) shows the percentage of EAR met by patients that provided a before elimination diet WFR (n=116). All micronutrients exceeded 100% of the EAR except for calcium (78%). All nutrients exceeded 100% RDI except for folate (84%) and calcium (65%). Potassium and sodium, for which an AI value and UL value were used, met 105% of the AI and 89% of the UL respectively.

(1a)



(1b)

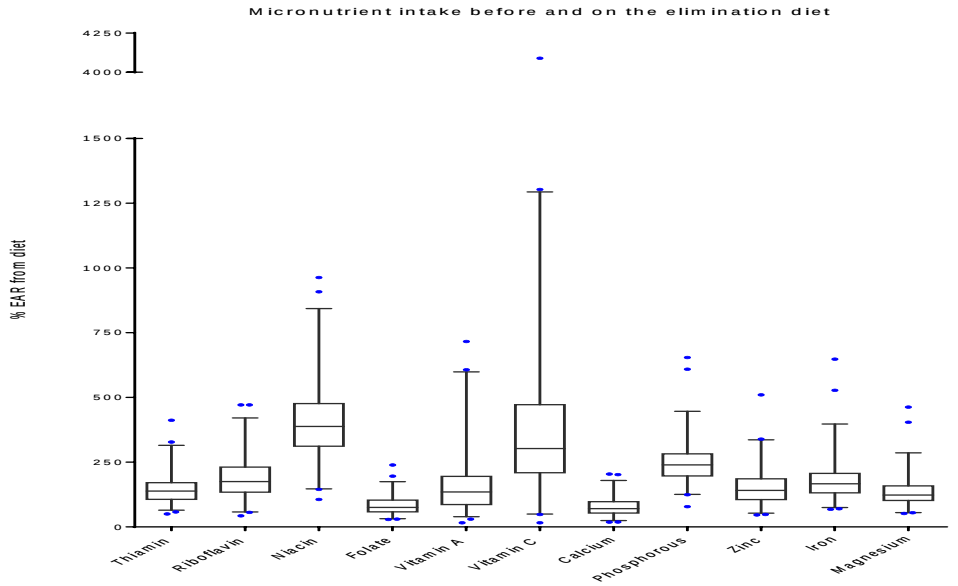


Figure 1. (Above) Total patients n=116 1a: Percentage of before elimination diet patients meeting Australian Guide to Healthy Eating (AGHE) food group recommendations, as well as all core food group recommendations; 1b: Percentage Estimated Average Requirement (EAR) of micronutrients being met from total dietary intake before elimination diet. Box showing median and interquartile range. Whiskers showing 10-90 percentiles, outliers shown by •

Patients on the elimination diet at the RPAH Allergy Unit

The initial dietary intake of patients who provided both an initial and on elimination diet WFR (n=31) were found to be representative of the total initial group (n=116) (Appendix 4) as indicated by nutrient and food group intake (Appendix 5).

Estimated Energy Intake

On average patients on the elimination diet met 78% of EER, 5% had an EEI of <70% EER, and 16% reported an EEI of >100% EER.

Food Groups

Table 1 shows the average intake and differences in the consumption of AGHE food group serve recommendations in the diets of patients both before and on the elimination diet. When comparing before and on the elimination diet, the average serve recommendations met increased in vegetables (67% to 98%), grains and cereals (52% to 63%), dairy and alternatives (43% to 48%), unsaturated oils and spreads (21% to 31%) and meat and alternatives (88% to 160%). Discretionary food intake decreased from 130% to 90% of the maximum recommended serves allowance. The percentage of people consuming ≥100% of maximum discretionary food allowance decreased from 61% to 42%. The percentage of people meeting recommendations for all five core food groups increased from 61% to 82%.

		Patients consuming <50% AGHE serve recommendations (%)	Patients consuming 50-99% AGHE serve recommendations (%)	Patients **consuming ≥** 100% AGHE serve recommendations (%)	Mean number of serves consumed compared to AGHE recommendations (%)
Vegetables	Before ED	35	35	29	67
	On ED	29	48	23	98
Fruit	Before ED	45	45	10	53
	On ED	55	39	6	45
Grains & cereals	Before ED	48	42	10	52
	On ED	39	45	16	63
Dairy & alternatives	Before ED	10	19	71	43
	On ED	19	19	61	48
Meat & alternatives	Before ED	13	45	42	88
	On ED	6	29	65	160
Unsaturated oils & spreads	Before ED	84	10	6	21
	On ED	74	13	13	36
Discretionary	Before ED	23	16	61	130
	On ED	26	32	42	90
Consuming ≥ 100% of all core food group AGHE serve recommendations	Before ED	26	74	0	61
	On ED	16	35	16	82

Table 1. Total patients n=31, average percentage AGHE food group recommended serves consumed by patients before elimination diet (Before ED) and on elimination diet (On ED)

Nutrients

Acceptable Macronutrient Distribution Range

Table 2 shows the macronutrient intake of patients before and on the elimination diet according to the AMDRs. The proportion of patients consuming within the AMDR increased from 58% to 68%. The proportion of patients consuming within the AMDRs for fat and carbohydrates decreased from 77% to 52%, and 48% to 26% respectively. The proportion of patients receiving >35% energy from fat increased from 5% before the elimination diet to 15% on the elimination diet. No patients exceeded the upper limit of the AMDR for carbohydrate intake in either before or on the elimination diet groups.

	Before ED (%)	On ED (%)
<15% Energy protein	13	16
15-25% Energy protein	58	68
>25% Energy protein	29	16
<20% Energy fat	6	0
20-35% Energy fat	77	52
>35% Energy fat	16	48
<45% Energy carbohydrate	52	74
45-65% Energy carbohydrate	48	26
>65% Energy carbohydrate	0	0

Table 2. Total patients n=31, Acceptable Macronutrient Distribution Range (AMDR) distribution before elimination diet (Before ED) and on elimination diet (On ED)

Micronutrients

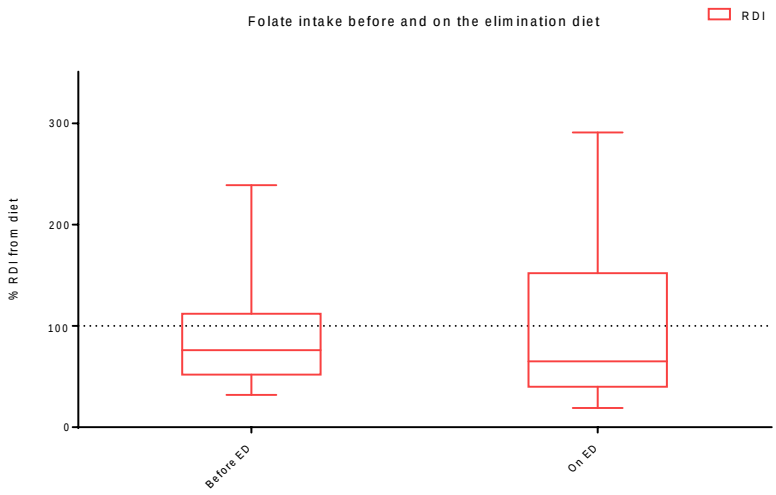
Table 3 shows micronutrient intakes where both before and on elimination diet patients were meeting RDI and EAR requirements. While both groups met intake requirements for thiamin, riboflavin, niacin and vitamin C these micronutrients were consumed on average at least four times the EAR by the on elimination diet group (926%, 711%, 475% and 411% respectively), while phosphorous, zinc and iron were consumed on average at least two times the EAR by the on elimination diet group (234%, 208% and 214%).

		EAR (%)	RDI (%)	AI (%)
Thiamin	Before ED	146	120	-
	On ED	926	764	-
Riboflavin	Before ED	192	158	-
	On ED	711	590	-
Niacin	Before ED	404	314	-
	On ED	475	370	-
Vitamin A	Before ED	188	133	-
	On ED	150	106	-
Vitamin C	Before ED	394	263	-
	On ED	411	274	-
Phosphorous	Before ED	245	147	-
	On ED	234	140	-
Zinc	Before ED	143	112	-
	On ED	208	171	-
Iron	Before ED	178	112	-
	On ED	214	128	-
Magnesium	Before ED	131	109	-
	On ED	129	106	-
Potassium	Before ED	-	-	101
	On ED	-	-	107

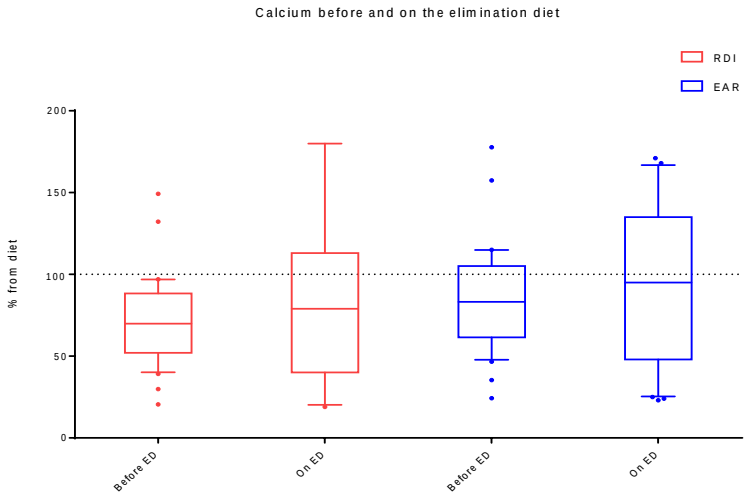
Table 3. Average percentage Estimated Average Requirement (EAR) and Recommended Dietary Intake (RDI) of micronutrients meeting requirements before elimination diet (Before ED) and on elimination diet (On ED)

Figure 2 shows average micronutrient intakes, which were not meeting the RDI or EAR requirements in patient's diets before the elimination diet, with the exception of folate EAR (105%). The data shows the extent of improvement in consumption of these micronutrients for patients on the elimination diet. Figures 2a shows the average intake for folate on the elimination diet increased from 84% to 125% of the RDI. Figure 2b shows the impact of the elimination diet on the average EAR and RDI intake of calcium. Before the elimination diet, patients were meeting 83% of EAR and 70% of RDI for calcium. On the elimination diet these values increases to 97% of EAR and 82% of RDI. Figure 2c shows the impact of the elimination diet on sodium intake. Before the elimination diet, sodium was being consumed at 93% of the recommended UL, but dropped to 45% for the on elimination diet group.

(2a)


Folate intake before and on the elimination diet
RDI
% RDI from diet
300
200
100
0
Before ED
On ED

(2b)


Calcium before and on the elimination diet
RDI
EAR
% from diet
200
150
100
50
0
Before ED
On ED
Before ED
On ED

(2c)

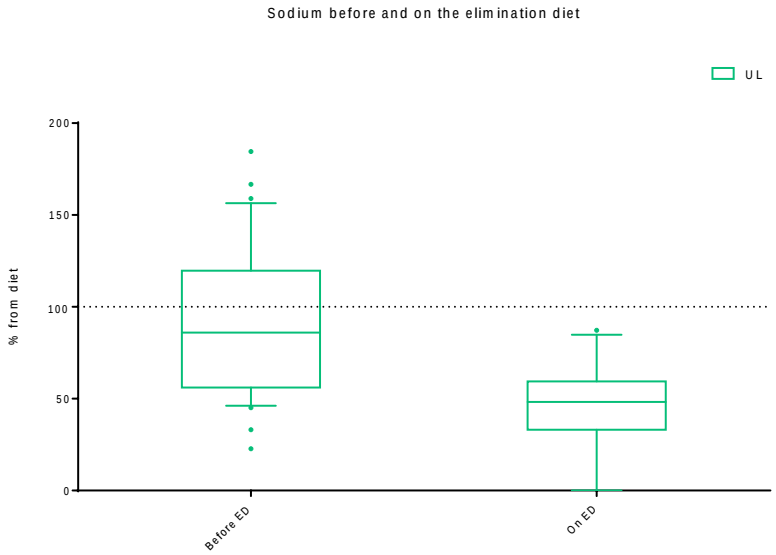

Sodium before and on the elimination diet
UL
% from diet
200
150
100
50
0
Before ED
On ED

Figure 2. Total patients before and on elimination diet n=31 (2a) Percentage Recommended Dietary Intake (RDI) of calcium consumed before (before ED) and on the elimination diet (on ED); (2b) Percentage RDI and Estimated Average Requirement (EAR) of calcium consumed before and on the elimination diet; (2c) Percentage Upper Level (UL) of sodium consumed before and on the elimination diet. Box showing median and interquartile range. Whiskers showing 10-90 percentiles, outliers shown by •

Discussion

Overall, patients following the elimination dietary guidelines demonstrated an improved quality of diet when compared to their 'normal' diet as indicated by meeting NRVs and improved AGHE recommendation intake.

Patients' dietary intake before commencing the elimination diet showed that overall there was an inadequate consumption of all AGHE food group recommendations. Patients were over consuming maximum recommended discretionary serve allowances (130%), and under consuming recommended serves for all core food groups (0%) before the elimination diet. When comparing the elimination diet to their before elimination diet intakes, there was an increase in the average serve consumption of all core food groups (61% to 82%) and an increase in percentage of those meeting all AGHE core food group recommendations (16%), which resulted in patients on the elimination diet being closer to the AGHE recommendations than before starting the elimination diet.

Vegetable food group average serves consumed increased from 67% before the elimination diet to 98% on the elimination diet, an encouraging result. However, in comparison to the evaluation of the 1995 NNS findings by[17,18] that 30% of Australian adults are consuming all 5 recommended serves of vegetables, there are still large inadequacies in the consumption patterns of this studies patients, with only 23% meeting 100% of recommended serves.

Average serves of fruit consumed on the elimination diet decreased from 53% to 45%, this result is unsurprising given the variety of fruits available on the elimination diet is decreased to varying degrees depending on the level of dietary restriction.

Grains and cereals average serves consumed improved from 52% to 63% despite more restrictions on the consumption of gluten. Those meeting recommendations for the grains and cereals food group increased from 10% to 16% but fell short of matching the percentage of the Australian population meeting recommendations (21%)[19].

Dairy and alternative average consumption of recommended serves improved from 43% to 48% on the elimination diet whereas the Australian adult population on average only met 37% of recommendations[20].

Meat and alternatives average consumption of recommended serves majorly increased from 88% to 160%, the majority of patients met their recommendations for this food group (65%). Contrary to the restriction of a lot of foods on the elimination diet, fresh meat and fish products are unrestricted and perhaps the increase seen in consumption is a representation of the substitution of restricted foods by meat products.

Maximum allowance of discretionary food items consumption decreased from 130% to 90%. The elimination diet limits the intake of many additives (and sometimes gluten, dairy and soy) and this results in the decreased availability of discretionary foods in particular.

On average, these results reveal that the elimination diet provides a diet more closely aligned with the majority of AGHE food group recommendations.

Macronutrient intake of patients before the elimination diet show the majority of patients had protein and fat intakes within the respective AMDRs, which is reflective of the NNS findings for the general Australian population[17]. However both fat and protein macronutrient contributions to energy increased on the elimination diet. This finding could possibly be accounted for when

the increased consumption of meat and alternatives and unsaturated oils and spreads are considered (Table 1).

Micronutrient intake shows that patients both before and on the elimination diet were meeting the RDIs and EARS for thiamin, riboflavin, niacin, vitamin A, vitamin C, phosphorous, zinc, iron and magnesium. Patients were also meeting the AI for potassium and not exceeding the UL for sodium (Table 3). On average, patients before and on the elimination diet did not meet the RDI for folate, although the EAR was met. The before elimination diet group did not meet the RDI or EAR for calcium. On the elimination diet, patients' folate intake was improved to exceed RDI from 84% to 174%. Calcium intake improved on the elimination diet, but still fell short of meeting EAR and RDI recommendations. These findings are similar to the NNS results, which showed that Australian adults generally have sufficient micronutrient intake, except for calcium[17]. The effect of dairy, soy and gluten restriction may have contributed to these results but will need to be further examined in future studies.

Patient total dietary intakes included food and supplement intake. The increase in supplement consumption (225 of patients before the elimination diet vs. 52% of patients on the elimination diet) may account for the large values of some micronutrients such as thiamin, riboflavin, niacin and vitamin C, which were recorded at an average intake of at least four times the EAR on the elimination diet (Table 3). Importantly average sodium intake was decreased from 93% of the UL to 45% on the elimination diet. This is despite table salt being an option for people on the elimination diet. This decrease was likely due to the decreased intake of discretionary food items as these items are often the main contributors of sodium in the diet[21]. Notably, a 40% decrease in sodium intake was found in a similar study by Soutar[22], and attributed to a decreased consumption in the processed food and bread.

The majority of patients both before and on the elimination diet consumed carbohydrates at lower than the recommended AMDR of 45-65% of energy intake (Table 2). This result is in line with the consumption levels of the majority of Australian adults[17]. However, may be in part explainable by their consumption of grains and cereals, and dairy and alternatives at lower than the AGHE recommendations. It is possible that intake may be further impacted by the additional dietary restrictions of dairy, soy and gluten.

Conclusion

The findings of this research show that those on the elimination diet have nutritional intakes that are generally better than before the elimination diet. Patients on the elimination diet demonstrated diets more closely aligned with the AGHE food group recommendations and, on average, demonstrated an increased in meeting the NRV recommendations of folate.
This research demonstrates that AGHE food group serve recommendations are not necessarily a sole marker for overall nutritional adequacy, nor is assessing NRVs. While no patient's, met all AGHE food group recommendations, almost all patients met micronutrient requirements and demonstrated macronutrient contributions to energy intake that lie within the AMDRs.

Average energy intake before and on the elimination diet was meeting only 77-78% of EER. While this appears to be a significant under consumption, the NNS estimates that adult males and females may generally under report by as much as 21%, as they desire to show dietary intakes that seem more aligned with a 'healthy' diet[17]. There was also room for error in this study with those patients using the Easy Diet Diary iOs application, because it did not allow for recipes or supplements to be recorded, and there can be large variances in similar dishes/foods available to choose from. Effort was made to ensure all WFRs that were collected were double-checked for missing information with clarification of supplement intake, physical activity levels and cooking methods. Whilst there maybe underreporting in energy

intake for both before and on elimination diet groups, it seems to be at the same level with the before elimination diet group reporting and average intake of 77% and the on elimination diet group reporting an average intake of 78%.

It is recommended that future research assess the impact of supplements on the nutritional adequacy of the elimination diet. The information gathered would be useful in determining the need for multivitamin and mineral supplements during the elimination diet. With further recruitment, the impact of varying degrees of dietary restriction of gluten, dairy and soy will further inform dietary advice.

The results of this study provide information useful in the advice/recommendations given to those undergoing the RPAH ED&CP.

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Conflict of interest

There is no conflict of interest to report.

Authorship

Imogen Hooper was the primary author involved in recruitment, data collection, entry and analysis, and writing the manuscript. Anna-Jane Debenham and Kristy-Lee Raso contributed to recruitment, data collection and data entry. Dr Robert Loblay, Dr Anne Swain, Brooke McKinnon, Carling Chan and Kirsty Le Ray were responsible for the study design and supervision.

References

1. Hodge L, Swain A, Faulkner-Hogg K. Food Allergy and Intolerance. Clinical Practice. 2009; 38(9): 705-707.
2. Partriarca G, Schiavino D, Pecora V, Lombardo C, Pollastrini E, Aruanno A, Sabato V, Colagiovanni A, Rizzi A, DePasquale T, Roncallo C, Decinti M, Musumeci S, Gasbarrini G, Alessandro B, Nucera E. Food Allergy and Food Intolerance: Diagnosis and Treatment. Journal of International Emergency Medicine. 2009; 4: 11-24.
3. Hayder H, Mueller U, Bartholomaeus A. Review of Intolerance Reactions to Food Additives. International Food Risk Analysis Journal. 2011; 1(2): 23-32.
4. Loblay R, Swain A. Recent Advances in Clinical Nutrition. Vol 2. London: Libbey Books; 1986. Food Intolerance; p.169-177.
5. Swain A, Soutter V, Loblay R. RPAH elimination diet guide with food & shopping guide. Sydney: Allergy Unit, Royal Prince Alfred Hospital; 2011.
6. Soutar J. Nutritional Assessment of Elimination Diets in Patients with Food Allergy and Food Intolerance [Masters Research Project]. RPAH, NSW. University of Sydney; 1996.
7. Chiu A. Nutritional Adequacy and Dietary Compliance in Children and Adults on Elimination Diets [Masters Research Project]. RPAH, NSW. University of Sydney; 1997.
8. Shepherd S, Gibson P. Nutritional Inadequacies of the Gluten-free Diet in both Newly Diagnosed and Long-term Patients with Coeliac Disease. Journal of Human Nutrition and Dietetics. 2013; 26(4): 349-358.
9. Schatzkin A, Graubard B, Schairer C. A Prospective Study of Diety Quality and Mortality in Women. Journal of the American Medical Association. 2000; 283(16): 2109-2115.
10. Wirt A, Collins C. Diet Quality – What is it and does it matter? Public Health Nutrition. 2009; 12: 2473-2492.
11. Drewnowski A. Concept of a nutritious food: toward a nutrient density scale. Journal of Clinical Nutrition. 2005; 82(4): 721-732.
12. Foote J, Murphy S, Wilkens L, Basiotis P, Carlos A. Dietary Variety Increases the Probability of Nutrient Adequacy Among Adults. The Journal of Nutrition. 2004; 134: 1779-1785.
13. The Australian & New Zealand Nutrient Reference Values [Internet] (Cited Aug 15, 2014) Available from: http://www.nrv.gov.au/

14. The Australian Dietary Guidelines [Internet] (Updated 29 July, Cited Aug 15, 2014) Available from: https://www.nhmrc.gov.au/guidelines/publications/n55
15. Neubauer A. Dietary Intake and Nutritional Adequacy among adults with suspected food intolerance before their initial appointment at the RPAH Allergy Unit. University of Sydney; 2014. p. 1-20.
16. Dynan N, McGirr C. Nutritional Adequacy , Dietary Habits and Psychological Characteristics of Patients Presenting to the Royal Prince Alfred Hospital Allergy Unit. University of Sydney; 2013. p. 9–11.
17. Australian Bureau of Statistics. National Nutrition Survey: Nutrient Intakes and Physical Measurements, Australia, 1995 [Internet]. National Nutrition Survey: Nutrient Intakes and Physical Measurements, Australia, 1995. 1998 [cited 2014 October 26]. Available from: http://www.abs.gov.au/ausstats/abs@.nsf/Latestproducts/4805.0Main Features11995?opendocument&tabname=Summary&prodno=4805.0&issue=1995&num=&view=
18. Margarey S, McKean S, Daniels L. Evaluation of fruit and vegetable intakes of Australian adults: the National Nutrition Survey 1995. Australian and New Zealand Journal of Public Health 2006; 30: 32-7.
19. Flight I, Clifton P. Cereal grains and legumes in the prevention of coronary heart disease and stroke: a review of the literature. Eur J Clin Nutr [Internet]. 2006 Oct [cited 2014 May 26];60(10):1145–59. Available from: http://www.ncbi.nlm.nih.gov/pubmed/16670693
20. Doidge JC, Segal L. Most Australians do not meet recommendations for dairy consumption: findings of a new technique to analyse nutrition surveys. Aust N Z J Public Health [Internet]. 2012 Jun [cited 2014 May 26];36(3):236–40. Available from: http://www.ncbi.nlm.nih.gov/pubmed/22672029
21. Rangan A, Schindeler S, Hector D, Gill T, Webb K. Consumption of “extra” foods by Australian adults: types, quantities and contribution to energy and nutrient intakes. *Eur J Clin Nutr* 2009; 63: 865–71.
22. Soutar J. Nutritional assessment of elimination diets in patients with food allergy and food intolerance. University of Sydney; 1996.

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NSW GOVERNMENT Health Sydney Local Health District

(Date)

SCREENING QUESTIONNAIRE AND RECRUITMENT TELEPHONE SCRIPT

Nutritional Adequacy and Factors Influencing Dietary Compliance in Children and Adults on the RPAH Elimination Diet

Hello_____.|

My name is _____ and I am a student dietitian from the RPAH Allergy Unit. I am calling about your/your child's upcoming appointment at the allergy unit on (date) and (time). Are you still able to attend?

Yes / No → OK, would you like me to cancel this appointment or arrange for one of the secretaries to call you to organise another time?

↓

Thank you. I will record that you have confirmed this appointment. I'd also like to let you know about a study we are conducting to assess the nutritional adequacy of the Elimination Diet we use for food intolerance.

There is no obligation for you to be involved but I can tell you more about it if you think you might be interested?

Yes / No → Thank you, that is fine. Your appointment has been confirmed and you will receive an email with additional details. Please read this before you attend the clinic as it has important information in it. We look forward to seeing you then.

↓

Ok, firstly can I just ask a few details so I can tell whether you/your child qualifies for the study?

What is the main reason for attendance?

↓

Inclusion criteria – any initial patients likely to go on the Elimination Diet, i.e. those with:
Urticaria/angioedema
Eczema
Irritable bowel syndrome
Migraine
Food reactions
Symptoms suspected to be food related

Exclusion Criteria – anyone who has seen a dietitian at the Allergy Unit previously for Food Intolerance and/or has done the Elimination Diet under a dietitian's care

Suitable /Not suitable → From the information you have told me, it looks like the study may not be suitable for you. Thank you for taking the time to speak to me. Your appointment has been confirmed and you will receive a reminder email with additional details. Please read this before you attend the clinic as it has important information in it. We look forward to seeing you then.

↓

It looks like the study may be suitable for you/your child. Briefly, the study will be assessing the nutritional adequacy of your/your child's diet. This will involve keeping a detailed food diary for a short period of time before your first appointment and then again on follow up. We will also be assessing general health, eating habits and quality of life which will require you to fill out some questionnaires when you attend the Allergy Unit.

Participation in this research is voluntary. If you don't want to take part, you don't have to. If you decide to take part and later change your mind, you're free to withdraw from the study at any stage. Whether you decide to participate or not will not affect the treatment you/your child receives, your relationship with Royal Prince Alfred hospital or those caring for you at the Allergy Unit.

Would you like me to post you some more information about the study?

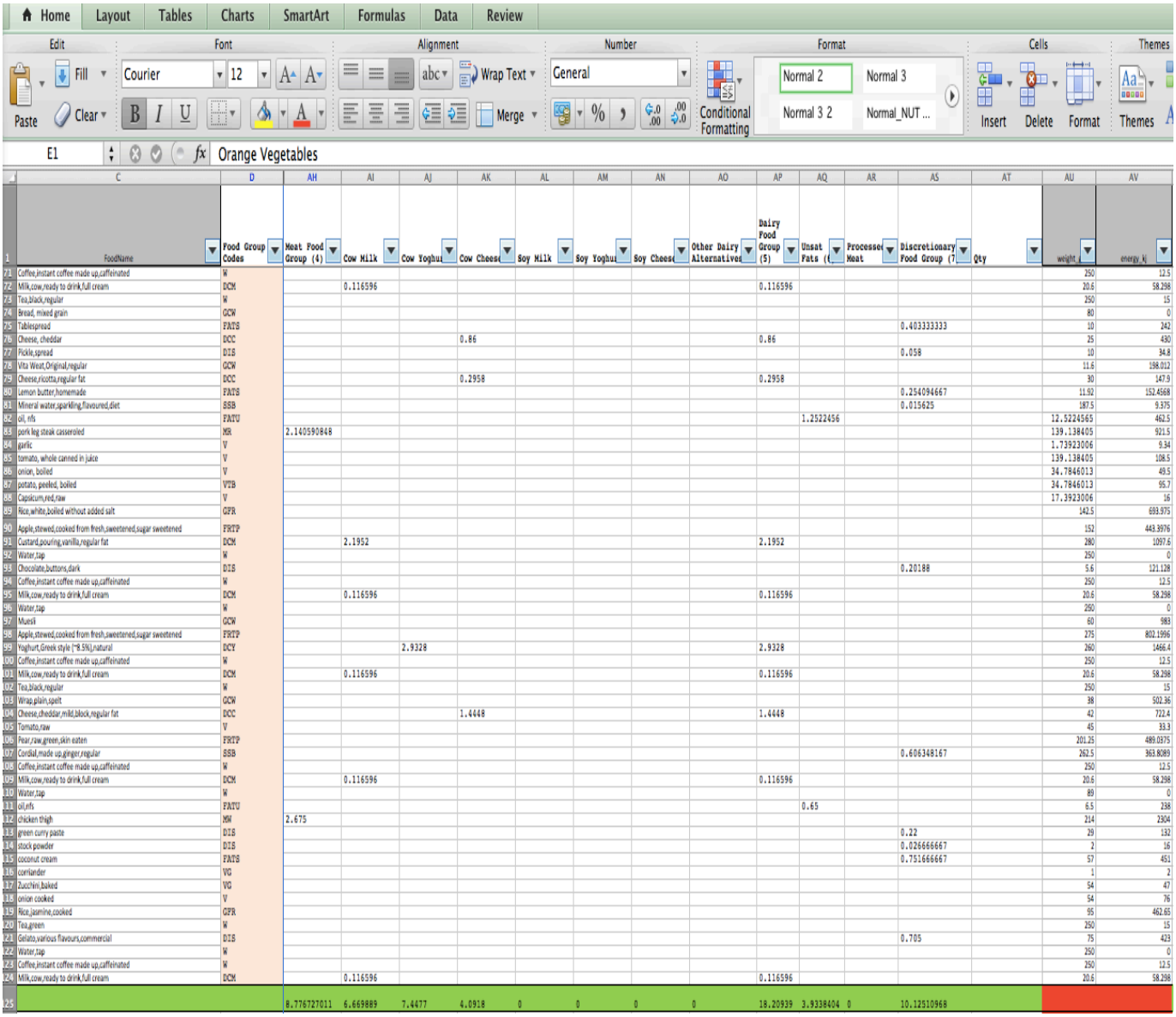
Yes /No → Thank you, that is fine. Your appointment has been confirmed and you will receive an email with additional details. Please read this before you attend the clinic as it has important information in it. We look forward to seeing you then.

↓

Would you prefer to be sent the information by post or email? What is the best address for me to send you the information?

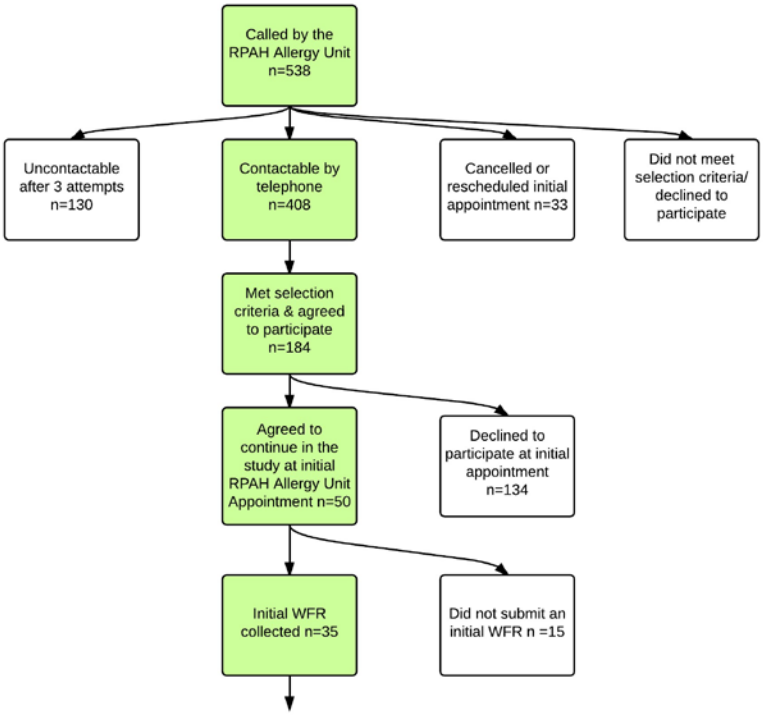
Thank you. Your appointment has been confirmed and you will receive an email with additional details. Please read this before you attend the clinic as it has important information in it. We look forward to seeing you then.

Appendix 1.Telephone script used to identify suitable patients for the study, including the inclusion and exclusion criteria.

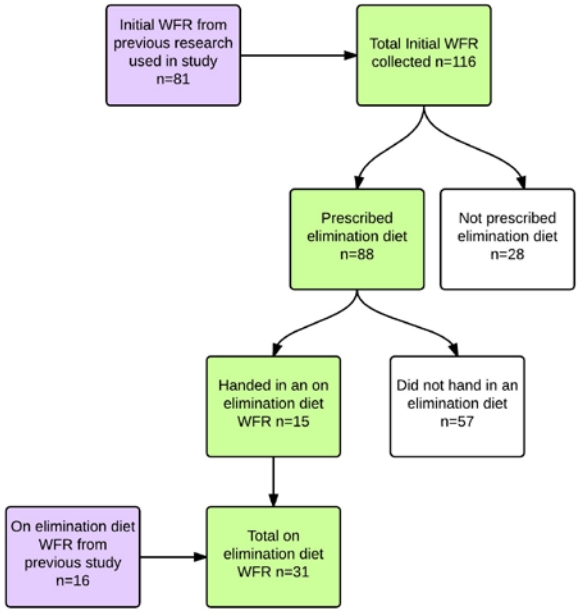


	C	D	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU	AV
1	FoodName	Food Group Codes	Meat Food Group (4)	Cow Milk	Cow Yoghu	Cow Chees	Soy Milk	Soy Yoghu	Soy Chees	Other Dairy Alternatives	Dairy Food Group (5)	Unsat Fats (	Processe Meat	Discretionary Food Group (7	Qty	weight_	energy_kj
71	Coffee,instant coffee made up,caffeinated	W														250	12.5
72	Milk,cow,ready to drink,full cream	DCM		0.116596							0.116596					20.6	58.298
73	Tea,black,regular	W														250	15
74	Bread, mixed grain	GCW														80	0
75	Tablespread	FATS												0.403333333		10	242
76	Cheese, cheddar	DCC				0.86					0.86					25	430
77	Pickle,spread	DIS												0.058		10	34.8
78	Vita Weat,Original,regular	GCW														11.6	198.012
79	Cheese,ricotta,regular fat	DCC				0.2958					0.2958					30	147.9
80	Lemon butter,homemade	FATS												0.254094667		11.92	152.4568
81	Mineral water,sparkling,flavoured,diet	SSB												0.015625		187.5	9.375
82	oil, nfs	FATU										1.2522456				12.5224565	462.5
83	pork leg steak casseroled	MR	2.140590848													139.138405	921.5
84	garlic	V														1.73923006	9.34
85	tomato, whole canned in juice	V														139.138405	108.5
86	onion, boiled	V														34.7846013	49.5
87	potato, peeled, boiled	VTB														34.7846013	95.7
88	Capsicum,red,raw	V														17.3923006	16
89	Rice,white,boiled without added salt	GFR														142.5	693.975
90	Apple,stewed,cooked from fresh,sweetened,sugar sweetened	FRTP														152	443.3976
91	Custard,pouring,vanilla,regular fat	DCM		2.1952							2.1952					280	1097.6
92	Water,tap	W														250	0
93	Chocolate,buttons,dark	DIS												0.20188		5.6	121.128
94	Coffee,instant coffee made up,caffeinated	W														250	12.5
95	Milk,cow,ready to drink,full cream	DCM		0.116596							0.116596					20.6	58.298
96	Water,tap	W														250	0
97	Muesli	GCW														60	983
98	Apple,stewed,cooked from fresh,sweetened,sugar sweetened	FRTP														275	802.1996
99	Yoghurt,Greek style (~9.5%),natural	DCY			2.9328						2.9328					260	1466.4
100	Coffee,instant coffee made up,caffeinated	W														250	12.5
101	Milk,cow,ready to drink,full cream	DCM		0.116596							0.116596					20.6	58.298
102	Tea,black,regular	W														250	15
103	Wrap,plain,spelt	GCW														38	502.36
104	Cheese,cheddar,mild,block,regular fat	DCC				1.4448					1.4448					42	722.4
105	Tomato,raw	V														45	33.3
106	Pear,raw,green,skin eaten	FRTP														201.25	489.0375
107	Cordial,made up,ginger,regular	SSB												0.606348167		262.5	363.8089
108	Coffee,instant coffee made up,caffeinated	W														250	12.5
109	Milk,cow,ready to drink,full cream	DCM		0.116596							0.116596					20.6	58.298
110	Water,tap	W														89	0
111	oil,nfs	FATU										0.65				6.5	238
112	chicken thigh	MH	2.675													214	2304
113	green curry paste	DIS												0.22		29	132
114	stock powder	DIS												0.026666667		2	16
115	coconut cream	FATS												0.751666667		57	451
116	corriander	VG														1	2
117	Zucchini,baked	VG														54	47
118	onion cooked	V														54	76
119	Rice,jasmine,cooked	GFR														95	462.65
120	Tea,green	W														250	15
121	Gelato,various flavours,commercial	DIS												0.705		75	423
122	Water,tap	W														250	0
123	Coffee,instant coffee made up,caffeinated	W														250	12.5
124	Milk,cow,ready to drink,full cream	DCM		0.116596							0.116596					20.6	58.298
125			8.776727011	6.669889	7.4477	4.0918	0	0	0	0	18.20939	3.9338404	0	10.12510968			

Appendix 2. Example of the spreadsheet used to code foods into their correct food groups and calculate quantity consumed.



Appendix 3. The above flow chart displays patient recruitment methods and sample size.



Appendix 4. The above flow chart represents how patients were split into groups for dietary intake analysis.

(5a)

	Vegetables (%)	Fruit (%)	Grains & cereals (%)	Dairy & alternatives (%)	Meat & alternatives (%)	Unsaturated oils & spreads (%)	Discretionary (%)	Average all 5 core food groups (%)
All initial WFR diaries	65	53	51	48	91	26	144	62
Prescribed elimination diet	64	52	48	47	88	23	142	60
Not prescribed elimination diet	67	55	61	50	103	35	150	69
Gave both WFR	67	51	52	43	88	21	130	61

(5b)

	All Initial WFR EAR (%)	Prescribed elimination diet EAR (%)	Not prescribed elimination diet EAR (%)	Gave both WFR EAR (%)
Thiamin	146	147	142	146
Riboflavin	192	193	186	192
Niacin	404	404	404	404
Folate	105	107	99	105
Vitamin A	166	166	164	188
Vitamin C	399	407	374	394
Calcium	78	79	73	83
Phosphorous	247	248	242	245
Zinc	156	151	170	143
Iron	181	183	174	178
Magnesium	134	133	138	131
Potassium (AI)	105	105	105	101
Sodium (UL)	89	88	91	93

Appendix 5. Table 5a and 5b show the comparison of baseline dietary intake of; all initial weighed food records (n=116), all the initial weighed food records of those who were prescribed the elimination diet (n=88), all the initial weighed food records of those not prescribed the elimination diet (n=28) and all the initial weighed food records of those who gave both a before and on elimination diet weighed food record (n=31). This was done to ascertain whether the three subgroups of; prescribed elimination diet, not prescribed elimination diet and gave both WFR were representative of the all initial WFR group.