Diet Quality and Nutritional Adequacy of Adult Patients Presenting to the Royal Prince Alfred Hospital Allergy Unit with Suspected Food intolerance

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This study aimed at assessing and comparing the diet quality and nutritional adequacy of patients with and without suspected food intolerance, presenting to the Royal Prince Alfred Hospital (RPAH) Allergy Unit.

All new adult patients were contacted by telephone, before their initial appointments at the RPAH Allergy Unit, to determine their eligibility. Eligible patients completed a 4-day weighed food record prior to their appointment. Patients were classified into two groups, depending on whether they proceeded to see a dietitian for dietary intervention or not. Those who proceeded to see a dietitian were described as having suspected food intolerance. Data was analysed using the software programme FoodWorks. Food items were classified into core and discretionary according to the standard used in the latest Australian Health Survey. Nutrient intake was compared against Australian and New Zealand Nutrient Reference Values, and food group intake was assessed using the current Australian Dietary Guidelines.

From the data, the two patient groups showed different characteristics. The food group intakes were similar except for dairy foods and vegetables. The nutrient intakes were similar except for vitamin A, vitamin C and dietary fibre. Discretionary food contributed the most to overall diary food and calcium intake in both patient groups.

To conclude, despite the differences in patient characteristics, the food group and nutrient intakes were similar between the two patient groups with a few exceptions. Further study is needed to confirm the findings.

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Keywords: food habits, food hypersensitivity, food intake, nutrition assessment

The candidate, ***Tommy Wong***, hereby declares that none of the work presented in this essay has been submitted to any other University or Institution for a higher degree and that to the best of his/her knowledge contains no material written or published by another person, except where due reference is made in the text.

Signature

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Abstract

Aims: To assess and compare the diet quality and nutritional adequacy of patients with and without suspected food intolerance, presenting to the Royal Prince Alfred Hospital (RPAH) Allergy Unit.

Methods: All new adult patients were contacted by telephone, before their initial appointments at the RPAH Allergy Unit, to determine their eligibility. Eligible patients completed a 4-day weighed food record prior to their appointment. Patients were classified into two groups, depending on whether they proceeded to see a dietitian for dietary intervention or not. Those who proceeded to see a dietitian were described as having suspected food intolerance. Data was analysed using the software programme FoodWorks. Food items were classified into core and discretionary according to the standard used in the latest Australian Health Survey. Nutrient intake was compared against Australian and New Zealand Nutrient Reference Values, and food group intake was assessed using the current Australian Dietary Guidelines.

Results: The two patient groups showed different characteristics. The food group intakes were similar except for dairy foods and vegetables. The nutrient intakes were similar except for vitamin A, vitamin C and dietary fibre. Discretionary food contributed the most to overall diary food and calcium intake in both patient groups.

Conclusion: Despite the differences in patient characteristics, the food group and nutrient intakes were similar between the two patient groups with a few exceptions. Further study is needed to confirm the findings.

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Keywords: food habits, food hypersensitivity, food intake, nutrition assessment

Introduction

Food intolerance is defined as non-immunological adverse reactions towards ingested food components, with various manifestations including gastrointestinal discomfort (e.g. diarrhoea and bloating), fatigue, headache, hives and narrowing of airways[1]. Common triggers include natural food chemicals (e.g. salicylates, amines and glutamate), food additives (e.g. preservatives and food colourings), soy and dairy products and gluten-containing cereals[1,2]. Reactions are dose-dependent and tend to be delayed (up to 48 hours), making it hard to identify the trigger. It is estimated that up to 25% of the Australian population believe they have certain degree of food intolerance[3].

For patients presenting to the Royal Prince Alfred Hospital (RPAH) Allergy Unit, if the physicians suspect that the symptoms are food-related, the patients will be prescribed to undergo dietary investigations using the elimination diet (ED). The ED is a dietary regime which consists of foods with low natural and added chemical content to settle symptoms[4]. If a patient is intolerant to these food chemicals, symptoms will settle on the diet. After that the food chemical substances will be tested according to a systematic challenge protocol, in order to identify the true cause of symptoms[4]. On the other hand, if the physicians suspect that the symptoms are not caused by food, patients will be treated individually and will not be prescribed the ED.

Food avoidance is commonly observed in people with suspected food intolerance. Previous studies on people suffering from irritable bowel syndrome (IBS) have shown that up to 62% of them avoided certain foods to reduce their symptoms, which included wheat, milk, coffee and vegetables[5,6]. For patients with suspected food intolerance, supervision by a dietitian is important to assist with identification of food triggers to prevent over-restriction of their diet, which could compromise nutritional adequacy[5,7].

While individual nutrients are still a main focus of ongoing research, studies into diet quality have received great attention in recent years, as it is realised that people eat whole foods rather than single nutrients[8]. Consequently, dietary recommendations based on individual nutrients are said to be hard to put into practice, while studies of food intake can be directly applied to devising dietary advice[8,9]. Considering this, the Australian Dietary Guidelines (ADG) 2013 and Australian Guide to Health Eating (AGHE) 2013 are based on food groups as well as nutrients[10]. Diets consistent with the guidelines have been shown to lead to positive health outcomes, such as lower all-cause mortality[10].

In the ADG, apart from classifying foods into five food groups (e.g. vegetables and meat), it also classified foods into core and discretionary food[10]. While core foods are those that fit into the five food groups, discretionary foods are those that are not necessary for a healthy diet and are generally high in energy, saturated fat, added sugars or added salt and low in fibre. The ADG recommends having discretionary foods only occasionally and in small amounts[10].

At the RPAH Allergy Unit, studies have been carried out to investigate the intake of nutrients and foods, as well as self-imposed dietary restrictions in patients with suspected food intolerance (Soutar J, 1996; Chiu A, 1997; Neubauer A, 2014, unpublished data). However to date there have been limited studies that have looked at the difference in diet quality between this patient group and the patients whose symptoms are unlikely to be food-related. This study aimed to 1) assess the diet quality and nutritional adequacy of adult patients' diets before undergoing dietary intervention for suspected food intolerance at the RPAH Allergy Unit and 2) compare this to a group of adult patients presenting to the RPAH Allergy Unit for symptoms unlikely to be related to food intolerance.

Method

This project was part of an ongoing clinical study at the RPAH Allergy Unit. It has been approved by the Ethics Review Committee (RPAH Zone) of the Sydney Local Health District (protocol no: X13-0208) and was performed in accordance with the ethical standards laid down in the 2013 version of the Declaration of Helsinki.

Subjects and Recruitment

All adult patients who were booked in for an initial appointment at the RPAH Allergy Unit were contacted via telephone by a dietitian one week prior to their appointment. They were informed of the study and questions were asked to determine their eligibility and interest to participate. Inclusion criteria were as follow:

1. Aged 18 years old or above

2. No previous consultation with a dietitian at the RPAH Allergy Unit for food intolerance, or no previous attempt on the RPAH ED elsewhere under a dietitian's care.

3. Suspected food intolerance based on symptoms described – urticaria, angioedema, eczema, IBS, migraine or food reactions, or symptoms suspected to be food related.

Patients who accepted to receive further information were sent an information pack and a four-day weighed food record (WFR) with instructions, either by email or post. Patients provided consent via completion and submission of the WFR. Involvement in the study was voluntary and participants could discontinue at any stage.

Data collection

Patients who agreed to participate were instructed to record their diet for four consecutive days, which could be done by completing a WFR either manually or electronically, or using the iOS application Easy Diet Diary (Xyris software, Brisbane, Australia). They were instructed to record the amount of food, drinks and nutritional supplements consumed using methods including weighing the food, reporting the serving sizes listed on packages or estimation using household measurements (e.g. cups or spoons). Cooking methods and brand names of food were also to be specified. For mixed dishes, patients were asked to provide the recipes. When eating out, the name of the restaurant and an estimation of the food and drinks consumed were to be recorded. In addition, they were also asked to record their usual physical activities per week.

Upon attending their initial appointment, the patient's WFR was collected by a dietitian and any missing information was clarified. Their weight and height were measured using a digital scale and a stadiometer respectively. As part of the clinical practice, patients also completed a patient information form, which included questions on symptoms experienced, medical history, dietary habits, quality of life and health status.

Data entry analysis

Patients were grouped into two groups:

A. Patients who saw a dietitian for ED (ED group)

B. Patients who did not see a dietitian for ED (NED group)

The patients' dietary intake from the WFRs were entered by student dietitians into the software programme FoodWorks (Professional Version 8, Xyris software, Brisbane, Australia;

databases used – AUSNUT 2013, AusBrands 2015 and AusFood 2015). Food items were classified into core or discretionary based on the food classification system in the Australian Health Survey (AHS) 2011-13[11] and were coded accordingly. For mixed dishes, recipes provided by patients were entered and the whole dish was coded as a single food item. Where recipes were not provided, either generic items from the FoodWorks databases were selected or standard recipes were created.

Data on energy intake, estimated energy requirement (EER), core/discretionary coding and key macro- and micronutrients was then exported to Microsoft Excel (2007) for analysis. Where appropriate, nutrient intakes were compared with the relevant Australian and New Zealand nutrient reference values (NRVs) specific for age and gender[12] – estimated average requirements (EAR), recommended dietary intake (RDI), adequate intake (AI) and upper level (UL). The percentage of total energy intake from protein, carbohydrate and fat was also compared to the acceptable macronutrient distribution range (AMDR).

Each food record was split into core and discretionary sections. The classification of food items in the whole diary, as well as those in the core and discretionary sections, into individual food groups was done by the built-in function of FoodWorks. Exported data on food group intakes was compared to the current ADG recommendations for the appropriate gender and age. Student dietitians also entered data from the patient information form into Microsoft Excel (2007) for analysis.

Results

28 WFRs in total were analysed, with 17 belonging to patients of the ED group and 11 belonging to patients of the NED group. The demographics, presenting symptoms and dietary

habits of the two groups are shown in Table 1. The means and ranges of age and BMI in both groups were similar, as was the gender ratio. As seen in Table 1, patients in the ED group reported more food triggers causing symptoms than the NED group, with one patient reported having 17 food triggers.

More patients in the ED group also reported modifying their diet than those in the NED group. More than half of the ED patients reported avoiding specific food items while less than one-fifth of the NED patients reported doing the same. Nearly half of the ED patients reported restricting or avoiding wheat or gluten, while less than one-fifth of the NED patients did so. One-third of the ED patients reported restricting or avoiding lactose or dairy foods, while none of the NED patients did so.

For presenting symptoms, more patients in the ED group reported suffering from symptoms related to the gastrointestinal and central nervous systems (e.g. headache, nausea), while more patients in the NED group reported suffering from respiratory symptoms. Moreover, more patients in the ED group reported taking nutritional supplements than the NED group, with the most common types being multivitamins and calcium supplements.

Intake of energy, macronutrients and food groups

Table 2 shows the energy, macronutrient and food group intakes of both patient groups. Both groups had a similar EER, with the ED group reporting a higher energy intake than the NED group. In general the majority of patients in both groups failed to meet the EERs.

The contributions from macronutrients towards the overall energy intake were identical between the two groups. The average carbohydrate intake of both groups accounted for just under half of the energy intake and fell on the lower end of the AMDR (45-65% of energy). The

average fat intake of both groups contributed nearly one-third, and protein intake made up around one-fifth of the total energy intake in both groups. The average intake of both fat and protein fell within the AMDRs (fat 20-35%, protein 15-25% energy). Saturated fat marginally exceeded the AMDR (<10% of energy) for both patient groups.

In terms of food groups, most patients in both groups were not having the recommended amount of vegetables, fruits, dairy and dairy alternatives, as shown in figure 1a. Notably, one patient in the NED group was not having any fruit and two patients in the ED group were not having any dairy or dairy alternative foods. When comparing the intake between both groups, the ED group had a higher intake of vegetables, fruits, grains and protein foods than the NED group. However the intake of dairy and dairy alternatives in the ED group was lower than the NED group. By adjusting the mean energy and food group intake of both groups, it was found that the intake of fruits and protein foods were similar between both patient groups (Appendix I).

Intake of micronutrients

The micronutrient intake of both patient groups are shown in Table 3. For most nutrients the EAR was met by more than half of the patients in both groups, except for calcium, potassium and dietary fibre. Only around one-fifth of the patients in both groups were meeting the EAR for calcium.

When comparing the intake of both groups, the ED group had a higher intake of vitamin A, vitamin C and dietary fibre than the NED group, as shown in Figure 1b and c.

Contribution from discretionary food to overall intake

The contribution of energy, nutrients and food groups from discretionary foods towards the overall intake are shown in Figure 2. On average, discretionary food contributed around a quarter of the overall energy and saturated fat intake in both groups. The ED group had a smaller portion of their overall energy and saturated fat intake on average coming from discretionary foods than the NED group (Figure 2a).

For food groups (Figure 2b), dairy and dairy alternatives had the greatest contribution from discretionary foods in both patient groups. The ED group had a greater portion of dairy and dairy alternatives coming from discretionary choices than the NED group.

Among the key nutrients (Figure 2c), calcium had the greatest portion of the overall intake coming from discretionary food, with the NED group had a greater portion of the overall intake coming from discretionary foods than the ED group.

Discussion

The two groups of patients in this study showed some similarities and differences in terms of food and nutrient intake.

First of all, although the energy intake of the ED group was higher than the NED group, both groups had similar average EER, average BMI and similar contribution by macronutrients towards total energy intake. This suggests that there was an underestimation of intake in the NED group, which might be partly contributed by the fact that the clarification of patients' WFRs in the NED group was not carried out to the same extent as those in the ED group. Previous studies also found a similar energy and macronutrient intake between the two

groups[13,14], while the contribution by macronutrients towards total energy intake of both groups were similar to the results of the AHS 2011[15].

For intake of food groups, both patient groups had their average intake of dairy and dairy alternatives below the recommendation, which echoed the previous finding that inadequate dairy food intake was common[16]. The ED group had a lower intake of dairy and dairy alternatives than the NED group, which was consistent with a previous study[14], with the difference being more marked after adjusting for the possible underreporting (Appendix I). This is likely to be due to the patients' self-imposed dairy restriction – a practice that was more commonly reported by the ED group. However this difference between the groups was not reflected in the intake of calcium, as the calcium intake of both patient groups were similar, although the actual intake for the NED group might be more than the obtained value considering the underreporting issue. It is worth noting that one patient in the ED group was not having any dairy food, yet was meeting the individual EAR for calcium, with her main calcium sources being vegetable dishes, such as vegetarian laksa, minestrone and vegetable curry. The high consumption of such dishes compensated the deficit in calcium brought about by the absence of dairy foods in her diet.

Most patients in both groups had their intake of fruits and vegetables below the recommendations, which is similar to the findings in the National Health Survey[17]. The ED group had a higher intake of vegetables than the NED group, even after adjusting for the possible underreporting (Appendix I), and the results were similar to the intake of nutrients contributed by this main food group, such as vitamin A, vitamin C and dietary fibre. The tendency for patients in the ED group to have more vegetables was recorded previously[14] and was possibly due to the increased health-consciousness of this particular patient group, which results in patients following diets with greater accordance towards established guidelines[14,18,19].

However it is worth considering that intake of vegetables could be a trigger of symptoms for patients with food intolerance[5,6]. The assistance of a dietitian is thus important in order to correctly identify the true triggers and to make dietary changes accordingly.

The intake of grains of most patients in both groups were higher than the recommendations as well as the average national intake[20]. Apart from that, the intake of the ED group was slightly higher than the NED group, which was in contrast to the fact that more ED patients reported restricting wheat or gluten intake. In addition there was no marked difference between the patient groups in the intake of the nutrients which grain foods are the main contributors (e.g. thiamin, riboflavin, niacin). It is possible that the restrictions were only carried out to a limited extent by the patients and this is supported by previous studies, which found that patients' adherence to the such dietary changes depends on several factors, such as self-efficacy, information provided about the food and perceptions of tolerance[21,22].

Discretionary food was described as energy-dense-nutrient-poor[10], however this food group may still contribute to one's nutrient intake. In this study the proportion of energy coming from discretionary food in both patient groups was less than the result of the AHS 2011[15], which could be due to the increased health-consciousness of the patients in the ED group or underreporting. Dairy and dairy alternatives was the food group with the greatest portion from discretionary food, with common sources including milk in sweetened drinks, cheese on crackers and chocolate. Calcium was the nutrient with the greatest contribution from discretionary foods, with the percentage contribution similar to a previous study[23].

Several limitations were present in this study. First of all, the small sample size hindered the generalisability of the results. The second point was the misreporting in the WFRs due to error in estimation of serving sizes, lack of details recorded in the WFRs and clarification of records not carried out to the same extent in the NED group. Moreover, exact matches in reported

items were not always found in FoodWorks and the Easy Diet Diary application, with examples including superfood powders, pickled mango and takeaway dishes.

Conclusion

Differences exist in diet modifications, number of food triggers and symptoms experienced between the patient groups. However, there were many similarities in food group and nutrient intakes between the patient groups and with previous survey data. Differences were shown in the intake of dairy foods and vegetables, which were reflected in the nutrient intakes, such as vitamin A, vitamin C and dietary fibre. For future directions, it is recommended to include a greater sample size for results to have a better statistical power. Moreover, as there were more patients in the ED group that reported food avoidance, the variety of patients' food intake may also be of interest when examining their diet quality. In addition, with the ED group likely to be more health-conscious, the habit of nutritional supplementation may be different between the two groups. In this study there were more patients in the ED group reported taking supplements than the NED group, however further analysis is needed for a better picture of this.

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Conflicts of interest

There is no conflict of interest to report.

Authorship

Tommy Wong was the primary author responsible for data collection, data entry and analysis, and writing the manuscript. Dr Robert H Loblay, Dr Velencia Soutter, Dr Anne R Swain, Wendy Stuart-Smith, Carling Chan, Kirsty Le Ray, Neelam Pun, Amy Wu, Rajshri Roy were responsible for the study design, recruitment and supervision.

References

1. Hodge L, Swain AR, Faulkner-Hogg K. Food allergy and intolerance. Aust Fam Physician. 2009;38(9):705–7.

2. Lomer MCE. Review article: the aetiology, diagnosis, mechanisms and clinical evidence for food intolerance. Aliment Pharmacol Ther [Internet]. 2014;41:262–75. Available from: http://doi.wiley.com/10.1111/apt.13041

3. NSW Food Authority. Allergy and intolerance [Internet]. 2013. Available from: http://www.foodauthority.nsw.gov.au/consumers/problems-with-food/allergy-and-intolerance/#Food-intolerances

4. Swain AR, Soutter VL, Loblay RH. RPAH Elimination Diet Handbook: With Food & Shopping Guide. Rev. Sydney: Allergy Unit, Royal Prince Alfred Hospital; 2011. 1-134 p.

5. Monsbakken KW, Vandvik PO, Farup PG. Perceived Food Intolerance in Subjects with Irritable Bowel Syndrome: Etiology, Prevalence and Consequences. Eur J Clin Nutr [Internet]. 2006;60(5):667–72. Available from: http://www.ncbi.nlm.nih.gov/pubmed/16391571

6. Hayes P, Corish C, O'Mahony E, Quigley EMM. A dietary survey of patients with irritable bowel syndrome. J Hum Nutr Diet [Internet]. 2014;27 Suppl 2:36–47. Available from: http://www.ncbi.nlm.nih.gov/pubmed/23659729

7. Clarke L, McQueen J, Samild A, Swain AR. The Dietary Management of Food Allergy and Food Intolerance in Children and Adults. Aust J Nutr Diet. 1996;53(3):89–98.

8. Jacobs Jr. DR, Tapsell LC, Temple NJ. Food Synergy: The Key to Balancing the Nutrition Effort. Public Health Rev [Internet]. 2011;33(2):1–24. Available from: http://search.proquest.com/docview/964268600?accountid=13042\nhttp://oxfordsfx.hosted.exlibrisgroup.com/oxford?url_ver=Z39.88-2004&rft_val_fmt=info:ofi/fmt:kev:mtx:journal&genre=article&sid=ProQ:ProQ:assiashell&atitle=Food+Synergy:+The+Key+to+Balancing+th

9. Alkerwi A. Diet quality concept. Nutrition [Internet]. Elsevier; 2014;30(6):613–8. Available from: http://dx.doi.org/10.1016/j.nut.2013.10.001

10. National Health and Medical Research Council. Australian Dietary Guidelines. Canberra: National Health and Medical Research Council; 2013. 1-45 p.

11. Australian Bureau of Statistics. Australian Health Survey: Users' Guide, 2011-13 [Internet]. 2013 [cited 2015 Aug 7]. p. ABS cat. No. 4363.0.55.001. Available from: http://www.abs.gov.au

12. NHMRC. Nutrient reference values for Australia and New Zealand [Internet]. 2005. Available from: http://www.nrv.gov.au/

13. Saito YA, Locke GR, Weaver AL, Zinsmeister AR, Talley NJ. Diet and Functional Gastrointestinal Disorders: A Population-Based Case-Control Study. Am J Gastroenterol [Internet]. 2005;100(12):2743–8. Available from: http://www.nature.com/doifinder/10.1111/j.1572-0241.2005.00288.x

14. Böhn L, Störsrud S, Simrén M. Nutrient intake in patients with irritable bowel syndrome compared with the general population. Neurogastroenterol Motil [Internet]. 2013;25(1):23–30.e1. Available from: http://www.ncbi.nlm.nih.gov/pubmed/22937900

15. Australian Bureau of Statistics. Australian Health Survey: Nutrition First Results - Foods and Nutrients, 2011-12 [Internet]. 2014 [cited 2015 Aug 5]. p. ABS cat. no. 4364.0.55.007. Available from: http://www.abs.gov.au

16. Doidge JC, Segal L. Most Australians do not meet recommendations for dairy consumption: Fndings 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

17. Australian Bureau of Statistics. National Health Survey: Summary of Results [Internet]. 2010. p. cat no. 4364.0. Available from: http://www.abs.gov.au/AUSSTATS/abs@.nsf/Latestproducts/4364.0Main Features42007-2008 (Reissue)?opendocument&tabname=Summary&prodno=4364.0&issue=2007-2008 (Reissue)&num=&view=

18. Williams EA, Nai X, Corfe BM. Dietary intakes in people with irritable bowel syndrome. BMC Gastroenterol [Internet]. BioMed Central Ltd; 2011;11(1):9. Available from: http://www.biomedcentral.com/1471-230X/11/9

19. Sommer I, MacKenzie H, Venter C, Dean T. Factors influencing food choices of food-allergic consumers: Findings from focus groups. Allergy Eur J Allergy Clin Immunol. 2012;67(10):1319–22.

20. Grains & Legumes Nutrition Council. Australians At Risk: 2014 Grains & Legumes Consumption & Attitudinal Study [Internet]. 2015 [cited 2015 Oct 28]. Available from: http://www.glnc.org.au/wp-content/uploads/2015/04/Australians-at-Risk-2014-Grains-Legumes-Consumption-Attitudinal-Study.pdf

21. Verrill L, Zhang Y, Kane R. Food label usage and reported difficulty with following a gluten-free diet among individuals in the USA with coeliac disease and those with noncoeliac gluten sensitivity. J Hum Nutr Diet. 2013;26(5):479–87.

22. Hall NJ, Rubin GP, Charnock A. Intentional and inadvertent non-adherence in adult coeliac disease. A cross-sectional survey. Appetite [Internet]. Elsevier Ltd; 2013;68:56–62. Available from: http://linkinghub.elsevier.com/retrieve/pii/S0195666313001530

23. Rangan AM, Schindeler S, Hector DJ, Gill TP, Webb KL. Consumption of “extra” foods by Australian adults: types, quantities and contribution to energy and nutrient intakes. Eur J Clin Nutr. 2009;63:865–71.

Appendix 1 – Adjusted mean energy and food group intake of the NED group compared with the data of ED group

	ED	**NED**	**NED adjusted**[†]
Mean EER (kJ)	9564.6	9712.0	9712.0
Mean energy intake (kJ)	9016.9	7114.7	8893.4
Average percentage EER met (%)	94.7	73.5	91.6
Food groups mean intake			
Fruits	2.0	1.1	1.4
Augmented mean intake of fruit[‡]	*1.6*		
Vegetables	4.4	2.8	3.5
Grains	8.0	5.9	7.4
Dairy and dairy alternatives	1.2	1.5	1.9
Protein foods	2.7	2.0	2.5

[†]Adjustment done by increasing the energy and food groups intake by 25%, which is roughly the difference of energy intake between the ED and NED group.

[‡]Calculated by excluding one outlying data-point

Figure legends

Figure 1a – Intake of vitamin A, folate and vitamin C in percentage EAR in both patient groups; 1b – intake of calcium in percentage EAR both patient groups; 1c – intake of different food groups in percentage of recommended serves in both patient groups.

Figure 2 – Mean percentage contribution of discretionary and core foods in both patient groups towards a) – key nutrient intakes; b) – food group intakes; c) – energy and saturated fat intake.

Table 1 – Demographics, dietary habits and presenting symptoms of both patient groups

	ED group (N=17)	NED group (N=11)
Demographics		
Age (years), mean (range)	44.8 (18-72)	44.7 (19-63)
BMI (kg/m^2), mean (range)	24.1 (19.0-30.6)	24.7 (19.4-28.7)
Gender: Male, n (%)	4 (23.5)	3 (27.3)
Female, n (%)	13 (76.5)	8 (72.7)
Dietary Habits		
Number of foods patients reported to trigger symptoms, mean (range)	5.4 (0-17)	1.8 (0-4)
Number of patients reported having diet modification[†]		
Limiting/avoiding wheat or gluten, n (%)	8 (47.1)	2 (18.2)
Limiting/avoiding dairy/lactose, n (%)	6 (35.3)	0 (0.0)
Limiting/avoiding other foods, n (%)	10 (58.8)	2 (18.2)
Vegetarian diet, n (%)	2 (11.8)	1 (9.1)
Other diet (e.g. paleolithic diet, low FODMAP) , n (%)	4 (23.6)	0 (0.0)
Presenting symptoms		
Number of patients presenting with symptoms from the following groups: [†]		
Skin (e.g. rash) , n (%)	7 (41.2)	6 (54.5)
Gastrointestinal tract (e.g. stomach, diarrhoea) , n (%)	7 (41.2)	1 (9.1)
Central nervous system (e.g. headache, nausea) , n (%)	6 (35.3)	3 (27.3)
Respiratory (e.g. nasal congestion) , n (%)	1 (5.9)	6 (54.5)
Patients reporting taking nutritional supplements, n (%)	7 (41.2)	3 (27.3)

[†]A patient can have more than one diet modification and presenting symptom.

Table 2 – Energy, macronutrient and food groups intake of both patient groups

	Recommendation according to age and sex		**ED group, Mean ± SD**	**NED group, Mean ± SD**
	19-50	**51-70**		
EER (kJ)[†]	Not applicable		9564.6 ± 1920.3	9712.0 ± 1836.7
Energy intake (kJ)			9016.9 ± 3134.0	7114.7 ± 2227.7
Average percentage EER met (%)			94.7 ± 29.5	73.5 ± 18.9
Number of patients with intake meeting EER, n (%)			6 (35.3)	1 (9.1)
Contribution of macronutrients				
Mean percentage energy intake (%)				
from carbohydrate	45-65		44.5 ± 12.1	43.5 ± 6.1
from protein	15-25		18.0 ± 5.0	17.9 ± 2.8
from fat	20-35		33.8 ± 9.5	33.6 ± 3.5
from saturated fat	<10		11.3 ± 3.6	11.8 ± 3.2
Food group intake				
Fruits, number of serves[‡]	M: 2; F: 2	M: 2; F: 2	2.0 ± 2.4	1.1 ± 0.8
Vegetables, number of serves	M: 6; F: 5	M: 5.5; F: 5	4.4 ± 2.3	2.8 ± 2.0
Grains, number of serves	M: 6; F: 6	M: 6; F: 4	8.0 ± 4.2	5.9 ± 2.3
Mean percentage contribution of wholegrain to overall grain intake (%)	Not applicable		28.6 ± 26.7	28.1 ± 20.9
Dairy and dairy alternatives, number of serves	M: 2.5; F: 2.5	M: 2.5; F: 4	1.2 ± 0.8	1.5 ± 1.0
Protein foods, number of serves	M: 3; F: 2.5	M: 2.5; F: 2	2.7 ± 1.4	2.0 ± 1.1

[†]EER – Estimated Energy Requirement; [‡]Excluding the outlying data point augmenting the mean of fruit intake of the ED group, gave a mean of 1.6, with SD of 1.3.

Table 3 – Key micronutrient intake of each group

	ED group		NED group	
	Mean intake in % NRV[†], % ± SD	Patients with intake above NRV[†], n ± %	Mean intake in % NRV[†], % ± SD	Patients with intake above NRV[†], n ± %
Vitamin A[‡]	305.3 ± 279.0	16 ± 94.1	116.2 ± 48.0	6 ± 54.6
Thiamin[‡]	157.2 ± 92.0	12 ± 70.6	172.3 ± 133.3	7 ± 63.6
Riboflavin[‡]	183.3 ± 73.4	16 ± 94.1	171.9 ± 80.8	9 ± 81.8
Niacin equivalent[‡]	362.0 ± 148.0	17 ± 100.0	305.7 ± 96.2	11 ± 100.0
Folate[‡]	173.9 ± 72.9	12 ± 70.6	186.4 ± 86.9	9 ± 81.8
Vitamin C[‡]	437.0 ± 273.3	17 ± 100.0	290.0 ± 150.7	10 ± 90.9
Calcium[‡]	82.1 ± 34.0	5 ± 29.4	84.5 ± 40.2	3 ± 27.3
Iron[‡]	207.1 ± 91.2	16 ± 94.1	163.6 ± 108.1	8 ± 72.7
Zinc[‡]	152.1 ± 58.5	14 ± 82.4	109.5 ± 38.8	6 ± 54.6
Iodine[‡]	139.5 ± 60.7	13 ± 76.5	156.7 ± 94.2	9 ± 81.8
Magnesium[‡]	136.0 ± 49.2	11 ± 64.7	116.2 ± 36.4	7 ± 63.6
Potassium[§]	107.3 ± 39.6	7 ± 41.2	86.3 ± 30.3	5 ± 45.5
Sodium[¶]	88.2 ± 49.1	5 ± 29.4	91.7 ± 26.1	3 ± 27.3
Dietary Fibre[§]	117.7 ± 66.6	7 ± 41.2	87.9 ± 39.8	3 ± 27.3

[†]NRV – Nutrient Reference Values; [‡]percentage of estimated average requirement (EAR); [§]percentage of adequate intake (AI); [¶]percentage of upper level (UL)

Figure 1

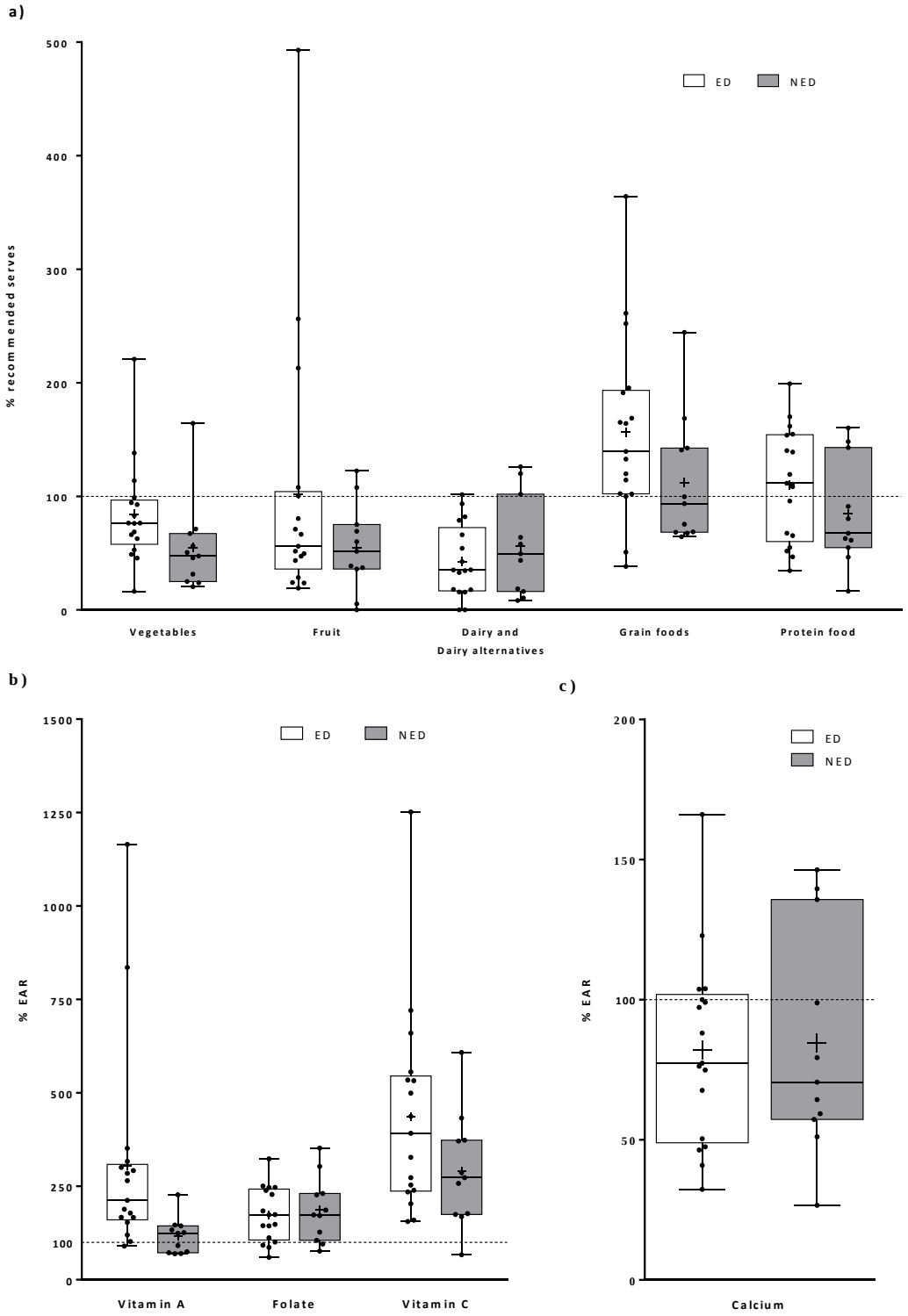
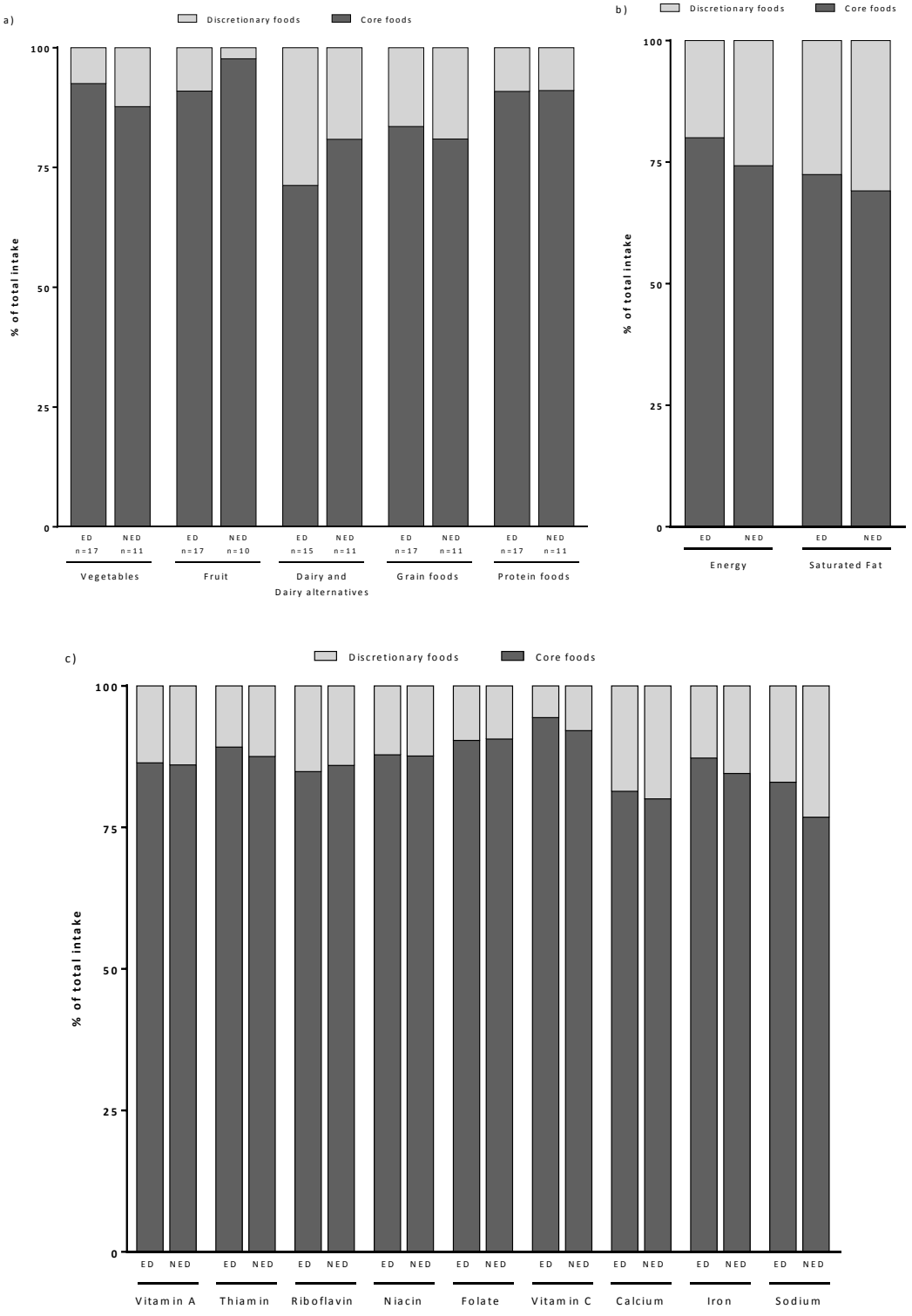

a)
% recommended serves
500
400
300
200
100
0
ED
NED
Vegetables
Fruit
Dairy and
Dairy alternatives
Grain foods
Protein food
b)
% EAR
1500
1250
1000
750
500
250
100
0
ED
NED
Vitamin A
Folate
Vitamin C
c)
% EAR
200
150
100
50
0
ED
NED
Calcium

Figure 2


a)
Discretionary foods
Core foods
% of total intake
100
75
50
25
0
ED n=17
NED n=11
ED n=17
NED n=10
ED n=15
NED n=11
ED n=17
NED n=11
ED n=17
NED n=11
Vegetables
Fruit
Dairy and Dairy alternatives
Grain foods
Protein foods
b)
Discretionary foods
Core foods
% of total intake
ED
NED
ED
NED
Energy
Saturated Fat
c)
Discretionary foods
Core foods
% of total intake
ED NED
Vitamin A
Thiamin
Riboflavin
Niacin
Folate
Vitamin C
Calcium
Iron
Sodium