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Evidence of High Sugar Intake and Low Fibre and Mineral Intake in The Gluten-Free Diet

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R2

**Full Title: Evidence of High Sugar Intake and Low
Fibre and Mineral Intake in The Gluten-Free Diet**

Short Title: Assessment of a GFD

Article Type: Original Research

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Evidence of High Sugar Intake and Low Fibre and Mineral Intake in The Gluten-Free Diet

SUMMARY

Background: The only therapy for coeliac disease (CD) is a long-term gluten-free diet (GFD). Little is known about the detailed composition of such a diet.

Aim: To clarify the nutritional composition of a GFD and to compare it to a non-GFD diet in representative non-CD populations.

Methods: 139 consecutive patients with CD were invited to fill in a prospective validated 5-day food diary, of which data from 93 were analysed. Results were compared with data from the National Diet and Nutrition Survey of Adults and the UK Women's Cohort Study.

Results: Individuals consuming a strict GFD generally had similar intakes of energy and nutrients to the comparison populations, but a higher proportion of carbohydrate intake was obtained from non-milk extrinsic sugars and intakes of non-starch polysaccharides were low. Compared to the UKWCS sample, females adhering to a GFD had lower intakes of magnesium, iron, zinc, manganese, selenium and folate. In males, intakes of magnesium and selenium were particularly low.

Conclusion: This study reinforces the need for clinicians to recognise that avoidance of gluten cannot be the sole focus of a GFD. Maintenance of adequate intakes of essential nutrients and in particular complex carbohydrates must also be the goal for patients.

Introduction

Increasing numbers of people are being diagnosed with Coeliac Disease (CD)¹, for which the only available treatment is a lifelong gluten-free diet (GFD)².

As the GFD has to be maintained for life, any imbalances in the diet would have significant implications for the overall health of a “treated” patient with CD. Although there have been numerous studies of the benefits to patients of going from a gluten containing to a GFD, on being diagnosed with CD¹, most studies considering the nutritional adequacy of the gluten free diet have been based outside the UK³⁻⁷ and there is little data on the detailed composition of GFDs in the UK. Kinsey et al⁸ reported on intakes of 49 patients with CD in the UK. They found inadequate intakes of non-starch polysaccharide (NSP), calcium and Vitamin D.

In a recent systematic review of previous research in the area, Robins et al⁹ highlighted that when considering iron, calcium and B vitamins, there is no evidence base to suggest that nutritional deficiency is a significant problem in individuals diagnosed with CD. However, neither is there any high level evidence that individuals with CD have good nutritional status. Furthermore, all eleven studies considered as part of the systematic review were considered to be at moderate or high risk of bias⁹.

A GFD should meet individual requirements and Dietary Reference Nutrient Intakes (RNIs) for the general population¹⁰. There may be a case for increased nutritional requirements in those with CD⁹ but there are currently no specific nutritional recommendations other than for calcium¹¹.

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6 The aim of this study is to investigate and quantify the nutritional content of
7
8 the GFD in order that its nutritional adequacy can be assessed.
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13 The objectives to achieve this aim are;

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15 To obtain high quality dietary information from a well-characterised group
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17 of treated coeliac patients, on a strict GFD, using a validated five-day food
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19 diary.
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21
22 To identify how what proportion of patients on a GFD are meeting the UK
23
24 recommended intakes for a number of macro and micronutrients by
25
26 comparing the dietary analysis with RNIs ¹⁰ and with specific
27
28 recommendations for calcium in those with CD ¹¹
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31
32 To compare the nutritional content of a GFD in the UK with a normal
33
34 (gluten containing) diet, by comparison with National Diet and Nutrition Survey
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36 (NDNS) ¹² data for the general (Northern) population and an age/sex matched
37
38 cohort from the United Kingdom Women's Cohort Study (UKWCS) ¹³
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44 Whilst a weighed food intake is considered by some to be the gold standard
45
46 for assessing dietary intake ¹⁴ it has a number of disadvantages including the
47
48 time it takes to complete and the inaccuracy for people consuming foods
49
50 outside the home or those not prepared in the home. Nutritional studies in the
51
52 UK arms of the European Prospective Investigation of Cancer (EPIC) study
53
54 use a validated (against both 16 day weighed records and urinary and
55
56 serological biomarkers) portion sized-based food diary to assess dietary
57
58 intake that minimises some of these limitations¹⁵.
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60

Methodology

Ethics approval was gained from Leeds (East) Research Ethics Committee.

Participants all had histologically confirmed CD (i.e. at least Marsh I criteria ¹⁶) and had been on a strict GFD for 6 months or more prior to being invited to take part in the study. Dietary compliance was assessed by self-reporting and dietitian review. Available coeliac serology was also assessed, although negative serology was not an absolute prerequisite for consideration of entry into the study. Previous studies suggest between 7% and 10% of coeliac patients self-reporting high compliance with a GFD still have positive serology ².

Patients who met the inclusion criteria were recruited by a dietitian in a weekly specialist gastroenterology clinic, or specialist coeliac clinics, in a large UK teaching hospital over an 18 month period from January 2007 to May 2008. Written consent was obtained. Participation was voluntary. Participants were invited to complete a detailed 5-day food diary, to include 3 weekdays and 2 days at the weekend. The EPIC validated food diary was used ¹⁵ which includes colour photographs for estimating food portion sizes. The dietitian gave detailed completion instructions at the time of recruitment and a follow up telephone call was made in the week following recruitment. Diaries were returned by post and telephone contact was made to clarify details where necessary.

Participants' weights and heights were recorded in clinic at recruitment for use in calculating energy requirements and body mass index (BMI). All patients

1
2
3 also had routine bloods and samples for micronutrient levels taken (data not
4
5 shown).
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10 The diaries were analysed using Microdiet version 2.52 (2005), a
11
12 computerised nutrient data bank, which has details of Glutafin “Gluten Free
13
14 Dietary” range built-in. Data for gluten free foods provided by other
15
16 manufacturers were also added to the database.
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22 Portions sizes were calculated from the photographs in the EPIC food dairies
23
24 using conversion data from the EPIC group ¹⁷, with weights provided by
25
26 participants or calculated from household measures using data from the FSA
27
28 Food Portion Sizes Guide ¹⁸. Nutrients provided by supplements were not
29
30 included in the nutritional analysis, although details of dietary supplements
31
32 consumed were recorded and reported separately.
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36 A comparison was made between reported energy intakes (calculated from
37
38 the 5 day food diary) and **estimated individual energy requirements based on**
39
40 **individual activity levels and basal metabolic rate (BMR - which in turn is**
41
42 **estimated using Schofield equations)**. As the original design of the study had
43
44 not included asking participants about their activity levels an assumption was
45
46 made that all patients were sedentary, which equates to a physical activity
47
48 level (PAL) of 1.4. **This calculated estimated individual energy requirement**
49
50 **was used to determine the level of under and over reporting in the food**
51
52 **dairies**. A threshold of +/-20% of **estimated individual energy requirement** was
53
54 used to assess level of under- and over- reporting in the returned food dairies;
55
56
57
58
59
60 no adjustment was made for BMI. **The lack of data regarding activity levels**

1
2
3 had no direct bearing on the interpretation of the data contained within the
4
5
6 food diaries – only on the assessment of under- and over- reporting.
7

8 Results obtained were compared against RNI ¹⁰ and in the case of calcium,
9
10 the British Society of Gastroenterology (BSG) guidelines for CD ¹¹. Nutrient
11
12 intakes were also compared against a comparable population from both the
13
14 NDNS: Northern Region and the UKWCS.
15
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19
20 Nutrient data from 195 male and 256 female participants of the National Diet
21
22 and Nutrition Survey selected from Northern region were sampled to provide a
23
24 non-coeliac reference population. The NDNS which was carried out between
25
26 June 2000 and July 2001 presents the most recent dietary intake data for a
27
28 UK population between the ages of 19 and 64 years ¹². In addition, it provides
29
30 regional data and where available it is this data that was used as being most
31
32 comparable to the study population.
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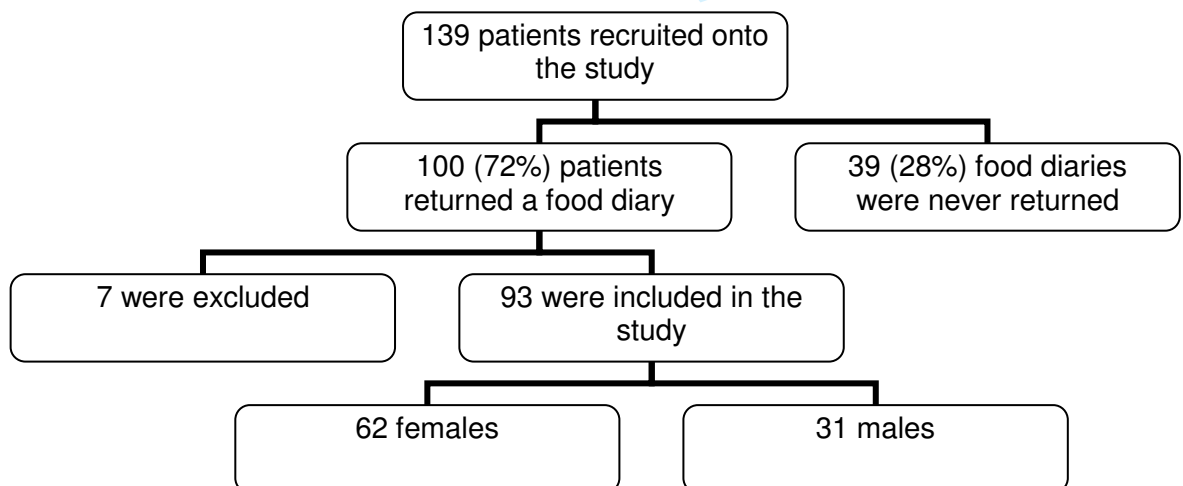
39 The UK Women's Cohort Study (UKWCS) was started in 1993 to investigate
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41 diet and cancer relationships in middle-aged women in the UK. A food
42
43 frequency questionnaire and 4 day semi-weighed food diary were used to
44
45 assess dietary intake ¹³. Participants had been initially selected to ensure a
46
47 wide range of dietary patterns were represented (including approximately one
48
49 third following a vegetarian diet) and at time of the completion of the original
50
51 questionnaire were aged 35-69. A sample of 708 randomly selected cancer-
52
53 free cohort participants that had a fully coded food diary was available as a
54
55 healthy non-coeliac reference population. Nutrient intakes were estimated
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58 from food diaries using in-house MS Access-based software based on the
59
60

Fifth Edition of the Composition of Foods and related supplementary food tables¹⁹.

A Student's unpaired t-test was used for comparison of means: GraphPad software was used, with a p-value<0.05 deemed as statistically significant.

Results

139 patients were recruited into the study; 100 (72%) food diaries were returned (mean age 54yrs; median age 55yrs). Of the 39 diaries not returned (23 females, 16 males) mean age was 41 years and median age was 43 years. Seven of the returned diaries were excluded as they did not meet the inclusion criteria on return: 3 diaries included foods containing significant amounts of gluten (1 male, 2 female) and 4 contained insufficient detail and could not be analysed accurately (3 male, 1 female). Therefore 93 diaries were included in the study; 62 (67%) by females. Females comprise 69% of coeliac clinic attendees.



Demographic Data

Mean age for females was 53 (21-79) years and for males 56 (18-74). Mean BMI was 25.5 and 25.4 respectively. For more detailed data see Table 1.

Coeliac Serology

54 of the 93 patients had coeliac serology (anti-tTG) from when they submitted their food diaries. Of these only 6 (11%) were positive (2 were described as “weak positive” and 3 of the remaining 4 positives also had positive anti-endomysial antibodies). **No patient with positive anti-tTG antibodies reported eating gluten in their diary and therefore this group was not analysed separately.**

Co-morbidities

Patients were asked about other conditions or dietary practices influencing their dietary intake (in addition to gluten restriction). One male patient reported trying to gain weight during the recorded week and 4 men had other health conditions including Type 2 Diabetes Mellitus (DM), pancreatic cancer, and enteropathy-associated T-cell lymphoma. Fifteen of the women reported other wide-ranging conditions **(including Type 1 DM and fibromyalgia, irritable bowel syndrome, Sjogrens syndrome, multiple sclerosis, Parkinson’s disease, idiopathic chronic constipation, thyroid disease and ulcerative colitis)** that could have affected their dietary intake. **One female participant was recorded**

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3 as vegetarian. Five other participants excluded other dietary components
4 such as lactose, soya or eggs and 2 reported trying to lose weight during the
5 week recording their diaries. The 15 females with reported co-morbidities had
6 a mean energy intake of 7486kJ (SD 1495) compared to 8018kJ (SD 1872)
7 for those with no reported co-morbidities (P=0.32). For the 4 males with
8 reported co-morbidities mean energy intake was 9244kJ (SD 3329) compared
9 to 10572kJ (SD 2977) for those with no reported co-morbidities (P=0.42) i.e.
10 there was no statistically significant differences in overall energy intake when
11 the data was stratified according to presence or otherwise of co-morbidities.
12 Therefore, all subjects were included in the data analysis regardless of their
13 health status. Co-morbidities were not recorded in NDNS and only minimally
14 in UKWCS.

32 Nutrient Intake

36 Determining the level of under and over reporting of energy intake

37 A threshold of +/-20% of estimated individual energy requirement was used to
38 assess level of under- and over- reporting; no adjustment was made for BMI.
39 Based on this assumption 26% males and 23% females under-reported and
40 23% males and 13% females over-reported their intake. No food diaries were
41 omitted on the basis of this analysis.

52 Macronutrients

53 Detailed data is given in Tables 2 and 3, with numbers of patients meeting
54 overall recommendations being given in Table 4. In summary, females on a
55 GFD consumed significantly ($p < 0.05$) more energy across all macronutrients
56 (i.e. protein, fat and carbohydrate) than an age and sex specific "local"
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3 population i.e. Northern cohort from NDNS. Compared to UKWCS
4
5 participants, study females had significantly ($p < 0.05$) lower intakes of fibre
6
7 (NSP), but similar intakes of macronutrients. **As only 1 of our female**
8
9 **participants declared herself as vegetarian (in contrast to 27% of those in**
10
11 **UKWCS) we compared NSP intakes in those females on a GFD with only**
12
13 **non-vegetarians in UKWCS. There was still a significantly lower mean intake**
14
15 **of NSP in females in our study (13.7 g/day and 16.5 g/day respectively;**
16
17 **$p < 0.001$).** Males on a GFD also consumed significantly ($p < 0.05$) more energy
18
19 (fat and carbohydrate, but not protein) compared to the local NDNS
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21 population but had a similar (low) intake of dietary fibre (NSP).
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32 **Micronutrients**

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34 Females on a GFD consumed significantly ($p < 0.05$) more calcium and
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36 magnesium than an age and sex matched "local" population i.e. Northern
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38 cohort from NDNS. Compared to UKWCS, the females had significantly lower
39
40 intakes of magnesium, iron, zinc, manganese, selenium and folate ($p < 0.05$),
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42 although there was no overall difference in the percentage of the population
43
44 meeting dietary reference values (DRVs) for nutrient intake apart from
45
46 significantly lower numbers of females in this study meeting DRVs for
47
48 magnesium (31% vs 71%) and selenium (11% vs 35%). However, for calcium
49
50 intake only 32% of under 55s and 18% of over 55s of female patients with CD
51
52 met current guidelines¹¹. There was no comparable population for males with
53
54 regards to micronutrients. Looking at percentage of males meeting DRVs,
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56 they also did not meet recommended intakes for magnesium and selenium
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3 (23% and 6% respectively), and the level of recommended manganese intake
4 was also low (48%). Levels of recommended calcium intake were not as low
5 as in females. There is no UK recommended intake for Vitamin D as a large
6 proportion is synthesised from sunshine – indeed Millen et al suggest that
7 total vitamin D intake from foods and supplements explains only 7% of the
8 variance in 25(OH)D concentrations between participants of the Women's
9 Health Initiative Trial²⁰. More details are given in Tables 2 to 5.

23 Dietary supplementation

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25
26 Just under half of the GFD study participants reported taking a combined
27 calcium and Vitamin D supplement (47% females and 48% males) the
28 majority having obtained these by prescription. Additionally, a further 2
29 females stated they had calcium and Vitamin D supplements prescribed but
30 did not take them. A smaller proportion of participants reported taking iron
31 supplements (11 (18%) females and 2 (7%) males), and of these, most had
32 received them on prescription.

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There was no correlation between dietary intake and dietary supplementation
i.e. those with low dietary intake were no more likely to be taking a
supplement than others.

53 Discussion

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This study shows that female patients on a GFD compared to the Northern
region population of the NDNS, (Table 2) consumed significantly more energy
(fat, CHO and protein), more calcium and more magnesium ($p < 0.05$). When

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3 comparing the intakes with the UKWCS cohort, the study females had
4 significantly lower intakes of fibre (NSP), magnesium, iron, zinc, manganese,
5 selenium and folate ($p < 0.05$) with no significant difference in energy intake.
6
7 This suggests less nutrient dense energy food choices by females in this
8 study, such as sugary snack foods. Comparing intakes of NMES supports
9 this. Whilst the UKWCS has no data for NMES, comparison with the NDNS
10 shows statistically significant higher intakes of NMES intake in those on a
11 GFD ($p < 0.01$). For the females with CD, 54% of the additional carbohydrate
12 comes from NMES and for the males, 35.7%. The recommended intake of
13 NMES is 10% total energy intake²¹ (Table 4).
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17 In males, a comparison of macronutrient intake with that of the NDNS again
18 reveals that males in this study consumed significantly more energy (fat and
19 CHO but not protein), ($p < 0.05$) (Table 3). Notwithstanding this only 42% of
20 males and females got more than 47% of their total energy intake from
21 carbohydrate sources (Table 4). It is recommended that at least 47% of total
22 energy intake comes from carbohydrate sources¹⁰. These data, and the
23 extrinsic sugar figures confirm that patients on a GFD are not consuming
24 enough complex carbohydrates.
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28 Calculation of estimated individual energy requirements indicates 22 (35%) of
29 the reported intakes from the females and 15 (48%) of the male reported
30 intakes fall outside $\pm 20\%$ of their requirements. This is comparable to similar
31 studies^{6, 22}. Bingham²³ suggests an average error of $\pm 10\%$ for calculated
32 energy intake and states, "Habitual energy intakes from dietary surveys of
33 groups of adults 72% or less than BMR are almost certainly invalid". None of
34 the intakes in this study were below this threshold. Hallert et al⁶ use a similar
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3 method for validating their data and suggest patients under-estimated intake
4 by about 25% which is a little more than levels found in this study. The NDNS-
5 reported intakes are compared to estimated average requirement (EAR) -
6 which does not take into account weight or activity, unlike the estimated
7 individual energy requirement. This comparison suggests the males (all
8 regions) reported an intake on average 92% of the EAR and females 85%
9 EAR. Corresponding figures for this study are 102.2% and 98.3% i.e. in this
10 study males “over-report” by only 2.2% and females “under-report” by only
11 1.7%.
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24 We collected data using a five-day food diary including a weekend (or 2 non-
25 working days) whilst previous studies³⁻⁸ used three or four day diaries.
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29 Levine and Morgan²⁴ suggest that a week is too short to assess intakes of
30 vitamins, minerals & trace elements. However, Livingstone et al²⁵ argue that
31 recordings lasting longer than 4 days may not necessarily be superior.
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35 Strengths of this study are that it is comprehensive, with nutritional
36 composition of gluten-free foods verified by contact with manufacturers. All
37 (bar one) of the patients in this study had been on a GFD for at least 6 months
38 – median time on a GFD was nearly 7 years for males and 9.5 years for
39 females.
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48 Unlike many other studies⁹, this study does present data of co-morbidities
49 and compares intake to comparable populations.
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52 Weaknesses of this study include the relatively small sample size (although
53 the authors are not aware of any larger cohort of patients on a GFD that have
54 been dietetically assessed). Previous similar studies³⁻⁸ have sample sizes
55 ranging from 30 to 71 participants. The cohort in the UKWCS by definition is
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3 a health conscious cohort of middle aged women, and a higher micronutrient
4 intake than those on a GFD could **therefore** be anticipated. However as the
5
6 study participants have maintained a rigid diet (GFD) and been regular
7
8 attendees of a specialist clinic, it could be contended that this group are
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10
11
12 “health conscious” too. As comparator populations, younger ages were under-
13 represented in the UKWCS cohort and in NDNS there is concern about the
14
15 probable under-reporting of nutrient intake (given the overall reported energy
16
17 intakes). In NDNS too the younger age ranges were under-represented - of
18
19 the women only 9 were aged 18-40.

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21
22 Significant differences between GFD and non-GFD groups of consumption of
23
24 home-prepared and processed food would skew our data, and it is generally
25
26 easier for non-GFD patients to “snack” and eat processed foods
27
28 spontaneously, especially outside the home. Data with regards to food
29
30 preparation is incomplete but a **random** subgroup of 30 diaries was
31
32 reanalysed, and of these only 5 (17%) patients had consumed a ready meal
33
34 during the 5 days covered by the food diary. **However**, in percentage terms
35
36 47% of energy intake was attributable to processed foods in those on a GFD.
37
38 There is no such equivalent data in UKWCS, **although** NDNS differentiates
39
40 between food eaten within and outside the household, allowing some
41
42 implications to be made. **Nonetheless**, the data is not robust enough to allow
43
44 comments upon (and therefore comparisons with this study) with regards to
45
46 eating of processed foods. **If this high percentage of energy from processed**
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48 **food is typical of a GFD, appropriate and detailed labelling of processed food**
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50 **is vital so as those on a GFD can make fully informed decisions.**
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3 In summary, this study of nutrient intakes in CD reveals adequate
4 macronutrient intakes but higher proportions of carbohydrate from NMES.
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6 Intakes of magnesium, iron, zinc, manganese, selenium and folate in females
7
8 are lower than a comparative population taking a gluten containing diet. In
9
10 males, the percentage of patients with CD achieving the RNI for magnesium
11
12 and selenium is particularly low. Whilst mean intakes of calcium are higher
13
14 than in gluten containing diets, many patients, particularly those over 55 years
15
16 of age, fail to achieve BSG recommended intakes for calcium.
17
18 Current dietary advice and recommendations for supplementation need
19
20 review to take account of these deficiencies. Where possible
21
22 recommendations should be made to address the low intakes of fibre, calcium
23
24 and iron. Maintaining available carbohydrate intakes without resorting to
25
26 sugary foods should be done. Patients should be encouraged that this could
27
28 occur without the need to wholly rely on special GF products, but rather by
29
30 increasing intake of food products such as beans and pulses, starchy
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32 vegetables such as sweet potato and potato or alternative grains as recently
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34 suggested by Lee et al.²⁶
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43 This work highlights the importance of all patients with coeliac disease having
44
45 the opportunity for dietary review with a suitably experienced dietitian on a
46
47 **regular** basis for advice on foods to achieve a balanced diet or appropriate
48
49 dietary supplementation.
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Table 1 Characteristics of gluten-free diet survey participants (n=70)

	Men	Women
Mean BMI (SD)	25.4 (4.0) n=25	25.5 (3.9) n=45
BMI range (kg/m ²)*	17.8-33.6	18.4-35.1
BMI <20	3	2
BMI 20-24.9	8	19
BMI 25-29.9	11	20
BMI 30-34.9	3	3
BMI> 35	0	1
Mean age (years)	56 (15) n=31	53 (13) n=62
Median age (years)	63	53
Mean duration of GFD (years)	8.43	11.28
Median duration of GFD (range)	6.71 (0.29-31.35)	9.52 (0.52-33.45)

*38 participants had a BMI>25; 24 females (38.7%) and 14 males (45.2%)

Of these 7 participants had a BMI >30; 4 females, 3 males.

Table 2 Average daily energy and nutrient intakes in 62 female participants consuming a gluten-free diet

	Units	GFD		NDNS Northern (n=256)			UKWCS (n=708)		
		Mean	SD	Mean	SD	P value (vs GFD)	Mean	SD	P value (vs GFD)
Energy	kJ	7945	1792	6770	1840	<0.01*	7666	1695	0.22
Protein	g	74.1	16.8	63.1	18.4	<0.01*	70.5	17.8	0.13
Fat	g	68.4	23.0	58.6	21.4	<0.01*	68.1	23.5	0.92
Carbohydrate	g	240.7	58.6	202	58	<0.01*	229.3	56.6	0.13
Alcohol	g	9.4	10.6				9.3	11.8	0.99
Starch Intake	g	79.6	31.5				116.9	34.3	<0.01*
Total sugars	g	106.7	34.7				107.5	36.0	0.87
Starch and intrinsic sugar	g	168.8	41.5	152	NA				
Extrinsic sugar	g	71.9	26.9	51	46	<0.01*			
Non-starch polysaccharides	g	13.7	4.5	12.4	5.2	0.07	17.3	6.1	<0.01*
Calcium	mg	888.3	346.7	786	285.8	0.02*	869.5	286.5	0.63
Vitamin D	ug	2.6	2.0				2.6	2.1	1.00
Magnesium	mg	253.0	86.2	228	71	0.02*	318.9	86.6	<0.01*
Manganese	mg	2.8	1.3	2.6	1.1	0.22	3.9	1.5	<0.01*
Iron	mg	10.7	3.2	9.9	4.1	0.15	12.5	3.8	<0.01*
Zinc	mg	7.7	2.5	7.3	2.2	0.21	8.5	2.6	0.02*
Selenium	ug	39.2	16.9				58.0	40.0	<0.01*
Folate	ug	264.3	92.1	249	95	0.25	291.5	102.3	0.04*

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47**Table 3 Average daily energy and nutrient intakes in 31 male participants consuming a gluten-free diet**

	Units	GFD		NDNS Northern (n=195)		
		Mean	Std. Deviation	Mean	SD	P value (vs GFD)
Energy	kJ	10462	3000	9450	2230	0.03*
Protein	g	92.7	24.9	86.7	24.73	0.21
Fat	g	93.2	36.6	81.7	25.39	0.03*
Carbohydrate	g	315.6	98.5	266	70	<0.01*
Alcohol	g	12.0	14.4			
Starch and intrinsic sugar	g	220.9	72.1	196	NA	
Extrinsic sugar	g	94.7	36.0	77	42.2	0.03*
Non-starch polysaccharides	g	13.7	5.3	14.3	5.44	0.57
Calcium	mg	1090.7	459.2	993	348.2	0.17
Vitamin D	ug	3.1	3.1			
Magnesium	mg	266.5	98.8	303	96.9	0.05
Manganese	mg	2.7	1.1	3.14	1.242	0.06
Iron	mg	13.8	5.4	12.6	4.46	0.18
Zinc	mg	10.1	3.7	10.1	3.04	1.00
Selenium	ug	46.3	38.3			
Folate	ug	310.0	101.6	332	116	0.32

Table 4 N (%) of patients on GFD meeting RNI for micronutrients and macronutrients from dietary sources

	RNI males/females	n (%) meeting RNI				
		Males (n=31)		Females on GFD (n=62)		UKWCS (n=708)
Folate	200/200µg	28 (90)		49 (79)		610 (86)
Calcium	700/700mg	23 (74)		42 (68)		500 (71)
Calcium (coeliac)	1000mg <=55yrs 1200mg >55 yrs	n=13; 7 (54) n=18; 7 (39)		n=34; 11 (32) n=28; 5 (18)		
Magnesium	300/270mg	7 (23)		19 (31)		500 (71)
Zinc	9.5/7mg	17 (55)		37 (60)		498 (70)
Iron	8.7/8.7-14.8mg	25 (81)		aged 18-54 RNI=14.8mg: N=31 aged 55-74 RNI=8.7mg : N=27	3(10) 20(74)	606 (86)
Selenium	75/60ug	2 (6)		7 (11)		247 (35)
Manganese	2.3/1.8mg	15 (48)		47 (76)		678 (96)
Protein	55.5-53.3/45- 46.5g	aged 18-50 RNI =55.5g: N=11 aged 50-74 RNI=53.3g: N=20	11(100) 20 (100)	aged 18-50 RNI =45g: N=27 aged 50-74 RNI=46.5g: N=35	26(96) 35(100)	
Energy as Fat	<33%/<33%	17 (55)		33 (53)		376 (53)
Energy as CHO	>47%/>47%	13 (42)		26 (42)		338 (48)
Energy as Extrinsic Sugar	<10%/<10%	8 (26)		15 (24)		

Table 5 Daily Calcium Intake in those on a Gluten-Free Diet

	N	Minimum	Maximum	Mean	Std. Deviation
Males <=55yrs	13	619.1	2269.7	1160.3	496.8
Males >55yrs	18	455.0	2005.3	1040.5	437.6
Females <=55yrs	34	259.1	1716.8	862.2	374.4
Females >55yrs	28	334.8	1970.8	920.1	313.4

Calcium intakes (mg/day) from diet only. Daily recommended intakes for calcium in adults with coeliac disease ¹¹ are 1000mg/day (1200mg/day for postmenopausal women and men over 55 years of age).

As we did not record menopausal status for the female cohort, 55 years of age has been used for the purpose of this analysis.

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