

1 **Long-term symptom severity in people with irritable bowel syndrome following dietetic**
2 **treatment in primary care – a service evaluation.**

3

4 **Transparency Declaration**

5 The lead author affirms that this manuscript is an honest, accurate, and transparent account of the
6 study being reported. The lead author affirms that no important aspects of the study have been
7 omitted and that any discrepancies from the study as planned have been explained.

8

9 **ABSTRACT**

10 Background: Evidence suggests dietary interventions can improve symptoms in people with
11 irritable bowel syndrome (IBS), but most data explores short-term (immediate) impact; data on
12 long-term (>6 months) impact are limited, especially from primary care settings. This study aimed
13 to investigate the long-term effect of dietetic-led interventions for IBS delivered in primary care.

14 Method: A service evaluation of a dietetic-led IBS clinic was completed, analysing data on
15 symptom severity, stool frequency and consistency, and healthcare input. Data were collected
16 before and immediately after dietary intervention as part of patients' routine clinical appointments.
17 Long-term data was collected via a postal questionnaire at least 11 months later.

18 Results: 211 patients responded to the long-term follow-up questionnaire at 13 months (median;
19 interquartile range 12-16 months) post follow-up appointment. 84% had been advised to follow the
20 low FODMAP diet. All symptoms were reported significantly less frequently short-term, and all,
21 except heartburn and acid regurgitation, remained so long-term. The four most commonly reported
22 bowel symptoms reduced in frequency by 62% abdominal pain, 50% bloating, 48% increased wind,
23 and 49% urgency to open bowels ($p<0.001$). Percent patients reporting satisfactory relief of gut
24 symptoms was 10% baseline and 55% long-term follow up ($p<0.001$). Visits to the GP reduced
25 (96% vs 34% $p<0.001$), and to the gastroenterologist (37% to 12%; $p=0.002$) during the year prior
26 to long-term follow up compared to the year prior to dietary intervention.

27 Conclusion: Patients with IBS, who received dietetic-led interventions in primary care reported
28 long-term symptoms improvements, which may result in reduced healthcare usage.

29

30 **1: INTRODUCTION**

31 Irritable bowel syndrome (IBS) is a chronic and debilitating functional gastrointestinal disorder with
32 estimated global prevalence of 4-9% ⁽¹⁾. It has a significant impact on healthcare utilisation with up
33 to 50% of IBS patients seeking medical advice, with the majority of these (90%) visiting their
34 General Practitioner (GP) ⁽²⁾. Repetitive appointments with GPs are common in this patient group,
35 with rates of attendance in primary care shown to be between 8.1–9.7/year in the UK ⁽³⁾. The
36 impact on secondary care services is also substantial, with 29% of IBS patients being referred to
37 specialists, including gastroenterologists and surgeons ⁽⁴⁾. Between 63-84% of patients have
38 expensive diagnostic procedures, including abdominal ultrasounds and colonoscopies ⁽⁵⁾, despite a
39 low probability of finding any organic pathology ⁽⁶⁾. Although IBS is not associated with serious
40 disease or mortality, it has been shown to have a negative effect on health-related quality of life ⁽⁷⁻
41 ⁸⁾. When the financial implications associated with reduced quality of life are combined with direct
42 healthcare costs, IBS has been estimated to cost between £45.6-£200 million/year in the UK alone
43 ⁽⁵⁾.

44 In order to alleviate the global burden of IBS, timely diagnosis and effective management of
45 symptoms is essential. Both the UK's National Institute of Care and Health Excellence (NICE) and
46 the British Society of Gastroenterology recommend primary care as being the most appropriate
47 setting to achieve this ⁽⁹⁻¹⁰⁾, however, other countries' guidelines are yet to focus on delivering
48 treatment specifically in primary care. Historically, the lack of effective IBS treatment options has
49 been the main challenge in isolating its management in primary care. However, because a large
50 proportion of people with IBS commonly report that foods induce or exacerbate their symptoms,
51 dietary treatments have now been explored as potential therapeutic options ^(7,11-13). A systematic
52 review, which was part of the development process of the British Dietetic Association's practice
53 guidelines for the dietary management of IBS, reported that various dietary interventions, including
54 altering intakes of alcohol, spicy foods, fat, as well as reducing intakes of fermentable
55 oligosaccharides, disaccharides, monosaccharides and polyols carbohydrates (FODMAPs) were
56 effective in improving certain symptoms in people with IBS ⁽¹⁴⁾. Improvements in symptoms of
57 people with IBS whilst following a low FODMAP diet have frequently been reported ⁽¹⁵⁻¹⁷⁾. As a
58 result, a low FODMAP diet is now recommended within the IBS management guidelines of several
59 countries ^(9, 14, 18-22). The gluten free diet has also been explored as a potential dietary treatment and
60 found to improve symptoms in people with diarrhoea predominant IBS ⁽²³⁻²⁵⁾.

61 With dietary interventions now recognised as an integral part of the management of IBS, dietitians
62 should play an essential role in the effective delivery of this therapeutic option. Prior to
63 recommending a dietary treatment, a dietitian must first complete an assessment with patients to
64 confirm the diagnosis of IBS and determine the most appropriate intervention. Other conditions,

65 including undiagnosed coeliac disease, non-coeliac gluten sensitivity and gastrointestinal food
66 allergy, can all present with similar symptom profiles to IBS, and are often misdiagnosed.
67 However, each of these conditions require different diets and variable levels of dietary stringency,
68 emphasizing the need for specialist dietetic intervention (²⁶⁻²⁹). Coeliac disease must first be excluded
69 via appropriate tests (⁹), and exploring a patient's atopic history may provide an indicator for a
70 potential food allergy (²⁹). Non-coeliac gluten sensitivity involves intestinal and extra-intestinal
71 symptoms that are triggered by gluten ingestion in the absence of coeliac disease and wheat allergy
72 (³⁰) and may also include 'foggy mind', tiredness, headaches, fibromyalgia-like joint or muscle
73 pain, and leg or arm numbness (³¹).

74 The majority of available evidence demonstrates the benefits of diet, including the low FODMAP
75 diet, on IBS symptoms immediately following implementation, and up to 9 months afterwards (^{15-17,}
76 ^{32-33, 24}). However, there is little reported on the benefits of diet beyond 11 months of
77 implementation. Studies that have examined the longer-term effects of the low FODMAP diet on
78 IBS symptoms (³⁴⁻³⁶) have primarily delivered the dietary advice in secondary care. Providing
79 dietetic input for IBS patients within primary care offers an opportunity to reduce the burden of the
80 condition on healthcare resources, including reducing unnecessary secondary care referrals and
81 associated costs (³⁷). The aim of this study was to assess the impact of dietetic-led interventions for
82 IBS patients delivered in primary care, a year after treatment completion.

83

84 **METHOD**

85 **Study design**

86 This is an observational service evaluation of a specialist dietetic-led gastroenterology clinic
87 [blinded for peer review] that was set up to provide dietary advice for patients with IBS in primary
88 care in January 2013. Patients referred into the clinic were initially diagnosed with IBS by their GP,
89 which as per the local diagnosis pathway, included assessment of alarming symptoms and exclusion
90 of coeliac disease via a negative tissue transglutaminase blood test. It was assumed GPs would
91 have considered alternative diagnoses as part of their assessment. Prior to referral patients were
92 encouraged to implement first line dietary advice discussed in the British Dietetic Association's
93 practice guidelines for the management of IBS (¹⁴), and support for this was delivered either by the
94 GP, or the general community dietetic clinics. Only those with intractable symptoms were referred
95 on to the specialist clinic. Those who attended the dietetic-led gastroenterology clinic were
96 assessed and counselled by a specialist gastroenterology dietitian. The patient attended at least two
97 dietetic appointments; an initial appointment for assessment and education on recommended dietary

98 intervention; and a follow up appointment at least 4 weeks later when they had implemented the
99 advised dietary changes. Some patients attended subsequent appointments if further dietetic
100 intervention was recommended at their first follow-up. At the final follow-up appointment, patients
101 were educated on how to complete relevant food challenges, and advice was provided on food
102 reintroductions and long-term self-management.

103 All patients seen in the clinic between May 2013 and April 2017 were included. Data was collected
104 at three time points: prior to their initial appointment (baseline), prior to their final follow-up
105 appointment (short-term follow-up) (both of which were part of the routine clinical care), and
106 approximately 11 months later (long-term follow-up) via postal questionnaire.

107 Ethical approval via the UK Health Research Authority was not required because it was deemed an
108 evaluation of the dietetic service. Local approval was given by [blinded for peer review] to carry
109 out the data collection.

110

111 **Dietary advice**

112 Patients were seen in the dietetic-led gastroenterology clinic by one of three specialist
113 gastroenterology dietitians. As per routine clinical practice, a medical, social and diet history was
114 completed along with an assessment of gut and non-gut related symptoms, followed by a discussion
115 regarding previous treatments and dietary habits. Following careful consideration of these
116 parameters, and in consultation with the patient, at the initial appointment one of the following
117 dietary interventions was recommended: low FODMAP diet, gluten free diet, or another single or
118 multiple food exclusion diets. Education was provided on the specific diet and patients received
119 practical advice on how to implement the dietary intervention along with appropriate written
120 booklets to provide additional support.

121

122 The patients were asked to implement dietary changes for a period of 4-8 weeks, and were then
123 reviewed in clinic as soon as possible after this time. If the initial dietetic intervention resulted in
124 minimal symptom improvements, an alternative dietary change may have been recommended if
125 appropriate for a further 4-8 weeks. At the final follow-up appointment with the dietitian, education
126 was provided on how to complete relevant food challenges, and advice was provided on food
127 reintroductions and long-term self-management

128

129 The following data were collected from the clinical notes for baseline and short-term follow-up and
130 from the questionnaire for the long-term follow-up:

131

132 **Gastrointestinal symptoms and stool output**

133 At each of the three time-points, patients were asked to assess severity of individual gastrointestinal
134 symptoms, based on frequency and the extent to which they affected their social activities, using the
135 Gastrointestinal Symptom Rating Scale (GSRs) ⁽³⁸⁾. Symptoms assessed included abdominal
136 pain/discomfort, abdominal bloating/distension, increased wind, belching/burping, gurgling noises
137 from stomach, urgency to open bowels, incomplete evacuation of stools, nausea, heartburn, acid
138 regurgitation and tiredness. Patients were also asked about their stool frequency and consistency
139 according to the Bristol Stool Form Scale (BSFS) ⁽³⁹⁾, which is a 7 point scale of stool types
140 ranging from type 1 (separate hard lumps) to type 7 (entirely liquid with no solid pieces).
141 Satisfaction with gut symptom relief was assessed by asking the question “*Do you currently have*
142 *satisfactory relief of your gut symptoms?*”

143

144 **Healthcare utilisation and resources**

145 At baseline and long-term follow-up, patients were asked to recall, in the previous 12 months, how
146 many times they had visited their GP or gastroenterologist for their IBS symptoms and whether they
147 had any investigations for gut symptoms. Patients were also asked to confirm whether or not they
148 were currently taking any prescribed medication for their gut symptoms.

149

150 **Statistical analysis**

151 Statistical analysis was performed using IBM SPSS (version 25) statistical software package.

152 Demographics, dietary intervention and baseline symptoms were analysed descriptively. Symptom
153 responses were assessed by changes in the proportion of patients reporting the presence of moderate
154 or severe symptoms on the GSRs. Stool frequency was reclassified into four categories depending
155 on number of times stools were passed; once every 4 or more days, between once every 3 days and
156 up to 3 times a day, 4 or more times a day, and variable. Stool frequency was also dichotomised as
157 normal (between once every 3 days and up to 3 times a day) or abnormal (any of the other three
158 categories). Similarly, stool consistency was grouped into four categories; BSFS 1-2 (hard), 3-4
159 (normal), 5-7 (loose) and mixed, and additionally dichotomised as normal (BSFS 3-4) or abnormal
160 (BSFS 1,2,5,6,7 and mixed).

161 A Wilcoxon ranked test was applied to determine if there were any significant differences over time
162 for individual symptom severity, number of GP and gastroenterologist visits, and number of

163 gastrointestinal investigations. A McNemar's test was applied to determine if there were any
164 significant associations across the time frames for satisfactory relief of symptoms, presence of
165 normal stool consistency and stool frequency, and current use of prescribed medication.

166 P values <0.01 were considered to be statistically significant. A p value lower than the usual 0.05
167 was applied to counteract the increased risk of a type 1 error associated with the multiple
168 comparisons completed.

169

170 **RESULTS**

171 There were 742 patients seen in the primary-care dietetic-led gastroenterology for their initial
172 appointment between May 2013 and April 2017. Of these, 547 attended at least one follow-up
173 appointment. 499/547 (91%) patients were sent postal questionnaires at least 11 months after their
174 final follow-up appointment as part of the service evaluation. The remaining 48/547 (9%) patients
175 were not sent postal questionnaire at 11 months due to: not completing recommended dietary
176 intervention (n=6); providing incomplete paperwork at initial and follow-up appointments (n=35);
177 or receiving on-going dietetic review (n=7). Of the 499 patients sent postal questionnaires, 227
178 patients (45%) returned completed questionnaires. Of these, 16 patients were referred for other
179 reasons than IBS, therefore 211 (44%) patients were analysed at long-term follow-up. The mean age
180 was 53.6 years (sd=15) and 182 (86%) were female. The median duration from baseline to short-
181 term follow-up appointment was 9 weeks, (interquartile range 9-13 weeks), and the median duration
182 from short-term to long-term follow-up was 13 months (interquartile range 12-16 months). Five
183 patients (2%) were sent postal questionnaires before the planned 11 months, due to an
184 administrative error. In 38 patients (18%) there was a >6 month delay in sending out questionnaires
185 after their final appointment due to other work priorities at the time.

186 As shown in Table 1, the majority of patients (84%) were advised to follow the low FODMAP diet,
187 either in isolation or combined with an additional dietary intervention. This is similar to the
188 proportion of the original cohort (n=547) who were advised to follow the low FODMAP diet (81%).

189

190 **Gastrointestinal Symptoms**

191 At baseline, the most common gastrointestinal symptoms were abdominal pain and bloating,
192 increased wind, and urgency to open bowels (Figure 1). Over 60% of patients rated the severity of
193 these symptoms as moderate or severe, with those included in the long-term follow-up analysis

194 (n=211) presenting with similar baseline symptom profiles as the whole cohort (n=547). Tiredness
195 was the most common symptom, reported by 71% and 69% of patients in the whole cohort and long-
196 term follow-up group respectively. There was a significant reduction ($p<0.001$ for all symptoms) in
197 the proportion of patients reporting presence of moderate or severe symptoms between baseline and
198 short-term follow-up (Figure 1) for both the whole cohort and the long-term follow-up group. The
199 significant difference from baseline was maintained at long-term follow-up for all symptoms apart
200 from heartburn (13% vs 10% $p=0.059$) and acid regurgitation (13% vs 12% $p=0.354$). The four
201 mostly commonly reported gastrointestinal symptoms reduced in frequency by approximately half
202 (abdominal pain by 62%; bloating by 50%; increased wind by 48%; and urgency to open bowels by
203 49%).

204 A sub-analysis was completed to determine if symptom improvements from baseline to long-term
205 follow-up were affected by the type of dietary intervention (Figure 2). Diets were re-classified into
206 two types: those that include the low FODMAP diet (n=177) and those that used other dietary
207 interventions (n=34), and an improvement in a symptom was defined as a positive change of at least
208 one on the GSRS. With both dietary approaches all symptoms improved but the size of the
209 improvement was not significantly different between the two approaches (Mann-Whitney U tests
210 $p>0.3$ for all symptoms) (Figure 2).

211 At baseline 10% of patients (n=22) reported having satisfactory relief of gut symptoms. At short-
212 term follow-up this increased to 66% (n=139, $p<0.001$) and was maintained at 55% (n=116; $p<0.001$)
213 at long-term follow-up.

214

215 **Stool Output**

216 At baseline, only 23% of patients reported a normal stool consistency (BSFS 3 or 4) (Table 2). The
217 most common stool types were mixed and loose stools (BSFS 5-7), and the least common was
218 constipation (type 1-2). At short-term follow-up the proportion of patients reporting normal stool
219 consistency significantly increased to 49% ($p<0.001$). At long-term follow-up this reduced to 45%
220 but remained significant when compared to baseline ($p<0.001$).

221 At baseline, 74% of patients reported a normal stool frequency (between once every 3 days and 3
222 times a day) (Table 2). This significantly increased to 89% ($p<0.001$) at short-term follow-up and
223 82% ($p=0.005$) at long-term follow-up.

224

225 **Healthcare utilisation and resources**

226 Table 2 shows the proportion of 140 patients who answered the question regarding number of GP
227 visits in the previous 12 months at baseline and 138 at long-term follow-up. Data indicates a
228 dramatic decrease in any patient visits to their GP (96% vs 34% $p<0.001$). Only 128 patients
229 provided information on the number of times they had seen a gastroenterologist in the previous 12
230 months at baseline and 125 at long-term follow-up (Table 2). Similar to GP visits, the proportion
231 visiting a gastroenterologist at least once reduced from 37% to 12% ($p=0.002$).

232 Whether investigations for gut symptoms occurred was reported by 130 patients at baseline and
233 long-term follow-up. Endoscopic investigation was the most common type, followed by ultrasound
234 (Table 2). At baseline, 49% patients reported having at least one investigation in the previous 12
235 months and 18% reported multiple investigations. At long-term follow-up this reduced to 17% and
236 5% respectively ($p<0.001$).

237 Results for medication usage showed a similar pattern; 57% reported using prescribed medication
238 for their gut symptoms at baseline, and this reduced to 49% at long-term follow-up, however this
239 was not significant based on our defined criteria ($p=0.034$) (Table 2).

240

241 **Discussion**

242 This observational service evaluation focuses on the long-term symptom severity of patients with
243 IBS, who have received dietetic-led dietary interventions, and it includes data from the largest
244 cohort of primary care based patients to date. The study demonstrated that after receiving dietetic
245 advice from a specialist dietitian based in primary care, patients with IBS reported improvements in
246 the severity of symptoms, and these improvements were sustained at least 11 months after treatment
247 completion. With over a half of patients reporting long-term satisfactory relief of symptoms, the
248 study supports the use of diet as a potential effective therapeutic option for the long-term
249 management of IBS. A reduction in the utilisation of healthcare services, including those in
250 secondary care, was reported in the year following dietary treatment, thereby suggesting a primary
251 care dietitian may be able to facilitate a reduction in healthcare usage in IBS patients.

252 Satisfactory control of gut symptoms was reported by 55% of patients, after a median of 13 months
253 following the completion of dietary intervention and this is consistent with the findings of O’Keeffe
254 et al (³⁵). These authors used a similar study design to the current study and found 57% of patients
255 had satisfactory relief of symptoms at long-term follow-up, which was between 6-18 months after
256 the completion of dietetic-led low FODMAP education. An earlier study that had a median follow-

257 up period of 16 months, reported 57% and 29% of IBS patients had a partial and full response to the
258 low FODMAP diet respectively (³⁴). These reported levels of satisfaction, are less than the more
259 recent findings of Nawawi et al (³⁶), who at 12 months demonstrated 76% of patients were satisfied
260 with the improvements in their symptoms. This study analysed data from 30 patients at long-term
261 follow-up, compared to the 211 patients in the current study. Nawawi et al (³⁶) also had patients
262 complete the long-term follow-up questionnaire in clinic during their final follow-up appointment,
263 whereas the current study used postal questionnaires for long-term data collection. These
264 differences in study design may contribute to variations in observed results.

265 Our study reported that after following dietetic advice, all individual gastrointestinal symptoms,
266 apart from heartburn and acid regurgitation, significantly improved in the long-term, but there were
267 differences between lower and upper gastrointestinal symptoms. Lower gastrointestinal symptoms
268 were the most commonly reported at baseline, with over 60% of patients reporting moderate or
269 severe abdominal pain, bloating or excess wind, and these symptoms reduced by approximately half
270 in the long-term for these symptoms. Although less common, upper gastrointestinal symptoms,
271 including heartburn and acid regurgitation, had a frequency of 13%, suggesting that although they
272 are seldom included in diagnostic criteria for IBS they are still symptoms that are reported by IBS
273 patients. Despite a significant improvement in these symptoms at short-term follow-up, changes at
274 the long-term follow did not remain significant for these upper gastrointestinal symptoms. These
275 findings are consistent with existing long-term studies (³⁴⁻³⁶).

276 Stool consistency significantly improved in our study at long-term follow-up (abnormal 77% vs
277 53%), and this is in keeping with findings of both O’Keeffe et al (³⁵) and Maagaard et al (³⁴). Stool
278 frequency also improved in our study and was deemed statistically significant, concurring with
279 O’Keeffe et al (³⁵). These findings along with the significant reduction in urgency to open bowels,
280 and incomplete evacuation, suggest dietary interventions may produce lasting improvements in
281 bowel habits in IBS patients. With a large proportion of patients stating that issues with bowel
282 habits have the most detrimental impact on their daily lives, effective therapeutic options addressing
283 this area may to lead to the most significant improvements in the quality of life of IBS patients.

284 We also showed that reported healthcare usage significantly reduced in IBS patients in the period
285 after receiving dietary advice. Both GP and gastroenterologist appointments went down
286 significantly after dietary intervention. This reduction may be explained by the symptom
287 improvements, however further work is required to compare healthcare utilisation in IBS patients
288 who do and do not receive dietetic advice. Dietetic intervention may have the potential to reduce
289 secondary care input and associated healthcare costs in the case of younger patients (<45 years of
290 age), by providing a therapeutic treatment option to a population who do not generally need

291 secondary care investigations to exclude alarming pathology, prior to their IBS diagnosis. With the
292 average age of the studied cohort being 54 years, one may argue the potential cost-savings from
293 reduced secondary care on a diagnostic basis is limited. However, in this cohort of patients,
294 effective dietetic-led interventions have the potential to reduce secondary care input by stopping the
295 revolving door effect of poor symptoms management leading to repeated secondary care referrals
296 and investigations. Nearly half the cohort (49%) reported having had at least one investigation in
297 the year prior to initial dietetic input; however clinical experience suggests if we had looked at the
298 number of investigations over the last 15 years, this number would have significantly increased, and
299 included repeated investigations. Patients often reported in clinic having suffered with IBS
300 symptoms for many years, and due to lack of effective treatment options, they had repeatedly
301 visited their GP and had repeated referrals to secondary care over many years. Therefore, there is
302 the potential to reduce healthcare usage in all age groups by offering effective dietetic treatments.

303 Additionally, due to the number of patients reporting having visited their GP and gastroenterologist
304 on numerous occasions before seeing the dietitian, it raises the question of whether earlier referral
305 to a dietitian could have resulted in further reductions in healthcare usage. Having the delivery of
306 dietary treatments based in primary care, rather than secondary care, is essential to optimise
307 potential cost savings. If GPs have access to dietitians offering effective dietary treatment options
308 within a primary care setting, it could reduce the number of referrals to secondary care and referrals
309 for unnecessary expensive investigations.

310 Patients included in this service evaluation, would have been encouraged to implement first-line
311 dietary approaches, recommended by the British Dietetic Association (¹⁴), before being referred
312 onto the specialist dietetic clinic. As these interventions were delivered in the patient's GP practice
313 or by another part of the community dietetic service, data on changes in symptoms following such
314 advice was not available for this service evaluation. As studies have shown traditional first-line
315 dietary approaches for IBS can be effective in reducing IBS symptoms (⁴⁰⁻⁴¹) and are less restrictive,
316 future studies should include analysis of these types of dietary interventions. The most frequently
317 used dietary intervention in this service evaluation was a low FODMAP diet in isolation or
318 combined with another dietary restriction. Only a few other diets were used, including a gluten-free
319 diet and other single dietary restrictions. However, the comparison of low FODMAP to 'other'
320 diets showed no significant differences in symptom improvements from baseline to long-term
321 follow-up. Patients on both dietary approaches improved equally well, suggesting that diets such as
322 gluten-free and other dietary exclusions may deliver long-term symptom improvements, and a
323 dietitian has the appropriate skills to make the assessment and recommend the most appropriate
324 dietary intervention. The mechanisms for how the low FODMAP diet leads to symptom

325 improvements include reductions in small intestinal water volume and colonic gas production (⁴²).
326 However, further studies including randomised control trials (RCTs), are required to assess the
327 mechanisms for the other diets used in clinical practice, along with the long-term implications and
328 safety, before the diets can be included in formal guidelines.

329 It may be that the improvements seen in patients following alternative diets (not low FODMAP)
330 was due to the diets being effective treatments for alternative diagnoses, rather than an effective
331 treatment for IBS. IBS is difficult to diagnose due to the vague symptoms, thus this diagnosis may
332 not always be accurate. Undiagnosed coeliac disease, non-coeliac gluten sensitivity and
333 gastrointestinal food allergy all present with similar symptom profiles to IBS. Further research is
334 needed to explore this area, however, this real-life service evaluation supports the view that a ‘one-
335 size fits all’ approach to dietary treatment of patients who present with IBS is not appropriate.
336 Dietitians, especially those with expertise in gastroenterology, can play an essential role in the
337 appropriate assessment and effective delivery of the dietary treatment options for IBS patients.

338 The main limitation of this study is that as it was an observational service evaluation, it is not
339 possible to draw clear conclusions on the cause and effect relationship, between symptoms
340 improvement and healthcare usage, and dietetic-led dietary intervention. Other factors including
341 stress levels, management strategies to help manage emotions, other dietary changes, use of
342 prebiotics and probiotics were not reported in this study, and may have all played a role in the
343 changes reported at long-term follow-up. Additionally, with approximately half of the patients
344 using medication for their gut symptoms at baseline and long-term follow-up, we can not exclude
345 medication as playing a role in improvements seen. Due to this, further RCTs are needed that
346 explore benefits of dietary treatments on IBS management, which also take into account these other
347 factors. Other limitations to this study include the increased risk of non-response bias associated
348 with a postal questionnaire design, as those patients who decided not to respond to the questionnaire
349 at long-term follow-up may differ from those who did. Questionnaire designs also increase the risk
350 of recall bias, which can lead to a deviation from true results. In this study, we included patients
351 who were referred for IBS, but we did not apply strict ROME IV criteria for inclusion. This was
352 because in real-life clinical practice, patients often report a wide range of variable gut symptoms
353 and bowel habits, which can potentially benefit from dietary interventions. Another limitation of
354 this study is that we did not assess adherence to dietary interventions. Nawawi et al (³⁶)
355 demonstrated stricter adherence to a diet resulted in greater symptom improvements; assessment of
356 adherence would provide a greater clarification on the size of impact of the dietary interventions.

357 In conclusion, our service evaluation demonstrated that IBS patients who received dietary
358 interventions, delivered by specialist gastroenterology dietitians in primary care, reported long-term

359 reductions in gastrointestinal symptom severity and improvements in bowel habits.. Healthcare
360 usage following dietetic intervention was also reduced, indicating the potential for cost savings by
361 including dietetic-led dietary interventions in the management pathways for IBS patients. However,
362 further RCTs are needed to explore the cause and effect relationship of dietetic-led interventions on
363 IBS management and healthcare usage.

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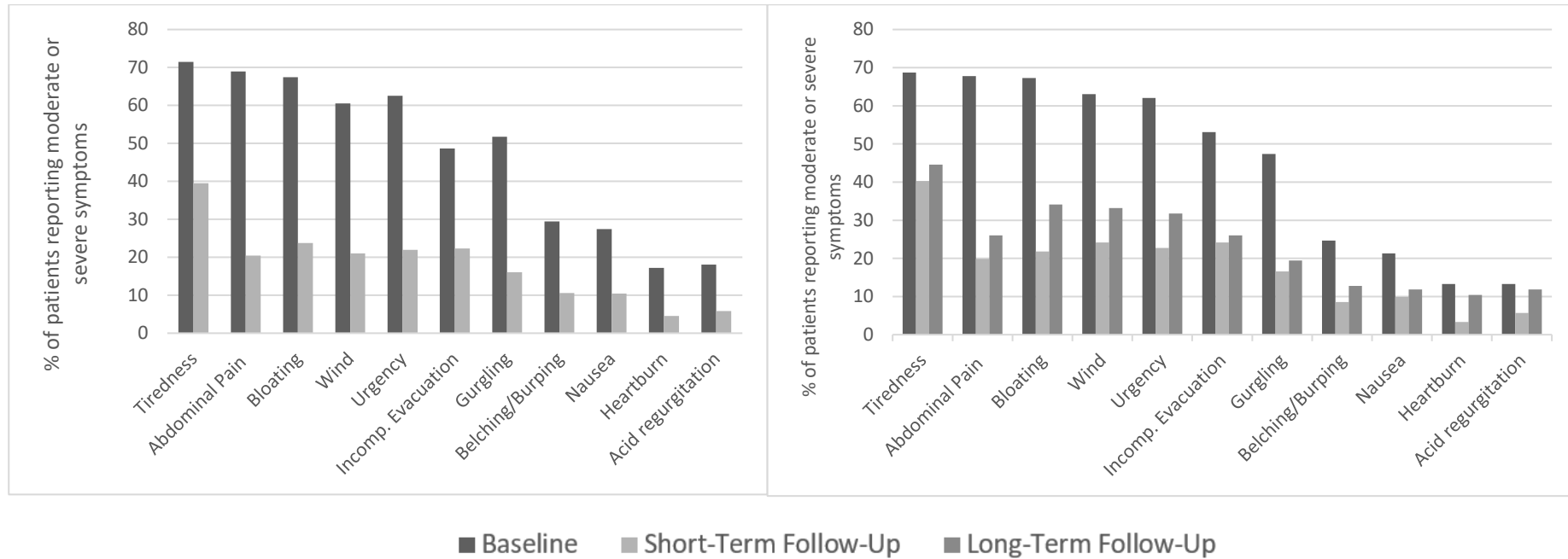
518

519 **Figure 1.** Proportion of patients reporting the presence of individual symptoms (moderate or severe) at a) baseline and short-term follow-up for whole
 520 group (n=547) and b) at baseline, short-term follow-up and long-term follow-up for the long-term follow-up group (n=211).

521

522 a) Whole Group

b) Long-term follow-up group



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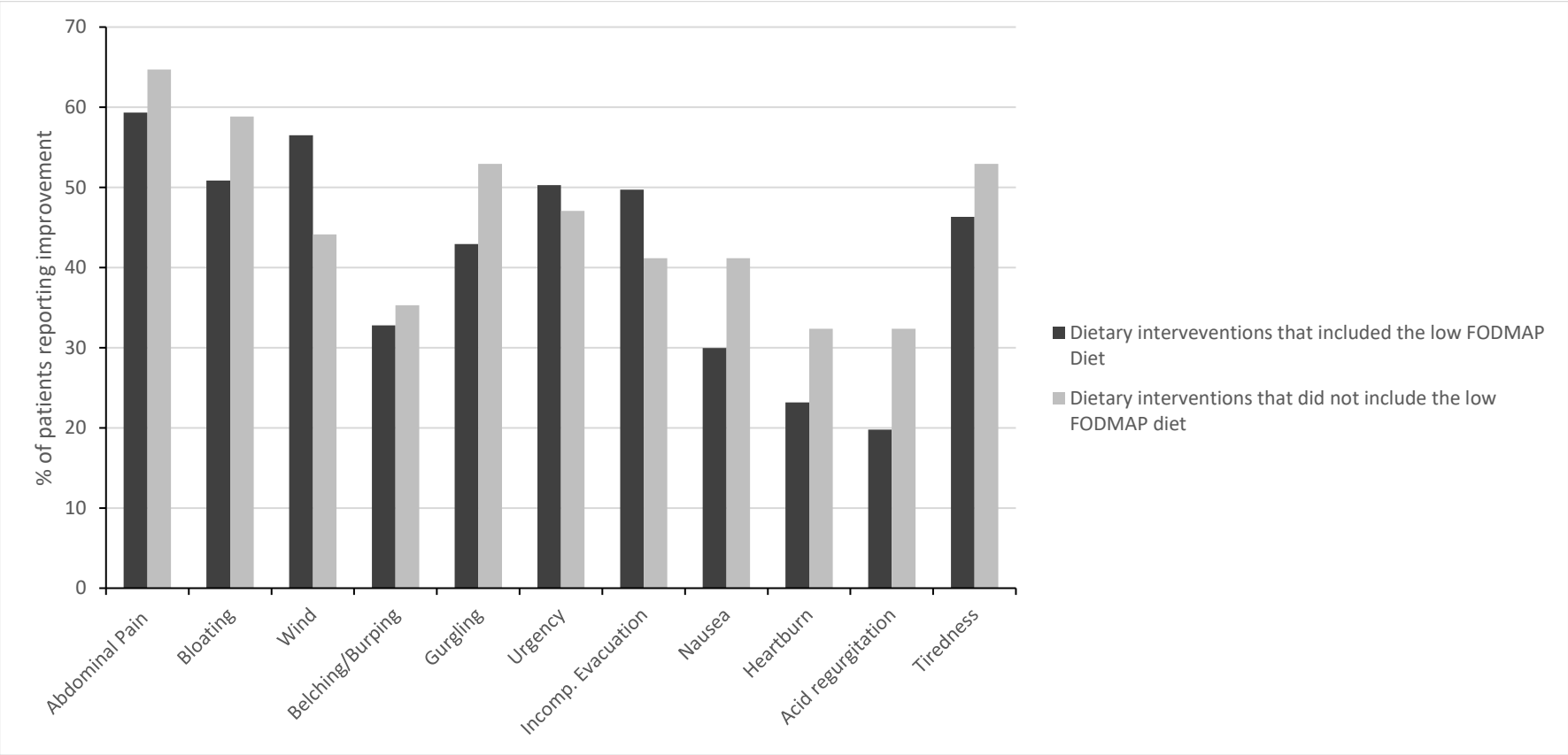
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528 **Figure 2.** Proportions of patients following low FODMAP or other dietary interventions who reported an improvement in individual symptoms at long-
 529 term follow-up compared to baseline.



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533

534 **Table 1.** Dietary interventions followed by patients

Dietary Intervention	For Whole Group n=547 n (%)	For Long-Term Follow-up Group n=211 n (%)
Low FODMAP	361 (66)	155 (74)
Low FODMAP with additional dietary exclusions	84 (15)	22 (10)
Gluten Free	22 (4)	8 (4)
Other single dietary exclusion	39 (7)	14 (7)
Other multiple dietary exclusions	31 (6)	9 (4)
Other	10 (2)	3 (1)

535

536 **Table 2.** Reported stool type and frequency, number of GP and gastroenterology visits and gastrointestinal investigations, and use of prescribed
537 medication at baseline, short-term follow-up and long-term follow-up

Outcome	Whole group at Baseline n=547	Whole group at Short Term Follow-up	Long-term follow up group at Baseline n=211	Long-term follow up group at Short Term Follow-up	Long-term follow-up group at Long Term Follow up
Stool Type, n (%)	n=547		n=211		
BSFS 1-2 (hard)	46 (9)	54 (10)	19 (9)	26 (12)	23 (11)
BSFS 3-4 (normal)	122 (22)	254 (47)	48 (23)	103 (49)	96 (46)
BSFS 5-7 (loose)	187 (34)	62 (11)	70 (33)	26 (12)	43 (20)
Mixed stool	191 (35)	133 (24)	74 (35)	56 (27)	45 (21)
Missing data	1 (0)	44 (8)	0 (0)	0 (0)	4 (2)
Stool Frequency, n (%)	n=547		n=211		
Once every 4 or more days	27 (5)	14 (3)	7 (3)	3 (1)	11 (5)
Between once every 3 days and 3 times a day (normal)	353 (65)	420 (77)	156 (74)	188 (89)	172 (82)
4 times or more a day	122 (22)	39 (7)	43 (21)	14 (7)	23 (11)
Variable	45 (8)	28 (5)	5 (2)	5 (2)	3 (1)
Missing data	0 (0)	46 (8)	0 (0)	1 (1)	2 (1)

Number of visits to GP in previous year, n (%)	n=377	n=140	
None	14 (4)	6 (4)	91 (65)
1 to 3	218 (58)	92 (66)	35 (25)
4 to 6	96 (25)	29 (21)	11 (8)
7 to 9	20 (5)	4 (3)	0 (0)
10 or more	27 (7)	9 (6)	1(1)
Missing data	2 (1)	0 (0)	2 (1)
Number of visits to Gastroenterologist in previous year, n (%)	n=377	n=128	
None	214 (57)	81 (63)	109 (85)
1	84 (22)	30 (23)	7 (6)
2	27 (7)	9 (7)	6 (5)
3	16 (4)	6 (5)	3 (2)
4	8 (2)	2 (2)	0 (0)
Missing data	28 (8)	0 (0)	3 (2)
Investigations in previous year for gut symptoms, n (%)	n=376	n=130	
None	178 (47)	66 (51)	108 (83)
Colonoscopy	38 (10)	13 (10)	7 (5)
Gastroscopy	14 (4)	5 (4)	3 (2)
Sigmoidoscopy	10 (3)	4 (3)	1 (1)
Barium enema/meal	4 (1)	1 (1)	1 (1)
Ultrasound	49 (13)	16 (12)	4 (3)
Multiple endoscopies	12 (3)	5 (4)	1 (1)
Multiple Others	51 (14)	19 (14)	5 (4)
Other	1 (0)	1 (1)	0 (0)
Missing Data	19 (5)	0 (0)	0 (0)
Using prescribed medication for gut symptoms, n (%)	n=547	n=211	
Yes	308 (56)	121 (57)	103 (49)
No	227 (42)	89 (42)	106 (50)
Missing data	12 (2)	1 (1)	2 (1)