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Long-term symptom severity in people with irritable bowel syndrome following dietetic treatment in primary care: A service evaluation

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Abstract

Background: Evidence suggests that dietary interventions can improve symptoms in people with irritable bowel syndrome (IBS), although most data explore the short-term (immediate) impact. Data on long-term (>6 months) impact are limited, especially from primary care settings. The present study aimed to investigate the long-term effect of dietetic-led interventions for IBS delivered in primary care.

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

Results: In total, 211 patients responded to the long-term follow-up questionnaire at a median of 13 months (interquartile range 12–16 months) post follow-up appointment. Of these, 84% had been advised to follow a low FODMAP (i.e., fermentable oligosaccharides, disaccharides, monosaccharides and polyols carbohydrates) diet. All symptoms were reported significantly less frequently short term, and all except heartburn and acid regurgitation remained so over the long term. The four most commonly reported bowel symptoms reduced in frequency were abdominal pain (62%), bloating (50%), increased wind (48%) and urgency to open bowels (49%) ($p < 0.001$). The percentage of patients reporting satisfactory relief of gut symptoms was 10% at baseline and 55% at long-term follow-up ($p < 0.001$). Visits to a general practitioner were reduced (from 96% to 34%; $p < 0.001$), as were those to the gastroenterologist (from 37% to 12%; $p = 0.002$), during the year prior to long-term follow-up compared to the year prior to dietary intervention.

Conclusions: Patients with IBS who received dietetic-led interventions in primary care reported long-term symptoms improvements that may result in reduced healthcare usage.

KEYWORDS
diet, dietitian, irritable bowel syndrome, long-term effects, primary care

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INTRODUCTION

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

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

With dietary interventions now recognised as an integral part of the management of IBS, dietitians should play an essential role in the effective delivery of this therapeutic option. Prior to recommending a dietary treatment, a dietitian must first complete an assessment with patients to confirm the diagnosis of IBS and determine the most appropriate intervention. Other conditions, including undiagnosed coeliac disease, non-coeliac gluten sensitivity and gastrointestinal food allergy, can all present with symptom profiles similar to those for IBS, and are often misdiagnosed. However, each of these conditions require different diets and variable levels of dietary stringency, emphasising the need for specialist dietetic intervention.[26-29] Coeliac disease must first be excluded via appropriate tests,[9] and exploring a patient's atopic history may provide an indicator for a potential food allergy.[29] Non-coeliac gluten sensitivity involves intestinal and extra-intestinal symptoms that are triggered by gluten ingestion in the absence of coeliac disease and wheat allergy[30] and may also include 'foggy mind', tiredness, headaches, fibromyalgia-like joint or muscle pain, and leg or arm numbness.[31]

The majority of available evidence demonstrates the benefits of diet, including the low FODMAP diet, on IBS symptoms immediately following implementation, and up to 9 months afterwards.[15-17,32-33,24] However, little has been reported on the benefits of diet beyond 11 months of implementation. Studies examining the longer-term effects of the low FODMAP diet on IBS symptoms[34–36] have primarily delivered the dietary advice in secondary care. Providing dietetic input for IBS patients within primary care offers an opportunity to reduce the burden of the condition on healthcare resources, including reducing unnecessary secondary care referrals and associated costs.[37] The present study aimed to assess the impact of dietetic-led interventions for IBS patients delivered in primary care, a year after treatment completion.

METHODS

Study design

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

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

All patients seen in the clinic between May 2013 and April 2017 were included. Data were collected at three time points: (1) prior to their initial appointment (baseline); (2) prior to their final follow-up appointment (short-term follow-up) (both of which were part of the routine clinical care); and (3) approximately 11 months later (long-term follow-up) via a postal questionnaire.

Ethical approval via the UK Health Research Authority was not required because it was deemed an evaluation of the dietetic service. Local approval was given by the Somerset NHS Foundation Trust Research Department to carry out the data collection.

Dietary advice

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

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

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

Gastrointestinal symptoms and stool output

At each of the three time points, patients were asked to assess severity of individual gastrointestinal symptoms, based on

frequency and the extent to which they affected their social activities, using the Gastrointestinal Symptom Rating Scale (GSRS).[38] Symptoms assessed included abdominal pain/discomfort, abdominal bloating/distension, increased wind, belching/burping, gurgling noises from stomach, urgency to open bowels, incomplete evacuation of stools, nausea, heartburn, acid regurgitation and tiredness. Patients were also asked about their stool frequency and consistency according to the Bristol Stool Form Scale (BSFS),[39] which is a seven-point scale of stool types ranging from type 1 (separate hard lumps) to type 7 (entirely liquid with no solid pieces). Satisfaction with gut symptom relief was assessed by asking the question '*Do you currently have satisfactory relief of your gut symptoms?*'.

Healthcare utilisation and resources

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

Statistical analysis

Statistical analysis was performed using SPSS, version 25 (IBM Corp.).

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

A Wilcoxon ranked test was applied to determine whether there were any significant differences over time for individual symptom severity, number of GP and gastroenterologist visits, and number of gastrointestinal investigations. McNemar's test was applied to determine whether there were any significant associations across the time frames for satisfactory relief of symptoms, presence of normal stool consistency and stool frequency, and current use of prescribed medication.

$p < 0.01$ was considered to be statistically significant. A p value lower than the usual 0.05 was applied to counteract the

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increased risk of a type 1 error associated with the multiple comparisons completed.

RESULTS

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

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

Gastrointestinal symptoms

At baseline, the most common gastrointestinal symptoms were abdominal pain and bloating, increased wind, and urgency to open bowels (Figure 1). Over 60% of patients rated the severity of these symptoms as moderate or severe, with those included in the long-term follow-up analysis ($n = 211$) presenting with baseline symptom profiles similar to those of the whole cohort ($n = 547$). Tiredness was the most common symptom, reported by 71% and 69% of patients in the whole cohort and long-term follow-up group, respectively. There was a significant reduction ($p < 0.001$ for all symptoms) in the proportion of patients reporting presence of moderate or severe symptoms between baseline and short-term follow-up (Figure 1) for both the whole cohort and the long-term follow-up group. The significant difference from baseline was maintained at long-term follow-up for all symptoms apart from heartburn (13% vs. 10% $p = 0.059$) and acid regurgitation (13% vs. 12% $p = 0.354$). The four mostly commonly reported gastrointestinal symptoms reduced in frequency by approximately half (abdominal pain by 62%; bloating by 50%; increased wind by 48%; and urgency to open bowels by 49%).

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

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

Stool output

At baseline, only 23% of patients reported a normal stool consistency (BSFS 3 or 4) (Table 2). The most common stool types were mixed and loose stools (BSFS 5–7) and the least common was constipation (type 1–2). At short-term

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)

FODMAP, fermentable oligosaccharides, disaccharides, monosaccharides and polyols carbohydrates.
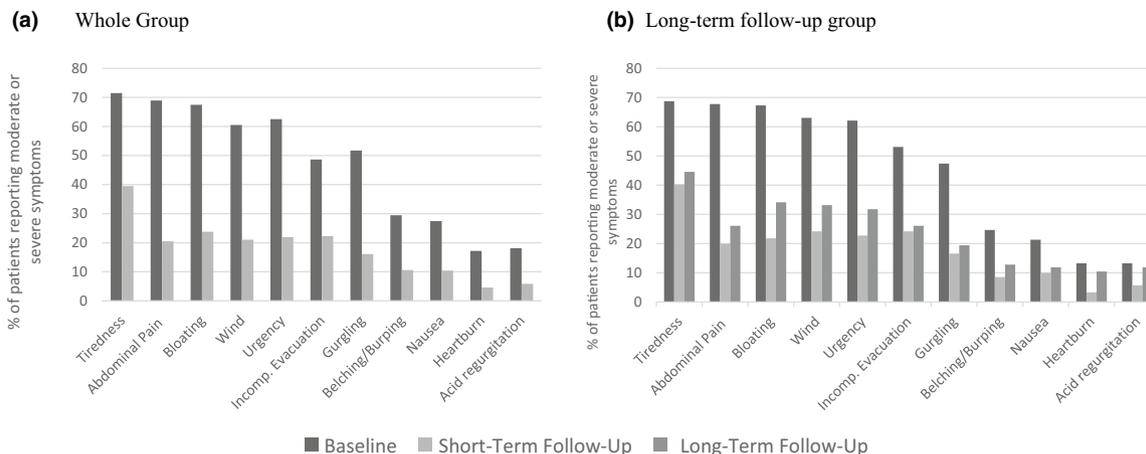
FIGURE 1   Proportion of patients reporting the presence of individual symptoms (moderate or severe) at (a) baseline and short-term follow-up for whole group (n = 547) and (b) at baseline, short-term follow-up and long-term follow-up for the long-term follow-up group (n = 211)
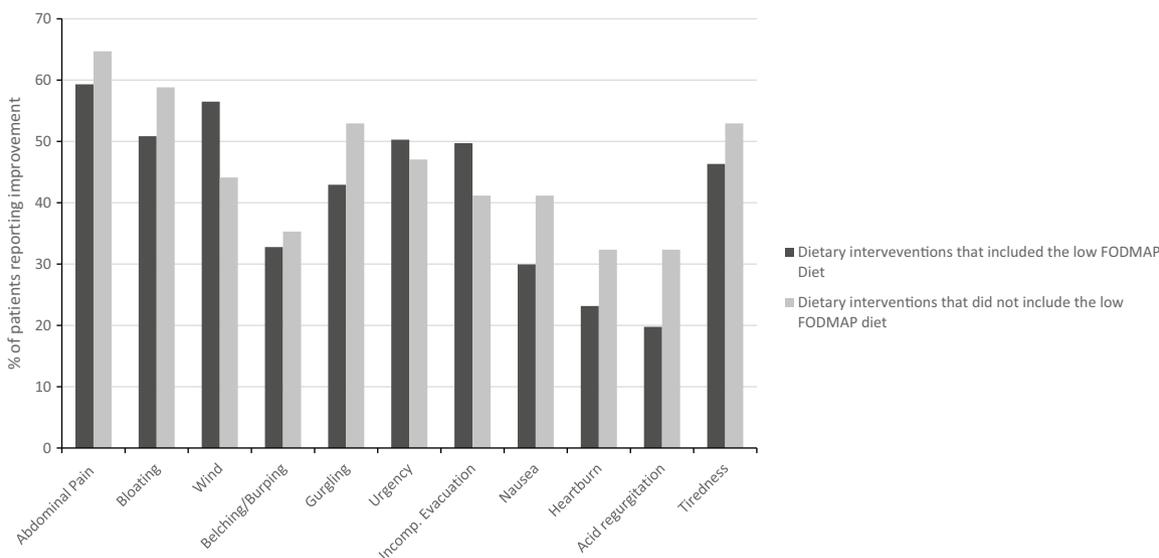
FIGURE 2   Proportions of patients following low FODMAP (i.e., fermentable oligosaccharides, disaccharides, monosaccharides and polyols carbohydrates) diet or other dietary interventions who reported an improvement in individual symptoms at long-term follow-up compared to baseline

follow-up, the proportion of patients reporting normal stool consistency significantly increased to 49% (p < 0.001). At long-term follow-up, this reduced to 45% but remained significant compared to baseline (p < 0.001).

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

Healthcare utilisation and resources

Table 2 shows the proportion of 140 patients who answered the question regarding number of GP visits in the previous 12 months at baseline and 138 at long-term follow-up. Data indicate a dramatic decrease in any patient visits to their GP (96% vs. 34% p < 0.001). Only 128 patients provided

information on the number of times they had seen a gastroenterologist in the previous 12 months at baseline and 125 at long-term follow-up (Table 2). Similar to GP visits, the proportion visiting a gastroenterologist at least once reduced from 37% to 12% (p = 0.002).

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

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

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TABLE 2 Reported stool type and frequency, number of GP and gastroenterology visits and gastrointestinal investigations, and use of prescribed 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)
Four 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)
1–3	218 (58)		92 (66)		35 (25)
4–6	96 (25)		29 (21)		11 (8)
7–9	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)

TABLE 2 (Continued)

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
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)

BSFS, Bristol Stool Form Scale; GP, general practitioner.

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DISCUSSION

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

Satisfactory control of gut symptoms was reported by 55% of patients, after a median of 13 months following the completion of dietary intervention, and this is consistent with the findings of O'Keeffe et al.[35] These authors used a similar study design to the current study and found that 57% of patients had satisfactory relief of symptoms at long-term follow-up, which was between 6 and 18 months after the completion of dietetic-led low FODMAP education. An earlier study with a median follow-up period of 16 months reported that 57% and 29% of IBS patients had a partial and full response to the low FODMAP diet, respectively.[34] These reported levels of satisfaction are less than the more recent findings of Nawawi et al.,[36] who demonstrated that 76% of patients were satisfied with the improvements in their symptoms at 12 months. Their study analysed data from 30 patients at long-term follow-up compared to the 211 patients in the present study. Nawawi et al.[36] also had patients complete the long-term follow-up questionnaire in clinic during their final follow-up appointment, whereas the present study used postal questionnaires for long-term data collection. These differences in study design may contribute to variations in the observed results.

The present study reported after following dietetic advice, all individual gastrointestinal symptoms, apart from heartburn and acid regurgitation, significantly improved in the long term, although there were differences between lower and upper gastrointestinal symptoms. Lower gastrointestinal symptoms were the most commonly reported at baseline, with over 60% of patients reporting moderate or severe abdominal pain, bloating or excess wind, and these symptoms reduced by approximately half in the long term. Although less common, upper gastrointestinal symptoms, including heartburn and acid regurgitation, had a frequency of 13%, suggesting that, although they are seldom included in diagnostic criteria for IBS, they are still symptoms that are reported by IBS patients. Despite a significant improvement in these symptoms at short-term follow-up, changes at the long-term follow did not remain significant for these upper

gastrointestinal symptoms. These findings are consistent with existing long-term studies.[34–36].

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

We also showed that reported healthcare usage was significantly reduced in IBS patients in the period after receiving dietary advice. Both GP and gastroenterologist appointments decreased significantly after dietary intervention. This reduction may be explained by the symptom improvements; however, further work is required to compare healthcare utilisation in IBS patients who do and do not receive dietetic advice. Dietetic intervention may have the potential to reduce secondary care input and associated healthcare costs in the case of younger patients (<45 years of age) by providing a therapeutic treatment option to a population who do not generally need secondary care investigations to exclude alarming pathology, prior to their IBS diagnosis. With the average age of the studied cohort being 54 years, it may be argued that the potential cost savings from reduced secondary care on a diagnostic basis is limited. However, in this cohort of patients, effective dietetic-led interventions have the potential to reduce secondary care input by stopping the revolving door effect of poor symptoms management leading to repeated secondary care referrals and investigations. Almost half the cohort (49%) reported having had at least one investigation in the year prior to initial dietetic input; however, clinical experience suggests that, if we had looked at the number of investigations over the last 15 years, this number would have significantly increased, and included repeated investigations. Patients often reported in clinic having suffered with IBS symptoms for many years and, as a result of a lack of effective treatment options, they had repeatedly visited their GP and had repeated referrals to secondary care over many years. Therefore, there is the potential to reduce healthcare usage in all age groups by offering effective dietetic treatments.

Additionally, as a result of the number of patients reporting having visited their GP and gastroenterologist on numerous occasions before seeing the dietitian, the question is raised of whether earlier referral to a dietitian could have resulted in further reductions in healthcare usage. Having the delivery of dietary treatments based in primary care, rather than secondary care, is essential for optimising potential cost savings. If GPs have access

to dietitians offering effective dietary treatment options within a primary care setting, this could reduce the number of referrals to secondary care and referrals for unnecessary expensive investigations.

Patients included in this service evaluation would have been encouraged to implement first-line dietary approaches, as recommended by the British Dietetic Association,[14] before being referred onto the specialist dietetic clinic. Because these interventions were delivered in the patient's GP practice or by another part of the community dietetic service, data on changes in symptoms following such advice were not available for this service evaluation. Because studies have shown that traditional first-line dietary approaches for IBS can be effective in reducing IBS symptoms[40,41] and are less restrictive, future studies should include an analysis of these types of dietary interventions. The most frequently used dietary intervention in this service evaluation was a low FODMAP diet in isolation or combined with another dietary restriction. Only a few other diets were used, including a gluten-free diet and other single dietary restrictions. However, the comparison of low FODMAP with 'other' diets showed no significant differences in symptom improvements from baseline to long-term follow-up. Patients on both dietary approaches improved equally well, suggesting that diets such as gluten-free and other dietary exclusions may deliver long-term symptom improvements, and a dietitian has the appropriate skills to make the assessment and recommend the most appropriate dietary intervention. The mechanisms for how the low FODMAP diet leads to symptom improvements include reductions in small intestinal water volume and colonic gas production.[42] However, further studies including randomised control trials (RCTs), are required to assess the mechanisms for the other diets used in clinical practice, along with the long-term implications and safety, before the diets can be included in formal guidelines.

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

The main limitation of the present study is that, because it was an observational service evaluation, it is not possible to draw clear conclusions on the cause and effect relationship, between symptoms improvement and healthcare usage, and

dietetic-led dietary intervention. Other factors, including stress levels, management strategies to help manage emotions, other dietary changes, and the use of prebiotics and probiotics, were not reported in the present study, and may have all played a role in the changes reported at long-term follow-up. Additionally, with approximately half of the patients using medication for their gut symptoms at baseline and long-term follow-up, we cannot exclude medication as playing a role in improvements seen. Accordingly, further RCTs are needed that explore benefits of dietary treatments on IBS management, which also take into account these other factors. Other limitations to the present study include the increased risk of non-response bias associated with a postal questionnaire design because those patients who decided not to respond to the questionnaire at long-term follow-up may differ from those who did. Questionnaire designs also increase the risk of recall bias, which can lead to a deviation from true results. In the present study, we included patients who were referred for IBS, although we did not apply strict ROME IV criteria for inclusion. This was because, in real-life clinical practice, patients often report a wide range of variable gut symptoms and bowel habits, which can potentially benefit from dietary interventions. Another limitation of the present study is that we did not assess adherence to dietary interventions. Nawawi et al.[36] demonstrated stricter adherence to a diet resulted in greater symptom improvements; assessment of adherence would provide a greater clarification on the size of impact of the dietary interventions.

In conclusion, our service evaluation has demonstrated that IBS patients who received dietary interventions, delivered by specialist gastroenterology dietitians in primary care, reported long-term reductions in gastrointestinal symptom severity and improvements in bowel habits. Healthcare usage following dietetic intervention was also reduced, indicating the potential for cost savings by including dietetic-led dietary interventions in the management pathways for IBS patients. However, further RCTs are needed to explore the cause and effect relationship of dietetic-led interventions on IBS management and healthcare usage.

ETHICS STATEMENT

Ethical approval via the UK Health Research Authority was not required because it was deemed an evaluation of the dietetic service. Local approval was given by Somerset NHS Foundation Trust Research & Development Department to carry out the data collection.

AUTHOR CONTRIBUTIONS

L.S. and M.W designed the study. L.S., M.W. and C.M. collected the data. L.S. processed the data, performed the

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analysis, and designed the tables and figures. L.S. wrote the manuscript in consultation with M.H. Critical feedback and contribution to the final version of the manuscript was given by Y.B., M.H., C.M. and M.W. All authors approved the final version of the paper submitted for publication.

TRANSPARENCY DECLARATION

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

PEER REVIEW

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MALNUTRITION AND FOOD INSECURITY

Food insecurity: Its prevalence and relationship to fruit and vegetable consumption

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Abstract

Background: Food insecurity in UK households is a substantial and growing concern. The present study identified those at risk of food insecurity and explored the relationship between food security and fruit and vegetable consumption.

Methods: Data were examined from the Food and You survey (2016) for a large representative sample ($n = 3118$) living in England, Wales and Northern Ireland. A 'Food Security Score' and a 'Food Changes Score' (relating to financially driven changes to food habits) were compiled and relationships with fruit and vegetable consumption were examined.

Results: The prevalence of marginal, low and very low food security was 12.6%, 5.4% and 2.8%, respectively. Significant correlations were observed between food security and fruit and vegetable consumption. Food security and food changes, independently, were significant predictors for fruit and vegetable consumption. With every unit increment in the Food Security Score (i.e., more food insecure), an 11% decrease in the odds of being a high fruit and vegetable consumer was evident. Likewise, the odds of being a high fruit and vegetable consumer decreases by 5% with every increment in the financially driven Food Changes Score.

Conclusions: A notable proportion (more than one-fifth) experienced marginal, low or very low food security. Food insecurity and financially driven food changes were accompanied by decreases in the odds of being a high fruit and vegetable consumer. Findings underline the potential consequences of food insecurity, and point to further work aiming to examine other dietary implications, as well as strategies to mitigate against food insecurity and its detriment.

KEYWORDS
diet, food insecurity, food security, fruit, fruit and vegetable consumption, vegetables

INTRODUCTION

Household food insecurity in high-income economies has serious public health consequences,[1] and the number of households affected in countries such as the USA, Canada, Australia is a growing concern.[2] In the UK, food insecurity is substantial and growing[3] with levels being among the worst in Europe.[3] Despite being one of the world's highest ranked economies,[4] an estimated 3.4 million people live in UK households where at least one person is moderately

or severely food insecure.[5] This is according to the United Nations Food and Agriculture Organisation (FAO) Voices of the Hungry project, based on relatively small samples of 1000 people,[6] and also potentially under representative of the highly vulnerable groups. Food insecurity has been reported to be linked to poverty associated with austerity and welfare changes.[7]

Central to food security are issues such as food availability, accessibility and affordability.[8] Moreover, food security encompasses the 'physical, social and economic access to sufficient, safe and nutritious food' to meet an individual's 'dietary needs and food preferences for an active and healthy life'.[9] Conversely, food insecurity has been defined as a 'household-level economic and social condition of limited or uncertain access to adequate food'[10] and limited or uncertain 'availability of nutritionally adequate and safe foods' or limited or uncertain 'ability to acquire acceptable foods in socially acceptable ways'.[11] Largely associated with socio-economic status, factors such as household income, working status, education, social network and capital have been found to be relevant to food insecurity.[12] Income, specifically, is an influential predictor for food security, and a UK study revealed receipt of means-tested benefits and perception of financial insecurity to be critical to food insecurity.[13] In every region of the world, women are slightly more likely than men to be food insecure,[14] and differences in food provision and preparation roles, as well as dietary intake [e.g., fruit and vegetable (FV) consumption[15,16]], are also apparent.

There have been calls to ascertain levels of food security in the UK and identify those most at risk.[17] Likewise, a new national initiative to measure food insecurity has been welcomed by social advocacy groups.[18] Both reflect increasing concerns, particularly regarding the growing numbers affected and the subsequent impact on public health and disease prevention.

Food security influences individuals' diets, and studies have examined associations between food insecurity and diet quality.[19–21] Notably, US research has suggested that, independent of poverty and socio-demographic differences, food-insecure individuals have poorer quality diets than food-secure adults.[19] Furthermore, food-insecure adults reportedly use food sources differently; analysis of the US National Health and Nutrition Examination Survey data indicated that the dietary quality of foods sourced from grocery stores was higher in the highly food secure individuals.[22]

Food security influences food choice. Accessibility to nutritious foods is central to food security and, likewise, is a pre-requisite to an adequate diet. Poor diet has been implicated in the global disease and mortality burden, and the need to improve diets has been highlighted.[23] Chief risk factors are diets high in sodium and those low in fruit, vegetables, whole grains, nuts and seeds, and omega-3 fatty acids, with each of these factors accounting for at least 2% of deaths globally.[23] Furthermore, the relevance of FV consumption to an adequate diet and food-based dietary guidelines internationally is established.[24] Therefore, the present study aimed to identify subgroups of the population that may be considered more at risk with respect to food security, as well as to explore the relationship between food security and FV consumption.

METHODS

The present study used data from the Food and You survey, a biennial cross-sectional survey administered by the Food Standards Agency. The Food and You survey focusses on the UK population's self-reported food-related behaviours, attitudes and knowledge.[25] Using a random probability cross-sectional design, a representative sample from all included countries (England, Wales and Northern Ireland) is obtained, with data collected via face-to-face interviews with a trained interviewer.[26] Further details on the methodology, including the sample design and sampling frame, are available elsewhere.[26] In 2016, for the first time, the Food and You survey included items on food security.[25] Cognitive testing techniques were used to check respondents' understanding and ability to select response options and the sensitivity of questions, before the full questionnaire was piloted; further details are available.[26,27] The presented study used data from this wave in 2016.[28] The data relate to a representative sample ($n = 3118$) aged ≥ 16 years, recruited with an overall response rate of 52.6%.[26] The Government Social Research guidelines were adhered to, including participants' informed consent (for participants under the age of 18 years, consent from the legal guardian/parent was obtained); ethical approval for the data collection was obtained from NatCen internal Research Ethics Committee[29] (NatCen 2019, personal communication).

Ten items from a validated measure of food security, included in the survey, were used in the presented study; these corresponded to the US Adult Food Security Survey Module developed by the US Department of Agriculture (USDA).[30–32] These items revolved around food-related behaviours and/or experiences related to difficulties in meeting food needs[30,31] (Table 1). In the study, these data were used to compile a Food Security Score (range: 0–10) on the basis of the Adult Food Security Scale.[32] The score corresponded to a measure of the severity of food insecurity[30] where a higher score indicated a *lower* food security. Cronbach's alpha coefficient was calculated and showed good internal consistency (0.86), which corresponded well with coefficients from other studies using the USDA measure for food security.[33] The original dataset also categorised respondents according to USDA food security status, that is, high, marginal, low and very low food security. High food security status reflects households with no difficulties or anxiety accessing adequate food, whereas marginal food security status households experience difficulties at times or anxiety (but overall, the quality, variety and quantity are not substantially affected). Low food security households decrease the quality, variety and desirability of food consumed, at the same time maintaining the overall quantity and normal eating patterns. In very low food secure

TABLE 1 Items relating to food security and financially driven food changes

Food security
'I/We worried whether my/our food would run out before I/we got money to buy more'
Was that often true, sometimes true, or never true for you/your household in the last 12 months?
'The food that I/we bought just didn't last, and I/we didn't have money to get more'
Was that often true, sometimes true, or never true for you/your household in the last 12 months?
'I/We couldn't afford to eat balanced meals'
Was that often true, sometimes true, or never true for you/your household in the last 12 months?
In the last 12 months, since last (name of current month), did you or other adults in your household ever cut the size of your meals or skip meals because there wasn't enough money for food? (if yes) How often did this happen – almost every month, some months but not every month, or in only 1 or 2 months?
In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money for food?
In the last 12 months, were you ever hungry but didn't eat because there wasn't enough money for food?
In the last 12 months, did you lose weight because there wasn't enough money for food?
In the last 12 months, did you or other adults in your household ever not eat for a whole day because there wasn't enough money for food? (if yes) How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months?
Financially driven food changes
Have you made any of these changes in the last 12 months for financial reasons?
Eaten at home more
Cooked at home more
Eaten fewer takeaways
Eaten out less
Made packed lunches more
Bought items that were on special offer more
Changed the places you buy food for cheaper alternatives
Changed the food you buy to cheaper alternatives
Prepared food that could be kept as leftovers more
Kept leftovers for longer before eating
Eaten food past its use-by date more

households, the eating patterns of at least one member of the household was disrupted with reduced intake.[25,34]

A further eleven items in the survey related to respondents' changes based on finances (Table 1). For the present study, these were deemed less 'severe' and used to compile the Food Changes Score, which ranged from 0 to 11, with a lower score reflecting fewer changes made. Cronbach's alpha coefficient for the food changes scale was 0.83, showing good internal consistency. Also in this study, a food changes status was compiled, with cases banded into four categories (i.e., no, few, some and many food changes made).

Fruit and vegetable consumption was established with three items: How often do you eat raw fruit? How often do you eat raw vegetables, including salad? How often do you eat cooked vegetables? The response options ranged from 'at least once a day' to 'never'. Responses for these items were combined to provide a FV score, with a higher FV score corresponding to more frequent consumption. Internal scale reliability was assessed using mean inter-item correlation (because there were three component items), which was calculated at 0.30, within the optimal range of 0.2–0.4.[35] Respondents were categorised based on their FV scores (i.e., never/rarely, sometimes, often and regularly consumes FV).

The dataset was analysed using SPSS, version 21 (IBM Corp.). Weighting was applied accordingly (further details are available elsewhere[25]), and descriptive analysis undertaken, with a focus on levels of food security and food changes by key demographic variables. Kendall's correlation tests, a nonparametric measure of the strength of the relationship between two ordinal variables, were conducted to examine scores. To examine the relationship between age and also gender and food security status, food changes status and FV consumption, chi-squared tests of independence were undertaken. A logistic regression model was developed to examine the relationship between Food Security Score and Food Changes Scores and FV consumption (dichotomised to high and low). The model was adjusted for gender, age, household income, education, working status and country. $p < 0.05$ was considered statistically significant.

RESULTS

Food security status and financially driven changes varied across demographic characteristics, Figure 1 and Table 2. The sample comprised 3118 participants (51.2% women); one-third of participants were 35–54 years (33.4%), and three-fifths (60.6%) were in work, with 22% being retired. Almost one-third had a degree/diploma in higher education as their highest attained qualification (32.1%).

Most (79.2%) were in the category of high food security; the remainder experienced marginal (12.6%), low (5.4%) and very low food security (2.8%). Food security status was associated with gender ($\chi^2 = 16.41$, df = 3, $n = 3118$, $p < 0.001$, $\varphi_c = 0.07$); more men (80.9%) were highly food secure compared to women (77.7%) and more women had a low and very low food security status. Interestingly, when considering only respondents with responsibility for all or most of the food preparation/cooking and food/grocery shopping (most of whom were women), then this association did not hold. There were significant associations between these responsibilities and gender (food preparation/cooking $\varphi_c = 0.41$; food/ grocery shopping $\varphi_c = 0.38$); the odds of being responsible for all or most of the food preparation/cooking for women was 4.70 times that of men; the equivalent for food/grocery shopping for women was 4.64 times that of men.

The most food secure age group was ≥ 75 years, with the least secure being the youngest (16–24 years). Here, low and very low food security accounted for 9.2% and 6.3%, respectively, of the youngest respondents; furthermore, one-fifth fell in the marginal food security band (21.2%). A general pattern of increasing food security with age was observed; food security status and age had a significant association but with a small effect size ($\chi^2 = 174.04$, df = 18, $n = 3115$, $p < 0.0001$, $\varphi_c = 0.14$). A greater proportion of unemployed
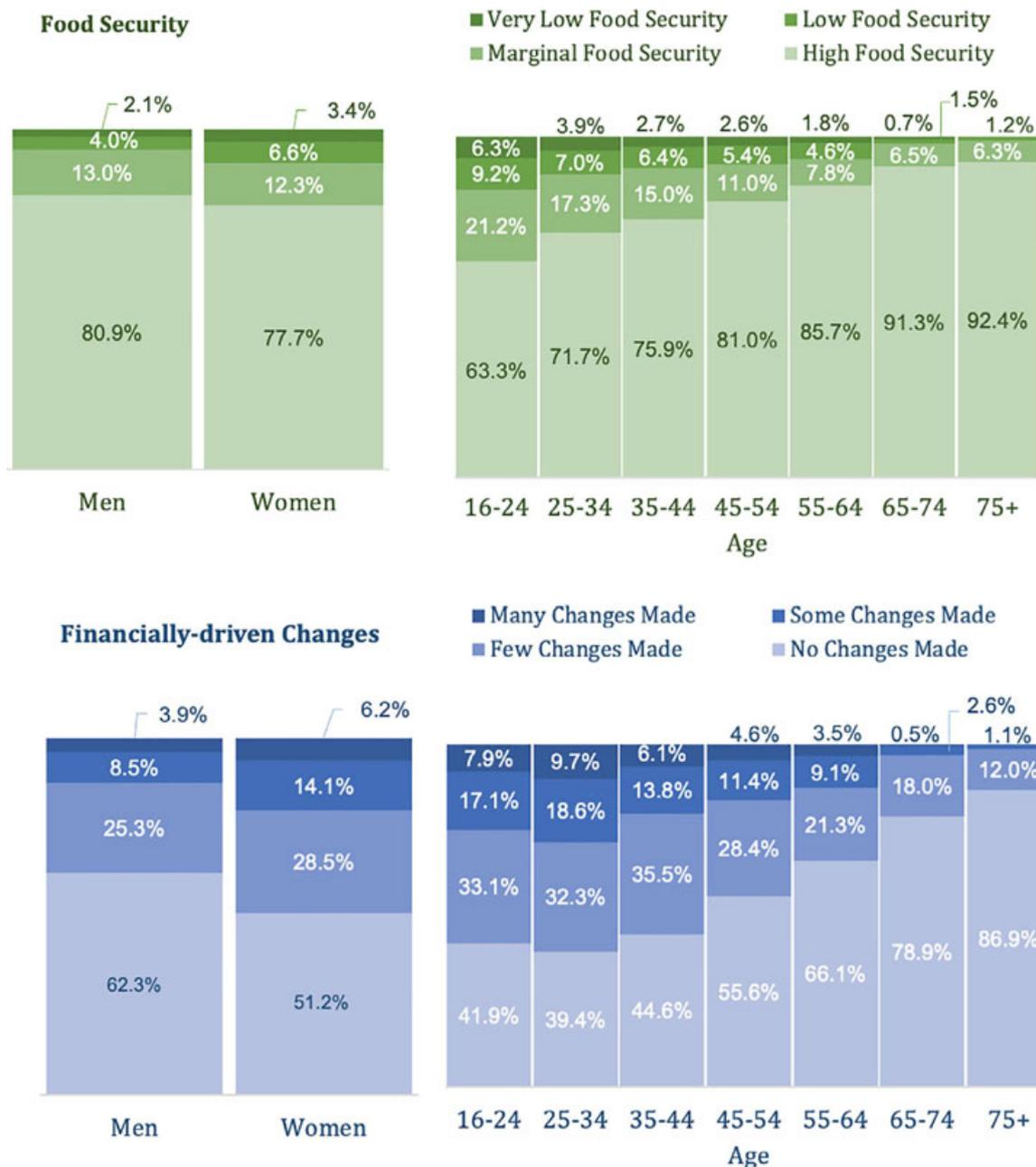
FIGURE 1 Food security status and financially driven changes: distribution (%) by gender and age

respondents had very low (19.8%) or low food security (15.1%) compared to other groups. The retired were the most food secure (91.5% with high food security status). The percentage of highly food secure individuals increases with household income. Households with the highest income were overwhelmingly in the highly food secure status (90.7%); in contrast, only 59.6% of those with an income less than £10,399 were highly food secure, and 14.5% were categorised as very low food secure.

When considering financially driven changes, more than two-fifths of respondents reported at least one change; for example, bought items that were on special offer more (20.3%) and changed the place to buy food for cheaper alternatives (17.6%). More women (48.8%) than men (37.7%)

reported at least one change, and a significant association (with a small effect size) was observed ($\chi^2 = 39.09$, df = 1, $n = 3118$, $p < 0.0001$, $\varphi = 0.11$). Likewise, more women (than men) reported any individual change (Figure 2); the associations between each change (except for eaten out less) and gender were significant (small effect sizes). When restricting the sample to only those with main responsibility for all or most of the food/grocery shopping and food preparation/cooking, the association between gender and reporting at least one change remained significant and weak ($\chi^2 = 14.04$, df = 1, $n = 1310$, $p < 0.0005$, $\varphi = 0.10$). Interestingly however, the association did not hold for four changes: eaten food past its use-by date more, kept leftovers for longer before eating, changed the places you buy food for cheaper alternatives and

TABLE 2 Food security status and financially driven changes according to demographic characteristics

	n (%)	Food security status (%)				Financially driven changes (%)			
		High Food security	Marginal Food security	Low Food security	Very low food security	No changes made	Few changes made	Some changes made	Many changes made
Total sample (n = 3118)		79.2	12.6	5.4	2.8	56.6	27.0	11.4	5.1
Working status (n = 3117)									
In work	1890 (60.6)	80.8	12.7	5.1	1.4	52.5	28.6	13.5	5.4
Unemployed	92 (3.0)	46.2	19.0	15.1	19.8	33.6	31.5	20.0	15.0
Retired	686 (22.0)	91.5	6.2	1.9	0.5	80.5	17.1	1.8	0.6
Other[a]	449 (14.4)	60.8	20.9	9.7	8.6	41.9	34.4	15.3	8.4
Education (n = 3108)									
GCSE (or equivalent)	602 (19.4)	71.9	15.4	8.6	4.1	54.4	30.3	9.9	5.4
Trade apprenticeship	95 (3.1)	87.6	7.2	2.5	2.7	65.4	19.6	12.0	3.0
A/AS level (or equivalent)	505 (16.2)	76.7	12.0	8.2	3.1	46.2	29.5	17.6	6.7
Degree/diploma in higher education (or equivalent)	999 (32.1)	84.6	9.8	3.7	1.9	55.2	25.7	12.5	6.6
Higher/postgraduate Degree	341 (11.0)	87.0	10.6	2.2	0.2	56.9	31.5	9.6	2.0
Other[b]	78 (2.5)	70.6	26.0	2.5	0.8	63.9	17.0	10.0	9.2
None of the specified	488 (15.7)	74.8	15.8	5.2	4.2	69.5	22.9	5.7	1.9
Household income (n = 2326)									
Less than £10,399	206 (8.9)	59.6	17.5	8.5	14.5	41.5	32.4	17.0	9.0
£10,400–£25,999	663 (28.5)	69.2	18.1	8.6	4.1	55.4	26.7	9.3	8.6
£26,000–£51,999	699 (30.1)	82.4	12.0	4.4	1.1	56.5	27.0	11.2	5.3
More than £52,000	758 (32.6)	90.7	6.5	2.6	0.3	60.3	25.0	11.5	3.2

Note: Not all questions were answered by all respondents.

[a]Other includes looking after family or home, full-time student/at school.

[b]Other qualifications (including overseas).

	men	women
Kept leftovers for longer before eating	3.0%	5.6%
Eaten food past its use-by-date more	6.0%	8.8%
Cooked at home more	9.5%	13.4%
Prepared food that could be kept as leftovers more	8.9%	14.8%
Changed the food you buy to cheaper alternatives	9.2%	14.6%
Eaten at home more	12.0%	16.7%
Made packed lunches more	12.5%	17.1%
Eaten fewer takeaways	13.5%	16.5%
Eaten out less	16.0%	17.9%
Changed the places you buy food for cheaper alternatives	14.4%	20.6%
Bought items that were on special offer more	14.3%	26.0%

FIGURE 2 Financially driven changes as reported by men and women (% of men and women, separately)

made packed lunches more. For all changes, an association between age and reporting financially driven changes was observed; with the largest effects being observed for 'no changes' ($\chi^2 = 327.92$, df = 6, $n = 3113$, $p < 0.0001$, $\varphi_c = 0.33$) where most 16–24 year olds (58.1%) and 25–34 year olds (60.6%) reported at least one change compared to a minority of those aged 75 years or more (13.1%) and 65–74 year olds (21.1%).

Gender was associated with FV consumption ($\chi^2 = 146.42$, df = 3, $n = 3119$, $p < 0.0001$, $\varphi_c = 0.22$) and more than one-half of women (52.6%) were regular consumers of FV compared to less than one-third of men (31.7%). FV consumption was also associated with age ($\chi^2 = 115.19$, df = 18, $n = 3114$, $p < 0.0001$, $\varphi_c = 0.11$); one-half of 65–74 year olds were regular consumers of FV (50.7%) compared to less than one-third of 16–24 year olds (30.8%).

Kendall's correlation tests revealed a significant but weak negative correlation ($\tau = -0.116$, $p < 0.0001$) between food security (higher Food Security Score corresponds to *lower* food security) and FV consumption (FV score), and between food changes (higher Food Changes Score corresponds to more changes) and FV consumption (FV score; $\tau = -0.043$, $p < 0.005$). There was a significant association between food security status and FV consumption ($\chi^2 = 91.07$, df = 9, $n = 3118$, $p < 0.0001$, $\varphi_c = 0.10$). More individuals of a higher food security status were in the highest consumers of FV compared to those of a lower food security status. Likewise, a significant association between food changes status and FV consumption was observed ($\chi^2 = 50.28$, df = 9, $n = 3119$, $p < 0.0001$, $\varphi_c = 0.07$). Effect sizes for both these associations are small.

The logistic regression model developed to examine the relationship between Food Security and Food Changes Scores with FV consumption as the dependent variable (dichotomised to high and low) was statistically significant ($\chi^2 = 345.01$, df = 23, $n = 2452$, $p < 0.0001$) and able to differentiate between those who reported a higher and a lower frequency for FV consumption, correctly classifying 65.4% of cases and explaining 18.4% (Nagelkerke R^2) of the variance in FV consumption. Food Security and Food Changes Scores, independently, were significant predictors ($p < 0.001$ and $p < 0.05$, respectively) for FV consumption. When controlling for age, gender, household income, working status, education and country, with every unit increment in the Food Security Score (i.e., less food secure), there was an 11% decrease [odds ratio (OR) = 0.89; 95% confidence interval (CI) = 0.83–0.95] in the odds of being a high FV consumer. Likewise, the odds of being a high FV consumer decreased by 5% (OR = 0.95; 95% CI = 0.91–0.99) with every unit increment in the Food Changes Score.

Other variables contributed to FV consumption, most notably gender [women were almost three times as likely (OR = 2.88) to report having a higher FV consumption then men], age [individuals aged 65–74 years being almost four times as likely (OR = 3.88) to report a high FV consumption compared to those aged 16–24 years] and education [those with a degree/diploma in higher education or a higher/postgraduate degree were more likely (OR = 1.77 and OR = 3.10, respectively) to report high FV consumption compared to those whose highest qualifications were GCSEs].

DISCUSSION

The present study examined food security and financially driven food changes in relation to FV consumption in a large

representative sample across England, Wales and Northern Ireland. Furthermore, the study demonstrated the relationship between food security and FV consumption. The findings revealed that, although most individuals were food secure, with no difficulty or anxiety around accessing adequate food, the prevalence rates of marginal, low and very low food security were 12.6%, 5.4% and 2.8%, respectively. This outlines the extent and nature of food insecurity, and responds to calls aiming to identify those at most risk.[17] It is interesting to consider these levels with reference to, for example, the prevalence of very low food security in the USA, at 4.3%.[36] The prevalence rates in the presented study can also be compared with FAO data for the UK (measured on a different scale, the Food Insecurity Experience Scale), which indicated a 3-year average for 2017–2019 of 5% at the moderate or severe level and 1.3% at the severe level for food insecurity.[5]

The present study also revealed a relationship between gender and both food security status and food changes status, with more women experiencing low and very low food security, and making more financially driven food changes. This may be a reflection of women as the traditional gatekeepers when it comes to food provision. In this representative sample, the odds of being responsible for all or most of the food preparation/cooking were more than four times higher for women than those for men; likewise, for all or most of the food/grocery shopping, the odds were more than four times higher for women than those for men. It may follow that women are more aware of levels of household food security by virtue of their responsibility for food provision. Interestingly, this argument is supported by the data, whereby food security and gender were no longer significantly associated when the sample was restricted to those respondents with responsibility for food. This was less apparent for financially driven food changes, where gender was still a significant variable for some changes. The role of gender in food security is critical; globally, women have been shown to have a higher probability of being food insecure compared to men.[37] Furthermore, in the developed regions of the European Union, women are almost five percentage points more likely to experience food insecurity of some level than men.[37]

As well as gender, age was also important in considering those most at risk, with younger individuals being more likely to have lower food security status and also make more financially driven food changes. An inverse association between age and food insecurity has been reported previously in the USA[38] and Australia.[39]

When examining food security and FV consumption, the more food insecure a person and the more changes to an individual's food habits because of financial reasons, the more likely they were to report a lower frequency of FV consumption. For every unit increment in the Food Security Score (i.e., less food secure), there was an 11% decrease in the likelihood of reporting a higher FV consumption. The number of financially driven food changes was also associated with FV consumption, showing a 5% decrease in the odds of reporting a higher FV consumption for every unit increment in the Food Changes Score. This provides evidence that an individual's food security status can influence the frequency of consumption of certain foods, in support of literature on the adverse relationship between food insecurity and dietary patterns.[40] Moreover, given the place of FV within dietary guidelines, and as a public health priority, then its relationship with food security is pertinent.

Previous work from across the world has found an association between food security and FV consumption.[41–44] A US study of low-income pregnant women found that, as the food security decreased, fresh FV variety in the home declined, which was then associated with reduced FV consumption.[41] An analysis of the Korean National Health and Nutrition Examination Survey showed food insecurity to be associated with inadequate dietary intake, including lower FV consumption.[42] Both studies measured food security based on the US Household Food Security Survey Module. A Brazilian study also adapted this module and found food insecurity to negatively affect FV consumption,[43] alongside other work reporting food-insecure households to have a more monotonous diet, largely composed of high energy foods.[45]

In the present study, it is important to acknowledge the limitations, including the self-report nature of the data. Likewise, the relevance of social desirability and social approval bias in general dietary self-report is relevant, as is the possibility of under-reporting of food insecurity. The study's cross-sectional nature and the model specificity, in terms of the variables included, should be acknowledged (e.g., food skills and nutrition knowledge were not considered). Furthermore, it is important to recognise the complex nature of food habits and the interplay of other variables, not included in the analysis. The Food Changes and FV scores are unique to this study, and should be considered in the context of the items, when comparing across studies. Furthermore, the FV score, based on three items, was at an individual level and incorporated raw fruit, raw/cooked vegetables and salad, but did not, for example, capture tinned fruit, and may have also been under-reported with respect to compound dishes.

This findings of the present study contribute to the mounting evidence concerning the prevalence of food insecurity, and likewise inform the development of dedicated strategies and interventions to address household food security. Given the observed relevance of the food gatekeeper (i.e., the individual with responsibility for most/all food), in addition to the greater risk of food insecurity in lower income households, as well as in those who are younger and unemployed, efforts should be targeted at those most relevant.

Other implications lie in the relationships observed between food security (also financially driven food changes) and FV consumption. With dietary risk factors being implicated in the global burden of non-communicable disease and diets low in FV being specifically highlighted,[23] there is a need to establish and address the full implications of food security on the diet of those affected. Future studies focussing on wholegrains, fast food consumption

and dietary patterns would provide a better understanding of diet across food security status in the UK. Food insecurity has been found to be associated with dietary outcomes for populations in US,[19] Canada[20] and France.[21] Likewise, studies could provide an understanding of the complexities of how compromised food security relates to lower FV consumption. This is critical to inform wider targeted strategies, and reflects recommendations to consider food insecurity alongside hunger, malnutrition and obesity, given their shared causal factors.[3] In this way, steps can be taken to ameliorate the dietary consequences on the individuals and households most affected.

CONCLUSIONS

Most of the population were considered to be in the category of high food security; a notable proportion, however, experienced marginal (12.6%), low (5.4%) or very low food security (2.8%). Food insecurity, as well as financially driven food changes, were accompanied by decreases in the odds of being a high FV consumer. As the prevalence of food insecurity in the UK rises, and its implications on diets materialise, the calls to develop measures to address food insecurity become more urgent, and there is a need to incorporate food security within strategies aiming to improve dietary practices. This reflects recommendations to consider hunger, malnutrition and obesity alongside food insecurity. Given the mounting evidence of its pervasive nature and the existing health inequalities, there is an imperative to act in an attempt to limit the reach and consequences of food insecurity.

CONFLICT OF INTERESTS
The authors have no conflicts of interest.

AUTHOR CONTRIBUTIONS
HE conceived the study. OT, HE and MH analysed and interpreted the data. OT drafted the manuscript, and all authors contributed to the revision of the manuscript, and also read and approved the final manuscript submitted for publication.

TRANSPARENCY DECLARATION
The lead author affirms that this manuscript is an honest, accurate and transparent account of the study being reported. The reporting of this work is compliant with STROBE guidelines. The lead author affirms that no important aspects of the study have been omitted and that any discrepancies from the study as planned have been explained.

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INFANTS AND CHILDREN

Caregivers' feeding behaviour, children's eating behaviour and weight status among children of preschool age in China

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Abstract

Background: Childhood overweight and obesity have become significant public health challenges worldwide. The present study aimed to investigate whether caregivers' feeding behaviour and children's eating behaviour were associated with the weight status of preschool children in China.

Methods: A cross-sectional questionnaire was administered to 912 caregivers of preschool children from April to July 2016. Caregivers' feeding behaviours were assessed by the Chinese Preschooler's Caregiver Feeding Behaviour Scale. Children's eating behaviours were evaluated using the Chinese Preschooler's Eating Behaviour Questionnaire. After controlling for demographic characteristics, multiple linear regression and logistic regression analyses were performed to evaluate the relationship between caregivers' feeding behaviour, children's eating behaviour and children's body mass index (BMI).

Results: The results showed that weight concerns on the part of caregivers ($\beta = 0.53$) and food responsiveness on the part of children ($\beta = 0.93$) were positively correlated with children's BMI, whereas caregivers' responsibility for feeding ($\beta = -0.68$) and children's external eating ($\beta = -0.53$) were negatively correlated with BMI. Among caregiver feeding behaviours, weight concerns [odds ratio (OR) =4.54, $p < 0.001$] and behaviour-restricted feeding (OR =0.29, $p < 0.001$) were positively correlated with children's BMI. A child's food responsiveness (OR =4.04, $p < 0.001$) was also positively correlated with his/her BMI, whereas the child's satiety responsiveness (OR =0.42, $p < 0.001$) and emotional eating habits (OR =0.56, $p < 0.001$) were negatively correlated with overweight/obesity status.

Conclusions: Our study demonstrated that children's eating behaviour and caregivers' feeding behaviour were associated with weight status among preschool children in China. Behaviour interventions on caregivers and their children may prevent or reduce weight problems in preschool children.

K E Y W O R D S
BMI, eating behaviour, feeding behaviour, overweight/obesity, preschool children

Jing Yuan, Xun Jiang and Tongyu Zhu equally contributed to this study.

INTRODUCTION

Overweight and obesity have become serious public health challenges worldwide in recent years.[1–5] A systematic analysis reported that the rates of overweight/obesity in developing and developed countries were 13% and 24%, respectively, in 2013.[4] The Nutrition and Chronic Diseases of Chinese Residents Report in 2015 showed that the prevalence of overweight and obesity in children < 6 years of age was 8.4% and 3.1%, respectively, and these rates are increasing.[2,6] Childhood overweight and obesity are closely related to the occurrence of chronic diseases such as hypertension, diabetes and coronary heart disease[3,5] and also have a negative association with mental health, intellectual and learning abilities, personality development and psychosocial well-being.[1]

Recent increases in the rates of childhood obesity and associated health risks have drawn the attention of scientists.[4,7–9] Ek et al.[10] showed that the occurrence of overweight and obesity was closely correlated with both feeding practices and eating behaviours. Moreover, previous evidence showed that the age range of 3–6 years is a critical period for the maturation of healthy eating behaviours and the prevention of childhood obesity.[11,12] At these ages, children begin to develop their eating habits,[13] which are strongly affected by the caregivers' feeding behaviour.[11,12] Caregivers control children's food intake by establishing routines for when, what and how their children eat and drink, as well as how the food and drinks are served.[14] Some studies have confirmed that inappropriate feeding practices lead to the development of unhealthy eating patterns in children, such as partial eclipse (having a preference for certain types of food), picky eaters (only eating food he/she likes without considering nutrition) and anorexia (lack or loss of appetite), resulting in increased rates of childhood overweight and obesity.[15–17] Although the caregiver's feeding behaviour plays an important role in the development of unhealthy eating patterns in children, other factors that may contribute to the changes in children's eating patterns and weight status should also be acknowledged. Preschool years (3–6 years old) are a critical period for the prevention of childhood obesity.[13,18,19] The identification of promising intervention strategies requires a thorough understanding of the modifiable factors contributing to overweight and obesity in children.

At present, most studies based on samples from European[12,20] and North American populations[21,22] report associations between caregivers' feeding behaviour, children's eating behaviour and body weight. It has been shown that food-related behaviours among caregivers and children vary greatly across cultures.[19,23] The association among caregiver's feeding behaviour, children's eating behaviours and body weight may be different in China compared to other countries. The association of these factors has not been well studied in Chinese children of preschool age. Thus, the present study aims to investigate whether caregivers' feeding practices and children's eating behaviours are correlated with weight status in preschool children. Our results may support the development of early interventions for obesity prevention in children.

METHODS

Subjects

The experimental protocol was approved by the University Research Ethics Committee (16 November 2018) and all procedures were performed in accordance with the relevant regulations and guidelines. Written informed consent was obtained from all recruited caregivers prior to the study, and data were collected anonymously. In total, 912 preschool children (3–6 years old) and their primary caregivers were recruited from five kindergartens in the urban and suburban areas of Xi'an and Jinan City in China during the period from April to July 2016 using a stratified sampling method at each kindergarten. The primary caregiver was defined as the person who was responsible for the majority of care/feeding (activity, diet, sleep, etc.), and had cared for the child for the longest time at home. This person could be the child's parent, grandparent or nanny. Each recruited caregiver provided their written informed consent before data were collected. All data were collected anonymously.

The inclusion criteria were: (i) age 3–6 years and (ii) caregiver agreed to participate and answer the questionnaire. The exclusion criteria were: (i) children with a history of chronic disease (e.g., constipation, chronic gastritis, chronic diarrhea, toddler's diarrhea) that might have influenced his/her eating behaviour over the last two months and (ii) caregiver unwilling to participate in the study or unable to communicate.

Study instruments

Caregivers' feeding behaviours were assessed using the Chinese Preschooler's Caregivers' Feeding Behaviour Scale (CPCFBS).[24] The CPCFBS comprises seven dimensions and 35 items. Dimension 1 – Responsibility Feeding reflects the feeding behaviours caused by caregivers' responsibility to maintain a healthy diet during feeding. Dimension 2 – Weight Concerns evaluates the association between parental worry on children's weight and their daily feeding behaviours. Dimension 3 – Encourage Healthy Feeding describes behaviours that encourage healthy eating. Dimension 4 – Content-Restricted Feeding and dimension 5 – Behaviour-Restricted Feeding assesses the limits set by the caregiver on food composition and eating behaviours. Dimension 6 – Forced Feeding measures the association between mandatory feeding practices and the children's healthy eating behaviours. Dimension 7 – Supervise Eating evaluates the association between caregiver monitoring and children's unhealthy eating patterns. Test–retest reliability was 0.85 and Cronbach's α coefficient for the total scale was 0.91. The construct validity of the scale was evaluated by factor analysis. Our previous analysis of reliability and validity showed

that the seven dimensions of this scale explained 58.6% of total variance in caregivers' feeding behaviour.[24]

Children's eating behaviours were evaluated with the Chinese Preschoolers' Eating Behaviour Questionnaire (CPEBQ), which consists of seven dimensions and 38 items.[25] Dimension 1 – Food Fussiness examines whether the child refuses food because of its taste, appearance, smell, or texture. Dimension 2 – Food Responsiveness assesses the child's desire to eat. Dimension 3 – Eating Habits detects unhealthy eating habits, such as watching television or playing with toys while waiting a long time for meals. Dimension 4 – Satiety Responsiveness evaluates satiety sensitivity. Dimension 5 – Exogenous Eating evaluates the child's response to external factors that might affect his/her eating. Dimension 6 – Emotional Eating assesses eating status when the child experiences negative emotions. Dimension 7 – Initiative Eating evaluates whether the child is able to eat independently. The CPEBQ has been shown to have good reliability and validity in Chinese children of preschool age.[25] The test–retest reliability was 0.72. The Cronbach's α coefficient for the entire scale was 0.92. The construct validity of the CPEBQ was evaluated by factor analysis. Our previous analysis of reliability and validity showed that the seven dimensions of this questionnaire explained 57.0% of the total variance in children's eating behaviour.[25]

The items in both scales evaluated feeding practices or eating behaviours that occurred over the 3 months leading up to the study. There were five options available for each item: never, rarely, sometimes, often and always, which were assigned scores of 1, 2, 3, 4 and 5, respectively. The average score for each dimension was calculated as the sum of the scores for each item divided by the number of items included in that dimension. Overall, higher scores indicated more engaged eating or feeding behaviours.

Demographic data including caregivers' age and educational level, total monthly household income, children's gender, children's age and the nature of the child–caregiver relationship were also collected. The height and weight of both caregivers and children were measured by an investigator at the kindergarten with standardised anthropometric protocols. BMI was calculated as: BMI = weight (kg)/height (m^2). All enrolled children were classified into four groups according to the BMI standards published by the Centre for Disease Control of China[26]: underweight (sex- and age-specific BMI < 15th percentile), normal weight (sex- and age-specific BMI between the 15th and 85th percentiles), overweight (sex- and age-specific BMI between the 85th and 95th percentiles) and obese (sex- and age-specific BMI >95th percentile). Caregivers were categorised into four groups: underweight (BMI < 20), normal weight (BMI between 20 and 24), overweight (BMI between 24 and 28) and obese (BMI > 28).[27] The educational level of caregivers was classified as junior high school or below, senior high school or college/university and above. The 25th percentile (P_{25}), 50th percentile (P_{50}) and 75th percentile (P_{75}) values for scores on the CPCFBS and CPEBQ were calculated, and the scores of all dimensions in these two scales were converted into four grades, by quartile (P_{25}, P_{50} and P_{75}).

Investigation and quality control

Caregivers recruited from each kindergarten were congregated in a single classroom. An investigator explained the aims and detailed requirements of the study to the caregivers. Then, the questionnaires were distributed to all caregivers. The completed questionnaires were collected by the investigator.

All of the questionnaires were administered by five paediatricians who had at least 5 years of experience in paediatric practice. All of the investigators were trained by paediatricians before the study to ensure that they fully understood the purpose, significance and requirements of the questionnaire, the meaning of all items in each subscale, and the physical examination methods. All completed questionnaires were carefully reviewed by the primary investigator. If the questionnaire was not complete, telephone interviews were conducted to collect missing information. A database was established using EpiData, version 3.1 (EpiData Association). To ensure data accuracy, a logic error-check was performed and a double-entry mode was used.

Statistical analysis

Statistical analyses were performed using SPSS, version 21 (IBM Corp.). $p < 0.05$ was considered statistically significant. Qualitative data are expressed as frequencies and percentages. Quantitative data are shown as the mean ± SD. Multiple linear stepwise regression was used to investigate the factors associated with abnormal BMI. Demographic characteristics and CPCFBS and CPEBQ scores were defined as independent variables (X). The child's BMI was defined as the dependent variable (Y) (see Supporting information, Appendix S1). Progressive advance logistic regression analysis was used to screen for factors associated with overweight/obesity in children. The demographic characteristics and CPCFBS and CPEBQ scores in seven dimensions were defined as the independent variables (X). The child's weight status (overweight or obese) was defined as the dependent variable (Y) (see Supporting information, Appendix S2). The inclusion criterion for the two regression analyses was $p < 0.05$. The rejection criterion was $p > 0.10$. The degree of interpretation of the independent variables in the model was determined by the model's determination coefficient, r^2. The larger the value of r^2, the better the model fit.

RESULTS

Characteristics of the children included in the study and their caregivers

Among 912 primary caregivers, valid questionnaires were collected from 768 participants (response rate = 84.2%). The characteristics of the children and caregivers are shown in Table 1. The mean ± SD age of the recruited

children was 4.9 ± 0.9 years. Among them, 52.0% resided in urban areas and 53.4% were boys. The majority of these children (66.8%) had normal weight. The rates of underweight, overweight and obesity among these children were 10.0%, 12.5% and 10.7%, respectively. The prevalence rates of underweight, overweight and obesity were higher in children who lived in urban areas compared to those residing in rural areas ($\chi^2 = 25.506$, $p = 0.013$). Gender differences were found in the weight status of children ($\chi^2 = 15.595$, $p < 0.001$). Gender was a variable with an influence not only on weight obesity, which was more prevalent in the 3–4-year-old age group, but also in those whose main caregiver was a grandparent ($\chi^2 = 20.53$, $p < 0.001$).

TABLE 1 Demographic characteristics of the children and their caregivers

| Group | Total | Weight status of childrene (n = 768) | | | | p |
		Underweight[a] (n = 77)	Normal weight[b] (n = 513)	Overweight[c] (n = 96)	Obesity[d] (n = 82)	
Urban/rural (%)						
Urban	52.0	55.8	61.4	63.5	54.9	0.013
Rural	48.0	44.2	38.6	36.5	45.1	
Child sex						
Male	53.4	44.2	50.5	67.7	63.4	< 0.001
Female	46.6	55.8	49.5	32.3	36.6	
Child age (years) (%)						
3	31.5	23.4	29.0	40.6	64.6	< 0.001
4	33.5	26.0	36.7	21.9	26.9	
> 5	35.0	50.6	34.3	37.5	8.5	
Child–caregiver relationship (%)						
Parent	76.2	85.7	77.6	77.1	57.3	< 0.001
Grandparent and others	23.8	14.3	22.4	22.9	42.7	
Caregiver age (years) (%)						
20–29	11.5	18.2	11.3	8.3	9.8	0.005
30–30	62.2	55.8	65.3	63.5	47.6	
40–49	7.4	13.0	5.9	8.3	10.9	
> 50	18.9	13.0	17.5	19.8	31.7	
Caregiver weight status (%)						
Underweight[e]	8.7	15.6	7.6	5.2	13.4	0.028
Normal weight[f]	45.1	36.4	47.6	48.9	32.9	
Overweight[g]	35.5	41.5	34.3	31.3	42.7	
Obesity[h]	10.7	6.5	10.5	14.6	11.0	
Caregiver education(%)						
Junior high school or below	27.6	28.6	26.5	27.1	34.2	< 0.001
Senior high school	25.4	28.6	22.2	18.7	50.0	
College/university or above	47.0	42.8	51.3	54.2	15.8	
Family monthly income(%)						
< $750	45.6	63.6	45.6	33.3	43.9	0.002
$750 to $1500	43.8	27.3	43.1	53.2	51.2	
> $1500	10.7	9.1	11.3	13.5	4.9	

[a]Sex- and age-specific body mass index (BMI) <15th percentile.

[b]Sex- and age-specific BMI between the 15th and 85th percentiles.

[c]Sex- and age-specific BMI between the 85th and 95th percentiles.

[d]Sex- and age-specific BMI >95th percentile.

[e]BMI < 18.5.

[f]BMI between 18.5 and 24.

[g]BMI between 24 and 28.

[h]BMI > 28.

CPCFBS and CPEBQ scores

The mean scores on each dimension of the CPCFBS and CPEBQ are presented in Tables 2 and 3. For the CPCFBS, scores were highest on the Supervised Eating dimension, followed by Responsibility Feeding and Encouraging Healthy Feeding. These results suggested that most caregivers performed their responsibilities during the feeding process. For the CPEBQ, scores were highest on the Initiative Eating and External Eating dimensions.

Except for Forced Feeding ($p < 0.05$), average scores on various dimensions of the CPCFBS differed significantly among children with different weight. Scores on the Weight Concerns dimension increased in overweight/obese children, whereas the results for Responsibility Feeding and Encouraging Healthy Feeding showed the opposite trend. For the CPEBQ, average scores on the Food Responsiveness, Food Fussiness, Eating Habits, Emotional Eating and Initiative Eating dimensions were significantly different among children who differed in terms of weight status ($p < 0.05$). Scores on the Food Responsiveness, Eating Habits and Emotional Eating dimensions increased in association with weight gain.

Association among feeding behaviours, eating behaviours and children's BMI

The results of multivariate linear stepwise regression analysis using BMI as the dependent variable (Y), the demographic characteristics (children's gender, children's age, caregivers' age, child–caregiver relationship, caregivers' educational level, monthly household income) and scores on the CPCFBS and CPEBQ as independent variables (X) are shown in Table 4. According to Model 1, in which demographic characteristics were independent variables, the factors associated with abnormal BMI were the child's gender ($\beta = 1.01$), the child's age ($\beta = -1.29$), caregiver educational level ($\beta = -1.45$) and monthly household income ($\beta = 0.72$; $F = 25.04$, $p < 0.001$). The model determination coefficient r^2 was 0.371. In Model 2, the demographic characteristics and caregivers' feeding behaviours were used as independent variables. The factors associated with BMI included child's gender ($\beta = 1.07$), child's age ($\beta = -1.08$), caregivers' educational level ($\beta = -1.11$), monthly household income ($\beta = 0.65$), Responsibility for Feeding ($\beta = -0.87$) and Weight Concerns ($\beta = 0.69$) on the CPCFBS ($F = 24.46$, $p < 0.001$). The model determination coefficient (r^2) was 0.484. In Model 3, the

TABLE 2 Average scores on each dimension of the Chinese Preschooler's Caregivers' Feeding Behaviour Scale in children, stratified by weight status

Behaviours	Underweight	Normal	Overweight	Obesity	Total
Responsibility feeding (X_{RF})	4.00 ± 0.57	3.92 ± 0.67	$3.72 \pm 0.69^{a,b}$	$3.47 \pm 0.77^{a,b,c}$	3.85 ± 0.69
Weight concerns (X_{WEC})	$1.73 \pm 0.84^{b,c}$	$2.12 \pm 0.92^{a,c}$	$2.49 \pm 0.94^{a,b}$	$2.56 \pm 0.73^{a,b}$	2.17 ± 0.93
Encourage healthy feeding (X_{EHF})	3.90 ± 0.56^{c}	3.87 ± 0.62^{c}	$3.63 \pm 0.68^{a,b}$	$3.36 \pm 0.69^{a,b,c}$	3.79 ± 0.65
Content-restricted feeding (X_{CTRF})	3.50 ± 0.89	3.66 ± 0.81^{c}	3.47 ± 0.86^{b}	3.45 ± 0.68^{b}	3.59 ± 0.81
Behaviour-restricted feeding (X_{BHRF})	3.63 ± 0.85	3.72 ± 0.75	3.50 ± 0.74^{b}	$3.31 \pm 0.68^{a,b}$	3.64 ± 0.76
Forced feeding (X_{FOF})	3.40 ± 0.83	3.55 ± 0.83	3.43 ± 0.70	3.48 ± 0.65	3.51 ± 0.82
Supervise eating (X_{SE})	3.97 ± 0.82	3.99 ± 0.77	3.81 ± 0.79	$3.63 \pm 0.80^{a,b}$	3.92 ± 0.82

[a]$P \leq 0.05$ vs. underweight.

[b]$P \leq 0.05$ vs. normal weight.

[c]$P \leq 0.05$ vs. overweight.

TABLE 3 Average scores on each dimension of the Chinese Preschoolers' Eating Behaviour Questionnaire in children, stratified by weight status

Behaviours	Underweight	Normal	Overweight	Obesity	Total
Food fussiness (X_{FF})	2.48 ± 0.55^{c}	2.56 ± 0.55	2.68 ± 0.47^{a}	$2.69 \pm 0.48^{a,b}$	2.58 ± 0.54
Food responsiveness (Y_{FR})	$2.20 \pm 0.53^{b,c}$	$2.38 \pm 0.63^{a,c}$	$2.53 \pm 0.57^{a,b}$	$2.77 \pm 0.68^{a,b,c}$	2.43 ± 0.65
Eating habit (X_{EH})	2.29 ± 0.68^{c}	2.37 ± 0.66^{c}	$2.54 \pm 0.63^{a,b}$	$2.71 \pm 0.59^{a,b}$	2.42 ± 0.67
Satiety responsiveness (X_{SR})	2.69 ± 0.54	2.70 ± 0.53	2.67 ± 0.50	2.81 ± 0.53	2.71 ± 0.54
External eating (X_{EXE})	2.82 ± 0.64	2.95 ± 0.65	2.90 ± 0.67	2.87 ± 0.60	2.92 ± 0.65
Emotional eating (X_{EE})	1.80 ± 0.67	1.95 ± 0.75	$2.28 \pm 0.87^{a,b}$	$2.47 \pm 0.80^{a,b}$	2.03 ± 0.79
Initiative eating (X_{IE})	3.90 ± 0.75^{c}	3.76 ± 0.68	3.64 ± 0.69^{a}	$3.50 \pm 0.61^{a,b}$	3.73 ± 0.69

[a]$P \leq 0.05$ vs. underweight.

[b]$P \leq 0.05$ vs. normal weight.

[c]$P \leq 0.05$ vs. overweight.

T A B L E 4 The association between caregivers' feeding behaviour, children's eating behaviour and children's body mass index

Model	Partial regression coefficient β	Standardised partial regression coefficient	95% CI Lower limit	Upper limit	p value	r²
Model 1					0.000	0.371
Child sex	1.01	0.12	1.02	1.57	0.001	
Child age (years)	−1.29	−0.30	−1.58	−1.01	0.000	
Caregivers' education						
Senior high school	0.02	0.02	–	–	0.579	
College/university or above	−1.45	−0.17	−2.03	−0.86	0.000	
Family monthly income						
$750 to $1500	0.72	0.09	0.02	0.12	0.019	
> $1500	0.06	0.05	–	–	0.148	
Model 2					0.000	0.484
Child sex	1.07	0.13	1.02	1.61	0.000	
Child age (years)	−1.08	−0.25	−1.37	−0.79	0.000	
Caregivers' education						
Senior high school	0.04	0.02	–	–	0.36	
College/university or above	−1.11	−0.13	1.02	1.61	0.000	
Family monthly income						
$750 to $1500	0.65	0.12	0.02	0.17	0.042	
> $1500	0.06	0.05	–	–	0.148	
RF	−0.87	−0.14	−1.27	−0.47	0.000	
WEC	0.69	0.15	0.39	0.99	0.001	
Model 3					0.000	0.601
Child sex	1.06	0.27	1.05	1.60	0.000	
Child age (years)	−1.01	0.23	−1.31	−0.72	0.000	
Caregivers' education						
Senior high school	−0.05	0.07	–	–	0.196	
College/university or above	−1.12	−0.13	−1.65	−0.58	0.000	
Family monthly income						
$750 to $1500	0.68	0.12	0.06	0.13	0.033	
> $1500	0.08	0.11	–	–	0.108	
RF	−0.68	−0.11	−1.08	−0.27	0.003	
WEC	0.53	0.12	0.22	0.84	0.001	
FR	0.93	0.15	1.04	1.41	0.000	
EXE	−0.53	−0.08	−0.97	−0.09	0.001	

Note:: (1) Model 1 used demographic characteristics as independent variables; Model 2 used demographic characteristics and Chinese Preschooler's Caregivers' Feeding Behaviour Scale scores as independent variables; Model 3 used demographic characteristics, Chinese Preschooler's Caregivers' Feeding Behaviour Scale scores and Chinese Preschoolers' Eating Behaviour Questionnaire scores as independent variables. (2) For classification variables, gender of the child, educational level of the caregiver and monthly family income were analysed based on 'female', 'junior high school or below' and 'under $750', respectively. (3) Data were analysed using the multivariate stepwise linear regression method.

Abbreviations: CI, confidence interval; FR, food responsiveness; EXE, external eating; RF, restricted feeding; WEC, weight concerns.

demographic characteristics, caregivers' feeding behaviours and children's eating behaviours were used as independent variables. The results showed that the factors associated with BMI were child's gender (β = 1.06), child's age (β = −1.01), caregivers' educational level (β = −1.12), monthly household income (β = 0.68), Responsibility for Feeding (β = −0.68) and Weight Concerns (β = 0.53) on the CPCFBS, as well as Food Responsiveness (β = 0.93) and External Eating (β = −0.53)

on the CPEBQ ($F = 21.18$, $p < 0.001$). The model determination coefficient (r^2) was 0.601. Moreover, BMI was higher among boys compared to girls ($p \leq 0.001$). Family monthly income and scores on the Weight Concerns and Food Responsiveness dimensions were positively correlated with children's BMI ($p < 0.05$). Children's age, caregivers' educational level, Responsibility for Feeding score on the CPCFBS and External Eating Behaviour in children were negatively

correlated with children's BMI ($p < 0.05$). A lower BMI was observed in younger children, in caregivers with higher educational levels and in subjects with higher scores on the Responsibility for Feeding and External Eating subscales.

Association among feeding behaviours, eating behaviours and children's weight status

In the binary logistic regression analysis, abnormal weight status (overweight/obesity) was used as the dependent variable (Y). The demographic characteristics (child gender, age, caregiver age, relationship with child, caregiver education, family monthly total income) and scores on the CPCFBS and CPEBQ were independent variables (X) (Table 5). According to Model 1, in which demographic characteristics were the independent variables, the factors associated with overweight/obesity included caregivers' educational level [odds ratio (OR) = 0.49, $p < 0.001$], monthly family income (OR = 3.01, $p < 0.001$) and children's age (OR = 0.42, $p < 0.001$) ($\chi^2 = 68.29$, $df = 6$, $p < 0.001$). In Model 2, demographic characteristics and caregivers' feeding behaviours were the independent variables. The factors associated with overweight/obesity were family monthly income (OR = 2.02, $p < 0.001$), Responsibility for Feeding (OR = 0.44, $p < 0.001$), Weight Concerns (OR = 5.36, $p < 0.001$), Behaviour-Restricted Feeding (OR = 0.53, $p < 0.001$) and Supervised Eating (OR = 0.52, $p < 0.001$) on the CPCFBS ($\chi^2 = 218.76$, $df = 13$, $p < 0.001$). According to Model 3, in which demographic characteristics, caregivers' feeding behaviours and children's eating behaviours were the independent variables, the factors associated with overweight/obesity were monthly family income (OR = 1.76, $p < 0.001$), Weight Concerns (OR = 4.54, $p < 0.001$), Behaviour-Restricted Feeding (OR = 0.29, $p < 0.001$) on the CPCFBS, as well as Food Responsiveness (OR = 4.04, $p < 0.001$), Satiety Responsiveness (OR = 0.42, $p < 0.001$) and Emotional Eating (OR = 0.56, $p < 0.001$) on the CPEBQ ($\chi^2 = 244.96$, $df = 17$, $p < 0.001$). The model determination coefficient (r^2) was 0.666. Furthermore, family monthly income, as well as scores on the Weight Concerns, Behaviour-Restricted Feeding and Food Responsiveness dimensions, were positively correlated with overweight/obesity status in children ($p < 0.05$). The higher the score on a given dimension, the higher the risk for overweight/obesity in children. Scores on the Satiety Responsiveness and Emotional Eating subscales were negatively correlated with abnormal weight status in children ($p < 0.05$). A higher likelihood of overweight/obesity was observed in participants with more monthly family income, with higher scores on the Weight Concerns and Behaviour-Restricted Feeding subscales on the CPCFBS, as well as higher scores on the Food Responsiveness subscale on the CPEBQ. A higher likelihood of overweight/obesity was also observed in participants with lower scores on the Satiety Responsiveness and Emotional Eating subscale on the CPEBQ ($p < 0.05$).

DISCUSSION

The identification of factors associated with weight status can optimise early intervention strategies to prevent childhood obesity. Recent studies have reported that demographic characteristics, such as children's age,[28] family environment,[29] caregivers' feeding behaviour[12,13,30–33] and children's eating behaviour,[10] are closely related to children's weight status. Furthermore, parental feeding practices are partially responsible for the relationship between children's eating behaviours and their BMI. On the other hand, children's eating behaviours explain part of the association between parental feeding behaviours and children's BMI.[13] Our multiple linear regression and binary logistic regression analyses consistently showed that children's weight status was associated with family demographic characteristics, children's eating behaviour and caregivers' feeding behaviour.

Association between family demographic characteristics and weight in children

Nowicka et al.[34] examined the psychometric properties of the Child Feeding Questionnaire (CFQ) and explored the relationship between parenting practices and children's weight status in Sweden.[35] The results showed that children's BMI and parents' foreign origin had a direct impact on restriction, and the pressure to eat was also affected by parental educational level. In 2014, Moreira et al.[29] confirmed the association between children's gender, children's age, child–caregiver relationship, family economic status and weight in children by analysing the data collected from the CFQ and the Overt and Covert Control Scale using linear regression analysis. They reported that family environment and maternal socio-economic factors were associated with the pressure to eat and perceived monitoring, whereas maternal health behavioural characteristics were associated with restriction. Rodenburg et al.[36] also found that socio-demographic variables, such as the child's ethnicity and the primary caregiver's educational level, were correlated with psychological control and the child's BMI. Using the Child Eating Behaviour Questionnaire (CEBQ), Alshammary et al.[19] found that obesogenic eating behaviours were associated with excess weight in both children and parents.

In the present study, the linear regression model showed that a child's gender, his or her age, caregiver's educational level and monthly household income were the main factors associated with BMI in children. BMI was higher in boys than girls. Higher caregiver educational level was associated with lower BMI values in children. These findings indicate that Chinese caregivers with lower monthly household incomes and higher educational levels are more likely to be concerned about childhood obesity. Their feeding practices were not associated with high BMI, indicating that these behaviours may reduce the risk of childhood obesity.

TABLE 5 The association between caregivers' feeding behaviour, children's eating behaviour, and children's overweight/obesity status

Model	Regression coefficient β	OR	Lower limit	Upper limit	p value	r²
			OR 95% CI			
Model 1					0.000	0.314
Caregivers' education					0.001	
Junior high school or below	–	–	–	–	–	
Senior high school	−0.06	0.94	0.62	1.43	0.783	
College/university or above	−0.71	0.49	0.33	0.75	0.001	
Family monthly income					0.000	
≤ $750	–	–	–	–	–	
> $750 to ≤ $1500	1.10	3.01	2.09	4.33	0.001	
> $1500	0.66	1.94	1.12	3.36	0.018	
Child age (years)					0.000	
3	–	–	–	–	–	
4	−0.62	0.54	0.37	0.77	0.001	
5-6	−0.86	0.42	0.29	0.61	0.000	
Model 2					0.000	0.432
Family monthly income					0.001	
≤ $750	–	–	–	–	–	
> $750 to ≤ $1500	0.71	2.02	1.42	2.89	0.000	
> $1500	0.36	1.44	0.82	2.53	0.010	
RF					0.005	
$< P_{25}$	–	–	–	–	–	
$P_{25}\sim$	−0.42	0.65	0.40	1.07	0.092	
$P_{50}\sim$	−0.82	0.44	0.27	0.73	0.002	
$\geq P_{75}$	−0.89	0.41	0.23	0.72	0.002	
WEC					0.000	
$< P_{25}$	–	–	–	–	–	
$P_{25}\sim$	0.57	1.71	1.01	3.12	0.048	
$P_{50}\sim$	1.68	5.36	3.30	8.72	0.000	
$\geq P_{75}$	2.15	8.54	4.69	15.54	0.000	
BHRF					0.001	
$< P_{25}$	–	–	–	–	–	
P_{25}	−0.57	0.95	0.57	1.55	0.023	
P_{50}	−0.63	0.53	0.33	0.86	0.010	
$\geq P_{75}$	−0.98	0.38	0.22	0.64	0.000	
SE					0.041	
$< P_{25}$	–	–	–	–	–	
P_{25}	−0.28	0.76	0.48	1.19	0.228	
P_{50}	−0.65	0.52	0.29	0.93	0.027	
$\geq P_{75}$	0.13	1.14	0.65	1.99	0.042	
Model 3					0.000	0.666
Family monthly income					0.012	
≤ $750	–	–	–	–	–	
> $750 to ≤ $1500	0.56	1.76	1.21	2.56	0.003	
> $1500	0.24	1.28	0.70	2.31	0.023	

(Continues)

TABLE 5 (Continued)

Model	Regression coefficient β	OR	OR 95% CI		p value	r²
			Lower limit	Upper limit		
WEC					0.000	
$< P_{25}$	–	–	–	–	–	
P_{25}	0.61	1.84	1.03	3.29	0.040	
P_{50}	1.51	4.54	2.73	7.55	0.000	
$\geq P_{75}$	1.79	5.97	3.20	11.12	0.000	
BHRF					0.000	
$< P_{25}$	–	–	–	–	–	
P_{25}	−0.20	0.98	0.58	1.64	0.039	
P_{50}	−0.71	0.49	0.31	0.78	0.003	
$\geq P_{75}$	−1.25	0.29	0.17	0.47	0.000	
FR					0.000	
$< P_{25}$	–	–	–	–	–	
P_{25}	0.14	1.15	0.72	1.82	0.559	
P_{50}	1.39	4.04	2.05	7.97	0.000	
$\geq P_{75}$	1.52	1.69	1.02	2.81	0.044	
SR					0.025	
$< P_{25}$	–	–	–	–	–	
P_{25}	−0.37	0.69	0.44	1.07	0.099	
P_{50}	−0.53	0.59	0.36	0.97	0.036	
$\geq P_{75}$	−0.88	0.42	0.23	0.76	0.004	
EE					0.000	
$< P_{25}$	–	–	–	–	–	
P_{25}	−0.58	0.56	0.34	0.91	0.019	
P_{50}	−0.18	1.19	2.04	0.69	0.014	
$\geq P_{75}$	−0.65	1.91	3.62	1.01	0.048	

Note:: (1) Model 1 used demographic characteristics as independent variables; Model 2 used demographic characteristics and Chinese Preschooler's Caregivers' Feeding Behaviour Scale scores as independent variables; Model 3 used demographic characteristics, as well as Chinese Preschooler's Caregivers' Feeding Behaviour Scale scores and Chinese Preschoolers' Eating Behaviour Questionnaire scores, as independent variables. (2) For classification variables, child's age, caregiver's level of education, and family monthly income were analysed based on '3–4 years old', 'junior high school or below' and 'under $750', respectively. (3) Data were analysed by logistic regression.

Abbreviations: BHRF, behaviour-restricted feeding; CI, confidence interval; EE, emotional eating; FR, food responsiveness; EXE, external eating; OR, odds ratio; RF, restricted feeding; SE, supervise eating; SR, satiety responsiveness; WEC, weight concerns.

The association between caregivers' feeding behaviour and weight in children

Childhood overweight/obesity has become a common concern in recent years. However, Branch et al.[21] found that concerns were rarely translated into healthier family meal characteristics or feeding behaviours. Maternal concerns alone may not be sufficient to motivate actions to reduce the risks of childhood obesity. In 2010, Webber et al.[20] used the CFQ to confirm the impact of maternal perceptions and concerns on the weight status of their children. Also, Ma et al.[37] developed a Young Child Feeding Questionnaire for 18-month-old infants and young children. The results obtained with use of this questionnaire showed that parental concerns about

infant weight were positively correlated with BMI-for-age z-scores (β = 0.293, p = 0.029). Consistently, we found that caregivers' concerns about children's weight status during feeding led to increased BMI, suggesting that these feeding behaviours may increase risk for childhood obesity.

In 2012, Cheah et al.[38] conducted a CFQ survey on Chinese and Korean caregivers of children (3–8 years of age) in the USA. The results demonstrated the impact of feeding responsibility on a child's weight.[38] It was found that caregivers' feeding responsibility correlated negatively with overweight/obesity in children. The stronger the caregiver's sense of responsibility, the higher the chance that he/she would have healthy feeding behaviours, which may decrease a child's BMI and reduce the risk of obesity.

Associations among caregivers' feeding behaviour, children's eating behaviour and children's weight status

To organise various potentially overlapping constructs in the literature, Rodgers et al.[18] conducted a principal components analysis in a sample of 2-year-old children to clarify a set of core independent constructs representing maternal feeding styles. It was found that weight-based restriction, encouragement to eat, emotional feeding and restriction were positively correlated with the development of children's obesogenic eating behaviours, including food approach behaviours (such as good appetite and enjoyment of food), tendency to overeat and emotional eating. Moreover, Sleddens et al.[39] reported that the use of snacks as a reward may increase the number of external factors related to eating for the child and also may affect the child's eating behaviours by increasing exposure to unhealthy snacks, leading to overeating and obesity in children. Therefore, parents were advised not to use food to regulate children's behaviour or mood, as well as to encourage children's interest and curiosity in tasting different kinds of food. In the present study, the linear regression model showed a negative correlation between External Eating and BMI in children. The binary logistic regression also showed that children's Emotional Eating was negatively correlated with the occurrence of overweight/obesity, indicating that stimulate children's interest in tasting and eating different foods may promote the development of healthy eating behaviours in children, thereby reducing children's weight and decreasing the risk of obesity.

Stunkard et al.[40] used a three-factor dietary behaviour scale as a measurement tool and found that food response had a strong positive correlation with children's BMI. Wu et al.[41] used the Dutch version of the Adult Dietary Behavior Scale in 1171 middle school students and reached the same conclusion. Jansen et al.[13] performed a cross-sectional study using the CEBQ and CFQ and found that higher levels of parental restriction, children's food responsiveness and enjoyment of food were associated with higher BMI values, independent of measured confounders. Consistent with their findings, our results showed that children's responsiveness to food was positively correlated with excessive dietary intake, which may lead to an increase in BMI and a higher risk of obesity.

Viana et al.[42] and Sleddens et al.[43] used CEBQ to evaluate the dietary behaviour of a paediatric population (3–13 years of age) in Portugal and another paediatric population (6–7 years of age) in The Netherlands. The results showed a strong negative correlation between children's satiety response and their BMI. Jansen et al.[13] also confirmed that children's fussiness, children's satiety responsiveness, and parents' pressure to eat were negatively correlated with children's BMI. Our linear regression model did not incorporate Satiety Responsiveness. However, the binary logistic regression showed that children's Satiety Responsiveness had a significant negative correlation with overweight/obesity, indicating that children with greater satiety responsiveness had better capacity to regulate food consumption, which

may prevent an excessive increase in BMI and reduce the incidence of overweight/obesity.

Previous evidence has shown that not only insufficient parental control,[44] but also parental over-control[45] contribute to overweight/obesity in children because children are likely tempted to overeat in the obesogenic environment. Poor parental restriction[46–48] and monitoring[46] of children's food intake were positively correlated with higher BMI values. Birch et al.[49] reported that caregivers' restriction of feeding may lead to unhealthy eating behaviours in children. Elford et al.[50] used an adapted version of the CFQ to explore the impact of other key care providers on the weight and eating habits of children. The results showed that a controlling maternal child-feeding style (e.g., restriction of certain food, the use of pressure to eat) was associated with fussy eating, overconsumption and abnormal weight. Conversely, a responsive child-feeding style, where children were encouraged to eat different kinds of food, encouraged to try new tastes and allowed to regulate their food intake, was associated with healthy eating styles and normal weight. Our results were not consistent with theirs. In the binary logistic regression model, Restriction Feeding was negatively correlated with the occurrence of overweight/obesity, indicating that a child had healthy eating behaviours when a caregiver restricted his/her food consumption, and thus the risk of overweight/obesity was decreased.

We did not identify a relationship among caregiver feeding behaviours (e.g., Content-Restricted Feeding, Forced Feeding, Supervised Eating), children's eating behaviours (e.g., Eating Habits, Initiative Eating) and children's BMI or overweight/obesity status. The influencing factors are complex because dietary culture and feeding habits vary among regions, ethnicities and family social environments. Another source of complexity is the diversity of caregivers' feeding practices and children's eating behaviours.

Limitations

The present study had some limitations. First, the study participants may not have been representative of the entire population of preschool children in China because we only recruited subjects from Jinan and Xi'an City. Second, the sample size was small. Third, the present study was limited by its cross-sectional design. Longitudinal studies are necessary to determine the direction of causality. Also, the information pertaining to children's eating behaviours was collected based on the subjective opinions of caregivers, which may have been confounded by reporting bias. Future investigations on other potential confounding factors will be needed.

CONCLUSIONS

In summary, the present study comprehensively evaluates the relationships among demographic characteristics,

caregivers' feeding behaviour, children's eating behaviour and children's weight status using regression analyses. Our results show that caregivers' feeding behaviours and children's eating behaviours are associated with children's weight status and the occurrence of overweight/obesity in China, suggesting that the prevention of overweight/obesity among children may require behavioural changes on the parts of both children and their caregivers. These findings provide reference information for the development of healthy feeding habits and the optimisation of prevention and intervention strategies for the management of childhood obesity.

CONFLICT OF INTERESTS
The authors have no conflicts of interest.

AUTHOR CONTRIBUTIONS
LS and JX conceived the study and led the writing of the manuscript. All authors designed the study and reviewed versions of the protocol. JY, TZ, YZ and YW organised and supervised the data collection phase of the study. JY, TZ, YZ and XY conducted the data analysis and also participated in the writing of the manuscript. LS, XJ and YZ analysed and interpreted the results and led the writing of the manuscript. All authors critically reviewed the manuscript and provided comments for revision. All authors read and approved the final version of the manuscript submitted for publication.

ETHICAL STATEMENT
This study was approved by the Research Ethics Committee of the Fourth Military Medical University (November 16, 2018) and all procedures were performed in accordance with the relevant regulations and guidelines. All caregivers recruited provided written informed consent prior to the collection of any information.

TRANSPARENCY DECLARATION
The lead author affirms that this manuscript is an honest, accurate and transparent account of the study being reported. The reporting of this work is compliant with STROBE guidelines. The lead author affirms that no important aspects of the study have been omitted and that any discrepancies from the study as planned have been explained.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

A qualitative exploration of dietitians' experiences of prescribing oral nutritional supplements to patients with malnutrition: A focus on shared tailoring and behaviour change support

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Abstract

Background: Oral nutritional supplements (ONS) are commonly prescribed to patients with malnutrition. Dietitians have been suggested as preferred prescribers but generally lack ONS prescribing rights. How dietitians with prescribing rights experience their professional practice of prescribing ONS remains understudied. Thus, by exploring dietitians' experiences of prescribing ONS, the present study aimed to obtain a deeper understanding of specific aspects that are of importance for dietitians when providing a nutrition therapy including ONS.

Methods: Qualitative individual interviews were conducted with 13 dietitians prescribing ONS to free-living adult outpatients with malnutrition or at nutritional risk in the hospital or primary care setting. Systematic text condensation was used for data analysis.

Results: Two main categories signifying important aspects were identified and labelled: 'Shared tailoring of the ONS prescription' and 'Supporting and facilitating ONS use'. First, the dietitians described tailoring the ONS prescription together with the patient, having their acceptance as a prerequisite, and being flexible regarding products and amounts prescribed. Second, they described performing different communication strategies and organising of practical issues (e.g., ONS delivery and support from others) to support and facilitate patients' ONS usage.

Conclusions: The present study identifies patient involvement and the role of dietitians as behaviour change facilitators as two important aspects when dietitians prescribe ONS. These findings allow for dietitians' ideals and strategies on how to prescribe ONS to be made more visible, which can inform both clinical practice and clinical trials for future improvements in nutrition therapy to address malnutrition.

KEYWORDS
behaviour change, dietitian, malnutrition, oral nutritional supplements, qualitative study

INTRODUCTION

Although prescribing oral nutritional supplements (ONS) is a common part of nutrition therapy for adult malnutrition, little is known about how dietitians experience the delivery of this intervention. ONS are medical nutrition products recommended to be added when food-based strategies are insufficient.[1,2,3] Multi-nutrient liquid supplements are the most frequently used ONS, although they also exist in powder and pudding form.[3] ONS prescriptions are similar to medical prescriptions because they are prescribed to patients, and are often dispensed by pharmacies and recommended for use under medical supervision.[4] However, ONS usage is often described as problematic, for example, as a result of the acceptance of taste, texture or volume, resulting in low compliance (or adherence).[5,6,7,8] To optimise compliance, it is recommended that the nutrition therapy with ONS be individually tailored and that patients' preferences for type of supplement, flavours and manner of consumption should be taken into account.[9]

Although dietitian support appears to be central when aiming for improvements in ONS prescribing appropriateness,[10] dietitians lack independent prescribing rights in many countries.[11,12,13,14] Accordingly, other ONS prescribing healthcare professionals have expressed a lack of confidence when prescribing ONS[12] and in choosing the ONS that is most appropriate.[15] One solution proposed by Irish general practitioners to better tackle malnutrition and ONS management was greater access to dietetic service.[12] In Sweden, dietitians, doctors and, in one out of 21 regions, district nurses have prescribing rights for ONS to adult hospital outpatients and free-living patients in the community, although dietitians are generally responsible for this task.[16] An ONS prescription in this context involves both communicating a recommended intake of the specific food (here ONS) based on a nutritional assessment,[17] as well as conducting a subsidised distribution of ONS to the patient. This entails an autonomous dietitian-led process concerning ONS, which is not dependent on permission or involvement from other healthcare professionals. Because dietetic professionals are suggested as a solution to the challenge of prescribing ONS[12] and as the best in making the choice of which supplement to use,[14] this Swedish setting is suitable for gaining more knowledge on dietitians' experiences from performing this task. Even though there are recommendations on how to deliver an appropriate ONS prescription (e.g., set desirable goals, tailor it individually, advice on food first strategies and monitor continuously),[9,10] researchers scarcely report on important details of ONS interventions, thus making it difficult to replicate successful trials.[18] Insights into important features of the dietetic professional practice of prescribing ONS would be valuable for characterising key aspects of a successful ONS prescription. Therefore, the present study focuses on dietitians' experiences of the prescribing process following a decision that a patient qualifies for a subsidised prescription. Consequently, by exploring those experiences, we aim to obtain a deeper understanding of specific aspects that are of importance for dietitians when providing a nutrition therapy including ONS.

METHODS

Study design

This is an explorative qualitative interview study focusing on dietitians' experiences of the phenomenon of prescribing ONS. The study was inspired by phenomenological philosophy in line with a study using Systematic Text Condensation (STC) as analysis procedure,[19,20] and took on a pragmatic theoretical approach.[19,21] Approval for the study was sought from the Swedish Ethical Review Authority (Reference No. 2019-01198) and informed consent was obtained from all participants.

Study participants and recruitment

Dietitians who regularly prescribed ONS to adult outpatients and who worked in all clinical settings and regions of Sweden were invited to participate via the Swedish Association of Clinical Dietitians' homepage, newsletter and Facebook group. Out of 1800 dietitians in Sweden,[22] approximately 1300 are members of the association.[23] To ensure a sufficient number of participants, in a second step of the recruitment process, managers of dietetic departments in geographical areas not yet covered were contacted and asked to spread the word about the study among their employees. This purposive sampling technique aimed to include dietitians with a broad range of experiences connected to prescribing ONS.[21] In line with the concept of adequate information power, recruitment ceased when we found the interviewees' descriptions to fulfil the aim of gaining new insights and understandings connected to the phenomena of prescribing ONS.[24] Thirteen dietitians were recruited, and all were women with a mean ± SD age of 36 ± 12 years and had, on average, 10 ± 10 years of working experience. Seven dietitians worked in primary healthcare, providing nutrition therapy to a mixed group of patients, where the frail elderly were the main category being prescribed ONS. Six dietitians worked in hospitals, where some of them were specialised in one field of expertise such as oncology or gastroenterology, and others worked at smaller hospitals within a wide range of medical specialties. The dietitians are named as D1–D13 in the results section. Seven out of 21 Swedish regions were represented by the dietitians and, in these regions, ONS prescriptions were subsidised for patients with malnutrition or at nutritional risk. However, the degree of subvention (e.g., a patient fee of €0.5 per bottle or a three-level system of €30, 80 or 140 per month depending on amount prescribed), product selection and the delivery of the products were locally organised within each region.

TABLE 1　Analysis process according to Systematic Text Condensation steps 1–4[19]

Preliminary themes[a] (step 1)	Code groups (step 2)	Subgroups (step 3)	Final categories (step 4)
Acceptance/taste	If it doesn't taste good, they won't drink it	Acceptance as the biggest challenge	Shared tailoring of the ONS prescription
		To find a flavour that works	
Navigating/'dancing' with the patient	The flexible ONS treatment	The tailored intervention	
		The adjustable prescribed amount	
Simple and effective	To make them take it	Facilitate ONS use – navigating the welfare system	Supporting and facilitating ONS use
		The conversation as tool	
Organisation and cost			
Self-management			

Abbreviations: ONS, oral nutritional supplement.

[a]The Preliminary themes should be regarded as separated from the Code groups because each theme is not directly connected to one specific code group but rather worked out as a starting point when forming the code groups.

Data collection

The individual semi-structured interviews were conducted by the first investigator (ELi) between October 2019 and April 2020. Based on reviewed literature and the study aim, an interview guide was created (see Supporting information, Appendix S1) with open-ended questions concerning experiences of prescribing ONS. The interview guide was tested in one pilot interview with a dietitian working in clinical practice; thereafter, minor changes were made. Each interview began by asking the dietitian to describe an ordinary day at work and continued by asking for a description of how she delivers ONS prescriptions in everyday practice. We aimed to capture areas regarding experiences of (i) the prescription occasion; (ii) the follow-up of a former prescription; (iii) patient usage of ONS and potential struggles faced; and, finally, (iv) the dietitians' conceptualisation of ONS. Prompts and follow-up questions were used in order to capture in-depth descriptions of the participants' experiences in everyday practice.[25] The locations for the face-to-face interviews were meeting rooms at the dietitians' work-places ($n = 8$), at restaurants ($n = 2$) and in the home environment ($n = 2$). One interview was rescheduled as a telephone interview as a result of travel restrictions because of the spread of COVID-19 during spring 2020. The interviews lasted from 39 to 68 min (mean of 55 min) and were audio-recorded and transcribed verbatim.

Data analysis

Data analysis was conducted following STC, a procedure for thematic cross-case analysis[19] and NVivo 11 Plus[26] was used to organise the data. All four investigators were involved in the analysis in collaboration, with ELi carrying out the principal coding of the material. The investigators are all registered dietitians, with experience in clinical practice. The first investigator (ELi) holds a clinical position at a university hospital but is on leave of absence during the doctoral studies. The other three investigators hold academic employments (AA – Ass Prof; ELö – PhD; MN – Prof Emer), conducting research and teaching within the field of nutrition and dietetics. No relationships were established with the interviewees prior to commencement. However, because the dietetic work force is small in Sweden, the dietitians were more or less acquainted with the research group. The STC analysis followed four steps. In the initial step (1), all four investigators read parts of the transcripts to gain a general impression of the material and agreed upon preliminary themes. In the second step (2), ELi identified meaning units representing descriptions of prescribing ONS and sorted them into code groups. In line with STC guidelines, those selected meaning units were limited to '*talk relevant for the study question*',[19] p. 797). In the third step (3), subgroups were created and the content within each subgroup was further rewritten into a condensate by ELi. All four investigators discussed and agreed upon the code groups, subgroups and their labels continuously during recurrent analysis meetings. Finally, (4) the condensates were used as starting points for synthesis and an analytical text. The analysis process was performed in an iterative mode: interviewing, transcribing and coding parts of the material in a mixed stepwise manner. In line with the phenomenological attitude and a data-driven study approach, our ambition was to bracket our preconceptions, as in phenomenology, referring to an intention to stay atheoretical and open minded, and to keep the dietitians' voices in focus.[20,21] In the latter phase of the analysis, we went back and forth between the dietitians' descriptions and theory/literature, following an editing analysis style.[19,27] Themes, code groups, subgroups and final categories are presented in Table 1. After finishing the analysis process, aiming to deepen the understanding, the results were interpreted though the shared decision-making framework[28] and the model of the Behaviour Change Wheel.[29] This elaboration is covered in the Discussion.

RESULTS

The dietitians described food-based strategies as the base of the nutritional intervention for malnutrition, although ONS was often talked about as being more simple and achievable

for many patients. The dietitians described a complex process once they had decided that a person could benefit from and was qualified to have a prescription of ONS. Two final categories reflecting important aspects for the dietitians when prescribing ONS were identified and labelled as 'Shared tailoring of the ONS prescription' and 'Supporting and facilitating ONS use'. Additional illustrative quotes are provided in the Supporting information (Appendix S2).

Shared tailoring of the ONS prescription

Because patient acceptance and involvement, in combination with dietitian flexibility, were expressed as essential when prescribing ONS, a picture of a shared tailoring process was identified. Patient acceptance was described as challenging and highlighted as the primary reason determining whether or not patients took their ONS. The sweetness or the metallic taste was recurrently addressed as the major taste obstacles. The dietitians described individuals' preferences as very diverse.

> Some of the patients are like "oh, it's so tasty, I could just eat those (ONS)", while some say "this is the most disgusting thing I've ever tasted". So, the patients' views are very varied
>
> (D2, hospital)

For those patients accepting the taste of ONS, an uncomplicated and successful treatment was often described. If the patient did not like the taste of the ONS, the dietitians considered the prescription to be inappropriate. Therefore, all dietitians stressed the importance of letting the patient try out the supplements before writing a prescription and arranged for testing trials in different ways, depending on the context. For the dietitians, having patients who had problems with accepting ONS was challenging because it meant that an effective solution to the nutritional problem was not an option:

> And the biggest challenge for us who have to prescribe or recommend it is that we hope they'll like it, that it works out. Otherwise, it won't work. So that's a major issue, and the biggest challenge to make it work is the acceptance
>
> (D12, hospital)

Several dietitians expressed that having an extensive variety of products available for prescription was helpful. The process of finding 'the right' (D10, primary healthcare) supplement that the patient liked and accepted was described as important and sometimes comprehensive. If the patient did not like any of the initial products tasted or if the preferences had changed, they could be offered more trials with other flavours. One dietitian who made home visits to elderly patients described the process of finding accepted products in the following way:

> I find the order that I've made and ask if there's one that they have tasted that they prefer. And

often, there are some (ONS) they haven't tasted and then we can try them out when I'm there. Then, I can also see how they react and what they think about it

> (D13, primary healthcare)

If a patient could not accept the optimal products as being suitable for a prescription, the dietitians described turning to less optimal ones in order to achieve at least a somewhat better nutritional status than before. Liquid milk-based supplements were generally described as the optimal ones, whereas products with less extensive nutrient profiles were presented as less optimal (e.g., juice-based supplements and fat-emulsions). Many dietitians also expressed the choice of a ready-made liquid supplement as being more simple and hence more successful than powder supplements or supplements that required the patient to make an effort:

> If they like one of them that I maybe wouldn't have chosen as a first choice, then it is still much better that they take the one they like, rather than the optimal one, because it's better than nothing. I think
>
> (D5, hospital)

> Powders and stuff, it's pretty seldom I prescribe those since I think it isn't as effective or doesn't become as much in the end. It also takes a bit more effort for the patients to prepare something with this powder. Ready-made ONS is much easier. It's just to open the bottle and drink it
>
> (D3, primary healthcare)

The dietitians shared that, if the patient expressed resistance towards being prescribed ONS, it was important to respect their choice. They endorsed having a collaborative relationship where other solutions were then negotiated. Although those were mainly food-based solutions, enteral and parenteral nutrition were also mentioned, primarily by hospital dietitians:

> A lot of compromising with the patient. And of course, it should be on their, I am there for their sake. They shouldn't do anything for my sake, but you have to make deals with them. Yes, like, can you possibly eat and drink this, and then most of the times they usually agree to it
>
> (D13, primary healthcare)

The dietitians described the amount prescribed as flexible and adjustable. Having an authoritarian and informative consultation style was not viewed as desirable. Moreover, the dietitian's clinical judgement on the optimal ONS amount required was often adjusted according to the patient's wishes and his or her ability to drink it. For example, the decision about the amount prescribed could be initiated by asking the patient how many supplements he or she could manage per day, and the

prescription could initially contain one per day even though the patient was evaluated as requiring three. At follow-up appointments, the prescribed amount was often changed based on acceptance and how many supplements the patient had consumed since the previous time. Also, body weight and total energy intake were important parts in deciding on continued amount. Another aspect of the flexible amount prescribed comprised reports about prescribing a range of ONS (e.g., 2–3 per day instead of a fixed amount). Arguments for this strategy were that the dietitians wanted to avoid making patients feel like they were forced to take ONS, to give patients freedom of choice and to support them in taking an active role in their nutrition therapy:

> I usually say yes, you can drink between two or three per day, that's not a problem. So I don't know, maybe it confuses them, gets a bit grey but typically the patient says him or herself that yes, I can drink one per day, and then I say yes, then we have one per day and that's the prescription then
>
> (D8, hospital)

Some dietitians also mentioned educating patients on energy and nutrient contents of foods for them to be able to compensate for missed meals with ONS on their own. Both patients with cancer undergoing oncological treatments and patients with inflammatory bowel disease with episodes of active disease were acknowledged as groups where this self-regulating strategy was applicable.

> If you can't eat the whole dinner, for example, then you should take two ONS. If you can eat half a dinner and half a lunch, then it is two ONS together for those, and if they have better appetite then they have to drink less. It is hard for me to say exactly how many they should take during a day since there's a big variation from day to day. They have to feel that it's a responsibility they need to take
>
> (D5, hospital)

Even if the dietitians expressed being very flexible with the amount prescribed, they also mentioned using fixed amounts, especially when they perceived the patient would benefit from having a specific recommendation. For example, one dietitian highlighted the importance of a clear and fixed prescription when communicating with the homecare service. In addition, another dietitian working at a hospital described situations where doctors sometimes decided if the patient was to be prescribed a complete ONS-based diet temporarily. The dietitian explained that these prescriptions were strict recommendations with no room for patient involvement.

Supporting and facilitating ONS use

The dietitians shared many experiences about supporting and facilitating ONS usage in the dialogue with patients and also by navigating external system entities such as payment level, ONS delivery and support from others. By informing, explaining and motivating, the dietitians encouraged ONS use. For example, they stated that they informed patients about ONS benefits such as the high calorie content in a small volume and also on how to make ONS more palatable (e.g., by mixing it with different seasonings or serving them in a pleasant way). They also emphasised informing patients that ONS should not replace food but, instead, be used as an add-on. Having a well-informed patient, who understood the aim of ONS, was viewed as important for achieving patient compliance. Several dietitians pointed out that communicating a detailed prescription beyond the amount, including time-frame and serving instructions such as '*drink half the bottle in the afternoon and half the bottle before you go to bed*' (D2, hospital) achieved better results than if it was left up to the patients to experiment for themselves. Another strategy for motivating ONS intake was to talk about ONS as medications to make patients take the prescription more seriously and improve compliance.

> It feels as if our prescriptions aren't taken seriously. But then, if you say that this is like a medicine for you …, then I feel that they might take it a bit more seriously
>
> (D3, primary healthcare)

When the dietitians shared their experiences of price subvention, delivery of the products and patient's dependency on the social system, a picture of the Swedish welfare system and its impact on ONS use appeared. Constantly navigating within this system, the dietitians described an active role in facilitating ONS use that often reached beyond the individual patient encounter. Price was perceived as central to patients and, as long as they accepted that the taste and the price was low, a great number of patients were described as finding an ONS prescription as being convenient. By contrast, dietitians perceived that, when patients were in a bad economic situation or if there was an increase in the payment fee, then patients were reluctant to comply with the ONS prescription. The solution could be having no prescription at all or prescribing a lower amount than what was optimal. Some dietitians also described being tempted to bypass the payment rules (e.g., by not increasing the fee even though they should).

> I think it's a bit hard to have that power because it plays on our conscience when someone can't afford it. Then it's a question of conscience – should I help you or not, even though I'm not allowed to
>
> (D5, hospital)

Dietitians expressed that home-delivery of ONS was common and superior to having patients pick it up at the healthcare unit or at a pharmacy. The interviews reflected that dietitians had to be very involved regarding the delivery of ONS because this was a prerequisite for patients to drink it in the end. Even if the system of delivery was set by the region, dietitians could

facilitate for patients; for example, by choosing home-delivery instead of self-pickup, even though it was more expensive for the hospital or by letting patients call them if they could not manage to order a refill delivery by themselves.

> For those who suffer from the most severe dementia, I have put in a notification in my calendar to order a delivery every month because it's no idea to even let them try. Then, I do it for them because then I know they'll drink it
>
> (D13, primary healthcare)

Treating patients with ONS who were dependent on others (e.g., frail elderly with dementia or people with function disabilities) was described by one dietitian as '*inducing an extra element of non-compliance*' (D12, hospital). Those situations meant that the dietitians had to inform and motivate home-care staff, personal assistants and family members to encourage them to serve ONS according to the prescription. In several interviews, the dietitians mentioned that the success of the ONS intake was often on the individuals surrounding the patient and how motivated they are when it comes to nutrition.

DISCUSSION

Shared tailoring and provision of support to facilitate ONS use are two important aspects when the interviewed dietitians prescribe ONS. The dietitians described having a very flexible approach towards the ONS prescription content, emphasising the importance of patient involvement. A patient-led and humanistic approach has previously been shown to be appreciated and perceived as helpful by patients in dietetic consultations.[30,31] Individualising care, according to the patients' needs and desires, as well as redistributing power to the patient, have been identified as important parts of a patient-centred care approach within dietetics.[32] One strategy for redistributing power to the patient, an ideal emphasised by the dietitians in this study, is to implement shared decision-making. In 1997, Charles *et al.*[28] presented four characteristics of shared decision-making, namely that (i) it involves two parties, the healthcare professional and the patient, and (ii) both parties take steps to participate in the decision-making process for the patient's care and treatment. Furthermore, shared decision-making implies that (iii) both parties share information [e.g., about treatment alternatives (healthcare professional) and illness narratives and values (patient)]. Finally, (iv) a decision is made, following both parties' involvement and agreement.[28] All these four steps were mentioned by the dietitians as important parts of the ONS prescription process. The 'at least two-party prerequisite' (i) and 'that both parties should take steps to participate in the treatment decision' (ii) are clearly evident in the descriptions of the tailoring process. Moreover, the dietitians described how they shared information about alternative treatments when ONS was not an option and that patients shared views on the ONS acceptance and preferences for

treatment alternatives (iii). Finally, a shared decision is made about prescribing ONS where ideally the patient is involved in selecting flavours/products and amount prescribed (iv).

This process of shared tailoring of the prescription and the highly individual preferences, as described by the dietitians, strengthens previous research on the value of having a wide ONS product selection from which to choose.[9] Nonetheless, even if a person-centred care approach is desirable, this shared tailoring process might result in a prescribed amount that is lower than what is suggested as clinically beneficial such as at least 30 kcal day^{-1} [2,3] or 600 kcal day^{-1}.[9] However, the dietitians expressed that they compensated for too low prescription amounts by, for example, intensifying their emphasis on food-based strategies. Similar to these results, in a literature review on nutritional interventions in older adults at risk of malnutrition, dietitian-combined nutritional counselling with ONS was most effective followed by dietitian-delivered nutritional counselling alone and, lastly, ONS alone.[33]

Both result categories identified in this present study are closely connected to the discussion on compliance or adherence to ONS and contribute by presenting strategies perceived by dietitians as supportive for patients' ONS use. As previously identified, both patients and dietitians found that counselling and support, beyond education, were important for improving adherence to the nutrition therapy.[34,35] In the continuing discussion, we acknowledge the challenge faced by patients in initiating and continuing to drink ONS as a behaviour change problem. Thus, our findings will be discussed in relation to the Behaviour Change Wheel (BCW), which is a framework for characterising behaviour change interventions.[29,36] In Figure 1, we have added our study findings to the BCW framework and present examples of strategies used by the dietitians to support the behaviour 'to drink ONS'. In the red circle of the wheel, nine intervention functions are presented suggesting that the dietetic strategies can be understood as affecting patient *capability*, *opportunity* and/or *motivation*, which enable behaviour change.[29] Several strategies mentioned by the dietitians, such as referring to ONS as medicines and the benefit of using ready-made ONS instead of powdered ones, have been identified before.[37,38] By use of the lens of the BCW framework, we obtain a deeper understanding of why those strategies might enable behaviour change. The outer grey circle of the wheel comprises seven policy categories, which are actions implemented by authorities that support behaviour change.[29] Policy categories often support the delivery of several intervention functions[36] and examples are shown in Figure 1. In the interviews, at least two of the policy categories were described as affecting patient's usage of ONS, namely *fiscal measures* and *service provision*. It is evident that the price subvention, as an effect of the Swedish tax system, was perceived as essential for the ONS therapy. The dietitians mostly described subvention as a facilitator for ONS usage; however, they stated that some patients still found the products to be too expensive. In line with those results, the cost of ONS has previously been identified as a barrier to using this treatment strategy
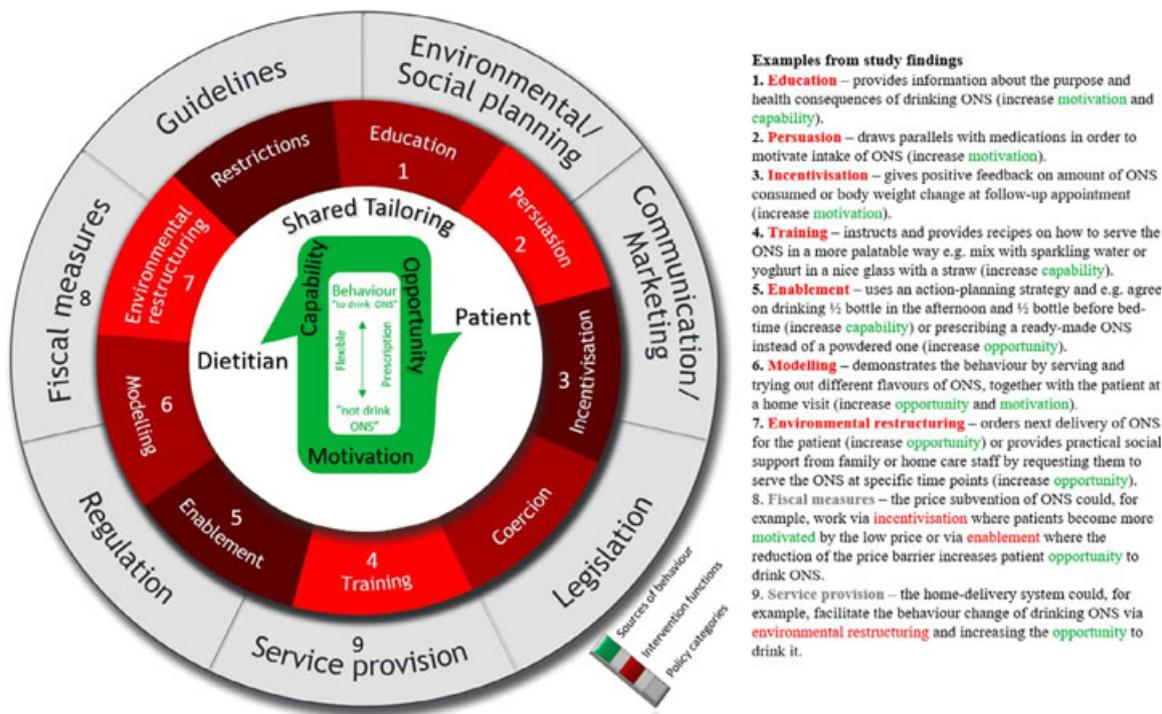
Examples from study findings

1. **Education** – provides information about the purpose and health consequences of drinking ONS (increase motivation and capability).
2. **Persuasion** – draws parallels with medications in order to motivate intake of ONS (increase motivation).
3. **Incentivisation** – gives positive feedback on amount of ONS consumed or body weight change at follow-up appointment (increase motivation).
4. **Training** – instructs and provides recipes on how to serve the ONS in a more palatable way e.g. mix with sparkling water or yoghurt in a nice glass with a straw (increase capability).
5. **Enablement** – uses an action-planning strategy and e.g. agree on drinking ½ bottle in the afternoon and ½ bottle before bed-time (increase capability) or prescribing a ready-made ONS instead of a powdered one (increase opportunity).
6. **Modelling** – demonstrates the behaviour by serving and trying out different flavours of ONS, together with the patient at a home visit (increase opportunity and motivation).
7. **Environmental restructuring** – orders next delivery of ONS for the patient (increase opportunity) or provides practical social support from family or home care staff by requesting them to serve the ONS at specific time points (increase opportunity).
8. **Fiscal measures** – the price subvention of ONS could, for example, work via incentivisation where patients become more motivated by the low price or via enablement where the reduction of the price barrier increases patient opportunity to drink ONS.
9. **Service provision** – the home-delivery system could, for example, facilitate the behaviour change of drinking ONS via environmental restructuring and increasing the opportunity to drink it.

FIGURE 1 Implementing the study findings of dietitians' experiences of prescribing Oral Nutritional Supplements (ONS) with the Behaviour Change Wheel (BCW). Including the patient and the dietitian in the core of the wheel, together with the term 'shared tailoring', reflects the importance of a shared decision-making process in tailoring and prescribing ONS (or not). The original BCW figure was published by Michie *et al.*[29] and is adapted with permission (licenced under CC BY 2.0). Modifications made: in the green hub of the wheel, we removed the different types of Capability (i.e., Psychological and Physical), Motivation (i.e., Automatic and Reflective) and Opportunity (i.e., Social and Physical) and added the patient, the dietitian, the shared tailoring term and the behaviour in focus for change. Furthermore, we have added numbers 1–9 on the Intervention functions and Policy categories, which are also represented by examples found in the study findings

for malnutrition[39] and the generous subvention in Sweden probably widely affects how often ONS is prescribed as part of the nutrition therapy. Accordingly, the *service provision* of home delivery of ONS was identified by the dietitians as facilitating ONS usage. Some dietitians described how they impacted the extent of those policy categories; for example, choosing home-delivery instead of self-pickup. The remaining policy categories (*communication/marketing*, *guidelines*, *regulation*, *legislation* and *environmental/social planning*) and non-exemplified intervention functions (*restriction* and *coercion*) were not discussed during the interviews but might be of relevance. The use of a data-driven approach rather than a deductive one[21] can serve as an explanation as to why not all parts of the BCW model were represented in the data.

A potential consequence of all efforts made by the dietitians when prescribing ONS might mean that a lot of time is spent on this task and that it is a high administration burden. From this point of view, having prescriber rights might serve as a drawback, leading to reduced amount of patient consultations and expanded waiting lists. However, when quantifying time spent by a small sample of renal dietitians in the USA, a limited amount of time was spent on ONS protocols.[40] This area is still unexplored and needs to be studied further.

Taken together, our findings identify the role of dietitians as a behaviour change facilitator and the importance of patient involvement as two important parts when providing an ONS prescription. Studies have identified the dietetic professional as a solution to the challenging task of prescribing ONS,[12,14] and this present study exemplifies dietitians' views on how to prescribe ONS successfully. From their perspectives, the ONS prescription in clinical practice is deeply intertwined with and flexibly adjusted, according to the patients' preferences and overall food intake. Those results show that the ONS prescription is seen as one part of a nutritional intervention, delivered from a person-centred care approach. This includes a combination of different components (e.g., tailored ONS prescription, food-based strategies and behaviour change strategies) and these are based on a thorough nutritional assessment and are monitored thereafter. Accordingly, we suggest that this dietitian-led nutrition therapy should be considered as a more complex process than just to provide ONS bottles 'as pills' to patients. However, in clinical trials, fixed amounts of prescribed ONS are often used,[7,41,42,43] and limited focus is placed on describing the components of ONS interventions,[10,18] indicating a potential underestimation of the complexity of delivering a successful ONS therapy. Although it is not possible to conclude from the present study that dietitian-led prescribing improves patient outcomes, those results can provide a deeper understanding of the prescribing process when performed by a nutrition professional and hopefully inspire prescribers in clinical practice and future research on this topic. When designing upcoming clinical trials with ONS, the intervention

needs to be carefully deliberated and described beyond the ONS products prescribed (e.g., brand name of ONS administered) into the procedure of prescribing (e.g., activities, processes, mode of delivery) and we suggest that the BCW framework is a helpful tool in this work.[29]

Strengths and limitations

All four investigators were involved in the analysis process, identifying patterns and categories that enhance the credibility of the study.[21] Performing the interviews face-to-face strengthens the findings because the dimension of communication through body language becomes included. Nevertheless, no triangulation of the data sources was made, and the inclusion of the patient perspective would have increased the validity.[44] For example, a discrepancy has previously been identified between dietitians' and older patients' views on harmful effects of malnutrition.[38] In the present study, we have described a dietitian-expressed ideal of patient involvement. However, we lack confirmation from patient experiences, which we consider as vital for fully understanding aspects of person-centred care and shared decision-making. By contrast to the dietitians' statements in our study, the level of patient involvement in the diet-related decision-making was quite low in a previous study on patient-dietitian conversations,[45] which further highlights the limitation of the missing patient perspective. Accordingly, an interviewer-effect must be considered, as well as the potential influence of having a dietitian, in her research-role, interviewing another dietitian about professional practice. This can affect what is revealed, and one risk is that the norm of prescribing ONS 'appropriately' might have been exaggerated. Interviewees are inclined to direct the interviewer's attention towards what they think he or she will understand instead of, for example, the complexity of their experience.[46] The Swedish welfare system and having the dietitian as the main professional prescribing ONS are context features that must be considered as affecting the transferability of the findings. However, including dietitians from different settings and backgrounds with a broad range of experiences of prescribing ONS makes the findings more transferable compared to when the interviewees, for example, are recruited from one clinical setting.

CONCLUSIONS

In the present study, providing a prescription of ONS can be understood as a sophisticated dietetic professional process, signified by shared tailoring and provision of support. The concept of shared decision-making together with behaviour change theory can help to explain the dietetic ONS prescribing process. The findings of our study allow for dietitians' ideals and strategies on how to prescribe ONS to be made more visible, which can inform both clinical practice and

clinical trials for future improvements in nutrition therapy aiming to address malnutrition.

CONFLICT OF INTERESTS
The authors have no conflicts of interest.

AUTHOR CONTRIBUTIONS
All authors actively contributed to the conceptualisation and design of the study and the analysis of data. ELi conducted the interviews and took a leading role in performing the analysis and drafting the manuscript. All authors were involved in reviewing the draft manuscript and approved the final submitted for publication.

TRANSPARENCY DECLARATION
The lead author affirms that this manuscript is an honest, accurate and transparent account of the study being reported. The reporting of this work is compliant with COREQ guidelines. The lead author affirms that no important aspects of the study have been omitted and that any discrepancies from the study as planned have been explained.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.