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# Self-completed online dietary recalls as an alternative method of dietary assessment for dietetic outpatient appointments: A feasibility study

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British Dietetic Association

## Abstract

**Background:** Integrating digital dietary assessment within dietetic care could save time and reduce costs, at the same time as increasing patient engagement. The present study explores the feasibility of implementing a web-based dietary assessment tool, myfood24 (<https://www.myfood24.org>), into routine healthcare.

**Methods:** This mixed methods feasibility study recruited dietitians and patients from a National Health Service (NHS) hospital outpatient setting. Patients completed and shared three online 24-h dietary recalls in advance, which were used as a dietary assessment by dietitians. Recruitment data were collected and questionnaires on technology, usability, and acceptability were completed. Patient interviews and focus groups with dietitians were conducted.

**Results:** Eleven dietitians working in allergy, bariatrics, diabetes, oncology, general, renal, infectious diseases, and coeliac services took part with 39 patients. Recruitment rates were highest in bariatrics and lowest in renal and oncology.

Compared to other studies, completion rates were good, with 29 (74.4%) completing three recalls despite lower technology readiness and software usability scores than in similar studies. Illness and difficulty with technology were reasons for non-completion. Opportunity to receive nutritional feedback from the tool and share this with a dietitian motivated patients to complete the record accurately. Consultation times were shortened in approximately one-third of appointments and a higher proportion of time was spent on nutritional education compared to usual practice. However, mean preparation time increased by 13 min per appointment because dietitians found nutritional analysis reports difficult to interpret.

**Conclusions:** It is feasible to introduce a digital dietary assessment tool into NHS dietetic practice. However, further development is needed to ensure that the tool is suitable for healthcare.

## KEYWORDS

technology, dietary assessment, dietetics, digital health

## Key points

- This is likely to be the first study in the UK investigating the use of digital dietary assessment in clinical dietetic practice.
- Seven different clinical specialities were included. Recruitment rates were highest in bariatrics and lowest in oncology and renal where ill health was given as a main reason for non-participation.

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- Non-completers had low technology readiness scores, which may suggest this tool could be used to identify individuals who may need more technological support.
- Dietitians reported that clinic preparation time took longer than usual care, but time was saved in one-third of consultations and more time was available for patient education.
- The intervention was moderately acceptable to patients and dietitians, although tailoring the software to clinical care and the availability of an app would likely improve this further.

## INTRODUCTION

Dietary assessment is an essential element of the nutrition care process in dietetic clinical practice.<sup>1</sup> Established assessment methods such as 24-h dietary recalls and paper food diaries require time and skills for both healthcare professionals (HCP) and patients and yet may be inaccurate because of under-reporting, misinterpretation, or daily variations in intake.<sup>2</sup> In epidemiological research, digital dietary assessment tools have been shown to improve completion rates, increase the accuracy of estimated nutritional intakes,<sup>3–5</sup> and reduce costs.<sup>6–8</sup> The number of tools available is growing and best practice guidance on their development has become necessary.<sup>9</sup> They have become more popular with the general public<sup>10–12</sup> and have begun to be used in healthcare.<sup>13</sup> They have the potential to benefit practice by providing valid estimates of nutritional intake in advance of a consultation,<sup>14,15</sup> thereby saving clinician time.<sup>13,16–18</sup> They enable remote appointments and monitoring, reducing hospital visits and associated treatment costs.<sup>12,13</sup> They also provide instant feedback to individuals on their dietary intake, thus improving self-management skills, treatment satisfaction, and quality of life, which are associated with improved clinical outcomes.<sup>13,16,17</sup>

Despite evidence of these benefits in dietetic care,<sup>12</sup> digital tools are yet to become integrated into practice<sup>18,19</sup> and change is slow, leading to warnings that the UK dietetic profession could be left behind in the move to digital technologies.<sup>20</sup> Future Dietitian 2025 calls for support for UK dietitians to address this by expanding the evidence base.<sup>21</sup> To the best of our knowledge, there are no UK studies exploring the use of digital dietary assessment in the NHS and therefore studies are urgently needed.

The present study aims to explore the feasibility of adopting a digital dietary assessment tool, myfood24 (<https://www.myfood24.org>), into routine dietetic practice. The study seeks to investigate its use with a diverse dietetic outpatient clinical population and consider recruitment and retention, intervention delivery, and patient and practitioner views about usability and acceptability in this setting, aiming to inform further research and development in this area.

## METHODS

### Digital dietary assessment tool

The assessment tool myfood24 was chosen for use in the present study. A consortium of UK academics, including nutritional epidemiologists and dietitians, funded by the Medical Research Council, iteratively developed<sup>8</sup> and validated<sup>22,23</sup> the tool. The design characteristics of myfood24 in comparison to other tools are well documented.<sup>9,24</sup> Characteristics of potential clinical benefits include a food database that uniquely provides micronutrient values for 40,000 foods and automatic data sharing between the user and provider.<sup>12,19</sup> One of the investigators (CG) had previous knowledge of the tool and has collaborated with the developers previously. Its main shortcomings at the time of the present study were that it was not yet optimised for a healthcare setting and access was via a website.

The tool is used by patients and dietitians. Patients complete a 24-h food record by searching for their food items from a database of generic and branded foods and various portion size guides can assist with portion estimation. Once the full day is completed and submitted, the website provides the patient with a report of the nutritional analysis of their dietary intake in the form of charts and tables. In addition to data on macronutrients, other nutrients of interest can be selected. Dietitians log on to myfood24 to view their list of patients and select an individual. They then have access to different reports relating to that patient's submitted food records. This includes similar feedback reports to the one that the patient receives, which they can use as an educational tool in consultations to discuss findings and trends. Additionally, they can access detailed nutritional analysis of every food item consumed for around 100 nutrients. This takes the form of spreadsheets, which the dietitians can manipulate to reduce the volume of data and tailor to each individual patient.

### Setting

This feasibility study took place in the Dietetic Department of a large teaching hospital in the United Kingdom.

Two of the investigators (CG and CT) were employed in this setting as registered dietitians; however, they had no prior relationship or clinical responsibility for the patients recruited for the study.

## Participants

Eligible participants were dietitians providing outpatient care and their patients. Patients were eligible if they were aged over 18 years, could read and understand English, had an email address and access to the Internet, and were due to attend a dietetic out-patient appointment (OPA) within the study period.

## Recruitment

CG and CT promoted the study to dietitians through team meetings, and eligible dietitians were invited to take part by letter.

Patients were initially screened from dietetic out-patient referrals and clinic lists and eligible patients were contacted and invited to take part. If they expressed

interest and their OPA was within the study period they were then contacted to make further eligibility checks to make sure they had online access (Figure 1). CG and CT contacted potential participants to answer questions and book consent appointments. The aim was to recruit a diverse population, representative of the clinic population.

## Intervention

At the consent appointment, patients received brief training of the myfood24 system from CG or CT and supporting information was provided. Patient participants were asked to record their dietary intake as accurately as possible using myfood24 for at least 3 days, including week and weekend days to represent their usual food intake, as well as to submit these at least 1 week before their appointment. They were encouraged to view their reports prior to their OPA to generate questions for the dietitian. Dietitians were given brief training and information on how to use the website. They were asked to review the nutritional data of participants prior to their appointments, and to use this in place of

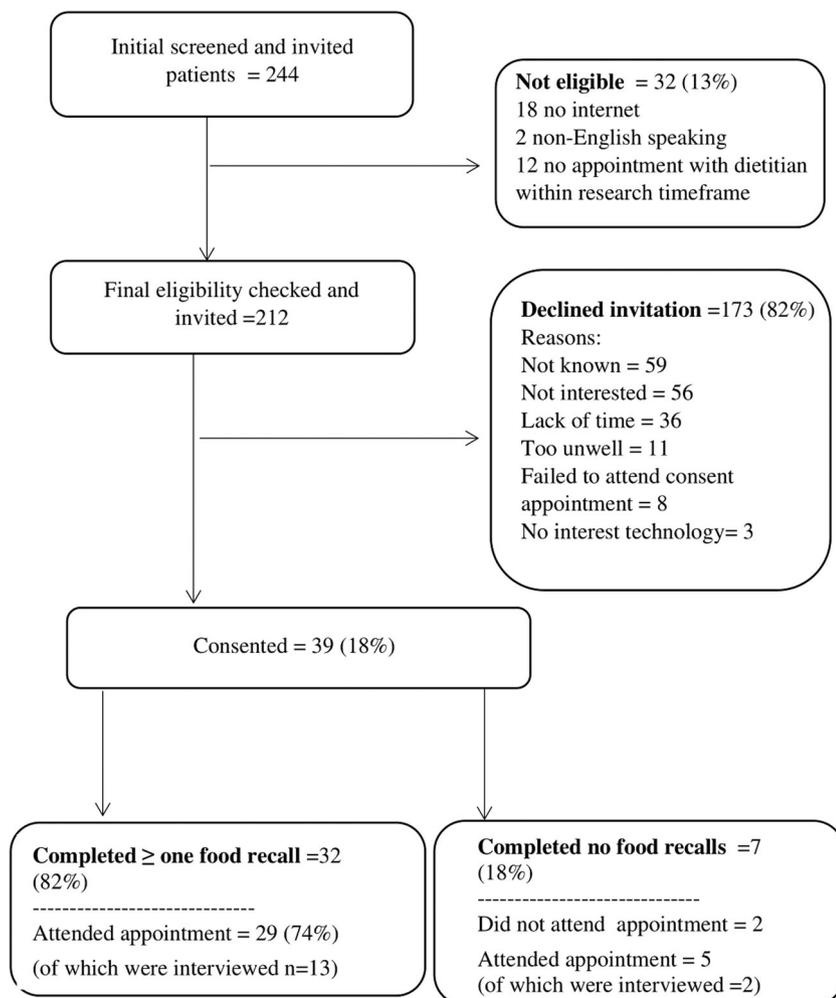


FIGURE 1 Patient recruitment flowchart

their usual dietary assessment method. Otherwise, consultations took place as usual.

## Data collection

A screening and recruitment log was kept throughout. Dietitians and patient participants attended a consent appointment where, following consent, demographic and technology use data were collected. Patients also self-completed additional questionnaires. Two validated questionnaires were chosen: (1) The Technology Readiness Index (TRI),<sup>25</sup> which assesses people's readiness to use new technologies in their lives and (2) The Patient Activation Measure (PAM<sup>®</sup>),<sup>26</sup> which measures people's knowledge, skills and confidence in managing their health. These were chosen to provide additional descriptive data about the study population.

At the end of the appointment, patients were provided with the remainder of the study questionnaires, along with instructions on when to complete these and stamped addressed return envelopes. These included a system usability scale (SUS), a validated usability questionnaire assessing ease of use of the website,<sup>27–29</sup> which was completed after doing the three online food recalls, and a bespoke acceptability questionnaire based on a theoretical framework of acceptability,<sup>30</sup> which was completed after their dietetic appointment (see Supporting information, Doc. S1). Both were returned by post or email.

Dietitians completed a questionnaire at the end of each consultation, which sought to compare the consultation with usual care including its duration and content. At the end of the study, they completed an adaptation of the patient acceptability questionnaire (see Supporting information, Doc. S1).<sup>30</sup> Both were returned via the hospital's internal post system.

All participating dietitians were invited to take part in focus groups to explore their views following the completion of all their patient consultations. Topics discussed included views on using the website to review patient data, experiences of using the tool in consultations, and ideas for further development of the tool. Three focus groups took place each lasting between one and two hours. They were audio-recorded with consent.

Patient participants were invited to take part in a semi-structured telephone interview at a time of their choice, aiming to explore their experience and views about using the tool. Patients were selected for interview using purposive sampling across a range of relevant characteristics, including age, gender, clinical condition, ethnicity, socio-economic status, and TRI score, also ensuring the inclusion of patients who failed to complete any recalls (non-completers). Because of time constraints, recruitment ended before it was possible to confirm that data saturation was reached. Interviews were conducted by CG and covered topics including views on accessing and using the website, ease of

understanding the reports, experience of the consultation, and suggestions for further development of the tool. Interviews lasted approximately 30 min and were audio-recorded with consent.

This was a pragmatic applied piece of health service research and focus group, and interview questions were developed to explore salient issues relating to the application of the tool. Topic guides were developed and used as aide memoires with opportunity for wider discussion around topics of interest to the dietitians and patient participants. The topic guides used for the focus groups (see Supporting information, Doc. S2) and interviews (see Supporting information, Doc. S3) are available.

## Data analysis: statistical and qualitative analysis

Descriptive statistics were calculated as the mean  $\pm$  SD or median and interquartile ranges (IQR) for continuous data and frequency and percentages for categorical data. Further analysis of demographics and technology readiness examined variables that contributed to recruitment. Comparisons were made using a chi-squared test for categorical data and an independent *t* test for continuous data. For all inferential statistics,  $p < 0.05$  (two-sided) was considered statistically significant.

Interviews and focus groups recordings were transcribed and anonymised. Coding frames were developed based on focus group and interview topic guides (see Supporting information, Docs S2 and S3). Three interview (20%) and one focus group transcript were read and coded independently by CG and LC to check consistency to refine the coding frame. Discrepancies were resolved through discussion before CG coded the remaining transcripts. Codes were grouped into themes relating to the research aims.

## RESULTS

### Characteristics of participants

Eleven dietitians, from the eight clinical areas shown in Table 1, consented to the study. Their characteristics are described in Table 2. Agenda for Change (AfC) banding ranged from 5 to 7 and their years of experience working as a dietitian ranged from 1.25 to 25 years (median 4 years).

Figure 1 shows the flow of patient recruitment through the study. Thirty-nine patients (21%) volunteered to participate, and their details are provided in Table 1. They ranged in age from 18 to 84 years, 56.4% were female, 92.3% were white, and 46% were of low socio-economic status (based on index of multiple deprivation). Their demographic characteristics were compared with the characteristics of those who declined to participate. No statistically significant differences were found. Recruitment rates were highest in bariatrics and

TABLE 1 Characteristics of patients who consented and declined

Patient characteristic	Consented, <i>n</i> = 39 <i>n</i> (%)	Declined, <i>n</i> = 173 <i>n</i> (%)	<i>p</i> value*
<b>Age (years), range, mean (SD)</b>	18–84 47.9 (17.8)	18–89 52.1 (18.7)	0.29
<25	3 (8)	14 (8)	
25–65	30 (77)	108 (62)	
>65	6 (15)	51 (30)	
<b>Female</b>	22 (56.4)	97 (56.1)	0.97
<b>Ethnicity</b>			0.16
White	36 (92.3)	137 (79.2)	
Asian	1 (2.6)	18 (10.4)	
Black	1 (2.6)	3 (1.7)	
Other	1 (2.6)	7 (4.0)	
Unknown	0 (0)	8 (4.6)	
<b>Socio-economic status (IMD), mean</b>	4.87	4.3	0.31
Low (1–3)	18 (46)	90 (52)	
Medium (4–7)	12 (31)	46 (27)	
High (8–10)	9 (23)	37 (21)	
<b>Clinical area</b>			NA
General outpatients	15 (38.5)	63 (36.4)	
Coeliac	7 (17.9)	35 (20.2)	
Renal	2 (5.1)	21 (12.1)	
Diabetes	5 (12.8)	24 (13.9)	
Bariatrics	6 (15.4)	14 (8.1)	
Infectious diseases	1 (2.6)	4 (2.3)	
Allergy	3 (7.7)	1 (0.5)	
Oncology	0 (0.0)	11 (6.4)	
<b>Access to Internet at home</b>	39 (100)	–	–
<b>Access to Internet via:</b>		–	–
Smartphone	34 (87.1)		
Home computer	34 (87.1)		
Tablet	22 (56.4)		
<b>Technology Readiness Index (TRI) score: median (IQR)</b>	3.1 (2.6–3.5)	–	–
<b>Experience of food diaries</b>	27 (69.2)	–	–
Of which electronic	19 (48.7)		

TABLE 1 (Continued)

Patient characteristic	Consented, <i>n</i> = 39 <i>n</i> (%)	Declined, <i>n</i> = 173 <i>n</i> (%)	<i>p</i> value*
<b>Previous dietetic appointments</b>	22 (56.4)	–	–
<b>Baseline PAM level (median, IQR)</b>	3 (IQR = 3–4)	–	–

Note: IMD where 1 is least deprived.

Abbreviations: IMD, index of multiple deprivation; IQR, interquartile range; PAM, patient activation measure.

\*Where  $p < 0.05$  is considered significantly different.

TABLE 2 Characteristics of dietitian participants ( $n = 11$ )

Characteristic	<i>n</i> (%)
Female, <i>n</i> (%)	9 (81.8%)
<b>AfC grading band</b>	
5	2 (18%)
6	5 (45%)
7	4 (36%)
	<b>Years (median, range)</b>
Since qualification	4 (1.25–25)
In current role	2 (0.1–10.8)

Abbreviation: AfC, Agenda for Change.

lowest in renal and oncology. Illness was the most common reason for non-participation in these areas. Further details of the patient recruits including baseline questionnaire scores are also shown in Table 1.

## Intervention

### Usability of myfood24 software for recording dietary recalls prior to OPA

Table 3 provides details of patient completion rates and usability scores for myfood24 dietary recalls. Twenty-nine (74.4%) patients completed at least three 24-h recalls as requested. Seven (17.9%) completed no recall as a result of technology issues or health issues. It was not possible to assess for statistical differences between completers and non-completers because of the low numbers involved; however, non-completers had lower TRI scores.

The mean usability score of the myfood24 software for patients was 67.5 (95% confidence interval = 58.9–76.1). Scores of 60–69 are categorised as marginally acceptable.

The majority of patients completed the recalls using a computer. The estimated time to complete one recall ranged from 21 to 30 min.

TABLE 3 Patient usage and usability of myfood24

	<i>n</i> (%)
<b>Number of food recalls completed per patient</b>	
0	7 (17.9)
1–2	3 (7.7)
3	14 (35.9)
>3	15 (38.5)
<b>Reason for non-completion</b>	
Website issues	3
Psychological or physical health	3
Not known	1
<b>Estimated time taken to complete one recall (range)</b>	21–30 min
<b>Device used to complete dietary recall</b>	
Home computer	17 (53)
Smartphone	6 (19)
Tablet	4 (13)
Other	1 (3)
<b>System usability scale (SUS)</b>	
<b>Returned questionnaire</b>	29 (91)
<b>SUS score mean, 95% CI</b>	67.5 (58.9–76.1)

Abbreviations: CI, confidence interval; SUS, system usability scale.

## Usability of myfood24 software as an alternative method for dietary assessment

Table 4 provides responses to the consultation experience questionnaire, completed by dietitians after every appointment. Not all respondents answered all the questions. The median time it took to review patient data prior to each appointment was 15 min compared to an estimated median time of 2 min for usual care.

The majority of dietitians perceived the tool to provide an accurate assessment of type, amount, and meal pattern. Around one-third of consultations were of shorter duration than usual, by an average of 13 min. In half of the appointments, the proportion of time spent on assessment reduced and more time was spent on education.

## Acceptability of the intervention

The acceptability questionnaire completed by both patients and dietitians was used to assess the perceived acceptability of the whole intervention. A maximum score of 50 indicates high acceptability. Median acceptability score for dietitians was 31 (IQR = 30.5–35.5) ( $n = 11$ , 100% response rate) and for patients was 39 (IQR 32–42) ( $n = 26$ , 81% response rate). Further examination of the responses to each individual

question based on different constructs of acceptability<sup>30</sup> indicated that, compared to dietitians, the patients found the intervention less of a burden, a more effective use of time and a more positive and successful experience (see Supporting information, Doc. S1).

Further insight into the acceptability of the intervention for dietitians and patients comes from a range of data, including that already reported and findings from interviews and focus groups discussed later.

## INTERVIEWS AND FOCUS GROUPS

### Characteristics of participants

Twenty patients who attended an OPA were invited for interview and fifteen consented to take part. Two had not completed any recalls using myfood24. All clinical areas were represented and no differences in demographic characteristics or acceptability scores of those interviewed were found compared to the whole study population; however, their mean SUS (74.0) was higher.

Ten dietitians attended one of the focus groups.

### Themes

Thematic analysis of interviews and focus groups relating to the acceptability and usability myfood24 in routine dietetic care identified the following themes: usability of software for clinical care, accuracy of assessment method, and consultation experience. The consultation experience includes the subthemes: preparation, use of website, time management, and relationships and engagement. Data from the patient semistructured interviews and dietitian focus groups are reported separately in relation to the first two themes; however, they have been integrated for the third theme, consultation experience, to show the interaction between the two groups of participants.

### Usability of software for clinical care

#### *Patient experience*

Both of the non-completers experienced difficulties in accessing their account or inputting data. Some completers also struggled because of software glitches. These problems led non-completers to feel worried and overwhelmed.

It won't accept any passwords or anything our computer. So, we've called it a day at the moment (Interview 1 non-completer)

The difficulty was you go into bread and there's so many breads. It was very confusing for me honestly (Interview 9 non-completer)

TABLE 4 Dietitians responses from consultation experience questionnaire ( $n = 29$ )

		<i>n</i> (%)	
Dietitian reviewed patient data		26 (90%)	
Estimated time taken to review data		Median = 15 min (Range 10–30 min)	
Dietitian agreed myfood24 provided accurate record of			
Type of food eaten		23 (79.3%)	
Amount of food eaten		23 (79.3%)	
Meal pattern		24 (82.8%)	
Which dietary assessment method would have been previously used?			
Typical day		20 (69%)	
24-h recall		9 (31%)	
Change in duration of consultation compared to usual: <i>n</i> (%) ( $n = 27$ )	<b>Took more time</b>	<b>Same</b>	<b>Took less time</b>
	3 (11%)	14 (52%)	10 (37%)
	Mean change +10 min		Mean change –13 min
Change in proportion of time spent on: ( $n = 27$ )	<b>Spent more time than usual</b>	<b>No change</b>	<b>Spent less time than usual</b>
Assessment <i>n</i> (%)	7 (27%)	5 (19%)	14 (54%)
Education <i>n</i> (%)	15 (58%)	5 (19%)	6 (23%)
Action planning <i>n</i> (%)	5 (19%)	16 (62%)	5 (19%)

Once logged on, inputting food intake digitally was viewed positively overall by completers, with just one person preferring a paper system. The website and functions received mixed feedback by patients and dietitians. Several dietitians noted the need for more world foods in the database.

Experience improved when instructions and tips were followed, and the website functions were used. Prior practice of recording food intake aided use. Completing recalls was found to be more difficult when cooking from scratch, eating away from home, or eating a wide variety of foods. Limited technology skills and lack of knowledge of food portion sizes also caused difficulties.

The web-based nature of the tool meant that patients could not record food in real time and the majority recorded at least some of their intake on paper and transferred it to the website. Over half said that this was a barrier to future use.

There isn't an app. You have to go to the website. Having it more accessible on the go, I'd probably use it a lot more rather than having to sit down at end of day and think back. Not everyone can sit down at a computer three times a day and input stuff (Interview 14)

Receiving the nutritional analysis reports and the opportunity to discuss their results with the dietitian were the main motivators to completion. Patients reported increased confidence and motivation, and feeling better informed, reassured, and more in control after looking at the analysis.

I've been extremely busy at work, but I have made time for this 'cos it has been very beneficial for me. It's helped me a lot because I can look at things in more detail' (Interview 3)

However, for some, the reports led to feelings of uncertainty around what they should be reviewing or eating and more individualised guidance on what was relevant to their clinical condition was requested.

So that much detail was unnecessary for diabetes. Maybe for some things it's important to get the full detail (Interview 8)

Preferences varied for the format of the nutritional analysis displays, so having a range of formats was appreciated. Improvements suggested by patients included being able to view their food intake and nutritional data together; to receive nutritional data in

real time rather than just on submission of a complete 24 h; and being able to individualise the fixed recommended nutrient intakes to their needs.

### *Dietitian experience*

Dietitians were unanimously negative about the nutritional analysis spreadsheets. They found the data was too detailed for their needs and took too much time to navigate, filter, and make meaningful, leaving little time to interpret it.

I found it time consuming in terms of, because of the spread sheet you get all the different nutrients, a lot of ones people haven't even heard of. I found that it is a lot of highlighting tabs and deleting out things that are irrelevant (Focus Group 2: 5)

They requested similar improvements to the reporting to the patient group. Further ideas included having specific reports for different clinical condition and expanding feedback for users to include, for example, top food contributors of different nutrients and suggested food swaps. Some felt that given the time and effort required, it would be easier to use the usual pen and paper method.

'used Carbs and Cals for portion estimation and still provided all that was required without the website and stress for the patient. I'm not sure in that time whether myfood24 would have given me any better information than that' (Focus Group 2: 4)

## Accuracy of assessment method

### *Patient experience*

Having the opportunity to receive tailored dietary advice was for some patients a motivation to provide an accurate food record.

I think that is what you need to stress to people, the more accurate the information you put in there, the more accurate the feedback will be. Then the person I was seeing could give me the best advice based on what I was eating. That's why I did it (Interview 12)

To achieve accuracy, patients felt recording in real time, either on paper or directly on to the website helped, as did website features including visual food portion size guides, handy measure descriptors, and missing item prompts. Only two people mentioned weighing their portions.

### *Dietitian experience*

Patients and dietitians felt more specialist dietary products were needed on the database and that guidance on making appropriate food substitutions was needed. Some felt unsure about the level of detail that needed to be recorded in the food log. For example, whether it was necessary for an individual to log fluids and low energy dense foods such as vegetables and spices.

... it doesn't have specialist gluten free products on there, which ultimately would be a massive issue in terms of assessing adherence ... Again, with gluten free it would be analysis of those specific products that are higher in calcium and things (Focus group 2:3)

Overall, dietitians felt the system was likely to provide a more accurate record of food intake than current practices for various reasons including more authentic food recalls and the software analysis.

Rather than coming to clinic and giving the perfect diet history and us saying 'oh that sounds alright' because that's all they have told you. I think she was maybe a bit more honest. I think maybe she felt like because it's a computer system, you are not being judged in the same way, so she just put it in' (Focus Group 1:1)

Dietitians felt it important to acknowledge that the data was merely a starting point and had limitations. Skill was required to assess for accuracy, relevance, and missing data.

We will do guesstimates of macronutrients from a diet history but you kind of know they are estimates. But when it comes out with a hard printed copy that says you've had this many calories, this much protein, this many milligrams of calcium, it feels more solid doesn't it? It's making sure you interpret it correctly, remembering the inaccuracies of the process' (Focus Group 2:6)

## The consultation experience

### *Preparation*

Preparation was found to be time consuming and, in future, dietitians would want time allocated for this. However, this was felt to be key to effective use of the data in the consultation. Less experienced dietitians found having this information in advance particularly helpful, although one felt this risked judging patients in advance of meeting them.

Even before I was going there, I was thinking this is going to be really tough. This is going to be really difficult, and I think that as a dietitian, it can make you a bit biased about how the consultation is going to go (Focus Group 2:8)

## Use of website

Dietitians and patients mostly reviewed the data together, either using the website (face-to-face and phone appointments) or reports that dietitians had generated. The visual displays were used as an educational tool and raised discussions on food swaps, portion sizes and sources of specific nutrients. Patients appreciated that the dietitian had reviewed and considered their data beforehand and could help to explain it.

Patients were dissatisfied when dietitians, mainly because of technical problems, did not review their data or share it in appointments.

## Time management

Dietitians experience on the impact of the tool on time management in the OPA was mixed.

Time was needed to discuss issues when things did not go to plan with the tool.

It made the consultation difficult because she was disappointed in herself that she hasn't been able to fill it in before she came so it was a negative impact to the consultation (Focus Group 2:6)

Having more tailored reports was requested by both groups, to help keep the focus and avoid taking up time discussing parts of the reports that were not relevant to the referral.

Dietitians found they became more efficient as they became familiar with the new process in appointments, and not doing a dietary assessment saved time for some.

Appointments were described by patients as time efficient, personalised and providing time for discussion and education. Some felt future appointments could be shorter or less often.

## Relationships

The impact on therapeutic relationships was positive. Dietitians sensed that patients felt more at ease, due in part to not being put 'on the spot' or having questions 'fired' at them. This was noticed particularly with people with chronic conditions.

They were able to take charge of their diet history as opposed to 'oh now I have to tell the dietitian right now everything that I have had to eat'. So, I think it made her feel more relaxed having done it from home before (Focus Group 1:1)

It also makes you think about what you've eaten before, so you aren't just sat there 'umming' and 'arrhing' when you are going through the interview part (Interview 8)

## Engagement

In addition to the tool being used for dietary assessment and education, it was also helpful for engaging people in self-care. Dietitians found this aspect a positive experience, which brought about a noticeable shift in self-management behaviours and motivation. Improvements in health literacy and ownership of the dietary assessment were more apparent because patients gave their views of the current situation and potential changes. Patients noted how they felt more confident to review their data at home after the consultation.

She was the one who said, 'oh I could have done with having more protein in my diet' and she could see that from the graph. It was like she had taken more ownership of it. Because she had figured it out before she had come, so the ball was in her court a little bit as well. That was good (Focus Group 1:1)

Patients acknowledged that they had not appreciated the benefits of this intervention beforehand and felt promoting these in advance to encourage its use as standard practice, not an additional extra, would be valuable.

## DISCUSSION

### Main findings

The present study demonstrates that, even after a brief trial of a digital dietary assessment tool in clinical practice, it is feasible to use it as an aid to clinical care. Dietitians and patients found this new type of care moderately acceptable, although patients found it a more positive experience and a better use of their time compared to the dietitians. Dietitians' experiences were affected largely by the unsuitability of the software for this setting. Patients and dietitians were positive about the new type of consultation, which showed the potential to improve quality of care and save time in some clinical situations.

## Strengths and limitations of the study

Recruitment rates of patients were lower than hoped as a result of under-recruiting in certain clinical areas. Consequently, this limited the experience for some dietitians.

The demographics of the study population were representative of the clinic population and were diverse in relation to age, sex, and socio-economic status, but not ethnicity. The PAM score of recruits suggested that they engaged in self-care and may not be typical of the whole clinic population. There was a low dropout rate for the intervention and questionnaire return rates were good. Interviewees were demographically diverse and included non-completers. However, post-interview analysis showed that interviewees had higher usability scores compared to the sample as a whole.

The mixed method study design and detailed screening and recruitment data led to a rich dataset, which contributed to achieving the research aim.

## Comparison with the existing literature

The present study sought to build on findings from previous myfood24 studies by using the assessment tool for the first time as part of the dietetic care process to assess its feasibility. To our knowledge, there are no UK studies that have examined the use of digital dietary assessment tools in clinical care, with most related research taking place in Australia<sup>12</sup>; however, there have been UK studies in non-clinical populations.<sup>8,31,32</sup>

A previous clinical study suggested that the way an intervention is introduced to patients is important for engagement.<sup>12</sup> In the present study, only 18% of the clinic population participated, which may indicate that our introduction needs further thought to engage a higher proportion of participants.

Previous myfood24 studies in non-clinical settings<sup>8,31,32</sup> have reported SUS scores of above 70 ('good'), which is higher than those found in the present study where usability was categorised as marginally acceptable. This suggests that patients did not find the myfood24 software as easy to understand and use compared to participants in non-clinical settings. There are a number of things that could have contributed to this. The TRI scores of our population were lower than reported elsewhere<sup>33</sup> and so could have had an impact. Where patient technology skills are lower, further support may be worthwhile<sup>33</sup> and TRI could potentially be used as a screening tool to identify where to target support. Common usability issues reported were similar to those identified in other digital dietary assessment studies, such as accessing the software, finding the right food on the database, or time concerns.<sup>9,32</sup> As with the present study, patients also felt that these issues impacted on the accuracy of their data input and data output.<sup>12</sup>

Completion rates for three food recalls were 74% in the present study, which was higher than the 39% reported in a previous study with a non-clinical population.<sup>32</sup> Chen *et al.*<sup>18</sup> suggest that motivation to use software is higher when it is introduced to HCP, there is good rapport between the patient and HCP, and there is the opportunity to share data and receive support from a trustworthy source. Our findings suggest that these factors may have contributed to the high completion rates in the present study.

An international survey of dietitians exploring their views of health apps highlighted a need for tools to be designed for a healthcare setting.<sup>34</sup> Low self-efficacy levels in using digital assessments were found to be another barrier to the use of digital tools by dietitians.<sup>19</sup> In the present study, more recently qualified dietitians reported more substantial concerns about using the software. Overall, most dietitians had few concerns about using it in clinics despite lack of practice. This could reflect the training and support that they received from the researchers and the fact that many were experienced dietitians.

As in other studies, even in this intervention of short duration and small numbers, patients and dietitians reported many positive aspects regarding this new approach in the consultation and the impact on therapeutic relationships and quality of care.<sup>13,35,36</sup> Our data supports findings elsewhere of the real potential for enhancing self-care through improving knowledge, problem-solving abilities, confidence, and motivation.<sup>13</sup>

## IMPLICATIONS FOR FUTURE CARE

This study has demonstrated that this tool was feasible to use and was acceptable as part of clinical care for patients and dietitians. The main concerns for use in future care are the lack of uptake by patients who could benefit, sufficient training and support provision to patients and dietitians, and the need to adapt the software for healthcare. The implication therefore is that this tool and others like it, do have a role in future dietetic care.

## Recommendations for future development

Future tools need to continue to improve usability to enable completion of food recalls with minimal support and to ensure that outputs are appropriate for healthcare, as well as supportive of care provision. Recommendations include providing nutritional analysis reports for patients and dietitians that meet individual and service needs, and also providing patient feedback in real time to aid food choice. Involving users in the design of tools is important for achieving this,<sup>19,36</sup> as is expert guidance on tool development.<sup>9</sup> Training for dietitians along with

advocacy from the British Dietetic Association is recommended to enable HCP to implement such technologies in practice.<sup>19</sup> Involving users in the development of promotional materials could also aid the uptake of interventions.

## Recommendations for future research

Once suitable tools for clinical use are available, studies should examine their impact on patient care further. The cost of developing high quality and effective technologies is high, which will generate upfront costs for the NHS. Their use, however is likely to be cost effective<sup>36</sup> and studies are required to explore this.

Questions remain regarding the practicalities of introducing these tools, such as when and how best to introduce them, who may and may not benefit, optimal number and frequency of recalls, and the impact of observer reporting rather than self-reporting via a carer or other HCP (e.g., a healthcare assistant).<sup>35,37</sup> Validity testing would need to be extended to include specific populations such as people with renal disease by, for example, using biomarkers.<sup>24</sup>

## CONCLUSIONS

To the best of our knowledge, this is the first study to explore the use of a digital dietary assessment tool in clinical practice in the UK and the study found that the use of myfood24, an online 24-h recall dietary tool, was feasible and acceptable for patients and dietitians. Digital dietary assessment tools potentially enable patients to become more autonomous decision makers through improved knowledge of their nutritional intake and this can improve quality of life and increase motivation to self-manage their health.<sup>38</sup> Potential benefits to dietetic care include more accurate dietary assessments, quick access to detailed nutritional analysis, and potential for shorter appointments with more time for patient education. Therefore, these findings are important to the future development of such tools for dietetic practice as recommended in the Future Dietitian 2025 report.<sup>21</sup> Limitations included the low uptake in certain clinical groups and in those with lower technology readiness, as well as the time it takes for patients to complete and for dietitians to review the data. Further software developments are needed prior to formal testing to examine the impact of this tool on treatment satisfaction, behaviour change, clinical outcomes, and cost effectiveness in a clinical setting.

## AUTHOR CONTRIBUTIONS

Carla Gianfrancesco designed and managed the study, undertook data collection, led on qualitative data analysis, and was the main author on the paper. Carolyn

Taylor was involved in setting up the study, recruitment, data collection, led on quantitative data analysis, and contributed to the paper. Liz Croot provided advice on the qualitative research study design, was involved in the analysis of the qualitative data, and contributed to the paper.

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## CONFLICTS OF INTEREST

Carla Gianfrancesco has served on an advisory panel for myfood24 as a Registered Dietitian and did not receive any financial payment for this. Carolyn Taylor and Liz Croot declare that they have no conflicts of interest.

## ETHICS STATEMENT

Ethical approval was granted by North West-Greater Manchester East REC 19/NW/0411.

## 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.

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## PEER REVIEW

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## SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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