Impact of a digitally enabled, time-restricted eating weight management program, the Roczen program, on eating behaviors, depression symptoms and health related quality of life

Siri Steinmo [a,b], Laura Falvey [a], Claudia Ashton [a], Ling Chow [a], Dipesh Patel [a,c,d], Jonathan Kwan [a,e], Barbara McGowan [a,f], Adrian Brown [a,g,h,i,*]

[a] *Reset Health Ltd London, UK*
[b] *Critical Care Department University College London NHS Hospital London, UK*
[c] *Diabetes and Endocrinology Department Royal Free NHS Trust London, UK*
[d] *Division of Medicine University College London London, UK*
[e] *Darent Valley Hospital Dartford Kent, UK*
[f] *Diabetes and Endocrinology Department Guys Hospital Guys & St Thomas's Hospital London, UK*
[g] *Centre for Obesity Research, University College London, London, UK*
[h] *Bariatric Centre for Weight Management and Metabolic Surgery, University College London Hospital NHS Trust, London, UK*
[i] *UCLH Biomedical Research Centre, National Institute of Health Research, London, UK*

ARTICLE INFO

ABSTRACT

Introduction: There is limited evidence around how weight management programs impact eating behavior and mental health in real-life settings. This retrospective service evaluation assessed the impact of a clinically-led, digitally delivered time-restricted eating intervention (TRE) (Roczen Program, Reset Health Ltd) on eating behavior, depression and health-related quality of life (HrQOL).
Methods: Patients were supported on a TRE plan with behavioral and social support from clinicians. Eating behaviors were assessed using Binge Eating Scale (BES) and Three Factor Eating Questionnaire-R18 (TFEQ). Depression symptoms were assessed using the Patient Health Questionniare-9 (PHQ-9) and HrQOL with the Euroquol-5 Dimension-5 Level (EQ-5D-5L-5L). Data were analysed at 12 and 24 weeks. Linear regressions explored predictors of eating behavior and weight loss, *p*-value <0.05, mean (SD) and median (IQR).
Results: 102 patients were included (mean age 51.1 ± 10.0 years; mean BMI 34.5 ± 5.0 kg/m^2; 57.8 % White Ethnicity; 72.5 % female). At 24 weeks, mean percentage weight loss was 11.0 % ± 6.1 ($p < 0.001$). There was a significant reduction in BES (-5.0 [2.0, 10.0]; $p < 0.001$). Uncontrolled eating and emotional eating improved by 0.76 ± 0.78 and 0.53 ± 0.95 points (both $p < 0.001$) respectively. Depression improved by 2.0 points and HrQOL by 0.04 (both p < 0.001). Higher baseline depression scores predicted higher emotional eating and BES scores. Higher restraint predicted lower percentage weight loss and was not associated with any other eating behaviors.
Conclusion: Our results show that the Roczen program engenders clinically significant weight loss and improves emotional eating, uncontrolled eating, BES, depression and HrQOL in those who are not already at high risk for eating disorder and can potentially be effective and safe.

1. Introduction

Overweight and obesity are significant global public health concerns, and currently healthcare systems demonstrate a limited capacity to offer lifestyle, psychological and pharmacological interventions to meet the demand (Ansari et al., 2020; Ells et al., 2020; WHO, 2024; Wolfenden et al., 2019). There is a well-established direct link between both depression (Luppino et al., 2010; Moussa et al., 2019; Rajan & Menon, 2017) and disordered eating with obesity. People living with obesity have a 55 % increased risk of developing depression, and people living

with depression have a 58 % increased risk of developing obesity (Luppino et al., 2010). It is recognised that there is a high prevalence of disordered eating in patients presenting for weight management intervention (Jebeile et al., 2023). However, there is limited evidence around how these programs may impact eating behavior, mental health or health-related quality of life (HrQOL) outcomes in a real-life setting and what support is needed (Marwood et al., 2023).

Binge Eating Disorder (BED), sub-clinical binge eating (BE) behavior and other disordered eating behaviors such as loss of control over food intake and emotional eating are prevalent among people living with overweight and obesity (Mason et al., 2022; Nagata et al., 2018; Nightingale & Cassin, 2019). BED, which is more common than anorexia and bulimia (Hay et al., 2015) is strongly associated with lifetime obesity (Adami et al., 1995; Da Luz, Hay, et al., 2018a; Da Luz, Sainsbury, et al., 2018b; Hudson et al., 2007) and reporting of binge episodes is common in people seeking weight loss interventions (Kessler et al., 2013; Mason et al., 2022; Nagata et al., 2018). BED, like all eating disorders (ED), is associated with negative affect and frequently co-occurs with other psychological disorders (Kessler et al., 2013; Pasquale et al., 2024; Stice et al., 2011).

Well-established theoretical models of eating disorder propose that restricting food intake to lose weight may promote the emergence of ED, sub-clinical disordered eating behavior and related cognitions (Fairburn et al., 2003; Neyland et al., 2020; Polivy & Herman, 1993; Stice et al., 1998, 2011). However, published evidence on the relationship between dietary restraint, inherent in dieting to lose weight, and disordered eating, has been inconsistent (Da Luz, Sainsbury, et al., 2018b; Wadden et al., 2004). Some data suggest disordered eating and ED risk may increase in people following restrictive diets (Duncan et al., 2017; Marwood et al., 2023; Mason et al., 2022; Stice et al., 2008), but this association is not fully supported throughout the literature, including two relevant systematic reviews concluding that behavioral weight management programs and high levels of dietary restriction with appropriate clinical support do not exacerbate disordered eating behaviors or increase risk (Da Luz, et al., 2015; Forrest & Grilo, 2022; Jebeile et al., 2023).

The Diagnostic and Statistical Manual of Mental Disorder DSM-5 highlights deliberately restricting food intake such as with fasting and skipping meals, uncontrolled eating such as with bingeing, and emotional distress in relation to food and/or using the control of food to cope with emotions as some of the primary eating behaviors associated with eating disorders (American Psychiatric Association, 2013). In non-clinical samples, maladaptive eating behaviors and cognitions, such as emotional eating and a loss of control, appear to share the same correlates of diagnosed ED, including depression, low self-esteem, body/shape/weight concerns, and maladaptive food-related cognitive patterns (Nightingale & Cassin, 2019). Hudson and colleagues' population study found that 79 % of respondents with BED met criteria for at least one comorbid psychiatric disorder as per the DSM-5 with over half reporting impairments to daily living (Hudson et al., 2007). Dietary restraint itself has also been associated with low mood, low self-esteem and negative body image (Schaumberg & Anderson, 2016; Stice et al., 2017). While weight loss may produce initial, short-term improvements to psychological wellbeing in people living with obesity, these are rarely sustained if weight is regained, which unfortunately is a common outcome (Da Luz, Sainsbury, et al., 2018b; McFarlane et al., 1999).

Although concerns have been raised that weight management programs may inadvertently promote restrictive or disordered eating behaviors, obesity management and prevention of eating pathology and psychological risk are not incompatible. There are clear differences between self-directed "dieting" to lose weight and behavioral weight loss intervention, on both weight loss efficacy and on eating disorder psychopathology (Balantekin & Hayes, 2024; Cardel et al., 2022).Evidence-based behavioral weight management interventions that are clinically supervised and designed to provide sustained person-centred support for behavior changes that improve overall health have the potential to positively impact eating behavior, internalised weight stigma, and mood alongside weight loss. Understanding the impact of these programs on mental health and eating pathology is crucial (Cardel et al., 2022; Jebeile et al., 2019; Leite et al., 2017; Webb & Wadden, 2017).

Recently, in response to the continued access issues for patients seeking effective weight management in the UK, the National Institute of Health and Care Excellence (NICE) conducted an early value assessment (EVA) of digitally delivered weight management programs, recommending in draft guidance several potentially cost-effective interventions for people living with obesity (Ansari et al., 2020; National Institute for Health and Care Excellence, 2022). Digital healthcare delivery forms an integral part of the National Health Service (NHS) Long-Term Plan (Kapur, 2020), however, there is little evidence around the impact of digital weight management interventions on eating behaviors, HrQOL and mental health.

Roczen (Reset Health Ltd) is a digitally-enabled, person-centred clinical program delivered by a multidisciplinary team (MDT) of healthcare professionals. (www.roczen.com). It is a multi-modal intervention designed for people living with obesity, T2D, and related complications. Roczen uses tools such as time-restricted eating (TRE), whole food, modified carbohydrate diets, peer-led social support, psychological support for eating behavior, patients' relationship to food and body image, and evidence-based behavior change techniques (Dicker et al., 2021; Gea Cabrera et al., 2021; Michie et al., 2009, 2013).

The Roczen Program has been designed by a multidisciplinary team (MDT) of specialists to help people living with obesity and/or Type 2 diabetes (T2D) and other complications to improve their health, quality of life and reduce associated disease risk.

All Roczen healthcare professionals (HCPs) working directly with patients are registered with the appropriate UK regulatory organisation. They are trained internally and supported to become Strategic Centre for Obesity Professional Education (SCOPE) - certified in obesity management. SCOPE certification is part of the World Obesity Federation and is an internationally recognised standard of obesity management expertise. Training includes teaching on recognising disordered eating DE behavior, interpreting validated questionnaires and in conducting DSM-5 clinical interviews to explore potential BE symptoms and related behaviors. A previous publication demonstrates that the program is effective for weight loss and other health improvements, however the intervention's effect on eating behavior or mood has not yet been evaluated (Brown et al., 2024).

A growing body of evidence supports the effectiveness of TRE for weight management and cardiometabolic health (Chen et al., 2023; Liu et al., 2022). TRE is a form of intermittent fasting involving restricting the times when food is consumed to a predetermined window within a 24-hour period, e.g., 16:8 (16 h fasting and 8 h eating) (Mattson et al., 2014). While some data suggests that TRE may improve mood (Aman, 2022; Steger et al., 2023), there is limited literature on its impact on disordered eating with some suggestion of increased risk (Ganson et al., 2022).

Therefore, the aim of this retrospective cross-sectional service evaluation was to explore the impact of Roczen, a digitally-delivered TRE weight management program on eating behaviors, HrQOL and depression at 24-week clinical review and the interrelationship between these factors and weight change in people living with obesity, overweight and T2D.

2. Method

2.1. Patient pathway

Patients initiated care via a self-referral and sign-up process, during which consent was given for the Roczen medical team to access their NHS Summary Care Records. If eligible, patients gained access to the Roczen Mobile App and the HCP was notified in the Roczen Clinic App.

Patients were provided with validated questionnaires to assess mental health, eating behaviors and HrQOL (referenced in methods) at baseline. Once a patient's eligibility was confirmed, their initial management plan was agreed with a Roczen clinician via video consultation. Though the timing of eating and fasting was tailored, patients were largely advised to eat two discrete meals and were discouraged from snacking. The most common TRE pattern was a fasting window of 16 h, followed by an eating window of 8 h. Alongside TRE, patients were supported in reducing their refined carbohydrate intake, concentrating on minimally processed, moderate protein meals. They were not encouraged to count or record calories or macronutrient intake. The program offers both clinical support and non-clinical peer-to-peer support wth mentoring via the Roczen Mobile App. Routine clinical review appointments occur at 4-week intervals and include a video consultation with a clinician and review of biometrics. HrQOL, mental health and eating behaviors are assessed formally at 12 weekly intervals, using validated questionnaires. Alongside the monthly video consultations, patients are able to contact the clinical team via an in-app messaging functionality for ongoing ad-hoc support. There is no defined end point to patients' episode of care, rather, patients can determine when they feel ready to discharge themselves from the service at their own discretion. Participation in the program is voluntary and funded either by the patient directly, or by their employer.

Roczen incorporates evidence-based behavior change techniques (BCTs), including goal setting,self-monitoring of health outcomes and feedback, motivational interviewing, educational written materials and social support and role modelling through the mentor-led peer support scheme (Cradock et al., 2017; Michie et al., 2009, 2013). These focus on engaging and empowering the patient in decisions that impact their health while highlighting the health consequences of chronic disease. Patient's received practical behavioral instruction on achieving realistic lifestyle changes, and the benefits of optimal obesity and diabetes management (Dicker et al., 2021; Gea Cabrera et al., 2021; Samdal et al., 2017). Content is personalised for other relevant conditions or considerations which may impact progress, such as shift work, dietary restrictions or menopause (See Supplementary Material A for a more detailed description of Roczen's Service Model).

2.2. Eligibility criteria

To be eligible, individuals had to be over 18 years old with minimum body mass index (BMI) criteria defining overweight (≥ 25 kg/m^2) related to ethnicity specific cut-offs (NICE) (≥ 22.5 kg/m^2). Further screening was carried out to ensure patients with exclusionary conditions such as type 1 diabetes, pregnancy, suicidal ideation, or medical conditions whereby the program would not be clinically appropriate, were not enrolled for safety reasons. Prior to commencing Roczen, patients were assessed for BED using the Binge Eating Scale (BES) and, if required, a clinical interview. For safety reasons, where there was a high index of suspicion for a diagnosis of BED, or any other previous or current eating disorder, patients were not enrolled onto the program and were provided with support to access specialist assessment and/or treatment (see Supplementary Material B for complete inclusion and exclusion criteria).

2.3. Outcome measures

Patients were provided with guidance on how to accurately collect their biometric data including weight, BMI and waist circumference, and these measurements were self-reported to clinicians, either during appointments or via the Roczen app, at baseline and four-weekly intervals. For pragmatic reasons, we used available questionnaire data assessing eating behavior, mood and HrQOL from routine 12 and 24 week clinical review appointments which are part of the standardized pathway.

2.4. Questionnaires

2.4.1. Binge Eating Scale (BES)

The BES is a 16-item self-report questionnaire including eight items describing BE behavior and eight items describing feelings and cognitions surrounding a binge episode (Gormally et al., 1982). Each item contains three to four levels of symptom descriptions with 0–2 or 0–3 points with a total score ranging from 0 to 46. Higher scores indicate more severe symptoms. The scale has very good reliability with a Cronbach's alpha 0.88 and composite reliability score of 0.96 (Duarte et al., 2015). Commonly used categorical severity ranges are: $\leq 17 =$ none to mild BE, 18–26 = moderate, or ≥ 27 points = severe BE problems (Marcus et al., 1985).

2.4.2. Three Factor Eating questionnaire (TFEQ-R18)

The TFEQ-R18 is an 18-item self-report questionnaire which measures eating behavior on three subscales of cognitive restraint to control of food intake, uncontrolled eating, emotional eating (De Lauzon et al., 2004).). Item responses are scored as 0–4 and summed and converted into a total score range of 0–100 and a subscale score range of 0–4. Each subscale has good reliability for adult populations (Cronbach's α: Restraint = 0.84, uncontrolled eating =0.83, emotional eating =0.87) Participants were categorised as 'high' or 'low' on each of the TFEQ subscales using a median split such that $\geq$median constituted 'high' self-reported levels of each factor, an approach also used by other colleagues in this field (Löffler et al., 2015; Porter & Johnson, 2011).

2.4.3. Patient Health Questionnaire-9 (PHQ-9)

The 9-item Patient Health Questionnaire (PHQ-9) (Kroenke et al., 2001) was used to assess depression symptoms. Participants were asked over the last 2 weeks how often they had been bothered by any of the nine DSM-IV criteria for depression from "0" (not at all) to "3" (nearly every day). Scores range from 0 to 27 with higher scores indicating more severe depression symptoms. Validated categorical severity ranges are: 0–4 = no depressive symptoms; 5–9 = mild symptoms; 10–14 = moderate; 15–19 = moderately severe; and 20–27 = severe symptoms. The PHQ-9 has excellent internal reliability and validity (Cronbach's α = 0.86–089 in the general population).

2.4.4. EuroQol 5 Dimension (EQ-5D-5L)

The EQ-5D-5L measures health-related quality of life in five dimensions: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression (Rabin & Charro, 2001). Participants self-classify their health for each of these five dimensions on a 5-point scale by reporting whether they are experiencing "no problems," "slight problems," "moderate problems," "severe problems," and "unable to/ extreme problems" for all dimensions. These dimensions were given a score between 1 and 5 respectively and following this, a health status number was created from the five responses to a 5-digit number (e.g., 12534). These 5-digit numbers were then converted into a singular index scores range from 0 to 1 (1 being the best possible health state; 0 worst possible health state) using download SPSS syntax from value sets deprived from general population sample in England (Devlin et al., 2017).

2.5. Statistical analysis

Analysis was performed using SPSS Statistics (Version 27.0). Data were analysed at 12 and 24 weeks for patients with complete data. Data were checked for normality. Statistical significance was defined as $p < 0.05$. Demographic data were summarised using mean $\pm$ standard deviation for continuous parametric variables or median (25th and 75th centiles interquartile [IQR]) for non-parametric continuous variables. Categorical variables were described with counts (percentages).

Data was compared using paired-sample *t*-tests or independent t-tests for normally distributed data and Wilcoxon signed-rank tests for non-

parametric data. Multiple comparisons were adjusted for using the Bonferroni correction.

A total of 106 patients had complete data at baseline however, to ensure normal distribution, one age-related outlier (78 years) and three weight outliers (>150 kg) were removed from the dataset, with a total of 102 patients in the final analysis. Sensitivity analysis was run on the entire data set of 106. When reporting the results, weight and BMI data was available for $n = 100$ at 12 weeks and $n = 89$ at 24 weeks, waist circumference data for $n = 86$ at 12 weeks and $n = 66$ at 24 weeks. We had full questionnaire data for all 102 patients at both clinical review time points.

Multivariable regression analysis was used to explore predictors of eating behavior and percentage weight loss. Stepwise regression models were run to identify the optimal multivariable model. Baseline factors (Age, Weight, Gender, Ethnicity, PHQ-9, EQ-5D-5L, BES, TFEQ Restraint, Uncontrolled Eating, Emotional Eating, or TFEQ total score) were entered into the original full model (see Supplementary Material Table S1 and S2), and a backward elimination approach was implemented with variables being kept in if $p < 0.1$. Due to limited numbers of ethnic minority groups within the study, to assess the impact of ethnicity on outcomes a dichotomous was created into white ethnicity (1) and ethnic monitory groups (0). Beta-coefficients, 95 % confidence intervals (CI) and *p*-values were reported. The assumptions of each model were checked and met. Statistical significance was defined as a p-value <0.05.

3. Results

A total of 102 patients with complete questionnaire data at baseline 12, and 24 weeks were included (mean age 51.1 ± 10.0 years; mean BMI 34.5 ± 5.0 kg/m^2; 57.8 % White ethnicity; 72.5 % ($n = 74$) female). None of the patients had previously been diagnosed with an eating disorder as this was screened for in both Summary Care Records and clinical consultations. At baseline, median BES score was 10.0 (IQR 6.0, 17.5, mean TFEQ score 43.2 ± 14.0, while mean scores for the TFEQ subscales were uncontrolled eating 2.42 ± 0.57, emotional eating 2.37 ± 0.53, and restraint, 2.29 ± 0.54. Using a median split on the TFEQ subscales, 59.8 % ($n = 61$) of participants were categorised as high restraint, 61.8 % ($n = 63$) high uncontrolled eating and 63.7 % ($n = 65$) high emotional eating. Median PHQ-9 score was 4.0 (IQR I1.0, 6.3). Median EQ-5D-5L score was 7.0 (IQR 6.0, 8.0) (see Table 1).

3.1. Pre and post intervention outcomes

At both 12 and 24 weeks, there was a significant reduction in weight (8.8 ± 5.0 kg; 10.8 ± 6.5 kg respectively, both p < 0.001) equating to 9.5 ± 5.1 % weight loss at 12-weeks and 11.0 ± 6.1 % weight loss at 24-weeks. Waist circumference significantly reduced by 9.4 ± 7.4 cm at 12 weeks and 12.3 ± 7.7 cm at 24 weeks (both *p* < 0.001). BMI reduced by significantly 3.1 ± 1.7 kg/m^2 and 3.8 ± 2.2 kg/m^2 at 12 and 24 weeks respectively (Table 2 and Fig. 1).

%, Percentage, kg, kilogram, w, weeks; *** p < 0.001.

When assessing changes in eating behavior, there was a significant reduction to median BES score by 6.0 and 5.0 points at 12 and 24 weeks respectively (*p* < 0.001) (Table 2 and Fig. 2). Both uncontrolled and emotional eating reduced significantly at both time points (uncontrolled 12 weeks 0.77 ± 0.74; 24 weeks; 0.76 ± 0.78; emotional 12-weeks 0.58 ± 0.91; 24 weeks 0.53 ± 0.95 [*p* < 0.001] respectively). There were increases in restraint at 12 and 24 weeks (0.13 ± 0.66 $p = 0.051$; 0.08 ± 0.67), though neither was statistically significant. Total TFEQ score significantly reduced at both 12 and 24 weeks (12.2 ± 13.7 and 12.3 ± 15.1, respectively, p < 0.001) (Table 2, Figs. 3–4).

w, weeks, BES, binge eating scale,*** p < 0.001.

Depression as measured by the PHQ-9, improved by 2.0 at both 12 weeks and 24-weeks (p < 0.001). HrQOL, as measured by the EQ-5D-5L, improved by 0.04 at 12 weeks and was also sustained at 24-weeks (p < 0.001) (Table 2 and Figs. 5–6).

Table 1
Baseline characteristics of Roczen patients.

Characteristics, *n*	Enrolled members ($n = 102$)
Men, *n* (%)	28 (27.5)
Women, *n* (%)	74 (72.5)
Age, years (SD)	51.1 (10.0)
Ethnicity, *n* (%)	
Black African	11 (10.8)
Black Caribbean	9 (8.8)
Indian	12 (11.8)
Middle Eastern	1 (1.0)
Mixed	2 (2.0)
Other	5 (4.9)
Pakistani	1 (1.0)
White	59 (57.8)
Bodyweight, kg (SD)	96.8 (16.3)
BMI, kg/m^2 (SD)	34.5 (5.0)
Waist circumference, cm (SD)	107.8 (12.2)
Metabolic classification, *n* (%)	
Overweight	15 (14.7)
Living with Class I Obesity	41 (40.2)
Living with Class II Obesity	46 (45.1)
Mental health and eating behavior scores	
PHQ-9 Depression (median, IQR)	4.0 (1.0,7.3)
EQ-5D-5L HrQOL (median, IQR)	0.89 (0.84, 0.94)
BES (median, IQR)	10.0 (6.0, 17.5)
TFEQ-18 Total (mean, SD)	43.2 (14.0)
TFEQ-18 Uncontrolled Eating (mean, SD)	2.42 (0.57)
TFEQ-18 Emotional Eating (mean, SD)	2.37 (0.53)
TFEQ-18 Restraint (mean, SD)	2.29 (0.54)

n, number; BMI, body mass index; kg/m^2, kilograms per metre squared; kg, kilograms; PHQ-9, Patient Health Questionnaire 9; GAD-7, Generalized Anxiety Scale; BES, Binge Eating Scale; TFEQ-18, Three Factor Eating Questionnaire-18; SD, standard deviation; %, percentage; IQR, Interquartile Range.

There was no difference in weight loss outcomes at 24-weeks between those who were classified as high versus low restrained, uncontrolled or emotional eaters at baseline.

3.2. Predictors of eating behavior

The final regression models explored whether ethnicity, PHQ-9 depression or EQ-5D-5L-5L HrQOL predicted emotional eating, uncontrolled eating or restraint scores on the TFEQ and whether gender, PHQ-9 depression, total TFEQ score or uncontrolled eating predicted BES at 24- weeks (Table 3). Only depression was significantly associated with emotional eating at 24 weeks with higher PHQ scores predicting higher emotional eating scores. For every point increase to the PHQ-9 there was a 0.52-point increase to the emotional eating score (p < 0.001: 95 % CI: 0.07–0.13) explaining 27.2 % of the variance ($R^2 = 0.272$. Higher pHQ-9 scores and higher TFEQ total score predicted higher BES at 24 weeks explaining 22.5 % of the variance ($R^2 = 0.225$), but as individual factors, neither restraint, emotional eating nor uncontrolled eating were significant predictors of BES score.

Ethnicity was also associated with uncontrolled eating- being of non-white ethnicity predicted higher uncontrolled eating 24 weeks later, explaining 13.2 % of the variance ($R^2 = 0.132$).

These results were mostly mirrored in the original full models (Supplementary Material: Table S1), which examined whether any of the baseline variables (Age, Weight, Gender, Ethnicity, PHQ-9, EQ-5D-5L, BES, TFEQ Restraint, Uncontrolled Eating, Emotional Eating, or TFEQ total score) predicted eating behaviors at 24 weeks, however ethnicity was not a significant predictor of uncontrolled eating.

When the TFEQ total score was entered into the model as the

Table 2

Summary of results in participants: Key outcomes at 12 and 24 weeks.

	Baseline ●	12 weeks	Change	95 % CI	*p* Value	24 weeks	Change	95 % CI	p Value
Weight (kg)	96.5 (16.3)	87.7 (15.3)	−8.8 (5.0)	−7.8 to −9.8	<0.001*	86.1 (15.7)	−10.8 (6.5)	−9.4 to −12.1	<0.001*
Weight loss (%)	–	−9.5 (5.1)		−8.5 to −10.5	<0.001*		−11.0 (6.1)	−9.7 to −12.3	<0.001*
BMI (kg/m²)	34.4 (5.0)	31.2 (4.7)	−3.1 (1.7)	−2.8 to −3.5	<0.001*	30.7 (4.7)	−3.8 (2.2)	−3.4 to −4.3	<0.001*
Waist (cm)	107.5 (12.4)	98.1 (10.9)	−9.4 (7.4)	−7.9 to −11.0	<0.001*	96.1 (11.0)	−12.3 (7.7)	−10.4 to −14.2	<0.001*
PHQ-9	4.0 (1.0, 7.3)	2.0 (0.0, 4.0)	2.0	–	<0.001*	2.0 (0.0, 4.0)	2.0	–	<0.001*
EQ-5D-5L	0.90 (0.84, 0.94)	0.94 (0.89, 1.00)	0.04	–	<0.001*	0.94 (0.86, 1.00)	0.04	–	<0.001*
BES	10.0 (6.0, 17.5)	4.0 (1.8, 8.0)	−6.0	–	<0.001*	5.0 (2.0, 10.0)	−5.0	–	<0.001*
TFEQ Total	43.2 (14.0)	31.0 (13.5)	−12.2 (13.7)	−9.6 to −14.9	<0.001*	31.0 (14.7)	−12.3 (15.1)	−9.4 to −15.3	<0.001*
UE	2.42 (0.57)	1.65 (0.48)	−0.77 (0.74)	−0.62 to −0.92	<0.001*	1.66 (0.52)	−0.76 (0.78)	−0.61 to −0.91	<0.001*
EE	2.37 (0.53)	1.79 (0.84)	−0.58 (0.91)	−0.40 to −0.76	<0.001*	1.84 (0.86)	−0.53 (0.95)	−0.34 to −0.72	<0.001*
Restraint	2.29 (0.54)	2.42 (0.57)	0.13 (0.66)	−0.26 to 0.00	0.051	2.37 (0.53)	0.08 (0.67)	−0.21 to 0.05	0.234

Data are in mean (SD). Median (IQR) n, number; BMI, body mass index; kg/m², kilograms per metre squared; kg, kilograms; PHQ-9 = Patient Health Questionnaire 9; BES, Binge Eating Scale; TFEQ, Three Factor Eating Questionnaire-R18; cm, centimetre; CI, confidence intervals. n = 102 for all variables at baseline *denotes significance; UE Uncontrolled eating, EE, Emotional eating.
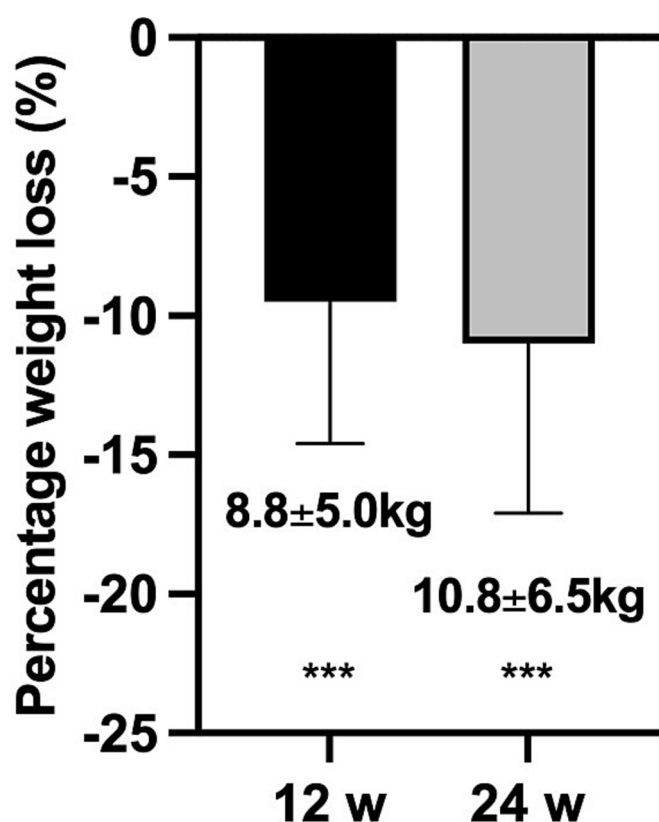
Fig. 1. Percentage weight loss at 12 and 24-weeks.
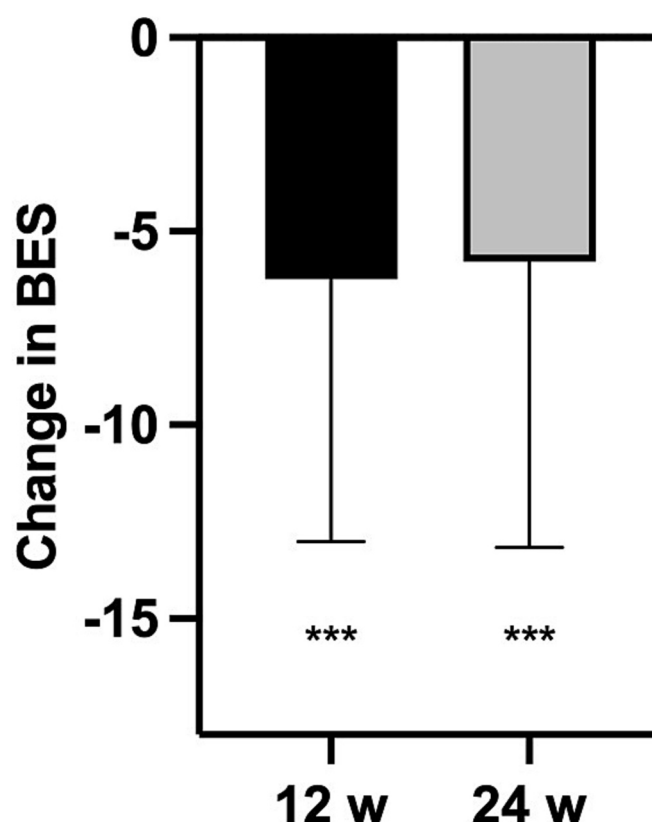
Fig. 2. Change to Binge Eating Scale score at 12 and 24-weeks.

dependent variable in place of the subscales, none of the baseline factors predicted the total score.

3.3. Predictors of percentage weight loss

An additional regression model found that restraint was the only variable that predicted percentage weight loss (Table 4). For every one-point increase to restraint, there was a 0.32-point decrease to percentage weight loss ($p < 0.02$; 95 % CI: −5.6 to −1.3). The model explained 10.4 % of the variance in percentage weight loss ($R^2 = 0.104$). This association was also reflected in the original full model with all variables entered (Supplementary File: Table S1).

4. Discussion

This service evaluation evaluated the impact of the Roczen program on eating behaviors, depression and HrQOL in patients living with overweight and obesity. It also explored whether any baseline factors were predictive of disordered eating behaviors or change to weight at 24 weeks.

These results show that emotional eating, binge eating, uncontrolled eating behaviors, depression and HrQOL were not negatively impacted despite some concern within the field over increased of risk of eating disorder pathology and mood during dieting to lose weight and behavioral weight management (Bray et al., 2023; Ganson et al., 2022;
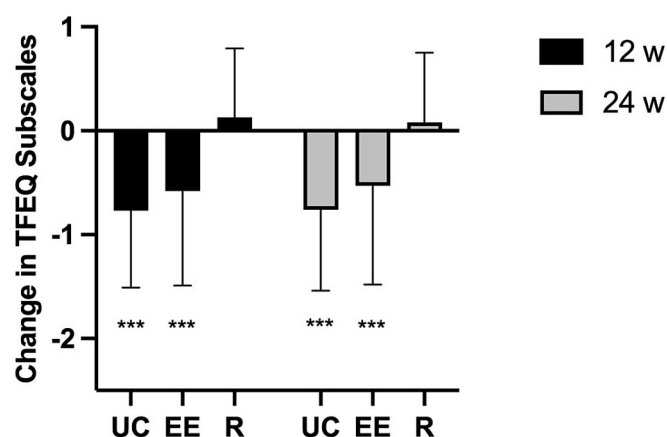
Fig. 3. Change to TFEQ-R18 Eating behavior subscales at 12 and 24-weeks. w, weeks, UC, uncontrolled eating; EE, emotional eating; R, restraint; TFEQ, three factor eating questionnaire,*** p < 0.001.
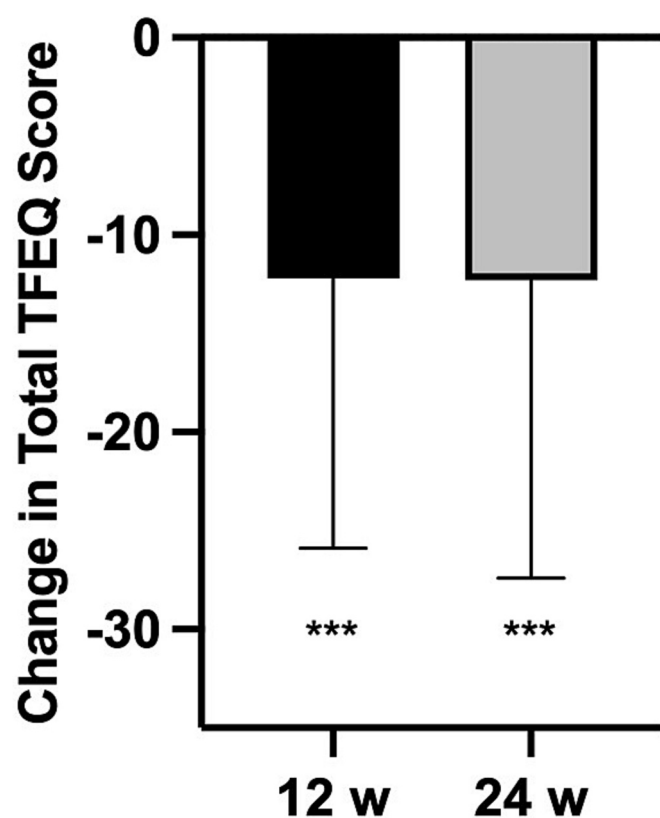

Fig. 4. Change to TFEQ-R18 total score at 12 and 24-weeks. w, weeks, TFEQ, three factor eating questionnaire,*** p < 0.001.

Fig. 5. Change to PHQ-9 Depression score at 12 and 24 weeks. w, weeks; PHQ-9, Patient Health Questionnaire-9,*** p < 0.001.

Marwood et al., 2023; Mason et al., 2022; McFarlane et al., 1999; Stice et al., 2008). Over the course of 24-weeks on the program, patients reported small improvements to emotional eating, uncontrolled eating, BE scores, depression and HrQOL, alongside significant weight loss. Despite restraint increasing slightly, BE score, emotional eating and uncontrolled eating scores did not worsen, which is reassuring considering restraint in and of itself may be a risk factor for disordered eating (Fairburn et al., 2003; Neyland et al., 2020; Polivy & Herman, 1993; Stice et al., 1998, 2011). Data from this service evaluation suggest that in a clinical, tailored environment, programs utilising TRE can be potentially effective and safe for people living with obesity without preexisting confirmed eating disorder or high levels of disordered
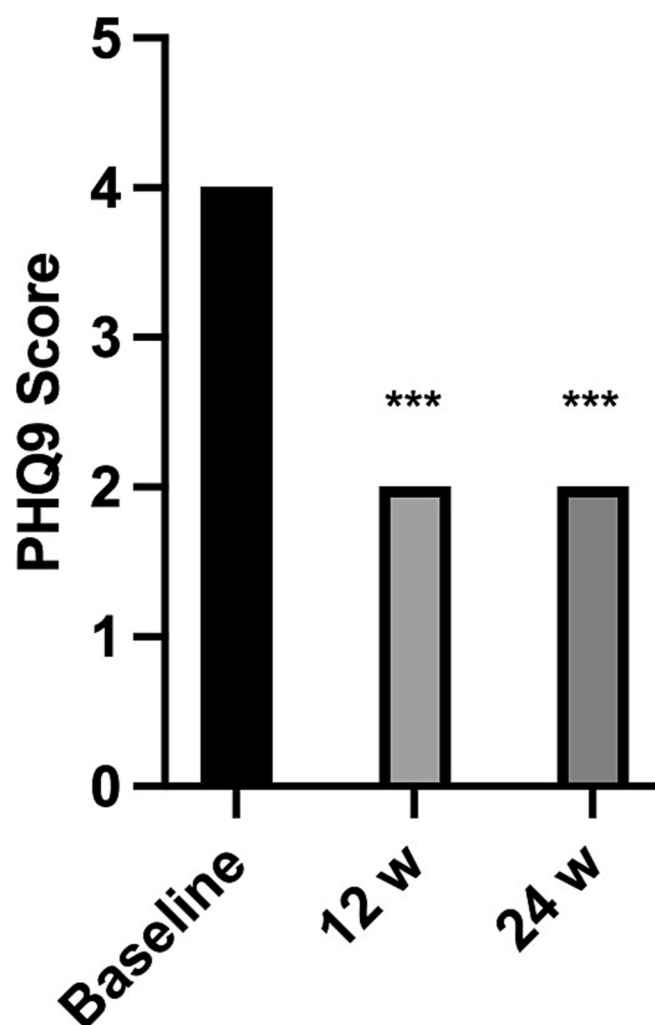
eating, (Jebeile et al., 2023),

Although the average BES for participants was mild at baseline, it significantly reduced at both timepoints. This is encouraging especially considering the association between the presence of BE behavior and loss of control, emotional distress and psychological comorbidity, regardless of whether full criteria for BED are met (Stice et al., 2017). While PHQ-9 scores at baseline indicated mild depression, this score was a significant predictor of eating behaviors at 12 and 24-weeks, with higher scores predicting higher emotional eating and BE. This aligns with existing literature on the association between mood and maladaptive eating behaviors in cohorts living with overweight and obesity (Dakanalis et al., 2023; Hudson et al., 2007; Kessler et al., 2013; Mason & Lewis, 2014; Pasquale et al., 2024).

It is of note that neither restraint, emotional eating nor uncontrolled eating predicted BE scores at follow up and vice versa - BE scores at baseline had no relationship to other eating behaviors 24 weeks later. It is particularly important to note that increased restraint did not correspond to increased BE or uncontrolled eating behavior. In this case, by slightly increasing restraint, some protection from other maladaptive eating behaviors may have been conferred, though it cannot be determined whether this effect would be seen if the increase in restraint had been more substantial or if disordered eating behaviors had been higher at baseline Of interest, was the lack of association between BE scores and uncontrolled eating, which are widely considered to be measuring similar concepts. One explanation could be that the BES is comprised of
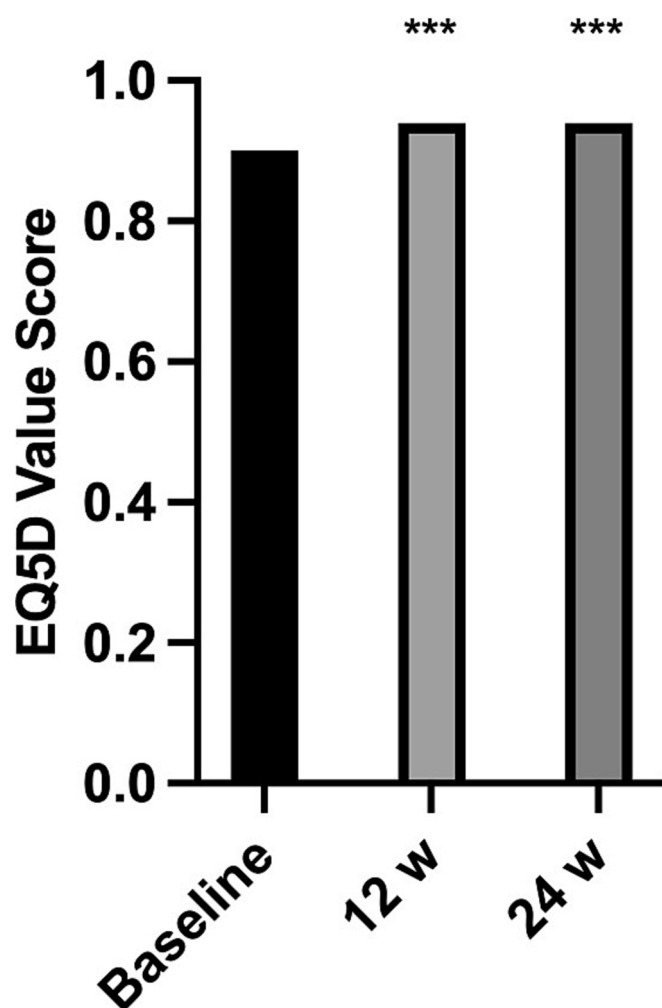
Fig. 6. Change to EQ-5D-5L HrQOL at 12 and 24 weeks.
w, weeks; EQ5D, EuroQol 5 Dimension,*** p < 0.001.

two subscales, BE behavior and maladaptive cognitions (Gormally et al., 1982) related to food and body shape, and that the cognition subscale may attenuate the relationship between the BES score and uncontrolled eating. Further research could explore the impact of each subscale on other eating behaviors. Ethnicity was found to share an association with uncontrolled eating, with patients of non-white ethnicity having higher scores. Although ethnicity may have directly impacted uncontrolled eating as suggested here, these findings might also relate to other sociocultural factors that impact eating including food insecurity (Loopstra et al., 2019), socioeconomic status (House of Commons UK Parliament, 2020; Office of National Statistics, 2023) and discrimination

(Schmengler et al., 2017) that disproportionately affect marginalized ethnic groups. As we did not measure these factors future research should consider these factors. The role of ethnicity in behavioral weight management is under researched and future studies should aim to examine these programs' impact on non-white populations.

Lower baseline levels of restraint predicted greater percentage weight loss suggesting an inverse relationship between restraint and weight loss in line with some literature (Chu et al., 2021). One explanation for this may be that, for people with low levels of restraint, engaging in supervised behavioral weight loss is a significant change from their baseline eating behavior, whereas those with high baseline restraint adapt their behavior less. As such, the intervention represented a more significant change for those with lower restraint levels for whom an increase is more achievable and sustainable, which therefore corresponded to greater weight reduction.

Contrary to our hypothesis, BE score, emotional eating and uncontrolled eating were not predictive of weight loss and there was no difference in weight loss outcome between individuals who scored above a median average on emotional eating, uncontrolled eating or restraint at baseline. There are extensive studies linking eating behaviors and weight change, but findings vary. Löffler and colleagues' population study of over 3000 participants (2015) showed a positive relationship between all TFEQ subscales and BMI with higher scores associated with higher BMI. While Nagata et al. (2018) found no significant association between BE and weight gain, other studies indicate that fasting and emotional eating are linked to weight gain only in those with a BMI < 25, suggesting that BMI may moderate the effect of eating behavior on weight change (Chu et al., 2021).

Our results have several limitations. First, as this was a service evaluation of a digital health program, there was no control condition. It is therefore difficult to determine with certainty whether changes observed were due to the Roczen program itself of other factors. Similarly, as several behavior change techniques were applied alongside the suggestion of a TRE plan, we cannot confidently determine the exact mechanisms of action in change to weight or eating behaviors. Furthermore, we have only been able to report outcome data for patients who were engaged with the program and therefore communicated regular biometric and questionnaire data. This study did not examine attrition as all data came from participants still active on the program at 24 weeks and we did not evaluate acceptability or feasibility of the

Table 4
Predictors of percentage weight loss at 24-weeks on Roczen program.

Predictor	Percentage weight loss	
	β	p-value
TFEQ restraint	−0.323	0.002 *

Dependent Variable: Percentage weight loss at 24-week follow-up.
Predictor (baseline): TFEQ Restraint.
Beta's represent standardized estimates in the regression model.

Table 3
Predictors of eating behaviors at 24-weeks on Roczen program (final regression models).

Predictor	Binge eating scale		Uncontrolled eating		Emotional eating		Restraint	
	β	p-value	β	p-value	β	p-value	β	p-value
Gender	0.133	0.152	–	–	–	–	–	–
Ethnicity	–	–	0.364	<0.001 *	–	–	–	–
PHQ-9	0.414	<0.001 *	–	–	0.522	<0.001 *	–	–
EQ-5D-5L	–	–	–	–	–	–	−0.154	0.125
TFEQ uncontrolled eating	0.099	0.275	–	–	–	–	–	–
Total TFEQ score	0.206	0.036 *	–	–	–	–	–	–

Dependent Variables (all at 24-week FU): Binge Eating Scale, TFEQ Uncontrolled Eating, TFEQ Emotional Eating, TFEQ Restraint.
Predictors (all at baseline): Ethnicity, PHQ-9 Depression, EQ-5D-5L Health Related Quality of Life, TFEQ Restraint, TFEQ Uncontrolled Eating, TFEQ Emotional Eating, TFEQ total score.
Beta's represent standardized estimates in the regression model.

service. The data points of 12 and 24 weeks were used as these correspond with clinical check points in the care model of the service. Patients were offered consultation with their clinician every four weeks, and there is no defined end point to care. Rather, patients have the ability to decide when they feel ready to discharge themselves from the service, as participation is voluntary. As such, the reported data does not reflect whether improvements are sustained post-intervention or in the long term. Further research is needed to establish whether the findings are consistent with patients who are less engaged with weight management programs.

Also due to the design of the study, a power calculation was not performed. We instead chose a stepwise elimination approach to the regression models to limit the number of variables in each model. With one exception, the results of the final, smaller models were the same as the full models with all baseline variables entered. This exception was that being of non-white ethnicity was predictive of higher uncontrolled eating in the small model, but not the original full model.

The use of a median split to define 'low' versus 'high emotional eating, uncontrolled eating and restraint, while aligned with other existing research using the TFEQ (Löffler et al., 2015; Porter & Johnson, 2011), may have led to loss of variability and potential misclassification of patients, however these results were similar to those of the linear regressions, which used the constructs as continuous variables. Additionally, due to the data being deidentified at source before individual questionnaire items were aggregated, we were unable to obtain the raw data and to therefore calculate internal reliability coefficients for the measures.

It is also important to place the results in context. While improvements to depression, HrQOL, emotional eating, uncontrolled eating and binge eating were statistically significant, changes were small and patients may not have experienced noticeable, clinically relevant improvement. However, these changes are at least indicative of stabilization, which considering the concern about how behavioral weight management programs should not do harm, is reassuring.

To prioritise clinical safety of patients on this program, those with either a history of or a current eating disorder (rather than subclinical symptoms of disordered eating) were excluded. A comprehensive eating disorders measure was also not used in the study cohort. It is therefore a limitation of this study that the results may therefore not be applicable to patients meeting clinical diagnostic criteria for BED or other eating disorders. We cannot therefore report with full certainly that the observed increases to restraint were not problematic for any of the cohort. Furthermore, restraint is a complex construct and there are different conceptions of restraint throughout the literature (Polivy et al., 2020), for example a restrictive mindset, with or without the accompanying restrained eating behavior and cognitive restraint divided into flexible versus rigid restraint. They all may have different effects on eating behavior, mood and weight loss, however the TFEQ-R18 captures it as one construct of cognitive restraint (Balantekin & Hayes, 2024; Polivy et al., 2020). While various factors have been associated with eating disorder onset, their predictive value remains inconsistent throughout the literature. We must acknowledge that an increase to restraint, albeit small, has the potential to cause harm to individuals already at risk and continual monitoring for emergence of symptoms is crucial (Charrat et al., 2023). Additionally, because post-treatment follow-up data are unavailable, the long-term implications of the observed increases in dietary restraint remain unclear and could still pose a risk for heightened disordered eating behaviors over time in this cohort. While participation in behavioral weight loss intervention may not increase risk in a general population (Jebeile et al., 2023), little is known about the potential additional risk for those already at risk considering that those with eating disorder are invariably screened out of such programs (Lister et al., 2024). There is now some well-conducted research being conducted to assess the safety of these programs for individuals with high-risk profiles, an area that is critically needed in the field (Forrest & Grilo, 2022; Grilo & Pittman, 2024).

Patients with uncontrolled psychiatric disorders were also excluded for clinical safety reasons and average PHQ-9 scores were low for our patient group. Our findings may not be applicable to patients living with clinically significant symptoms of depression or other comorbid psychiatric disorders and it is of note that depression scores were mild from the outset, and we did not measure any other aspects of poor mental health.

When considering the practical application of digitally or remotely delivered weight management services, the ability to screen for, and monitor disordered eating symptomology and mental health changes should be considered. Recognised clinical tools, such as the Mental State Examination, can be adapted to a remote environment and provide trained clinicians with further scope to thoroughly assess patients and ensure their safety throughout an intervention. In instances where use of these tools and assessments identify a patient at higher risk, a multidisciplinary team case discussion, with input from clinical psychology and behavior change scientists, can provide a more thorough assessment on suitability to continue a program or the need for referral to specialist support. In fact, the ability for clinicians to send questionnaires and engage with patients asynchronously, outside of regular scheduled interactions, may well lead to an increase in identification of patients in need of further support, highlighting the potential power of such services in empowering individuals to obtain help, or clinicians to identify deterioration, at an earlier stage, which is likely to lead to better outcomes (Allen et al., 2023).

Our cohort was ethnically diverse with 42 % from non-white ethnic backgrounds, highlighting the broad acceptability of a digital approach to behavioral weight management across diverse populations. However, it is a limitation that we were not able to further analyse specific ethnicity groups due to the limited sample size.

5. Conclusion

Clinically supported digitally delivered TRE programs may be effective and safe weight management interventions for people living with obesity and overweight. For individuals without eating disorder and with low eating disordered eating pathology, such programs may improve maladaptive eating behaviors and low mood, which are common in this population. There is a need for holistic and integrated approaches to obesity management and disordered eating that place importance on monitoring and improving mental health, quality of life and eating behavior alongside weight loss.

CRediT authorship contribution statement

Siri Steinmo: Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Conceptualization. **Laura Falvey:** Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Data curation, Conceptualization. **Claudia Ashton:** Writing – review & editing, Conceptualization. **Ling Chow:** Writing – review & editing, Data curation, Conceptualization. **Dipesh Patel:** Writing – review & editing, Conceptualization. **Jonathan Kwan:** Writing – review & editing, Conceptualization. **Barbara McGowan:** Writing – review & editing, Supervision, Project administration, Methodology, Conceptualization. **Adrian Brown:** Writing – review & editing, Writing – original draft, Validation, Supervision, Project administration, Methodology, Formal analysis, Data curation, Conceptualization.

Funding sources

Declaration of competing interest

AB, DP, JK, SS, BM are on the Medical Advisory Board and are

shareholders in Reset Health Ltd. LC is an employee and shareholder of Reset Health Ltd. LF, CA are employees of Reset Health Ltd. AB reports research funding from the National Institute for Health and Care Research, Medical Research Council, Rosetrees Trust, British Dietetic Association, Biotechnology and Biological Sciences Research Council, Innovate UK, Public Health England, and Novo Nordisk. AB reports honoraria from Novo Nordisk, Office of Health Improvement and Disparity, Johnson and Johnson, and Obesity UK outside the submitted work. DP reports personal fees from Astra Zeneca, Boehinger Ingelheim, Eli Lilly, MSD, Novo Nordisk, and Sanofi non-financial support from Novo Nordisk outside the submitted work. DP is a member of the CaReMe UK group. BM performs Advisory and educational work for Novo Nordisk, Sanofi, Johnson and Johnson, Orexigen, Amgen and advisory work for Astra Zeneca, Lilly, Pfizer, Boehringer Ingelheim and Johnson & Johnson.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.eatbeh.2025.102007.

Data availability

The authors do not have permission to share data.

References

Adami, G. F., Gondolfo, P., Bauer, B., & Scopinaro, N. (1995). Binge eating in massively obese patients undergoing bariatric surgery. *International Journal of Eating Disorders, 17*(1), 45–50.

Allen, K. L., Mountford, V. A., Elwyn, R., Flynn, M., Fursland, A., Obeid, N., … Wade, T. (2023). A framework for conceptualising early intervention for eating disorders. *European Eating Disorders Review, 31*(2), 320–334. https://doi.org/10.1002/erv.2959

Aman, Y. (2022). Time-restricted eating improves mood and health. *Nature Aging, 2*(10), 873. https://doi.org/10.1038/s43587-022-00297-7

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders (5th ed.)* (5th ed.).

Ansari, S., Haboubi, H., & Haboubi, N. (2020). Adult obesity complications: Challenges and clinical impact. *Therapeutic Advances in Endocrinology and Metabolism, 11*. https://doi.org/10.1177/2042018820934955, 204201882093495.

Balantekin, K. N., & Hayes, J. F. (2024). Unpacking the controversies of weight loss and dietary restraint with binge-eating disorder: Commentary on Grilo and Pittman. *International Journal of Eating Disorders, eat.24342*. https://doi.org/10.1002/eat.24342

Bray, B., Sadowski, A., Bray, C., Bradley, R., & Zwickey, H. (2023). Clinical aspects of binge eating disorder: A cross-sectional mixed-methods study of binge eating disorder experts' perspectives. *Frontiers in Psychiatry, 13*. https://doi.org/10.3389/fpsyt.2022.1087165

Brown, A., Dobbie, L. J., Falvey, L., Patel, D. C., Kwan, J. T. C., Steinmo, S., … McGowan, B. M. (2024). Real-world data of a digitally enabled, time-restricted eating weight management program in public sector workers living with overweight and obesity in the United Kingdom: A service evaluation of the Roczen program. *Obesity Science & Practice, 10*(1), Article e730. https://doi.org/10.1002/osp4.730

Cardel, M. I., Newsome, F. A., Pearl, R. L., Ross, K. M., Dillard, J. R., Miller, D. R., … Balantekin, K. N. (2022). Patient-centered care for obesity: How health care providers can treat obesity while actively addressing weight stigma and eating disorder risk. *Journal of the Academy of Nutrition and Dietetics, 122*(6), 1089–1098. https://doi.org/10.1016/j.jand.2022.01.004

Charrat, J.-P., Massoubre, C., Germain, N., Gay, A., & Galusca, B. (2023). Systematic review of prospective studies assessing risk factors to predict anorexia nervosa onset. *Journal of Eating Disorders, 11*(1), 163. https://doi.org/10.1186/s40337-023-00882-0

Chen, W., Liu, X., Bao, L., Yang, P., & Zhou, H. (2023). Health effects of the time-restricted eating in adults with obesity: A systematic review and meta-analysis. *Frontiers in Nutrition, 10*, 1079250. https://doi.org/10.3389/fnut.2023.1079250

Chu, J., Ganson, K. T., Vittinghoff, E., Mitchison, D., Hay, P., Tabler, J., … Nagata, J. M. (2021). Weight goals, disordered eating behaviors, and BMI trajectories in US young adults. *Journal of General Internal Medicine, 36*(9), 2622–2630. https://doi.org/10.1007/s11606-021-06702-y

Cradock, K. A., ÓLaighin, G., Finucane, F. M., Gainforth, H. L., Quinlan, L. R., & Ginis, K. A. M. (2017). Behavior change techniques targeting both diet and physical activity in type 2 diabetes: A systematic review and meta-analysis. *International Journal of Behavioral Nutrition and Physical Activity, 14*(1), 18. https://doi.org/10.1186/s12966-016-0436-0

Da Luz, F. Q., Hay, P., Touyz, S., & Sainsbury, A. (2018a). Obesity with comorbid eating disorders: Associated health risks and treatment approaches. *Nutrients, 10*(7), 829. https://doi.org/10.3390/nu10070829

Da Luz, F. Q., Sainsbury, A., Mannan, H., Touyz, S., Mitchison, D., Girosi, F., & Hay, P. (2018b). An investigation of relationships between disordered eating behaviors, weight/shape overvaluation and mood in the general population. *Appetite, 129*, 19–24. https://doi.org/10.1016/j.appet.2018.06.029

Dakanalis, A., Mentzelou, M., Papadopoulou, S. K., Papandreou, D., Spanoudaki, M., Vasios, G. K., … Giaginis, C. (2023). The association of emotional eating with overweight/obesity, depression, anxiety/stress, and dietary patterns: A review of the current clinical evidence. *Nutrients, 15*(5), 1173. https://doi.org/10.3390/nu15051173

De Lauzon, B., Romon, M., Deschamps, V., Lafay, L., Borys, J.-M., Karlsson, J., … Charles, M. A. (2004). The three-factor eating questionnaire-R18 is able to distinguish among different eating patterns in a general population. *The Journal of Nutrition, 134*(9), 2372–2380. https://doi.org/10.1093/jn/134.9.2372

Devlin, N., Shah, K., Feng, Y., Mulhern, B., & van Hout, B. (2017). Valuing health-related quality of life: An EQ-5D-5L value set for England. *Health Economics, 1-16.*

Dicker, D., Alfadda, A. A., Coutinho, W., Cuevas, A., Halford, J. C. G., Hughes, C. A., … Caterson, I. D. (2021). Patient motivation to lose weight: Importance of healthcare professional support, goals and self-efficacy. *European Journal of Internal Medicine, 91*, 10–16. https://doi.org/10.1016/j.ejim.2021.01.019

Duarte, C., Pinto-Gouveia, J., & Ferreira, C. (2015). Expanding binge eating assessment: Validity and screening value of the Binge Eating Scale in women from the general population. *Eating Behaviors, 18*, 41–47. https://doi.org/10.1016/j.eatbeh.2015.03.007

Duncan, A. E., Ziobrowski, H. N., & Nicol, G. (2017). The prevalence of past 12-month and lifetime DSM-IV eating disorders by BMI category in US men and women: BMI and eating disorders. *European Eating Disorders Review, 25*(3), 165–171. https://doi.org/10.1002/erv.2503

Ells, L., Radley, D., Matu, J., Clare, K., Blackshaw, J., Feely, A., … Brown, A. (2020). *Supporting weight management services during the COVID-19 pandemic: Phase I insights.* Public Health England.

Fairburn, C. G., Cooper, Z., & Shafran, R. (2003). Cognitive behavior therapy for eating disorders: A "transdiagnostic" theory and treatment. *Behavior Research and Therapy, 41*(5), 509–528. https://doi.org/10.1016/S0005-7967(02)00088-8

Forrest, L. N., & Grilo, C. M. (2022). Change in eating-disorder psychopathology network structure in patients with binge-eating disorder: Findings from treatment trial with 12-month follow-up. *Journal of Consulting and Clinical Psychology, 90*(6), 491–502. https://doi.org/10.1037/ccp0000732

Francis-Devine, B. (2020). House of commons library insight report: Which ethnic groups are most affected by income inequality? Published August 2020. https://commonslibrary.parliament.uk/income-inequality-by-ethnic-group/?utm_source=chatgpt.com.

Ganson, K. T., Cuccolo, K., Hallward, L., & Nagata, J. M. (2022). Intermittent fasting: Describing engagement and associations with eating disorder behaviors and psychopathology among Canadian adolescents and young adults. *Eating Behaviors, 47*, Article 101681. https://doi.org/10.1016/j.eatbeh.2022.101681

Gea Cabrera, A., Caballero, P., Wanden-Berghe, C., Sanz-Lorente, M., & López-Pintor, E. (2021). Effectiveness of workplace-based diet and lifestyle interventions on risk factors in workers with metabolic syndrome: A systematic review, meta-analysis and meta-regression. *Nutrients, 13*(12), 4560. https://doi.org/10.3390/nu13124560

Gormally, J., Black, S., Daston, S., & Rardin, D. (1982). The assessment of binge eating severity among obese persons. *Addictive Behaviors, 7*(1), 47–55. https://doi.org/10.1016/0306-4603(82)90024-7

Grilo, C. M., & Pittman, B. (2024). Exploring dietary restraint as a mediator of behavioral and cognitive-behavioral treatments on outcomes for patients with binge-eating disorder with obesity. *International Journal of Eating Disorders, 57*(12), 2475–2481. https://doi.org/10.1002/eat.24288

Hay, P., Girosi, F., & Mond, J. (2015). Prevalence and sociodemographic correlates of DSM-5 eating disorders in the Australian population. *Journal of Eating Disorders, 3*(1), 19. https://doi.org/10.1186/s40337-015-0056-0

Hudson, J. I., Hiripi, E., Pope, H. G., & Kessler, R. C. (2007). The prevalence and correlates of eating disorders in the national comorbidity survey replication. *Biological Psychiatry, 61*(3), 348–358. https://doi.org/10.1016/j.biopsych.2006.03.040

Jebeile, H., Gow, M. L., Baur, L. A., Garnett, S. P., Paxton, S. J., & Lister, N. B. (2019). Treatment of obesity, with a dietary component, and eating disorder risk in children and adolescents: A systematic review with meta-analysis. *Obesity Reviews, 20*(9), 1287–1298. https://doi.org/10.1111/obr.12866

Jebeile, H., Libesman, S., Melville, H., Low-wah, T., Dammery, G., Seidler, A. L., … Lister, N. B. (2023). Eating disorder risk during behavioral weight management in adults with overweight or obesity: A systematic review with meta-analysis. *Obesity Reviews, 24*(6), Article e13561. https://doi.org/10.1111/obr.13561

Kapur, N. (2020). The NHS long term plan: putting people first. *SUSHRUTA Journal of Health Policy & Opinions, 12*(1), 10–11. https://doi.org/10.38192/12.1.4

Kessler, R. C., Berglund, P. A., Chiu, W. T., Deitz, A. C., Hudson, J. I., Shahly, V., … Xavier, M. (2013). The prevalence and correlates of binge eating disorder in the World Health Organization world mental health surveys. *Biological Psychiatry, 73*(9), 904–914. https://doi.org/10.1016/j.biopsych.2012.11.020

Kroenke, K., Spitzer, R. L., & Williams, J. B. W. (2001). The PHQ-9: Validity of a brief depression severity measure. *Journal of General Internal Medicine, 16*(9), 606–613. https://doi.org/10.1046/j.1525-1497.2001.016009606.x

Leite, P. B., Dâmaso, A. R., Poli, V. S., Sanches, R. B., Silva, S. G. A., Fidalgo, J. P. N., … Caranti, D. A. (2017). Long-term interdisciplinary therapy decreases symptoms of binge eating disorder and prevalence of metabolic syndrome in adults with obesity. *Nutrition Research, 40*, 57–64. https://doi.org/10.1016/j.nutres.2017.03.006

Lister, N. B., Baur, L. A., Paxton, S. J., Garnett, S. P., Ahern, A. L., Wilfley, D. E., … Jebeile, H. (2024). Eating disorders in weight-related therapy (EDIT) collaboration:

Rationale and study design. *Nutrition Research Reviews, 37*(1), 32–42. https://doi.org/10.1017/S0954422423000045

Liu, L., Chen, W., Wu, D., & Hu, F. (2022). Metabolic efficacy of time-restricted eating in adults: A systematic review and meta-analysis of randomized controlled trials. *The Journal of Clinical Endocrinology & Metabolism, 107*(12), 3428–3441. https://doi.org/10.1210/clinem/dgac570

Löffler, A., Luck, T., Then, F. S., Sikorski, C., Kovacs, P., Böttcher, Y., … Riedel-Heller, S. G. (2015). Eating behaviour in the general population: An analysis of the factor structure of the German version of the Three-Factor-Eating-Questionnaire (TFEQ) and its association with the body mass index. *PLoS One, 10*(7), Article e0133977. https://doi.org/10.1371/journal.pone.0133977

Loopstra, R, Reeves, A, & Tarasuk, V (2019 Jul). The rise of hunger among low-income households: an analysis of the risks of food insecurity between 2004 and 2016 in a population-based study of UK adults. *Journal of Epidemiology and Community Health, 73*(7), 668–673. https://doi.org/10.1136/jech-2018-211194

Luppino, F. S., De Wit, L. M., Bouvy, P. F., Stijnen, T., Cuijpers, P., Penninx, B. W. J. H., & Zitman, F. G. (2010). Overweight, obesity, and depression: A systematic review and meta-analysis of longitudinal studies. *Archives of General Psychiatry, 67*(3), 220. https://doi.org/10.1001/archgenpsychiatry.2010.2

Marcus, M. D., Wing, R. R., & Lamparski, D. M. (1985). Binge eating and dietary restraint in obese patients. *Addictive Behaviors, 10*(2), 163–168. https://doi.org/10.1016/0306-4603(85)90022-x

Marwood, J., Brown, T., Kaiseler, M., Clare, K., Feeley, A., Blackshaw, J., & Ells, L. J. (2023). Psychological support within tier 2 adult weight management services, are we doing enough for people with mental health needs? A mixed-methods survey. *Clinical Obesity, 13*(4), Article e12580. https://doi.org/10.1111/cob.12580

Mason, T. B., & Lewis, R. J. (2014). Profiles of binge eating: the interaction of depressive symptoms, eating styles, and body mass index. *Eating Disorders, 22*(5), 450–460. https://doi.org/10.1080/10640266.2014.931766

Mason, T. B., Do, B., Chu, D., Belcher, B. R., Dunton, G. F., & Lopez, N. V. (2022). Associations among affect, diet, and activity and binge-eating severity using ecological momentary assessment in a non-clinical sample of middle-aged fathers. *Eating and Weight Disorders - Studies on Anorexia, Bulimia and Obesity, 27*(2), 543–551. https://doi.org/10.1007/s40519-021-01191-8

Mattson, M. P., Allison, D. B., Fontana, L., Harvie, M., Longo, V. D., Malaisse, W. J., … Panda, S. (2014). Meal frequency and timing in health and disease. *Proceedings of the National Academy of Sciences, 111*(47), 16647–16653. https://doi.org/10.1073/pnas.1413965111

McFarlane, T., Polivy, J., & McCabe, R. E. (1999). Help, not harm: Psychological foundation for a nondieting approach toward health. *Journal of Social Issues, 55*(2), 261–276. https://doi.org/10.1111/0022-4537.00115

Michie, S., Abraham, C., Whittington, C., McAteer, J., & Gupta, S. (2009). Effective techniques in healthy eating and physical activity interventions: A meta-regression. *Health Psychology, 28*(6), 690–701. https://doi.org/10.1037/a0016136

Michie, S., Richardson, M., Johnston, M., Abraham, C., Francis, J., Hardeman, W., … Wood, C. E. (2013). The behaviour change technique taxonomy (v1) of 93 hierarchically clustered techniques: Building an international consensus for the reporting of behaviour change interventions. *Annals of Behavioral Medicine, 46*(1), 81–95. https://doi.org/10.1007/s12160-013-9486-6

Moussa, O. M., Ardissino, M., Kulatilake, P., Faraj, A., Muttoni, E., Darzi, A., … Purkayastha, S. (2019). Effect of body mass index on depression in a UK cohort of 363 037 obese patients: A longitudinal analysis of transition. *Clinical Obesity, 9*(3), Article e12305. https://doi.org/10.1111/cob.12305

Nagata, J. M., Garber, A. K., Tabler, J. L., Murray, S. B., & Bibbins-Domingo, K. (2018). Prevalence and correlates of disordered eating behaviors among young adults with overweight or obesity. *Journal of General Internal Medicine, 33*(8), 1337–1343. https://doi.org/10.1007/s11606-018-4465-z

National Institute for Health and Care Excellence. (2022). *Obesity: Identification, assessment and management (No. cg189)*. National Institute for Health and Care Excellence. https://www.nice.org.uk/guidance/cg189

Neyland, M. K. H., Shank, L. M., & Lavender, J. M. (2020). Theoretical development and maintenance models of binge eating. In G. K. W. Frank, & L. A. Berner (Eds.), *Binge eating* (pp. 69–82). Springer International Publishing. https://doi.org/10.1007/978-3-030-43562-2_6.

Nightingale, B. A., & Cassin, S. E. (2019). Disordered eating among individuals with excess weight: A review of recent research. *Current Obesity Reports, 8*(2), 112–127. https://doi.org/10.1007/s13679-019-00333-5

Office of National Statistics Report. (2023). Ethnicity pay gaps, UK: 2012 to 2022. Published November https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/earningsandworkinghours/articles/ethnicitypaygapsingreatbritain/2012to2022.

Pasquale, E. K., Strong, D. R., Manzano, M. A., Eichen, D. M., Peterson, C. B., & Boutelle, K. N. (2024). Exploring relationships among appetitive traits, negative affect, and binge eating in adults with overweight or obesity. *Eating Behaviors, 53*, Article 101871. https://doi.org/10.1016/j.eatbeh.2024.101871

Polivy, J., & Herman, C. P. (1993). Etiology of binge eating: Psychological mechanisms. In C. G. Fairburn, & G. T. Wilson (Eds.), *Binge eating: Nature, assessment, and treatment* (pp. 173–205). Guildford Press.

Polivy, J., Herman, C. P., & Mills, J. S. (2020). What is restrained eating and how do we identify it? *Appetite, 155*, Article 104820.

Porter, K. N., & Johnson, M. A. (2011). Obesity is more strongly associated with inappropriate eating behaviors than with mental health in older adults receiving congregate meals. *Journal of Nutrition in Gerontology and Geriatrics, 30*(4), 403–415. https://doi.org/10.1080/21551197.2011.623960

Rabin, R., & Charro, F. D. (2001). EQ-5D-5L: A measure of health status from the EuroQol group. *Annals of Medicine, 33*(5), 337–343. https://doi.org/10.3109/07853890109002087

Rajan, T., & Menon, V. (2017). Psychiatric disorders and obesity: A review of association studies. *Journal of Postgraduate Medicine, 63*(3), 182–190. https://doi.org/10.4103/jpgm.JPGM_712_16

Samdal, G. B., Eide, G. E., Barth, T., Williams, G., & Meland, E. (2017). Effective behavior change techniques for physical activity and healthy eating in overweight and obese adults; systematic review and meta-regression analyses. *International Journal of Behavioral Nutrition and Physical Activity, 14*(1), 42. https://doi.org/10.1186/s12966-017-0494-y

Schaumberg, K., & Anderson, D. (2016). Dietary restraint and weight loss as risk factors for eating pathology. *Eating Behaviors, 23*, 97–103. https://doi.org/10.1016/j.eatbeh.2016.08.009

Schmengler, H., Ikram, U. Z., Snijder, M. B., et al. (2017). Association of perceived ethnic discrimination with general and abdominal obesity in ethnic minority groups: The HELIUS study. *J. Epidemiology and Community Health, 71*, 453–460.

Steger, F. L., Jamshed, H., Bryan, D. R., Richman, J. S., Warriner, A. H., Hanick, C. J., … Peterson, C. M. (2023). Early time-restricted eating affects weight, metabolic health, mood, and sleep in adherent completers: A secondary analysis. *Obesity, 31*(S1), 96–107. https://doi.org/10.1002/oby.23614

Stice, E., Shaw, H., & Nemeroff, C. (1998). Dual pathway model of bulimia nervosa: Longitudinal support for dietary restraint and affect-regulation mechanisms. *Journal of Social and Clinical Psychology, 17*(2), 129–149. https://doi.org/10.1521/jscp.1998.17.2.129

Stice, E., Davis, K., Miller, N. P., & Marti, C. N. (2008). Fasting increases risk for onset of binge eating and bulimic pathology: A 5-year prospective study. *Journal of Abnormal Psychology, 117*(4), 941–946. https://doi.org/10.1037/a0013644

Stice, E., Marti, C. N., & Durant, S. (2011). Risk factors for onset of eating disorders: Evidence of multiple risk pathways from an 8-year prospective study. *Behavior Research and Therapy, 49*(10), 622–627. https://doi.org/10.1016/j.brat.2011.06.009

Stice, E., Gau, J. M., Rohde, P., & Shaw, H. (2017). Risk factors that predict future onset of each DSM–5 eating disorder: Predictive specificity in high-risk adolescent females. *Journal of Abnormal Psychology, 126*(1), 38–51. https://doi.org/10.1037/abn0000219

Wadden, T. A., Foster, G. D., Sarwer, D. B., Anderson, D. A., Gladis, M., Sanderson, R. S., … Phelan, S. (2004). Dieting and the development of eating disorders in obese women: Results of a randomized controlled trial. *The American Journal of Clinical Nutrition, 80*(3), 560–568. https://doi.org/10.1093/ajcn/80.3.560

Webb, V. L., & Wadden, T. A. (2017). Intensive lifestyle intervention for obesity: Principles, practices, and results. *Gastroenterology, 152*(7), 1752–1764.

WHO. (2024). *World Health Organization: Obesity and overweight fact sheet (newsroom fact sheets)*. World Health Organization. https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight.

Wolfenden, L., Ezzati, M., Larijani, B., & Dietz, W. (2019). The challenge for global health systems in preventing and managing obesity. *Obesity Reviews, 20*(S2), 185–193. https://doi.org/10.1111/obr.12872