Impact of Digital Engagement on Weight Loss Outcomes in Obesity Management: A Retrospective Service Evaluation of GLP-1 and Dual GLP-1/GIP Receptor Agonist Therapy in the United Kingdom

Hans Johnson, David Huang, Vivian Liu, Mahmoud Al Ammouri, Christopher Jacobs, Austen El-Osta

Submitted to: Journal of Medical Internet Research
on: November 30, 2024

Table of Contents

Impact of Digital Engagement on Weight Loss Outcomes in Obesity Management: A Retrospective Service Evaluation of GLP-1 and Dual GLP-1/GIP Receptor Agonist Therapy in the United Kingdom

Hans Johnson[1, 2*] MBChB, MRes, MSc; David Huang[1*] MBBS, BSc; Vivian Liu[1*] MAS, BSc; Mahmoud Al Ammouri[3*] MD, MPH; Christopher Jacobs[4*] MB BChir, MRes, MD (res); Austen El-Osta[3*] MSc, MPA, PhD

[1]Menwell Ltd (t/a Voy) London GB
[2]Department of Digital Health and Care, School of Engineering Mathematics and Technology University of Bristol Bristol GB
[3]Self-Care Academic Research Unit (SCARU), Department of Primary Care & Public Health, School of Public Health Imperial College London London GB
[4]Department of Psychology University of Bath Bath GB
[*]these authors contributed equally

Corresponding Author:
Hans Johnson MBChB, MRes, MSc
Menwell Ltd (t/a Voy)
Unit L, Taper Building, 175 Long Lane
London
GB

Abstract

Background: Obesity is a global public health challenge. Pharmacological interventions, such as GLP-1 receptor agonists (e.g., semaglutide) and dual GLP-1/GIP receptor agonists (e.g., tirzepatide), have demonstrated significant weight loss. Digital health platforms offering behavioral support may enhance the effectiveness of these medications.

Objective: This retrospective service evaluation investigated the impact of engagement with an app-based digital weight loss program on weight loss outcomes among individuals using GLP-1 receptor agonists (semaglutide) and dual GLP-1/GIP receptor agonists (tirzepatide) in the United Kingdom over 5 months.

Methods: Data was collected from the Voy weight loss digital health platform between February 2023 and August 2024. Participants were adults aged 18–75 years with a body mass index (BMI) ?30 or ?27.5 kg/m² with presence of obesity-related comorbidities who initiated a weight management program involving semaglutide or tirzepatide. Engagement was defined based on attendance at coaching sessions, frequency of app usage, and regular weight tracking. Participants were categorized as "engaged" or "non-engaged" accordingly. Weight loss outcomes were assessed over a period of up to 5 months. Statistical analyses included chi-square tests, independent t-tests, Kaplan-Meier survival analysis and calculations of Cohen's d for effect sizes.

Results: A total of 57,975 participants were included in the analysis, with 31,407 (54.2%) classified as engaged and 26,568 (45.8%) as non-engaged. Engaged participants achieved significantly greater weight loss at each time point. At month 3, engaged participants had a mean weight loss of 9.0% (95% CI: 9.0% to 9.1%) compared to 5.9% (95% CI: 5.9% to 6.0%) in non-engaged participants (P?<?.001), representing a mean difference of 3.1 percentage points (95% CI: 3.1% to 3.1%). Cohen's d effect size of 0.89 indicated a large effect. At month 5, engaged participants had a mean weight loss of 11.53% (95% CI: 11.5% to 11.6%) compared to 8.0% (95% CI: 7.9% to 8.0%) in the non-engaged (P?<?.001). A Cohen's d effect size of 0.56 indicated a moderate effect. Participants using tirzepatide achieved more significant weight loss than those using semaglutide at month 5 (13.9% [95% CI: 13.5% to 14.3%] vs. 9.5% [95% CI: 9.% to 9.71%]; P?<?.001). The proportion of engaged participants achieving ?5%, ?10%, and ?15% weight loss was significantly higher than the non-engaged group at corresponding time points from months 3 to 5 respectively (P?<?.001).

Conclusions: Engagement with a digital weight management platform significantly enhances weight loss outcomes among individuals using GLP-1 receptor agonists. The combination of pharmacotherapy and digital behavioral support offers a promising strategy to promote the supported self-care journey of individuals seeking clinically effective obesity management interventions.

(JMIR Preprints 30/11/2024:69466)
DOI: https://doi.org/10.2196/preprints.69466

Preprint Settings

1) Would you like to publish your submitted manuscript as preprint?

✓ **Please make my preprint PDF available to anyone at any time (recommended).**
Please make my preprint PDF available only to logged-in users; I understand that my title and abstract will remain visible to all users.
Only make the preprint title and abstract visible.
No, I do not wish to publish my submitted manuscript as a preprint.

2) If accepted for publication in a JMIR journal, would you like the PDF to be visible to the public?

✓ **Yes, please make my accepted manuscript PDF available to anyone at any time (Recommended).**
Yes, but please make my accepted manuscript PDF available only to logged-in users; I understand that the title and abstract will remain v
Yes, but only make the title and abstract visible (see Important note, above). I understand that if I later pay to participate in <a href="http

Original Manuscript

Original Paper

Impact of Digital Engagement on Weight Loss Outcomes in Obesity Management: A Retrospective Service Evaluation of GLP-1 and Dual GLP-1/GIP Receptor Agonist Therapy in the United Kingdom

Abstract

Background:
Obesity is a global public health challenge. Pharmacological interventions, such as GLP-1 receptor agonists (e.g., semaglutide) and dual GLP-1/GIP receptor agonists (e.g., tirzepatide), have demonstrated significant weight loss. Digital health platforms offering behavioral support may enhance the effectiveness of these medications.

Objective:
This retrospective service evaluation investigated the impact of engagement with an app-based digital weight loss program on weight loss outcomes among individuals using GLP-1 receptor agonists (semaglutide) and dual GLP-1/GIP receptor agonists (tirzepatide) in the United Kingdom over 5 months.

Methods:
Data was collected from the Voy weight loss digital health platform between February 2023 and August 2024. Participants were adults aged 18–75 years with a body mass index (BMI) ≥30 or ≥27.5 kg/m² with presence of obesity-related comorbidities who initiated a weight management program involving semaglutide or tirzepatide. Engagement was defined based on attendance at coaching sessions, frequency of app usage, and regular weight tracking. Participants were categorized as "engaged" or "non-engaged" accordingly. Weight loss outcomes were assessed over a period of up to 5 months. Statistical analyses included chi-square tests, independent t-tests, Kaplan-Meier survival analysis and calculations of Cohen's d for effect sizes.

Results:
A total of 57,975 participants were included in the analysis, with 31,407 (54.2%) classified as engaged and 26,568 (45.8%) as non-engaged. Engaged participants achieved significantly greater weight loss at each time point. At month 3, engaged participants had a mean weight loss of 9.0% (95% CI: 9.0% to 9.1%) compared to 5.9% (95% CI: 5.9% to 6.0%) in non-engaged participants ($P < .001$), representing a mean difference of 3.1 percentage points (95% CI: 3.1% to 3.1%). Cohen's d effect size of 0.89 indicated a large effect. At month 5, engaged participants had a mean weight loss of 11.53% (95% CI: 11.5% to 11.6%) compared to 8.0% (95% CI: 7.9% to 8.0%) in the non-engaged ($P < .001$). A Cohen's d effect size of 0.56 indicated a moderate effect. Participants using tirzepatide achieved more significant weight loss than those using semaglutide at month 5 (13.9% [95% CI: 13.5% to 14.3%] vs. 9.5% [95% CI: 9.% to 9.71%]; $P < .001$). The proportion of engaged participants achieving ≥5%, ≥10%, and ≥15% weight loss was significantly higher than the non-engaged group at corresponding time points from months 3 to 5 respectively ($P < .001$).

Conclusions:

Engagement with a digital weight management platform significantly enhances weight loss outcomes among individuals using GLP-1 receptor agonists. The combination of pharmacotherapy and digital behavioral support offers a promising strategy to promote the supported self-care journey of individuals seeking clinically effective obesity management interventions.

Keywords: obesity; weight loss; semaglutide; tirzepatide; digital health; engagement; behavior; coaching; retrospective study; service evaluation

Introduction

Background

The global obesity epidemic continues to pose a significant challenge to public health systems worldwide [1].). Obesity is characterized by excessive fat accumulation that impairs health and is associated with an increased risk of multiple noncommunicable diseases (NCDs), including type 2 diabetes (T2D), cardiovascular diseases and certain cancers [2]. Beyond individual health consequences, this so called “disease of the lifestyle” [3] imposes substantial societal and economic burdens due to elevated healthcare costs and reduced productivity, with a global economic impact estimated at £1.3 trillion [4].

Traditional management strategies for obesity predominantly focus on lifestyle modifications such as dietary changes, increased physical activity and behavioral interventions [1, 5]. While these approaches are fundamental to initiating weight loss and improving health, they often fail to produce long-term results for many individuals [6]. This limitation is partly due to complex physiological adaptations that occur in response to weight loss, including metabolic slowdown and increased appetite, which traditional interventions may not adequately address [7].

Recent advancements include the introduction of pharmacological interventions to promote obesity management. Glucagon-like peptide-1 (GLP-1) receptor agonists (e.g., semaglutide, marketed as Wegovy and Ozempic) [8], and dual GLP-1/gastric inhibitory polypeptide (GIP) receptor agonists like tirzepatide (Mounjaro) [9], represent breakthroughs by targeting physiological pathways that regulate appetite and energy balance. These pharmacotherapies demonstrated the ability to achieve and maintain significant weight loss, ranging from 10% to 20% over two years, serving as promising adjuncts to lifestyle interventions [10, 11].

Notably, the National Institute for Health and Care Excellence (NICE) recognized the significant role of digital tools in supporting weight management and provided guidance on the integration of digital health interventions that offer evidence-based behavioral support to individuals aiming to manage their weight effectively [12]. These tools should be designed to promote sustained weight loss through ongoing engagement, personalized feedback and tailored advice, complementing pharmacological treatments like GLP-1 receptor agonists. The incorporation of such digital platforms aligns with NICE's broader strategy to enhance the accessibility and effectiveness of obesity management programs across diverse populations whilst supporting the weight loss journey of individual self-carers who are overweight but otherwise healthy, as well as patients who need to lose weight to tackle multiformity.

However, significant weight loss is not solely a product of medication use but also depends on sustained behavior change and self-care approaches to promote adherence to treatment protocols. Behavioral factors critically influence the success of weight loss interventions [13]. Supported self-management weight loss programs involving pharmacotherapy, such as the digitally enabled Voy, incorporate behavioral change components and utilize technology to promote end-user engagement. By integrating behavior change theories like Social Cognitive Theory [14] and facilitating self-monitoring, goal setting and feedback mechanisms, these platforms encourage patients to actively manage their health and wellbeing journey in the community and other settings [15] [16]. Behavioral activation complements weight loss interventions by helping individuals identify and engage in positive, goal-oriented activities that align with their health objectives. It emphasizes breaking the cycle of avoidance or inactivity often associated with obesity, replacing these behaviors with structured, rewarding actions like regular physical activity, healthy eating, and consistent self-monitoring [17]. By focusing on small, achievable steps, behavioral activation builds motivation and self-efficacy, which are crucial for sustained adherence to treatment protocols. When combined with digital tools, such as goal-setting features and real-time feedback, this approach empowers individuals to take ownership of their weight management journey, enhancing both engagement and long-term outcomes [18]. Multicomponent interventions are attractive because they address both the physiological and behavioral aspects of obesity. This approach potentially enhances the effectiveness of pharmacological treatments through ongoing support and education using real-time microlearning approaches to promote individual self-care capability [19], as well as through supporting the adoption of health-seeking self-care behaviors using nudges and personalized insights delivered using an accessible digital platform [20, 21].

Clinically significant weight loss is typically defined as a reduction of at least 5% of initial body weight [22], which is associated with improvements in obesity-related comorbidities such as hypertension, dyslipidemia, and insulin resistance [23]. Achieving weight loss of 10% or more is linked to additional health benefits, including enhanced glycemic control, decreased need for diabetic medications, and reduced risk of cardiovascular events [24]. Weight loss of 15% or greater can lead to substantial clinical improvements, such as remission of type 2 diabetes and significant reductions in cardiovascular risk factors [25]; ultimately interventions in obesity management that aim to reduce weight should ideally also reach thresholds that confer meaningful health benefits.

Digitally supported self-care approaches [26] and supported self-management are integral to lifestyle medicine [27]. Despite the rapid adoption of digital health technologies, there remains a substantial gap in understanding how these digital interventions can complement pharmacological treatments in obesity for improved clinical outcomes compared to pharmacological treatment alone. Randomized controlled trials have examined eHealth platforms with behavioral change coaching for weight loss [28]. However, existing literature is limited, as the integration of digital platforms with pharmacological therapy for weight loss has yet to be extensively researched due to its novelty [29-31].

Objectives

The aim of this study was to address this gap by exploring the impact of engagement with app-based digital weight loss programs that combine pharmacotherapy using GLP-1 receptor agonists semaglutide and the dual GLP-1/GIP receptor agonist tirzepatide. Considering that the ideal focus is on achieving and sustaining clinically significant weight loss through digital engagement support over specified durations, this study sought to provide valuable insights

into the potential and limitations of digital health strategies in enhancing the efficacy of obesity management.

Methods

Study Design and Setting

This retrospective 2-arm study was conducted to assess the effectiveness of GLP-1 receptor agonists. Specifically semaglutide (marketed as Wegovy and Ozempic) and the dual GLP-1/GIP receptor agonist tirzepatide (marketed as Mounjaro) within a digitally delivered weight management program. The evaluation utilized data extracted from the Voy digital health platforms, which provided remote support through digital tools, including direct delivery of pharmacotherapy.

The study period spanned February 2023 to August 2024, including up to 5 months of data for participants using both semaglutide and tirzepatide. The selection of 5-month follow-up duration was based on data availability, representing a cross-sectional cohort of individuals who were recently onboarded to the platform for the weight loss service, allowing for a consistent assessment of early treatment outcomes across all participants in the initial 5 months where significant weight loss is typically observed [9].

Procedure

Participants enrolled in the Voy digital health platform's weight management program, which integrates GLP-1 receptor and GLP-1/GIP receptor agonist pharmacotherapies with digital behavioral support to enhance weight loss outcomes (see Figure 1. flow chart). Upon enrollment, participants underwent an initial assessment to confirm eligibility, including verification of age, BMI, and absence of exclusion criteria as outlined in *eligibility criteria* below. Participants also completed online asynchronous consultations, which included medical suitability checks, identity verification through photo ID, and submission of any required documentation. Baseline demographic information, medical history and lifestyle factors were requested at the initiation of the program.

Eligible participants received prescriptions for either semaglutide or tirzepatide based on clinical considerations. Medications were delivered directly to participants, with comprehensive medication management provided through the platform. Instructional materials ensured correct medication administration, and participants had unlimited consultations with guidance and support from a team of clinicians and coaches.

Participants attended group onboarding sessions and were offered fortnightly coaching to enhance engagement and adherence. Coaches were trained based on principles from Social Cognitive Theory, Self-Determination Theory, the Transtheoretical Model, and the Theory of Planned Behavior [14, 32-34]. These techniques focused on fostering intrinsic motivation, goal setting, and problem-solving to promote sustainable lifestyle changes tailored to participants' individual progress and challenges [21]. Participants were encouraged to actively engage with the App's dynamic educational content, which adapted based on their engagement with specific topics, including nutrition, physical activity, and lifestyle factors impacting weight management. The educational content aimed to enhance self-efficacy and equip participants with practical skills to sustain weight loss over time [35].

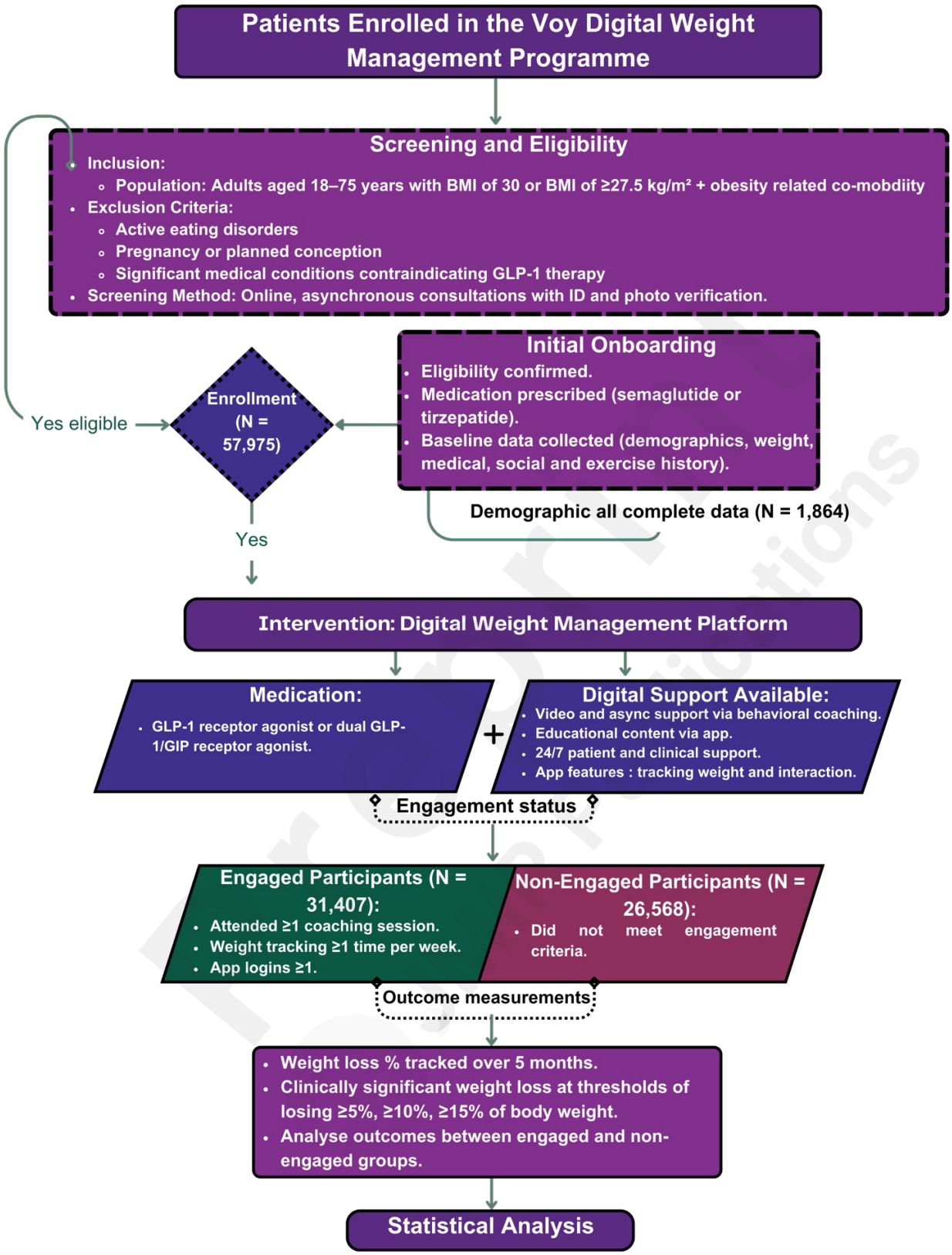


Figure 1. Flowchart illustrating the critical steps of the retrospective analysis conducted for the Voy digital weight management programme.

Participants

Participants were adult residents of the United Kingdom, aged between 18 and 75 years, with a body mass index (BMI) of 30 kg/m^2 or higher, or >27.5 kg/m^2, with presence of obesity related comorbidities. All participants initiated a weight management program involving either semaglutide or tirzepatide.

Eligibility Criteria

Eligibility required access to a smartphone or tablet to engage with the digital health platform. Exclusion criteria included history of self-reported eating disorders (e.g., anorexia nervosa, bulimia nervosa), pregnancy or active attempts to conceive, known allergies or hypersensitivity to any components of the prescribed medications, and severe medical conditions such as a personal or family history of medullary thyroid carcinoma, multiple endocrine neoplasia syndrome type 2, significant hepatic impairment, renal impairment requiring dialysis, uncontrolled cardiovascular diseases, or severe gastrointestinal disorders (e.g., gastroparesis, pancreatitis). Participants who met the eligibility criteria were identified through the digital health platforms' databases. All eligible individuals who initiated the program within the study period were included, resulting in a sample reflective of real-world clinical practice.

Data Availability

Engagement metrics and weight loss outcomes were available for the entire sample of 57,975 participants who used the digital platform during the study period. Complete demographic information (e.g., age, sex, ethnicity) was available for a subset of 1,864 participants who enrolled during the initial phase of the service. This subset represents the early adopters for whom detailed baseline data were systematically collected to inform program development and initial evaluations.

Defining Engagement and Outcome

The primary outcome measured in this study was the degree of weight loss measured in percentage weight change. Engagement with the digital platform's program was evaluated as an exposure variable, with levels of engagement assessed for their impact on the outcome of weight loss.

Participants were categorized into "engaged" or "non-engaged" groups based on their interaction with the following components of the program: (i) attendance at weight coaching sessions, (ii) regularity of weight tracking, and (iii) frequency of app usage. The categorization of engagement was determined with input from the clinical team delivering the intervention.

Participants were classed as engaged if they met any number of the below criteria during the study: (i) attended at least one weight coaching session, (ii) tracked weight at least once per week, and/or (iii) logged into the App at least once. Otherwise, participants were classified as non-engaged.

Variables

The primary outcome of the study was the percentage weight change from baseline, calculated as the aggregated average of each individual's weekly weight change converted to a monthly average and then pooled across all participants. This outcome included the effect of weight loss medication use, reaching clinically significant weight loss thresholds defined as loss of ≥5%, ≥10%, and ≥15% of baseline weight. Engagement with the digital platform was assessed as an

exposure variable, whereas engagement level was measured by quantifying components such as attendance at coaching sessions, tracking weight within the app and logging into the app. Other exposure variables included the type of medication used, categorized as semaglutide or tirzepatide.

Statistical Analysis

Descriptive statistics were used to summarize baseline characteristics, with means and standard deviations (SD) for continuous variables and frequencies and percentages for categorical variables. Chi-square tests were used to compare the proportion of participants achieving clinically significant weight loss (≥5%, ≥10%, and ≥15% of baseline weight) between the engaged and non-engaged groups. In cases where small sample sizes or low expected frequencies were present (i.e. n <5), Fisher's exact test was used. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated to quantify the strength of the association between engagement and weight loss success through 2x2 contingency tables.

To assess the time-to-event data for achieving clinically significant weight loss, Kaplan-Meier survival analysis was performed, comparing the time to reach ≥5%, ≥10%, and ≥15% weight loss between the engaged and non-engaged groups. The log-rank test was used to evaluate the statistical significance of differences between the survival curves of the two groups. This approach allowed us to visualize the cumulative incidence of weight loss over time and assess the role of engagement in accelerating weight loss success.

An independent sample t-test was used to compare the mean weight change between the engaged and non-engaged groups. Cohen's d was calculated to determine the effect size, providing insight into the magnitude of differences between groups. Prior to conducting the t test, assumptions of normality and homogeneity of variances were assessed using the Shapiro–Wilk test. When assumptions were violated, a nonparametric alternative, the Mann–Whitney U test, was considered.

All statistical analyses were performed using R (version 4.3.1) and its statistical packages. A significance level of $P < .05$ was set for all statistical tests.

Sample Size Calculation

A sample size calculation was performed to estimate the number of participants required to detect a significant difference in weight loss between engaged and non-engaged groups. Using an estimated effect size of a 15% difference in the proportion of participants achieving ≥10% weight loss between groups, with an expected 30% of engaged participants and 15% of non-engaged participants achieving this outcome, a minimum of 118 participants per group was calculated to provide 80% power at a 5% significance level. To account for attrition, a target sample size of 250 participants per group was set.

Baseline demographic information, medical history and lifestyle factors were requested at the initiation of the program. Data concerning medication adherence were monitored through self-reports and prompted reminders. All data were anonymized upon extraction to ensure confidentiality in compliance with the General Data Protection Regulation (GDPR).

Bias and Missing Data

Self-reported weight measurements could introduce reporting bias. To mitigate this, participants were encouraged to provide accurate measurements through regular reminders

and had the option to upload progress photographs, enhancing data validity. Additionally, data validation checks were performed to identify and address implausible values. Selection bias was minimized by including all eligible participants who initiated the program within the study period, ensuring the sample was representative of the population utilizing these services.

Ethical Considerations

Imperial College Research Ethics Committee (REC) provided a favorable opinion for this study (ICREC#7363051). As this evaluation utilized anonymized data collected during routine care, formal ethical approval from the National Health Service (NHS) REC was not required under NHS standards for service evaluations. The study adhered to the principles outlined in the Declaration of Helsinki. Participants provided informed consent for their anonymized data to be used for research and service improvement purposes upon enrollment in the program. Data protection and confidentiality were strictly maintained in compliance with GDPR regulations.

Adherence to STROBE Guidelines

To improve the quality of the reporting, this study adhered to the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines [36] (See Supplementary. File 1).

Results

Participant Characteristics

A total of 57,975 participants were included in the engagement and outcome analyses. Among these, 31,407 (54.2%) were classified as engaged and 26,568 (45.8%) as non-engaged at baseline (month 0). Due to changes in data collection practices over time and staggered onboarding during the study period, the number of participants reporting weight data decreased at subsequent time points, comprehensive demographic and clinical characteristics were available for a subset of 1,864 participants who enrolled at the inception of the service. The characteristics of this subset are presented in **Table 1**.

Table 1. Baseline characteristics of participants with available data (N = 1,864).

Characteristic	**Value**
Age, mean (SD), years	45.2 (± 10.5)
Sex, n (%)	
Female	1,592 (85.4%)
Male	272 (14.6%)
BMI, mean (SD), kg/m²	34.9 (± 4.9)
Weight, mean (SD), kg	96.2 (± 20.9)
Ethnicity, n (%)	
White British/Irish	1,439 (77.2%)
White Other	199 (10.7%)
Asian Indian	39 (2.1%)

Asian Pakistani	21 (1.1%)
Black African	32 (1.7%)
Other Ethnic Groups	134 (7.2%)
Comorbidities, n (%)	
Type 2 Diabetes	80 (4.3%)
High Blood Pressure	289 (15.5%)
High Cholesterol	193 (10.4%)
Osteoarthritis	123 (6.6%)
Chronic Back Pain	231 (12.4%)
Depression	512 (27.5%)
Lifestyle Factors, n (%)	
Smoking Status	
Never Smoked	945 (50.7%)
Ex-smoker	433 (23.2%)
Current Smoker	108 (5.8%)
Not Answered	378 (20.3%)
Alcohol Consumption/weekly	
None (0 units)	765 (41.1%)
1–6 units	235 (12.6%)
7+ units	864 (46.3%)
Dietary Habits	
Balanced Diet	1,238 (67.5%)
High in Animal Products	293 (16.0%)
Vegetarian/Vegan	132 (7.1%)
Not Answered	175 (9.4%)
Physical Activity	
Daily	180 (9.7%)
Regularly (3–4/week)	626 (33.6%)
Occasionally (1–2/week)	702 (37.7%)
Rarely/Never	356 (19.1%)
Family History of Obesity, n (%)	988 (53.1%)
Medications, n (%)	
Blood Pressure Meds	211 (11.3%)
Cholesterol Meds	182 (9.8%)
Diabetes Meds	136 (7.3%)
Thyroid Meds	97 (5.2%)
Antidepressants	247 (13.2%)

Engagement Levels

At baseline (month 0), among the 57,975 participants who tracked their weight, 31,407

(54.2%) were engaged, and 26,568 (45.8%) were non-engaged. Engagement levels decreased over time, with 3,622 (6.3%) engaged participants remaining at month 5 (Table 2.).

Table 2. Mean percentage of weight loss by engagement in participants taking medication and using the digital platform. All weight loss values are mean aggregates and are in a negative value. **P*-values derived from independent t-test.

Month from Medication Start	Engagement	Mean % Weight Lost (95% CI)	Absolute % Point Difference	*P*-Value*	Effect size (*d*)	Relative % Difference	Number of Patients	Total Patients
0	No	N/A					26568	
0	Yes	N/A	0.00	N/A	0.00	N/A	31407	57975
1	No	2.87 (2.86 - 2.88)					1429	
1	Yes	3.84 (3.83 - 3.85)	0.97	<.001	0.179	33.8	21877	23306
2	No	5.03 (5.01 - 5.05)					1848	
2	Yes	6.90 (6.89 - 6.91)	1.88	<.001	0.291	37.4	12978	14826
3	No	5.93 (5.90 - 5.96)					1691	
3	Yes	9.04 (9.02 - 9.06)	3.11	<.001	0.891	52.4	8429	10120
4	No	6.99 (6.95 - 7.03)					1331	
4	Yes	10.67 (10.64 - 10.70)	3.68	<.001	0.616	52.7	5495	6826
5	No	7.97 (7.93 - 8.01)	3.53	<.001	0.560	44.3	1377	4999

Weight Loss Outcomes

Weight Loss by Engagement Status

Engaged participants consistently achieved greater weight loss compared to non-engaged participants at each time point (Figure 2). At month 1, engaged participants experienced a mean weight loss of 3.8% (95% CI: 3.9% to 3.8%), whereas non-engaged participants had a mean weight loss of 2.9% (95% CI: 2.9% to –2.9%), a significant difference ($P < .001$). This trend persisted over subsequent months. By month 5, engaged participants had a mean weight loss of 11.5% (95% CI: 11.6% to 11.5%), while non-engaged participants had a mean weight loss of 8.0% (95% CI: 8.0% to 7.9%), a significant difference of 3.56 percentage points ($P < .001$).

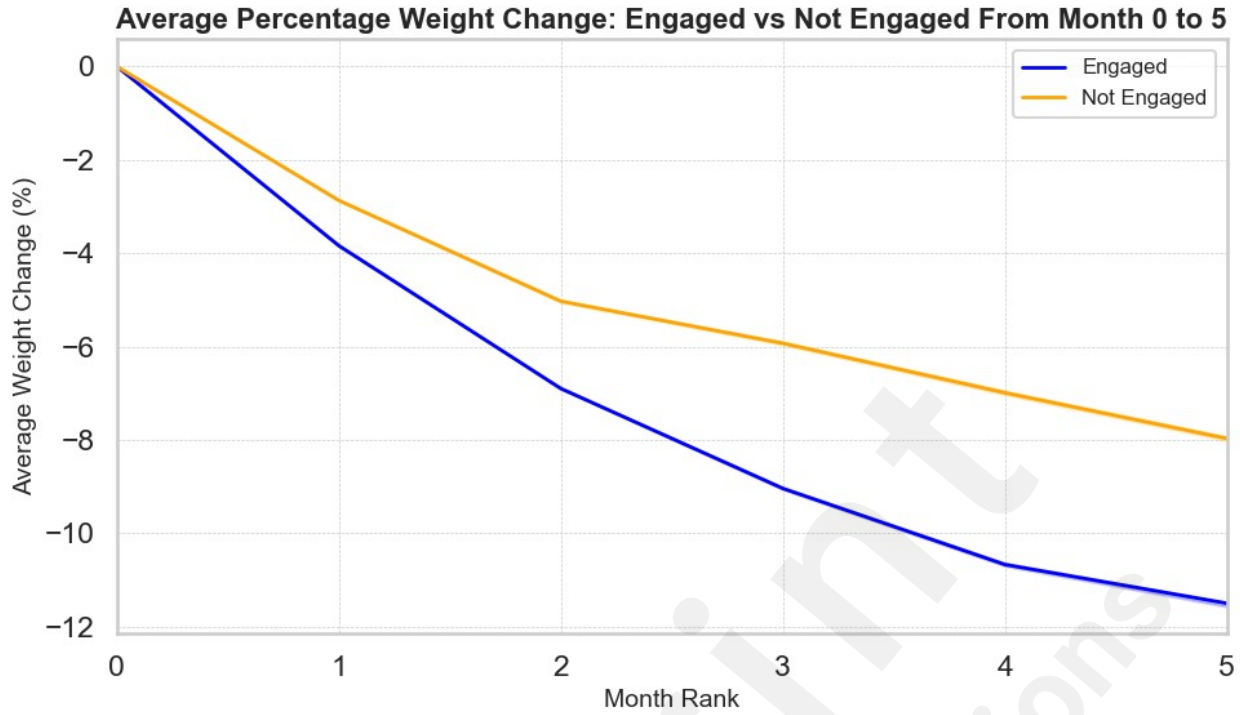


Figure 2. Average weight loss (Kg) trajectory over time by engagement status.

Weight Loss by Medication Type

Participants were prescribed either semaglutide or tirzepatide (Mounjaro). Weight loss trajectories differed significantly between the two medication groups over the study period (Figure 3.; Appendix 1. Table 6.). At month 5, participants using tirzepatide achieved a mean weight loss of 13.9% (95% CI: 14.3% to 13.5%), significantly greater than the 9.5% (95% CI: 9.7% to 9.2%) observed in semaglutide users ($P < .001$).

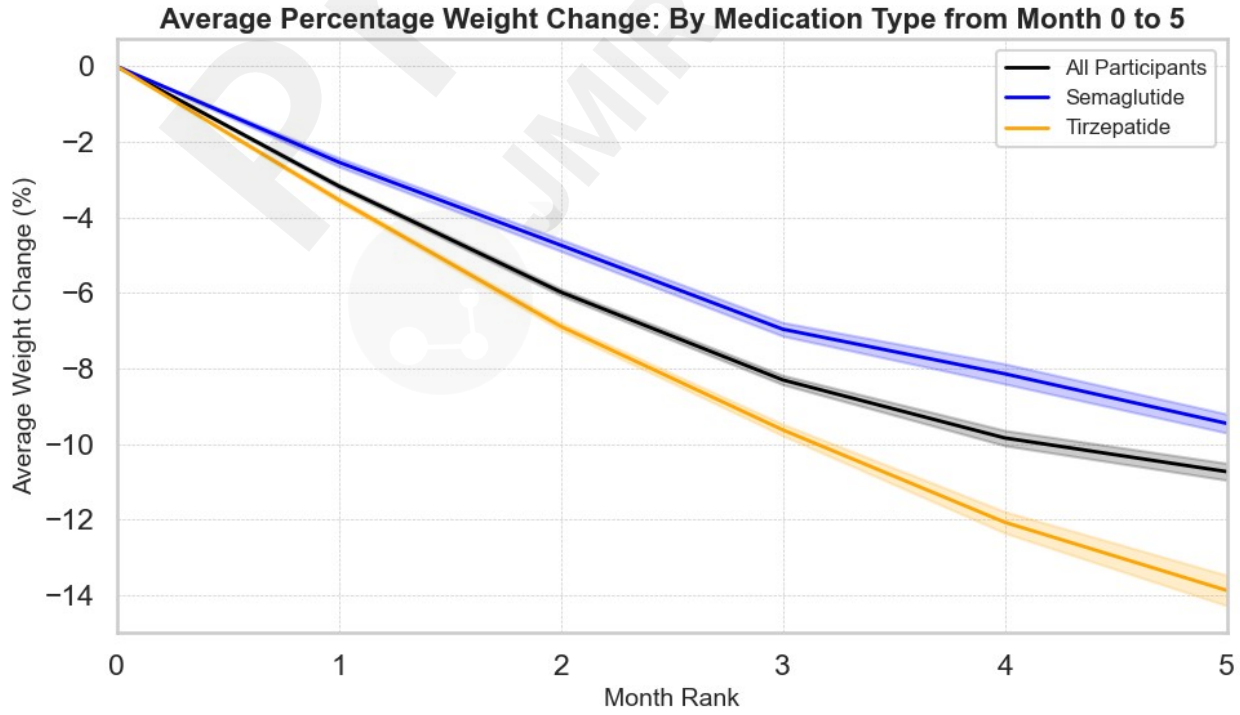


Figure 3. Depicts the mean percentage of weight loss over time by medication type. ‘All

participants' shows the combined weight loss trajectory for both tirzepatide and semaglutide users.

Proportion Achieving Clinically Significant Weight Loss

The proportion of participants achieving clinically significant weight loss thresholds (≥5%, ≥10%, and ≥15% of baseline weight) was higher among engaged participants compared to non-engaged participants. At the ≥5% weight loss threshold, engaged participants had significantly higher odds of achieving this goal compared to non-engaged participants at all assessed time points. **Table 3** Presents the detailed odds ratios for achieving ≥5% weight loss over time.

Table 3. Odds Ratios for Achieving ≥5% Weight Loss by Engagement Status. **P*-value derived from Chi-squared test.

Month	Engaged Achieved Goal (n)	Engaged Did Not Achieve Goal (n)	Non-Engaged Achieved Goal (n)	Non-Engaged Did Not Achieve Goal (n)	Odds Ratio	95% CI	*P*-Value*
1	3,083	17,332	104	1,066	1.82	1.49–2.24	<.001
2	6,386	6,678	140	612	4.18	3.47–5.04	<.001
3	5,454	3,522	136	352	4.01	3.27–4.91	<.001
4	3,850	2,198	99	214	3.79	2.97–4.83	<.001
5	2,664	1,705	69	117	2.65	1.96–3.59	<.001

For the ≥10% weight loss threshold, significant differences emerged from month 2 onward. Table 4 provides the odds ratios for achieving ≥10% weight loss over time.

At the ≥15% weight loss threshold, significant differences were observed at months 3 and 4. Table 5 details the odds ratios for achieving ≥15% weight loss over time.

Table 4. Odds Ratios for Achieving ≥10% Weight Loss by Engagement Status. **P*-value derived from Chi-squared test.

Month	Engaged Achieved Goal (n)	Engaged Did Not Achieve Goal (n)	Non-Engaged Achieved Goal (n)	Non-Engaged Did Not Achieve Goal (n)	Odds Ratio	95% CI	*P*-Value*
1	331	20,084	25	1,145	0.75	0.50-1.14	0.22
2	1,246	11,818	26	726	2.94	1.98–4.37	<.001
3	2,378	6,598	51	437	3.09	2.30–4.14	<.001
4	2,217	3,831	39	274	4.07	2.90–5.71	<.001
5	1,722	2,647	34	152	2.91	2.00–4.24	<.001

Table 5. Odds Ratios for Achieving ≥15% Weight Loss by Engagement Status. **P*-value derived from Chi-squared test.

Mont	Engaged	Engaged Did	Non-	Non-	Odds	95% CI	*P*-Value*

h	Achieved Goal (n)	Not Achieve Goal (n)	Engaged Achieved Goal (n)	Engaged Did Not Achieve Goal (n)	Ratio		
1	93	20,322	12	1,158	0.44	0.24–0.81	.01
2	176	12,888	11	741	0.92	0.50–1.70	0.92
3	509	8,467	9	479	3.20	1.64–6.22	<.001
4	793	5,255	14	299	3.22	1.88–5.54	<.001
5	752	3,617	20	166	1.73	1.08–2.76	.03

Time to Achieve Weight Loss Thresholds

Kaplan-Meier analyses (Figures 4–6) revealed significant differences in the proportions of individuals achieving 5%, 10%, and 15% weight loss over 5 months between engaged and non-engaged participants. For example, at month 4, the proportion not achieving the 5% threshold was 49.3% for engaged participants compared to 69.8% for non-engaged participants (P < .001). Similarly, by month 5, 59.9% of engaged participants had yet to achieve the 10% threshold compared to 81.5% of non-engaged participants (P < .001). For the 15% threshold, while differences were less pronounced, 86.5% of engaged participants had not reached this target by month 5, compared to 93.5% of non-engaged participants (P = .017). These findings underscore the role of engagement in facilitating weight loss, with the effect diminishing at higher thresholds.

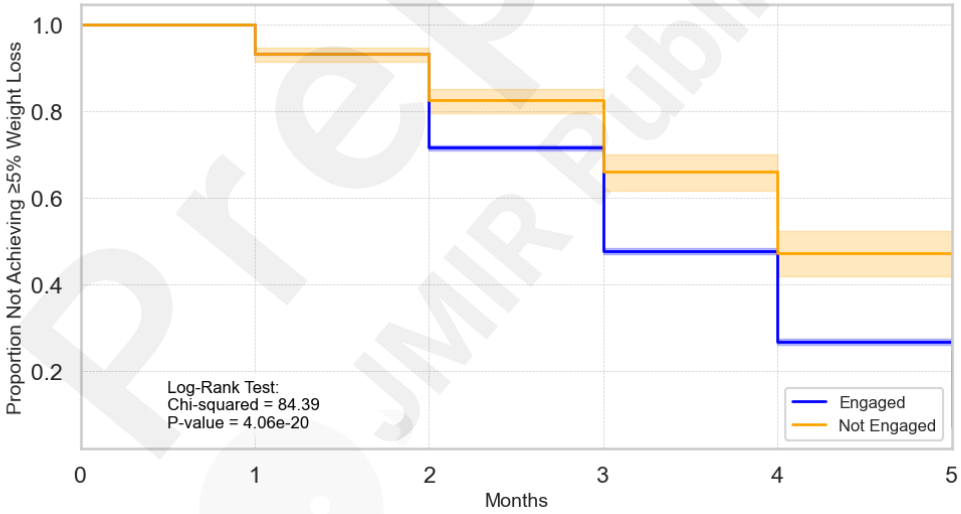


Figure 4. Kaplan–Meier survival curves for time to achieve ≥5% weight loss by engagement status.

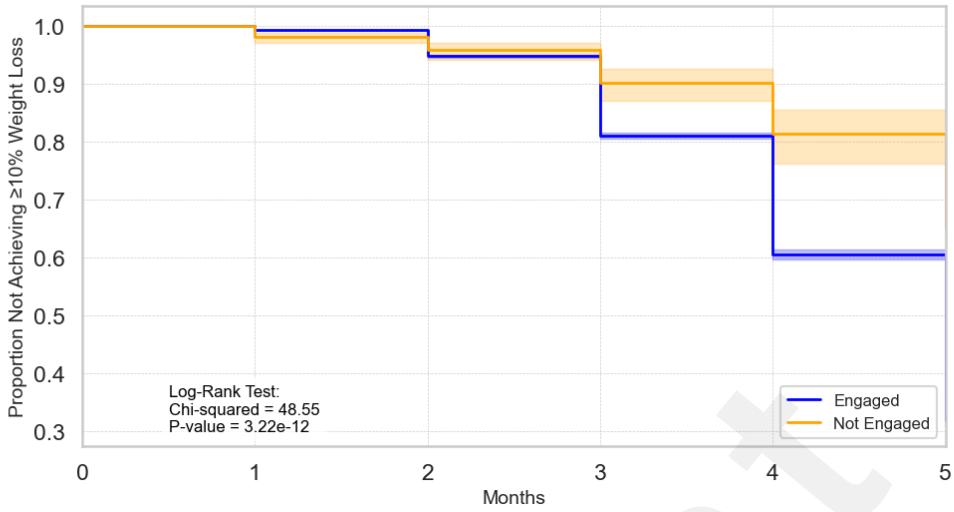


Figure 5. Kaplan–Meier survival curves for time to achieve ≥10% weight loss by engagement status.

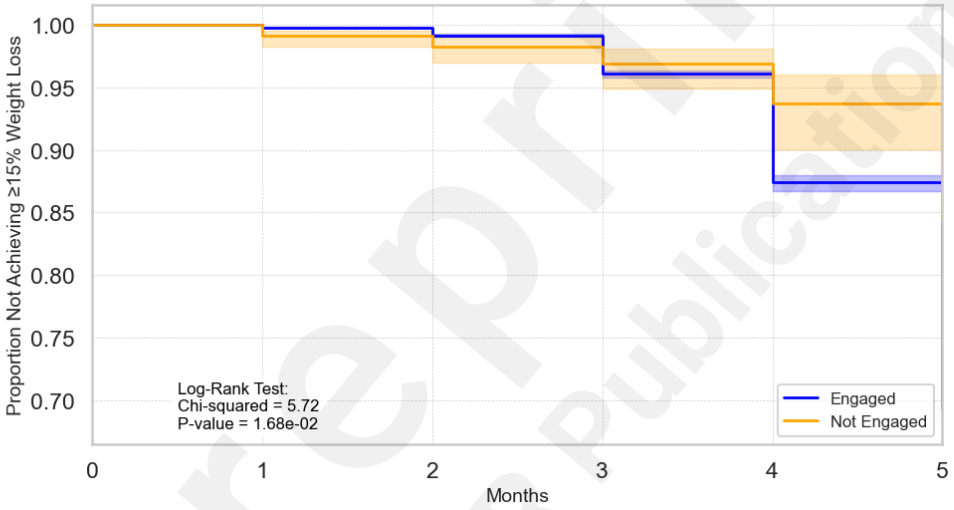


Figure 6. Illustrates the Kaplan–Meier survival curves for time to achieve ≥15% weight loss by engagement status.

Discussion

Principal Results

This study provided compelling evidence that engagement with digital health platforms significantly enhances weight loss outcomes among individuals undergoing pharmacotherapy with GLP-1 receptor agonists for obesity management. Engaged participants achieved greater mean weight loss over time and reached clinically significant weight loss thresholds more rapidly than their non-engaged counterparts. The superior efficacy of tirzepatide over semaglutide observed in this real-world study aligns with findings from recent clinical trials reinforcing the potential of dual agonist therapies in obesity management [37].

Limitations

The principal limitation of this study was the potential selection bias, as participants who chose

to engage with the digital platform may inherently possess higher motivation levels or greater health literacy. This could confound the relationship between engagement and weight loss outcomes. Although we sought to minimize this selection bias by including all eligible participants, unmeasured confounding must be considered. The discrepancy in available demographic data and the reduction in participant numbers over time may also introduce attrition bias. We also acknowledge that missing data on key variables limits the ability to adjust for confounders and affects the representativeness of the sample.

The discrepancy in demographic data collection reflects adaptations made during program scaling to improve accessibility. Initially, comprehensive data were collected; however, this was streamlined to simplify onboarding and enhance user experience, prioritizing essential data for engagement analysis. While this approach limits detailed subgroup analysis, the broader dataset ensures robust insights into program effectiveness. The collection of data and availability of participant information may account for reducing participant numbers at time intervals. Also, participants may have chosen to no longer engage with the provider. This was retrospective data, and missing observations are more common [38].

Reliance on self-reported weight data also introduces the potential for reporting bias, as participants may underreport or overreport their weight due to social desirability or recall bias. The provision of options to upload progress photographs may mitigate this but does not eliminate the issue. Crucially, the absence of a randomized control group limits the ability to establish causality definitively. Observed associations may also be influenced by unmeasured confounding variables or external factors. Pertinently, the maximum follow-up period of 5 months may not capture long-term weight maintenance or the sustainability of engagement with the digital platform. Given that weight regain is a common challenge in obesity management, longer-term studies are needed to assess enduring effects.

The study population was predominantly female and of White British/Irish ethnicity, which also may limit the generalizability of the findings to more diverse populations as cultural, socioeconomic and gender differences may influence engagement and weight loss outcomes. Additionally, whereas only a subset of 1,864 participants was available for analysis, we acknowledge that this subset may not likely be representative of the total population..

We also acknowledge that the requirement for smartphone or tablet access may exclude individuals from lower socioeconomic backgrounds or older adults less comfortable with technology, potentially exacerbating health disparities.

.

Building on the insights from this study, future research should conduct RCTs comparing pharmacotherapy with and without digital behavioral support to establish causality and quantify the added benefit of digital engagement. Qualitative studies investigating user experiences, barriers to engagement and facilitators of sustained use can inform the design of more effective digital interventions. Longitudinal studies with extended follow-up periods are needed to evaluate the sustainability of weight loss and the impact of ongoing engagement on weight maintenance and metabolic health. Efforts to collect comprehensive demographic and clinical data for all participants will improve the ability to adjust for confounding factors and understand the differential effects across subgroups.

Research should focus on strategies to streamline timely access to supported self-management technologies, including pharmacotherapy, cognitive behavior therapy approaches and digital

self-care interventions among diverse populations, including those with limited digital literacy, to ensure equitable benefits and reduce health disparities. Incorporating microdata from wearables, biomarker assessments, and validated scales for psychological measures, quality of life and individual self-care capability can enhance the accuracy of outcomes and provide a more holistic evaluation of health improvements.

Comparison with Prior Work

The integration of supported self-care interventions involving pharmacotherapy into obesity management represents a major shift that can help address the various challenges associated with weight loss and maintenance. Digital platforms offer scalable, personalized and accessible supported self-management solutions that transcend traditional barriers to healthcare delivery [39]. In this example, the digital platforms facilitated self-monitoring, behavioral coaching and personalized feedback components that are critical to promoting sustained behavior change. The theoretical foundations of digital interventions are grounded in established behavior change models such as the Transtheoretical Model and Self-Determination Theory [40], emphasizing self-efficacy, intrinsic motivation and readiness to change [41]. By providing real-time feedback and reinforcing positive behaviors, digital platforms can strengthen self-regulatory processes essential for weight management [42].

The increasing pervasiveness of mobile health technologies facilitates continuous engagement and data collection [43] and presents an unprecedented opportunity for self-driven healthcare approaches to deliver interventions at scale and reach populations traditionally underserved or facing barriers to in-person care [26]. The enhanced weight loss observed among engaged participants highlights the potential of digital platforms to augment traditional treatment modalities.

Several synergistic mechanisms likely contributed to the enhanced weight loss observed among engaged participants. Enhanced self-monitoring and accountability are fundamental, as frequent tracking of weight and behaviors is a consistent predictor of weight loss success [44]. Digital self-care platforms simplify this process through user-friendly interfaces and automated reminders, reducing the burden of manual tracking and increasing adherence (37). Tailored interventions have been shown to be more effective than generic advice in promoting behavior change for weight loss [45]. This is likely because personalized behavioral support provided through coaching and tailored feedback also addresses individual barriers and facilitators to weight loss, further enhancing motivation and self-efficacy [46]. The principles of behavioral activation with a focus on action following analysis of behaviors enables a structured problem-solving approach that provides a treatment foci related to change [47]. This incorporation of evidence-based behavior change techniques, such as goal setting, action planning and problem-solving, is associated with improved weight loss outcomes [48]. Features enabling interaction with peers or health professionals provide social support, which is a critical determinant of weight management success [49], whereas social comparison and normative influence may further motivate adherence to weight loss plans [50]. Regular engagement with the app may also facilitate the formation of automatic healthy behaviors through repetition and reinforcement, as suggested by Habit Formation Theory [51]. Combining behavioral interventions with pharmacotherapy may produce a synergistic effect, enhancing the biological mechanisms of weight loss medications through improved adherence and lifestyle modifications [52].

Our findings align with and extend existing literature on integrating digital interventions with pharmacological treatments for obesity. Previous studies have demonstrated that digital behavioral interventions can enhance the effectiveness of weight loss medications [53]. For example, a meta-analysis by Beleigoli et al. [54] found that web-based interventions resulted in modest but significant additional weight loss compared to standard care. The superior weight loss outcomes associated with tirzepatide in our study are also consistent with clinical trials demonstrating its efficacy over other GLP-1 receptor agonists [55, 56]. We acknowledge that the dual action on GIP and GLP-1 receptors may confer additive or synergistic effects on glycemic control and appetite regulation, leading to greater weight reductions [57].

Conclusions

This study provided compelling evidence that structured engagement with a digital self-management platform significantly enhances weight loss outcomes by as much as 53% at month four in engaged individuals undergoing pharmacotherapy for obesity. The integration of digital behavioral support with pharmacological treatments represents a synergistic approach that addresses both the biological and behavioral dimensions of obesity. By facilitating self-monitoring, providing personalized feedback and using nudge and gamification to promote sustained engagement, digital self-management tools can amplify the effectiveness of pharmacotherapies. As the prevalence of obesity continues to rise globally, innovative self-driven healthcare solutions that leverage technology to support behavior change are needed to scale benefits to individuals with non-communicable diseases, and so called “diseases of the lifestyle”.

Acknowledgements

Author Contributions

All authors contributed to the conception and design of the study. HJ performed the data analysis and interpretation of the results, along with MA (interpretation). VL and HJ ran the statistical analysis, with assessment of analysis by MA. HJ, DH,VL, CJ, and AO drafted the manuscript, and all authors critically reviewed and approved the final version for publication

Funding

No external funding was received for this study. The research was conducted as part of routine service evaluation activities within the organization. AO is supported by the National Institute for Health and Care Research (NIHR) Applied Research Collaboration (ARC) Northwest London. The views expressed are those of the authors and not necessarily those of the NHS, the NIHR or the Department of Health and Social Care.

Conflicts of Interest

The authors HJ, DH, and VL are members within the organization Voy, Menwell™; HJ is the clinical researcher, DH is the innovation director, and VL is the research lead. The authors AO, MA and CJ declare that they have no conflicts of interest relevant to the content of this article.

Abbreviations

BMI: body mass index

CI: confidence interval
GDPR: General Data Protection Regulation
GIP: gastric inhibitory polypeptide
GLP-1: glucagon-like peptide-1
NHS: National Health Service
OR: odds ratio
RCT: randomized controlled trial
SD: standard deviation
STROBE: Strengthening the Reporting of Observational Studies in Epidemiology

Appendix 1

Table 6. The table provides a detailed summary of weight change data across six time points (Month Rank 0 to 5) for three groups: All participants, those on Semaglutide, and those on Mounjaro. *P-value derived from independent t-test.

Month Rank	Avg Weight Change (%) - All (95% CI)	Avg Weight Change (%) - Semaglutide (95% CI)	Avg Weight Change (%) - Tirzepatide (95% CI)	*P-Value** (Semaglutide vs Tirzepatide)
0	0 (0–0)	0 (0–0)	0 (0–0)	N/A
1	-3.17 (-3.23–-3.11)	-2.54 (-2.66–-2.42)	-3.54 (-3.60–-3.47)	<.001
2	-5.98 (-6.07–-5.89)	-4.74 (-4.89–-4.58)	-6.89 (-6.99–-6.78)	<.001
3	-8.31 (-8.43–-8.18)	-6.96 (-7.14–-6.78)	-9.63 (-9.78–-9.48)	<.001
4	-9.84 (-10.05–-9.64)	-8.14 (-8.41–-7.88)	-12.08 (-12.36–-11.79)	<.001
5	-10.74 (-10.96–-10.51)	-9.46 (-9.71–-9.21)	-13.88 (-14.29–-13.48)	<.001

Supplementary File 1

S.1 Adherence to STROBE Guidelines

This study adhered to the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines. Attached with paper.

References

1. Elmaleh-Sachs A, Schwartz JL, Bramante CT, Nicklas JM, Gudzune KA, Jay M. Obesity Management in Adults: A Review. Jama 2023 Nov 28;330(20):2000-15. PMID: 38015216. doi: 10.1001/jama.2023.19897.
2. Felisbino-Mendes MS, Cousin E, Malta DC, Machado Í E, Ribeiro ALP, Duncan BB, et al. The burden of non-communicable diseases attributable to high BMI in Brazil, 1990-2017: findings from the Global Burden of Disease Study. Popul Health Metr 2020 Sep 30;18(Suppl

1):18. PMID: 32993699. doi: 10.1186/s12963-020-00219-y.
3. El-Osta A, Webber D, Gnani S, Banarsee R, Mummery D, Majeed A, et al. The Self-Care Matrix: A unifying framework for self-care. SelfCare 2019;10(3):38-56.
4. Dobbs R, Sawers C, Thompson F, Manyika J, Woetzel JR, Child P, et al. Overcoming obesity: an initial economic analysis: McKinsey global institute; 2014.
5. Hartmann-Boyce J, Johns DJ, Jebb SA, Summerbell C, Aveyard P. Behavioural weight management programmes for adults assessed by trials conducted in everyday contexts: systematic review and meta-analysis. Obes Rev 2014 Nov;15(11):920-32. PMID: 25112559. doi: 10.1111/obr.12220.
6. Machado AM, Guimarães NS, Bocardi VB, da Silva TPR, Carmo ASD, Menezes MC, et al. Understanding weight regain after a nutritional weight loss intervention: Systematic review and meta-analysis. Clin Nutr ESPEN 2022 Jun;49:138-53. PMID: 35623805. doi: 10.1016/j.clnesp.2022.03.020.
7. Greenway FL. Physiological adaptations to weight loss and factors favouring weight regain. Int J Obes (Lond) 2015 Aug;39(8):1188-96. PMID: 25896063. doi: 10.1038/ijo.2015.59.
8. Moore PW, Malone K, VanValkenburg D, Rando LL, Williams BC, Matejowsky HG, et al. GLP-1 Agonists for Weight Loss: Pharmacology and Clinical Implications. Adv Ther 2023 Mar;40(3):723-42. PMID: 36566341. doi: 10.1007/s12325-022-02394-w.
9. de Mesquita YLL, Pera Calvi I, Reis Marques I, Almeida Cruz S, Padrao EMH, Carvalho PEP, et al. Efficacy and safety of the dual GIP and GLP-1 receptor agonist tirzepatide for weight loss: a meta-analysis of randomized controlled trials. Int J Obes (Lond) 2023 Oct;47(10):883-92. PMID: 37460681. doi: 10.1038/s41366-023-01337-x.
10. Rosenstock J, Wysham C, Frías JP, Kaneko S, Lee CJ, Landó LF, et al. Efficacy and safety of a novel dual GIP and GLP-1 receptor agonist tirzepatide in patients with type 2 diabetes (SURPASS-1): a double-blind, randomised, phase 3 trial. The Lancet 2021;398(10295):143-55.
11. Health–Europe TLR. Semaglutide and beyond: a turning point in obesity pharmacotherapy. The Lancet Regional Health-Europe 2024;37. PMID: 38362559.
12. NICE. Digital technologies for delivering multidisciplinary weight-management services: early value assessment. National Institute for Health and Care Excellence 2023 26 October 2023(HTE14).
13. Pigsborg K, Kalea AZ, De Dominicis S, Magkos F. Behavioral and Psychological Factors Affecting Weight Loss Success. Curr Obes Rep 2023 Sep;12(3):223-30. PMID: 37335395. doi: 10.1007/s13679-023-00511-6.
14. Anton S, Das SK, McLaren C, Roberts SB. Application of social cognitive theory in weight management: Time for a biological component? Obesity (Silver Spring) 2021 Dec;29(12):1982-6. PMID: 34705335. doi: 10.1002/oby.23257.
15. Spring B, Duncan JM, Janke EA, Kozak AT, McFadden HG, DeMott A, et al. Integrating technology into standard weight loss treatment: a randomized controlled trial. JAMA Intern Med 2013 Jan 28;173(2):105-11. PMID: 23229890. doi: 10.1001/jamainternmed.2013.1221.
16. El-Osta A, Alkanani Z, Soljak M, Majeed A. Weight Management Pilot Intervention Programme at Imperial College Healthcare NHS Trust. 2019.
17. Carlbring P, Lindner P, Martell C, Hassmén P, Forsberg L, Ström L, et al. The effects on depression of Internet-administered behavioural activation and physical exercise with treatment rationale and relapse prevention: study protocol for a randomised controlled trial. Trials 2013;14:1-8. doi.org/10.1186/1745-6215-14-35.
18. Arnott B, Kitchen CEW, Ekers D, Gega L, Tiffin PA. Behavioural activation for overweight and obese adolescents with low mood delivered in a community setting: feasibility study. BMJ Paediatr Open 2020;4(1):e000624. PMID: 32399504. doi: 10.1136/bmjpo-2019-000624.
19. Wang C, Bakhet M, Roberts D, Gnani S, El-Osta A. The efficacy of microlearning in

improving self-care capability: a systematic review of the literature. Public Health 2020 Sep;186:286-96. PMID: 32882481. doi: 10.1016/j.puhe.2020.07.007.
20. Irvin L, Madden LA, Marshall P, Vince RV. Digital Health Solutions for Weight Loss and Obesity: A Narrative Review. Nutrients 2023 Apr 12;15(8). PMID: 37111077. doi: 10.3390/nu15081858.
21. Teixeira PJ, Carraça EV, Marques MM, Rutter H, Oppert J-M, De Bourdeaudhuij I, et al. Successful behavior change in obesity interventions in adults: a systematic review of self-regulation mediators. BMC Medicine 2015 2015/04/16;13(1):84. doi: 10.1186/s12916-015-0323-6.
22. Williamson DA, Bray GA, Ryan DH. Is 5% weight loss a satisfactory criterion to define clinically significant weight loss? Obesity (Silver Spring) 2015 Dec;23(12):2319-20. PMID: 26523739. doi: 10.1002/oby.21358.
23. Jensen MD, Ryan DH, Apovian CM, Ard JD, Comuzzie AG, Donato KA, et al. 2013 AHA/ACC/TOS guideline for the management of overweight and obesity in adults: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines and The Obesity Society. Circulation 2014 Jun 24;129(25 Suppl 2):S102-38. PMID: 24222017. doi: 10.1161/01.cir.0000437739.71477.ee.
24. Ryan DH, Yockey SR. Weight Loss and Improvement in Comorbidity: Differences at 5%, 10%, 15%, and Over. Curr Obes Rep 2017 Jun;6(2):187-94. PMID: 28455679. doi: 10.1007/s13679-017-0262-y.
25. Wilding JPH, Batterham RL, Calanna S, Davies M, Van Gaal LF, Lingvay I, et al. Once-Weekly Semaglutide in Adults with Overweight or Obesity. N Engl J Med 2021 Mar 18;384(11):989-1002. PMID: 33567185. doi: 10.1056/NEJMoa2032183.
26. El-Osta A, Rowe C, Majeed A. Developing a shared definition of self-driven healthcare to enhance the current healthcare delivery paradigm. Journal of the Royal Society of Medicine 2022;115(11):424-8. PMID: 36455623.
27. Symington E, El-Osta A, Birrell F. Supported self-care is integral to lifestyle medicine: Can virtual group consultations promote them both? Journal of Lifestyle Medicine 2021:https://onlinelibrary.wiley.com/doi/10.1. 1002/lim2.43.
28. Hesseldal L, Christensen JR, Olesen TB, Olsen MH, Jakobsen PR, Laursen DH, et al. Long-term Weight Loss in a Primary Care–Anchored eHealth Lifestyle Coaching Program: Randomized Controlled Trial. J Med Internet Res 2022 2022/9/23;24(9):e39741. doi: 10.2196/39741.
29. Huntriss R, Haines M, Jones L, Mulligan D. A service evaluation exploring the effectiveness of a locally commissioned tier 3 weight management programme offering Face-To-Face, telephone and Digital Dietetic support. Clinical obesity 2021;11(3):e12444. PMID: 33600056.
30. Richards R, Wren GM, Campion P, Whitman M. A Remotely Delivered, Semaglutide-Supported Specialist Weight Management Program: Preliminary Findings From a Retrospective Service Evaluation. JMIR Form Res 2023 Dec 28;7:e53619. PMID: 38153780. doi: 10.2196/53619.
31. Richards R, Wren G, Whitman M. The Potential of a Digital Weight Management Program to Support Specialist Weight Management Services in the UK National Health Service: Retrospective Analysis. JMIR Diabetes 2024 Jan 24;9:e52987. PMID: 38265852. doi: 10.2196/52987.
32. Silva MN, Vieira PN, Coutinho SR, Minderico CS, Matos MG, Sardinha LB, et al. Using self-determination theory to promote physical activity and weight control: a randomized controlled trial in women. Journal of behavioral medicine 2010;33:110-22. PMID: 20012179.
33. Mastellos N, Gunn LH, Felix LM, Car J, Majeed A. Transtheoretical model stages of change

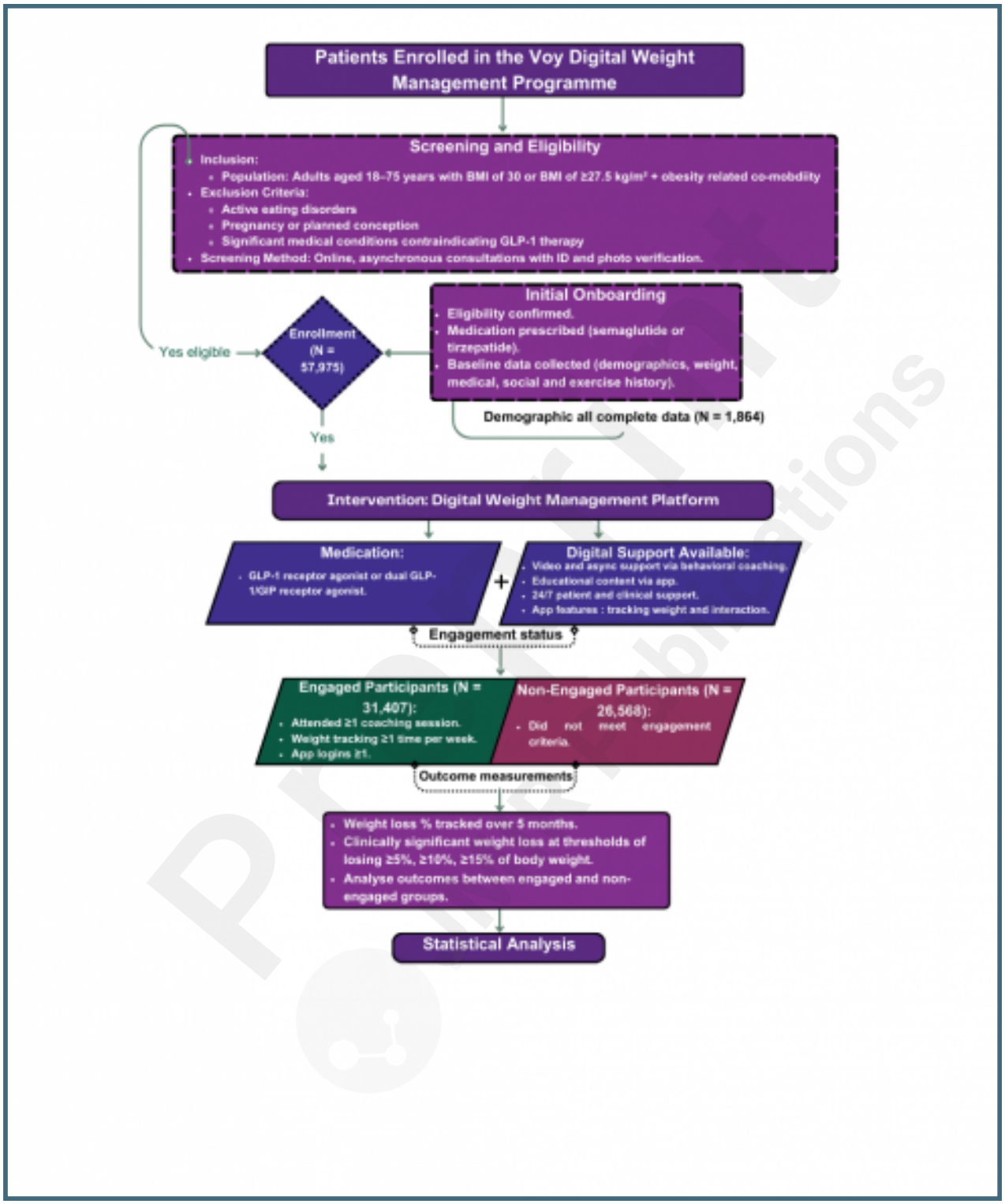
for dietary and physical exercise modification in weight loss management for overweight and obese adults. Cochrane Database of Systematic Reviews 2014 (2). PMID: 24500864
34. Chung LMY, Fong SSM. Predicting actual weight loss: A review of the determinants according to the theory of planned behaviour. Health Psychology Open 2015;2(1):2055102914567972. PMID: 28070350.
35. Timpel P, Cesena FHY, da Silva Costa C, Soldatelli MD, Gois Jr E, Castrillon E, et al. Efficacy of gamification-based smartphone application for weight loss in overweight and obese adolescents: study protocol for a phase II randomized controlled trial. Therapeutic advances in endocrinology and metabolism 2018;9(6):167-76. PMID: 29854386.
36. Von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. The lancet 2007;370(9596):1453-7. PMID: 18064739.
37. Karagiannis T, Malandris K, Avgerinos I, Stamati A, Kakotrichi P, Liakos A, et al. Subcutaneously administered tirzepatide vs semaglutide for adults with type 2 diabetes: a systematic review and network meta-analysis of randomised controlled trials. Diabetologia 2024:1-17. PMID: 38613667.
38. Altman DG, Bland JM. Missing data. Bmj 2007 Feb 24;334(7590):424. PMID: 17322261. doi: 10.1136/bmj.38977.682025.2C.
39. Wang Y, Min J, Khuri J, Xue H, Xie B, L AK, et al. Effectiveness of Mobile Health Interventions on Diabetes and Obesity Treatment and Management: Systematic Review of Systematic Reviews. JMIR Mhealth Uhealth 2020 Apr 28;8(4):e15400. PMID: 32343253. doi: 10.2196/15400.
40. Ryan RM, Deci EL. Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. Am Psychol 2000 Jan;55(1):68-78. PMID: 11392867. doi: 10.1037//0003-066x.55.1.68.
41. El-Osta A, Sasco E, Barbanti E, Webber I, Alaa A, Karki M, et al. Tools for measuring individual self-care capability. A systematic scoping review of the literature. BMC Public Health 2023. doi.org/10.1186/s12889-023-16194-6.
42. Holmes WS, Moorhead SA, Coates VE, Bond RR, Zheng H. Impact of digital technologies for communicating messages on weight loss maintenance: a systematic literature review. European Journal of Public Health 2019;29(2):320-8. PMID: 30239699.
43. Krebs P, Duncan DT. Health App Use Among US Mobile Phone Owners: A National Survey. JMIR Mhealth Uhealth 2015 Nov 4;3(4):e101. PMID: 26537656. doi: 10.2196/mhealth.4924.
44. Burke LE, Wang J, Sevick MA. Self-monitoring in weight loss: a systematic review of the literature. J Am Diet Assoc 2011 Jan;111(1):92-102. PMID: 21185970. doi: 10.1016/j.jada.2010.10.008.
45. Ryan K, Dockray S, Linehan C. A systematic review of tailored eHealth interventions for weight loss. Digit Health 2019 Jan-Dec;5:2055207619826685. PMID: 30783535. doi: 10.1177/2055207619826685.
46. Noar SM, Benac CN, Harris MS. Does tailoring matter? Meta-analytic review of tailored print health behavior change interventions. Psychol Bull 2007 Jul;133(4):673-93. PMID: 17592961. doi: 10.1037/0033-2909.133.4.673.
47. Annesi JJ. Behavioral Weight Loss and Maintenance: A 25-Year Research Program Informing Innovative Programming. Perm J 2022 Jun 29;26(2):98-117. PMID: 35933678. doi: 10.7812/tpp/21.212.
48. Michie S, Ashford S, Sniehotta FF, Dombrowski SU, Bishop A, French DP. A refined taxonomy of behaviour change techniques to help people change their physical activity and healthy eating behaviours: the CALO-RE taxonomy. Psychol Health 2011 Nov;26(11):1479-98.

PMID: 21678185. doi: 10.1080/08870446.2010.540664.
49. Wing RR, Jeffery RW. Benefits of recruiting participants with friends and increasing social support for weight loss and maintenance. J Consult Clin Psychol 1999 Feb;67(1):132-8. PMID: 10028217. doi: 10.1037//0022-006x.67.1.132.
50. Rancourt D, Leahey TM, LaRose JG, Crowther JH. Effects of weight-focused social comparisons on diet and activity outcomes in overweight and obese young women. Obesity (Silver Spring) 2015 Jan;23(1):85-9. PMID: 25407550. doi: 10.1002/oby.20953.
51. Lally P, Van Jaarsveld CHM, Potts HWW, Wardle J. How are habits formed: Modelling habit formation in the real world. European journal of social psychology 2010 10;40(6):998-1009. doi: 10.1002/ejsp.674.
52. Wadden TA, Sarwer DB, Berkowitz RI. Behavioural treatment of the overweight patient. Baillieres Best Pract Res Clin Endocrinol Metab 1999 Apr;13(1):93-107. PMID: 10932678. doi: 10.1053/beem.1999.0008.
53. Thomas JG, Raynor HA, Bond DS, Luke AK, Cardoso CC, Foster GD, et al. Weight loss in Weight Watchers Online with and without an activity tracking device compared to control: A randomized trial. Obesity (Silver Spring) 2017 Jun;25(6):1014-21. PMID: 28437597. doi: 10.1002/oby.21846.
54. Beleigoli AM, Andrade AQ, Cançado AG, Paulo MN, Diniz MFH, Ribeiro AL. Web-Based Digital Health Interventions for Weight Loss and Lifestyle Habit Changes in Overweight and Obese Adults: Systematic Review and Meta-Analysis. J Med Internet Res 2019 Jan 8;21(1):e298. PMID: 30622090. doi: 10.2196/jmir.9609.
55. Jastreboff AM, Aronne LJ, Ahmad NN, Wharton S, Connery L, Alves B, et al. Tirzepatide Once Weekly for the Treatment of Obesity. N Engl J Med 2022 Jul 21;387(3):205-16. PMID: 35658024. doi: 10.1056/NEJMoa2206038.
56. Frías JP, Davies MJ, Rosenstock J, Pérez Manghi FC, Fernández Landó L, Bergman BK, et al. Tirzepatide versus Semaglutide Once Weekly in Patients with Type 2 Diabetes. N Engl J Med 2021 Aug 5;385(6):503-15. PMID: 34170647. doi: 10.1056/NEJMoa2107519.
57. Tschöp M, Nogueiras R, Ahrén B. Gut hormone-based pharmacology: novel formulations and future possibilities for metabolic disease therapy. Diabetologia 2023 Oct;66(10):1796-808. PMID: 37209227. doi: 10.1007/s00125-023-05929-0.

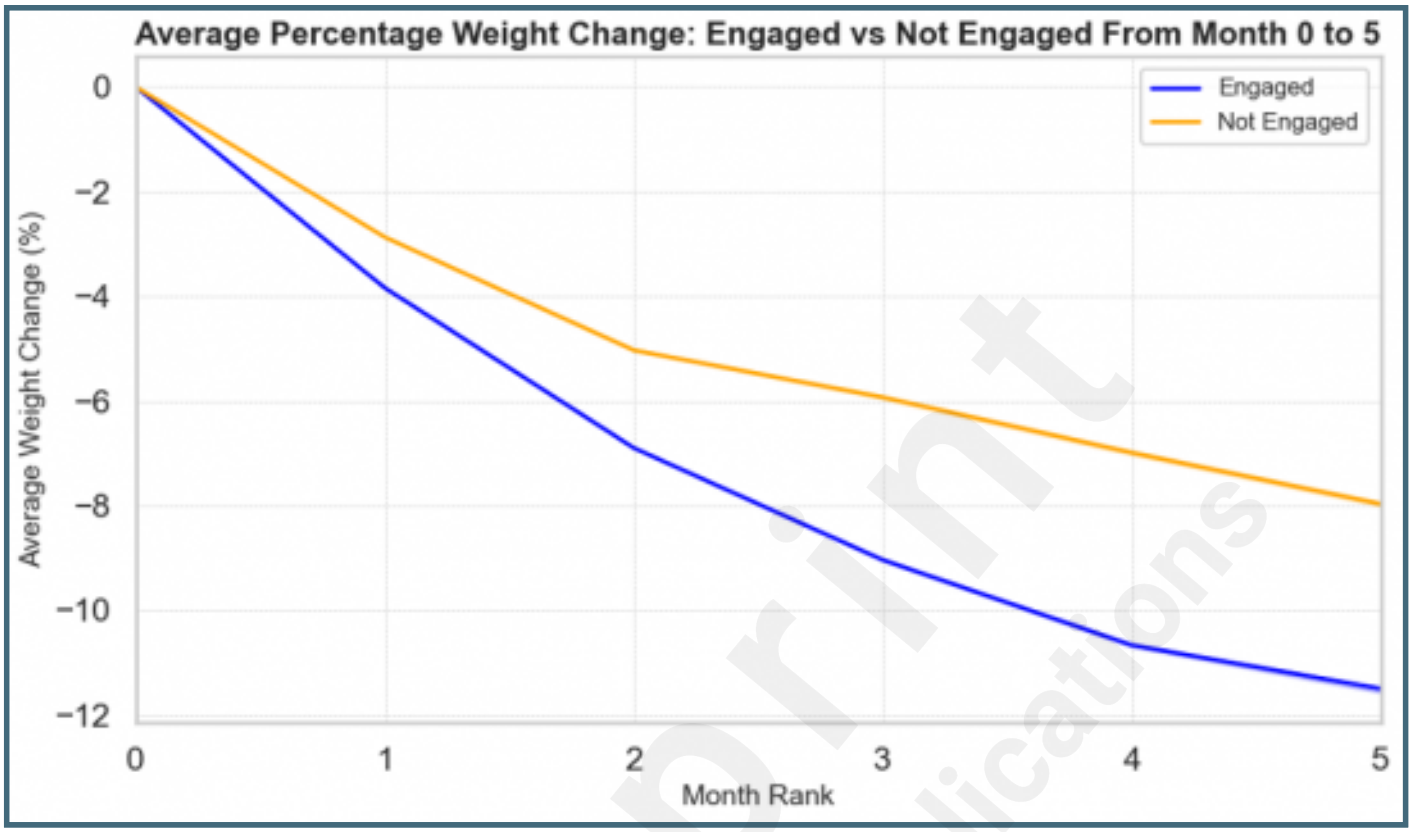
Supplementary Files

Figures

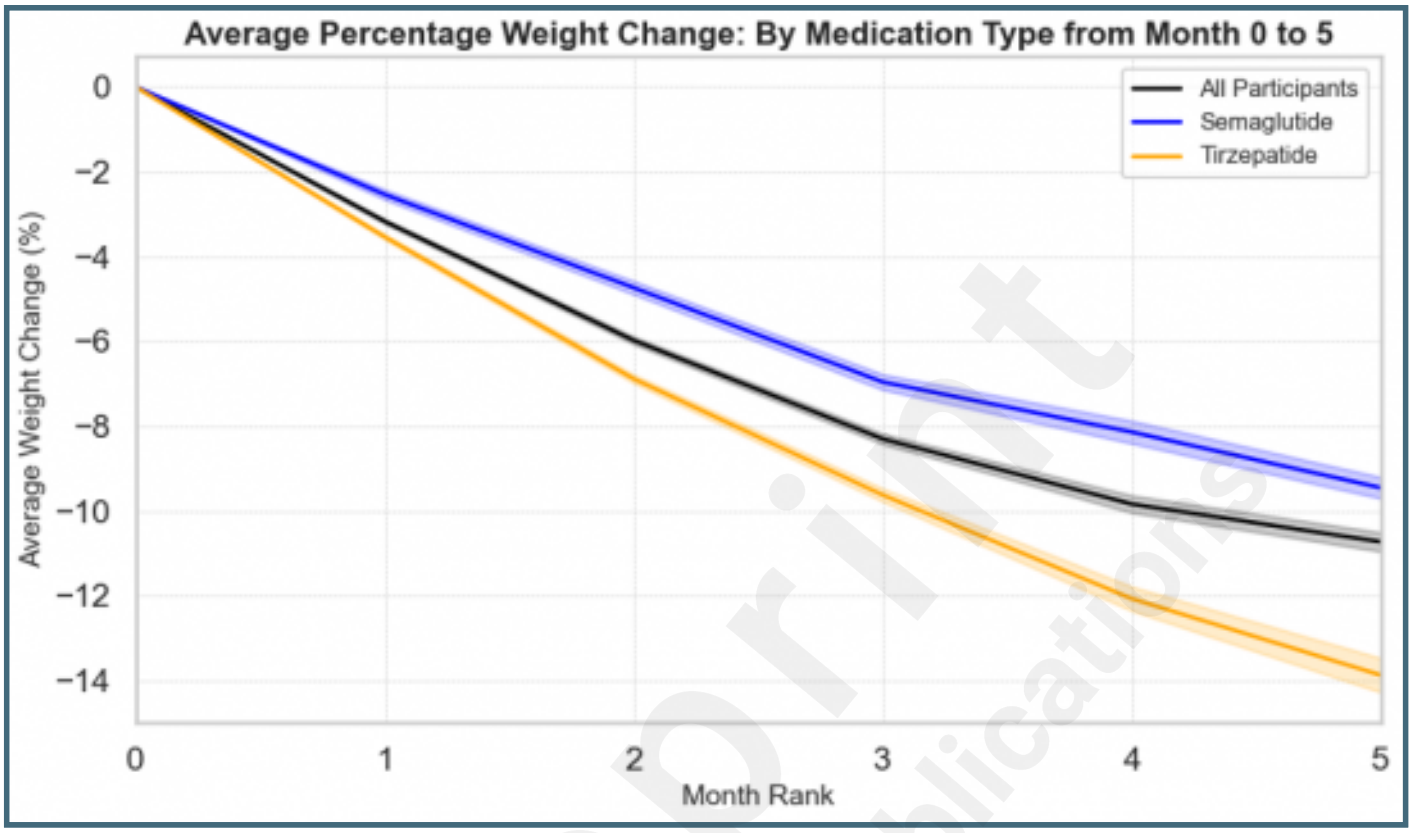
Flowchart illustrating the critical steps of the retrospective analysis conducted for the Voy digital weight management programme.



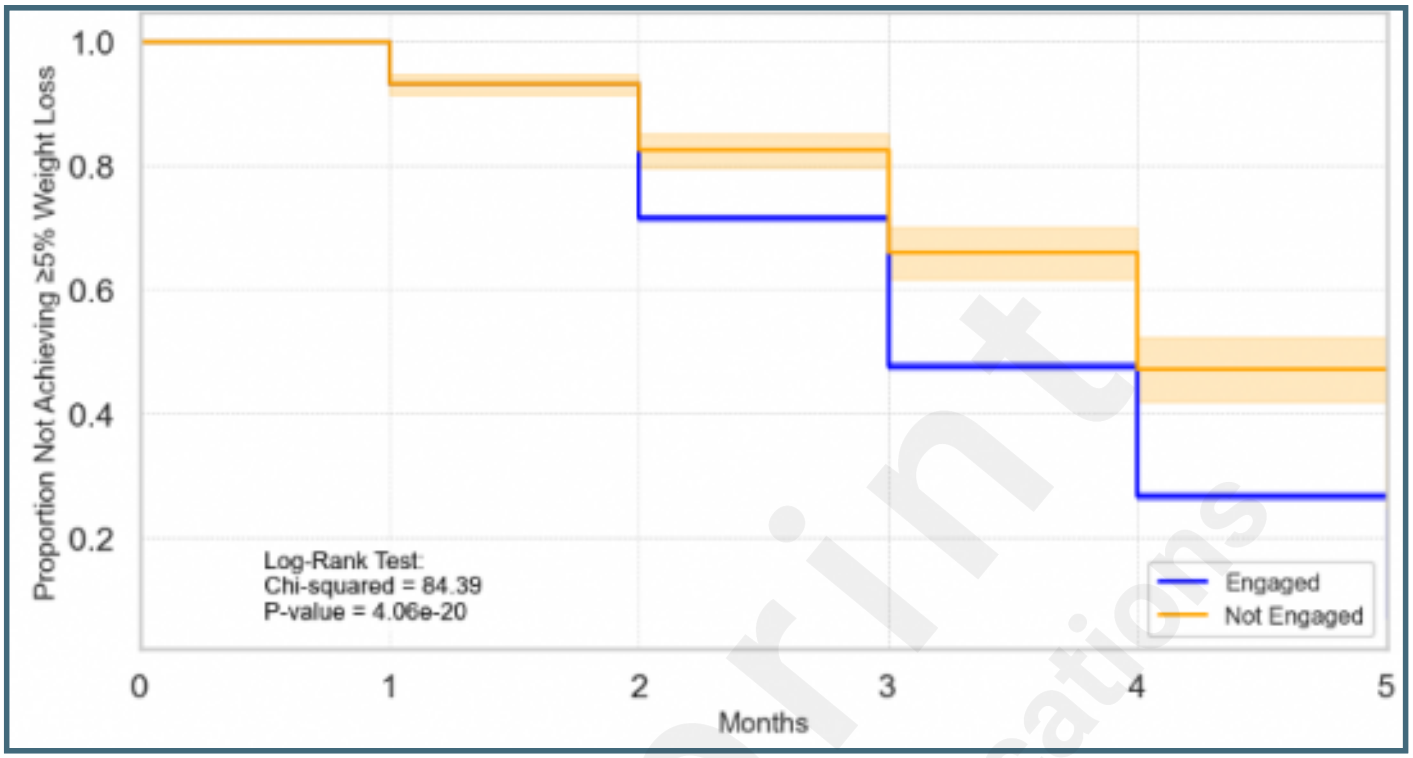
Average weight loss (Kg) trajectory over time by engagement status.



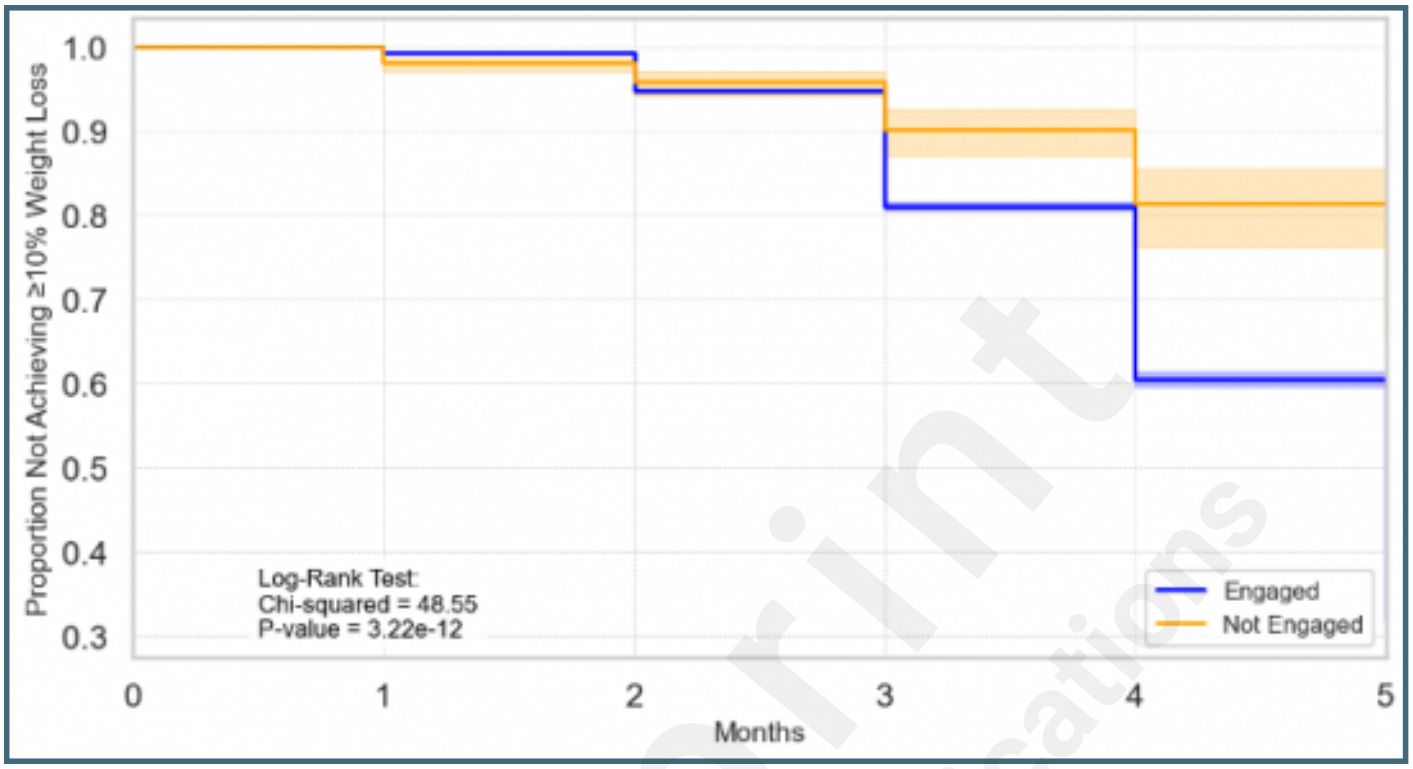
Depicts the mean percentage of weight loss over time by medication type. ‘All participants’ shows the combined weight loss trajectory for both tirzepatide and semaglutide users.



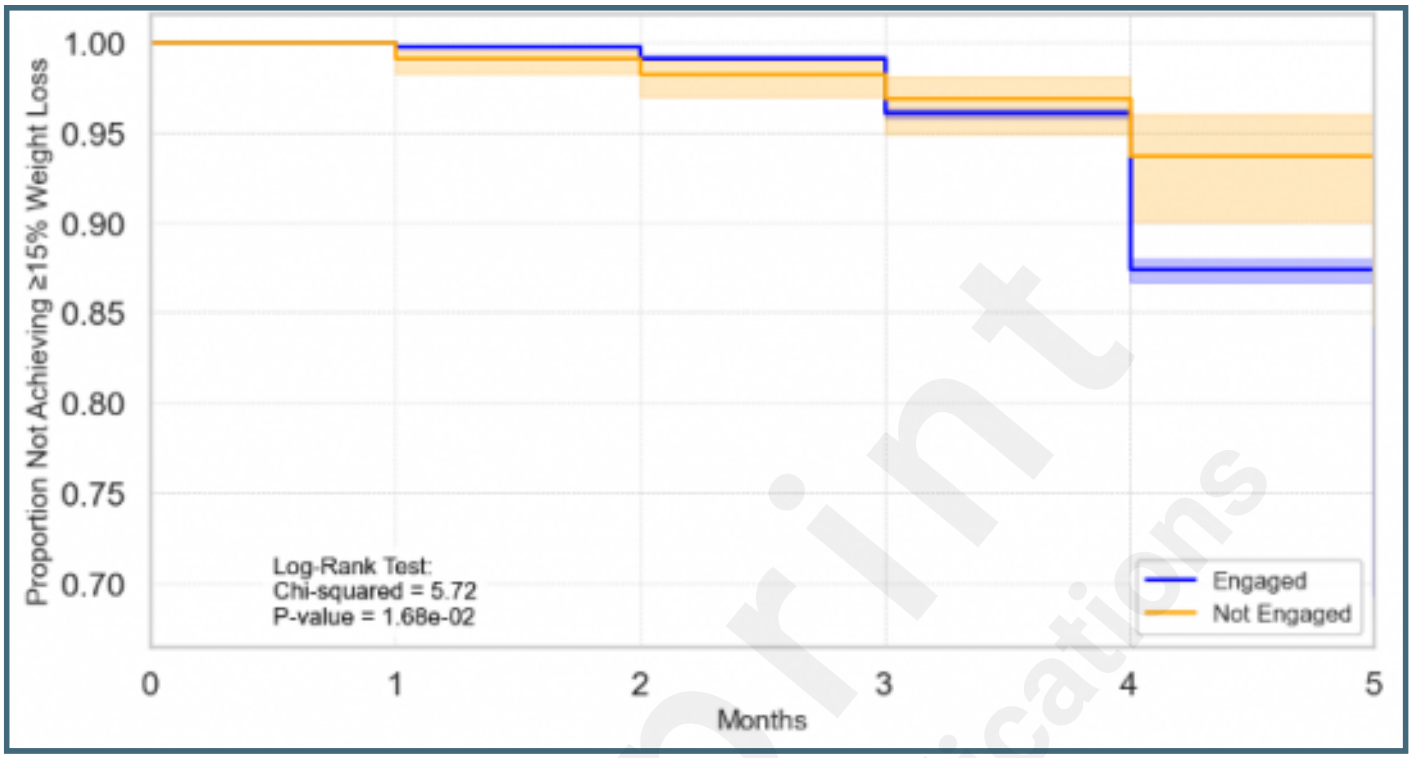
Kaplan–Meier survival curves for time to achieve ?5% weight loss by engagement status.



Kaplan–Meier survival curves for time to achieve ?10% weight loss by engagement status.



Illustrates the Kaplan–Meier survival curves for time to achieve ?15% weight loss by engagement status.



CONSORT (or other) checklists

Adherence to STROBE Guidelines This study adhered to the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines. Attached with paper.
URL: http://asset.jmir.pub/assets/17f38765e4ee5ada744de778963280dd.pdf