








## ORIGINAL ARTICLE

## Epidemiology/Genetics

# Association between the month of starting a weight management program and weight change in people at high risk of type 2 diabetes: A prospective cohort study

Dimitrios A. Koutoukidis<sup>1,2</sup>  | Emma Barron<sup>3</sup> | Richard Stevens<sup>1</sup>  |  
Paul Aveyard<sup>1,2</sup>  | Jonathan Valabhji<sup>3,4,5</sup>  | Susan A. Jebb<sup>1,2</sup> 

<sup>1</sup>Nuffield Department of Primary Care Health Sciences, University of Oxford, Oxford, UK

<sup>2</sup>NIHR Oxford Biomedical Research Centre, Oxford University Hospitals NHS Foundation Trust, Oxford, UK

<sup>3</sup>NHS England and NHS Improvement, London, UK

<sup>4</sup>Department of Diabetes and Endocrinology, Imperial College Healthcare NHS Trust, London, UK

<sup>5</sup>Division of Metabolism, Digestion, and Reproduction, Imperial College London, London, UK

## Correspondence

Dimitrios A. Koutoukidis, Nuffield Department of Primary Care Health Sciences, University of Oxford, Radcliffe Observatory Quarter, Woodstock Rd., Oxford OX2 6GG, UK.  
Email: [dimitrios.koutoukidis@phc.ox.ac.uk](mailto:dimitrios.koutoukidis@phc.ox.ac.uk)

## Funding information

NIHR Oxford Biomedical Research Centre, Grant/Award Number: IS-BRC-1215-20008; Oxford NIHR Applied Research Collaboration

## Abstract

**Objective:** Weight loss is one of the most common New Year's resolutions, but it is unclear whether attempting to lose weight in January is more successful than attempting it at other times of the year.

**Methods:** In this prospective cohort study from the English National Health Service (NHS) Diabetes Prevention Program, adults with nondiabetic hyperglycemia were enrolled in a structured behavioral weight management program. Repeated measures models assessed the mean difference between baseline and follow-up weight adjusting for monthly variation in weight among those with  $\geq 1$  weight measurement.

**Results:** Among 85,514 participants with a mean baseline BMI of 30.3 kg/m<sup>2</sup> (range: 13.4 to 84.2), mean weight change at the end of the program after an average 7.9 (SD: 4.5) sessions over 6.4 (SD: 5.6) months was  $-2.00$  kg (95% CI:  $-2.02$  to  $-1.97$  kg) or  $-2.33\%$  (95% CI:  $-2.35\%$  to  $-2.32\%$ ). Compared with participants starting in January, participants starting in other months lost less weight, ranging between 0.28 kg (95% CI: 0.10 to 0.45 kg) less weight in those starting in March and 0.71 kg (95% CI: 0.55 to 0.87 kg) less weight in those starting in November. April and May were the only exceptions, in which the estimates followed the same direction but were not statistically significant. Higher session attendance mediated the effects, with participants starting in January attending, on average, 0.2 to 0.7 more sessions than those starting in other months.

**Conclusions:** People starting a weight management program in January lost 12% to 30% more weight than people starting it at other times of the year.

## INTRODUCTION

Overweight and obesity increase the risk of chronic diseases and premature mortality [1], and losing weight reduces this risk [2].

Weight loss attempts with formal support in a weight management program lead to significantly greater weight loss over the medium term than simple advice [3].

In Western countries, January is typically regarded as a time for a "fresh start." The projection of a perceived new identity is theorized to be an important source of motivation and goal setting for behavior

Dimitrios A Koutoukidis and Emma Barron contributed equally to this study.

This is an open access article under the terms of the [Creative Commons Attribution-NonCommercial](https://creativecommons.org/licenses/by-nc/4.0/) License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited and is not used for commercial purposes.

© 2023 The Authors. *Obesity* published by Wiley Periodicals LLC on behalf of The Obesity Society.

change [4]. Weight loss is one of the most common New Year's resolutions [5], but self-reported data suggest that these resolutions are short-lived [6]. However, it remains unclear whether these resolutions can be sustained longer in the context of a formal, structured, and supportive program, thereby leading to larger weight loss. If there is a differential response in weight loss outcomes by the month of starting a weight management program, this could inform the design and implementation of additional strategies at the beginning of the program in specific months to encourage engagement and adherence. This is crucial because evidence has consistently shown that program engagement and adherence over the first few weeks are strong independent predictors of long-term weight loss [7–9]. Therefore, it is plausible that the higher motivation for weight loss in January may lead to higher attendance of program sessions and, therefore, to larger weight loss.

In 2016, the National Health Service (NHS) in England established The Healthier You: NHS Diabetes Prevention Program (NHS DPP). The NHS DPP was developed to prevent or delay the onset of type 2 diabetes in adults identified with nondiabetic hyperglycemia by delivering group-based, face-to-face structured behavioral programs. These programs encourage weight loss (in those with overweight and obesity), increased physical activity, and healthier diets. Routine internal monitoring indicated visual differences in weight change by the month of starting the program that warranted further investigation.

Therefore, this study aimed to examine the association between the starting month of the NHS DPP and weight change at the end of the program to inform ongoing development. We examined whether those who started in January lost more weight than those who started in other months. We further examined whether this association was mediated by higher session attendance in January.

## METHODS

### Study design

This prospective cohort study used data from the English NHS DPP. Data were included for all those who enrolled between January 2017 and December 2018. This service evaluation involves assessment of anonymized data collected during routine service delivery; NHS England has published an information governance framework setting out the legal basis for data collection and data flows, ensuring that the service and its evaluation are delivered in compliance with data protection legislation [10].

### Participants

Adults ( $\geq 18$  years and excluding pregnancy) without type 2 diabetes but with a blood test indicating nondiabetic hyperglycemia (hemoglobin A<sub>1c</sub>: 42–47 mmol/mol [6.0%–6.4%] or fasting plasma glucose: 5.5–6.9 mmol/L) in the last 12 months were eligible. Participants were identified following an NHS Health Check, through retrospective

### Study Importance

#### What is already known?

- Engaging with a weight management program leads to significant weight loss.
- Starting the program in January is commonly seen as a “fresh start.”
- It is unclear whether this January-specific motivation and goal setting make people lose more weight than attempting the program at other times of the year.

#### What does this study add?

- Using data from National Health Service Diabetes Prevention Program, this analysis shows that people at high risk of type 2 diabetes who started in January lost 12% to 30% more weight than people starting the program at other times of the year.
- This association was mediated by higher attendance of sessions among participants starting in January.

#### How might these results change the direction of research or the focus of clinical practice?

- Developing and implementing additional strategies to incentivize program engagement and adherence among participants starting in the later months of the year may enhance weight loss and reduce the burden of type 2 diabetes.

searches of general practice records, or through routine clinical practice [11, 12].

### Behavioral weight management program

The NHS DPP aims to prevent or delay type 2 diabetes through group-based behavioral programs that encourage (a) weight management through weight loss for those with overweight or obesity or maintenance of a healthy weight for those without overweight, (b) increased physical activity in line with the national physical activity recommendations, and (c) a healthier diet in line with the national dietary recommendations related to fiber, fruit, vegetables, oily fish, saturated fat, salt, and free sugars [13, 14]. Providers ( $n = 4$ ) delivered the program based on a national standardized service specification for behavior change, as previously described [11, 15]. Providers are allowed to develop their own program to meet the service specification but they have to use a known framework for behavior change in line with the national guidance on behavior change interventions, which focuses on goal setting, action planning, weight measurement

**TABLE 1** Demographic characteristics by month of first program session between January 2017 and December 2018

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
<i>Total</i>	7,175	5,697	6,038	6,102	5,867	7,248	7,443	6,821	9,482	10,686	10,416	2,539	85,514
<i>Age (y) (%)</i>													
<40	2	3	3	3	3	3	3	3	2	3	3	3	3
40–64	38	38	39	39	38	40	38	38	39	39	39	37	39
65–74	39	37	37	37	38	36	37	36	36	37	37	37	37
75–109	21	22	21	21	21	21	22	23	22	21	21	22	21
Mean	66	65	65	65	65	65	65	65	65	65	65	65	65
SD	11	12	12	12	12	12	12	12	12	12	12	12	12
<i>Sex (%)</i>													
Male	46	47	46	46	46	45	44	45	44	45	45	48	45
Female	54	53	54	54	54	54	55	55	56	55	55	52	55
Indeterminate/unknown	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Ethnic group (%)</i>													
Asian	9	10	11	11	10	11	12	11	12	10	10	10	11
Black	6	6	5	6	6	6	6	6	6	6	5	4	6
Mixed	3	3	2	2	1	1	1	1	1	1	2	1	2
Other	2	2	1	2	1	1	1	1	1	2	2	2	2
Unknown	10	12	9	7	10	8	6	6	7	7	8	7	8
White	71	68	72	72	72	73	75	74	73	74	72	76	73
<i>Deprivation quintile (%)</i>													
IMD 1 (most deprived)	15	16	17	16	16	18	17	15	16	17	16	18	16
IMD 2	19	20	19	19	19	19	19	18	19	19	18	16	19
IMD 3	21	20	20	22	22	21	20	20	21	20	20	18	20
IMD 4	20	21	21	21	22	20	21	21	21	21	22	22	21
IMD 5 (least deprived)	24	23	23	23	22	23	24	26	23	23	24	26	23
Unknown	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>BMI grouping (%)</i>													
Underweight	0.4	0.2	0.3	0.3	0.3	0.4	0.4	0.4	0.5	0.4	0.4	0.3	0.4
Healthy	13	13	14	13	15	15	16	15	15	15	14	15	15
Overweight	34	35	35	34	34	34	34	35	34	35	34	36	35
Obesity	50	48	49	50	48	48	47	48	48	47	49	47	48
Unknown	2	3	2	2	2	2	2	2	2	2	2	1	2

(Continues)

TABLE 1 (Continued)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
<i>Baseline weight (kg)</i>													
Mean	84.6	84.4	84.4	84.6	84.0	83.7	83.1	83.3	83.2	83.5	84.1	84.5	83.9
SD	18.7	18.7	18.7	19.1	18.7	18.8	19.1	18.7	18.9	18.7	19.1	19.4	18.9
<i>Baseline BMI (kg/m<sup>2</sup>)</i>													
Mean	30.4	30.4	30.4	30.5	30.3	30.3	30.2	30.1	30.1	30.2	30.4	30.2	30.3
SD	5.8	5.9	6.0	6.1	6.0	6.1	6.1	6.0	6.1	6.0	6.2	6.0	6.0

Note: BMI grouping is adjusted for ethnicity in line with the National Institute for Health and Care Excellence guidelines (if ethnicity was unknown, BMI was grouped according to the White ethnicity group) [25]. Unknown BMI values are due to lack of data on height.

Abbreviation: IMD, Index of Multiple Deprivation.

at each session, feedback, self-monitoring, and social support [16]. Each of the four programs was delivered in a face-to-face group format in ≥13 sessions over ≥9 months with ≥16 hours of total contact time. Details of the intervention intensity and length by provider are available in Supporting Information Table S1.

## Data collection

Demographic information (age, self-reported ethnicity, and postcode) was collected at referral or at the initial assessment. Residential postcode was used to derive deprivation quintile from the Index of Multiple Deprivation [17]. Body weight was objectively measured at each session with participants in light indoor clothing. We have previously outlined the legal basis for data collection [10].

## Statistical analysis

Participants starting at the same month of a different year were combined. The baseline weight was defined as the weight at the first program session attended, and the follow-up weight was defined as the weight at the last attended program session. For participants who attended only one session, the same weight was used as their baseline and final weight.

We initially conducted a univariate analysis of weight change by month of starting the program. To model the mean difference between baseline and follow-up weight adjusting for the time of the year (i.e., the natural monthly variation in weight), we used a repeated measures model with weight as the dependent variable and the following independent variables: month, coded in 12 categories, and a dummy variable coded as 1 for the follow-up session and as 0 for the baseline session. To examine whether there was additional weight change by the starting month, we then added to the model 12 multiplicative interaction terms between the aforementioned dummy variable (0 = baseline, 1 = follow-up) and one of 12 dummy variables coded as 1 if participants had started on a specific month and 0 otherwise (e.g., if a participant has started in January, the interaction term for January would be 1 and the terms for all other months would be 0). We included in the models everyone who attended at least one program session (enrolled) and who had their weight measured at least once.

We conducted an exploratory mediation analysis to examine whether weight loss was attributable to more frequent attendance of sessions, because attendance strongly predicts weight loss [9]. For this, we ran two additional models: (a) adjusting the main model for the number of sessions and (b) running a linear regression with the starting month and attended sessions as the independent and dependent variables, respectively. We conducted an additional mediation analysis examining whether completion of the program (i.e., attendance of at least 60% of sessions coded as yes/no) was also a mediator between starting month and weight loss.

There was some variation in how long participants took to finish the program. Therefore, to further account for monthly variability, we

ran a sensitivity analysis restricting it to participants who started and completed the program at the same calendar month 1 year later.

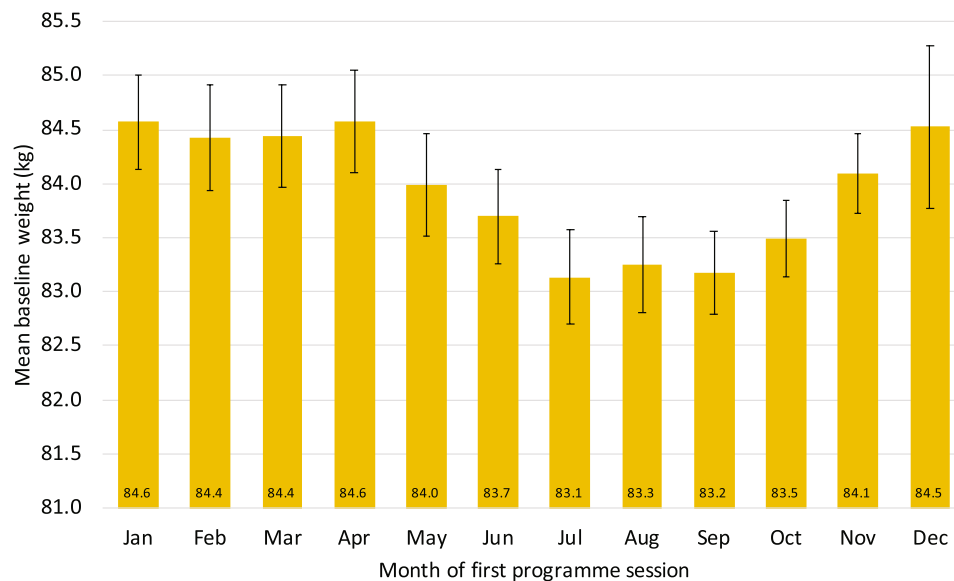
Analyses were conducted in Stata version 16 (StataCorp LLC). A  $p$  value  $< 0.05$  was considered statistically significant.

## RESULTS

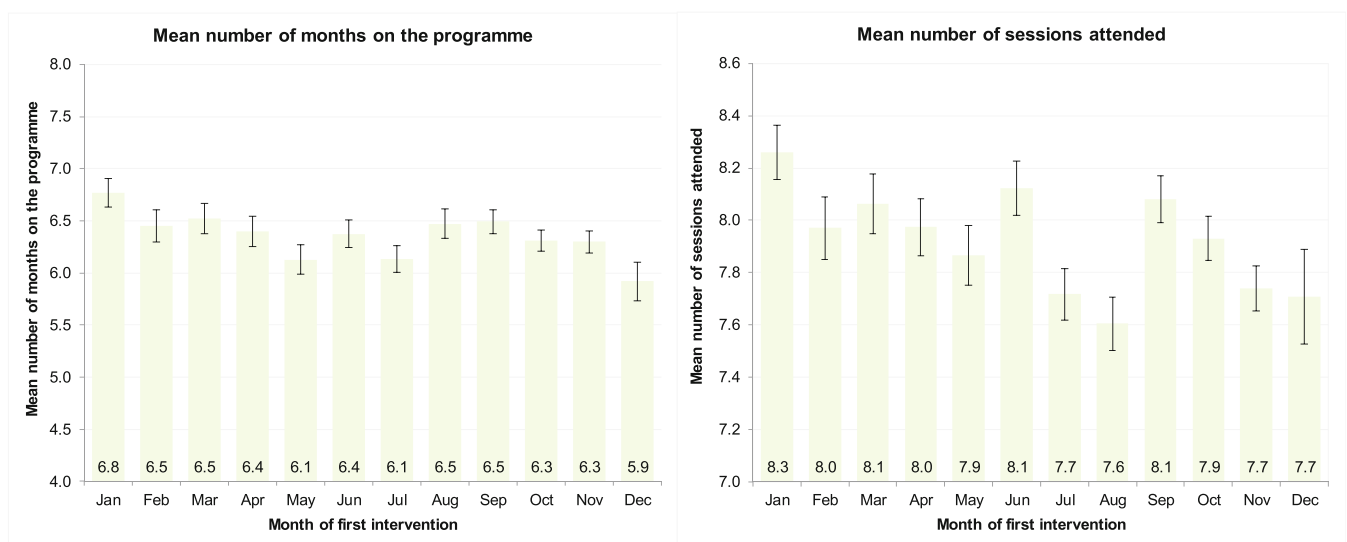
There were 93,932 participants who attended at least one program session between January 2017 and December 2018. Of those, 85,514 (91%) had a valid weight measurement recorded at both their first and last program session attended. The average number of people starting the program each month was 7126, with slight variation between

January and August, increasing to 9,482, 10,686, and 10,416 in September, October, and November, respectively, and decreasing to 2,539 in December (Table 1). The characteristics of participants are shown in Table 1: 45% of people were male, the mean (SD) age was 65 (12) years, and 20% were of Black, Asian, mixed, or other ethnicity, 73% were of White ethnicity, and 8% were of unknown ethnicity. There were higher proportions of participants from the least deprived quintile compared with the most deprived quintile, 23% versus 16%, respectively. These characteristics did not differ by starting month.

The mean baseline weight was 83.9 (SD: 18.9) kg, and the mean body mass index (BMI) was 30.3 (SD: 6) kg/m<sup>2</sup>. Mean baseline BMI was higher among younger people and those from more deprived areas. Participants of Asian ethnicity had the lowest mean baseline



**FIGURE 1** Mean baseline weight (kilograms) with 95% CI by month of first program session [Color figure can be viewed at [wileyonlinelibrary.com](https://onlinelibrary.wiley.com/terms-and-conditions)]



**FIGURE 2** Mean number of months on the program and mean number of sessions attended by month of first program session between January 2017 and December 2018 [Color figure can be viewed at [wileyonlinelibrary.com](https://onlinelibrary.wiley.com/terms-and-conditions)]

**TABLE 2** Mean (top row) with SD (bottom row) of weight change in kilograms (with mean SD of percentage weight loss in parentheses) by demographic characteristics and month of first program session between January 2017 and December 2018 based on univariate analysis

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Overall
Overall	-2.54 (-2.9%) 4.58 (5.1%)	-2.29 (-2.7%) 4.14 (4.9%)	-2.36 (-2.8%) 4.15 (4.6%)	-2.34 (-2.7%) 4.05 (4.6%)	-2.25 (-2.6%) 4 (4.7%)	-1.87 (-2.2%) 4.27 (4.9%)	-1.65 (-1.9%) 3.69 (4.3%)	-1.61 (-1.9%) 3.99 (5%)	-1.79 (-2.1%) 3.84 (4.5%)	-1.84 (-2.1%) 4.24 (5.1%)	-1.87 (-2.2%) 3.93 (4.7%)	-1.83 (-2.1%) 3.75 (4.3%)	-2 (-2.3%) 4.08 (4.8%)
Age													
<40	-1.26 (-1.3%) 4.44 (4.3%)	-1.01 (-1.1%) 3.27 (3.6%)	-1.33 (-1.4%) 4.24 (4.2%)	-1.53 (-1.6%) 4.79 (4.8%)	-0.86 (-0.9%) 3.22 (3.5%)	-1.15 (-1.1%) 5.34 (4.7%)	-0.63 (-0.6%) 3.71 (4.1%)	-1.29 (-1.4%) 4.02 (4.1%)	-0.69 (-0.7%) 3.25 (3.4%)	-0.5 (-0.5%) 3.15 (3.9%)	-0.75 (-0.8%) 2.85 (3.1%)	-1.17 (-1.2%) 3.74 (4%)	-0.94 (-1%) 3.82 (4%)
40-64	-2.42 (-2.6%) 4.96 (5.2%)	-1.95 (-2.1%) 4.49 (5%)	-2 (-2.2%) 4.17 (4.6%)	-1.97 (-2.2%) 4.27 (4.5%)	-1.93 (-2.1%) 4.31 (5.1%)	-1.69 (-1.8%) 4.81 (5.4%)	-1.52 (-1.7%) 4.12 (4.4%)	-1.4 (-1.5%) 3.86 (4.3%)	-1.47 (-1.6%) 4.12 (4.7%)	-1.61 (-1.8%) 4.64 (5%)	-1.61 (-1.8%) 4.05 (4.3%)	-1.61 (-1.8%) 3.63 (4%)	-1.74 (-1.9%) 4.35 (4.8%)
65-74	-2.78 (-3.3%) 4.6 (5.2%)	-2.71 (-3.2%) 4.14 (5.1%)	-2.78 (-3.3%) 4.1 (4.6%)	-2.75 (-3.3%) 3.88 (4.5%)	-2.69 (-3.2%) 4.06 (4.7%)	-2.11 (-2.5%) 3.98 (4.5%)	-1.9 (-2.3%) 3.56 (4.7%)	-1.86 (-2.2%) 3.94 (4.8%)	-2.16 (-2.6%) 3.87 (4.5%)	-2.15 (-2.6%) 4.03 (4.8%)	-2.02 (-2.6%) 3.78 (4.5%)	-2.21 (-2.6%) 4.1 (4.6%)	-2.33 (-2.8%) 4.01 (4.7%)
75-109	-2.46 (-3.1%) 3.71 (4.7%)	-2.33 (-2.9%) 3.45 (4.4%)	-2.42 (-3%) 4.08 (4.7%)	-2.4 (-3%) 3.74 (5%)	-2.27 (-2.9%) 3.28 (4.2%)	-1.89 (-2.4%) 3.42 (4.2%)	-1.61 (-2%) 3.03 (3.8%)	-1.6 (-2%) 4.22 (6.1%)	-1.89 (-2.5%) 3.22 (4.2%)	-1.9 (-2.4%) 3.85 (5.7%)	-1.92 (-2.4%) 4.01 (5.6%)	-1.65 (-2.1%) 3.24 (4.1%)	-2.01 (-2.5%) 3.66 (4.9%)
Sex													
Male	-2.98 (-3.1%) 5.35 (5.4%)	-2.62 (-2.8%) 4.34 (4.6%)	-2.71 (-2.9%) 4.41 (4.5%)	-2.49 (-2.7%) 4.07 (4.5%)	-2.4 (-2.6%) 3.95 (4.2%)	-2.09 (-2.2%) 4.6 (4.6%)	-1.73 (-1.9%) 3.86 (4%)	-1.79 (-1.9%) 3.91 (4%)	-1.94 (-2.1%) 4.02 (4.3%)	-2.15 (-2.3%) 4.22 (4.4%)	-2 (-2.2%) 4.19 (4.7%)	-2.1 (-2.3%) 3.79 (4.1%)	-2.22 (-2.4%) 4.28 (4.5%)
Female	-2.17 (-2.8%) 3.77 (4.9%)	-1.99 (-2.5%) 3.93 (5.1%)	-2.05 (-2.6%) 3.88 (4.7%)	-2.2 (-2.8%) 4.04 (4.8%)	-2.13 (-2.7%) 4.05 (5.2%)	-1.69 (-2.1%) 3.98 (5.1%)	-1.58 (-2%) 3.56 (4.4%)	-1.46 (-1.8%) 4.05 (5.6%)	-1.68 (-2.1%) 3.69 (4.7%)	-1.58 (-2%) 4.24 (5.6%)	-1.77 (-2.3%) 3.69 (4.6%)	-1.59 (-2%) 3.69 (4.4%)	-1.8 (-2.3%) 3.9 (5%)
Ethnicity													
Asian	-1.36 (-1.7%) 4.5 (5.8%)	-1.07 (-1.3%) 3.37 (4.9%)	-0.96 (-1.2%) 2.88 (3.6%)	-1.26 (-1.7%) 3.6 (4.7%)	-1.16 (-1.5%) 2.77 (3.7%)	-0.67 (-0.9%) 3.04 (4.4%)	-0.8 (-1.1%) 3.02 (3.8%)	-0.72 (-1%) 2.53 (3.5%)	-0.91 (-1.2%) 2.88 (3.9%)	-0.83 (-1%) 4.44 (4.9%)	-1 (-1.3%) 2.78 (3.5%)	-0.95 (-1.3%) 2.82 (3.5%)	-0.95 (-1.2%) 3.31 (4.3%)
Black	-1.87 (-2.1%) 3.72 (4.3%)	-2.05 (-2.3%) 4.7 (4.8%)	-1.64 (-1.9%) 3.23 (3.6%)	-1.49 (-1.8%) 3.31 (3.8%)	-1.6 (-1.9%) 4.25 (5.2%)	-1.7 (-1.8%) 5.66 (7.2%)	-1.22 (-1.4%) 3.08 (3.7%)	-1.61 (-1.9%) 3.53 (4%)	-1.36 (-1.6%) 3.9 (4.3%)	-1.24 (-1.4%) 3.98 (5%)	-1.65 (-1.9%) 3.68 (4.4%)	-1.34 (-1.6%) 3 (3.6%)	-1.56 (-1.8%) 3.96 (4.7%)
Mixed	-2.52 (-2.9%) 4.54 (5.1%)	-1.92 (-2.3%) 3.51 (4.2%)	-1.84 (-2.2%) 3.28 (4.1%)	-2.63 (-3%) 4.64 (5%)	-1.65 (-1.9%) 3.17 (3.5%)	-1.31 (-1.7%) 4.14 (4.6%)	-0.8 (-1.1%) 2.15 (2.8%)	-1.19 (-1.4%) 2.9 (3.6%)	-1.32 (-1.7%) 3.54 (3.8%)	-1.14 (-1.3%) 3.27 (3.7%)	-1.87 (-2.2%) 3.67 (4.4%)	-1.87 (-2.2%) 3.68 (4.5%)	-1.74 (-2.1%) 3.71 (4.3%)
Other	-1.52 (-2%) 2.93 (3.7%)	-1.3 (-1.6%) 3.05 (4%)	-1.85 (-2.4%) 3.77 (4.4%)	-1.57 (-2%) 2.44 (3.2%)	-1.9 (-2.3%) 3.67 (4.8%)	-0.87 (-1.1%) 2.36 (3%)	-1.74 (-2.1%) 3.57 (4%)	-0.72 (-0.9%) 2.76 (3.5%)	-1.3 (-1.7%) 3.91 (4.6%)	-1.24 (-1.5%) 3.8 (4.3%)	-1.1 (-1.4%) 3.28 (4.4%)	-1.28 (-1.3%) 3.97 (4.6%)	-1.32 (-1.7%) 3.35 (4.1%)
Unknown	-2.38 (-2.7%) 4.95 (5.9%)	-2.04 (-2.5%) 3.89 (4.5%)	-1.98 (-2.4%) 3.26 (3.9%)	-2.08 (-2.4%) 3.64 (4.2%)	-1.72 (-2%) 4.54 (6.2%)	-1.7 (-2%) 4.19 (4.8%)	-1.51 (-1.7%) 3.46 (3.9%)	-1.16 (-1.2%) 6.28 (9.6%)	-1.59 (-1.8%) 4.15 (5.2%)	-1.83 (-2.1%) 4.24 (4.8%)	-1.71 (-2%) 3.5 (4%)	-1.49 (-1.7%) 2.88 (3.5%)	-1.81 (-2.1%) 4.2 (5.2%)
White	-2.8 (-3.2%) 4.61 (5%)	-2.58 (-3%) 4.24 (5%)	-2.69 (-3.1%) 4.43 (4.9%)	-2.61 (-3%) 4.19 (4.7%)	-2.55 (-3%) 4.04 (4.6%)	-2.11 (-2.4%) 4.31 (4.7%)	-1.84 (-2.1%) 3.85 (4.4%)	-1.81 (-2.1%) 3.96 (4.6%)	-2.01 (-2.4%) 3.92 (4.5%)	-2.05 (-2.4%) 4.23 (5.1%)	-2.05 (-2.4%) 4.13 (4.9%)	-2.02 (-2.3%) 3.93 (4.4%)	-2.22 (-2.6%) 4.17 (4.8%)
Deprivation													
IMD 1 (most deprived)	-2.03 (-2.3%) 4.49 (4.9%)	-1.55 (-1.7%) 3.8 (4.5%)	-2.03 (-2.3%) 4.21 (4.6%)	-1.87 (-2.2%) 3.56 (4.1%)	-1.96 (-2.2%) 3.95 (4.6%)	-1.46 (-1.6%) 4.66 (5.3%)	-1.29 (-1.4%) 3.97 (4.9%)	-1.32 (-1.5%) 3.59 (4.7%)	-1.4 (-1.6%) 3.8 (4.7%)	-1.35 (-1.5%) 5.15 (5.8%)	-1.31 (-1.5%) 4.36 (5.5%)	-1.61 (-1.9%) 3.89 (4.4%)	-1.55 (-1.8%) 4.24 (5%)
2	-2.45 (-2.8%) 4.76 (5.3%)	-2.24 (-2.5%) 4.51 (5.6%)	-2.11 (-2.4%) 4.5 (4.8%)	-2.19 (-2.6%) 3.88 (4.6%)	-2.08 (-2.4%) 4.5 (5.6%)	-1.68 (-1.9%) 4.8 (5.6%)	-1.45 (-1.7%) 3.56 (4.1%)	-1.39 (-1.5%) 4.82 (6.7%)	-1.65 (-1.9%) 4.13 (4.7%)	-1.66 (-1.9%) 3.95 (4.3%)	-1.7 (-2%) 3.56 (4.2%)	-1.69 (-1.9%) 4.11 (4.3%)	-1.84 (-2.1%) 4.25 (5%)
3	-2.56 (-2.9%) 4.93 (5.4%)	-2.39 (-2.8%) 3.88 (4.4%)	-2.49 (-3%) 4.13 (4.6%)	-2.3 (-2.7%) 4.33 (5%)	-2.27 (-2.7%) 3.69 (4.3%)	-2.01 (-2.3%) 4.28 (4.4%)	-1.74 (-2.1%) 3.67 (4.2%)	-1.65 (-2%) 3.8 (4.4%)	-1.76 (-2.1%) 3.62 (4.2%)	-1.76 (-2%) 4.2 (6%)	-1.93 (-2.3%) 3.92 (4.4%)	-1.77 (-2.1%) 3.39 (4.1%)	-2.03 (-2.4%) 4.05 (4.7%)
4	-2.64 (-3%) 4.46 (5.2%)	-2.41 (-2.9%) 4.02 (4.5%)	-2.6 (-3.1%) 4.04 (4.6%)	-2.47 (-2.9%) 4.04 (4.8%)	-2.43 (-2.8%) 3.81 (4.5%)	-2.11 (-2.5%) 3.92 (4.6%)	-1.8 (-2.2%) 3.48 (4%)	-1.82 (-2.1%) 3.98 (4.7%)	-1.95 (-2.3%) 3.93 (4.6%)	-2.12 (-2.5%) 4.03 (4.6%)	-2.05 (-2.4%) 4.02 (4.6%)	-2.1 (-2.4%) 4.16 (4.7%)	-2.18 (-2.6%) 4 (4.6%)

(Continues)



TABLE 2 (Continued)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Overall
IMD 5 (least deprived)	-2.85 (-3.4%)	-2.64 (-3.1%)	-2.48 (-3%)	-2.69 (-3.2%)	-2.4 (-2.8%)	-2 (-2.4%)	-1.8 (-2.2%)	-1.74 (-2%)	-2.09 (-2.5%)	-2.15 (-2.6%)	-2.17 (-2.6%)	-1.87 (-2.3%)	-2.23 (-2.7%)
	4.24 (4.8%)	4.3 (5.1%)	3.9 (4.6%)	4.23 (4.5%)	4.06 (4.6%)	3.75 (4.5%)	3.37 (3.9%)	3.66 (4.2%)	3.7 (4.5%)	3.87 (4.5%)	3.76 (4.6%)	3.26 (3.8%)	3.87 (4.5%)
BMI													
Underweight	-0.18 (-0.4%)	-0.43 (-0.3%)	-0.64 (-1.3%)	-0.88 (-1.8%)	-0.72 (-1.1%)	-0.33 (-0.7%)	-0.55 (-1.2%)	1.7 (3.6%)	0.06 (0.1%)	0.18 (0.5%)	-0.23 (-0.5%)	-1.29 (-3%)	-0.11 (-0.2%)
	2.01 (4.3%)	2.67 (4.8%)	1.72 (3.7%)	1.27 (2.5%)	2.29 (3.6%)	1.59 (3.4%)	1.29 (2.7%)	8.07 (16.3%)	2.05 (4.2%)	3 (6.4%)	1.81 (4%)	2.44 (4.7%)	3.13 (6.4%)
Healthy	-1.56 (-2.4%)	-1.32 (-2%)	-1.67 (-2.6%)	-1.48 (-2.4%)	-1.13 (-1.8%)	-1.14 (-1.8%)	-0.9 (-1.4%)	-0.88 (-1.4%)	-1.15 (-1.8%)	-1.15 (-1.8%)	-1.2 (-1.9%)	-1.03 (-1.6%)	-1.2 (-1.9%)
	3.42 (5.3%)	3.87 (6.7%)	2.77 (4.3%)	2.89 (4.6%)	3.36 (5.4%)	3.34 (5.5%)	2.96 (4.7%)	3.03 (4.8%)	2.96 (4.7%)	3.53 (6.3%)	3.08 (5%)	2.72 (4.1%)	3.2 (5.3%)
Overweight	-2.4 (-3.1%)	-2.25 (-2.9%)	-2.28 (-2.9%)	-2.26 (-2.9%)	-2.18 (-2.8%)	-1.48 (-2.2%)	-1.59 (-2.1%)	-1.53 (-2%)	-1.73 (-2.3%)	-1.7 (-2.2%)	-1.86 (-2.4%)	-1.85 (-2.4%)	-1.91 (-2.5%)
	3.95 (5.3%)	3.47 (4.4%)	3.77 (4.8%)	3.55 (4.7%)	3.54 (4.7%)	3.51 (4.6%)	3.02 (3.9%)	3.83 (5.5%)	3.39 (4.5%)	3.64 (4.9%)	3.31 (4.3%)	3.2 (4.1%)	3.54 (4.7%)
Obesity	-2.92 (-3%)	-2.61 (-2.7%)	-2.65 (-2.7%)	-2.65 (-2.8%)	-2.7 (-2.8%)	-2.28 (-2.3%)	-1.98 (-2.1%)	-1.97 (-2%)	-2.07 (-2.2%)	-2.17 (-2.3%)	-2.13 (-2.3%)	-2.11 (-2.2%)	-2.33 (-2.4%)
	5.19 (5%)	4.6 (4.6%)	4.67 (4.7%)	4.55 (4.5%)	4.41 (4.6%)	4.97 (4.8%)	4.27 (4.3%)	4.29 (4.3%)	4.34 (4.5%)	4.81 (4.8%)	4.37 (4.5%)	4.37 (4.4%)	4.6 (4.6%)

Abbreviation: IMD, Index of Multiple Deprivation.

BMI and participants of Black ethnicity had the highest (Supporting Information Table S2). Of the 85,514 who attended at least one program session with valid first and last session weights recorded, 52% completed the program (i.e., attended at least 60% of sessions).

Baseline weight varied between a highest mean of 84.6 (SD: 19.1) kg in January and April and a lowest mean of 83.1 (SD: 19.1) in July (Figure 1), with significant differences for 15 out of the 66 pairwise combinations of months (Supporting Information Table S2). There was no evidence that the monthly pattern of baseline BMI varied by demographic characteristic (age, sex, BMI group, deprivation quintile, or ethnicity; Supporting Information Table S3).

The mean number of months on the program for all participants who attended at least one program session was 6.4 (SD: 5.6), and the mean number of sessions attended was 7.9 (SD: 4.5). Both the mean number of months and the mean number of sessions attended were highest for those starting in January (6.8 [SD: 5.9] months and 8.3 [SD: 4.5] sessions, respectively) with a broadly downward trend throughout the year, such that participants starting in December attended for 5.9 (SD: 5.6) months and 7.7 (SD: 4.6) sessions (Figure 2).

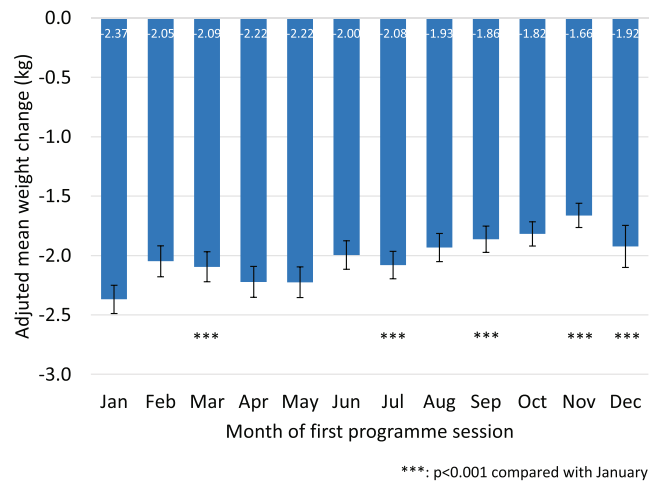
Univariate analyses of weight change are in Table 2. Among all enrolled participants, the mean weight change at the end of the program was -2.00 kg (95% confidence interval [CI]: -2.02 to -1.97) or -2.33% (95% CI: -2.35% to -2.32%) of the baseline weight. There were significant differences in the unadjusted mean weight change by month, with weight loss greatest for those starting the program in January (-2.54 kg) and lowest for those starting in August (-1.61 kg). This pattern was consistent irrespective of demographic characteristics (Table 2). The adjusted regression analyses, used to assess natural monthly variation in weight, confirmed that monthly differences existed and showed that, compared with January, when participants lost -2.37 kg (95% CI: -2.49 to -2.25), participants starting in any other month (except April and May) lost less weight, ranging between 0.28 kg (95% CI: 0.10 to 0.45) less weight in those starting in March and 0.71 kg (95% CI: 0.55 to 0.87) less weight in those starting in November (Supporting Information Table S4 and Figure 3).

## Sensitivity analysis

To further account for monthly variability, we restricted the analysis to the 4435 participants who finished the program exactly a year after being enrolled (e.g., enrolled in March 2018 and completed in March 2019). The direction of the effect remained consistent across all months, but the estimates attenuated. Compared with participants starting and finishing in January who lost -2.98 kg (95% CI: -3.37 to -2.60), only participants starting and finishing in August or November lost significantly less weight (0.69 kg [95% CI: 0.11 to 1.27] and 0.59 kg [95% CI: 0.01 to 1.16], respectively; Supporting Information Figure S1 and Table S5).

Separate regression models for each of the four program providers explored the moderating impact of each provider. These indicated that the direction of the associations in the main model was, with a few exceptions, broadly consistent across all providers.





**FIGURE 3** Mean weight change (kilograms, with 95% CI) by month of starting the program adjusted for monthly trends [Color figure can be viewed at [wileyonlinelibrary.com](http://wileyonlinelibrary.com)]

Participants starting in November lost less weight regardless of the program provider compared with those starting in January (Supporting Information Figure S2).

### Mediation analysis

Mediation analysis showed that the number of sessions attended was a significant partial mediator of the association between starting month and weight loss. First, the starting month was significantly associated with the number of sessions attended. Compared with starting in January, when participants attended 8.3 (SD: 4.5) sessions, starting in any other month except June was associated with attending significantly fewer sessions, with the reduction ranging between  $-0.18$  (95% CI:  $-0.32$  to  $-0.04$ ) sessions for September and  $-0.66$  (95% CI:  $-0.80$  to  $-0.51$ ) sessions in August (Supporting Information Table S7). Second, adjusting the primary regression model for the number of sessions attended showed that each additional session attended was associated with an additional  $-0.29$  kg (95% CI:  $-0.30$  to  $-0.29$ ) of weight loss, and this attenuated the effects of starting month (i.e., the interaction terms; Supporting Information Table S8). For example, by the end of program in the primary model, those starting in November lost, on average,  $0.71$  kg (95% CI:  $0.55$  to  $0.87$ ) less than those starting in January. After controlling for the number of sessions attended, this difference remained significant but attenuated to  $0.25$  kg (95% CI:  $0.09$  to  $0.40$ ).

The results of the second mediation analysis were consistent with the first one, showing that completing the program was a partial mediator of the association between starting month and weight loss achieved. Starting in any month other than January (except September) was associated with lower odds of completing the program compared with starting in January (average odds ratios ranging between  $0.80$  and  $0.92$ ; Supporting Information Table S9). Adjusting the primary model for completion slightly attenuated the

interaction terms, indicating that the association was partly mediated by completion (Supporting Information Table S10).

## DISCUSSION

### Statement of principal findings

Starting a structured weight management program in January was independently associated with greater weight loss than starting a program in other months. Starting in November or August was consistently associated with less weight loss compared with starting in January. Secondary analyses suggest that the association was partly, but not fully, mediated by higher attendance of sessions among people starting in January and greater likelihood of completion, compared with those starting in other months.

### Strengths and weaknesses of the study

Strengths of the study include a large representative sample of adults in England being offered a standardized behavioral weight management program as part of the NHS DPP, objectively measured weight and height, and regression modeling to account for the significant monthly variation in baseline weight. Limitations include the observational nature of the study that cannot establish causality. Our model took into account starting weight but no other factors because demographic characteristics did not differ by starting month, so these would be unlikely to confound the analysis. However, the possibility of residual confounding due to unknown factors that influence both the choice of starting month and weight loss remains.

To reduce biases from missing data, we included everyone with at least one valid weight measurement. Unlike trials in which participants complete their follow-up at prespecified time points, participants in the NHS DPP completed the program at various time points, but our modeling accounted for this and the sensitivity analysis of people starting and finishing at the same calendar month did not lead to conclusions different from those of the main analysis.

### Strengths and weaknesses in relation to other studies, discussing important differences in results

To our knowledge, this is the first study showing that the weight people lose may depend on the month of the year they start the program. A smaller previous study ( $n = 19,153$ ) found no association between starting month and weight loss 1 to 2 months after program start, but that lack of effect may have been due to their lack of adjustment for monthly variation and the smaller achieved mean weight loss ( $1.3$  kg) [18]. Our data are consistent with the literature showing greater baseline weight in winter months and lower baseline weight in summer months [19, 20]. This might be because people typically have higher energy intake over the winter holiday season and lower energy

expenditure during the winter months [20]. Furthermore, weight gain over the winter holiday season is not compensated for in the spring or summer months, leading to increases in weight over time [19, 21].


### Meaning of the study: possible explanations and implications for clinicians and policy makers

Weight loss is strongly associated with improvements in hemoglobin A<sub>1c</sub> and future reductions in the incidence of type 2 diabetes [11]. The strongest independent predictors of long-term weight loss are engagement (i.e., session attendance) and adherence (i.e., weight loss) in the first months of an attempt to lose weight [7–9]. October and November were the months that most people started the program, indicating that people may be motivated to start in autumn, but these participants had lower engagement and adherence than January starters. Our analysis suggests that additional strategies should be implemented to incentivize engagement and adherence among participants who start in the months associated with lower weight loss. Such strategies may include making participants aware of the potential challenges associated with starting in months other than January, asking people to commit to New Year-like resolutions, additional contact with participants, implementation of behavior change techniques around holiday food, and additional efforts to reengage people who may lapse over the holiday period. For example, two strategies associated with less weight gain during holidays are regular weighing and choosing specific foods worth eating versus skipping [22]. This is also supported by a randomized trial of a brief behavioral intervention focusing on weight tracking and provision of physical activity calorie equivalent information that prevented weight gain by 0.5 kg compared with the control group over the Christmas period [23].

### Unanswered questions and future research

The reasons explaining the variation in attendance and achieved weight loss depending on the starting month remain to be elucidated. It is plausible that associating January with a “fresh start” due to New Year’s resolutions, social norms of weight loss attempts, and heavy marketing of weight loss programs may provide additional motivation to people, leading to higher session attendance and, subsequently, larger weight loss. Weight loss was lowest for people starting in August. This is typically a holiday month in England, and the lack of routine activities may lead to lower implementation of behaviors necessary for weight loss, even among people actively trying to lose weight [24]. Furthermore, November and December precede and coincide with the Christmas holiday season, which may explain the substantial disengagement from the program and smaller weight loss for people starting a program during these months.

In conclusion, starting a structured weight management program in January was associated with a 12% to 30% greater weight loss than starting a program at other months. Developing and implementing additional strategies to incentivize program engagement in months of

the year when adherence is low may improve the overall effectiveness of behavioral weight management programs. 

### AUTHOR CONTRIBUTIONS

Susan A. Jebb and Emma Barron conceived the study. Dimitrios A. Koutoukidis, Richard Stevens, Paul Aveyard, and Susan A. Jebb designed the study. Emma Barron managed the data and conducted the analysis with input from Richard Stevens and Dimitrios A. Koutoukidis. All authors collaborated in the interpretation of the results. Dimitrios A. Koutoukidis drafted the initial version of manuscript. All authors contributed to and critically revised the manuscript. Dimitrios A. Koutoukidis is the guarantor. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

### FUNDING INFORMATION

National Health Service England funded program development, implementation, and evaluation. This study was funded by the National Institute for Health Research (NIHR) Oxford Biomedical Research Centre (grant number: IS-BRC-1215-20008). Susan A. Jebb and Paul Aveyard are also funded by the Oxford NIHR Applied Research Collaboration. Paul Aveyard is an NIHR Senior Investigator. The views expressed are those of the authors and not necessarily those of the National Health Service, the NIHR, or the Department of Health and Social Care.

### CONFLICT OF INTEREST STATEMENT

Dimitrios A. Koutoukidis, Susan A. Jebb, and Paul Aveyard report being investigators in two investigator-led publicly funded (National Institute of Health Research) trials in which the weight loss intervention was donated by Nestle Health Science and Oviva to the University of Oxford outside the submitted work. None of these associations led to payments to these authors personally. Paul Aveyard spoke at a symposium at the Royal College of General Practitioners conference that was funded by Novo Nordisk. The other authors declared no conflict of interest.

### DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from National Health Service England. Restrictions apply to the availability of these data.

### ORCID

Dimitrios A. Koutoukidis  <https://orcid.org/0000-0002-1955-7234>

Richard Stevens  <https://orcid.org/0000-0002-9258-4060>

Paul Aveyard  <https://orcid.org/0000-0002-1802-4217>

Jonathan Valabhji  <https://orcid.org/0000-0001-9756-4061>

Susan A. Jebb  <https://orcid.org/0000-0001-9190-2920>

### REFERENCES

1. Zheng Y, Manson JE, Yuan C, et al. Associations of weight gain from early to middle adulthood with major health outcomes later in life. *JAMA*. 2017;318(3):255–269.
2. Ma C, Avenell A, Bolland M, et al. Effects of weight loss interventions for adults who are obese on mortality, cardiovascular disease, and cancer: systematic review and meta-analysis. *BMJ*. 2017;359:j4849. doi:10.1136/bmj.j4849

3. Ahern AL, Wheeler GM, Aveyard P, et al. Extended and standard duration weight-loss programme referrals for adults in primary care (WRAP): a randomised controlled trial. *Lancet*. 2017;389(10085):2214-2225.
4. West R. The PRIME theory of motivation as a possible foundation for addiction treatment. In: Henningfield JE, Santora PB, Bickel WK, eds. *Drug Addiction Treatment in the 21st Century: Science and Policy Issues*. John's Hopkins University Press; 2007.
5. Ibbetson C. How many people kept their 2020 New Year's resolutions? YouGov. Published December 30, 2020. Accessed March 29, 2021. <https://yougov.co.uk/topics/society/articles-reports/2020/12/30/new-years-resolutions-2020-and-2021>
6. Rossner SM, Hansen JV, Rossner S. New Year's resolutions to lose weight--dreams and reality. *Obes Facts*. 2011;4(1):3-5.
7. Astbury NM, Tudor K, Aveyard P, Jebb SA. Heterogeneity in the uptake, attendance, and outcomes in a clinical trial of a total diet replacement weight loss programme. *BMC Med*. 2020;18(1):86. doi: [10.1186/s12916-020-01547-4](https://doi.org/10.1186/s12916-020-01547-4)
8. Unick JL, Neiberg RH, Hogan PE, et al. Weight change in the first 2 months of a lifestyle intervention predicts weight changes 8 years later. *Obesity*. 2015;23(7):1353-1356.
9. Piernas C, MacLean F, Aveyard P, et al. Greater attendance at a community weight loss Programme over the first 12 weeks predicts weight loss at 2 years. *Obes Facts*. 2020;13(4):349-360.
10. NHS England and NHS Improvement. Diabetes Prevention Programme Information Governance and Data Flows Framework. Published May 2016. Accessed February 5, 2022. <https://www.england.nhs.uk/wp-content/uploads/2019/09/diabetes-prevention-programme-information-governance-and-data-flows-framework.pdf>
11. Valabhji J, Barron E, Bradley D, et al. Early outcomes from the English National Health Service Diabetes Prevention Programme. *Diabetes Care*. 2020;43(1):152-160.
12. Robson J, Dostal I, Sheikh A, et al. The NHS Health Check in England: an evaluation of the first 4 years. *BMJ Open*. 2016;6(1):e008840. doi: [10.1136/bmjopen-2015-008840](https://doi.org/10.1136/bmjopen-2015-008840)
13. UK Department of Health and Social Care. Start Active, Stay Active: A Report on Physical Activity for Health from the Four Home Countries' Chief Medical Officers. Published July 11, 2011. Accessed October 28, 2022. [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/830943/withdrawn\\_dh\\_128210.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/830943/withdrawn_dh_128210.pdf)
14. Public Health England. The EatWell Guide. Published March 17, 2016. Updated September 18, 2018. Accessed October 28, 2022. <https://www.gov.uk/government/publications/the-eatwell-guide>
15. NHS England. NDPP National Service Specification. Accessed October 28, 2022. <https://www.england.nhs.uk/wp-content/uploads/2016/08/dpp-service-spec-aug16.pdf>
16. National Institute for Health and Care Excellence. Behavior change: individual approaches. Public health guideline PH49. Published January 2, 2014.
17. UK Ministry of Housing, Communities & Local Government. English indices of deprivation 2019. Published September 26, 2019. Accessed November 05, 2022. <https://www.gov.uk/government/statistics/english-indices-of-deprivation-2019>
18. Christensen RAG, Wharton S, Brooks JD, Bondy SJ, Kuk JL. The association of sex and calendar month with changes in weight: a retrospective cohort study of a community-based weight management clinic. *Obes Res Clin Pract*. 2021;15(5):515-517.
19. Turicchi J, O'Driscoll R, Horgan G, et al. Weekly, seasonal and holiday body weight fluctuation patterns among individuals engaged in a European multi-centre behavioural weight loss maintenance intervention. *PLoS One*. 2020;15(4):e0232152. doi: [10.1371/journal.pone.0232152](https://doi.org/10.1371/journal.pone.0232152)
20. Ma Y, Olendzki BC, Li W, et al. Seasonal variation in food intake, physical activity, and body weight in a predominantly overweight population. *Eur J Clin Nutr*. 2006;60(4):519-528.
21. Yanovski JA, Yanovski SZ, Sovik KN, Nguyen TT, O'Neil PM, Sebring NG. A prospective study of holiday weight gain. *N Engl J Med*. 2000;342(12):861-867.
22. Olson K, Coffino JA, Thomas JG, Wing RR. Strategies to manage weight during the holiday season among US adults: a descriptive study from the National Weight Control Registry. *Obes Sci Pract*. 2021;7(2):232-238.
23. Mason F, Farley A, Pallan M, Sitch A, Easter C, Daley AJ. Effectiveness of a brief behavioural intervention to prevent weight gain over the Christmas holiday period: randomised controlled trial. *BMJ*. 2018;363:k4867. doi: [10.1136/bmj.k4867](https://doi.org/10.1136/bmj.k4867)
24. Fahey MC, Klesges RC, Kocak M, Talcott GW, Krukowski RA. Seasonal fluctuations in weight and self-weighing behavior among adults in a behavioral weight loss intervention. *Eat Weight Disord*. 2020;25(4):921-928.
25. National Institute for Health and Care Excellence. Obesity: identification, assessment and management. Clinical guideline CG189. Published November 27, 2014. Updated September 8, 2022.

## SUPPORTING INFORMATION

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

**How to cite this article:** Koutoukidis DA, Barron E, Stevens R, Aveyard P, Valabhji J, Jebb SA. Association between the month of starting a weight management program and weight change in people at high risk of type 2 diabetes: A prospective cohort study. *Obesity (Silver Spring)*. 2023;31(6):1707-1716. doi:[10.1002/oby.23762](https://doi.org/10.1002/oby.23762)