Research Paper

Negative impact of the first COVID-19 lockdown upon health-related behaviours and psychological wellbeing in people living with severe and complex obesity in the UK

Adrian Brown[a,b,c], Stuart W. Flint[d,e], Anastasia Z. Kalea[f,g], Mary O'Kane[h], Simon Williams[i], Rachel L. Batterham[a,b,c,*]

[a] Centre for Obesity Research, University College London, London, UK
[b] Bariatric Centre for Weight Management and Metabolic Surgery, University College London Hospital NHS Trust, London, UK
[c] UCLH Biomedical Research Centre, National Institute of Health Research, London, UK
[d] School of Psychology, University of Leeds, Leeds, UK
[e] Scaled Insights, Nexus, University of Leeds, Leeds, UK
[f] Division of Medicine, University College London, London, UK
[g] Institute of Cardiovascular Science, University College London, UK
[h] Leeds Teaching Hospitals NHS Trust, Leeds, UK
[i] Institute of Management and Health, University of Wales Trinity Saint David, Carmarthen, Wales, UK

ABSTRACT

Background: Coronavirus disease 2019 (COVID-19) has led to unprecedented changes in the way we live, particularly for people at higher risk of severe illness from COVID-19. People with pre-existing health conditions have been markedly impacted and, in some instances, left unsupported due to reduced provision of routine healthcare services. People living with obesity (PLWO) are identified as at higher risk of severe illness from COVID-19 infection. Currently, there is a paucity of evidence about the impact of the first COVID-19 lockdown on PLWO, including those accessing weight management and bariatric surgery services (WMS).

Methods: 543 adults (16−80 years) with obesity (BMI ≥ 30 kg/m^2) were recruited between 14th May and 9th July 2020 through social media advertisements, professional and patient obesity organisations and WMS. Participants completed an online survey regarding the impact of the first COVID-19 lockdown upon, mental health, well-being, health-related behaviours, risk mitigating behaviours, access to WMS and weight stigma.

Findings: During the first COVID-19 lockdown, the majority of PLWO reported deterioration of their mental health and health-related behaviours such as diet, physical activity (PA) and sleep. With 55% reporting an unhealthier diet, 61% reduced PA and 80% worsening of their sleep. Higher depression and lower wellbeing scores were found to associate with the greatest adverse impact upon health-related behaviours. PLWO who were attending WMS prior to the first lockdown reported a greater deterioration of their diet, with nearly 50% reporting worsening of their diet and PA worsening compared to PLWO who were not attending WMS. Most participants took two or more risk mitigating actions (73%). PLWO attending WMS reported reduced access (44%) with insufficient information (49%) from their clinical service providers. The majority of participants reported no change in perceived weight stigma.

Interpretation: This study shows the detrimental impact of the first COVID-19 lockdown on PLWO in relation to health-related behaviours, mental health and access to WMS. Our findings show that PLWO with poor mental health and those attending WMS were most adversely impacted and highlights the need for greater mental health support and continued provision of support from WMS for PLWO during future lockdowns.

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1. Introduction

Coronavirus (COVID-19) has led to unprecedented changes in the way we live, particularly for people at higher risk of severe illness

* Corresponding author at: Centre for Obesity Research, University College London, London, UK.
E-mail address: r.batterham@ucl.ac.uk (R.L. Batterham).

Research in context

Evidence before this study

We searched PubMed for original research articles using combinations of terms 'obesity', 'COVID-19', 'health-related behaviours', 'mental health', 'physical activity', 'diet', 'weight management' until December 21st, 2020. Evidence in the general population has shown a negative impact on weight-related behaviours, physical activity, and psychological wellbeing. Studies examining the impact of the first COVID-19 lockdown on health-related behaviours, risk mitigating actions and stigma experienced by people living with obesity (PWLO) was limited.

Added value of this study

This study provides novel insights into the impact of the first COVID-19 lockdown on UK PLWO, in particular those with severe and complex obesity. These data show that the first COVID-19 lockdown negatively impacted self-reported diet, physical activity, sleep, mental health and access to weight management services (WMS). People attending WMS reported greater worsening of their diet and physical activity. Higher depression and lower wellbeing were key predictors of adverse changes in health-related behaviours during the first COVID-19 lockdown.

Implications of all the available evidence

Our data highlight the need for policy makers and WMS providers to ensure greater provision of support for PLWO during future lockdowns. In particular, to target support to PLWO with poor mental health and ensure that WMS are prioritised as protected key services.

from COVID-19. People living with obesity (PLWO) were identified by the UK Government as one of the population subgroups at 'higher risk' [1], with evidence showing that obesity increases the likelihood of hospitalisation and advanced respiratory support, and an increased risk of death from COVID-19 infection [2−4].

Early in the first COVID-19 lockdown in the UK, NHS England [5] released guidance that weight management services (WMS) were to cease face-to-face contact in order to help 'flatten the curve' and reduce transmission rates. Alongside the redeployment of healthcare professionals and changes to delivery approaches, the provision of WMS was negatively impacted [6].

Governmental policies adopted to manage the pandemic, including social distancing and shielding interrupted important opportunities for social support and accentuated feelings of social isolation and loneliness [7]. Whilst evidence of the negative impact of COVID-19 pandemic on psychological wellbeing, health-related behaviours, physical activity (PA) and diet have been reported, much of this research has focussed on the general population. Consequently, it remains unclear how PLWO and those accessing WMS were impacted during the first COVID-19 lockdown.

This study aimed to examine the impact of the first COVID-19 lockdown on UK PLWO, including those attending WMS. Specifically, the study explored their actions, health-related behaviours, mental health and wellbeing.

2. Methods

2.1. Design

This study used an online survey method, hosted by University College London (UCL) Opinio.

Recruitment invitations were disseminated via social media advertisements, professional and patient obesity organisations and WMS. Eligibility criteria were PLWO (BMI $\geq$ 30 kg/m^2) aged 16−80 years, and/or attending a Tier 2/3 weight management or bariatric surgery service (Tier 4) in the UK. Prior to completing the survey, participants read the information sheet and provided electronic informed consent. The study was granted ethical approval by the UCL Research Ethics Committee (REC number 16191/004).

2.2. COVID-19 survey

This survey was developed to explore the impact of the first COVID-19 lockdown on PLWO, including those attending WMS. The survey was developed in collaboration with PLWO from obesity advocacy groups. This ensured that the length, terminology and questions where targeted and appropriate for PLWO.

After providing informed consent, participants provided demographic data including age, gender and ethnicity, and self-reported weight and height. Participants also indicated if they had a BMI $\geq$ 40 kg/m^2, had undergone bariatric surgery, and were accessing WMS at the point of the first UK COVID-19 lockdown.

The survey was comprised of the following six sections, consisting of both open and closed questions:

1. Awareness, thoughts and actions relating to COVID-19, including awareness of COVID-19 symptoms and perceived risk.
2. Risk mitigating actions (e.g. social distancing, self-isolation).
3. Access to WMS.
4. Mental health, wellbeing and depression which included the validated Warwick-Edinburgh Mental Wellbeing Scale (WEMWBS) [8] and Patient Health Questionnaire (PHQ-9) [9].
5. Health-related behaviours including diet, physical activity and sleep.
6. Experiences of stigma and discrimination.

See the Supplementary Materials for a copy of the survey and validated questionnaires.

2.3. Statistical analysis

Demographic factors were summarised using mean (standard deviation [SD]) for normally distributed continuous variables or median (interquartile [IQR] or entire range) for continuous variables that were not normally distributed. Categorical variables were described with counts (percentages). Statistical analyses were performed using SPSS Version 24.0. Statistical significance was defined as a p-value $< 0 \bullet 05$.

To examine the impact of stigma on risk mitigating behaviours, attempting to lose weight and on mental health, this variable was operationalised dichotomously by adding the following responses together; "Yes, and No, I was stigmatised before" were added together to create the variable stigmatised (1); and "No and No I felt less stigmatised" were added together to create the variable not stigmatised (0).

Descriptive information was generated regarding the impact of first COVID-19 lockdown on health-related behaviours, access to WMS, mental health, depression, psychological wellbeing and stigma. To examine between group differences, normally distributed data and skewed data were analysed using appropriate tests (t-tests, Mann-Whitney U test), while categorical data was analysed using chi-squared tests, following this a series of regression models were built.

Binomial and ordinal logistic regression alongside generalised linear models of the data were used to analyse the impact of COVID-19 on the following outcomes: (1) mental health, wellbeing and self-reported stigma and health-related behaviours; (2) risk mitigating

behaviour; (3) access to WMS. Covariates included in the models were BMI, age, gender and number of high risk indicators as identified by UK Government [1] and mental health including the WEMWBS [8] and PHQ-9 [9]. Ethnicity was not added to the models due to insufficient numbers of people in ethnic groups other than White.

Continuous data (depression and wellbeing) were analysed using hierarchical multiple linear regression using three separate models to assess predictors during first COVID-19 lockdown. Model 1 used demographic data, baseline BMI, age, gender and number of risk indicators; Model 2 added self-reported change in mental health and stigma; and Model 3 added on concerns of infection and severe illness from COVID-19. Dummy-coded variables were used for categorical variables (number of risk indictors and self-reported mental health). Odd ratios, 95% confidence intervals (CI) and *p*-values were reported for ordinal and binomial logistic regression, while beta-coefficients and *p*-values appear in Tables. The assumptions of each model were checked and met.

2.4. Role of funding source

The funder of the study had no role in the study design, data collection, data analysis, interpretation or writing of the report. All authors had full access to the data in the study and the corresponding author has final responsibility for the decision to submit for publication.

3. Results

A total of 655 people (569 female, 79 male, 2 reported other and 2 identified as transgender) completed the survey between the 14th May and 9th July 2020. Due to small numbers, participants who responded 'other' or 'transgender' were removed from the analysis, as were 109 who reported a BMI of less than 30 kg/m^2, leaving 543 participants in the final analysis.

The mean age of the participants was 51.6 (SD 9.9) years with a median BMI of 37.7 kg/m^2 (IQR, 36.0, 48.7), 352 (65.3%) reported their BMI was $\geq$ 40 kg/m^2 and 501 (92.3%) identified as White-British, Irish or other, with 453 (90.4%) residing in England (Table 1; Table S1 summarises baseline characteristics for those attending WMS). Most participants had at least one higher risk factor (56% [*n* = 304]) identified by UK Government as increasing risk of severe illness from COVID-19 (Table 1). Of those surveyed, 15.7% (*n* = 78) reported experiencing symptoms of COVID-19 (Table S2).

3.1. Mental health, wellbeing, depression and self-reported stigma

Most participants reported that their mental health had become worse or much worse during the first COVID-19 lockdown (*n* = 299 [55.1%], Table 2). Mean wellbeing score (WEMWBS) was 38.4 (SD 10.2) and mean depression score (PHQ-9) was 13.4 (SD 7.0). Based on the categorisation of UK population wellbeing as measured by the WEMWBS [10], 65.2% (*n* = 281) reported wellbeing in the bottom 15th centile and 36.7% (*n* = 154) moderately severe to severe depression (Table 2).

When participants were asked if they felt stigmatised or discriminated against since the COVID-19 outbreak because of their higher body weight, 16.7% (*n* = 69) reported feeling more stigmatised, while 43.7% (*n* = 181) did not feel stigmatised (Table 2). Of the remaining participants, 37.4% (*n* = 155) reported not feeling stigmatised during the first COVID-19 lockdown as they had felt stigmatised before and there was no change, whilst 2.2% (*n* = 9) reported that they felt less stigmatised.

Those attending WMS had lower wellbeing (29.1% vs 34.8%, *p* < 0.001). There were no differences according to age, BMI, depression or number of co-morbidities of those attending WMS compared to those not attending services prior to the first COVID-19 lockdown.

Table 1
Baseline characteristics.

Characteristic	
Age, years, mean (SD)	51.6 (9.9)
Gender, (n, [%])	
Male	66 (12.2)
Female	477 (87.8)
Ethnicity	
White - British, Irish, other	501 (92.3)
Asian/Asian British	8 (1.5)
Black/Black British	9 (1.7)
Chinese/Chinese British	4 (0.7)
Middle Eastern/Middle Eastern British	2 (0.4)
Mixed race - White and Black/Black British	5 (0.9)
Mixed race - other	8 (1.5)
Other ethnic groups	3 (0.6)
Prefer not to say	3 (0.6)
Weight (kg), median (IQR)	103.4 (97.0, 137.0)
BMI (kg/m^2), median (IQR)	37.7 (36.0, 48.7)
Country of Residence	
England	453 (90.4)
Wales	14 (2.8)
Scotland	23 (4.6)
Northern Ireland	11 (2.2)
Living with Obesity, *n* = 540 (n, [%])	503 (93.1)
BMI >40 kg/m^2, *n* = 539 (n, [%])	352 (65.3)
Bariatric surgery, *n* = 539 (n, [%])	83 (15.3)
Surgery Type	
RYGB	28 (34.6)
LSG	37 (45.7)
LAGB	11 (13.6)
BPD	1 (1.2)
DS	1 (1.2)
Mini Bypass/MGB/OAGB	2 (2.5)
Other	1 (1.2)
Year of surgery, median (IQR)	2017 (2013, 2018)
Health conditions, *n* = 543 (n, [%])	
Aged 70 or older	7 (1.3)
Respiratory Disease	92 (16.9)
Heart Disease	9 (1.7)
Kidney Disease	6 (1.1)
Liver Disease	3 (0.6)
Neurological Condition	7 (1.3)
Diabetes	92 (16.9)
Problem with the Spleen	2 (0.4)
Weakened Immune system	17 (3.1)
Pregnant	3 (0.6)
No additional disease or condition	245 (45.1)
Other disease or condition not listed	183 (33.7)
Multiple Co-morbidities *n* = 543 (n, [%])	
0	239 (44.0)
1	207 (38.1)
2+	97 (17.9)
At the time of COVID-19 outbreak were you attending? *n* = 504, (n, [%])	
Tier 2 – GP & commercial WMS	65 (12.9)
Tier 3 – Specialist WMS	54 (10.7)
Tier 4 – 1st appointment Bariatric Services	26 (5.2)
Tier 4 – awaiting surgery/pre-op diet	31 (6.2)
Tier 4 – Post bariatric surgery	37 (7.3)
No current programme	291 (57.7)

Note: n, number, BMI, body mass index, RYGB. Roux-en-Y Gastric Bypass, SG, sleeve gastrectomy, LAGB, Laparoscopic Adjustable Gastric Band, BPD, biliopancreatic diversion, DS, duodenal switch; MGB, mini gastric bypass; OAGB, one-anastomosis gastric bypass; WMS, weight management and bariatric services.

3.2. Health-related behaviours

In general, participants reported that their health-related behaviours had been impacted either a lot or a great deal during the first COVID-19 lockdown. Shopping behaviour was affected the most (*n* = 296, [68.8%]), with 54.5% (*n* = 208) reporting an unhealthier diet and 61.3% (*n* = 234) reduced PA (see Table 3). Nearly a third of participants reported their diet becoming healthier or PA increasing (31.4% [*n* = 120]; 28.3% [*n* = 108], respectively). Furthermore, 72% (*n* = 306)

Table 2

Summary of mental health during the first COVID-19 lockdown in people living with obesity.

Survey Questions	
Since COVID-19 outbreak my mental health has been, (n, [%])	
Much Better	5 (0.9)
Better	23 (4.2)
Neither	111 (20.4)
Worse	208 (38.3)
Much Worse	91 (16.8)
WEMWBS, mean (SD)	38.4 (10.2)
Warwick Population Centiles, n = 431 (n, [%])	
Top 15th Centile	13 (3.0)
Remainer 15th Centile	137 (31.8)
Bottom 15th Centile	281 (65.2)
PHQ-9, mean (SD)	13.4 (7.0)
PHQ-9 Depression Score, n = 420 (n, [%])	
Minimal Depression	64 (15.2)
Mild Depression	86 (20.5)
Moderate Depression	116 (27.6)
Moderately Severe Depression	94 (22.4)
Severe Depression	60 (14.3)
Have you felt stigmatised since the COVID-19 outbreak? n = 414 (n, [%])	
Yes	69 (16.7)
No	181 (43.7)
No, I felt stigmatised before	155 (37.4)
No, I feel stigmatised less	9 (2.2)

PHQ-9, Patient Health Questionnaire-9; WEMWBS Warwick-Edinburgh Mental Well-being Scale; SD, standard deviation, COVID-19, Coronavirus disease 19; n, numbers;%, percentages. Warwick population centiles were taken from Strange et al. (2014) and used for comparison against the general population WEMWBS scores.

Table 3

Summary of changes to health-related behaviours during the first COVID-19 lockdown in people living with obesity.

Survey Questions	
Has your shopping changed since COVID-19 outbreak? n = 430, (n, [%])	
Not at all	19 (4.4)
A little	39 (9.1)
A moderate amount	76 (17.7)
A lot	102 (23.7)
A great deal	194 (45.1)
Has your diet changed since COVID-19 outbreak? n = 428, (n, [%])	
Not at all	34 (7.9)
A little	77 (18.0)
A moderate amount	151 (35.3)
A lot	100 (23.4)
A great deal	66 (15.4)
How did diet change? n = 382, (n, [%])	
Healthier	120 (31.4)
No change	54 (14.1)
Unhealthier	208 (54.5)
Have you used food to manage your emotions during COVID-19? n = 425, (n, [%]) outbreak?	
Yes	306 (72.0)
No	119 (28.0)
Has your physical activity changed since COVID-19 outbreak? n = 421, (n, [%])	
Not at all	33 (7.8)
A little	53 (12.6)
A moderate amount	117 (27.8)
A lot	106 (25.2)
A great deal	112 (26.6)
How did physical activity change? n = 382, (n, [%])	
Increased	108 (28.3)
No change	40 (10.5)
Reduced	234 (61.3)
Has your sleep quality or quantity change since COVID-19 outbreak? n = 424, (n, [%])	
Yes	293 (69.1)
No	131 (30.9)
How did sleep change? n = 284, (n, [%])	
Better	33 (11.6)
No change	23 (8.1)
Worse	228 (80.3)
How many hours sleep have you got since COVID-19? Mean (SD)	5.8 (1.7)
Have you actively been attempting to lose weight since the COVID-19 outbreak?	341 (66.1)

SD, standard deviation, COVID-19, Coronavirus Disease 2019; n, numbers;%, percentages.

reported using food to manage their emotions during the first COVID-19 lockdown. Sleep quality and quantity was impacted (69.1% [n = 293]) with 80.3% (n = 228) of participants reported worse sleep during the first COVID-19 lockdown (Table 3).

When considering the combination of health-related behaviours (diet plus PA plus sleep), 2.7% (n = 7) reported positive changes to their PA, diet and sleep, while 14.8% (n = 53) reported positive change to their PA and diet, and 39.5% (n = 141) reported worsening of their PA and diet. Of those attended WMS, 68% (n = 102), 66.7% (n = 100), and 85.7% (n = 96) reported worse PA, diet and sleep, respectively.

Comparing those that attended a WMS before and during the first COVID-19 lockdown and those not attending, significantly more people attending services reported worsening of their diet (66.7% attending vs 46.1% not attending, p < 0.001), and also worsening of both diet and PA (48.8% attending vs 33.6% not attending, p = 0.002). There was no difference in emotional eating between those attending (77.2%) and not attending WMS (69%, p = 0.070). There was no statistically significant difference in attempts to lose weight (341 participants reported an attempt) during the first COVID-19 lockdown between those attending (68.5%) and not attending services (63.9%, p = 0.279).

3.3. Risk mitigating behaviours

Most participants reported following UK Government socially distancing guidance (n = 433 [79.7%]). Less than half of the sample reported using protective apparel, including masks (not recommended at the time) or gloves (n = 256 [47.1%]), followed by self-isolation and shielding (30.2%, 18.2%, respectively; Table S3). Most participants took two or more risk mitigating actions (n = 395, [72.7%]) with 124 (22.8%) following four or more actions.

One hundred and eighty-two participants (58.5%) believed they were at higher risk of infection, with 253 (81.4%) believing they were at greater risk due to a BMI of ≥ 40 kg/m^2 (Table S3). Over half of those with a self-reported BMI < 40 kg/m^2 believed that they were at an increased risk of severe illness from COVID-19 infection (n = 93 [56.7%]).

Comparing WMS attendance or not, use of risk mitigating behaviours did not statistically significantly differ apart from practicing shielding. Participants attending a WMS reported shielding more often than those not attending a service (26.3% vs 13.7%, p 0 < 0.001).

For more detailed analysis of participants COVID-19 concerns and risk mitigating actions, see Supplementary Materials.

3.4. Predictors of health-related behaviours

Shopping: Compared to before the first COVID-19 lockdown, older participants were more likely to report greater change in their shopping (OR 1.02 for each additional year in age, 95% CI 1.00 to 1.03; p = 0.045) (Table 4). In addition, those with better wellbeing were less likely to report a greater change in their shopping habits during the first COVID-19 lockdown (OR 0.97 per additional wellbeing score as measured by the WEMWBS, 95% CI 0.95 to 0.99; p = 0.007). There was no statistically significant difference in shopping behaviour according to gender, number of co-morbidities, BMI or depression (Table 4).

Diet: Participants with higher depression and lower wellbeing scores reported greater deterioration in their diet (OR, 1.04 per

additional point in depression, 95% CI 1.00 to 1.08, p = 0.034; OR 0.97 per additional point in wellbeing, 95% CI 0.95 to 0.99, p = 0.010, respectively) (Table 4).

In terms of direction of change, older people were more likely to report their diet had become unhealthier (OR 1.03 for each additional year in age, 95% CI 1.01 to 1.05; p = 0.001) (Table 5). In addition, those with higher depression were more likely to report their diet becoming unhealthier (OR, 1.06 per additional point in depression, 95% CI 1.02 to 1.11, p = 0.003), while those with higher wellbeing scores were less likely to report a perceived worsening of their diet (OR 0.96 per additional point in wellbeing, 95% CI 0.94 to 0.99, p = 0.005) (Table 5).

Participants who reported a perceived worsening of their diet had approximately 3 times higher odds of emotional eating than those who reported a perceived improvement in their diet (OR = 3.05, 95% CI 1.7 to 5.4, p < 0.001). Men were significantly less likely to use food to manage their emotions during the first COVID-19 lockdown (OR 0.34, 95% CI 0.16 to 0.71, p = 0.004) (Table S4).

Physical Activity: Participants with higher depression were more likely to report a greater change in their PA, with each additional point in depression associated with an OR of 1.04 (95% CI 1.00 to 1.07; p = 0.047; Table 4).

Depression score was negatively associated with PA with those with higher depression scored reporting the greatest decrease in PA compared to before the first COVID-19 lockdown (OR, 1.05 per additional point in depression score 95% CI 1.01 to 1.10, p = 0.019). While those with higher wellbeing were less likely to report a reduction in PA (OR 0.97 per additional point in wellbeing, 95% CI, 0.94 to 0.99, p = 0.011) (Table 5). Participants with higher BMI were more likely to report a reduced PA (OR 1.03 per additional kg/m^2 in BMI, 95% CI, 1.01 to 1.05, p = 0.013).

Sleep: Participants with higher wellbeing reported their sleep quality and quantity was impacted less compared to before the first COVID-19 lockdown (OR 0.95 per additional wellbeing score as measured by the WEMWBS, 95% CI 0.91 to 0.99, p = 0.008; Table 5).

3.5. Predictors of experiencing stigma and impact of stigma during the first COVID-19 lockdown

Binomial logistic regression showed that younger participants with a higher BMI and greater depression were more likely to have experienced stigma before and during the first COVID-19 lockdown (OR 0.98 per additional year in age, 95% CI 0.96 to 0.99, p = 0.010; OR 1.05 per additional kg/m^2 in BMI; 95% CI 1.03 to 1.08, p < 0.001; OR 1.04 for point increase in depression, 95% CI 1.00 to 1.09, p = 0.045, respectively) (Table S4). Experiencing stigma was not associated with risk mitigating behaviour other than shopping online (p = 0.002) or weight loss attempts during the first COVID-19 lockdown (p = 0.245).

Participants who had experienced stigma took more risk mitigating actions (2.9 ± 1.2 vs 2.2 ± 1.1, p = 0.010), had lower wellbeing (36.2 ± 10.3 vs 41.3 ± 10.7, p < 0.001), higher depression, (13.3 ± 6.6 vs 10.3 ± 6.7, p < 0.001), higher BMI (46.0 ± 10.9 vs 40.3 ± 10.0 kg/m^2, p < 0.001) and were younger (48.9 ± 12.2 vs 44.7 ± 10.8 years, p < 0.001). Sleep quantity did not differ (p = 0.578).

3.6. Access to WMS during the first COVID-19 lockdown

Participants attending a WMS (n = 132, 44.2%) reported that their services had either been cancelled or delayed during the first COVID-19 lockdown; this varied across the different services (see Table S5).

When asked about whether clinical service providers had provided enough information during the first COVID-19 lockdown, 76 (48.7%) reported they had not, with less than a third reporting they had (n = 50 [32.1%]) (Table S5). Ninety-six (60.4%) participants reported that the way in which services communicated with them changed over the first COVID-19 lockdown, 66 (42.3%) reported that

access to support groups had changed and 59 (37.8%) said it had not. Participants with lower wellbeing were less likely to report that the amount of communication had changed during the first COVID-19 lockdown (OR 0.92 95% CI 0.87 to 0.97, p = 0.003, Table S6). Most participants (n = 361; 81.3%) were not aware of specific COVID-19 guidance for PLWO.

Participants with a higher BMI were more likely to be aware of guidance (OR 1.04 for every 1 unit increase of BMI, 95% CI 1.01 to 1.06, p = 0.004). While participants reporting higher depression were less likely to be aware of guidance (OR 0.96 for each point increase in depression score, 95% CI 0.92 to 0.99, p = 0.024) (Table S5).

Participants who had undergone bariatric surgery reported higher depression (8.0 [SD 0.9] vs 7.7 [SD 0.4] p = 0.012; OR 1.04 for each point increase in depression that participants had bariatric surgery, 95% CI 1.01 to 1.08, p = 0.013), slept less (6.1 vs 5.7 h, p = 0.043) and were older (50.4 vs 45.1 years, p = 0.0002; OR 1.04 for each additional year in age, 95% CI 1.02 to 1.07, p < 0.001) than those who had not had surgery. They did not differ in the number of risk mitigating actions (2.4 [SD 1.3] vs 2.3 [SD1.4] actions, respectively; p = 0.776) or wellbeing (p = 0.320; Table S5).

Participants with a lower BMI, post-bariatric surgery and higher wellbeing score had a greater likelihood of attempting to lose weight during the first COVID-19 lockdown (OR 1.02 95% CI 1.00 to 1.04, p = 0.043; OR 3.39 95% CI 1.06 to 10.82 p = 0.039; OR 1.01, 95% CI 1.00 to 1.02, p = 0.039, respectively).

4. Discussion

This study offers novel insights into the impact of first COVID-19 lockdown on UK PLWO and particularly those accessing WMS in the UK. Two thirds of the participants were living with severe obesity (BMI ≥ 40 kg/m^2) and over half reported at least one additional higher risk factor for severe illness from COVID-19 as reported by the UK Government.

Understanding how people have and will cope with the challenges of COVID-19 are of paramount importance, particularly in population subgroups identified as the most vulnerable. The first national lockdown enforced many people to shield and self-isolate at home, raising concerns about the increased risk of overeating, sedentary behaviour and weight gain [11], which align with the current study findings in PLWO. This study shows that COVID-19 negatively impacted on diet, PA and sleep, alongside self-reported mental health and access to clinical services and support. Of particular note is that worsening of diet and PA was significantly more common in people attending WMS when compared to people who were not. This finding highlights the need for greater support of people attending WMS now and during future restrictive measures/lockdowns.

In a recent online survey of UK adults, weight-related behaviours alongside barriers to weight management (i.e. reduced motivation) were negatively impacted compared to before the first COVID-19 lockdown [12], with more pronounced trends amongst people with a higher BMI. While not specifically recruiting PLWO, a higher BMI (BMI ≥ 35 kg/m^2) was associated with lower PA, worse diet quality and greater frequency of overeating. Interestingly, increasing BMI was associated with greater reduction in PA but did not associate with changes in diet quality or emotional eating. Furthermore, sleep was negatively impacted during the first COVID-19 lockdown in PLWO, both in degree of change and quality. Interestingly, data from the general population showed that most people reported more sleep and more exercise than before COVID-19 [13]. Although the exact reason for this difference is unclear, with lower psychological wellbeing and concern of COVID-19 infection reported in PLWO may in part help to explain this.

Our study also shows that PLWO reported high concern about risk of infection and severe illness from COVID-19, specifically due to their body weight. These concerns may have led to the increased risk

Table 4

Regression models predicting how shopping, diet and physical activity changed during the first COVID-19 lockdown

Predictor	Has the way you shop changed since the COVID-19 lockdown?[a,b]		Has your diet changed since the COVID-19 lockdown?[a,b]		Has your physical activity changed since the COVID-19 outbreak?[a,b]	
	β	p-value	β	p-value	β	p-value
Gender (Male)	−0.375	0.193	−0.384	0.183	0.419	0.155
Number of additional risk indicators (1 indicator)	0.153	0.784	−0.127	0.518	−0.200	0.819
Age	0.016	0.045	−0.004	0.592	−0.002	0.842
BMI	−0.12	0.150	−0.001	0.860	−0.011	0.202
Wellbeing	−0.031	0.007	−0.029	0.010	−0.002	0.868
Depression	0.032	0.078	0.038	0.034	0.035	0.047

Ordinal Logistic Regression.

[a] Model:(Threshold), Gender, Number Co Morbidities, Age, BMI, Warwick Score, PHQ 9 Score.

[b] Higher scores indicate greater subjective change over COVID-19 - "A great deal" as reference category

Beta's represent standardised estimates in the regression model; BMI Body Mass Index.

mitigating actions with particularly social distancing, shielding and wearing protective apparel observed in our study, even before governmental advice to use face masks was issued. Thus, some PLWO appear to have been taking extra precautions to possibly reduce risk during the first COVID-19 lockdown, particularly shielding. Shielding was the only risk mitigating action that significantly differed between those attending and not attending WMS. Shielding was more common in people attending WMS. This difference most likely reflects the guidance given to people with a BMI $\geq$ 40 kg/m2 to shield and this group were more likely to be attending WMS.

Our study identified that over half of participants had worse or much worse self-reported mental health compared to before the first COVID-19 lockdown, which is substantially higher than the Office of National Statistics that reported that only 35% of 'vulnerable people' reported worsening mental health [14]. Furthermore, compared with national averages and studies of the general population [15], mean wellbeing was lower [8] and depression was higher in the current study. This suggests that PLWO have been disproportionately impacted regarding their mental health during the first COVID-19 lockdown.

Self-reported mental health declined during the first COVID-19 lockdown, which was not associated with higher BMI, confirming previous reports [12]. Mental health status, specifically depression and wellbeing, may therefore be greater drivers of worsened health-related behaviour during the first COVID-19 lockdown than BMI itself in PLWO. Moreover, younger age was associated with lower wellbeing and higher likelihood of experiencing stigma. The reason for this remains unclear and warrants further exploration. With the continued concerns of the COVID-19 pandemic and new local lockdown periods in operation, it is essential that healthcare providers support PLWO experiencing depression and poor wellbeing to mitigate further worsening of health-related behaviours.

Weight-based stigma and discrimination has been shown to have a significant impact on PLWO [16]. Concerns were raised at the start of first lockdown that weight stigma might increase [11], with data suggesting that pre-pandemic weight stigma was associated with greater concern, engagement in protective behaviour, less trust in people and greater decline in connection with others [17,18]. Despite these concerns, participants in the current study reported weight stigma experiences were unchanged during the first national lockdown compared to before, although our data still suggests that the majority of participants were experiencing stigma during the pandemic. A possible reason for participants not reporting increases in weight stigma is internalisation of weight bias, which is commonplace in PLWO. Thus participants may not have reported experiences due to acceptance and in some instances, endorsement of weight stigma towards themselves. Interestingly, experiencing stigma either before or during COVID-19 predicted poorer psychological wellbeing (both lower wellbeing and higher depression), with poorer psychological wellbeing negatively impacting health-related behaviours, this could infer that stigma may be in part mediating this effect. However, as higher depression was associated with perceived stigma, the direction of this relationship remains unknown.

It should be noted that this study has limitations. It offers only cross-sectional analysis about the first COVID-19 lockdown period, therefore inferences of how people have been impacted throughout the COVID-19 pandemic cannot be drawn. It must also be noted the limited representation from BAME groups and men, with the majority of respondents being White females and as some participants did not complete all questions within the survey, this may have led to a bias based on which participants responded to the questions, this should therefore be taken into account when interpreting the results of this study. Furthermore due to the online recruitment method, people experiencing digital poverty may not have been recruited.

Table 5

Regression models predicting direction of change in diet, physical activity and sleep during the first COVID-19 lockdown

Predictor	How did your diet change over the COVID-19 lockdown?[a,b]		How did your physical activity change over the COVID-19 lockdown?[a,b]		How did your sleep change over the COVID-19 lockdown?[a,b]	
	β	p-value	β	p-value	β	p-value
Gender (Male)	−0.151	0.656	−0.316	0.339	−0.409	0.382
Number of additional risk indicators (1 indicator)	0.026	0.911	−0.032	0.897	0.068	0.847
Age	0.031	0.001	0.015	0.097	0.007	0.593
BMI	−0.003	0.740	0.027	0.013	0.000	0.994
Wellbeing	−0.040	0.005	−0.036	0.011	−0.055	0.008
Depression	0.062	0.003	0.052	0.019	0.051	0.121

Ordinal Logistic Regression.

[a] Model:(Threshold), Gender, Number Co Morbidities, Age, BMI, Warwick Score, PHQ 9 Score.

[b] Higher scores indicate worsening over COVID-19 – diet "less healthy"; physical activity "reduced"; sleep "worse" as reference categories

Beta's represent standardised estimates in the regression model; BMI Body Mass Index.

Our study offers novel insights about the disproportionate impact of first COVID-19 lockdown on PLWO in the UK. PLWO have considerable concern about the risk of infection and severe illness, taking more risk mitigating actions. Significant changes in diet, PA, sleep and mental health were reported by participants during the first national lockdown. With higher depression and lower wellbeing appearing to impact negatively on health-related behaviours during COVID-19, local and national strategies to increase access to WMS and to mental health support should be key priorities. For those attending WMS, COVID-19 not only impacted on access to clinical services, communication, information and guidance but also appeared to have a greater negative impact on dietary and PA habits. These data identify key areas to policymakers, healthcare and clinical services where additional support is needed for PLWO during the recovery from the pandemic and for the management of future lockdowns, with there being a need for WMS to be prioritised as protected key services.

Declaration of Competing Interest

Acknowledgments

Author contribution

AB conceived the study. AB, SWF, RB, SW, MOK and AZK contributed to the study and survey design and methodology. AB was responsible for the oversight of the study. AB, SWF, RB, SW, MOK and AZK contributed to the recruitment of participants. AB, SWF and RB were responsible for the data analysis. All authors contributed to data interpretation, and the writing of the manuscript. All authors contributed to critical revision of the manuscript and gave final approval.

Data sharing statement

De-identified participant data that underlie the results reported in this article will be made available on publication and ending 5 years after publication. Proposals should be made to the corresponding author and will require a data access agreement.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.eclinm.2021.100796.

References

[1] Public Health England. Guidance on social distancing for everyone in the UK. (Last Accessed November 29th 2020)

[2] Petrilli CM, Jones SA, Yang J, et al. Factors associated with hospital admission and critical illness among 5279 people with coronavirus disease 2019 in New York City: prospective cohort study. BMJ 2020;369:m1966.

[3] Lighter J, Phillips M, Hochman S, et al. Obesity in patients younger than 60 years is a risk factor for COVID-19 hospital admission. Clin Infect Dis 2020;71(15):896–7.

[4] Simonnet A, Chetboun M, Poissy J, et al. High prevalence of obesity in severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) requiring invasive mechanical ventilation. Obesity 2020;28(7):1195–9.

[5] NHS England. COVID-19 prioritisation within community health services. 2020. https://www.england.nhs.uk/coronavirus/wp-content/uploads/sites/52/2020/03/C0145-COVID-19-prioritisation-within-community-health-services-1-April-2020.pdf. (Last Accessed November 29th 2020)

[6] Public Health England. Supporting Weight Management Service During The Covid-19 Pandemic - Phase 1 Insights. PHE Publications; 2020 https://www.gov.uk/government/publications/weight-management-services-during-covid-19-phase-1-insights (Last Accessed November 29th 2020).

[7] Academy of Medical Sciences and MQ. Survey Results: Understanding People's Concerns About The Mental Health Impacts Of The Covid-19 Pandemic. United Kingdom: Academy of Medical Sciences; 2020. p. 1–36.

[8] Tennant R, Hiller L, Fishwick R, et al. The Warwick-Edinburgh Mental Well-Being Scale (WEMWBS): development and UK validation. Health Qual Life Outcomes 2007;5(1):63.

[9] Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. J Gen Intern Med 2001;16(9):606–13.

[10] Stranges S, Samaraweera PC, Taggart F, Kandala NB, Stewart-Brown S. Major health-related behaviours and mental well-being in the general population: the health survey for England. BMJ Open 2014;4(9):e005878.

[11] Pearl RL. Weight stigma and the "quarantine-15. Obesity 2020;28(7):1180–1.

[12] Robinson E, Boyland E, Chisholm A, et al. Obesity, eating behavior and physical activity during COVID-19 lockdown: a study of UK adults. Appetite 2020:104853.

[13] Robinson E, Gillespie S, Jones A. Weight-related lifestyle behaviours and the COVID-19 crisis: an online survey study of UK adults during social lockdown. Obes Sci Pract 2020:1–6.

[14] Statistics. OoN. Coronavirus and shielding of clinically extremely vulnerable people in England: 29 May to 3 June 2020 https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/conditionsanddiseases/bulletins/coronavirusandshieldingofclinicallyextremelyvulnerablepeopleinengland/28mayto3-june2020 (Last Accessed November 29th 2020)

[15] Fancourt D., Bu, Feifei, Wan Mak, H. Steptoe A. COVID-19 social study, Results Release 16 2020 https://www.covidsocialstudy.org/results (Last Accessed November 29th 2020).

[16] Puhl RM, Heuer CA. The stigma of obesity: a review and update. Obesity 2009;17 (5):941–64.

[17] Sutin AR, Robinson E, Daly M, et al. BMI, weight discrimination, and psychological, behavioral, and interpersonal responses to the coronavirus pandemic. Obesity 2020;28(9):1590–4.

[18] Puhl RM, Lessard LM, Larson N, Eisenberg ME, Neumark-Stzainer D. Weight stigma as a predictor of distress and maladaptive eating behaviors during COVID-19: longitudinal findings from the EAT study. Ann Behav Med 2020;54(10):738–46.