



# Obesity, lifestyle behaviours and psychological effects of the COVID-19 lockdown: A survey of patients attending a tertiary weight loss clinic

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## Summary

Lockdown measures due to coronavirus-19 disease (COVID-19) have impacted lifestyle factors. This study aimed to explore whether health and lifestyle behaviours changed during the 2020 COVID-19 lockdown among patients with obesity. A specifically designed online survey and the Depression Anxiety Stress Scale (DASS-21) were administered to patients scheduled to attend a tertiary weight management service between 6 June–12 August 2020. A total of 210 participants completed the survey; mean age (SD) was 52.1 (12.5) years, 69% female and 67% Caucasian. Only 1.4% had tested positive to COVID-19. There was a statistically significant increase in weight pre- and post-COVID-19 lockdown, with no sex differences. Most (61.3%) gained weight, 30.4% lost weight and 8.3% maintained. The majority changed their overall purchasing (88.4%) and eating behaviours (91.6%). Two-thirds (64%) reported they did some form of exercise during the lockdown. Of those, exercise declined in 56.8% and increased in 18%. DASS-21 scores were positively correlated to worry about COVID-19, eating fewer core foods and eating more convenient/treat foods and negatively correlated with exercise. The results provide insights into how and why behaviour change occurs during stressful periods like the COVID-19 pandemic. Although there was variability in individual weight trajectories, on average people with obesity gained weight and changed lifestyle behaviours during the COVID-19 lockdown period. Strategies and support for people with obesity are required at these times.

## KEYWORDS

behaviour, COVID-19, obesity, psychosocial

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**What is already known about this subject**

- Obesity increases the risk of severe illness from COVID-19.
- Pandemics, lockdown and food shortages have been shown to cause distress and change behaviours in different countries.

**What this study adds**

- This study provides insights from the Australian perspective regarding both the positive and negative dietary changes in people with obesity during lockdown.
- The impact of COVID-19 lockdowns in Australia on individuals with obesity with respect to distress and poor habits were similar to that reported in other countries, despite COVID-19 case numbers in Australia being lower.
- Changes in dietary and purchasing behaviours for individuals with obesity during COVID-19 lockdowns were linked to increased depression, anxiety and stress scores.

**1 | INTRODUCTION**

The severe acute respiratory syndrome coronavirus 2 (SARS-CoV2 or COVID-19), a highly infectious virus, was first identified in the Wuhan region of China in 2019.<sup>1</sup> As cases of COVID-19 increased worldwide, the World Health Organization declared a global pandemic on 11 March 2020.<sup>1</sup> Australian cases of COVID-19 were first reported on 25 January 2020, all of which were in travellers returning from Wuhan.<sup>2</sup> By late February and early March, supermarket shelves were being emptied due to panic buying. Unlike other countries, this panic buying occurred before case numbers of COVID-19 rose and before any lockdown measures were announced.<sup>3</sup> By mid- to late-March 2020, Australian states and territories began closing their borders and implementing lockdown measures to minimise transmission of COVID-19. Lockdown measures potentially limit incidental and organised activity by restricting access to the wider physical environment.<sup>4,5</sup> Lockdowns have also been shown to increase psychosocial distress<sup>4,5</sup> that may be influenced by the duration of the lockdown, the provision of information, fear of infection, isolation, financial hardship and the perceived availability of supplies. Population-based surveys, conducted in the context of the COVID-19 outbreak, reported significant declines in healthy dietary patterns and exercise and an increase in weight.<sup>4</sup>

Concurrent with lockdown measures, hospital departments were asked to minimize routine care, limit vulnerable people entering the hospital and prepare for an influx of COVID-19 cases. The subsequent cancellation of many outpatient weight management services was injudicious given the evidence that obesity (body mass index [BMI]  $\geq 30$  kg/m<sup>2</sup>) is associated with more severe illness from COVID-19, as for other respiratory infections such as influenza.<sup>6</sup> The proposed mechanisms include impaired lung function, endothelial dysfunction, immune dysfunction and inflammation.<sup>6</sup>

The present study aimed to explore and quantify the effects of the COVID-19 pandemic on weight, purchasing behaviours, food consumption, exercise and symptoms of depression, anxiety and stress among patients with obesity who had attended a tertiary weight management service. It was hypothesised that adults with obesity would

report a deterioration in healthy lifestyle habits despite previous education and have an increase in body weight.

**2 | MATERIALS AND METHODS**

This cross-sectional study surveyed patients scheduled to attend appointments at an outpatient tertiary weight management service in Sydney, Australia, between April and September 2020. The service provides outpatient weight management services for people with obesity (BMI  $\geq 35$  kg/m<sup>2</sup>), including access to publicly funded bariatric surgery. Patients undergo lifestyle-based weight management education and receive ongoing therapeutic support from medical and allied health professionals including endocrinologists, dietitians, a clinical nurse consultant, a physiotherapist and a psychologist. During the pandemic, most outpatient services were suspended or curtailed. The study was approved by the Sydney Local Health District's Ethics Review Committee (RPAH Zone X20-0152). All participants provided informed consent.

Initial lockdown measures were mandated in New South Wales from 23 March to 15 May 2020. Eligible participants were sent the online survey on 6 June 2020, and all surveys were received by 12 August 2020. Participants without a recorded email address were contacted by telephone and invited to provide an email address. Three contact attempts were made. If participants had not replied to the initial email invitation, two reminder emails were sent, 2 weeks apart. Exclusion criteria included participants who were not proficient in English, those without internet access or a valid email, those who were uncontactable and those who were unable to provide their own consent.

**2.1 | Data collection**

The online survey, based on a previously published version,<sup>7</sup> was further developed and piloted by the research team that included two endocrinologists, three dietitians, one nurse, one physiotherapist and

one psychologist. The survey ascertained weight, diagnosis of COVID-19, purchasing behaviours, food consumption, exercise and symptoms of depression, anxiety and stress. There were 41 questions (multiple-choice, single choice, numeric and open-ended). The option of 'other' was provided for all relevant questions. Survey responses were collated with participants' measured anthropometry from their medical record. Study data were collected and managed using Research Electronic Data Capture (REDCap), a secure, web-based software platform designed to support data capture for research studies, hosted at the Sydney Local Health District.<sup>8</sup>

Basic demographic information was collected including age, sex, ethnicity, education and changes in employment, which included working from home, reduced wages or work hours and unemployment. Baseline height and weight were recorded from healthcare professional measured clinic data including the last weight prior to lockdown. Post-lockdown weight was self-reported and provided to a healthcare professional during a telehealth appointment. Participants were asked if they tested positive for COVID-19, experienced any flu-like symptoms and measures undertaken to protect themselves from contracting COVID-19.

To ascertain changes in purchasing behaviour, participants were asked if they had been anxious or stressed that they would run out of food or not be able to purchase a specific food item with a Likert-scale response. They were also asked which items they purchased more of and the reasoning for these increased purchases. The options were: 'in case I might want it', 'I didn't want to miss out', 'I wanted to be prepared', 'it was on special', 'I have been bored', 'to help cope with my emotions', 'to support local business' and 'because we are eating more of that food'. This was followed by asking about decreased purchasing behaviours with the same list of items. The options for decreased purchasing habits were: 'it hasn't been available', 'I didn't think I would miss out', 'I had enough', 'I have been trying to make better choices', 'it hasn't been on special', 'to manage my weight', 'supermarket product purchasing limitations e.g. only 2 cans of tinned beans per person or 2 long life milk etc.', 'was at home and therefore didn't need to purchase e.g. didn't buy lunch at work as made lunch at home' and 'was trying to reduce my risk of exposure to the COVID-19 virus'. Participants could also indicate that there had not been any change in their purchasing behaviour. The list of items that respondents could choose from included: core foods (fruit and vegetables; bread and bread products; milk and dairy products; meat, chicken, fish and eggs; rice and pasta; breakfast cereal), convenience/treat foods (ready-made meals, frozen convenience foods, snack foods, take-away and home delivered take-away food, juice, soft drinks and take-away coffee) and miscellaneous (alcohol, staples and meal replacement products).

To understand changes in food consumption, participants responded to the same list as for food purchasing behaviours. Participants could also indicate if they had not changed their food consumption. If it increased, they were then asked the reasons ('I don't know', 'I have been more hungry', 'to make myself feel better', 'I have been bored', 'because I have been working from home', 'the food was there', 'others in the household were eating/drinking it' and 'because I bought more of the food'). Conversely, if it decreased, they were also asked the reasons ('I don't know', 'I haven't been as hungry', 'to make me feel better', 'I haven't been

bored', 'because I have been working from home', 'I have wanted to save my food', 'I was influenced by other household members' and 'because I bought less food').

For exercise, participants were asked whether they exercised, the type of exercise, if it had changed and to estimate how much time they spent exercising including the number of days per week. Types of exercise included: 'walking, jogging or running outside'; 'home exercise equipment inside e.g. treadmill, exercise bike etc.'; 'weights and/or resistance training (bands, water bottles)' and 'stretching exercises e.g. yoga, Pilates'. Response options ranged from <30 min to over 1 h on 1–2 days, 3–4 days or 5–7 days.

Symptoms of depression, anxiety and stress were measured using the validated 21-item Depression Anxiety Stress Scale (DASS-21) questionnaire.<sup>9</sup> Participants were asked to rate the extent to which they experienced each negative emotional symptom over the preceding 7 days using a 4-point Likert rating scale. DASS-21 total scores for depression, anxiety and stress were categorized as normal, mild, moderate, severe and extreme.<sup>9</sup> Post-lockdown weight was determined once clinics were reopened. All questionnaire data collected between August and December 2020 was self-reported.

## 2.2 | Statistical analysis

Statistical analyses were performed in SPSS for Windows 26.0 (IBM) and Stata 14.2. Paired and independent t-tests, ANOVA and Chi-square tests were used to analyse the results. Levene's test of equality was used to establish equality of variance. Bonferroni or Tukey post hoc testing were used to adjust for multiple comparisons. Data were presented as mean  $\pm$  standard deviation (SD), 95% confidence interval (CI) or as number and percentage in parentheses (%). Percentages were calculated based on the number of respondents unless otherwise indicated. Foods purchased or eaten were collapsed into three categories: (1) core foods (2) convenience/treat foods and (3) miscellaneous for correlation analysis. Spearman's rho was used to determine correlation between DASS-21 variables and the three categories. Mann Whitney U test was used to test differences in DASS-21 scores between choosing a reason for change behaviour or not. Significance was defined as *p* values < .05.

Further analysis to evaluate the associations between demographic variables with purchasing behaviour, food consumption and the results of the DASS-21 were unable to be conducted as answers were anonymous.

## 3 | RESULTS

A total of 481 patients were contacted via email. Of those, 226 participants started the survey, 210 (43.7%) completed the entire survey and 16 (3.3%) partially completed the survey. Completion rates varied depending on the question. Those who responded were slightly younger than those who did not respond ( $52.1 \pm 12.5$  years vs.  $54.7 \pm 11.8$  years; *p* < .001). There was no significant difference in sex distribution between those who did or did not respond.

**TABLE 1** Patient demographic of those who responded ( $n = 226$ )

Variables	Number or mean (SD)	Percentage or range
Age, years (SD)	52.1 (12.5)	19.6–80.3
Sex		
Females	144	68.6
Males	66	31.4
Anthropometry		
Females		
Height (m)	1.6 (0.1)	1.4–1.8
Weight (kg)	111.2 (26.4)	62.1–206.0
Body mass index (kg/m <sup>2</sup> )	42.3 (9.6)	23.7–83.6
Males		
Height (m)	1.8 (0.1)	1.6–1.9
Weight (kg)	131.9 (35.6)	63.1–239.1
Body mass index (kg/m <sup>2</sup> )	42.0 (9.8)	23.5–71.9
Ethnicity		
Aboriginal or Torres Strait Islander	24	11.4
Asian or South East Asian	9	4.3
Caucasian or European	140	66.7
Middle Eastern	13	6.2
Pacific Islander	10	4.8
Other	14	6.7
Education		
High school or less	79	35.6
Certificate I-IV	24	10.8
Diploma or advanced diploma	36	16.2
Bachelor's degree	33	14.9
Postgraduate qualifications	43	19.4
Other	7	3.2

Abbreviation: SD, standard deviation.

Table 1 summarizes the participants' demographic, anthropometric and clinical characteristics. Most participants were female (68.6%) and Caucasian (66.7%). Over a third had either a high school education or less (35.2%) or a bachelor's degree or above (34.3%). The lockdown affected employment in less than half of the participants with changes including working from home (24%), reduced work hours or wages (16%) or loss of employment (3%).

### 3.1 | Weight changes

Post-lockdown weight was available for 168 (75%) participants (Table 1). Of those, the average pre-lockdown weight was 116.5

$\pm 30.5$  kg ( $131.9 \pm 35.6$  kg in males and  $111.2 \pm 26.4$  kg in females). There was no statistical difference in pre-lockdown weight between those who returned for a follow-up appointment and those who did not. Weight was higher post-lockdown in the entire cohort ( $118.0 \pm 32.4$  kg,  $p < .05$ ) and for both sexes ( $135.8 \pm 39.1$  kg in males,  $p < .05$  and  $110.9 \pm 26.1$  kg in females,  $p < .05$ ). Weight changes ranged from  $-31$  kg to  $+37.2$  kg with 103 (61.3%) gaining on average  $5.8 \pm 5.4$  kg (range: 0.6–37.2 kg), 51 (30.4%) losing on average  $7.0 \pm 6.1$  kg (range:  $-31.0$  to  $-0.7$  kg) and 14 (8.3%) remaining within  $<0.5$  kg ( $0.1 \pm 0.2$  kg, range:  $-0.5$  to 0.4 kg) of their pre-COVID-19 lockdown weight. Of those who gained weight, 84 (50.0%) gained 2 kg or more. Fifty-six (33%) had previous bariatric surgery. Weight remained stable in these individuals during the lockdown ( $110.7 \pm 29.5$  kg pre-lockdown and  $110.3 \pm 28.0$  kg post-lockdown,  $p = .733$ ).

### 3.2 | Diagnosis of COVID-19 and symptoms and preventative measures

Of 222 participants who answered the question, three (1.4%) had tested positive to COVID-19 and 25 (11.3%) reported flu-like symptoms. The majority of participants reported being anxious or stressed about contracting COVID-19, with 121 (54.5%) participants responding 'a bit to some of the time' and a further 49 (22.1%) responding 'most or all the time'.

In an effort to mitigate their risk of exposure to COVID-19, participants made the following changes: 97% self-isolated, 87.8% washed or sanitised their hands more frequently, 64.4% tried to self-isolate, 51.8% cleaned items entering the house and 40.5% wore a mask or gloves outside the home. Five percent did not report making any of these changes.

When participants were asked directly about self-isolation, almost the entire sample (96.9%) reported some level of self-isolation, with most (61.7%) reporting isolating 'most of the time. I only left my home to buy food and other essential items and/or go to work'. About one fifth (19.8%) 'almost never' left their home. When asked directly about the reasons for leaving their home, the two most common reasons were to 'buy food or other essentials' (86.1%) and to 'attend medical appointments or go to the pharmacy' (82.1%). Other reasons were to 'exercise' (41.3%), 'go to work' (24.7%), 'other' (5.4%) and to 'socialise (e.g. meet up with people, dates etc.)' (4.9%).

### 3.3 | Purchasing behaviour

Changes in purchasing behaviour are shown in Table 2. The majority of participants (88.4%) changed their overall purchasing behaviour in some way. Of the items purchased more often, 70.5% of participants reported buying more core food items and 56.2% reported buying more convenience or treat foods. Fruit and vegetables were the only food category that reached significance for participants who reported purchasing more compared to less or remaining the same. The only

**TABLE 2** Change in purchasing behaviour as a consequence of the lockdown measures

<i>n</i> = 215 (96.8% <sup>a</sup> )	Increased		Decreased		No change		Unsure	
	<i>n</i>	% <sup>b</sup>	<i>n</i>	% <sup>b</sup>	<i>n</i>	% <sup>b</sup>	<i>n</i>	% <sup>b</sup>
Core foods								
Fruit and vegetables, including legumes	100	46.5	21	9.8 <sup>c,d</sup>	83	38.6	11	5.1
Bread and bread products	65	30.2 <sup>c</sup>	28	13.0 <sup>c,d</sup>	120	55.8	2	0.9
Milk and dairy products	90	43.1	10	6.0 <sup>c,d</sup>	113	52.6	2	0.9
Meat, chicken, fish and eggs	93	43.3	18	8.4 <sup>c,d</sup>	99	46.0	5	2.3
Rice and pasta	65	31.0 <sup>e</sup>	34	16.2 <sup>c,f</sup>	111	52.9	5	2.3
Breakfast cereal	39	18.1 <sup>c</sup>	26	12.1 <sup>c</sup>	148	68.8	2	0.9
Convenience/treat foods								
Ready-made meals	25	11.6 <sup>c</sup>	28	13.0 <sup>c</sup>	160	74.4	2	0.9
Frozen convenience foods	33	15.3 <sup>c</sup>	44	20.5 <sup>c</sup>	136	63.3	2	0.9
Snack foods, biscuits and cake products and/or confectionery	65	30.2 <sup>c</sup>	38	17.7 <sup>c</sup>	109	50.7	3	1.4
Take-away and home delivered take-away food	52	24.2 <sup>g</sup>	83	38.6 <sup>f</sup>	74	34.4	6	2.8
Juice and soft drinks	32	14.9 <sup>c</sup>	32	14.9 <sup>c</sup>	148	68.8	3	1.4
Take-away coffee	25	11.6 <sup>a</sup>	44	20.5 <sup>c,h</sup>	143	66.5	3	1.4
Miscellaneous								
Alcohol	22	10.2 <sup>c</sup>	36	16.7 <sup>c</sup>	157	73.0	0	0.0
Staples such as flour and sugar	47	21.9 <sup>c</sup>	29	13.5 <sup>c,h</sup>	111	52.9	0	0.0
Meal replacement products	28	12.9 <sup>c</sup>	24	11.1 <sup>c</sup>	209	96.3	1	0.5
Other	5	2.3	2	0.9	209	96.3	1	0.5

Note: The unsure group were not included in the statistical analysis due to it being so different to the other groups.

<sup>a</sup>Percentage of participants who started the survey (*n* = 226).

<sup>b</sup>Percentage of participants who answered the question.

<sup>c</sup>Significant *p* < .001 from no change.

<sup>d</sup>Significant difference *p* < .001 from increase.

<sup>e</sup>Significant *p* < .01 difference from no change.

<sup>f</sup>Significant difference *p* < .01 from increase.

<sup>g</sup>Significant difference *p* < .05 from no change.

<sup>h</sup>Significant difference *p* < .05 from increase.

item that was statistically significant for participants purchasing less rather than more was take-away foods, including take-away coffee.

The two main cited reason for buying more were 'I have wanted to be prepared' (50.6%) and 'to help cope with my emotions' (27.8%). Other reasons included 'I didn't want to miss out' (24.4%), 'in case I might want it' (22.8%), 'because we are eating more of that food' (17.8%), 'other' (16.7%), 'it was on special' (13.9%), 'I have been bored' (13.9%) and 'to support local business' (12.2%). The main reasons participants cited buying less were 'I have been trying to make better choices' (33.8%), 'I was trying to reduce my risk of exposure to the COVID-19 virus' (31.7%), 'to manage my weight' (28.3%) and 'it hasn't been available' (27.6%). Other reasons included 'I was at home and therefore didn't need to purchase, e.g. didn't buy lunch at work as made lunch at home' (24.8%), 'supermarket product purchasing limitations, e.g. only 2 cans of tinned beans per person or 2 long life milks etc.' (18.6%), 'I had enough' (13.8%), 'other' (11.7%), 'I didn't think I would miss out' (9.0%) and 'it hasn't been on special' (4.8%).

### 3.4 | Food consumption

The change in consumption of specific food and beverage items, as a consequence of the lockdown measures, are shown in Table 3. The majority of participants (91.6%) changed their eating behaviour in some way. Of the items reported being consumed more, 72.1% of participants reported eating more core food items and 56.7% ate more convenience/treat foods. In terms of individual food items, the majority of participants reported no change in their intake of core foods, convenience/treat foods or items in the miscellaneous section. The exceptions were fruit and vegetables and snack foods, where a similar percentage of participants reported an increase or no change in consumption. More participants increased rather than decreased their intake of bread and bread products; milk and dairy products; meat, chicken, fish and eggs; snack foods and take-away coffee. Similar numbers reported decreasing their intake of take-away meals compared to not changing. More people reported decreasing their intake of staples (such as flour and sugar),

**TABLE 3** Change in food consumption as a consequence of the lockdown measures

<i>n</i> = 215 (96.8% <sup>a</sup> )	Increased		Decreased		No change		Unsure	
	<i>n</i>	% <sup>b</sup>	<i>n</i>	% <sup>b</sup>	<i>n</i>	% <sup>b</sup>	<i>n</i>	% <sup>b</sup>
Core foods								
Fruit and vegetables, including legumes	84	39.1	37	17.2 <sup>c</sup>	89	41.4	5	2.3
Bread and bread products	64	29.8 <sup>d</sup>	30	14.0 <sup>d,e</sup>	116	54.0	5	2.3
Milk and dairy products	49	22.8 <sup>f</sup>	20	9.3 <sup>d,e</sup>	140	65.1	6	2.8
Meat, chicken, fish and eggs	72	33.5 <sup>d</sup>	13	6.0 <sup>d,e</sup>	128	59.5	2	0.9
Rice and pasta	40	18.6 <sup>d</sup>	43	20.0 <sup>d</sup>	127	59.1	5	2.3
Breakfast cereal	18	8.4 <sup>d</sup>	20	9.3 <sup>d</sup>	176	81.9	1	0.5
Convenience/treat foods								
Ready-made meals	16	7.4 <sup>d</sup>	32	14.9 <sup>d</sup>	166	77.2	1	0.5
Frozen convenience foods	26	12.1 <sup>d</sup>	42	19.5 <sup>d</sup>	145	67.4	2	0.9
Snack foods, biscuits and cake products and/or confectionery	76	35.3	38	17.7 <sup>c,d</sup>	98	45.6	3	1.4
Take-away and home delivered take-away food	55	25.6 <sup>f</sup>	68	31.6	92	42.8	0	0.0
Juice and soft drinks	22	10.2 <sup>d</sup>	21	9.8 <sup>d</sup>	170	79.1	2	0.9
Take-away coffee	16	7.4 <sup>d</sup>	43	20.0 <sup>d,e</sup>	154	71.6	2	0.9
Miscellaneous								
Alcohol	20	9.3 <sup>d</sup>	31	14.4 <sup>d</sup>	163	75.8	1	0.5
Staples such as flour and sugar	9	4.2 <sup>d</sup>	36	16.7 <sup>c,d</sup>	169	78.6	1	0.5
Homemade tea or coffee	56	26.0 <sup>d</sup>	8	3.7 <sup>c,d</sup>	150	69.8	1	0.5
Meal replacement products	14	6.5 <sup>d</sup>	31	14.4 <sup>d,g</sup>	170	79.1	0	0.5
Other	4	1.9 <sup>d</sup>	5	2.3 <sup>d</sup>	206	95.8	0	0.0

Note: The unsure group was excluded from the statistical analysis due to low response rate.

<sup>a</sup>Percentage of participants who started the survey (*n* = 226).

<sup>b</sup>Percentage of participants who answered the question.

<sup>c</sup>Significant difference *p* < .001 from increase.

<sup>d</sup>Significant *p* < .001 from no change.

<sup>e</sup>Significant difference *p* < .01 from increase.

<sup>f</sup>Significant *p* < .01 difference from no change.

<sup>g</sup>Significant difference *p* < .05 from increase.

take-away coffee and meal replacement products compared to increasing intake.

Reasons for more food being eaten was provided by 189 participants. The most common reasons for increased consumption were 'to make myself feel better' (37.6%), 'I have been bored' (31.7%) or 'the food was there' (30.7%). The other reasons were 'because I bought more of the food' (25.9%), 'others in the household were eating/drinking it' (21.7%), 'because I have been working from home' (19.0%), 'other' (19.0%), 'I have been more hungry' (16.4%) and 'I don't know' (14.8%).

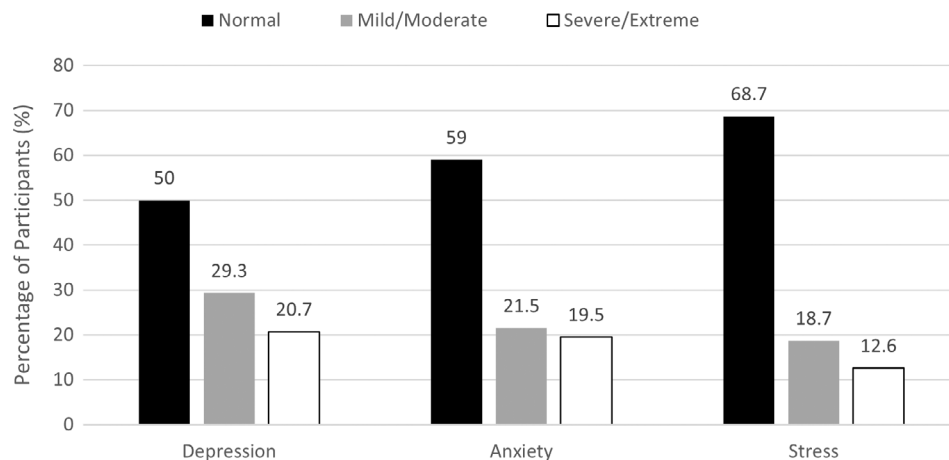
One hundred and fifty participants provided reasons why they ate less. The most frequently mentioned reason was 'other' (33.3%). In the free text section, the commonest reasons given included 'not wanting to go outside the home due to COVID-19' or 'trying to eat healthier'. Other reasons chosen were 'I don't know' (26.0%), 'to make me feel better' (17.3%), 'because I bought less food' (14.7%), 'because I have been working from home' (8.0%), 'I was influenced by other household

members' (8.0%), 'I have wanted to save my food' (7.3%), 'I haven't been as hungry' (6.7%) and 'I haven't been bored' (3.2%).

### 3.5 | Exercise

Over two-thirds of participants (64%) said they did some form of exercise during the lockdown. Of those, 126 (56.8%) responded that their exercise had declined from pre-lockdown levels and 40 (18%) said it had increased. Of those who reported exercising, 33.8% exercised 1–2 times, 41% exercised 3–4 times and 24.6% exercised 5–7 times per week. The most common types of exercises undertaken were walking, jogging or running outside (71.4%); home exercise equipment inside (20.7%); weights and resistance training (20.7%) and stretching exercises (13.6%). The most common amount of time spent exercising was 30–60 min (47.9%), followed by less than 30 min (39.4%) and more than 1 h (12.7%).

**FIGURE 1** Percentage of the participants who were classified into normal, mild/moderate or severe/extreme categories for depression, anxiety and stress



**TABLE 4** Correlation between core foods, convenience/treat foods or alcohol with DASS-21 variables (in bold)

		Depression score	Anxiety score	Stress score
<b>Core foods</b>				
Bought more core foods	Correlation coefficient	-0.046	-0.010	0.032
	Significance (2-tailed)	0.200	0.888	0.651
	Number	198	200	198
Bought less core foods	Correlation coefficient	0.141	0.220	0.223
	Significance (2-tailed)	<b>0.047</b>	<b>0.002</b>	<b>0.002</b>
	Number	198	199	197
Ate more core foods	Correlation coefficient	0.035	0.149	0.131
	Significance (2-tailed)	0.627	<b>0.035</b>	0.067
	Number	198	200	198
Ate less core foods	Correlation coefficient	0.239	0.312	0.280
	Significance (2-tailed)	<b>0.001</b>	<b>&lt;0.001</b>	<b>&lt;0.001</b>
	Number	198	200	198
<b>Convenience/treat foods</b>				
Bought more convenience or treat foods	Correlation coefficient	0.294	0.296	0.296
	Significance (2-tailed)	<b>&lt;0.001</b>	<b>&lt;0.001</b>	<b>&lt;0.001</b>
	Number	198	200	198
Bought less convenience or treat foods	Correlation coefficient	-0.097	0.017	0.067
	Significance (2-tailed)	0.174	0.811	0.349
	Number	198	199	197
Ate more convenience or treat foods	Correlation coefficient	0.362	0.305	0.360
	Significance (2-tailed)	<b>&lt;0.001</b>	<b>&lt;0.001</b>	<b>&lt;0.001</b>
	Number	198	200	198
Ate less convenience or treat foods	Correlation coefficient	-0.108	-0.042	-0.025
	Significance (2-tailed)	0.132	0.550	0.725
	Number	198	200	198

Note: Spearman's rho was used to determine significance of correlation.

Abbreviation: DASS-21, Depression, Anxiety and Stress Scale 21.

### 3.6 | Depression, anxiety and stress symptoms

The mean and SD for the scores were  $6.0 \pm 5.6$  for depression,  $3.9 \pm 4.3$  for anxiety and  $5.9 \pm 5.3$  for stress. Most participants reported

normal symptom levels of anxiety (59.0%), stress (68.7%) and depression (50%). Approximately 12% of participants reported extreme symptom levels of depression and anxiety but only 2% of participants reported extreme stress symptoms (shown in Figure 1).

There was a statistically significant, moderate, positive correlation between degree of worry about COVID-19 and the depression score ( $r = 0.363$ ,  $p < .001$ ), anxiety score ( $r = 0.453$ ,  $p < .001$ ) and stress score ( $r = 0.494$ ,  $p < .001$ ). Those who did not exercise during the pandemic had higher mean scores for depression ( $7.4 \pm 5.6$  vs.  $5.2 \pm 5.5$ ;  $p = .024$ ), anxiety ( $4.9 \pm 4.4$  vs.  $3.3 \pm 4.1$ ;  $p = .009$ ) and stress ( $7.0 \pm 5.2$  vs.  $5.3 \pm 5.2$ ;  $p = .011$ ). The length of time exercising was not related to DASS-21 scores. Those who decreased their exercise had higher depression scores ( $7.1 \pm 5.8$  vs.  $3.8 \pm 4.1$ ;  $p = .033$ ), anxiety scores ( $4.5 \pm 4.2$  vs.  $2.2 \pm 3.2$ ;  $p = .020$ ) and stress scores ( $6.7 \pm 5.2$  vs.  $4.2 \pm 4.0$ ;  $p = .004$ ) compared with those who increased their exercise. There was no difference in those who reported no change in exercise. There was no difference in anxiety or stress scores for number of days exercising but there was a difference in depression scores with those who exercised for 5–7 days per week ( $3.6 \pm 3.7$ ) having lower depression scores compared to those who exercised 1–2 days per week ( $6.8 \pm 6.5$ ;  $p = .023$ ).

Correlation between the purchasing and consumption of core foods and convenience and treat foods with component scores of the DASS-21 are shown in Table 4. Purchasing or consuming fewer core

foods and more convenience/treat foods was positively correlated to all the DASS-21 variables. Mean DASS-21 scores for each food item eaten more, less or unchanged are shown in Table 5. Higher DASS-21 scores for depression, anxiety and stress were seen for those who ate less fruit and vegetables and more take-away or home-delivered meals. Alcohol purchasing or consumption was not associated with any of the DASS-21 variables.

People who responded that they bought more 'in case they may want it' had significantly higher median scores for stress (7.0 vs. 3.5;  $p = .002$ ), anxiety (5.0 vs. 1.0;  $p = .001$ ) and depression (7.0 vs. 3.0;  $p = .001$ ) than those who did not report buying more for this reason. Those who reported they bought more 'to cope with emotions' had higher median stress scores (6.0 vs. 4.0;  $p = .035$ ) but there was no difference in anxiety or depression median scores compared to those who did not report this reason for change in purchasing behaviour. Participants who reported buying less because 'the food was not available' reported higher median scores for stress (7.0 vs. 3.5;  $p = .002$ ), anxiety (5.0 vs. 1.0;  $p = .001$ ) and depression (7.0 vs. 3.0;  $p = .001$ ) compared to those who did not report this reason. Those who reported not knowing why they ate more or less food reported

**TABLE 5** Mean (SD) scores for DASS-21 variables by change in eating variable

n = 215 (96.8%#)	Depression			Anxiety			Stress		
	Ate more Mean (SD)	Ate less Mean (SD)	No change Mean (SD)	Ate more Mean (SD)	Ate less Mean (SD)	No change Mean (SD)	Ate more Mean (SD)	Ate less Mean (SD)	No change Mean (SD)
<b>Core foods</b>									
Fruit and vegetables, including legumes	4.9 <sup>b</sup> (5.4)	9.2 <sup>a</sup> (5.6)	5.3 <sup>b</sup> (5.2)	3.3 <sup>b</sup> (4.1)	6.3 <sup>a</sup> (4.5)	3.1 <sup>b</sup> (3.7)	5.2 <sup>b</sup> (4.7)	9.9 <sup>a</sup> (5.3)	4.5 <sup>b</sup> (4.4)
Bread and bread products	7.1 (6.3)	7.2 (5.6)	4.9 (4.9)	4.7 (5.3)	5.0 (4.5)	2.9 (3.7)	6.8 (5.6)	6.0 (4.6)	5.1 (4.8)
Milk and dairy products	6.3 (6.5)	7.2 (5.2)	5.7 (5.4)	4.9 (4.6)	6.1 <sup>c</sup> (5.0)	3.1 (3.8)	6.8 (5.7)	8.6 (5.5)	5.3 (4.8)
Meat, chicken, fish and eggs	5.9 (6.1)	10.0 (6.3)	5.6 <sup>b</sup> (5.2)	3.9 (4.4)	6.0 (4.0)	3.6 (4.2)	6.3 (5.5)	9.9 (6.2)	5.3 <sup>b</sup> (4.8)
Rice and pasta	7.6 (6.0)	6.3 (6.2)	4.9 <sup>d</sup> (4.8)	4.7 (4.7)	4.6 (4.5)	3.1 (3.7)	6.9 (5.2)	6.2 (5.5)	5.1 (4.7)
Breakfast cereal	8.0 (6.9)	7.6 (7.8)	5.6 (7.8)	5.6 (5.2)	4.2 (4.3)	3.6 (4.2)	8.9 (7.2)	6.7 (5.9)	5.6 (4.9)
<b>Convenience/treat foods</b>									
Ready-made meals	6.9 (5.6)	6.7 (6.9)	5.8 (5.4)	4.4 (4.7)	4.7 (4.4)	3.6 (4.2)	6.1 (4.8)	6.0 (5.0)	5.8 (5.3)
Frozen convenience foods	8.9 (6.2)	4.9 <sup>d</sup> (5.5)	5.7 <sup>d</sup> (5.3)	5.7 (4.4)	3.7 (4.5)	3.6 (4.1)	8.3 (6.1)	4.8 <sup>d</sup> (4.8)	5.7 (5.0)
Snack foods, biscuits and cake products and/or confectionery	7.6 (6.0)	4.5 <sup>d</sup> (5.36)	5.3 <sup>d</sup> (5.1)	4.8 (4.3)	3.1 (4.0)	3.4 (4.3)	7.6 (5.5)	4.6 <sup>d</sup> (5.0)	5.0 <sup>d</sup> (4.8)
Take-away and home delivered take-away food	9.2 <sup>b</sup> (5.7)	5.1 <sup>a</sup> (5.4)	4.7 <sup>a</sup> (5.0)	5.9 <sup>b</sup> (5.1)	3.1 <sup>a</sup> (3.7)	3.2 <sup>a</sup> (3.8)	8.6 <sup>b</sup> (5.9)	4.5 <sup>a</sup> (4.1)	5.2 <sup>a</sup> (5.0)
Juice and soft drinks	8.8 (6.3)	5.7 (6.1)	5.6 (5.4)	6.0 (5.0)	4.2 (4.7)	3.5 (4.1)	8.5 (5.8)	6.5 (5.5)	5.5 (5.0)
Take-away coffee	3.8 (4.4)	6.0 (5.7)	6.2 (5.7)	3.2 (3.6)	3.9 (3.8)	3.8 (4.4)	6.2 (4.3)	5.9 (5.1)	5.8 (5.3)
<b>Miscellaneous</b>									
Alcohol	6.6 (5.4)	6.4 (6.0)	5.9 (5.6)	4.4 (4.2)	4.1 (4.2)	3.8 (4.3)	6.7 (5.4)	6.7 (5.9)	5.6 (5.1)
Staples such as flour and sugar	4.0 (2.9)	7.2 (6.6)	5.9 (5.5)	3.6 (3.3)	5.0 (4.7)	3.7 (4.2)	6.0 (1.9)	6.9 (6.0)	5.7 (5.2)
Homemade tea or coffee	5.6 (5.6)	8.0 (7.6)	6.0 (5.6)	3.8 (4.2)	5.6 (5.9)	3.8 (4.3)	6.4 (5.3)	8.9 (7.7)	5.6 (5.1)
Meal replacement products	4.4 (5.2)	6.4 (6.4)	6.0 (5.5)	3.2 (4.0)	4.6 (4.1)	3.8 (4.3)	6.4 (5.9)	6.7 (5.7)	5.7 (5.1)

<sup>a</sup> $p < .01$  from 'Ate more'.

<sup>b</sup> $p < .01$  Different from 'Ate less'.

<sup>c</sup> $p < .05$  from 'No change'.

<sup>d</sup> $p < .5$  from 'Ate more'.

#Percentage of participants who started the survey ( $n = 226$ ).



higher median scores for stress (7.0 vs. 3.5;  $p = .002$ ), anxiety (5.0 vs. 1.0;  $p < .001$ ) and depression (7.0 vs. 3.0;  $p < .001$ ) compared to those who did not choose this reason for eating more or less. There were no statistically significant differences in median DASS-21 scores for stress, anxiety or depression in responses for eating more for emotional or boredom reasons.

## 4 | DISCUSSION

The stay-at-home mandated orders implemented in New South Wales Australia in 2020 impacted upon weight, lifestyle and wellbeing in our sample of patients with obesity. The entire cohort reported undertaking some form of COVID-19 preventative measures, with the majority (96.9%) restricting their movements away from home, in keeping with the conditions of the government-imposed lockdown. The COVID-19 lockdown negatively affected several obesity-related health behaviours. Most participants (56%) reported purchasing and eating more convenience/treat foods. The majority (64%) did some form of exercise although of those who did, over half (56.7%) said they had decreased their exercise habits. One in five participants reported severe or extremely severe depression (20.7%) or anxiety symptoms (19.5%). Those who did not exercise or reduced their exercise over the pandemic had higher DASS-21 scores. On average, bodyweight increased with 61.3% gaining weight with weight gain less likely to occur if the participant had previous bariatric surgery. These results have implications for clinical practice and management of patients with obesity during periods of restriction and stress.

Our results are comparable to other studies that have reported on weight change during COVID-19 lockdown periods.<sup>10-13</sup> There was however a wide range of weight change within the sample (-31 to +37.2 kg). Approximately 61.3% of the sample gained weight, with 50% gaining 2 kg or more. Conversely, almost one in three lost weight. An American study, in patients attending a weight management service prior and during the pandemic, reported similar rates; 57% of their sample gained weight, 27% maintained weight and 15% lost weight.<sup>10</sup> It is not surprising that weight change occurred. The COVID-19 pandemic led to greater social isolation with enforced lockdown rules, including the closure of many exercise facilities. Although people were allowed out of their homes to exercise each day, there were limitations leading to reduced opportunities such as the closure of gyms, swimming pools and even beaches for certain periods. There was an increase in psychosocial burden, with almost 77% of responders reported feeling anxious or stressed about catching COVID-19. Furthermore, reports have suggested that maintaining weight loss strategies during lockdown is more difficult.<sup>10</sup> An Italian study conducted during the first months of lockdown reported weight gain was associated with not paying attention to the healthiness of food choices, lower education and self-reported depression or anxiety levels.<sup>12</sup>

For individual items, the majority of participants reported no change in purchasing or eating behaviour. However overall, the majority (~80%) of participants in this study changed their food purchasing

and consumption behaviours for both core and convenience/treat foods to some extent during the COVID-19 lockdown period. This was despite supermarkets remaining open at all times with no restrictions on accessing supermarkets or other grocery stores and no real food shortages occurring in New South Wales. The two predominant reasons participants provided for increased purchasing behaviour were 'I have wanted to be prepared' or 'to help cope with my emotions'. Those who ate less core foods and more convenience/treat food also reported greater depression, anxiety and stress scores. A quarter bought less, the reasons given for the change included to manage weight or make better choices, as reported in other studies.<sup>14,15</sup> Almost half the sample bought more core foods including fruit and vegetables with slightly lower numbers eating more core foods, suggesting that not all changed behaviours were unhealthy. The increase is likely to reflect less food eaten outside the home, less take-away foods and more foods needing to be prepared by the participant and others within the home. One of the main reasons for decreased purchasing of certain items was to limit exposure to COVID-19 as by buying less, less time and frequency was spent outside the home.

Although a quarter to a third aimed to make better food choices to manage their weight, a similar percentage ate more to feel better or cope with emotions or boredom. Buying and eating food to cope with emotions is commonly reported in people with obesity.<sup>16</sup> A study from the United States, investigating the lived experience of people with obesity during the pandemic, reported that the most common reasons for eating were 'comfort eating', 'eating because they were fed up' or 'eating out of boredom'.<sup>15</sup> In line with national alcohol consumption data during this period, the majority of participants did not change their alcohol consumption.<sup>17</sup> Furthermore, alcohol consumption was not related to any of the DASS-21 scores. This suggests that participants were not using alcohol to cope with the stressors of COVID-19 pandemic but this finding might be due to the age of the cohort. Australian data reported that 18-34 year olds were most likely to increase alcohol consumption during the pandemic to cope with mental health issues.<sup>17</sup>

The finding of reduced exercise during the COVID-19 lockdown period was similar to other studies.<sup>12,14,18,19</sup> Studies have reported physical activity levels decreased in populations with obesity<sup>12,14</sup> and within the general population.<sup>18,19</sup> Physical activity is a key component of maintaining weight loss and improving mental health, and it is recommended that participants complete at least 150 min/week of moderate to vigorous physical activity or expend >2500 kcal on exercise per week for weight maintenance.<sup>20</sup> The lockdown period caused disruptions in exercise, with 57% reporting a decline in activity.

The physical health concerns related to COVID-19 are well documented.<sup>21</sup> There are also a number of studies reporting on the detrimental effects of COVID-19 on psychological disorders.<sup>5</sup> A systematic review and meta-analysis, that included studies investigating the prevalence of stress, anxiety and depression among the general population during the COVID-19 pandemic, reported the prevalence of stress as 29.6% (95% CI 24.3-35.4) in five studies ( $n = 9074$ ), the prevalence of anxiety as 31.9% (95% CI 27.5-36.7) in 17 studies ( $n = 63\,439$ )

and the prevalence of depression as 33.7% (95% CI 27.5–40.6) in 14 studies ( $n = 44\,531$ ).<sup>5</sup> People with overweight or obesity, compared to those with a healthy weight, have a 25% increased risk of developing mood and anxiety disorders during non-pandemic time periods.<sup>22,23</sup> This study suggests a link between mood and eating in that participants reporting detrimental changes in their purchasing and eating behaviour had higher depression, anxiety and stress scores on the DASS-21. Although emotional eating occurs in populations with a healthy BMI, difficulties in both identifying and tolerating emotion have been associated with more problematic eating behaviours in people with obesity.<sup>24,25</sup> In our study, DASS-21 scores were significantly positively correlated with not knowing why changes occurred in consumption behaviour and may be reflective of difficulties in identifying and/or tolerating emotional states.

Inactivity reported by participants could also have had a negative effect on their mental health and coping with stress and anxiety during the lockdown period. The data showed poorer DASS-21 scores in those who reported no exercise or a decline in exercise compared to those who reported exercising or increasing their exercise. Interestingly, the responders reported lower stress scores than those of the general Australian population during the COVID-19 lockdown period.<sup>26</sup> It is possible that this may be a consequence of the timing of administering the questionnaire, with many participants completing it during the easing of restrictions.

#### 4.1 | Strengths and limitations

A strength of this study is that it provides an Australian perspective from a range of ethnicities on how patients attending a tertiary obesity management program responded to the COVID-19 lockdown measures. Compared to similar studies around the world, the lockdowns appeared to have a comparable effect on lifestyle behaviours and psychological outcomes despite Australia's comparatively lower mortality rate from COVID-19.

There are several limitations of this study. One is that it was administered after some of the lockdown restrictions had been eased, which may have underestimated the impact of the lockdown measures. The study also collected post-lockdown weights over a period of 6 months after restrictions had been eased and weight change may have occurred outside of the lockdown period. Post-lockdown weights were self-reported because COVID-19 restrictions prohibited in-person appointments. They were however reported during a telehealth appointment allowing the healthcare professional to assess whether the self-reported weight was legitimate. People, particularly those with obesity, typically under-report their weight.<sup>27,28</sup> Given the tendency for under-reporting of weight, this may overall overestimate the amount of weight lost and maintained, and underestimate weight gained. Furthermore, there is a potential for bias as the questionnaire was administered by the weight management clinic the participants were attending, and this may have influenced their responses. The results may be less generalisable because the sample was more educated than the general Australian population with obesity.<sup>29</sup>

## 5 | CONCLUSION

People with obesity attending a tertiary weight management service prior to the COVID-19 lockdown in New South Wales changed their behaviour during the lockdown in both positive and negative ways and, on average, gained weight. There however was variability in individual weight trajectories. Most participants purchased more convenience/treat foods, except take-away which declined. Participants reported purchasing and consumption patterns that were influenced by mood with poorer food choices associated with poorer mood values. Uncertainty was also likely to be correlated with depression, anxiety and stress symptoms. The majority of participants did some form of exercise during the lockdown although most did less than pre-lockdown levels. Exercising was related to better mood indices.

#### AUTHOR CONTRIBUTIONS

*Study concept and design:* Janet Franklin, Kyra A. Sim, Jessica M. Swinbourne, Gabrielle Maston, Elisia Manson, Hannah Nelthorpe, Tania Markovic, Samantha Hocking. *Acquisition, analysis or interpretation of data:* Janet Franklin, Kyra A. Sim, Samantha Hocking. *Drafting of the manuscript:* Janet Franklin, Kyra A. Sim, Jessica M. Swinbourne, Samantha Hocking, Tania Markovic. *Critical revision of the manuscript for important intellectual content:* Janet Franklin, Kyra A. Sim, Jessica M. Swinbourne, Gabrielle Maston, Elisia Manson, Hannah Nelthorpe, Tania Markovic, Samantha Hocking. *Statistical analysis:* Janet Franklin. *Administrative, technical or material support:* Janet Franklin. *Study supervision:* Samantha Hocking.

#### ACKNOWLEDGEMENT

Open access publishing facilitated by The University of Sydney, as part of the Wiley - The University of Sydney agreement via the Council of Australian University Librarians.

#### CONFLICT OF INTEREST

No conflict of interest was declared.

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**How to cite this article:** Franklin J, Sim KA, Swinbourne JM, et al. Obesity, lifestyle behaviours and psychological effects of the COVID-19 lockdown: A survey of patients attending a tertiary weight loss clinic. *Clinical Obesity*. 2022;e12567. doi:10.1111/cob.12567