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Understanding eating behaviours, mental health and weight change in young adults: protocol paper for an international longitudinal study

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ABSTRACT

Introduction Understanding the complexities of change in eating behaviours, mental health, well-being and weight is crucial to inform healthcare and service provision, particularly in light of the exacerbating effects of the COVID-19 pandemic. This study aims to address the need for more comprehensive cross-sectional and longitudinal evidence, by tracking eating behaviours, mental health, health related behaviours and weight over a 12-month period, in a sample of young adults (18–35 years) in the UK and Australia.

Methods and analysis Online surveys administered via the Prolific online research platform will be used for data collection at baseline, 6 months and 12 months. The survey (approximately 45 min) measures demographics, the impact of COVID-19, body mass index (BMI), weight management and health service usage, eating behaviours, personality, mental health, and health-related behaviours. An optional substudy component at each time point aims to validate self-reported weight in the main survey through images. Study inclusion criteria are; aged 18–34 years at baseline, BMI ≥20 kg/m², and residing in the UK or Australia. A target of 500 participants at baseline was set, recruited through Prolific, and with recruitment stratified by BMI, sex and country. The proposed analyses include creating static predictive models using baseline data (eg, using latent class analysis, factor analysis or similar), and mapping changes longitudinally (eg, using multivariate regressions). These analyses will enable changes in the study measures to be identified, as well as predictors and outcomes of change.

Ethics and dissemination Ethical approval was granted by Leeds Beckett University, UK (reference number 86004) and the University of Newcastle, Australia (reference number H-2022–0110). Study findings will be disseminated through scientific journals, conferences, institute websites and social media, and briefings tailored to policy, practice and the public, with the intention to help inform the future development of health and well-being care and support for young adults across Australia and the UK.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ The longitudinal study design is critical to providing evidence of change in eating behaviours, mental health, health-related behaviours and weight over time in a sample of young adults (18–35 years).

⇒ Key measures will be comprehensively assessed using multiple tools to assess different aspects.

⇒ Using the Prolific online research platform allows stratified recruitment and a diverse participant group to be recruited.

⇒ Attrition is a potential study limitation, given the population group of young adults and that few studies of this duration have been conducted using the Prolific online research platform.

⇒ Patients and the public are involved throughout the project.

the life span. Understanding the complexities and interrelationships of these changes and of other factors, such as socioeconomic factors, behavioural and personality traits,[1] is crucial to improve healthcare service and support provision. This knowledge is especially pertinent in the UK and Australia given current research and policy is driving for improved healthcare that addresses multimorbidity and determinants of health.[2 3] This research and policy direction is in response to high national prevalence of obesity, disordered eating, mental ill-health and related health conditions and risk factors in these two countries.[2 3]

A particularly important life stage for change is young adulthood, commonly defined as 18–35 years of age.[4] Eating behaviours developed during young adulthood are typically continued throughout adulthood,[5] while 63% of mental disorders present by age 25 years[6] and young adults also have the highest weight gain of any adult life stage.[7–9] Young adulthood is often characterised by changing circumstances with respect

INTRODUCTION

Eating behaviours, mental health, well-being and weight status are subject to change across

to living arrangements, finances, employment and education, social relationships and familial responsibilities, all of which significantly impact eating and other health behaviours, mental health, well-being and weight.[5 10 11]

A large body of evidence exists which explores the relationships between eating behaviours, mental health and weight. For example, studies of adult populations have demonstrated associations between disordered eating behaviours and weight gain, overweight and obesity,[12 13] as well as between such eating behaviours and substance use disorder, depression and anxiety.[14–17] Furthermore, research points to broader associations between overweight and obesity and common mental disorders like depression.[18] Studies have also delved into potential moderating factors in these relationships. For example, cross-sectional studies have reported higher prevalence of food addiction in adults with obesity, including morbid obesity, but that it is not exclusive to obese individuals, and other factors are associated such as quality of life and impulsivity traits.[19 20] However, studies are predominantly cross-sectional, specifically in the context of eating behaviours, and therefore limited in providing insight into causation and directionality of relationships as well as changes in these factors over time. Many studies consider a limited number of health behaviours/ outcomes despite known interrelationships between these factors, and studies are often in general adult samples rather than specific life stages of adulthood such as young adulthood. Furthermore, many studies have assessed a limited number of moderating factors or predictors of change, and/or included a narrow assessment of certain constructs, particularly eating behaviours and personality traits.

The COVID-19 pandemic has exacerbated relationships between mental health, eating behaviours and weight gain, while increasing demand and necessitating changes to service delivery for weight management and mental health services.[21–24] For example, a recent Organisation for Economic Co-operation and Development report into the mental health impacts of COVID-19 found 2 and 2.5 times higher rates of depression in the UK and Australia, respectively, in 2020 compared with 2019 (ie, prepandemic).[25] Cross-sectional studies among adult populations have also reported negative changes in health behaviours including eating and physical activity during the COVID-19 pandemic, such as emotional eating of processed foods as a maladaptive coping strategy.[22 24] In terms of health services, more than 80% of high-income countries were replacing in-person with digital mental health services in mid-2020, while also catering for increased service demand.[25] This highlights an increased urgency for service provision in response to the COVID-19 pandemic, and an associated urgency for the research data to inform services.

Tracking eating behaviours, mental health and weight over time is essential in order to understand the complexities of change, including the direction of effects, influencing factors and the nuances of non-linear change. For

example, longitudinal studies exploring depression and obesity have demonstrated that a bidirectional relationship exists with an almost equivalent odds of depression among individuals with obesity and of obesity among individuals with depression.[18] This information is essential in directing this population to appropriate services, and for the development of targeted services that cater for multiple risk behaviours rather than for one comorbidity in isolation. For example, weight management services often exist in isolation to mental health services. However, when individuals present with multiple needs it is unclear which to prioritise in stepped care models or if both should be actioned simultaneously.[26] The lack of integration of these different services is also problematic as there may be shared determinants to different health conditions, such as disordered eating underpinning obesity and eating disorders.[27] Multimorbidity is a key issue in the context of disordered eating, mental ill-health and obesity, and early intervention in young adulthood may help to prevent progression of individual conditions as well as multimorbidity.[28] To identify service needs and inform interventions for this group, further exploratory research and longitudinal data are needed.

As a means of conducting large-scale, longitudinal research, online research platforms such as Prolific provide the scope, and are particularly useful in terms of enhancing the reach and the ability to obtain diverse and representative samples, including from hard-to-reach populations.[29 30] Online research is also generally well suited for a young adult population given the accessibility and familiarity of the technology.[31]

This study aims to address the need for more comprehensive cross-sectional data and longitudinal evidence, by tracking eating behaviours, mental health, health related behaviours and weight over a 12-month period, in a sample of young adults (18–35 years) living in the UK and Australia, using online surveys. The objectives are to:

1. Characterise subsets of young adults (18–35 years) of varying weight status by eating behaviours, mental health factors, personality, health-related behaviours and sociodemographics;
2. Investigate eating behaviours, mental health factors, personality, health-related behaviours and sociodemographics as contributors to weight change among young adults (18–35 years) over a 12-month period;
3. Compare health service usage of young adults (18–35 years) of varying characteristic subsets, for example, weight status, including changes over time.

METHODS AND ANALYSIS
Study design
This study is a longitudinal design, with data collection time points at baseline, 6 months and 12 months. Baseline data were collected between 9 December 2021 and 11 February 2022, with a 1 month pause in data collection from 17 December 2021 to 17 January 2022 to avoid coinciding with Christmas and New Year holidays. This

was the time taken to achieve the desired sample size and representation across demographic characteristics as outlined below. Six-month data collection is planned for June-July 2022 and 12-month data collection during December 2022-January 2023.

Data collection

Data collection is by online survey hosted via the Qualtrics survey platform (https://www.qualtrics.com/) and administered via the Prolific online research platform (https://www.prolific.co/). Prolific has a database of over 150 000 participants internationally, from which a specific sample can be recruited based on over 100 demographic characteristics. The survey used in this study takes approximately 45 min to complete, consisting of 250 questions across seven sections. These include demographics (including the impact of COVID-19, body mass index (BMI)); weight management and health service usage; eating behaviours; personality; mental health; and health-related behaviours. Participants are paid £5.00 per survey at each time point.

Substudy component

At each time point there is an additional substudy, aiming to validate participants' self-reported weight in the main survey through collecting images of the individuals' weight captured on a set of scales. The substudy survey is hosted by the REDCap survey platform (https://www.project-redcap.org/) and participants are paid £1 for completion of the survey which takes less than 5 min. This is an optional extra component and, if choosing to participate, is intended to be completed within 7 days of completing the main survey to limit the time between the two sets of data being collected. For those who choose not to complete the substudy survey, they are invited to complete an additional brief survey (three questions) to determine their reasons for non-participation. Participants are paid £0.20 p for completion of this additional survey. The conduct and reporting of this work will adhere to Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for reporting cohort studies.[32]

Participants

Inclusion criteria

Inclusion criteria for the study were young adults, aged 18–34 years at baseline, with a body mass index (BMI) $\geq 20 \, kg/m^2$, and residing in either the UK or Australia. Although the age range of young adults was defined as 18–35 years, participants aged 35 years at baseline were excluded as they would be outside of this age range by the 12-month follow-up stage. BMI $\geq 20 \, kg/m^2$ was chosen based on excluding underweight individuals (BMI $< 18.5 \, kg/m^2$) and those on the lower end of the healthy weight range who may be at risk of becoming underweight. Participants residing in the UK and Australia were of interest, in line with current research and policy direction as outlined in the introduction. Exclusion criteria were being pregnant, trying to get pregnant, breast feeding and not fluent in English.

Recruitment

Participants were sourced via Prolific, with invitations sent by the researchers to potentially eligible participants based on the inclusion criteria and their demographic characteristics as collected by Prolific. Interested participants first completed an eligibility screening questionnaire to confirm they met the above inclusion criteria before proceeding to the main survey and the optional substudy survey.

Sample size calculation

A target of 500 participants at baseline was set. A total of 500 participants provides adequate statistical power to detect a $0.5 \, kg/m^2$ difference over time in BMI, assuming an alpha of 0.05, power of 0.80, correlation of 0.60, a baseline mean of $23.2 \, kg/m^2$ and SD of 4.5 based on previous research,[33] and accounting for 20% attrition. A set proportion of the 500 were recruited within each BMI, sex and country category, to ensure adequate numbers for future analyses by these characteristics. The target was 100 participants per BMI category ($20–24.9 \, kg/m^2$; $25–29.9 \, kg/m^2$; $30–34.9 \, kg/m^2$; $35–39.9 \, kg/m^2$; $\geq 40 \, kg/m^2$), with 50% male and female and 50% from the UK and Australia within each BMI category. However, due to more participants on the prolific platform in the UK compared with Australia the target was adjusted to a ratio of 4:1.

Study measures

Survey sections and the measures used are described below, listed in the same order as they appear in the survey. Attention check questions (n=6) were included throughout, to check the concentration of the participant and quality of the data collected. Instructive text was included for each section within the survey and for the different survey tools where appropriate, including to bring participants' attention to the fact that different sections and survey tools asked them to report on different time periods of reference.

Survey testing

The survey was pretested by the members of the research team, as well as our patient and public involvement (PPI) members who represent young adults with a lived experience of the psychological impact of weight management (n=3), and adjustments made prior to baseline data collection. Adjustments included reordering some questions and adding/editing instructional text for clarity. Collected survey responses will also be checked for completeness and quality, and rejected if either incomplete, or incorrect responses are entered for more than one of the attention check questions.

Section: Demographic questions (n=27 questions)
Sociodemographics

Sociodemographic data collected included age, gender, sexual orientation, country of residence, household

income, highest level of education completed, ethnic group and whether participants were currently enrolled at university/college (including current grades if yes). Income and education questions were tailored to whether participants resided in the UK or Australia in terms of currency and educational systems. Questions were sourced/adapted from the Australian and UK census questionnaires.[34 35]

Impacts of the COVID-19 pandemic

Ten questions were included regarding the COVID-19 pandemic, and included asking whether participants were in lockdown at the time of participating in the survey, and whether they had been in lockdown within the past 6 months. Participants were also asked to rate the impact of the COVID-19 pandemic on their eating habits, weight, mental health, physical activity, sleep, alcohol intake, tobacco smoking and non-prescribed drug use over the past 6 months on a 5-point Likert Scale (eg, from *Eating much less healthy* to *Eating a lot more healthy*). The questions for alcohol intake, tobacco smoking and non-prescribed drug use also had the option of not applicable in the case of participants not engaging in these behaviours.

Height and weight

Participants were asked to report their height in either metres or feet and inches, and to indicate whether their height was measured by themselves, a health professional or was an estimate. Participants were asked to report their weight in kilograms, pounds, or stones and pounds, and to indicate whether their weight was measured by themselves, a health professional or was an estimate. Participants were also asked to rate their level of confidence in the accuracy of their reported weight on a scale of 0/Not at all confident to 100/Entirely confident, and to indicate how long ago their weight was measured. The questions used to gather height and weight are standard questions in biomedical research.[36]

Section: Weight management and health service usage (n=9 questions)

Health service usage

Participants were asked to report which health services they had accessed within the last 3 months from a predefined list (General Practitioner (GP); Psychologist; Psychiatrist; Dietitian; Medical Specialist; Exercise Physiologist; Physiotherapist; other, please specify; I have not used any healthcare services in the last 3 months).

Weight management

Participants were asked the number of times they had tried to lose weight in the last six months, the number of years they had been trying to lose weight, the number of times in their lifetime that they had lost more than 11 lbs (5 kg) by dieting, and whether they were currently trying to manage their weight. Those who indicated yes to currently trying to manage their weight were asked two follow-on questions. First, whether they were receiving support/treatment for their weight management from

one of a predefined list of options (GP; Dietitian; Pharmacy; Exercise Physiologist; Physiotherapist; Personal trainer; Health coach; other, please specify; I am not currently receiving any support/treatment for weight management). Second, whether they were using any products/diets for weight management (supplements; meal replacements; meal delivery services; support group; smartphone app or online support; very low calorie diet; low calorie diet; low carbohydrate diet; fasting diet; other, please specify; I am not currently using products/diets for weight management). Participants were asked whether they were currently using any medications that may affect their weight (steroids; antidepressants; contraceptive pill; other, please specify; not currently taking any medications that affect my weight). Lastly, an optional open response question was asked to gather their views on support options that would be most helpful in managing weight or eating behaviours in future (What support would you find most helpful in managing your weight or eating behaviours in the future?).

Section: Eating behaviours (n=68 questions)

Given the complexity and scope of assessing eating behaviours, five tools were included to assess different aspects of eating behaviours.

Addictive eating

Addictive eating behaviours were assessed using the Modified Yale Food Addiction Scale 2.0 (mYFAS 2.0).[37] The mYFAS 2.0 is a 13-question tool which assesses addictive eating behaviours, and associated clinically significant distress and impairment. From this, the number of food addiction symptoms can be calculated (0–11), and it can be determined whether an individual is food addicted (≥2 symptoms and endorsement of the criteria for clinical impairment or distress) or not, and the severity of food addiction (mild; 2–3 symptoms, moderate; 4–5 symptoms, severe; ≥6 symptoms). The mYFAS 2.0 usually assesses behaviour over the past 12 months; however in this study participants are asked to think about the past 6 months in order to align with the study data collection time points.

Grazing

Grazing patterns were assessed using the Short Inventory of Grazing, which includes two questions regarding the presence/frequency of grazing, and of grazing with a sense of loss of control over the past 3 months.[38] Questions are answered on a 7-point Likert Scale from 0/none at all to 6/eight or more times per week, then summed and categorised into mild (1–3 episodes per week), moderate (4–7 episodes per week) or extreme/severe (≥8 episodes per week) grazing.

Disordered eating

The Eating Disorder Examination Questionnaire 6.0 was included, which is a 28-item tool for assessing the range and severity of behavioural features of eating disorders over the past 28 days.[39] Twenty-two of the questions relate to severity and are scored on a 7-point Likert Scale (0–6),

while the remaining six questions assess frequency of key behavioural features (eg, binge eating) and are not included in scoring. The questions relating to severity cover four subscales (restraint; eating concern; shape concern; weight concern) which can be scored individually, as well as calculating a global score. Subscale and global scores range from 0 to 6, calculated as the sum of the individual question scores, divided by the number of questions. Scores of 4 or higher are indicative of clinical range symptoms.

Emotional eating
The 19-item Positive-Negative Emotional Eating Scale was included as a measure of usual eating behaviours in response to positive and negative emotions.[40] Seven and 12 questions relate to positive and negative emotional eating, respectively, all scored on a 5-point Likert Scale from 0/Never to 4/Very often. Higher positive/negative subscale scores indicate higher likelihood of eating in response to positive/negative emotions.

Reward based eating was assessed using the Rapid Assessment of Reward-Related Eating Drive (RED-X5).[41] The RED-X5 consists of five questions to assess current behaviour regarding overconsumption and preoccupation with food (eg, I don't get full easily), answered on a 5-point Likert Scale (0/Strongly disagree to 4/Strongly agree). Responses are summed to give a total score (0–20), where a higher score indicates stronger reward-based eating.

Section: Personality (n=89 questions)
Four tools were included to assess different aspects of personality.

Impulsivity
The Short Urgency-Premeditation-Perseverance-Sensation-Seeking-Positive-Urgency Impulsive Behaviour Scale was included.[42] This is a 20-question tool assessing impulsive behaviour across five domains (negative urgency, lack of perseverance, lack of premeditation, sensation seeking, positive urgency), via items answered using a 4-point Likert Scale (4/Disagree strongly to 1/Agree strongly'). Each four-item subscale is scored by either summing (or averaging) responses to produce scores from 4 to 16 (or 1–4), with higher scores indicating greater impulsivity.

Delay discounting
The 27-item Monetary Choice Questionnaire was included to assess delay discounting.[43] The questions ask participants to choose between a smaller, immediate monetary reward or a delayed, larger monetary reward X number of days later, with the amount of money and number of days varying for each question (eg, 'Would you prefer £54 today, or £55 in 117 days?'). The amounts were expressed in pounds or dollars depending on whether the participant resided in the UK or Australia, respectively. The rate of discounting (k) is calculated, with a larger k indicative of a steeper discounting rate and greater level of impulsive choice.

Emotional regulation
The Sensitivity to Punishment and Sensitivity to Reward Questionnaire – Short Form was included,[44] which consists of 24 yes/no response questions relating to usual reactions or feelings to each of the situations described. Responses are summed to produce scores for sensitivity to punishment (14-items; score range 0–14) and sensitivity to reward (10-items; score range 0–10), with higher scores indicating greater sensitivity.

Emotional regulation was assessed using the Difficulties in Emotion Regulation-18.[45] This includes 18 questions, three relating to each of six subscales: lack of (1) Awareness of one's emotions, (2) Clarity about the nature of one's emotions, (3) Acceptance of one's emotions, (4) Access to effective emotion regulation strategies, (5) Ability to engage in goal-directed activities during negative emotions, and (6) Ability to manage one's impulses during negative emotions. Items are answered using 5-point Likert Scale responses (1/Almost never to 5/Almost always), which are then summed to produce subscale (score ranges 3–15) and total (score range 18–90) scores, where higher scores represent more difficulty in regulating emotions.

Section: Mental health (n=27 questions)
Stress
Stress was assessed using the Perceived Stress Scale 4 (PSS-4).[46] The PSS-4 assesses an individual's perception of stress in day-to-day life over the past month, using a 5-point Likert Scale (0/Never to 4/Very often). Scores are summed to give a total from 0 to 16, where a higher PSS-4 Score is indicative of higher perceived stress.

Anxiety
Anxiety was assessed using the Generalised Anxiety Disorder 7-item Scale (GAD-7).[47] The GAD-7 assesses frequency of experiencing seven different symptoms of anxiety over the past 2 weeks, using a 4-point Likert Scale (0/Not at all to 3/Nearly every day). Scores are summed to give a total from 0 to 21, where a higher GAD-7 score is indicative of higher anxiety, and scores can also be categorised into minimal (0–4), mild (5-9), moderate (10-14) and severe (15-21) levels of anxiety.

Depression
Depression was assessed using the Centre for Epidemiological Studies Depression Scale 10-item screening questionnaire (CES-D-10).[48] The CES-D-10 assesses frequency of depressive symptoms over the past week, using a 4-point Likert Scale (0/less than 1 day to 3/5–7 days). Scores are summed to give a total from 0 to 30, where a higher CES-D-10 score indicates greater depression symptoms.

Quality of life
Health-related quality of life was assessed using the EQ-5D.[49] The EQ-5D is a six-question tool which assesses

current health across five dimensions (mobility, self-care, usual activities, pain/discomfort, anxiety/depression) on a 5-point Likert Scale (1/No problems to 5/Extreme problems), as well as asking respondents to rank overall health on a scale of 0 (worst health imaginable) to 100 (best health imaginable). An index value is generated from the five Likert Scale questions, by applying a formula and country-specific weights to each level within each dimension.

Section: Health-related behaviours (n=29 questions)
Dietary intake
Five short diet questions were included as key indicators of usual dietary intake. Questions were sourced/adapted from the Australian National Health Survey and New South Wales (Australia) Adult Population Health Survey.[50 51] Questions assessed respondents' usual serves/portions of fruit per day, and vegetables per day ('I don't eat fruit (vegetables)' to 'six or more serves (portions)'), frequency of consuming a breakfast meal, and fast food takeaway meals or snacks, for example, burgers, pizza (1/never or rarely to 6/every day), and frequency of consuming sugar-sweetened drinks (0–7 days per week). Questions assessing fruit and vegetable intake specified serves or portions depending on whether the participant resided in Australia or the UK, respectively, in line with the relevant national dietary guidelines. These questions were accompanied by an explanation of what constitutes a serve/portion and picture examples.

Alcohol intake
Alcohol intake was assessed using the Alcohol Use Disorders Identification Tool-C (AUDIT-C).[52] The AUDIT-C is a three-question tool assessing usual behaviour in terms of frequency of consuming alcohol, number of standard drinks consumed on drinking occasions, and frequency of consuming six or more standard drinks on a drinking occasion. Responses are scored and categorised into two levels based on the total score and participant sex. AUDIT-C Scores of ≥4 for men and ≥3 for women are categorised as hazardous drinking levels, or non-hazardous levels for scores below these thresholds. These questions were accompanied by an explanation of what constitutes a standard drink and picture examples.

Tobacco smoking and drug use
The Alcohol, Smoking and Substance Involvement Screening Test (ASSIST) was used to assess tobacco smoking and drug use.[53 54] The ASSIST is a seven-question tool assessing lifetime and past 3-month use and consequences of use of tobacco, alcohol and other drugs including cannabis, cocaine, amphetamine-type stimulants, inhalants, sedatives, hallucinogens, opioids and 'other drugs'. A risk score is calculated for each substance consumed (score range 0–36), and

categorised as low (0–3), moderate (4–26) or high (27+) risk.[53 54]

Food security
Food security over the past 30 days was assessed using the US Department of Agriculture Food Security Survey Module six-item short form.[55] This six-item tool focuses on economic access to food, including whether respondents: ran out of food, couldn't afford to eat balanced meals, ever cut the size of meals or skipped meals (and how often), ate less than they felt they should, or went hungry, due to not having enough money for food. Affirmative responses are given a score of 1, and individual responses summed to give a total score between 0 and 6. A score of 0–1 indicates high/marginal food security, 2–4 low food security and 5–6 very low food security.

Physical activity
The International Physical Activity Questionnaire Short Form (IPAQ-SF) was used to assess physical activity.[56] The IPAQ-SF assesses number of days and time (minutes and hours) per week spent in walking, moderate and vigorous activity, as well as the usual amount of time spent sitting on weekdays, over the past 7 days. Responses are summed to give MET (metabolic equivalents) minutes per week of physical activity, as well as to classify individuals as inactive, minimally active or highly active. Inactive is considered as engaging in less than the minimally active criteria. Minimally active includes meeting either of the following; three or more days of at least 20 min of vigorous activity per week; five or more days of at least 30 min of moderate activity per week; or five or more days of walking, moderate or vigorous activity and at least 600 MET-minutes per week. Highly active is considered as meeting either of the following; vigorous activity on three or more days and 1500 or more MET-minutes per week; or walking, moderate or vigorous activity on 7 days and 3000 or more MET-minutes per week.

Sleep
Sleep was assessed using the single-item Sleep Quality Scale.[57] Respondents are asked to rate their overall sleep quality over the past 7 days on a scale of 0–10, considering hours of sleep, ease of falling asleep, waking during the night, wake time and how refreshing sleep was. Ratings relate to the following categorisations; terrible (0), poor (1–3), fair (4–6), good (7–9) and excellent (10) sleep quality.

Section: Other (n=1 question)
The final survey question was an optional open response question (Is there anything else you would like to add regarding the survey or your responses/experiences?).

Substudy survey
In the optional substudy survey, participants were asked to take an image of their weight recorded on a set of

scales and upload this within the survey platform. Instructions were provided to participants on how to accurately measure weight (eg, place scales on a hard, flat surface), and how to take the image (eg, ensure the scale reading is visible), as well as a sample image as a visual aid. Participants were also asked to indicate the units of measurement of their scales (open response question). For those who chose not to participate and upload an image of their weight, they were asked to complete a brief survey consisting of three questions to determine their reasons for not participating. The first question asked whether they uploaded an image (yes/no/can't remember) and two follow on multiple choice questions were asked for those that responded no or can't remember, to determine their main reason, and any further reasons for not participating (eg, no access to scales, felt uncomfortable uploading an image of their weight, did not have the time).

Data analysis plan
Primary analyses
The primary research aims include:

1. To characterise subsets of young adults (18–35 years) of varying weight status by eating behaviours, mental health factors, personality, health-related behaviours and sociodemographics;
2. To investigate eating behaviours, mental health factors, personality, health-related behaviours and sociodemographics as contributors to weight change among young adults (18–35 years) over a 12-month period;
3. To compare health service usage of young adults (18–35 years) of varying characteristic subsets, for example, weight status, including changes over time.

The proposed analyses include creating static predictive models using baseline data (eg, using latent class analysis, factor analysis or similar), and mapping changes longitudinally (eg, using multivariate regressions). These analyses will enable changes in the study measures to be identified, as well as predictors and outcomes of change.

Secondary analyses
The secondary research aims and proposed analyses include:

1. To examine the shared and unique role of established substance use risk factors in food and substance addictions. The proposed analyses will involve a series of hierarchical linear and logistic regressions and/or multivariate analysis of variance, to explore predictors of food addiction, binge eating and substance use.
2. To determine the weight management support needs of young adults living with excess weight. The proposed analyses are mixed methods, with a thematic analysis of qualitative data and moderated logistic regressions exploring the relationship between weight status and service use and how this varies by gender, socioeconomic status and ethnicity.
3. To assess the impact of the COVID-19 pandemic on health-related behaviours in young adults. Proposed

analysis will examine these factors using linear regression.
4. To validate self-reported weight against weight by image upload. The proposed analyses includes paired t-tests to evaluate differences between the two measures of weight, Pearson correlation to explore the strength of the linear relationship and Bland-Altman plots to evaluate the degree of agreement.

Additional exploratory analyses may be completed as indicated.

Public and patient involvement
PPI members who represent young adults with a lived experience of the psychological impact of weight management (n=3) will be involved throughout the project. PPI members pretested and provided feedback on the survey, and going forward, findings from the study will be shared with PPI members and their interpretation of the findings considered alongside those of the research team. Their interpretation of the findings will be critical to our reporting and dissemination. For example, suggestions for research, policy and practice generated from study findings will be made in consultation with the PPI members.

ETHICS AND DISSEMINATION
Ethical approval was granted by Leeds Beckett University, UK (reference number 86004) and the University of Newcastle, Australia (reference number H-2022–0110). All participants provided informed consent to participate prior to completing the surveys. Study findings will be disseminated through scientific journals, conferences, institute websites and social media, and briefings tailored to policy, practice and the public. Our dissemination strategy will be designed to help inform the future development of health and well-being care and support for young adults across Australia and the UK.

DISCUSSION
The knowledge gained from this longitudinal study will fill important gaps in the evidence base for young adults, informing health service delivery, and future observational and interventional research in eating, mental health and weight-related behaviours. Importantly, this includes knowledge of how services could work together for better patient outcomes. Dissemination is a key component of this study, and the plans to share findings with key stakeholders working within public health, local authority, and weight management service providers, users and the general public will help to maximise impact. It is also anticipated that this study will identify areas of enquiry for further research, including observational and interventional studies.

A deeper understanding of temporal relationships and causality between changes in eating behaviours, mental health, health-related behaviours and weight, and their

predictors, can not only help to identity avenues for intervention but also for prevention, by identifying factors for negative and positive changes over time. This information can be used to direct individuals to appropriate services, and develop more effective targeted interventions and services. In particular, the ability to inform preventative efforts/interventions targeting young adults before the onset of multimorbidity, is critical to optimising quality of life, and reducing disease burden, healthcare utilisation and subsequent economic costs.

The overarching strengths of this study will be the longitudinal evidence related to eating behaviours, mental health, health-related behaviours and weight, and their predictors, in young adults (18–35 years), and the large sample size stratified by gender and BMI. Multiple validated tools have been included for each key measure, to provide a comprehensive assessment from different perspectives. Additionally, PPI members supported the development of the survey and amends were made in response to their feedback to optimise readability and usability. PPI members are to be involved throughout, with their input critical to the understanding and interpretation of results, and generation of ideas to inform policy, practice and research.

Attrition is a potential study limitation, as the population group includes young adults, who typically show higher attrition rates than other adult age groups.[58] In addition, few studies run on the Prolific platform have been undertaken for 12 months duration or longer,[29] therefore the attrition of platform participants over time is currently unknown. Although participation relies on technological access of participants, which may exclude socioeconomically deprived groups, the use of online methods does facilitate the recruitment of broad and diverse populations internationally, and is an accepted data collection method which may also encourage greater self-disclosure for some.[59 60] As Prolific participants are paid for their contribution, this may also potentially influence the profile of survey completers.

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