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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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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, wellbeing and weight is crucial to inform health care and service provision. 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 Prolific online research platform will be used for data collection at baseline, 6- and 12-months. The survey (approx. 45 minutes) 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 sub-study 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/m^2, 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

(e.g. using latent class analysis, factor analysis or similar), and mapping changes longitudinally (e.g. 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 wellbeing care and support for young adults across Australia and the UK.

Strengths and limitations of this study

- This study will provide longitudinal evidence of change in eating behaviours, mental health, health related behaviours and weight over a 12-month period, in a sample of young adults (18-35 years)
- Key measures will be comprehensively assessed using multiple tools to assess different aspects
- The study will provide important information on the validity of using online reporting for weight
- Attrition is a potential study limitation, given the population group of young adults and that few studies of this duration have been conducted using Prolific online research platform
- The study may also be limited in terms of geographical location of participants and may not be representative of minority populations

KEYWORDS

Cohort study; protocol; eating behaviours; weight status; mental health

INTRODUCTION

Eating behaviours, mental health, wellbeing and weight status are subject to change across the lifespan. 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 health care service and support provision. This is especially pertinent in the UK and Australia given current research and policy is driving for improved health care that addresses multi-morbidity and determinants of health [2 3]. This 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 to 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 [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 to living arrangements, finances, employment and education, social relationships and familial responsibilities, all of which significantly impact eating and other health behaviours, mental health, wellbeing and weight [5 10 11].

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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 also 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 also 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.

Another more recent consideration for research is the impact of the COVID-19 pandemic, which has exacerbated relationships between mental health, eating behaviours and weight gain, whilst 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 (OECD) report into the mental health impacts of COVID-19 found two and 2.5 times higher rates of depression in the UK and Australia respectively in 2020 compared with 2019 (i.e. pre-pandemic) [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, whilst 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 bi-directional 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 co-morbidity 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. 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 [26]. Multi-morbidity 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 multi-morbidity [27]. To identify service needs and inform interventions for this group, further exploratory research and longitudinal data are needed.

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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 [28] [29]. Online research is also generally well-suited for a young adult population given the accessibility and familiarity of the technology [30].

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 socio-demographics;
2. Investigate eating behaviours, mental health factors, personality, health related behaviours and socio-demographics 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 e.g. 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 and 12 months. Baseline data were collected between 9th December 2021 – 11th February 2022, with a one month pause in data collection from 17th December 2021 – 17th 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 in December 2022-January 2023. Data collection is by online survey hosted via Qualtrics survey platform (https://www.qualtrics.com/) and administered via 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 minutes to complete, consisting of 250 questions across seven sections. These include demographics (including the impact of COVID-19, 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. At each time point there is an additional sub-study, 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 sub-study survey is hosted by REDCap survey platform (https://www.project-redcap.org/) and participants are paid £1 for completion of the survey which takes less than 5 minutes. This is an optional extra component and, if choosing to participate, is intended to be completed within seven 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 sub-study survey, they are invited to complete an additional brief survey (three questions) to determine their reasons for non-participation. Participants are paid £0.20p for completion of this additional survey. The conduct and reporting of this work will adhere to STROBE guidelines for reporting cohort studies [31].

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Participants

Inclusion criteria

Inclusion criteria for the study were young adults, aged 18-34 years at baseline, with a body mass index (BMI) ≥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 ≥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, breastfeeding, and not fluent in English.

Recruitment

Participants were sourced via Prolific, with invitations sent 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 sub-study 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 standard deviation of 4.5 based on previous research,[32] 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; 25-29.9; 30-34.9; 35-39.9; ≥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 to 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. The survey was pre-tested 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 re-ordering 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 >1 of the attention check questions.

Section: Demographic Questions (n=27 questions)

Socio-demographics

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 [33] [34].

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 six 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 six months on a 5-point Likert scale (e.g. 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 [35].

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 three months from a pre-defined list (GP; Psychologist; Psychiatrist; Dietitian; Medical Specialist; Exercise Physiologist; Physiotherapist; other, please specify; I have not used any health care 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 11lbs (5kgs) 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. Firstly, whether they were receiving support/treatment for their weight management from one of a pre-defined 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). Secondly, 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

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(steroids; anti-depressants; contraceptive pill; other, please specify; not currently taking any medications that affect my weight), and lastly an optional open response question to gather their views on support options that would be most helpful in managing weight or eating behaviours in 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).[36] 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), as well as determining 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 six months in order to align with the study data collection time points.

Grazing

Grazing patterns were assessed using the Short Inventory of Grazing (SIG), which includes two questions regarding the presence/frequency of grazing, and of grazing with a sense of loss of control over the past three months.[37] Questions are answered on a seven 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 (EDE-Q) 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.[38] Twenty two of the questions relate to severity and are scored on a seven point Likert scale (0-6), while the remaining six questions assess frequency of key behavioural features (e.g. 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. Sub-scale and global scores range from 0-6, calculated as the sum of the individual question scores, divided by the number of questions. Scores of four or higher are indicative of clinical range symptoms.

Emotional eating

The 19-item Positive-Negative Emotional Eating Scale (PNEES) was included as a measure of usual eating behaviours in response to positive and negative emotions.[39] Seven and twelve questions relate to positive and negative emotional eating respectively, all scored on a five point Likert scale from 0/Never to 4/Very often. Higher positive/negative sub-scale 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).[40] The RED-X5 consists of five questions to assess current behaviour regarding overconsumption and pre-occupation with food (e.g. I don't get full easily), answered

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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 (SUPPS-P) Impulsive Behaviour Scale was included.[41] 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 four point Likert scale (4/Disagree strongly to 1/Agree strongly'). Each four-item sub-scale is scored by either summing (or averaging) responses to produce scores from 4-16 (or 1-4), with higher scores indicating greater impulsivity.

Delay discounting

The 27-item Monetary Choice Questionnaire (MCQ) was included to assess delay discounting.[42] 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 (e.g. "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 (SPSRQ) – Short Form was included, [43] 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 (DERS-18).[44] This includes 18 questions, three relating to each of six sub-scales: 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 five point Likert scale responses (1/Almost never to 5/Almost always), which are then summed to produce sub-scale (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).[45] The PSS-4 assesses an individual's perception of stress in day-to-day life over the past month, using a five point Likert

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scale (0/Never to 4/Very often). Scores are summed to give a total from 0-16, 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).[46] The GAD-7 assesses frequency of experiencing seven different symptoms of anxiety over the past two weeks, using a four point Likert scale (0/Not at all to 3/Nearly every day). Scores are summed to give a total from 0-21, 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).[47] The CES-D-10 assesses frequency of depressive symptoms over the past week, using a four point Likert scale (0/less than one day to 3/5-7 days). Scores are summed to give a total from 0-30, 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.[48] 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 five 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.[49] [50] Questions assessed respondents' usual serves/portions of fruit per day, and vegetables per day ('I don't eat fruit [vegetables]' to '6 or more serves [portions]'), frequency of consuming a breakfast meal, and fast food takeaway meals or snacks e.g. 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).[51] 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. An AUDIT-C score of ≥4 for males and ≥3 for females is categorised as hazardous drinking levels, or

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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 [52] [53]. The ASSIST is a seven question tool assessing lifetime and past three 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 [52] [53].

Food security

Food security over the past 30 days was assessed using the United States Department of Agriculture (USDA) Food Security Survey Module (FSSM) 6-item short form.[54] 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 one, and individual responses summed to give a total score between 0-6. 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.[55] 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 seven 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 minutes of vigorous activity per week; five or more days of at least 30 minutes 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 seven days and 3000 or more MET-minutes per week.

Sleep

Sleep was assessed using the Single-Item Sleep Quality Scale (SQS).[56] Respondents are asked to rate their overall sleep quality over the past seven 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 to gather any additional information from participants regarding the survey or their responses and experiences.

Sub-study survey

In the optional sub-study 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 (e.g. place scales on a hard, flat surface), and how to take the image (e.g. 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. These questions asked whether they uploaded an image (yes/no/can't remember) and two follow on multiple choice questions for those that responded no or can't remember, to determine their main reason, and any further reasons for not participating (e.g. 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 socio-demographics;
2. To investigate eating behaviours, mental health factors, personality, health related behaviours and socio-demographics 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 e.g. weight status, including changes over time.

The proposed analyses include creating static predictive models using baseline data (e.g. using latent class analysis, factor analysis or similar), and mapping changes longitudinally (e.g. 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 but are not limited to the following:

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, socio-economic 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

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weight, Pearson correlation to explore the strength of the linear relationship, and Bland-Altman plots to evaluate the degree of agreement.

Public and Patient Involvement

Patient and Public 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 pre-tested 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.

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 wellbeing care and support for young adults across Australia and the UK.

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STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	1-2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	2-4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	4-5
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5-11
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5-11
Bias	9	Describe any efforts to address potential sources of bias	NA
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	NA
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	11
		(*b*) Describe any methods used to examine subgroups and interactions	
		(*c*) Explain how missing data were addressed	
		(*d*) If applicable, explain how loss to follow-up was addressed	
		(*e*) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	NA
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	NA
		(b) Indicate number of participants with missing data for each variable of interest	
		(c) Summarise follow-up time (eg, average and total amount)	
Outcome data	15*	Report numbers of outcome events or summary measures over time	NA

Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	NA
		(*b*) Report category boundaries when continuous variables were categorized	
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
Discussion			
Key results	18	Summarise key results with reference to study objectives	NA
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	NA
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	NA
Generalisability	21	Discuss the generalisability (external validity) of the study results	NA
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	15

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.

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

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1 **Understanding eating behaviours, mental health, and weight change in young**
2 **adults: Protocol paper for an international longitudinal study**

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23 **ABSTRACT**

24 **Introduction**

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

31 **Methods and analysis**

32 Online surveys administered via Prolific online research platform will be used for data
33 collection at baseline, 6- and 12-months. The survey (approx. 45 minutes) measures
34 demographics, the impact of COVID-19, body mass index (BMI), weight management and
35 health service usage, eating behaviours, personality, mental health, and health related
36 behaviours. An optional sub-study component at each time point aims to validate self-reported
37 weight in the main survey through images. Study inclusion criteria are; aged 18-34 years at
38 baseline, BMI ≥20 kg/m^2, and residing in the UK or Australia. A target of 500 participants at
39 baseline was set, recruited through Prolific, and with recruitment stratified by BMI, sex and

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country. The proposed analyses include creating static predictive models using baseline data (e.g. using latent class analysis, factor analysis or similar), and mapping changes longitudinally (e.g. 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 wellbeing 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 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 Prolific online research platform
- Patient and Public Involvement members are involved throughout the project

KEYWORDS

Cohort study; protocol; eating behaviours; weight status; mental health

INTRODUCTION

Eating behaviours, mental health, wellbeing and weight status are subject to change across the lifespan. 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 health care service and support provision. This knowledge is especially pertinent in the UK and Australia given current research and policy is driving for improved health care that addresses multi-morbidity 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 to 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 [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 to living arrangements, finances, employment and education, social relationships and familial responsibilities, all of which significantly impact eating and other health behaviours, mental health, wellbeing and weight [5] [10,11].

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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, whilst 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 (OECD) report into the mental health impacts of COVID-19 found two and 2.5 times higher rates of depression in the UK and Australia respectively in 2020 compared with 2019 (i.e. pre-pandemic) [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, whilst 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 bi-directional 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 co-morbidity 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]. Multi-morbidity 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 multi-morbidity [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

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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 socio-demographics;
2. Investigate eating behaviours, mental health factors, personality, health related behaviours and socio-demographics 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 e.g. 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 and 12 months. Baseline data were collected between 9th December 2021 – 11th February 2022, with a one month pause in data collection from 17th December 2021 – 17th 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 in December 2022-January 2023.

Data collection

Data collection is by online survey hosted via Qualtrics survey platform (https://www.qualtrics.com/) and administered via 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 minutes to complete, consisting of 250 questions across seven sections. These include demographics (including the impact of COVID-19, 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.

Sub-study component

At each time point there is an additional sub-study, 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 sub-study survey is hosted by REDCap survey platform (https://www.project-redcap.org/) and participants are paid £1 for completion of the survey which takes less than 5 minutes. This is an optional extra component and, if choosing to participate, is intended to be completed within seven 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 sub-study survey, they are invited to complete an additional brief survey (three questions) to determine their reasons for non-participation. Participants are paid £0.20p for

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completion of this additional survey. The conduct and reporting of this work will adhere to 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) ≥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 ≥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, breastfeeding, 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 sub-study 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 standard deviation 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; 25-29.9; 30-34.9; 35-39.9; ≥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 to 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 pre-tested 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 re-ordering some questions and adding/editing instructional text for clarity. Collected survey responses will also be checked for completeness

5

1 and quality, and rejected if either incomplete, or incorrect responses are entered for >1 of the
2 attention check questions.

3

4 Section: Demographic Questions (n=27 questions)

5 *Socio-demographics*

6 Sociodemographic data collected included age, gender, sexual orientation, country of
7 residence, household income, highest level of education completed, ethnic group, and
8 whether participants were currently enrolled at university/college (including current grades if
9 yes). Income and education questions were tailored to whether participants resided in the UK
10 or Australia in terms of currency and educational systems. Questions were sourced/adapted
11 from the Australian and UK census questionnaires [34] [35].

12 *Impacts of the COVID-19 pandemic*

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

21 *Height and Weight*

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

30

31 Section: Weight Management and Health Service Usage (n=9 questions)

32 *Health Service Usage*

33 Participants were asked to report which health services they had accessed within the last three
34 months from a pre-defined list (GP; Psychologist; Psychiatrist; Dietitian; Medical Specialist;
35 Exercise Physiologist; Physiotherapist; other, please specify; I have not used any health care
36 services in the last 3 months).

37 *Weight Management*

38 Participants were asked the number of times they had tried to lose weight in the last six
39 months, the number of years they had been trying to lose weight, the number of times in their
40 lifetime that they had lost more than 11lbs (5kgs) by dieting, and whether they were currently
41 trying to manage their weight. Those who indicated yes to currently trying to manage their
42 weight were asked two follow on questions. Firstly, whether they were receiving
43 support/treatment for their weight management from one of a pre-defined list of options (GP;

6

1 Dietitian; Pharmacy; Exercise Physiologist; Physiotherapist; Personal trainer; Health coach;
2 other, please specify; I am not currently receiving any support/treatment for weight
3 management). Secondly, whether they were using any products/diets for weight management
4 (supplements; meal replacements; meal delivery services; support group; smartphone app or
5 online support; very low calorie diet; low calorie diet; low carbohydrate diet; fasting diet; other,
6 please specify; I am not currently using products/diets for weight management). Participants
7 were asked whether they were currently using any medications that may affect their weight
8 (steroids; anti-depressants; contraceptive pill; other, please specify; not currently taking any
9 medications that affect my weight). Lastly, an optional open response question was asked to
10 gather their views on support options that would be most helpful in managing weight or eating
11 behaviours in future (What support would you find most helpful in managing your weight or
12 eating behaviours in the future?).

13

14 Section: Eating Behaviours (n=68 questions)

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

17 *Addictive eating*

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

27 *Grazing*

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

34 *Disordered eating*

35 The Eating Disorder Examination Questionnaire 6.0 (EDE-Q) was included, which is a 28-item
36 tool for assessing the range and severity of behavioural features of eating disorders over the
37 past 28 days.[39] Twenty two of the questions relate to severity and are scored on a seven point
38 Likert scale (0-6), while the remaining six questions assess frequency of key behavioural
39 features (e.g. binge eating) and are not included in scoring. The questions relating to severity
40 cover four subscales (restraint; eating concern; shape concern; weight concern) which can be
41 scored individually, as well as calculating a global score. Sub-scale and global scores range
42 from 0-6, calculated as the sum of the individual question scores, divided by the number of
43 questions. Scores of four or higher are indicative of clinical range symptoms.

44 *Emotional eating*

7

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

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

11

12   Section: Personality (n=89 questions)

13   Four tools were included to assess different aspects of personality.

14   *Impulsivity*

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

22   *Delay discounting*

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

31   *Emotional regulation*

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

37   Emotional regulation was assessed using the Difficulties in Emotion Regulation-18 (DERS-
38   18).[45] This includes 18 questions, three relating to each of six sub-scales: lack of 1) awareness
39   of one's emotions, 2) clarity about the nature of one's emotions, 3) acceptance of one's
40   emotions, 4) access to effective emotion regulation strategies, 5) ability to engage in goal-
41   directed activities during negative emotions, and 6) ability to manage one's impulses during
42   negative emotions. Items are answered using five point Likert scale responses (1/Almost
43   never to 5/Almost always), which are then summed to produce sub-scale (score ranges 3-15)
44   and total (score range 18-90) scores, where higher scores represent more difficulty in
45   regulating emotions.

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3   1
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5   2   Section: Mental Health (n=27 questions)
6
7   3   *Stress*
8
9   4   Stress was assessed using the Perceived Stress Scale 4 (PSS-4).[46] The PSS-4 assesses an
10   5   individual's perception of stress in day-to-day life over the past month, using a five point Likert
11   6   scale (0/Never to 4/Very often). Scores are summed to give a total from 0-16, where a higher
12   7   PSS-4 score is indicative of higher perceived stress.
13
14   8   *Anxiety*
15
16   9   Anxiety was assessed using the Generalised Anxiety Disorder 7-item scale (GAD-7).[47] The
17   10   GAD-7 assesses frequency of experiencing seven different symptoms of anxiety over the past
18   11   two weeks, using a four point Likert scale (0/Not at all to 3/Nearly every day). Scores are
19   12   summed to give a total from 0-21, where a higher GAD-7 score is indicative of higher anxiety,
20   13   and scores can also be categorised into minimal (0-4), mild (5-9), moderate (10-14) and
21   14   severe (15-21) levels of anxiety.
22
23   15   *Depression*
24
25   16   Depression was assessed using the Centre for Epidemiological Studies Depression Scale 10-
26   17   item screening questionnaire (CES-D-10).[48] The CES-D-10 assesses frequency of depressive
27   18   symptoms over the past week, using a four point Likert scale (0/less than one day to 3/5-7
28   19   days). Scores are summed to give a total from 0-30, where a higher CES-D-10 score indicates
29   20   greater depression symptoms.
30
31   21   *Quality of life*
32
33   22   Health related quality of life was assessed using the EQ-5D.[49] The EQ-5D is a six question
34   23   tool which assesses current health across five dimensions (mobility, self-care, usual activities,
35   24   pain/discomfort, anxiety/depression) on a five point Likert scale (1/No problems to 5/Extreme
36   25   problems), as well as asking respondents to rank overall health on a scale of 0 (worst health
37   26   imaginable) to 100 (best health imaginable). An index value is generated from the five Likert
38   27   scale questions, by applying a formula and country specific weights to each level within each
39   28   dimension.
40
41   29
42
43   30   Section: Health related behaviours (n=29 questions)
44
45   31   *Dietary intake*
46
47   32   Five short diet questions were included as key indicators of usual dietary intake. Questions
48   33   were sourced/adapted from the Australian National Health Survey and New South Wales
49   34   (Australia) Adult Population Health Survey.[50 51] Questions assessed respondents' usual
50   35   serves/portions of fruit per day, and vegetables per day ('I don't eat fruit [vegetables]' to '6 or
51   36   more serves [portions]'), frequency of consuming a breakfast meal, and fast food takeaway
52   37   meals or snacks e.g. burgers, pizza (1/never or rarely to 6/every day), and frequency of
53   38   consuming sugar sweetened drinks (0-7 days per week). Questions assessing fruit and
54   39   vegetable intake specified serves or portions depending on whether the participant resided in
55   40   Australia or the UK respectively, in line with the relevant National dietary guidelines. These
56   41   questions were accompanied by an explanation of what constitutes a serve/portion and picture
57   42   examples.
58
59   43   *Alcohol intake*
60

9

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

9 *Tobacco smoking and drug use*

10 The Alcohol, Smoking and Substance Involvement Screening Test (ASSIST) was used to
11 assess tobacco smoking and drug use [53 54]. The ASSIST is a seven question tool assessing
12 lifetime and past three month use and consequences of use of tobacco, alcohol and other
13 drugs including cannabis, cocaine, amphetamine-type stimulants, inhalants, sedatives,
14 hallucinogens, opioids, and 'other drugs'. A risk score is calculated for each substance
15 consumed (score range 0-36), and categorised as low (0-3), moderate (4-26) or high (27+)
16 risk [53 54].

17 *Food security*

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

26 *Physical activity*

27 The International Physical Activity Questionnaire Short Form (IPAQ-SF) was used to assess
28 physical activity.[56] The IPAQ-SF assesses number of days and time (minutes and hours) per
29 week spent in walking, moderate and vigorous activity, as well as the usual amount of time
30 spent sitting on weekdays, over the past seven days. Responses are summed to give MET
31 (metabolic equivalents) minutes per week of physical activity, as well as to classify individuals
32 as inactive, minimally active or highly active. Inactive is considered as engaging in less than
33 the minimally active criteria. Minimally active includes meeting either of the following; three or
34 more days of at least 20 minutes of vigorous activity per week; five or more days of at least
35 30 minutes of moderate activity per week; or five or more days of walking, moderate or
36 vigorous activity and at least 600 MET-minutes per week. Highly active is considered as
37 meeting either of the following; vigorous activity on three or more days and 1500 or more MET-
38 minutes per week; or walking, moderate or vigorous activity on seven days and 3000 or more
39 MET-minutes per week.

40 *Sleep*

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

46

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2
3   1   Section: Other (n=1 question)
4
5   2   The final survey question was an optional open response question (Is there anything else you
6   3   would like to add regarding the survey or your responses/experiences?).
7
8   4
9
10 5   Sub-study survey
11
12 6   In the optional sub-study survey, participants were asked to take an image of their weight
13 7   recorded on a set of scales and upload this within the survey platform. Instructions were
14 8   provided to participants on how to accurately measure weight (e.g. place scales on a hard, flat
15 9   surface), and how to take the image (e.g. ensure the scale reading is visible), as well as a
16 10 sample image as a visual aid. Participants were also asked to indicate the units of
17 11 measurement of their scales (open response question). For those who chose not to participate
18 12 and upload an image of their weight, they were asked to complete a brief survey consisting of
19 13 three questions to determine their reasons for not participating. These questions asked
20 14 whether they uploaded an image (yes/no/can't remember) and two follow on multiple choice
21 15 questions for those that responded no or can't remember, to determine their main reason, and
22 16 any further reasons for not participating (e.g. no access to scales, felt uncomfortable uploading
23 17 an image of their weight, did not have the time).
24
25 18
26
27 19 **Data analysis plan**
28
29 20 Primary analyses
30
31 21 The primary research aims include:
32
33 22   1. To characterise subsets of young adults (18-35 years) of varying weight status by
34 23   eating behaviours, mental health factors, personality, health related behaviours and
35 24   socio-demographics;
36 25   2. To investigate eating behaviours, mental health factors, personality, health related
37 26   behaviours and socio-demographics as contributors to weight change among young
38 27   adults (18-35 years) over a 12-month period;
39 28   3. To compare health service usage of young adults (18-35 years) of varying
40 29   characteristic subsets e.g. weight status, including changes over time.
41
42 30 The proposed analyses include creating static predictive models using baseline data (e.g.
43 31 using latent class analysis, factor analysis or similar), and mapping changes longitudinally
44 32 (e.g. using multivariate regressions). These analyses will enable changes in the study
45 33 measures to be identified, as well as predictors and outcomes of change.
46
47 34 Secondary analyses
48
49 35 The secondary research aims and proposed analyses include:
50
51 36   1. To examine the shared and unique role of established substance use risk factors in
52 37   food and substance addictions. The proposed analyses will involve a series of
53 38   hierarchical linear and logistic regressions and / or multivariate analysis of variance,
54 39   to explore predictors of food addiction, binge eating and substance use.
55 40   2. To determine the weight management support needs of young adults living with
56 41   excess weight. The proposed analyses are mixed methods, with a thematic analysis
57 42   of qualitative data and moderated logistic regressions exploring the relationship
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11

1 between weight status and service use and how this varies by gender, socio-
2 economic 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.

9 Additional exploratory analyses may be completed as indicated.

Public and Patient Involvement

Patient and Public 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 pre-tested 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 wellbeing 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. 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 multi-morbidity, is critical to optimising quality of life, and reducing disease burden, healthcare utilisation and subsequent economic costs. 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.

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

12

adults (18-35 years), and the large sample size stratified by gender and body mass index. 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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AUTHOR CONTRIBUTIONS: T.B., L.E., T.F., M.W., K.K., J.M., and T.E. were involved in conceiving and designing the study. T.F., M.W., and K.K. are primarily responsible for data acquisition and data organisation. T.B., L.E., T.F., M.W., K.K., J.M., and T.E. will conduct/ contribute to the planned data analyses and interpretation. M.W. and T.B. drafted the protocol paper, with input and critical review from L.E., T.F., K.K., J.M., and T.E.

COMPETING INTERESTS STATEMENT: None declared

WORD COUNT: 4944

DATA AVAILABILITY STATEMENT: No data are available

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STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	1-2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	2-4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	4-5
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5-11
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5-11
Bias	9	Describe any efforts to address potential sources of bias	NA
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	NA
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	11
		(*b*) Describe any methods used to examine subgroups and interactions	
		(*c*) Explain how missing data were addressed	
		(*d*) If applicable, explain how loss to follow-up was addressed	
		(*e*) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	NA
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	NA
		(b) Indicate number of participants with missing data for each variable of interest	
		(c) Summarise follow-up time (eg, average and total amount)	
Outcome data	15*	Report numbers of outcome events or summary measures over time	NA

Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included		NA
		(*b*) Report category boundaries when continuous variables were categorized		
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period		
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses		NA
Discussion				
Key results	18	Summarise key results with reference to study objectives		NA
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias		NA
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence		NA
Generalisability	21	Discuss the generalisability (external validity) of the study results		NA
Other information				
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based		15

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.

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

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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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23 **ABSTRACT**

24 **Introduction**

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

31 **Methods and analysis**

32 Online surveys administered via Prolific online research platform will be used for data
33 collection at baseline, 6- and 12-months. The survey (approx. 45 minutes) measures
34 demographics, the impact of COVID-19, body mass index (BMI), weight management and
35 health service usage, eating behaviours, personality, mental health, and health related
36 behaviours. An optional sub-study component at each time point aims to validate self-reported
37 weight in the main survey through images. Study inclusion criteria are; aged 18-34 years at
38 baseline, BMI ≥20 kg/m^2, and residing in the UK or Australia. A target of 500 participants at
39 baseline was set, recruited through Prolific, and with recruitment stratified by BMI, sex and

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country. The proposed analyses include creating static predictive models using baseline data (e.g. using latent class analysis, factor analysis or similar), and mapping changes longitudinally (e.g. 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 wellbeing 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 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 Prolific online research platform
- Patient and Public Involvement members are involved throughout the project

KEYWORDS

Cohort study; protocol; eating behaviours; weight status; mental health

INTRODUCTION

Eating behaviours, mental health, wellbeing and weight status are subject to change across the lifespan. 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 health care service and support provision. This knowledge is especially pertinent in the UK and Australia given current research and policy is driving for improved health care that addresses multi-morbidity 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 to 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 [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 to living arrangements, finances, employment and education, social relationships and familial responsibilities, all of which significantly impact eating and other health behaviours, mental health, wellbeing 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, whilst 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 (OECD) report into the mental health impacts of COVID-19 found two and 2.5 times higher rates of depression in the UK and Australia respectively in 2020 compared with 2019 (i.e. pre-pandemic) [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, whilst 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 bi-directional 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 co-morbidity 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]. Multi-morbidity 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 multi-morbidity [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

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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 socio-demographics;
2. Investigate eating behaviours, mental health factors, personality, health related behaviours and socio-demographics 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 e.g. 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 and 12 months. Baseline data were collected between 9th December 2021 – 11th February 2022, with a one month pause in data collection from 17th December 2021 – 17th 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 in December 2022-January 2023.

Data collection

Data collection is by online survey hosted via Qualtrics survey platform (https://www.qualtrics.com/) and administered via 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 minutes to complete, consisting of 250 questions across seven sections. These include demographics (including the impact of COVID-19, 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.

Sub-study component

At each time point there is an additional sub-study, 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 sub-study survey is hosted by REDCap survey platform (https://www.project-redcap.org/) and participants are paid £1 for completion of the survey which takes less than 5 minutes. This is an optional extra component and, if choosing to participate, is intended to be completed within seven 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 sub-study survey, they are invited to complete an additional brief survey (three questions) to determine their reasons for non-participation. Participants are paid £0.20p for

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completion of this additional survey. The conduct and reporting of this work will adhere to 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) ≥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 ≥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, breastfeeding, 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 sub-study 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 standard deviation 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; 25-29.9; 30-34.9; 35-39.9; ≥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 to 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 pre-tested 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 re-ordering some questions and adding/editing instructional text for clarity. Collected survey responses will also be checked for completeness

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1 and quality, and rejected if either incomplete, or incorrect responses are entered for >1 of the
2 attention check questions.

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4 Section: Demographic Questions (n=27 questions)

5 *Socio-demographics*

6 Sociodemographic data collected included age, gender, sexual orientation, country of
7 residence, household income, highest level of education completed, ethnic group, and
8 whether participants were currently enrolled at university/college (including current grades if
9 yes). Income and education questions were tailored to whether participants resided in the UK
10 or Australia in terms of currency and educational systems. Questions were sourced/adapted
11 from the Australian and UK census questionnaires [34 35].

12 *Impacts of the COVID-19 pandemic*

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

21 *Height and Weight*

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

30

31 Section: Weight Management and Health Service Usage (n=9 questions)

32 *Health Service Usage*

33 Participants were asked to report which health services they had accessed within the last three
34 months from a pre-defined list (GP; Psychologist; Psychiatrist; Dietitian; Medical Specialist;
35 Exercise Physiologist; Physiotherapist; other, please specify; I have not used any health care
36 services in the last 3 months).

37 *Weight Management*

38 Participants were asked the number of times they had tried to lose weight in the last six
39 months, the number of years they had been trying to lose weight, the number of times in their
40 lifetime that they had lost more than 11lbs (5kgs) by dieting, and whether they were currently
41 trying to manage their weight. Those who indicated yes to currently trying to manage their
42 weight were asked two follow on questions. Firstly, whether they were receiving
43 support/treatment for their weight management from one of a pre-defined list of options (GP;

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1   Dietitian; Pharmacy; Exercise Physiologist; Physiotherapist; Personal trainer; Health coach;
2   other, please specify; I am not currently receiving any support/treatment for weight
3   management). Secondly, whether they were using any products/diets for weight management
4   (supplements; meal replacements; meal delivery services; support group; smartphone app or
5   online support; very low calorie diet; low calorie diet; low carbohydrate diet; fasting diet; other,
6   please specify; I am not currently using products/diets for weight management). Participants
7   were asked whether they were currently using any medications that may affect their weight
8   (steroids; anti-depressants; contraceptive pill; other, please specify; not currently taking any
9   medications that affect my weight). Lastly, an optional open response question was asked to
10 gather their views on support options that would be most helpful in managing weight or eating
11 behaviours in future (What support would you find most helpful in managing your weight or
12 eating behaviours in the future?).

13

14 Section: Eating Behaviours (n=68 questions)

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

17 *Addictive eating*

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

27 *Grazing*

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

34 *Disordered eating*

35 The Eating Disorder Examination Questionnaire 6.0 (EDE-Q) was included, which is a 28-item
36 tool for assessing the range and severity of behavioural features of eating disorders over the
37 past 28 days.[39] Twenty two of the questions relate to severity and are scored on a seven point
38 Likert scale (0-6), while the remaining six questions assess frequency of key behavioural
39 features (e.g. binge eating) and are not included in scoring. The questions relating to severity
40 cover four subscales (restraint; eating concern; shape concern; weight concern) which can be
41 scored individually, as well as calculating a global score. Sub-scale and global scores range
42 from 0-6, calculated as the sum of the individual question scores, divided by the number of
43 questions. Scores of four or higher are indicative of clinical range symptoms.

44 *Emotional eating*

7

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

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

11

12 Section: Personality (n=89 questions)

13 Four tools were included to assess different aspects of personality.

14 *Impulsivity*

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

22 *Delay discounting*

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

31 *Emotional regulation*

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

37 Emotional regulation was assessed using the Difficulties in Emotion Regulation-18 (DERS-
38 18).[45] This includes 18 questions, three relating to each of six sub-scales: lack of 1) awareness
39 of one's emotions, 2) clarity about the nature of one's emotions, 3) acceptance of one's
40 emotions, 4) access to effective emotion regulation strategies, 5) ability to engage in goal-
41 directed activities during negative emotions, and 6) ability to manage one's impulses during
42 negative emotions. Items are answered using five point Likert scale responses (1/Almost
43 never to 5/Almost always), which are then summed to produce sub-scale (score ranges 3-15)
44 and total (score range 18-90) scores, where higher scores represent more difficulty in
45 regulating emotions.

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5   2   Section: Mental Health (n=27 questions)
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7   3   *Stress*
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9   4   Stress was assessed using the Perceived Stress Scale 4 (PSS-4).[46] The PSS-4 assesses an
10   5   individual's perception of stress in day-to-day life over the past month, using a five point Likert
11   6   scale (0/Never to 4/Very often). Scores are summed to give a total from 0-16, where a higher
12   7   PSS-4 score is indicative of higher perceived stress.
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14   8   *Anxiety*
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16   9   Anxiety was assessed using the Generalised Anxiety Disorder 7-item scale (GAD-7).[47] The
17   10   GAD-7 assesses frequency of experiencing seven different symptoms of anxiety over the past
18   11   two weeks, using a four point Likert scale (0/Not at all to 3/Nearly every day). Scores are
19   12   summed to give a total from 0-21, where a higher GAD-7 score is indicative of higher anxiety,
20   13   and scores can also be categorised into minimal (0-4), mild (5-9), moderate (10-14) and
21   14   severe (15-21) levels of anxiety.
22
23   15   *Depression*
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25   16   Depression was assessed using the Centre for Epidemiological Studies Depression Scale 10-
26   17   item screening questionnaire (CES-D-10).[48] The CES-D-10 assesses frequency of depressive
27   18   symptoms over the past week, using a four point Likert scale (0/less than one day to 3/5-7
28   19   days). Scores are summed to give a total from 0-30, where a higher CES-D-10 score indicates
29   20   greater depression symptoms.
30
31   21   *Quality of life*
32
33   22   Health related quality of life was assessed using the EQ-5D.[49] The EQ-5D is a six question
34   23   tool which assesses current health across five dimensions (mobility, self-care, usual activities,
35   24   pain/discomfort, anxiety/depression) on a five point Likert scale (1/No problems to 5/Extreme
36   25   problems), as well as asking respondents to rank overall health on a scale of 0 (worst health
37   26   imaginable) to 100 (best health imaginable). An index value is generated from the five Likert
38   27   scale questions, by applying a formula and country specific weights to each level within each
39   28   dimension.
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43   30   Section: Health related behaviours (n=29 questions)
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45   31   *Dietary intake*
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47   32   Five short diet questions were included as key indicators of usual dietary intake. Questions
48   33   were sourced/adapted from the Australian National Health Survey and New South Wales
49   34   (Australia) Adult Population Health Survey.[50] [51] Questions assessed respondents' usual
50   35   serves/portions of fruit per day, and vegetables per day ('I don't eat fruit [vegetables]' to '6 or
51   36   more serves [portions]'), frequency of consuming a breakfast meal, and fast food takeaway
52   37   meals or snacks e.g. burgers, pizza (1/never or rarely to 6/every day), and frequency of
53   38   consuming sugar sweetened drinks (0-7 days per week). Questions assessing fruit and
54   39   vegetable intake specified serves or portions depending on whether the participant resided in
55   40   Australia or the UK respectively, in line with the relevant National dietary guidelines. These
56   41   questions were accompanied by an explanation of what constitutes a serve/portion and picture
57   42   examples.
58
59   43   *Alcohol intake*
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1 Alcohol intake was assessed using the Alcohol Use Disorders Identification Tool-C (AUDIT-
2 C).[52] The AUDIT-C is a three question tool assessing usual behaviour in terms of frequency
3 of consuming alcohol, number of standard drinks consumed on drinking occasions, and
4 frequency of consuming six or more standard drinks on a drinking occasion. Responses are
5 scored and categorised into two levels based on the total score and participant sex. An AUDIT-
6 C score of ≥4 for males and ≥3 for females is categorised as hazardous drinking levels, or
7 non-hazardous levels for scores below these thresholds. These questions were accompanied
8 by an explanation of what constitutes a standard drink and picture examples.

9 *Tobacco smoking and drug use*

10 The Alcohol, Smoking and Substance Involvement Screening Test (ASSIST) was used to
11 assess tobacco smoking and drug use [53 54]. The ASSIST is a seven question tool assessing
12 lifetime and past three month use and consequences of use of tobacco, alcohol and other
13 drugs including cannabis, cocaine, amphetamine-type stimulants, inhalants, sedatives,
14 hallucinogens, opioids, and 'other drugs'. A risk score is calculated for each substance
15 consumed (score range 0-36), and categorised as low (0-3), moderate (4-26) or high (27+)
16 risk [53 54].

17 *Food security*

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

26 *Physical activity*

27 The International Physical Activity Questionnaire Short Form (IPAQ-SF) was used to assess
28 physical activity.[56] The IPAQ-SF assesses number of days and time (minutes and hours) per
29 week spent in walking, moderate and vigorous activity, as well as the usual amount of time
30 spent sitting on weekdays, over the past seven days. Responses are summed to give MET
31 (metabolic equivalents) minutes per week of physical activity, as well as to classify individuals
32 as inactive, minimally active or highly active. Inactive is considered as engaging in less than
33 the minimally active criteria. Minimally active includes meeting either of the following; three or
34 more days of at least 20 minutes of vigorous activity per week; five or more days of at least
35 30 minutes of moderate activity per week; or five or more days of walking, moderate or
36 vigorous activity and at least 600 MET-minutes per week. Highly active is considered as
37 meeting either of the following; vigorous activity on three or more days and 1500 or more MET-
38 minutes per week; or walking, moderate or vigorous activity on seven days and 3000 or more
39 MET-minutes per week.

40 *Sleep*

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

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1 Section: Other (n=1 question)

2 The final survey question was an optional open response question (Is there anything else you
3 would like to add regarding the survey or your responses/experiences?).

4

5 Sub-study survey

6 In the optional sub-study survey, participants were asked to take an image of their weight
7 recorded on a set of scales and upload this within the survey platform. Instructions were
8 provided to participants on how to accurately measure weight (e.g. place scales on a hard, flat
9 surface), and how to take the image (e.g. ensure the scale reading is visible), as well as a
10 sample image as a visual aid. Participants were also asked to indicate the units of
11 measurement of their scales (open response question). For those who chose not to participate
12 and upload an image of their weight, they were asked to complete a brief survey consisting of
13 three questions to determine their reasons for not participating. These questions asked
14 whether they uploaded an image (yes/no/can't remember) and two follow on multiple choice
15 questions for those that responded no or can't remember, to determine their main reason, and
16 any further reasons for not participating (e.g. no access to scales, felt uncomfortable uploading
17 an image of their weight, did not have the time).

18

19 **Data analysis plan**

20 Primary analyses

21 The primary research aims include:

22   1. To characterise subsets of young adults (18-35 years) of varying weight status by
23   eating behaviours, mental health factors, personality, health related behaviours and
24   socio-demographics;
25   2. To investigate eating behaviours, mental health factors, personality, health related
26   behaviours and socio-demographics as contributors to weight change among young
27   adults (18-35 years) over a 12-month period;
28   3. To compare health service usage of young adults (18-35 years) of varying
29   characteristic subsets e.g. weight status, including changes over time.

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

34 Secondary analyses

35 The secondary research aims and proposed analyses include:

36   1. To examine the shared and unique role of established substance use risk factors in
37   food and substance addictions. The proposed analyses will involve a series of
38   hierarchical linear and logistic regressions and / or multivariate analysis of variance,
39   to explore predictors of food addiction, binge eating and substance use.
40   2. To determine the weight management support needs of young adults living with
41   excess weight. The proposed analyses are mixed methods, with a thematic analysis
42   of qualitative data and moderated logistic regressions exploring the relationship

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1. between weight status and service use and how this varies by gender, socio-economic 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

Patient and Public 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 pre-tested 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 wellbeing 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 multi-morbidity, 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 body mass index. 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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AUTHOR CONTRIBUTIONS: T.B., L.E., T.F., M.W., K.K., J.M., and T.E. were involved in conceiving and designing the study. T.F., M.W., and K.K. are primarily responsible for data acquisition and data organisation. T.B., L.E., T.F., M.W., K.K., J.M., and T.E. will conduct/ contribute to the planned data analyses and interpretation. M.W. and T.B. drafted the protocol paper, with input and critical review from L.E., T.F., K.K., J.M., and T.E.

COMPETING INTERESTS STATEMENT: None declared

WORD COUNT: 4944

DATA AVAILABILITY STATEMENT: No data are available

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STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	1-2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	2-4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	4-5
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5-11
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5-11
Bias	9	Describe any efforts to address potential sources of bias	NA
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	NA
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	11
		(*b*) Describe any methods used to examine subgroups and interactions	
		(*c*) Explain how missing data were addressed	
		(*d*) If applicable, explain how loss to follow-up was addressed	
		(*e*) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	NA
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	NA
		(b) Indicate number of participants with missing data for each variable of interest	
		(c) Summarise follow-up time (eg, average and total amount)	
Outcome data	15*	Report numbers of outcome events or summary measures over time	NA

Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	NA
		(*b*) Report category boundaries when continuous variables were categorized	
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA

Discussion

Key results	18	Summarise key results with reference to study objectives	NA
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	NA
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	NA
Generalisability	21	Discuss the generalisability (external validity) of the study results	NA

Other information

| Funding | 22 | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based | 15 |

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.