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Exploring factors influencing late evening eating and barriers and enablers to changing to earlier eating patterns in adults with overweight and obesity

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ABSTRACT

Late evening eating is a potential risk factor for overconsumption and weight gain. However, there is limited qualitative research investigating the complex factors that influence late evening eating in adults living with obesity. Identifying the factors that influence late evening eating can inform interventions to reduce late evening eating and associated health risks. Therefore, this study aimed to: i) explore factors that contribute to eating late, and ii) apply the Capability, Opportunity, and Motivation Behaviour (COM-B) model to understand the barriers and enablers to changing to earlier food intake timings in UK adults who report eating late. Semi-structured interviews with seventeen participants [32.47 ± 6.65 years; 34.68 ± 7.10 kg/m^2; 71% female (n = 12); 41% White (n = 7)] investigated reasons for late evening eating and the potential barriers and enablers to changing to earlier eating patterns. Thematic analysis identified four main contributors to late evening eating: 1) internal signals (e.g., feeling hungry in the evening); 2) external and situational factors (e.g., work schedules and the food-rich environment); 3) social factors (e.g., interactions with family) and 4) behavioural and emotional factors (e.g., personal preferences and negative feelings in the evening). Time constraints and work schedules were identified as main barriers to changing to earlier eating patterns. Whereas, having high motivation (e.g., contentment with eating earlier in the evening) and interpersonal support were identified as main enablers to eating earlier. This study provides in-depth insights into the psychological, social, and environmental factors contributing to late evening eating. The findings highlight potential targets for future interventions to facilitate earlier eating times in individuals at risk of overweight and obesity.

1. Introduction

Obesity is related to increased risk of various metabolic disorders, such as type 2 diabetes and cardiovascular disease (Sarma et al., 2021). Additionally, obesity is associated with adverse psychological consequences, including body dissatisfaction (Weinberger et al., 2016), eating disorders (da Luz et al., 2018), weight stigmatisation (Puhl & Suh, 2015), lower self-esteem, and depression (Sarwer & Polonsky, 2016). Currently, nutritional strategies to prevent and treat obesity have focused on improving dietary composition (e.g., increasing consumption of fruits and vegetables) and reducing overall caloric intake (Hwalla & Jaafar, 2020). However, recent evidence emphasises the potential importance of meal timing in healthy weight management.

Multiple studies have found that late evening eating, defined as eating at a later time in the evening, is associated with increased energy intake (Baron et al., 2011; de Castro, 2004; Jacob et al., 2023; Reid et al., 2014). For example, using a 3-day food diary to assess food intake and the distribution of energy and macronutrient intake, Jacob et al. (2020), found that greater energy intake consumed after 20:00 was associated with higher total daily energy intake. However, several other studies have found no relationship between eating late and energy intake (Garaulet et al., 2013; Ruiz-Lozano et al., 2016). For example, an observational study assessed dietary intake with a 24-h food diary and showed no differences in total daily energy intake between early eaters and late eaters (Dashti et al., 2021). A possible explanation for inconsistent findings is that studies tend to assess dietary intake using self-reported methods without accounting for well-documented under-reporting found with self-reported food intake (Livingstone & Black, 2003). Indeed, most studies that report no significant associations between meal timing and energy intake report differences in more

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objective and longer-term measures between early and late eaters, such as lower insulin sensitivity (Dashti et al., 2021), higher BMIs and less weight loss (e.g., Dashti et al., 2021; Garaulet et al., 2013; Ruiz-Lozano et al., 2016) in late versus early eaters. Furthermore, other research comparing late and early eaters has found that late eaters are more likely to eat when stressed, overeat at night, and eat while watching TV, compared with early eaters (Dashti et al., 2021). Levels of hunger, prospective food consumption and desire to eat are also higher in the evening compared to the morning, which could promote overconsumption in some individuals at the end of the day (Qian et al., 2019; Scheer et al., 2013).

Additionally, numerous studies have shown that late evening eating increases the risk of overweight and obesity (Gong et al., 2021; Madjd et al., 2021; Martínez-Lozano et al., 2020; McHill et al., 2017; Okada et al., 2019; Zaman et al., 2019). A prospective study found that individuals who consumed 20% or more of their daily caloric intake after 20:00 had almost double the risk of obesity at the study's onset and after 7 years (Maukonen et al., 2019). Baron et al. (2011) also found that calorie intake after 20:00 increased the risk of obesity. Late evening eating has also been linked with several eating behaviour traits linked with increased risk of overconsumption and increased BMIs such as disinhibition and emotional eating (Bryant et al., 2008; Dakanalis et al., 2023). Jacob et al. (2023) found late eating was significantly associated with traits, such as disinhibition and susceptibility to hunger in participants with overweight or obesity. Metabolic mechanisms may partly explain the relationship between later meal timing and increased BMI. Postprandial metabolic processes, such as the rate of gastric emptying and postprandial energy expenditure, are deregulated in the evening compared with in the morning (Morris et al., 2015). Moreover, late eating is associated with a lower thermic effect of food (Shaw et al., 2019), reduced fat mobilisation and oxidation (Gu et al., 2020). Therefore, while there are some inconsistencies in the food timing literature, eating late is identified as a risk factor for obesity in the long term.

Moreover, both cross-sectional and intervention studies suggest that eating late during the day is associated with less weight loss (Dashti et al., 2021; Garaulet et al., 2013; Jakubowicz et al., 2013; Lombardo et al., 2014; Raynor et al., 2018). A randomised clinical trial in women with overweight or obesity found that women who consumed their evening meals between 19:00 and 19:30 lost more weight and had a greater weight reduction than those who ate between 22:30 and 23:00 over a 12-week period (Madjd et al., 2021). Time-restricted eating, which is defined as limiting eating to a specific time window, thereby prolonging the fasting period, has also been related to weight reduction (Adafer et al., 2020; Huang et al., 2023; Moon et al., 2020). For instance, a randomised controlled trial in adults with overweight or obesity indicated that participants in a time-restricted eating group who were instructed to eat during an 8-h window showed greater weight loss and consumed earlier meals than non-time restricted eating group who followed typical eating habits (Simon et al., 2022). Traditional time-restricted eating often aligns with daylight hours, but late evening eating has the potential to extend the eating window to later in the day and reduce the fasting period.

Collectively, timing of food intake is emerging as a predictor of overall health and a potentially relevant risk factor for obesity. While research on the impact of meal timing on health is ongoing, there has been little focus on factors that influence late evening eating (de Cabo & Mattson, 2019). Previous evidence indicates that meal timing could be influenced by a variety of factors, ranging from individual characteristics and choices, cultural contexts, environmental to physiological determinants (Dashti et al., 2019; Leung et al., 2019; Vetter & Scheer, 2017). For instance, studies on chronotype, which refers to an individual's specific activity-rest preference over a 24-h period, show that individuals with later chronotypes eat later meals than early chronotype (Lucassen et al., 2013; Maukonen et al., 2017). Similarly, a systematic review of 43 studies found that late chronotype is associated with unhealthy eating habits, such as eating late at night and eating processed/ultra-processed foods (Teixeira et al., 2022). Furthermore, in a qualitative study using focus groups, pregnant black women (n = 18) reported individual and interpersonal contributors to late-night eating, including hunger, foetal movements, altered sleep patterns and the influence of social others (e.g. children and parents in the household who were eating; Kroeger et al., 2019). However, to date, there is no qualitative research investigating the factors that influence late evening eating and barriers and enablers to encourage earlier eating times in adults living with overweight and obesity who are not pregnant. Understanding the reasons for late evening eating could provide in-depth information that can be used to inform interventions to encourage individuals at risk of obesity to reduce late evening eating.

The Behaviour Change Wheel (BCW) is a systematic framework for the understanding and changing behaviours (Michie et al., 2011). At the core of this framework lies the COM-B model which represents three determinants to a given behaviour (B): Capability (C), Opportunity (O) and Motivation (M). Capability consists of physical (e.g., physical strength, skill or stamina) and psychological (e.g., knowledge or comprehension). Opportunity comprises physical (e.g., time, location) and social (e.g., cultural norms, interpersonal influences, social cues). Motivation consists of reflective (e. g., evaluations, self-conscious plans) and automatic processes (e. g., emotions, desires, impulses) (Michie et al., 2011). COM-B model has been found to be an important tool for understanding behaviour change and designing effective interventions. The COM-B model offers a useful tool to understand behaviours, such as late evening eating, and where needed, guide intervention development to change behaviours (e.g., shift to earlier eating patterns).

Therefore, the aims of this study were to: i) explore the factors that contribute to late eating and ii) draw on the COM-B model (Michie et al., 2011) to understand the barriers and enablers to changing to earlier food intake timings in adults with overweight and obesity who report eating late.

2. Methods

2.1. Design

This study used phenomenological approach and consisted of qualitative semi-structured interviews with participants living with overweight or obesity and reported last eating episodes after 8 p.m. Interviews were conducted between July and September 2023. The study was approved by the University of Sheffield's ethics committee (# 053823) and was pre-registered on the Open Science Framework (https://osf.io/my2k9/).

2.2. Participants and recruitment

Participants were identified by purposive sampling and recruited from the local area within Sheffield, UK via posters at community centres, through social media, and online classified adverts. Prior to the interviews, participants were asked to self-report the times they usually ate each meal and snacks, including breakfast, lunch and evening meal. Self-reported height and weight were collected to compute BMI (in kg/m^2). To be eligible, participants needed to be aged between 18 and 65 years, living with overweight or obesity (BMI$\geq$25 kg/m^2), have no current or history of eating disorders, not be pregnant or breastfeeding, and report consuming their last eating episodes after 8 p.m., as established by prior research (Baron et al., 2011; Jacob et al., 2023; Maukonen et al., 2019). Eligibility was assessed with an online screening questionnaire via Qualtrics (Provo, UT). Eligible participants could opt for in-person or online interviews. In-person interviews were conducted at the University of Sheffield. Participants were contacted by the researcher by email to book the appointment for in-person or online interviews, and a reminder email was sent 24 h before the interview. To achieve saturation (whereby no new themes emerged), Hennink and

Kaiser (2022) recommended conducting interviews with 9–17 participants. Therefore, the minimum sample size for this study was nine. Prior to the interviews, study information was provided, and consent was obtained. At the start of the interviews, participants were instructed that there were no right or wrong answers to encourage uninhibited responses. After conducting 17 interviews, saturation was established, and no new information or themes were identified in the data (Guest et al., 2006). Upon completion of the study, participants received a £20 Amazon voucher for online interviews and a £25 Amazon voucher for in-person interviews.

2.3. Data collection

2.3.1. Interviews

Interview questions were developed by the researcher (BY) and reviewed and confirmed by the research team (NJB and SJC). A practice session was used with a peer researcher to test and finalise interview questions. The semi-structured interviews were conducted by one researcher (BY) either in-person (at the University of Sheffield) or online via Google Meet. The first part of the interview questions explored reasons for late evening eating. The second part explored barriers and enablers to changing late evening eating habits. Participants were also asked about their willingness to change to earlier eating patterns and willingness to participate in a programme designed to encourage earlier eating patterns (see Supplementary Table 1 for interview questions). Interviews lasted between 30 and 60 min and were audio-recorded (Philips digital voice tracer LFH 620).

2.3.2. Survey

After the interview, participants completed an online questionnaire to provide demographic information, including employment type, education, ethnicity, household income (£), work schedule (e.g., shift work), health conditions and night eating syndrome (Allison et al., 2008) to characterise the sample. The 14-item Night Eating Questionnaire was used to characterise the sample given its relevance to night eating and timing of food intake (Cronbach's $\alpha = 0.70$). After survey completion, participants were debriefed.

2.4. Data analysis

The semi-structured interviews were transcribed verbatim with names and other identifiers removed. Participant numbers (P#), randomly generated from 100, were used to identify each participant.[1] Age and gender were not included in the quotes to prevent participant identification. Transcripts were coded using thematic analysis in NVivo (Version 14, QSR International, Melbourne, Australia). The researcher (BY) analysed the data following the six phases of thematic analysis recommended by Braun and Clarke (2006), including data familiarisation, generating the codes, searching for themes, reviewing themes, defining and naming themes, and producing the report. Phrases and sentences were inductively identified and assigned codes, demonstrating a data-driven approach to analysis (Thomas, 2006). Codes were then grouped into themes. The use of a single researcher has the advantage of assuring coherent analysis and consistent interpretation, with an emphasis on understanding the interpretation of participants' words rather than trying to achieve numerical or semantic agreement between multiple coders (Braun & Clarke, 2022; Morse et al., 2002; Nowell et al., 2017). The final themes were reviewed and discussed with another researcher (NJB). The themes that referred to barriers and enablers to changing late evening eating habits were deductively mapped to the COM-B constructs, which could be more targeted to identify and address specific barriers and enablers. Deductive mapping of themes was carried out by two researchers (BY, NJB), taking into account the relevance between theme, transcripts and definitions of each COM-B component. Although the themes were analysed in two sections, there was flexibility in transferring themes between these sections. Any disagreement between BY and NJB was resolved through regular discussion to ensure quality and rigour of the method. The audit trail was used to document the data collection process and the various stages of data analysis, stored in NVivo, to enhance the trustworthiness and credibility of the study (Patton, 2014; O'Brien et al., 2014). The study is reported in line with the Standards for Reporting Qualitative Research (SRQR) reporting guideline (O'Brien et al., 2014) for quality and transparency of the research (for researcher characteristics and reflexivity, see https://osf.io/my2k9/). Demographic data collected during the interviews was analysed using descriptive statistics in IBM Statistical Package for the Social Sciences (Version 27). Means ± standard deviations (95% confidence interval) are reported unless specified.

3. Results

3.1. Participant characteristics

The final sample (n = 17) consisted mostly of women (71%, n = 12) with a mean age of 32.5 ± 6.7 (29.1, 35.9) years and a mean BMI of 34.7 ± 7.1 (31.0, 38.3) kg/m^2. All other measures are shown in Table 1. Of note, most participants were White and Asian or Asian British, reported full-time regular day work and had at least a bachelor's degree. Three participants were screened as potentially having night eating syndrome by using the cut-off score of 25 (Allison et al., 2008).

3.2. Factors contributing to late evening eating

Four core themes on reasons for late evening eating were identified: internal signals influencing late evening eating; external and situational drivers of late evening eating; social influences, and behavioural and emotional influences on late evening eating. Themes, sub-themes and example quotes are presented in Table 2.

3.2.1. Theme 1: Internal signals influencing late evening eating

Most participants linked late evening eating habits to physiological triggers and bodily cues, such as feeling hungry in the evening. Some participants also referred to eating late in the evening due to hunger and increased gastric acid, which made them uncomfortable. For instance:

> *"Usually in the evening, I feel some kind of hunger because I'm a little bit early for dinner. I have dinner at 6 pm. I think it's quite a bit early, so that leads me to other meals in the evening because I feel hungry."* (P178)

> *"Okay, the main factor is actually that I have got something like stomach acid. Indigestion I think, indigestion in my stomach, so, that's the reason why I usually need to eat at night because if not I will be hungry and then my stomach acid is going to be higher."* (P111)

> *"So, I need to get full up to make my stomach not empty. We have the acid in the stomach, and I think because of it, my stomach has become hungry and there is some gas here so I'm feeling uncomfortable."* (P148)

3.2.2. Theme 2: External and situational drivers of late evening eating

3.2.2.1. Sub-theme: Evening time constraints. Many participants highlighted the significance of time in their late evening eating patterns. Meal preparation and the multiple steps involved, from preparing the ingredients to actually cooking was referred to as time-consuming by multiple participants. Moreover, they stated that post-work activities such as cleaning and organising meant it was late by the time, they started meal preparations.

[1] We used randomly generated ID numbers, rather than numbers 1–17 to support participant anonymity.

Table 1
Participant characteristics.

Variable (total n)	n (%) or M ± SD
Ethnicity (n = 17)	
White	7 (41%)
Asian or Asian British	7 (41%)
Black, African, Caribbean, or Black British	1 (6%)
Mixed or multiple ethnic groups	1 (6%)
Other	1 (6%)
Education (n = 17)	
No formal qualifications.	1 (6%)
2 or more A-levels or equivalent qualifications.	2 (12%)
Bachelor's degree or equivalent.	9 (53%)
Doctoral or higher education.	3 (18%)
Other qualifications including foreign qualifications	2 (12%)
Employment (n = 17)	
Full-time employment	11 (65%)
Student	3 (18%)
Unemployed	1 (6%)
Unable to work	2 (12%)
Work schedule (n = 17)	
Regular day work [a]	10 (59%)
Rotating shift work[b]	2 (12%)
Regular night work	1 (6%)
Not applicable, not currently working	4 (24%)
Annual income *(n = 17)*	
Below £10,000	2 (12%)
£10,001 - £20,000	4 (24%)
£20,001 - £30,000	3 (18%)
£30,001 - £40,000	2 (12%)
£40,001 - £50,000	3 (18%)
Above £60,000	3 (18%)
Health condition (n = 17, note some participants selected multiple answers)	
Chronic Fatigue Syndrome	1 (5%)
Insomnia	1 (5%)
Sleep apnoea	1 (5%)
Crohn's disease	1 (5%)
Gastroesophageal reflux disease	1 (5%)
Postural Orthostatic Tachycardia Syndrome	1 (5%)
Non-Epileptic Attack Disorder	1 (5%)
Asthma	2 (10%)
Depression	1 (5%)
High Blood pressure	1 (5%)
None apply	9 (45%)
Night Eating Questionnaire (NEQ) (n = 17)[c]	17.12 ± 6.57

Note.
There were no relationships between the researcher and participants who had a doctoral or higher education degree.
[a] Regular day work refers to work during the daytime, e.g., from 9 a.m. to 5 p.m.
[b] Rotating shift work refers to work alternate night and daytime (Fujino et al., 2006).
[c] Night Eating Questionnaire (NEQ) was used to assess night eating syndrome, using a cut-off score of ≥25 to screen for possible night eating syndrome (Allison et al., 2008).

> *"By the time I've finished work and then I've tidied up and got myself sorted, and then figured out what I'm going to cook, and then cook my tea by the time I've actually done all of that and then sat down, it tends to be quite late."* (P181)

3.2.2.2. Sub-theme: Work-related late evening eating patterns. Furthermore, work schedule was identified as a potential factor resulting in late evening eating habits. Participants described how their work affected the timing of their evening meals. Most participants reported that work-related commitments, such as arriving home late or continuing work tasks into the night, led to late evening meals.

> *"It's main work that impacts why I eat so late, I usually don't finish until seven o'clock."* (P170)

> *"I finish working at 6:00 or 7:00. And at night usually because I'm still awake until midnight sometimes doing my work or doing my part-time*

Table 2
Themes, sub-themes and example quotes of factors contributing to late evening eating.

Themes	Sub-themes	Example quotes
Internal signals influencing late evening eating	Physiological triggers for late evening eating	"*And because I'm hungry the food is so late I will eat something because your body needs something to be going.*" (P180)
		"*I'm hungry quite a lot in the evening to be honest. That's why I probably snack as well because I still feel hungry later.*" (P197)
External and situational drivers of late evening eating	Evening time constraints	"*Our meals take 1 to 2 h to cook, it's not like a fast cooking, you have to make things, you have to chop, cut and everything which is time consuming.*" (P180)
		"*Trying to cook from scratch, also, pushes me back, rather than eating convenience food.*" (P105)
	Work-related late evening eating patterns	"*Working. I work in a different city, so I don't get home until late. So, that pushes me back to eat late. It's mainly the working factor because I work quite late.*" (P105)
		"*Work mainly. Because I don't get in until later.*" (P180)
	Seasonal impact on evening eating	"*It depends on the time of the year, I tend to have dinner when the sun is set, so, I don't tend to have dinner with the sunlight. So, in winter it's usually around 7:00 or 6:00 earliest, but usually, you know, in the summer or spring it's usually after 8:00/9:00.*" (P165)
		"*Maybe because especially in the summer the sunset is very late, other than the winter or autumn or spring, so it makes my food behaviour change also.*" (P171)
	Travel contexts influencing evening eating flexibility	"*Or if I'm on holiday I might eat earlier.*" (P197)
		"*So, during travelling I usually skip eating the evening meal. But, at home I will take it even though it's late.*" (P148)
	Challenge resisting tempting food due to easy access	"*Yes, I definitely easily get tempted by food.*" (P120)
		"*There's a shop outside my daughter's school, so if I am hungry, I will nip into the shop before I pick her up and buy a snack. Just because the shops there. If there wasn't a shop there, I probably wouldn't.*" (P169)
		"*We eat 1 Kit Kat or something you know and if there's a, we always stock up things at home, so there is a little pantry of biscuits, cakes and all those things. And because they are there it's difficult for me to resist.*" (P180)
	Proximity-driven temptation management	"*It is easy to access. I mean I guess I'm trying to be a bit better recently. I'm calorie counting so I'm trying to avoid it, once I've had my meal. I can*

(*continued on next page*)

Table 2 (*continued*)

Themes	Sub-themes	Example quotes
		still have snacks if I've got calories left but it helps to try and not eat as much." (P197) "*But I don't always let myself eat it.*" (P105)
Social influences	Impact of the family on late evening eating	"*Yes, because we have to cook for everyone then this makes us have to cook, just not, like, me, I can decide to have anything and just have dinner because of family. I have to have proper food. It's one of the reasons I have to eat a bit late because of cooking proper food for everyone to be able to enjoy.*" (P174) "*I live with my brother as well who gets in late from work, so I don't really try and cook any earlier otherwise it's too early for him as well.*" (P197)
	Impact of flatmates on late evening eating	"*But, when I arrived in the UK and my flatmate ate during the night I was, like, 'Okay, I want to eat as well.' For example, when I take water in the kitchen and one of my flatmates cooks noodles or something, and then the smell starts to fill the kitchen, and it's, like, 'Okay, I think I can take one.' So, that influences me directly.*" (P166)
Behavioural and emotional influences on late evening eating	Habitual evening eating schedule	*"I'm, like, a night owl, so I'm very active in the night, so my brain is working better in the night. So, usually, I will do my hard thinking work during the night. So, that's why it takes more energy, it needs more energy, so that's why I eat in the evening."* (P166) "*And then my time eating is actually more influenced by what time I wake up at that day, and then, for example, if I wake up at 8:00 so I eat at 9:00, and then after 4 h I eat again, and then 12:00 and then 4:00pm and then 8:00pm, something like that. So, the influential things, I think, is my wake-up time.*" (P111)
	Emotion-driven late evening eating	"*Whenever, for example, I get very, very disappointed by my supervisor's comments, I will not eat lunch. And then evening is the only meal that I take to cope with those kinds of bad comments, and, okay, I eat and go back to sleep.*" (P166) "*Emotional, yes. Sometimes when I want to eat something sweet or something fresh, maybe juice or I'm in the mood of eating something sweet. So, usually sometimes I crave chocolate as well, chocolate or strawberry milk or something. Yes, sometimes my mood influences my decision in eating.*" (P111)
	Stress-induced late evening eating	"*Yes, usually, because I am feeling under pressure by the dissertation deadline, and because my dissertation is quite hard, so I get stressed. And I tend to eat a lot in the evening.*" (P148) *"Like, stress, even the slightest bit recently."* (P121)
	Boredom-induced late evening eating	"*At that moment usually, I feel bored. Usually, I'm not quite a bit hungry, but I feel bored, and I need to taste something in my mouth, and I like to chew something in my mouth, so I feel like looking for a snack.*" (P178)
	Tiredness-induced late evening eating	"*If I'm tired and I'm just feeling a bit, like, I can't be bothered to go and make very much, crisps is an easy option to just grab out of the cupboard.*" (P181)
	Variety of feelings after late evening eating	"*Well, actually, I'm quite feeling guilty about eating at night, but not necessarily guilty because I know that the calorie counting and what my body needs is usually the same. So, I maybe feel guilty.*" (P148) "*I feel satisfied, and then I feel okay. It makes me calm, and then I feel that I'm sleepy, and then I can go to sleep.*" (P166)

job, this is the reason also after using my brain for thinking and then I eat some snacks at midnight." (P111)

"My transport, because I live in Chester, but I work in the Wrexham Industrial Estate, so it takes 1 hour and 30 minutes by bus, and sometimes the bus is late. That's the reason why I've been eating late." (P124)

3.2.2.3. Sub-theme: Seasonal impact on evening eating. Participants reported that their evening eating was affected by seasonal changes, especially the variable times of sunset. Many people appeared to time their evening meals around the time of sunset, resulting in different eating schedules between winter and summer, with evening meals tending to be later in the summer than winter.

"Sometimes I forget to eat, like, the evening meal. Usually, I eat around 6 and 7, but because of the summer, I forget. And then, 'This is already 9,' so I eat, like, very late. And then during the winter, for example, 4 pm is already dark, I feel already hungry because of that." (P166)

3.2.2.4. Sub-theme: Travel contexts influencing evening eating flexibility. The majority of participants talked about how their evening eating schedule was more flexible when they were travelling or on holiday compared to their regular routine. Furthermore, it was observed that some individuals tend to eat earlier in the evening, as they planned to dine out with their family and booked tables for specific hours.

"We've just recently come back from holiday and we were having our evening meal while we were on holiday, like around 18:30 to 19:00." (P169)

"Yes, when I'm travelling that is, I'm not cooking for myself, then I tend to eat early definitely. There will be a set time depending on where I am or things like that. I know where I'm going, I've got the hotel booked, everything booked then I have a set time to go and eat. Then I will be eating early because I eat because it's dinner time. It's open, I will eat." (P174)

"I think when we are travelling when we are on holiday there are some places where you know the food. For example, if we were in Wales lots of

good places do start shutting off at 8, so we will book a table at half 6. So, when you are travelling you eat a bit early." (P180)

3.2.2.5. Sub-theme: Challenge resisting tempting food due to easy access. Additionally, the accessibility of tempting foods was also highlighted as a potential influence on evening eating habits. Numerous participants stated that temptation increased when tempting foods were easily accessible.

"It's easy to get all of the tempting food that I want, yes, because I store it in an easy place so I can get it easily and eat it directly without thinking." (P171)

"I probably feel tempted to eat the easy-access food from the cupboard and snack before I have my main meal." (P105)

"I will generally go and get something to eat if it's there, like, and snack on through the night." (P170)

3.2.2.6. Sub-theme : Proximity-driven temptation management. Nevertheless, not all participants reported yielding to the temptation to eat easily available foods. A small number of participants commented that they were not tempted by tempting foods. Several stated that they had the ability to manage such temptations and consumed only when there were remaining calories to reach their calorie goal within their dietary intake.

"I think I can manage it, yes, because I like to cook, so I tend to within the options to have more healthy options. I'm not a person who eats fast food. So, in that sense it's helpful, but sometimes, for me crisps or nuts that have salt or things like that, I know it's not healthy or are empty calories, those are the more problematic things, or sweets, ice-cream or something. But I think generally it's not that strong." (P165)

"It is easy to access. I mean I guess I'm trying to be a bit better recently. I'm calorie counting so I'm trying to avoid, like, once I've had my meal. I can still have snacks if I've got calories left but it helps to try and not eat as much. I wouldn't say I really go out to the shop or anything. I am close to shops, but I wouldn't go out too late unless I really needed something. But I do have a lot of snacks in my cupboard." (P197)

3.2.3. Theme 3: Social influences

The social context, particularly interactions with family and flatmates, emerged as a factor influencing evening eating patterns. A number of participants described scenarios where family routines led to eating meals late in the evening. A few adjusted their evening eating times to match their family's.

"I usually wait for my husband or he'll wait for me, and we usually eat late in the evening once we've done everything that needs to be done for the day and we kind of like eat his meal and then we'll settle down." (P169)

"*Probably quite heavily. I live with my partner and he also doesn't get in from work until later on. So, he probably doesn't get in until about 7 o'clock. So, that influences it quite heavily as well.*" (P105)

Furthermore, living with flatmates influenced some participants' evening meal choices. The smell of cooking food often stimulated interest in eating in the evening.

"It's only my friends who also cook at night because they are on schedule. And they usually share it with their flatmates, so usually they ask me to get the taste of it, and because they are sometimes cooking in the evening, and I smell the food and I become interested in that food, I try it recently." (P148)

3.2.4. Theme 4: Behavioural and emotional influences on late evening eating

3.2.4.1. Sub-theme: Habitual evening eating schedule. Many participants' late-night eating was deeply ingrained in their daily routines, leading to a persistent pattern of late evening consumption. Participants reported that their evening meal schedule corresponded to their daily habits and personal preferences.

"Usually, it takes around every day. It's like it becomes a habit, so I usually have that meal around 8pm and 9pm, and the very, very last meal or snack I have maybe around 9.30. That's the last meal." (P178)

"I think it's a habit thing and also, you know, when I come back from work around 6:00 I do some stuff in my home. I take care of certain things and then I cook, that takes time, and then when I finally have dinner it's later. It's usually two hours after I at least come home." (P165)

3.2.4.2. Sub-theme: Emotion-driven late evening eating. Additionally, participants also reported that emotional triggers influenced late evening eating. Several participants described that emotions like sadness, disappointment and anxiety can affect eating habits in the evening.

"I'm an emotional eater, so if I am sad about something, I would go and look for my comfort food and eat it." (P180)

"Or if I'm feeling a bit anxious or something like that, I might get something, like I might eat more." (P188)

3.2.4.3. Sub-theme: Stress-induced late evening eating. Some participants also reported that increased stress levels, whether due to work or personal challenges, led them to seek the comfort of food in the evening.

"So yes, if I have any stress, it would be later in the evening because I tend to work on my dissertation to reduce the stress, to finish some remaining job or remaining task. So because of the schedule, I need to push back my evening meal, dinner schedule." (P148)

"I think I eat more; I do eat more in the evening when like I'm stressed." (P188)

"With stresses, like, I recently had a very big stress in my life about 3 weeks ago, and I noticed I was eating more as a distraction." (P120)

3.2.4.4. Sub-theme: Boredom-induced late evening eating. Participants noted that when they were bored or not engaged in activities, they tended to look for food as a way to distract themselves.

"So, I think for me personally, in the evenings, because you're more relaxed, let's just say, you know, you're at home, you're comfortable, I think partly it's boredom if I'm open and honest. So I boredom eat, I think it's a bit of a comfort thing, for myself." (P120)

"I tend to be when I'm watching TV, so to be honest I think part of it is perhaps a little bit out of boredom. You know, I'm watching TV and I think it's not very good whatever I'm watching and I'm bored and I say, 'Yes, I'll get something to eat." (P181)

3.2.4.5. Sub-theme: Tiredness-induced late evening eating. Participants described the influence of fatigue on evening eating habits. Several participants reported that they were more likely to eat in the evening when they felt tired.

"But I just obviously, yes like tiredness I think is obviously quite a, it's not really an emotion, but like the fatigue side of it, I think emotionally fatigue is exhausting. So, I do think that comes into it quite a lot with how I'm eating." (P188)

3.2.4.6. Sub-theme: Variety of feelings after late evening eating. In addition, participants expressed different feelings after eating late in the evening. Some participants felt guilty, recognising the potential health implications of eating close to bedtime. Others, however, associated eating late at night with a feeling of satisfaction and contentment.

> *"I feel quite guilty because I know for a fact that eating late at night is not good, especially around when I'll sleep, but there's no other way I can do it."* (P124)

> *"Most of the time I feel good, especially when you have your favourite meal. Like, I really like to get a cup of noodles like instant noodles, anything like that, and when you have that in the evening it's very, very delicious and defining for me, so yes it's really nice to have that."* (P178)

> *"Because I need that food not only to make my stomach full but to make me more relaxed. And also, I need to get the taste of it in my mouth so it becomes relaxing."* (P148)

3.3. Barriers and enablers to changing to earlier evening eating

Six core themes on barriers and enablers to changing to earlier evening eating were identified, including understanding and perception of evening eating habits, physiological drivers, social influences, time and scheduling constraints, behavioural and emotional associations with late evening eating and willingness to change. These themes were then deductively mapped to six COM-B constructs (psychological capability, physical capability, social opportunity, physical opportunity, automatic motivation and reflective motivation), as detailed in Table 3.

3.3.1. Understanding and perception of evening eating habits (psychological capability)

Participants expressed different views on the definition of a late evening meal. Some considered any meal after 10 p.m. to be late, while others considered eating after 12 p.m. (midnight) to be late. This variability presents a challenge for generalised advice, but also an opportunity for tailored interventions that take into account participants' perceptions and usual meal timings.

> *"I think 12am in the night. So, whenever I can't sleep my stomach starts to crave something."* (P166)

> *"Probably, like, 9:30, 10 o'clock. That starts to get a bit late."* (P105)

> *"Maybe around 22:00."* (P124)

> *"12:00 am."* (P148)

> *"Maybe around 10 pm is quite late, so I never have snacks, I never have a meal after 10 pm."* (P178)

Understanding the reasons behind participants' perceptions of late evening eating times can be valuable. The majority of participants had clear reasons for defining certain times as 'late evening', such as concerns about weight gain, sleep disturbance and gastrointestinal health.

> *"Because I usually go to sleep at 1:00 am or 2:00 am, so I think that if I eat later than 12:00 am, it will impact the sleep because I still need time to process the food here in my stomach, and any of this effort can cause stomach aches."* (P148)

> *"Because I think since I'm going to be at 12:00, around 12:00, and like I said, I need to digest a bit before going to bed, if I eat too late then I have to clean the dishes and then, you know, I'll clean everything and rest a bit before going to bed, and I think that's too close."* (P165)

> *"I think because it's closest to my sleeping hour, like, I sleep around 1 am or 2 am. And then if I eat, like, at 12 am it's too short, and then it's very late, and then it's almost the end of the day. And if I counted how many times I've eaten, it could be the fourth time of my meal, so the second evening meal. So, that's very late I think."* (P166)

Table 3
COM-B analysis of the barriers and enablers of changing to earlier eating timings.

COM-B construct	Themes	Barriers and enablers of changing to earlier eating timings	Example quotes
Psychological capability	**Understanding and perception of evening eating habits**	Barrier: High variability with the perception of late evening eating time	"*After 8:30*" (P111) "*Well, I think after 10:00/10:*30 *that's too late.*" (P165) "*I'd say 9 o'clock.*" (P169)
		Barrier: Uncertainty about the benefit of eating earlier	"*I don't know if there would be any benefit. I don't know if there are. I do feel personally that if I eat that early, I might feel hungry later.*" (P165) "*I think I'm not really sure about that.*" (P166)
		Enabler: Information on the reasons for the perception of late evening eating time	"*I think it's a lot because I eat so late. Yes, it makes me tired, but I can't settle. And still, I can't settle, and it weighs heavy on my stomach and I tend not to sleep.*" (P121) "*Because it's near the time to go to bed. That means you will not digest before going to bed.*" (P174)
		Enabler: Raising awareness about the benefits of early evening eating	"*Maybe if somebody was telling me the benefits of it, maybe some more understanding about why it would be good to eat earlier, that might be helpful.*" (P105) "*If there are any disadvantages, maybe pointing that out might help people to be aware that that's not a healthy habit for example. But I think it would have to be, you know, if there's clear evidence that that's the case then I would.*" (P165)
Physical capability	**Physiological drivers**	Barrier: Bodily signals leading to late evening eating	"*And I'm not sure whether my stomach's reaction actually needs to be fulfilled or I need to bear it, because it feels like a spike on the stomach during late night that makes me uncomfortable, and then that's why I take some meal to make it better.*" (P166)

(*continued on next page*)

Table 3 (*continued*)

COM-B construct	Themes	Barriers and enablers of changing to earlier eating timings	Example quotes
			"And feeling hungry again later." (P197)
Social opportunity	**Social influences**	Barrier: Interpersonal influence	"*Yes, I guess if I was going to my mum's, it would be difficult for me to try and eat earlier. Because I always eat at eight, nine, ten o'clock, I'd have to make a really big effort and make my own food and have my own tea and eat it despite them not eating their tea at that time. So, I think that would be a bit of a barrier for me, to try and eat early in that environment.*" (P181)
			"*The challenge for me of course is my family. I have to take care of them quite longer because they don't feel exhausted, and they don't feel tired at all.*" (P171)
		Enabler: Impact of the family on evening eating times	*"And also, I think when you live with your parents, when you live with your family, when you live with your wife, it's good enough to have support from the family and people who live with you at home, to remind you and to take care of you. Because you cannot be absolute at the end, so you try to get some, like, support from home so you don't fall into that habit."* (P178)
			"*Yes, I think family is the main factor, because I need to take care of my kids and my wife at home. So I need to be more disciplined with time so I need to be up early.*" (P148)
		Enabler: Community support for early evening eating	"*Maybe some community where we can support each other, and we can share the benefits of eating earlier in the evening.*" (P148)
			"*Yes, probably a group would be quite good.*" (P170)

Table 3 (*continued*)

COM-B construct	Themes	Barriers and enablers of changing to earlier eating timings	Example quotes
Physical opportunity	**Time and scheduling constraints**	Barrier: Time constraints for food preparation	"*We cook everyday home food, we don't do shortcuts, we don't do frozen and put it in microwave, we will do everything from scratch.*" (P180)
			"It means I need to order on the first from the food delivery services and they need to come here, and then I just receive my food at 8:00 something and then I just eat it." (P111)
		Barrier: Work schedules do not support eating earlier	"*It's more the time I some cooking after work that would delay my dinner time.*" (P174)
			"*Because the office finishes at 5, but because you're working you don't have that much time to prepare meals in advance.*" (P180)
			"*So, I think it is, like, about finishing work at 5 or later.*" (P181)
Automatic motivation	**Behavioural and emotional associations with late evening eating**	Barrier: Existing habits inhibit eating earlier	"*And the second one is the habit.*" (P148)
			"*I'm used to eating late at night. On some days if I didn't put the habit for myself, then I will be still craving.*" (P166)
		Enabler: Promote eating early through the reward system	"*And also, maybe like a competition if you do participate, you have to be rewarded.*" (P148)
			"*There's like an incentive you want to try it out.*" (P180)
		Enabler: Provide evening eating time reminder	"*So, maybe, like, a reminder. For example, 'It's already 8pm, you cannot eat,' or a reminder, for example, the last time I can eat is 7pm. That would be much helpful.*" (P166)
			"*Just as a reminder*". (P171)
		Enabler: Have positive feelings with eating early	"*Yes, I do feel more content, of course. Yes, because I can achieve it so that I can predict that the next day I will decrease my weight.*" (P171)

(*continued on next page*)

Table 3 (*continued*)

COM-B construct	Themes	Barriers and enablers of changing to earlier eating timings	Example quotes
			"*Content, I feel content if I eat before 8:00.*" (P111)
Reflective motivation	**Willingness to change**	Barrier: Unwillingness to change late eating	"*Well, I want to but I can't.*" (P124)
			"*At the moment probably not just because I just don't know how I'd be able to get those meals in.*" (P188)
		Barrier: Unwillingness to take part in the programme	"*I'd have to eat on the bus. It's quite hard because I would love to move to closer accommodation but there are a lot of circumstances that are happening. I can only eat earlier during the weekends but during the weekdays I have to eat my dinner late.*" (P124)
			"*No*" (P165)
		Enabler: Willingness to change	"*Yes, I'm going to try and do that.*" (P170)
			"*Yes, of course, because I gain more positive impact when I stop eating in the evening. Yes, I will change.*" (P171)
		Enabler: Willingness to take part in the programme	"*Yes, of course, I do.*" (P171)
			"*Yes, why not.*" (P174)
		Enabler: Beliefs about the health consequences	"*I would like to say it's because I want to reduce my intake, so I want to a little bit reduce my weight because I'm feeling so much overweight.*" (P178)
			"*Trying to lose some weight, getting some weight off and feeling better about myself.*" (P170)
			"*I think that it would probably improve my gut health as well. I think eating earlier in the evening would be better, allowing myself to digest the food before settling back down to bed.*" (P188)
		Enabler: Pre-planning for early evening eating	"*Quick meals, like quick meal ideas.*" (P197)
			"*Maybe preparing earlier on, meal prep. Stuff like that would probably make it easier so I'm not having to think about, like, cooking things, something from scratch. Yes, anything like that.*" (P105)
		Enabler: Alternative strategies to changing late evening eating	*"I think going out can prevent it. Like, having a chat with my friends. I'm engaged with those kinds of activities, then I will not eat."* (P166)
			"Sometimes. Some after school activities that my daughter does, that are like, not really linked to school, that she does in an evening. If she's got something like that on, we might have to eat a little bit earlier." (P169)

Another barrier was uncertainty about the benefits of eating earlier. While many were aware of general suggestions that eating earlier might be beneficial, there was limited understanding about the specific health benefits of eating earlier in the evening.

> *"I don't know the benefits because it's not something that I do, I don't really know about the health side of things, I don't really know the health benefits. I'm sure there'll be some sort of health benefit I'm just not fully aware of."* (P181)

> *"I don't know if I'd notice much of a difference really. I don't know if it would make me feel slightly better going to sleep, but I suppose I haven't really tried it enough times to be able to know."* (P105)

> *"To be honest, I'm not really sure. I know some people say that it has, like, loads of health benefits about helping you lose weight, with your metabolism and everything like that. But when I was eating before 8 pm, I never really saw a change myself, and I was doing that for 5 years. So, I know there are plenty of benefits to it and some things will work for some people and some things will work for others. But I just seem to have not found something that works yet."* (P121)

Participants expressed a willingness to learn more information about eating earlier in the evening and said how such information could motivate eating earlier in the evening.

> *"You see benefits in that, maybe I don't know if this research would, you could share more health benefits of eating a bit earlier which would motivate me."* (P180)

> *"I think knowing the health. For example, yesterday I took a test for research on future health, and then knowing the results that my cholesterol is a little bit high, then I started to avoid eating late at night. I think understanding the bad effect of my habit makes me realise that 'Okay, I need to stop eating like that."* (P166)

3.3.2. Physiological drivers (physical capability)

Some participants suggested that body cues, such as hunger or

stomach discomfort, could be barriers to changing late evening eating.

"And I'm not sure whether my stomach's reaction actually needs to be fulfilled or I need to bear it, because it feels like a spike on the stomach late at night that makes me uncomfortable, and then that's why I take some meal to make it better." (P166)

"Usually in the evening I feel some kind of hunger because I'm a little bit early on the dinner. I have dinner at 6 pm. I think it's quite a bit early, so that leads me to other meals in the evening because I feel hungry because it's quite a bit of a long time between the last meal until I go to bed and at that moment usually, I feel bored." (P178)

3.3.3. Social influences (social opportunity)

Most participants reported that the social environment was a significant barrier to evening meals. Many noted that arranging family schedules and preparing meals for family members often resulted in later evening meal times. For these participants, family routines often overrode their preference to eat earlier in the evening.

"To me, it's my family, I'll be honest it's my family because they are not ready to change the schedule and as a family, I'm bound. I'm not saying, I can eat alone before them, but we cook together, so if I eat alone before let's say 6, 6.30, there's no food because the food gets cooked after 7. And we eat after 8, 9." (P180)

"Because I work from home for a couple of days a week, if my partner wasn't coming in, then I'd maybe be able to eat earlier and stuff like that." (P105)

"I cook for my brother. I could cook earlier probably but I'd have to make sure it goes in the fridge and make sure it's things that can be reheated." (P197)

Conversely, some participants were encouraged to adopt similar routines through the influence of family members who had early evening meals. It was emphasised that early evening meals with the family could create a supportive environment for changing early evening eating habits.

"I think if I was around someone or lived with someone, like my granddad for example, who had that set routine, it's easier for me to adopt that routine myself because that's what's happening. So, I think being around someone who does eat earlier would influence when I eat because I don't want him waiting until nine o'clock to eat when he's used to eating at half five, or six o'clock. So, I would make that effort to eat at that time then, and then probably adopt that habit myself. So, I think if I was around someone who had that habit already, it will be easier for me to do that myself." (P181)

"Yes, I think family is the main factor because I need to take care of my kids and my wife at home. So, I need to be more disciplined with time, so I need to be up early." (P148)

In addition to family influences, community support was recognised as an enabler for early evening eating. Participants suggested that they would be encouraged if they received community support, which could be useful for long-term maintenance.

"Maybe I need a support group so I can never feel alone in order to maintain my motivation." (P171)

"Maybe some community where we can support each other, and we can share the benefits of eating earlier in the evening." (P148)

3.3.4. Time and scheduling constraints (physical opportunity)

Most participants encountered challenges because of time constraints and work schedules. Many participants highlighted the challenge of finding enough time to prepare meals earlier in the evening. In addition, for those who prioritise cooking from scratch, the process can be time-consuming, especially if the ingredients require preparation and cooking.

"I'm not quite sure. I think, if I wanted to eat earlier, I think it would have to be more like convenience food and stuff like that, and I try to avoid that kind of thing because, even though we do eat late, I do try to eat stuff that's less highly processed and whatnot." (P105)

"It means I need to order on the first from the food delivery services and they need to come here, and then I just receive my food at 8:00 something and then I just eat it." (P111)

Another barrier was the mismatch between work schedules and the goal of eating earlier. Some participants reported that by the time they returned home and started cooking, it was already late. It would be even worse if factors such as commuting times or unexpected work demands were taken into account. Therefore, even with the intention of eating earlier, the constraints of their work prevented participants from making this change.

"If I've finished work at a set time every day and then I was able to know that I would be able to eat between 18:00 and 18:30, that would be easy, but I can sometimes be at work till 18:30 or 19:00." (P169)

"The main barrier is transportation time. If I can get home earlier, it means I can have dinner earlier. The bus takes 1 hour and a half and eating on the bus is not nice. I mean I can eat on the bus, but I don't want to." (P124)

3.3.5. Behavioural and emotional associations with late evening eating (automatic motivation)

Participants also reported that existing habits and daily routines prevented them from eating early in the evening, some of which included their previous lifestyles with irregular routines and a preference for eating after sunset.

"But personally, I like to have an evening snack really, so compared to the advantage of the benefit, I would like to say I would prefer to have an evening snack." (P178)

"I think because I used to be an architect and I didn't sleep very well at night, and the eating schedule is also irregular, that makes my habit of eating late at night become something very regular nowadays. I think because of the bad, kind of, schedule of my life in the previous days, that became something really, really bad. So, it becomes habit nowadays." (P166)

"I am also not used to eating with sunlight as dinner. I think it's, for me, dinner is, kind of, a closing thing of the day, not a thing in the middle." (P165)

However, some participants suggested that a reward system could act as a motivator to encourage them to eat earlier in the evening.

"And also, maybe like a competition if you do participate, you have to be rewarded." (P148)

"There's like an incentive you want to try it out." (P180)

Another practical solution suggested by some participants was having regular reminders. Participants described how a constant reminder could prompt them not to eat late in the evening, which could help them avoid eating late in the evening.

"Maybe a constant reminder of not eating snacks that late. Because sometimes when people eat dinner earlier around 18:00-18:30, around 20:00-21:00 they have a feeling of wanting to munch on something. So maybe the programme could help to remind someone not to have snacks that late." (P124)

"Maybe it's good to have some reminders on your phone to remind you." (P178)

Feelings about eating earlier in the evening were also related to attitudes towards eating earlier in the evening. Some participants expressed positive feelings about eating earlier in the evening, such as contentment, satisfaction and a sense of accomplishment, which may make them more likely to eat earlier in the evening.

"I think first of all I'd feel more content and less guilty or not guilty at all because I know that that's the proper dinner time, not 20:00 or later." (P124)

"I would like to think that I would feel a lot more content than how I do very late on." (P121)

"I think it's the small sense of achievement because I can stick to my daily routine and doing it consistently would make me feel that job is done." (P148)

"I think what I'll feel if I achieve that is, I'll feel satisfied because I can control myself." (P166)

3.3.6. Willingness to change (reflective motivation)

Participants expressed mixed feelings regarding their intentions to change to eating earlier in the evening. Overall, most participants (n = 9) were willing to change their late-night eating, but some (n = 5) reported unwillingness to change to earlier eating in the evening, due to habits and preferences. Three participants described that they could eat earlier in the evening on some days instead of every day.

"I think I need to stop because it is not good for my health. But at this moment, I just enjoy it." (P148)

"So, compared to the advantage or the benefit, I would like to say I would prefer to have an evening snack." (P178)

When asked about willingness to participate in a programme that might encourage people to eat earlier. The majority of participants were willing to participate (n = 13). Some of the participants (n = 4) indicated that they would not like to participate in this programme, because of preference and work-life balance.

"I don't care, and I'm not interested. Really, I'm not interested in that kind of programme because I feel I'm in control. When I want to eat after 8 pm I eat then, and when I don't want to eat after 8 pm I don't want to eat, so I feel I still can control my desire to eat. So, I'm not interested in that kind of programme, really." (P178)

"I would love to, but I would be a very bad person for it because the work life." (P120)

However, there was wide variation in beliefs about the health consequences of eating earlier in the evening, including weight loss, mental health benefits, improved sleep quality and improved gut health.

"I think maybe having a longer fasting period is probably better as well for mental health and stuff like that." (P105)

"So, I'm hoping it would make me feel a lot more content and settled in, and I would find it easier to sleep." (P121)

"So, if I eat late at like 20:00 or 22:00, I will not reduce my weight even though I weigh out my rice and stuff like that." (P124)

Many participants found that investing time in planning their meals in advance, or preparing some ingredients earlier in the day, optimised the evening cooking process and made it more feasible to eat earlier.

"I think if the program can help to organise the weekly proper time, you know, how you organise yourself getting food ready when you go back to work." (P174)

"I think a big help would be having an idea of what food I'm cooking, having it almost portioned out in a way, prepared. And having in my mind what I'm going to cook with this food, and how I'm going to cook it. So, like, a recipe or an idea of what I'm doing. I think that would be a big help." (P181)

"The main factors would be like doing some preparation work in advance. So just warming up, but then you eat food and then you cook for the next day." (P180)

Participants reported some strategies that may be effective to change late evening eating habits. Activities such as going to the gym or meeting up with friends were reported as activities that minimise the usual late-night eating habits.

"Sometimes, maybe going to the gym, or anything like that, or if I'm meeting up with a friend or anything like that, I probably won't eat until later on." (P105)

"On Tuesday's I have karate, so I have to eat before then. In fact, Tuesdays I probably do eat earlier actually because of that. I probably eat about half five which is early for me." (P197)

However, some participants indicated that there was a lack of alternative strategies to prevent them from eating late at night. For these participants, eating late at night is a source of stimulation or has become a habit. Eating could provide energy to support their late-night activities.

"Not in particular. There' s nothing that's stopping me from eating late at night. As I said, it's stimulation for me whilst I am working that I'm, you know, I'm eating late at night." (P120)

"Not really here there's something that can stop me from eating because, yes, everywhere I am, for example, at the office or at other places, my family's places, I usually keep some snacks around me. So, yes, I still keep eating whatever I think it is I'm doing." (P111)

4. Discussion

This study identified the physiological (e.g., feeling hungry in the evening), environmental (e.g., food rich environment) and emotional (e.g., negative feelings in the evening) factors contributing to late evening eating in adults living with overweight and obesity. Although barriers to changing late evening eating were highlighted, participants also reported that having high motivation (e.g., contentment with eating earlier in the evening) and interpersonal support could facilitate earlier eating times. A second member checked the process to minimise concerns over single coder approaches.

4.1. Factors contributing to late evening eating

Feelings of hunger were identified as a main contributor to late evening eating and was also discussed as a barrier to changing to earlier eating patterns. This aligns with previous quantitative work showing higher levels of hunger in the evening in both healthy adults and adults with overweight or obesity (Carnell et al., 2018; McHill et al., 2018; Sargent et al., 2016; Scheer et al., 2013; Wehrens et al., 2017). Furthermore, hunger is one of the main barriers to engaging in weight loss programs in the long-term (O'Connor et al., 2021; Stubbs, 2012). Alongside physiological hunger, the scores of liking and wanting for high-fat foods are higher later in the day (Beaulieu et al., 2020). The finding that hunger plays an important role in late evening eating aligns with a previous qualitative study (Kroeger et al., 2019) in pregnant women and extends this finding to a non-pregnant sample of adults with overweight and obesity. As such, it will be beneficial for future research to explore strategies to reduce heightened hunger in the evening, such as encouraging intake of foods low in energy density (Buckland et al., 2018; Rolls, 2017), high in protein (de Carvalho et al., 2020) and high in fibre (St-Pierre et al., 2009).

In addition to physiological triggers, this study highlighted that a food-rich environment, characterised by easy access to a variety of

palatable foods, contributes to late evening eating. High availability of palatable foods is a main driver of increased energy intake (Cohen & Babey, 2012; Hill et al., 2003; Privitera & Zuraikat, 2014). Food cues, such as the thought, sight and smell of foods, induce physiological responses, such as increased salivation and heart rate (Nederkoorn et al., 2000; Nederkoorn & Jansen, 2002; Pelchat et al., 2004). Some individuals are particularly susceptible to food cues (Martin et al., 2010) and experience cravings and increased energy intake in response to food cues (Jansen, 1998; Cornell et al., 1989; van den Akker et al., 2013). The participants in the current study also reported that easy access to palatable foods was related to snack consumption in the evening. Observational data suggest that evening snacking is associated with consumption of energy-dense foods high in fat and sugar, which could increase the risk of higher energy intake and have adverse metabolic effects, especially when consumed in misalignment with circadian rhythms in metabolism (Barrington & Beresford, 2019; Chaix et al., 2019; Si Hassen et al., 2018). However, in the current study, not all participants reported challenges resisting a food-rich environment. While it is common to report the experience of cravings, not all cravings lead to food intake (Hill, 2007; Smithson & Hill, 2017). As such, the current findings highlight that a food-rich environment contributes to late evening eating, but there is individual variability with some participants being able to manage such hedonic temptations. This finding has important implications and suggests that future interventions to promote earlier eating patterns could target increasing the craving control in people susceptible to consuming foods in the evening (Dalton et al., 2017). More broadly, consideration should also be given to how to promote an environment that supports healthy eating and physical activity, such as by increasing exposure to cues associated with healthy dietary intake (Buckland et al., 2018; Carter et al., 2018).

Psychological factors, such as anxiety, sadness and stress were also identified as a contributor to late evening eating. This aligns with previous work indicating that late eaters were more likely to eat when stressed (Dashti et al., 2021). In addition, emotional overeating is linked with increased snack consumption in the evening (Leblanc et al., 2012). Indeed, previous research has demonstrated that individuals with evening chronotypes are more likely to experience negative psychological symptoms including anxiety, emotional overeating and stress related eating (Konttinen et al., 2014; Mazri et al., 2019; Vera et al., 2018). One possible explanation is that there are less self-regulating resources to manage negative affect later in the day (Millar, 2017). The current findings are also consistent with the Escape Theory by Heatherton and Baumeister (1991), which posits that food is used as an emotional defence from negative affective states, including anxiety, depression.

4.2. Barriers and enablers of changing to early evening eating

In the present study, while there was uncertainty about the precise benefits of early evening eating, participants were aware of general recommendations about eating earlier in the evening. Participants also referred to health benefits being a main enabler to changing to earlier eating times. Epidemiological evidence has shown eating late during the day is associated with higher risk of obesity (Gong et al., 2021; Madjd et al., 2021; Martínez-Lozano et al., 2020; McHill et al., 2017; Okada et al., 2019; Zaman et al., 2019) and reduced weight loss (Dashti et al., 2021; Garaulet et al., 2013; Jakubowicz et al., 2013; Lombardo et al., 2014; Raynor et al., 2018). It has also been recommended by NHS England to avoid eating a large meal just before going to bed to help digestion (NHS, 2022). Communicating such health benefits in an engaging and relatable way may be persuasive to influence earlier eating patterns. Indeed, 'inform about health consequences' (BCIO:007063; https://bciosearch.org/BCIO_007063) is a Behaviour Change Technique within the Behaviour Change Technique Ontology (BCTO). The Behaviour Change Technique Ontology (BCTO) consists of 281 BCTs organised into 20 higher-level groups over five hierarchical levels, designed to provide a standard terminology and comprehensive classification system for the content of behaviour change interventions (Marques et al., 2023).

The influence of social others (social opportunity) was identified as a key barrier to changing late evening eating patterns. This is consistent with previous research by Kroeger et al. (2019), in which most pregnant women described late evening eating due to others in the household. The findings of current study also align with Social-ecological Model (SEM), which suggests an individual's behaviour is influenced by multifaceted levels, including intrapersonal characteristics, interpersonal processes, institutional factors, community features and public policy. At the interpersonal level, the SEM highlights the role of social relationships and networks in shaping behaviours (Salihu et al., 2015). In the present study, social engagements or family routines could inhibit changing to earlier eating patterns. Conversely, social influence was also reported as a potential enabler for promoting earlier eating patterns. This is also in line with Larson et al. (2013), where the frequency of communal meals correlated with better dietary patterns among adults, highlighting the role of social dynamics in meal timing (Dashti et al., 2019). Furthermore, previous research has demonstrated that social support, particularly from family members, is a valuable approach to enhancing the sustainability of health interventions (Murray et al., 2013). Therefore, it is recommended that future studies consider the role of interactions within the family or co-habitants and develop tailored strategies to account for social influences.

Time constraint (physical opportunity) was also repeatedly highlighted as a barrier to changing to earlier eating patterns. Previous qualitative studies have indicated that time constraint is identified as a common barrier to meal preparation (Jabs & Devine, 2006; Jabs et al., 2007; Mancino et al., 2007). Meal planning has been suggested as a solution to balance time demands and meal preparation (Virudachalam et al., 2016). Indeed, previous studies have demonstrated that meal planning is associated with increased food variety, better dietary quality and reduced risk of obesity (Aubé & Marquis, 2011; Ducrot et al., 2017; Virudachalam et al., 2016). For example, an observational study of 1136 Australian women showed that women who planned meals consumed more fruit and vegetables than women who decided what to eat for dinner on the same evening (Crawford et al., 2007). As such, it will be beneficial for future research to explore strategies to address time constraints and support meal planning and preparation (e.g. planning ahead the foods that will be consumed for the next few days; Ducrot et al., 2017). Participants in this study suggested that there should be practical strategies to offset time scarcity, such as pre-prepared meals in the freezer, use of a slow cooker or air fryer, and batch cooking. This aligns with previous research that has indicated air frying shows a higher nutritional quality than conventional technology to support healthy eating patterns and provide environmental advantages (Liu et al., 2023; Zaghi et al., 2019). These recommendations also suggest practical tips about how to facilitate earlier eating patterns (e.g., information about preparing meals in advance, providing meal recipes and meal planning).

4.3. Strengths and limitations

The present study has several strengths. Firstly, participants comprised of a community-based sample with overweight and obesity living in Sheffield, Yorkshire. Yorkshire and Humber have some of the UK's highest levels of overweight or obesity (NHS Digital, 2019). Therefore, this study represents a community-based sample living in a regional area with high rates of overweight and obesity. Secondly, this study is the first to use a theoretical model (COM-B model) to explore the barriers and enablers associated with changing to earlier eating patterns among UK adults living with overweight and obesity. Use of theory is important as interventions which specifically target theory-informed barriers are more likely to change behaviour than less defined or targeted interventions (Michie et al., 2008). Thirdly, study is also one of few studies that have used qualitative methods that enable participants to describe their experiences in detail, providing rich insights into this

topic. This study used semi-structured interviews to extend a previous qualitative study using focus groups in pregnant women to adults living with overweight or obesity (Kroeger et al., 2019). However, despite its strengths, this study has limitations that need to be considered. Firstly, most of the sample were well-educated, White or Asian/Asian British, and reported relatively high household incomes (36% $\geq$ £40,000). As such, the findings may not generalise to other individuals from other ethnicities and lower socioeconomic backgrounds. This is particularly important given the social gradient in obesity with highest obesity rates amongst those from the most deprived areas (Brehm & D'Alessio, 2000). Culture has been found to be a contributor influencing the time of food intake (Dashti et al., 2019), therefore, future studies need to explore the cultural factors influencing late evening eating by focusing on communities in different cultural contexts, those often underserved by research and by comparing participants from different countries. Secondly, the sample was self-selecting, which could result in the recruitment of participants who are particularly interested in meal timing and potentially more willing to change late evening eating. Thirdly, this study only assessed self-reported meal timings. Therefore, it is not possible to explore meal composition and dietary quality. Future studies could incorporate meal timing and dietary intake to provide a comprehensive understanding of the evening eating patterns in people living with overweight and obesity. Finally, chronotype was not assessed in this study. It has been shown that later chronotypes consume twice as many calories after 8 p.m. and have lower levels of physical activity than early chronotypes (Lucassen et al., 2013; Sempere-Rubio et al., 2022). Future research could incorporate chronotype assessments to provide a more comprehensive analysis of the factors, including behavioural lifestyle factors that influence late evening eating.

4.4. Conclusion

In conclusion, the current research used semi-structured interviews to identify main factors that influence late evening eating in people living with obesity. The study also identified barriers and enablers to changing to earlier evening consumption by integrating the COM-B model. Late evening eating emerged as a complex behaviour modulated by both intrinsic and extrinsic determinants. While participants noted some barriers to changing to earlier eating patterns, practical strategies are provided to address such barriers, such as increasing the awareness of the health benefits of early evening eating and addressing time constraints around meal planning and preparation. The next step will be to apply these findings to inform interventions to encourage earlier eating times in people at risk of overconsumption and obesity.

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Ethics statement

This study was approved by the University of Sheffield's Ethics Committee # 053823.

CRediT authorship contribution statement

Bixuan Yan: Conceptualization, Data curation, Formal analysis, Methodology, Writing – original draft, Writing – review & editing. **Samantha J. Caton:** Conceptualization, Formal analysis, Methodology, Writing – review & editing, Supervision. **Nicola J. Buckland:** Conceptualization, Formal analysis, Methodology, Writing – review & editing, Supervision.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data analysed are available and accessible from the Open Science Framework (https://osf.io/my2k9/).

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.appet.2024.107646.

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