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Identification of factors influencing motivation to undertake time-restricted feeding in humans

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ABSTRACT

The interaction between time of day and energy intake, termed chrono-nutrition, has received considerable recent interest. One aspect of chrono-nutrition with potential to benefit long-term cardio-metabolic health is time-restricted feeding (TRF). Current support for TRF primarily derives from animal research, although recent small-scale human studies indicate possible translational benefit. Whether free-living humans, however, can incorporate TRF into their daily lives is poorly understood. This study reports data from participants (n = 608) who completed an online questionnaire to investigate daily routine, likelihood of TRF incorporation within work vs free-days, and key considerations influencing TRF uptake. The majority of participants reported a typical daily feeding window (time between first and last energy intake) of between 10 and 14 h on workdays and free days, 62.7 and 65.5% respectively. Likelihood of adherence to TRF declined with an increase in the proposed restriction of the feeding window by 0.5 to 4-h per day. We then examined data from participants with a typical daily feeding window of 12+ h on workdays (n = 221) and free-days (n = 223) to investigate the likelihood of using TRF, and the most important considerations in making this decision. Of these participants, (n = 132) on workdays and (n = 125) on free days would likely reduce their feeding window by 3-h. Multiple regression analysis revealed that key considerations determining the likelihood of adopting TRF were: cost, time availability, and perceived health benefits (on workdays); wake time, bed time, time availability, motivation to change and perceived health benefits (on free-days). These data provide novel information regarding public attitudes towards TRF and highlight important aspects to be considered when translating controlled laboratory studies to public dietary advice.

1. Introduction

An internal circadian timing system regulates metabolism in most living organisms, including humans (Johnston, Ordovas, Scheer, & Turek, 2016; Reinke & Asher, 2019; Stenvers, Scheer, Schrauwen, la Fleur, & Kalsbeek, 2019). As a result of metabolic rhythms, humans exhibit marked changes in nutritional physiology and postprandial responses to meals across the day (Johnston, 2014; Leung, Huggins, Ware, & Bonham, 2019; Morgan, Hampton, Gibbs, & Arendt, 2003). The interaction between biological time and food intake is termed chrono-nutrition.

Analysis into the daily eating patterns of US and Indian cohorts reveals that more than 50% of the respondents distributed their energy intake over a feeding window of 15-h or longer (Gill & Panda, 2015; Gupta, Kumar, & Panda, 2017). Recent interest in chrono-nutrition has prompted studies investigating the physiological effects of temporal food intake. One such temporal programme is time-restricted feeding (TRF). The premise of TRF is to restrict the time between first and last energy intake each day, and therefore prolong the daily fasting period (Longo & Panda, 2016; Melkani & Panda, 2017; Rothschild, Hoddy, Jambazian, & Varady, 2014). Animal studies have suggested that TRF reduces weight gain in response to a high-fat diet (Hatori et al., 2012; Sherman et al., 2012). Other reported benefits of TRF on rodent metabolic physiology include lowered fat mass, lowered serum cholesterol, improved glucose tolerance (Chaix, Zarrinpar, Miu, & Panda, 2014) and prevention of the metabolic consequences of genetic disruption to the circadian clock (Chaix, Lin, Le, Chang, & Panda, 2019).

There is a growing number of trials investigating the effects of TRF in humans. Some research delayed the onset of energy intake by 5-h to initiate a daily 7-h feeding window from 13:00–20:00 h in resistance-

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trained male athletes (Moro et al., 2016). Other studies have brought the evening meal forward by 6-h in a so-called 'early TRF' (eTRF) protocol (Jamshed et al., 2019; Ravussin, Beyl, Poggiogalle, Hsia, & Peterson, 2019; Sutton et al., 2018). Alternative approaches include symmetrical compression of daily feeding by approximately 3-h in order to minimise bias towards morning vs evening energy intake (Antoni, Robertson, Robertson, & Johnston, 2018) and restriction of nocturnal eating (LeCheminant, Christenson, Bailey, & Tucker, 2013). Studies employing controlled timing and quantity of energy intake report reduced adiposity and other markers of cardiometabolic health (Jamshed et al., 2019; Sutton et al., 2018; Wilkinson et al., 2019). In studies that do not control quantity of energy consumption, it appears that TRF leads to a reduced daily energy intake (Antoni et al., 2018; LeCheminant et al., 2013). Studies enabling *ad libitum* feeding within a self-selected 8-h window resulted in weight loss, reduced visceral fat, and lean mass (Chow et al., 2020; Gabel et al., 2018).

Although further research in larger studies is required to demonstrate the efficacy and mechanism of TRF, initial evidence suggests that it may lead to important health benefits in humans (Lynch, Johnston, & Robertson, 2021). TRF is thus a behavioural intervention that has potential for the treatment of human obesity or to provide body weight-independent health benefits. For TRF to be effective, however, it is essential that individuals can adopt its principles into their daily routines. Furthermore, considering the variation in TRF interventions that have been undertaken in humans, it is important to ascertain what level of temporal restriction is compatible with daily functioning, both during workdays and free days.

The objectives of this questionnaire study were therefore to: 1) evaluate the motivation of free-living participants to undertake a TRF regime on workdays and free days; 2) explore the minimum and maximum duration of energy restriction that individuals would commit to with TRF; 3) assess whether this likelihood is predicted by their demographics, habits, feeding window and other relevant considerations. Such information will greatly help the design of future physiological studies that include interventions suitable for use in free-living populations.

2. Methods

2.1. Ethics

A self-assessment for governance and ethics application and discussions with a member of the University of Surrey's Research Integrity & Governance Office concluded that this study was deemed not to require a favourable ethical opinion by the University of Surrey Research Ethics Committee.

2.2. Participants

A total of 608 participants recruited via email to University of Surrey staff and students, and social media platforms completed the online questionnaire. Participants consisted of 447 females and 160 males (plus 1 of unspecified sex).

2.3. Design

This study used a cross-sectional quantitative design to explore the likelihood of free-living participants adhering to a TRF protocol of various durations on workdays and free-days, and the predictors of their intended behaviour.

2.4. Measures

2.4.1. Demographics

Participants used a link to transfer to an online questionnaire (supplementary methods), developed using Qualtrics software, and were required to provide consent before continuing. Only after consent was given were participants able to complete the questionnaire. Participants recorded their sex, age, ethnicity and living arrangements. Age categories in years were: 18–24, 25–34, 35–44, 45–54 and 55+. Ethnic groups were described as: White, Asian/Asian British, Black/African/Caribbean/Black British, Mixed/Multiple ethnic group, or Other ethnic group. Living arrangements were defined as: living with partner only, living with a partner and children, living on their own, living with family, living with friends or in shared accommodation, or living with children under-18 years old.

2.4.2. Habits

Participants described the following: i) Regular work schedule and whether they had taken part in shift work in the past three months (yes/no); ii) Method of transport to and from work (car or public transport/walking or cycling/work from home); iii) Time spent commuting (0–15 min/16–30 min/31–45 min/46–60 min/60+ minutes); iv) Sleep habits on workdays and free-days (time of getting into bed/asleep by time/time of wakefulness - recorded on a 24-h dropdown menu in timeframes of 1-h); v) Time it takes to fall asleep and to get out of bed (0–30 m/31 - 60 m/60 m+); vi) Dietary habits on workdays and free-days (inclusive of all foods and drinks containing calories (kcal) - first energy: 06:00–08:00/ 08:00–10:00/ 10:00–12:00/ after 12:00 and last energy: 18:00–20:00/ 20:00–22:00/ 22:00–00:00/ after 00:00).

2.4.3. Feeding window

Feeding window (daily timeframe in which all calories from food and drink are consumed) was measured on a five-point Likert scale: under 8-h/ 8–10 h/ 10–12 h/ 12–14 h/ 14+ hours. Estimated feeding window from recorded first and last energy intakes were compared with their perceived feeding window for accuracy.

2.4.4. Likelihood of adhering to time restricted feeding

The likelihood of participants adhering to TRF was rated as follows: i) Realistic: participants rated how realistic it would be to adhere to TRF using 3 statements (I would follow TRF if there were clear health benefits associated with it/I would be able to follow TRF on workdays/I would be able to follow TRF on free-days; No/sometimes/Yes); ii) Likelihood of TRF by 3-h: participants rated the likelihood of reducing their typical daily feeding window by the proposed 3-h on workdays and free-days as Extremely unlikely (1); Neither likely nor unlikely (2); Extremely likely (3); iii) Likelihood of different time frames: participants rated the likelihood of reducing feeding window on workdays and free days by a specific amount of time: Under 0.5-h/ 0.5–1 h/ 1.1–2 h/ 2.1–3 h/ 3.1–4 h/ over 4-h (Extremely unlikely (1); Neither likely nor unlikely (2); Extremely likely (3).

2.4.5. Key considerations

Participants rated the importance of a list of 20 key considerations when deciding whether to adhere to TRF: Cost/Income/Easy to follow/Time availability/Work commitments/Personal cooking knowledge/Personal nutritional knowledge/Inclusion of food likes/dislikes/Food preparation time/Health status/Motivation to change/Cultural requirements/Ethical requirements/Dietary requirements/Dietary type/Strength of evidence for diet/behaviour/Source of advice/Qualifications of adviser/Number of social media followers and Social media support for diet/behaviour. This was performed on a 3-point Likert scale: Not at all important (1); Moderately important (2); Extremely important (3). These considerations were recategorized into factors of relevance: majority of responses (>50%) for (1) categorised as of little relevance (LR); a non-majority (<50%) spread between (1, 2 and 3) categorised as intermediate relevance (IR); majority response (>50%) for (3) categorised as highly relevant (HR).

2.5. Data analysis

Data were analysed to describe participant demographics, habits, feeding window, likelihood of uptake of TRF and key considerations using descriptive statistics. Pearson Correlation was used to test the relationship between time availability and the likelihood of TRF uptake, and also whether commuter times affected TRF uptake. Participants with a daily feeding window of >12-h were selected for further analysis and the role of demographics, habits, feeding window and key considerations in predicting the likelihood of adopting TRF to shorten current temporal window by 3-h on work days and free days was assessed using Multiple Regression analysis. Statistical analysis was performed in SPSS 25.0 for Windows (SPSS Inc., Armonk, USA.)

3. Results

3.1. Participant demographics

A full summary of participant demographics is shown in Table 1. The participants were predominantly female (n = 447). Most described themselves as white (n = 491), with a minority identifying as Asian/ Asian British (n = 65), mixed/multiple ethic group (n = 21), Black/ African/Caribbean/Black British (n = 10) or 'Other' ethnic group (n = 19). Most participants were aged between 25 and 34 years old (n = 209), with the remaining participants aged 18–24 (n = 128), 35–44 (n = 130), 45–54 (n = 96) and 55+ (n = 43). The highest proportion of participants reported living with a partner (n = 182), followed by living with a partner and children (n = 140), living on their own (n = 95), living with family (n = 93), living with friends or in shared accommodation (n = 140), or living with children under the age of 18 (n = 8).

3.2. Work and sleep patterns in all participants

3.2.1. Work

Supplementary table 1 shows participants' work patterns, with a majority reporting a regular working schedule (n = 480). A small minority of participants had carried out shift work in the past 3 months (n = 72). Median work start, and end times were 09:00 and 17:00. Respondents predominantly travelled to work by car or public transport (n = 378) while others either walked or cycled (n = 126) and the fewest worked from home (n = 98). The highest number of participants took between 16 and 30 min to travel to work (n = 169); other participants took 0–15 min (n = 111), 31–45 min (n = 100), 46–60 min (n = 62) and 60+ minutes (n = 58). Travelling home from work, participants mainly took 16–30 min (n = 173) then 0–15 min (n = 108), 31–45 min (n = 92), 46–60 min (n = 67) and 60+ minutes (n = 60). There were 108 missing responses for the duration of time it took to travel to work and home from work.

Table 1
Participant demographics.

Sex	N	%
Female	447	73.5
Male	160	26.3
Age		
18 - 24	128	21.1
25 - 34	209	34.4
35 - 44	130	21.4
45 - 54	96	15.8
55+	43	7.1
Ethnicity		
White	491	80.8
Asian/British	65	10.7
Mixed/Multiple ethnic groups	21	3.5
Black/African/Caribbean/Black British	10	1.6
Other ethnic group	19	3.1
Living arrangements		
I live on my own	95	15.6
I live with partner only	182	29.9
I live with children U-18	8	1.4
I live with family	93	15.3
I live with friends/In shared accommodation	88	14.5
I live with partner + children	140	23

Notes. Values are shows as number and % of contribution to the demographics of participants.

3.2.2. Sleep

The largest proportion of respondents went to bed between 22:00–23:00 on workdays (n = 238) and free-days (n = 194) (supplementary table 2). The number of participants going to bed between midnight and 01:00 increased on free-days (from n = 49 to n = 78), in addition to a contrast in majority wake habits between workdays (n = 234/06:00–07:00) and free-days (n = 178/'other', implying a wake time after 09:00). A total of (n = 213) participants reported a sleep onset time between 22:00–23:00 on workdays which decreased to (n = 165) on free-days. More participants reported a later sleep onset time between 23:00–00:00 on free-days (n = 162) when compared to workdays (n = 127).

3.3. Feeding window in all participants

Data are shown in Fig. 1. Many of the participants reported first energy intake of the day at 06:00–08:00 on workdays (n = 275) and final energy intake was consumed between 20:00–22:00 (n = 294). Most participants had a feeding window of 10–12 h on workdays (n = 204). On free-days, first energy intakes were recorded mainly at 08:00–10:00 (n = 300). Last energy intake of the day was predominantly recorded between 20:00–22:00 (n = 285). Total feeding window on free-days was recorded as being mainly 10–12 h (n = 225). Upon closer inspection, only (n = 17) participants gave an overview of their first and last energy intake timings that were in keeping with their estimated feeding window on both workdays and free-days (supplementary table 3).

3.4. Uptake of time-restricted feeding in all participants

The overall likelihood of uptake of TRF, and whether participants would be able to compress their feeding window by 3-h on workdays and free days is shown in Table 2. Most participants stated they would follow TRF if there were clear health benefits associated with it (n = 397). Again, most of the participants claimed they would be able to follow TRF on workdays (n = 409), although this amount slightly reduced for free days (n = 373). The results would suggest it is extremely likely that many of the participants would be able to adopt TRF by 3-h on workdays (n = 341) and free-days (n = 353).

Overall, the percentage of participants' likelihood of uptake of TRF declined as the duration of time restriction increased (under 0.5-h = 85.6%) to (4+hours = 20.4%) (Table 3). The majority were able to follow TRF by up to 2-h on workdays (n = 381) and free-days (n = 422), with the majority also stating they would be able to increase this to 3-h on free-days (n = 311). When a 'yes' response is combined with 'sometimes' responses, there are strong indications that most of the participants have the potential to restrict their feeding window by 4+hours on workdays and free-days on most, if not all, days (Table 3).

Pearson correlation highlighted an inverse relationship between commute time to work and the likelihood of being able to adopt TRF by 3.1–4 h (n = 476, $r = -0.134$, $p < .003$) and 4+hours (n = 474, $r = -0.121$, $p < .009$). In a similar light, commute time home was inversely correlated to TRF restrictions of 3.1–4 h (n = 476, $r = -0.128$, $p < .005$) and 4+hours (n = 474, $r = -0.113$, $p < .014$). Further correlational analysis displayed an inverse relationship between time availability and the capacity to adhere to TRF between 3.1 and 4 h (n = 570, $r = -0.086$, $p < .041$) and 4+hours (n = 567, $r = -0.105$, $p < .013$) on workdays and (n = 570, $r = -0.110$, p < .009), (n = 569, $r = -0.112$, p < .008) on free-days (supplementary table 4).

The key considerations (supplementary table 5) deemed to be highly relevant (defined by a response of >50% in the 'extremely important' category), as indicated by all 608 participants included: easy to follow (62%), time availability (69.5%), work commitments (54.1%), inclusion

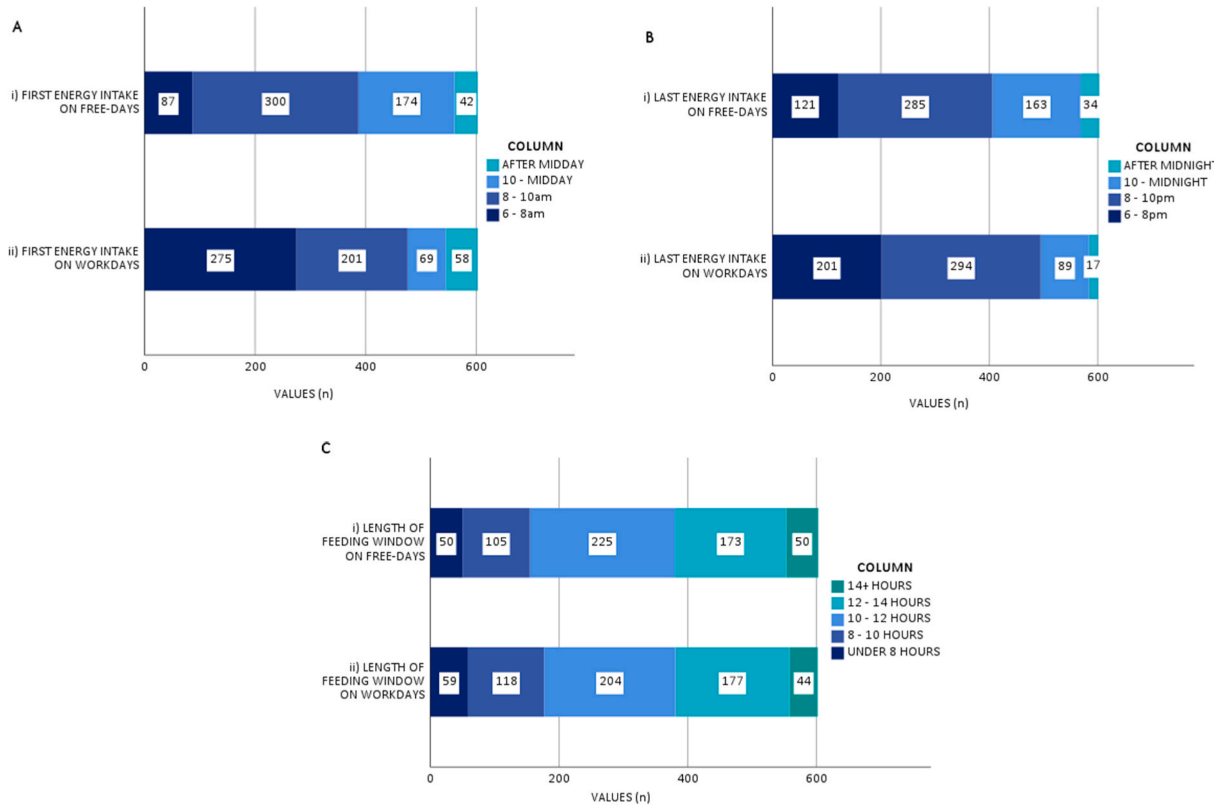

Fig. 1. An overview of participant dietary feeding patterns on workdays and free-days, (A) time of the first energy intake of the day on free-days (i) and workdays (ii), (B) The time of the last energy intake of the day on free-days (i) and workdays (ii), (C) The overall length of the feeding window on free-days (i) and work-days (ii).

Table 2
Likelihood of uptake of TRF by 3-h based on health benefits, on workdays & free-days.

N	Yes	No	Sometimes
I would follow TRF based on: 'health benefits'	397	98	109
I would be able to follow TRF on: 'workdays' ('free-days')	409 (373)	123 (118)	69 (112)
I would be able to follow TRF: '3-hr restriction on workdays' ('free-days')			
Extremely likely	341 (353)		
Neither likely nor unlikely	63 (90)		
Extremely unlikely	195 (153)		

Notes. Values are shown for responses made to statements including 'I would follow TRF based on the health benefits', 'I would be able to follow TRF on workdays/free-days', I would be able to follow TRF by 3-h on workdays/free-days'. Values for free-days are shown in brackets.

Table 3
Likelihood of reducing feeding window through uptake of TRF by 0.5–4+ hours.

	(A) Unable to comply	(B) Sometimes	(C) Yes
On workdays and (free days) I would be able to reduce FW via TRF by:			
Under 0.5 h	30 (22)	53 (53)	494 (506)
Between 0.5 and 1 h	26 (20)	61 (58)	488 (495)
Between 1.1 and 2 h	35 (26)	156 (130)	381 (422)
Between 2.1 and 3 h	44 (34)	264 (232)	261 (311)
Between 3.1 and 4 h	98 (74)	315 (307)	163 (196)
4+hours	176 (133)	280 (298)	117 (145)

Notes. Values show the number of participants Unable to comply (A), Sometimes (B) or Yes (C) in following the conditions of TRF, the number in brackets relates to free-days.
FW = Feeding Window.
TRF = Time-Restricted Feeding.

of food likes and dislikes (65.2%), food preparation time (64.5%), health status (65.6%), motivation to change (77.1%), strength of evidence (71.9%), source of advice (68.5%) and the qualifications of advisor (71.5%). The considerations of moderate importance and intermediate relevance defined as a response rate <50% for all three categories were made up by cost (31.8%), income (34.3%), cooking knowledge (35.2%), nutrition knowledge (33.6%), ethical requirements (24.9%), dietary requirements (25.3%) and dietary type (20.7%). Considerations where participants indicated these were not deemed to be important and therefore, of little relevance were defined by a response rate of >50% in the 'not at all important' category included cultural requirements (65.2%), number of social media followers of advisor (90.2%), and the social media support for the diet (83.4%).

3.5. Uptake of time-restricted feeding in participants with a daily feeding window of over 12 h

Participants with a feeding window of >12-h on workdays (n = 221) and free days (n = 223) were selected and further analysed to determine the likelihood that they would follow TRF. Details of participants with a feeding window over >12-h and the likelihood of following TRF and condensing habitual eating window by 3-h on workdays and free-days are displayed in Table 4. Participants with a feeding window lasting

>12-h would be inclined to follow TRF on workdays (n = 132) and free days (n = 125).

Multiple regression analysis, based on the responses of 221 participants with a feeding window of >12- hours, showed that the best predictors of the likelihood of uptake of TRF on workdays were; cost ($P <$ .02), time availability ($P <$ .006) and health benefits associated with TRF ($P <$ .001) accounting for 17.5% of the variance (Table 5). In 223 participants, the best predictors of the likelihood of uptake of TRF on free days were bed time ($P <$ .008), time availability ($P <$ .012), motivation to change ($P <$ .019) and the health benefits of TRF (P < .001) accounting for 13.9% of the variance (Table 6).

4. Discussion

This research provides novel insight into the likelihood of free-living individuals adopting a TRF regime into their daily routine. The majority (62.7 and 65.5%) of participants from this study reported a typical daily window of energy intake of 10–14 h on workdays and free days, respectively. Previous research highlighted the median daily feeding window of a small US cohort to be 14.75-h (Gill & Panda, 2015). Animal research has previously demonstrated a 12-h daily eating period improves metabolic fitness (Chaix et al., 2014). In light of this, the main analysis of our study therefore focused on individuals with a daily feeding window of >12-h as this cohort are expected to have greatest benefit from a TRF intervention. Overall, 56% and 59% of the participants with a feeding window of >12-h stated their likelihood of being able to restrict feeding by 3-h using TRF on workdays and free-days, respectively. The multiple regression analysis identified some of the key factors influencing the decision to adopt TRF, revealing different considerations being most important on free and work days.

Most human TRF studies have reported benefits to adiposity and other markers of metabolic health (Lynch, Johnston, & Robertson, 2021). However, assessment of TRF in humans has been complicated by the variety of protocols used. Some human TRF studies to date have used highly constrained feeding protocols to measure its effects on metabolic physiology (Jamshed et al., 2019; Ravussin et al., 2019; Sutton et al., 2018). Other trials have investigated TRF under free-living conditions (Anton et al., 2019; Antoni et al., 2018; Gill & Panda, 2015; Wilkinson et al., 2019). Early TRF (eTRF) in comparison to delayed TRF (dTRF) delivered improvements to postprandial glucose tolerance highlighting potential benefit for individual's with early morning feeding preferences (Hutchison et al., 2019). Compliance was unmeasured in this study and since it was a trial lasting only 2-weeks, it is difficult to conclude with confidence the longevity of either eTRF or dTRF maintenance under free-living arrangements. Self-selection of an 8-h feeding time frame in keeping with lifestyle resulted in adherence to the regime on 6 out of 7 days and an approximate 2.6 kg loss in weight (Anton et al., 2019). The factors determining likely adoption of TRF within a real-life scenario are nonetheless poorly understood.

Across all of our 608 respondents, the likelihood of TRF uptake diminished with increasing length of proposed feeding restriction. More specifically, from 86% uptake for a <0.5-h restriction down to 20% for a 4+hour restriction, and subsequently inversely correlating time availability with capacity to incorporate feeding restrictions of 3.1–4 h and 4+hours. Of participants with a typical feeding window of >12-h per day, results indicate that as many as 150 (67%) of the 221 participants on workdays and 163 (73%) of the 223 participants on free-days would be able to adhere to a 3+ h restriction which is perhaps a reflection of their increased flexibility and availability to comply with TRF. Our data indicated a shift in sleep and feeding behaviour on workdays compared with free days. Assessment of the participants' feeding window delivered some interesting findings, most notably a delay to the first energy intake of the day on free days. This might reflect participants waking up later in the morning on free days and subsequently delaying energy intake. This delay to waketime and energy intake may be related to an individual's chronotype along with the social and behavioural implications influencing sleep and feeding habits (Dashti, Scheer, Saxena, & Garaulet, 2019). The delayed shift in final energy intake from 22:00–00:00 on workdays to after 00:00 on free days might further reflect an individual synchronising behaviour to their chronotype or they may be affected by social jetlag and behavioural factors. Since this

Table 4
Feeding window and likelihood of uptake of TRF by 3-h in participants with a 12+hour feeding window.

Feeding window	Work-days		Free-days	
	N	%	N	%
12–14 h	177	80.1	173	77.6
14+ hours	44	19.9	50	22.4
Total	221	100	223	100
Likelihood of restricting FW by 3-h				
	N	%	N	%
Yes	132	59.2	125	56.1
Sometimes	18	8.1	38	17
Unable to comply	71	31.8	58	26

Notes. Participants with a 12+hour feeding window were selected and data shows the likelihood of this cohort following time-restricted feeding for 3-h on workdays and free-days.
FW = Feeding Window.

Table 5
Factors predicting uptake of TRF on workdays in participants with a 12+hour feeding window.

Predictors	Beta Coefficients	Sig.	F Change	Sig.F Change
Sex	-.008	.908	10.147	.000
Age	-.028	.685		
Work flexibility	.052	.428		
Asleep time on work days	.074	.247		
First calorie on work days	.016	.818		
Last calorie on work days	-.053	.465		
Feeding window on work days	.107	.121		
[a]Cost	**.160**	**.020**		
[b]Time availability	**-.190**	**.006**		
Cooking knowledge	-.122	.069		
Motivation to change	-.120	.072		
[c]Health benefits of TRF	**.349**	**.000**		

Notes. Predictors were added to Multiple regression analysis models to determine what variables explain the variance in following time-restricted feeding. Significant predictors are shown in bold.

Table 6
Factors predicting uptake of TRF on free days in participants with a 12+hour feeding window.

Predictors	Beta Coefficients	Sig.	F Change	Sig.F Change
Sex	.033	.643	5.818	.000
Age	-.091	.235		
Asleep time on free-days	-.136	.147		
Wake time on free-days	-.151	.051		
First calorie on free-days	.151	.084		
Last calorie on free-days	-.135	.119		
Feeding window on free-days	.109	.186		
Up after on free-days	.026	.706		
Cost	.075	.290		
[d]Time availability	**-.175**	**.012**		
Cooking knowledge	.042	.539		
[e]Motivation to change	**-.160**	**.019**		
[f]Health benefits of TRF	**.280**	**.000**		

Notes. Predictors were added to Multiple regression analysis models to determine what variables explain the variance in following time-restricted feeding. Significant predictors are shown in bold.

would have an impact on adherence to TRF, future studies should consider these changes to sleep and feeding habits on workdays and free days to decipher whether these are driven by social, biological, or psychological factors.

Our data indicate that the potential health benefits of TRF are an important incentive to adopting a protocol during both workdays and free days. However, it is previously known that dietary and lifestyle interventions are rarely sustained long-term (Barte et al., 2010). The likelihood of bias towards attracting health-conscious individuals to complete the survey is possible and this may explain the significance of health benefits. This was an online questionnaire advertised on popular social media platforms with followers that may potentially be health conscious and receptive towards TRF and its health benefits. Within our data, cost has been identified as a key consideration for some respondents but TRF, as an intervention aimed at controlling temporal feeding rather than dietary quality, does not have any major financial implications. Indeed, the potential of TRF to induce health benefits with minimal impact on dietary choice and related costs is one of its enticing qualities.

In summary, our results suggest that the strongest predictors of the likelihood of carrying out TRF on workdays are cost, time availability and health benefits (accounting for 17.5% of the total variance) and on free days are bed-time, time availability, motivation to change and health benefits (accounting for 13.9% of the total variance). These findings are important to determine whether TRF can be translated from a promising experimental paradigm to an intervention that can be maintained within the real world. For some individuals, TRF may reflect a positive lifestyle intervention that can be implemented within their social constraints.

4.1. Limitations and areas for future research

TRF is rare amongst dietary interventions, in that it requires minimum effort and knowledge to remain compliant with eating during a certain timeframe. This cross-sectional questionnaire does, however, come with its limitations. Although the proportion of responses from different ethnicities closely represents UK demographics, variability within gender and age groups was low. Future quantitative studies would benefit from a larger sample size and increased sampling from Black, Asian and Minority Ethnicities (BAME) to reflect cultural diversity within the population. Furthermore, unequal age and gender distribution may affect the interpretation of what motivates participants to undertake TRF, with larger, comparative studies required to deliver insightful feedback.

In this study we included no direct analysis of socioeconomic status (SES), which is noteworthy given that potential barriers and opportunities to engage with healthy eating may be driven by SES (Reidpath, Burns, Garrard, Mahoney, & Townsend, 2002). However, as cost and dietary quality are minor features of TRF, SES is not necessarily a major basis of TRF uptake. Nonetheless, deeper insight into the education, occupation and income of respondents will be of interest. Although SES was not directly assessed using conventional methods, our exploration of key considerations including cost, income, work commitments, ease of dietary instructions, knowledge of nutrition and culinary skills, and individual health status implies SES was indirectly measured. The purpose for this was to emphasise TRF's strengths which have long been weaknesses of dietary interventions favouring continuous energy restriction or compositional changes (Kelly, 2005).

A brief explanation of TRF was included within the questionnaire. Questions were designed to assess current eating habits of the respondents and asked them to consider applying the relevant changes in eating window to their own circumstances. However, a cross-check between reported first and last energy intakes with estimated feeding window indicated misreporting, leading to an inaccurate representation of actual feeding habits. Accurately reporting feeding habits would therefore be crucial if TRF is to be effectively prescribed. Even though this report investigates some well-known social and behavioural factors including work habits, sleep hygiene and living arrangements, we did not explore these in depth. The key considerations assessed for importance before making anticipated dietary adjustments is not an exhaustive list, potentially leading to gaps in our understanding. We acknowledge limitations to the way in which the relevance of the key considerations is reported. A non-majority <50% of response for cost, nutrition knowledge, ethical requirements, dietary requirements and dietary type still clearly indicates favourability to the importance or respective unimportance of each consideration as outlined in supplementary table 3. The multiple regression analysis confirms this as a shortfall since cost was reported as a significantly meaningful factor in predicting the likelihood of uptake of TRF.

5. Conclusion

Emerging evidence suggests that TRF has the potential to become a behavioural intervention that can benefit health within specific patient groups and the wider population. However, this potential can only be realised if people are able to incorporate TRF into their daily lifestyle. Our study provides novel information that identifies key factors determining likelihood of adherence to TRF. Similar research will be required in different population groups but is essential to maximise the translational impact of TRF in the real world.

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Author contributions

PJ, MDR and JDJ conceived the study; PJ and JO created the survey and conducted statistical analysis; all authors contributed to writing of the manuscript.

A self-assessment for governance and ethics application and discussions with a member of the University of Surrey's Research Integrity & Governance Office concluded that this study was deemed not to require a favourable ethical opinion by the University of Surrey Research Ethics Committee.

Declaration of competing interest

JDJ has previously undertaken consultancy work for Kellogg Marketing and Sales Company (UK) Limited and had research collaborations with Nestlé Institute of Health Sciences.

PWJ, JO and MDR have no conflicts of interest.

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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.2021.105240.

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