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Assessment of potentially motivating factors to follow time-restricted eating protocols in a population of adults living in Portugal

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ABSTRACT

Chrononutrition is a growing field that has been attracting significant attention for its potential benefits in metabolic health and body weight regulation. Among chrononutrition strategies, time-restricted eating (TRE) is the most extensively investigated approach in clinical studies. TRE intends to synchronise eating and fasting cycles with the human circadian rhythms. However, larger and longer randomised clinical trials are still needed to establish the effectiveness and long-term health outcomes of TRE interventions. Furthermore, it is crucial to explore whether individuals in free-living conditions, outside controlled clinical settings, can successfully adopt TRE principles into their daily routines to achieve potential health benefits. This study aimed to investigate the association between daily routines and potential adherence to TRE protocols, as well as to identify factors that can potentially predict adherence to these protocols in a sample of adults living in Portugal. A cross-sectional study was conducted using an online questionnaire to assess dietary and sleeping habits, daily routines and the likelihood of adherence to various restrictions in daily eating windows. Associations between variables were analysed using the Spearman correlation coefficient and the Chi-Square test, while an ordinal logistic regression was performed to identify predictive factors. Statistical analyses were conducted on IBM SPSS Statistics version 29.0. The questionnaire was filled out by 130 participants (80 % women) with a mean age of 37.9 ± 13.59 years. On workdays, 71.6 % of participants reported a daily eating window of 12 to 14 h, while on free days, the highest percentage (46.6 %) reported between 10 and 12 h. A significant inverse correlation was observed between willingness to adhere to a TRE protocol based on perceived health benefits and both age ($\rho = -0.356$, $p < 0.001$) and sex ($\rho = -0.321$, $p < 0.001$). Moderate correlations were also found between the willingness to follow a TRE protocol on workdays ($\rho = 0.538$) and free days ($\rho = 0.598$) and the potential health benefits of this type of intervention ($p < 0.001$). Additionally, sex was associated with potential adherence to the TRE protocol ($\chi^2(2) = 10.644$, $p = 0.005$), with a tendency for men to show lower willingness for adherence. Associations were also identified between body weight management and reducing the eating window by 1 to 2 h ($\chi^2(12) = 24.883$, df = 12, $p = 0.015$) and 2 to 3 h ($\chi^2(12) = 22.367$, $p = 0.034$). Moreover, the perceived importance of income, body weight management and cooking knowledge were significant predictors of the likelihood of adherence to a TRE protocol with a 3 to 4 h restriction in the eating window on workdays ($p < 0.005$). These results provide valuable insights that should be considered when translating research into clinical practice, specifically in an adult population, as individuals' willingness and motivation to adopt TRE protocols in free-living conditions are influenced by multiple factors.

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1. Introduction

Time-restricted eating (TRE) has recently emerged as a promising dietary approach for weight loss, offering potential cardiometabolic benefits (Chang et al., 2024; Manoogian & Laferrère, 2023). This strategy involves consuming all daily calories within a restricted time window, typically <12 h, followed by an extended fasting period (Longo & Panda, 2016; Melkani & Panda, 2017; Rothschild et al., 2014). The protocols of TRE are distinct from intermittent fasting as they are specifically aimed at aligning the eating/fasting cycles with the metabolic circadian rhythms (Longo & Panda, 2016).

The endogenous circadian system regulates metabolic processes in humans (Johnston et al., 2016; Reinke & Asher, 2019; Stenvers et al., 2019) and, consequently, metabolic rhythms induce adjustments in nutritional physiology and postprandial metabolic responses throughout the day (Johnston, 2014; Leung et al., 2020; Morgan et al., 2003). This interplay between dietary intake and biological timing is referred to as chrononutrition, a research field that has garnered interest in recent years. This growing interest in chrononutrition promoted a rise in studies that explore the physiological effects of food intake timing, which encompass TRE studies leveraging the development of several different TRE protocols. Some studies implemented a delayed onset of energy intake with an established 8 h eating window (Moro et al., 2016), others advanced the evening meal to adopt an 'early TRE' approach (Jamshed et al., 2019; Ravussin et al., 2019; Sutton et al., 2018), and others imposed eating windows as limited as 4 h (Cienfuegos et al., 2020). In another study, the authors opted for a proportioned 1.5 h delayed breakfast and advanced dinner (Antoni et al., 2018).

In studies that do not control energy intake, TRE appears to lead to a spontaneous decrease in daily energy consumption (Antoni et al., 2018; LeCheminant et al., 2013). Additionally, studies with research protocols that allowed ad libitum intake within a self-selected 8 h eating window reported a decrease in body weight, visceral fat, and lean mass (Chow et al., 2020; Gabel et al., 2018).

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Although preliminary evidence emphasise the potential of TRE approaches for significant health benefits in humans, large-scale studies are still required to further support and establish its efficacy and underlying mechanisms (Lynch et al., 2021). Additionally, as previously mentioned, there is a great variation in the TRE protocols implemented in human studies (Jefcoate et al., 2021), so it is important to establish which temporal restrictions are compatible with daily routines and activities, outside the controlled environment of clinical studies. TRE represents a nutritional and behavioural intervention with potential for obesity management or promotion of metabolic health benefits independent of body weight; however, the effectiveness of these dietary strategies is often limited by poor adherence. Therefore, the potential benefits of these interventions depend on the willingness of individuals to incorporate its principles into their daily routines within the constraints of both workdays and leisure periods, and this adherence is influenced by a diversity of factors that require further exploration (Jefcoate et al., 2023; O'Connor et al., 2022).

Behavioural and contextual factors influencing adherence to TRE, including work routines, social and family commitments, and sleep patterns, may also directly affect metabolism and associated biochemical parameters. Poor adherence or misalignment between eating-fasting windows with endogenous circadian rhythms may impair glucose and lipid metabolism, increase systemic inflammation, and ultimately hamper the metabolic benefits associated with TRE (Che et al., 2021; Guo et al., 2023; Turner et al., 2024). TRE interventions may modulate the activity of nutrient- and circadian-sensitive genes such as Sirtuin 1 (SIRT1), a key regulator of glucose and lipid homeostasis, mitochondrial function, and ageing-related processes (Haigis & Sinclair, 2010). The expression and activation of SIRT1 are influenced by fasting and feeding cycles (Çakir et al., 2009; Orozco-Solis et al., 2015), which are central to TRE. SIRT1 activation has been associated with improved appetite regulation and protection against metabolic dysfunction (Martins, 2016, 2017). Therefore, TRE may bring additional metabolic benefits through epigenetic and molecular pathways (Lilja et al., 2021; Opstad et al., 2021). These mechanisms underscore the importance of dietary adherence and lifestyle modifications in optimising the potential of TRE interventions. Understanding the influence of daily routine aspects is relevant not only to promote and support adherence but also to enhance therapeutic outcomes in the prevention and management of obesity and other metabolic conditions.

The characteristic of TRE, based on restricting the daily eating window, is distinct from other dietary strategies, which may influence behavioural adherence, presenting both advantages and challenges (Bjerre et al., 2022; Dashti et al., 2019; Lee et al., 2020; O'Connor et al., 2021). For instance, TRE might be simpler to follow, compared with other dietary strategies, as individuals can consume an ad libitum diet within a designated time window, without the need to monitor energy intake or macronutrient composition. However, although the premises of TRE may support long-term sustainability and adherence (O'Connor et al., 2021), this dietary approach requires restructuring and compressing the eating windows, which may present unique challenges for some individuals (Bjerre et al., 2021), particularly those with limited control over their daily schedules or whose TRE protocol is not compatible with their personal preferences, cultural/societal habits, and/or physiological needs.

Evidence from TRE studies suggest high adherence, with an adherence rate of approximately 80 % (Adafer et al., 2020). Furthermore, all participants from a study by Gill and Panda (Gill & Panda, 2015) expressed interest in continuing the TRE protocols after the study period. However, these adherence rates are assessed only in the short term and within the time framework of the clinical studies. Limited data are available on the long-term sustainability of TRE among free-living individuals following TRE schedules, including variations in eating window duration and meal timing (Adafer et al., 2020). Additionally, to date, few studies have explored the facilitators and barriers to adherence to TRE protocols among free-living individuals, outside the schedules of a clinical study setting.

Therefore, the present study aimed to evaluate the willingness to adhere to different TRE protocols on workdays and free days and to determine potential predictors of adherence.

2. Methods

2.1. Study design and participants

This was a free-living population-based cross-sectional study conducted on adults (≥ 18 years) living in Portugal, designed to explore the association between daily habits (eating schedules, sleep schedules and work routines), and the willingness to adhere to TRE protocols on workdays (or weekdays) and free days (or weekends), and to identify potential predictors to this adherence.

Participants were recruited using a convenience sampling strategy through institutional email lists disseminated via academic and professional networks. The inclusion criteria were: (i) being 18 years of age or older, (ii) residing in Portugal, and (iii) providing informed consent prior to completing the questionnaire. Participation was entirely voluntary, and no financial or material incentives were offered.

The questionnaire was available online and remained open for a two-month period, from February to March 2023, to maximise participation. Due to the convenience-based recruitment and limited sample size, the study population is not representative of the Portuguese adult population, particularly regarding sex representation, as approximately 80 % of

participants were women.

2.2. Data collection

The questionnaire was adapted and translated from a previous study conducted by Jefcoate and colleagues (Jefcoate et al., 2021). In the present study, the questionnaire was developed on the LimeSurvey® platform and was made available to the participants via a link shared through the institutional email. The first page of the questionnaire contained information about the study, including an introduction outlining the study objectives, a definition of TRE, and the contact details of the research team for any clarifications. Participants were only able to complete the questionnaire after providing informed consent.

The structured questionnaire to assess factors potentially influencing adherence to TRE protocols among adults in Portugal was divided into four main sections:

1. Sociodemographic Information: This section collected data on the age, sex, nationality, living arrangements, education level, and the presence of diagnosed health conditions of the participants.
2. Daily Routines: Participants provided information about their typical work routines, including occupation, whether they followed a regular work schedule or shift work, times of work start and end, type of transportation to and from work, and average commute time. Sleep patterns were also assessed, with participants reporting their usual sleep and wake times on both workdays (weekdays) and free days (weekends).
3. Dietary Habits: This section examined the daily eating schedules of participants, specifically the timing of their first and last meals on workdays and free days. It also inquired whether participants followed any specific dietary regimen, with respondents required to specify the type if applicable.
4. TRE Adherence and Motivational Factors: The final section assessed the willingness of the participants to follow TRE protocols under various conditions. Participants were asked whether they would be able to follow a TRE protocol if it provided health benefits, whether they could implement it on workdays or free days, and whether they would be able to follow TRE protocols involving reductions in eating window duration (ranging from 30 min to over 4 h). It was also required that participants estimated the duration for which they believed they could sustain a TRE protocol (ranging from less than a week to >12 months).

2.3. Statistical analysis

Descriptive statistics were used to characterise participant sociodemographic data, eating windows and willingness to undertake protocols of TRE. Associations between variables were assessed using the Spearman correlation coefficient and the Chi-square test. Comparisons between categorical variables were conducted using the Fisher–Freeman–Halton Exact Test. Additionally, an ordinal logistic regression analysis was conducted to identify predictive factors of the likelihood of adopting TRE protocols to reduce the daily eating window. Statistical analyses were conducted on IBM SPSS Statistics version 29.0. Statistical significance was set at a p-value of <0.05.

2.4. Ethical considerations

The study was approved by the Ethics Committee of the Polytechnic University of Leiria (n.° CE/IPLEIRIA/31/2021) and conducted following the principles of the Declaration of Helsinki. The study was designed and implemented in compliance with ethical standards and the General Data Protection Regulation (EU) 2016/679. To fill out the questionnaire, the participants had to provide their consent to participate in the study and accept the terms and conditions of the study, namely, being 18 years old or above and residing in Portugal.

3. Results

3.1. Sociodemographic characterisation of the population

A total of 130 participants (80 % women and 20 % men) with a mean age of 37.9 ± 13.59 years (minimum: 18 years; maximum: 69 years) completed the online questionnaire. The main characteristics of the participants are presented in Table 1.

3.2. Daily routines: sleep, commute, and work patterns

Most participants (69.8 %) started work between 8:00 to 10:00 am and ended it between 5:00 to 7:00 pm (41.6 %). Participants predominantly went to work by car (80.5 %) and took 15 min or less to get to work (50.0 %), while 21.3 % took 16 to 30 min. For their return home, most participants took 15 min or less (45.9 %) or 16 to 30 min (24.6 %).

Regarding sleep patterns, the largest percentage of participants went to bed between 11:00 pm to midnight on workdays (41.8 %), and between midnight and 1:00 am (54.1 %) on free days. On workdays, the percentage of participants who went to bed after midnight decreased to 27.0 %. Additionally, the percentage of participants who went to bed before 11:00 pm dropped from 18.9 % on workdays to 10.7 % on free days. On workdays, most of the participants woke up between 7:00 and 8:00 am (48.4 %), while on the free days, the highest percentage of the participants woke up between 9:00 and 10:00 am (28.7 %).

3.3. Eating habits on workdays and free days

A statistically significant difference was observed in the distribution of first energy intake times between workdays and free days. On workdays, the majority of participants reported consuming their first energy intake between 8:00 and 10:00 am (56.4 %) and their final energy intake between 8:00 and 10:00 pm (80.0 %) (Table 2). On free days, similar timeframes were reported for both the first and last energy intake, with 46.6 % and 76.5 %, respectively, indicating the same periods as on workdays. However, compared to workdays, there was a shift

Table 1
Sociodemographic characteristics of the participants.

Characteristics	
Age (mean ± SD)	37.9 ± 13.59
Sex [*n* (%)]	
Female	104 (80.0)
Male	26 (20.0)
Education Level [*n* (%)]	
High School	36 (27.7)
Higher Education – Bachelor's Degree	36 (27.7)
Higher Education – Master's Degree	26 (20.0)
Higher Education – Doctorate Degree	32 (24.6)
Living Arrangements [*n* (%)]	
Lives on their own	18 (13.8)
Lives with a partner only	25 (19.2)
Lives with children under 18 years	10 (7.7)
Lives with children under 18 years in shared custody	4 (3.1)
Lives with family	53 (40.8)
Lives with friends/In shared accommodation	5 (3.8)
Lives with a partner and children	15 (11.5)
Nationality [*n* (%)]	
Portuguese	125 (96.2)
Brazilian	2 (1.5)
Spanish	1 (0.8)
Andorran	1 (0.8)
Australian	1 (0.8)
Regular Work Schedule [*n* (%)]	
Yes	63 (50.0)
No	63 (50.0)
Shift Work (Last 3 Months) [*n* (%)]	
Yes	17 (13.5)
No	109 (86.5)

SD, standard deviation.

Table 2
Comparison of first and last energy intake frequencies and percentages between workdays and free days.

Energy intake	Workdays [*n* (%)]	Free Days [*n* (%)]	*p*-value
Time of first energy intake			
6:00 am to 8:00 am	35 (31.8 %)	7 (6.0 %)	<0.001[†]
8:00 am to 10:00 am	62 (56.4 %)	54 (46.6 %)	
10:00 am to 12:00 pm	5 (4.5 %)	44 (37.9 %)	
After 12:00 pm	8 (7.3 %)	11 (9.5 %)	
Time of last energy intake			
6:00 pm to 8:00 pm	10 (9.1 %)	6 (5.0 %)	<0.001[†]
8:00 pm to 10:00 pm	88 (80.0 %)	91 (76.5 %)	
10:00 pm to 12:00 am	12 (10.9 %)	21 (17.6 %)	
After 12:00 am	0 (0 %)	1 (0.8 %)	

[†] Fisher-Freeman-Halton Exact Test.

in the timing of the first energy intake on free days: the proportion of participants who consumed their first meal before 8:00 am decreased, while those who initiated energy intake after 10:00 am increased.

Most of the participants reported an eating window of 12 to 14 h on workdays (71.6 %), whereas on free days, it changed to 10 to 12 h (46.6 %) (Table 3).

3.4. Willingness to adhere to time-restricted eating protocols

In terms of overall adherence to a TRE protocol, most of the participants (56.5 %) indicated willingness to follow it if clear health benefits were associated with it, whereas 18.2 % reported they would not adhere to TRE (Table 4). Furthermore, 51.5 % of participants expressed they would be able to follow a TRE protocol on workdays, but this percentage decreased to 39.4 % on free days.

Overall, the percentage of participants' likelihood of adhering to TRE decreased as the proposed reduction in eating duration increased. Specifically, 66.3 % of participants on workdays and 68.4 % on free days responded "Agree" or "Totally agree" to adhering to a 30-minute restriction, whereas only 22.3 % (workdays) and 27.1 % (free days) expressed the same level of agreement for a restriction of >4 h (Fig. 1).

Most participants reported a willingness to follow TRE protocols involving a reduction in eating window up to between 30 min to 1 h on workdays (59.3 % responded "Totally agree" plus "Agree") and 1–2 h on free days (50.6 % responded "Totally agree" plus "Agree").

Regarding the expected duration of adherence, the largest proportion of participants (32.9 %) reported they could maintain a TRE protocol for 4 weeks to 6 months, while a similar percentage (32.8 %) were uncertain about how long they could adhere. Additionally, 17.9 % believed they could follow TRE for up to 4 weeks, 3.0 % for 6 to 12 months, and 13.4 % for >12 months.

3.5. Influence of demographic and behavioural factors on TRE adherence

Weak negative correlations were observed between commute time from work to home and the willingness to adhere to a TRE protocol involving a 3 to 4 h eating window restriction ($\rho = -0.259$, $p = 0.026$) and a restriction of >4 h ($\rho = -0.255$, $p = 0.028$) on workdays. Similarly, a weak negative correlation was found between age and the potential health benefits of TRE ($\rho = -0.356$, $p < 0.001$). In contrast, moderate positive correlations were identified between the potential benefits of TRE and the willingness to follow TRE on workdays ($\rho = 0.538$, $p < 0.001$) and free days ($\rho = 0.598$, $p < 0.001$).

Table 3
Comparison of eating window frequencies and percentages between workdays and free days.

Eating window	Workdays [*n* (%)]	Free Days [*n* (%)]	*p*-value
<8 h	2 (1.8 %)	2 (1.7 %)	
8 to 10 h	8 (7.3 %)	19 (16.4 %)	
10 to 12 h	12 (11.0 %)	54 (46.6 %)	<0.001[†]
12 to 14 h	78 (71.6 %)	37 (31.9 %)	
>14 h	9 (8.3 %)	4 (3.4 %)	

[†] Fisher-Freeman-Halton Exact Test.

Table 4
Likelihood of participants adhering to a Time-Restricted Eating protocol based on health benefits, on workdays and free days.

	Yes *n* (%)	No *n* (%)	Sometimes *n* (%)
I would follow a TRE protocol if there were clear health benefits associated with it.	56 (56.6 %)	18 (18.2 %)	25 (25.3 %)
I would be able to follow a TRE protocol on workdays.	51 (51.5 %)	22 (22.2 %)	26 (26.3 %)
I would be able to follow a TRE protocol on free days.	39 (39.4 %)	23 (23.2 %)	37 (37.4 %)

TRE, Time-Restricted Eating.

No significant correlations were found between time availability and the willingness to adhere to TRE protocols on workdays and free days. However, when considering adherence across different levels of eating window restriction, weak negative correlations were observed between time availability and the willingness to reduce the eating window by 1 to 2 h ($\rho = -0.346$, $p = 0.002$), 2 to 3 h ($\rho = -0.306$, $p = 0.008$), 3 to 4 h ($\rho = -0.305$, $p = 0.008$) and >4 h ($\rho = -0.262$, $p = 0.024$).

A significant association was observed between sex and potential adherence to TRE ($\chi^2(2) = 10.644$, $p = 0.005$). Adjusted standardised residuals (ASR) analysis indicated that men were more likely to respond that they would not adhere to a TRE protocol (ASR = 2.8), whereas women were significantly less likely to choose this response (ASR = −2.8). Additionally, women were significantly more likely to select the option that they would sometimes adhere to a TRE protocol (ASR = 2.3), while men were significantly less likely to select this option (ASR = −2.3). No significant sex differences were observed in the likelihood of selecting the option "Yes" to adhere to a TRE protocol (ASR = 0.2 for women and ASR = −0.2 for men).

Additionally, significant associations were observed between the perceived importance of body weight management and the willingness to reduce the eating window by 1 to 2 h ($\chi^2(12) = 24.883$, $p = 0.015$) and 2 to 3 h ($\chi^2(12) = 22.367$, $p = 0.034$), suggesting that individuals who place greater importance on weight management might be more willing to adhere to these particular TRE protocols.

3.6. Key factors influencing TRE adherence decisions

Regarding the set of key considerations, most participants identified health status (59.2 %), health benefits (55.1 %), motivation to change (52.0 %) and qualifications of the advisor (57.1 %) as extremely important in their decision to adhere to TRE protocols (Table 5). Other factors commonly rated as extremely important included hunger (46.9 %), body weight management (42.9 %), nutritional needs (42.9 %), strength of scientific evidence (40.8 %), and source of advice (40.8 %). Conversely, cooking knowledge (14.3 %), cultural requirements (24.5 %), and ethical requirements (18.4 %) were the factors most frequently considered not important at all.

3.7. Ordinal logistic regression analysis of TRE adherence

The model of the ordinal logistic regression was statistically significant ($\chi^2(18) = 42.408$, $p < 0.001$), indicating that the inclusion of predictor variables significantly improved model fit over the intercept-only model. The goodness-of-fit statistics showed that the model adequately fit the data well, as both the Pearson $\chi^2(234) = 239.035$ and Deviance $\chi^2(234) = 171.445$ were non-significant. The Test of Parallel Lines indicated that the proportional odds assumption was met, $\chi^2(84) = 51.656$, $p = 0.565$, suggesting that the relationship between the

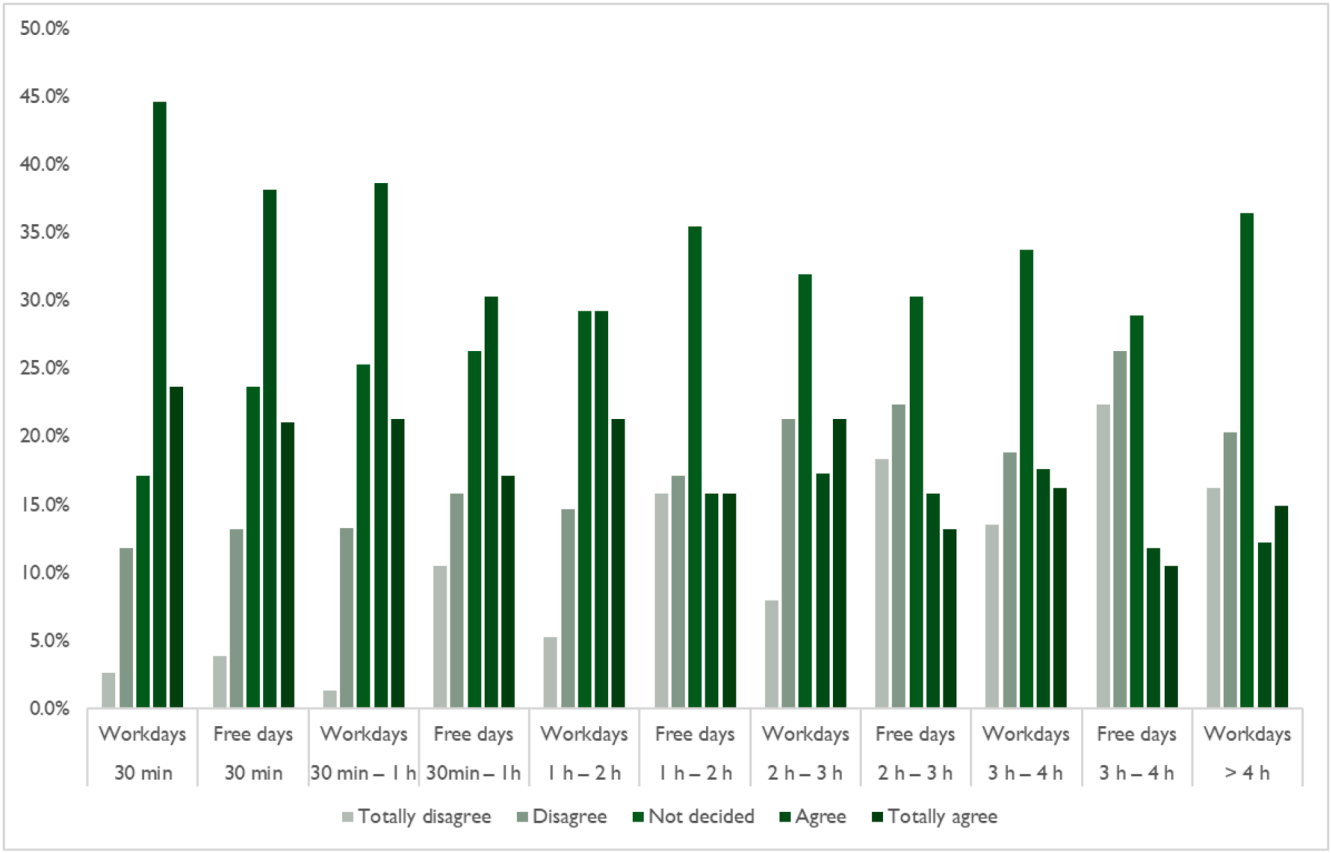

Fig. 1. Willingness to adhere to Time-Restricted Eating protocols by reducing the eating window, ranging from 30 min to >4 h, on workdays and free days.

Table 5
Participants' ratings of the importance attributed to key factors influencing their decision to adhere to Time-Restricted Eating protocols.

	Not at all important n (%)	Not very important n (%)	Moderately important n (%)	Important n (%)	Extremely important n (%)
Hunger	1 (1.0 %)	7 (7.1 %)	15 (15.3 %)	29 (29.6 %)	46 (46.9 %)
Body weight management	0 (0.0 %)	7 (7.1 %)	14 (14.3 %)	35 (37.7 %)	42 (42.9 %)
Impact on social life	3 (3.1 %)	15 (15.3 %)	21 (21.4 %)	38 (38.8 %)	21 (21.4 %)
Costs	5 (5.1 %)	10 (10.2 %)	16 (16.3 %)	44 (44.9 %)	23 (23.5 %)
Income/salary	8 (8.2 %)	9 (9.2 %)	20 (20.4 %)	41 (41.8 %)	20 (20.4 %)
Easy to follow	2 (2.0 %)	3 (3.1 %)	19 (19.4 %)	38 (38.8 %)	36 (36.7 %)
Time availability	2 (2.0 %)	2 (2.0 %)	18 (18.4 %)	37 (37.8 %)	39 (39.8 %)
Work commitments	8 (8.2 %)	5 (5.1 %)	18 (18.4 %)	37 (37.8 %)	30 (30.6 %)
Cooking knowledge	14 (14.3 %)	11 (11.2 %)	27 (27.6 %)	26 (26.5 %)	20 (20.4 %)
Nutrition knowledge	8 (8.2 %)	9 (9.2 %)	20 (20.4 %)	34 (34.7 %)	27 (27.6 %)
Inclusion of food preferences	4 (4.1 %)	2 (2.1 %)	16 (16.5 %)	39 (40.2 %)	36 (37.1 %)
Food preparation time	4 (4.1 %)	3 (3.1 %)	11 (11.2 %)	42 (42.9 %)	38 (38.8 %)
Health status	1 (1.0 %)	2 (2.0 %)	8 (8.2 %)	29 (29.6 %)	58 (59.2 %)
Health benefits	1 (1.0 %)	0 (0.0 %)	9 (9.2 %)	34 (34.7 %)	54 (55.1 %)
Support from family/friends	9 (9.2 %)	12 (12.2 %)	26 (26.5 %)	33 (33.7 %)	18 (18.4 %)
Flexibility	2 (2.0 %)	0 (0.0 %)	22 (22.4 %)	45 (45.9 %)	29 (22.3 %)
Motivation to change	2 (2.0 %)	2 (2.0 %)	8 (8.2 %)	35 (35.7 %)	51 (52.0 %)
Cultural requirements	24 (24.5 %)	20 (20.4 %)	26 (26.5 %)	20 (20.4 %)	8 (8.2 %)
Ethical requirements	18 (18.4 %)	20 (20.4 %)	25 (25.5 %)	21 (21.4 %)	14 (14.3 %)
Environmental requirements	9 (9.2 %)	13 (13.3 %)	32 (32.7 %)	33 (33.7 %)	11 (11.2 %)
Nutritional needs	2 (2.0 %)	1 (1.0 %)	18 (18.4 %)	35 (35.7 %)	42 (42.9 %)
Dietary type	21 (21.4 %)	17 (17.3 %)	27 (27.6 %)	25 (25.5 %)	8 (8.2 %)
Strength of scientific evidence	4 (4.1 %)	6 (6.1 %)	12 (12.2 %)	36 (36.7 %)	40 (40.8 %)
Source of advice	3 (3.1 %)	2 (2.0 %)	16 (16.3 %)	37 (37.8 %)	40 (40.8 %)
Qualifications of the advisor	2 (2.0 %)	4 (4.1 %)	7 (7.1 %)	29 (29.6 %)	56 (57.1 %)
Information on social media	15 (15.3 %)	16 (16.3 %)	32 (32.7 %)	25 (25.5 %)	10 (10.2 %)

independent variables and the dependent variable was consistent across response categories, supporting the appropriateness of the ordinal logistic regression model. The multicollinearity of the variables was assessed using the Variance Inflation Factor (VIF) and Tolerance values. All predictor variables had VIF values below 10 and Tolerance values above 0.1, suggesting that the independent variables do not exhibit high intercorrelation.

The model fit was assessed using pseudo-R^2 values. The Cox & Snell R^2 was 0.428, the Nagelkerke R^2 was 0.447, and the McFadden R^2 was 0.178, suggesting that the model explains a moderate proportion of the

variance in the likelihood of adherence to a TRE protocol with a 3 to 4 h restriction in the eating window, on workdays.

Table 6 presents the results of the ordinal logistic regression analysis predicting the likelihood of participants adhering to a TRE protocol, with a 3 to 4 h reduction in the eating window, on workdays. The dependent variable is coded as "1 = Totally disagree", "2 = Disagree", "1 = Not decided", "4 = Agree", "5 = Totally agree". Independent variables represent factors influencing adherence coded as "1 = Not at all important", "2 = Not very important", "3 = Moderately important", "4 = Important" and "5 = Extremely important". The odds ratio (OR) indicates the likelihood of moving to a higher category of adherence compared to the reference category, for each independent variable.

Table 6
Ordinal logistic regression results for predictors of adherence to a Time-Restricted Eating protocol with a 3 to 4 h restriction in the eating window on workdays.

Predictor Variable	Estimate	SE	*p*-value	Odds Ratio	95 % CI
Threshold					
Totally Disagree (1)	−2.701	0.848	0.001	0.067	−4.364 to −1.039
Disagree (2)	−1.050	0.801	0.190	0.350	−2.620 to 0.519
Not Decided (3)	0.740	0.795	0.352	2.096	−0.819 to 2.298
Agree (4)	2.017	0.831	5.894	7.516	0.389 to 3.646
Sex					
Female (vs. male)	0.851	0.639	0.183	2.342	−0.402 to 2.104
Income/salary					
Not at all important (1) (vs 5)	3.993	1.310	**0.002**	54.217	1.425 to 6.560
Not very important (2) (vs 5)	3.846	1.118	**< 0.001**	46.805	1.656 to 6.036
Moderately important (3) (vs 5)	1.857	0.879	**0.035**	6.404	0.135 to 3.579
Important (4) (vs 5)	0.727	0.622	0.242	2.069	−0.492 to 1.946
Body weight management					
Not at all important (1) (vs 5)	−2.652	1.176	**0.024**	0.071	−4.957 to −0.348
Not very important (2) (vs 5)	−1.582	0.763	**0.038**	0.206	−3.078 to −0.085
Moderately important (3) (vs 5)	−1.146	0.567	**0.043**	0.318	−2.257 to −0.035
Personal cooking knowledge					
Not at all important (1) (vs 5)	−3.417	1.138	**0.003**	0.033	−5.648 to −1.186
Not very important (2) (vs 5)	−3.001	1.087	**0.006**	0.050	−5.132 to −0.870
Moderately important (3) (vs 5)	−1.420	0.812	0.080	0.242	−3.011 to 0.172
Important (4) (vs 5)	−1.706	0.886	0.054	0.182	−3.443 to 0.030
Motivation to change					
Not very important (2) (vs 5)	−20.497	0.000	–	0.000	−20.497 to −20.497
Moderately important (3) (vs 5)	−1.625	1.002	0.105	0.197	−3.589 to 0.339
Important (4) (vs 5)	−0.049	0.563	0.930	0.952	−1.154 to 1.055
Time availability					
Not very important (2) (vs 5)	−1.307	2.011	0.516	0.271	−5.249 to 2.636
Moderately important (3) (vs 5)	−0.837	0.742	0.259	0.433	−2.291 to 0.617
Important (4) (vs 5)	0.603	0.573	0.292	1.828	−0.520 to 1.726

Sex was not a significant predictor of TRE adherence (OR = 2.34, 95 % CI [−0.402, 2.104], $p = 0.183$), indicating that while women had higher odds of agreeing to adhere to a TRE protocol compared to men, this effect did not reach statistical significance (Table 6). Additionally, the perceived importance of motivation to change and time availability were also not significant predictors of adherence to TRE.

Compared to participants who considered income/salary as "Extremely important", those who considered it "Not at all important", "Not very important" and "Moderately important" were significantly more likely to agree with the TRE protocol. Participants who considered body weight management as "Not at all important", "Not very important", and "Moderately important" were significantly less likely to adhere to TRE, compared to those in the highest category. Similarly, compared to the participants who rated personal cooking knowledge as "Extremely important", those who considered this factor as "Not at all important" and "Not very important" were less likely to adhere to the TRE protocol.

In summary, ordinal logistic regression analysis indicated that the perceived importance of income ($p < 0.001$), body weight management ($p = 0.024$), and cooking knowledge ($p = 0.003$) were significant predictors of the likelihood of TRE adherence with a 3 to 4 h restriction in the eating window, on workdays. However, sex, motivation to change and time availability were not significant predictors of the likelihood of adherence to TRE.

4. Discussion

The findings of this study described the willingness of a sample of adults living in Portugal to potentially adhere to different TRE protocols on workdays and free days. Additionally, it identified factors associated with their likelihood of adhering to TRE protocols and provided insights into their eating windows.

The study showed that, on workdays, most of the participants (71.6 %) exhibited an eating window of 12 to 14 h. However, on free days, this percentage decreased to 31.9 %, while the percentage of participants with an eating window of 10 to 12 h increased to 46.6 % (compared to 11.0 % on workdays). This shift is likely due to a delayed start of the first energy intake on free days, typically during the weekends, as has been observed by previous studies (Santos et al., 2024; Teixeira et al., 2024). The range of the eating windows also aligns with those reported in the study by Jefcoate et al. (Jefcoate et al., 2021), conducted on staff and students of the University of Surrey, who observed that most participants had a daily energy intake window of 10 to 14 h on both workdays (62.7 %) and free days (65.5 %). Similarly, previous research based on a U.S. cohort found that the median daily eating window in that population was 14.75 h (Gill & Panda, 2015). To the best of our knowledge, no studies have specifically reported the eating window of the Portuguese adult population. However, findings from the European Prospective Investigation into Cancer and Nutrition (EPIC) calibration study provide some insights into dietary patterns across some European countries (Huseinovic et al., 2019). Although the authors do not explicitly report the eating window, they provide data on the time of food consumption occasions (FCO), spanning from before breakfast until during the evening (Huseinovic et al., 2019). According to the EPIC study, in Spain, FCO begins at 8:00 am and extends until midnight, corresponding to a 16 h eating window. Similarly, in Italy and France, FCOs start at 7:00 am and conclude at 10:00 pm, which results in a 15 h eating window. In contrast, the Netherlands follows a more restricted eating pattern with FCOs occurring from 8:00 am to 8:00 pm, corresponding to a 12 h eating window. In Greece, FCO spans from 8:00 am to 11:00 pm, which leads to an extended eating window of 15 h. Meanwhile, Germany, the United Kingdom, and Denmark begin FCO before breakfast at 7:00 am and continue until 9:00 pm, yielding a 14 h eating window (Huseinovic

et al., 2019).

The timing of the first and last energy intake observed in the present study aligns with the patterns of most of the countries reported in the EPIC study, as most of the participants consumed their first energy intake between 8:00 am and 10:00 am on both workdays (56.4 %) and free days (46.6 %). Similarly, most participants had their last energy intake between 8:00 pm and 10:00 pm on both workdays (80.0 %) and free days (76.5 %). These findings are consistent with the EPIC study's observations, which highlighted later meal consumption in the Mediterranean countries compared with Central and Northern European countries (Huseinovic et al., 2019).

Evidence suggest that various dietary strategies aimed at creating an energy deficit can be equally effective in facilitating weight loss (Kim, 2021; Ramage et al., 2014; van Baak & Mariman, 2019). However, high attrition rates remain a significant challenge in these weight-loss dietary interventions (Moroshko et al., 2011). This highlights the importance of incorporating individual preferences to improve adherence rates to nutritional interventions and enhance their potential health benefits. Furthermore, it is crucial to implement strategies that align with the demands and lifestyle patterns of modern society and its daily living conditions. Adherence to different TRE protocols implemented in clinical studies has been reported to range from 63 % to 100 % (Anton et al., 2019; Chow et al., 2020; Jefcoate et al., 2023; Lowe et al., 2020; Parr, Devlin, Radford et al., 2020; Ravussin et al., 2019; Sutton et al., 2018; Tinsley et al., 2017, 2019). However, as these success rates were often measured using self-reported methods, the findings should be interpreted with caution due to the potential for reporting bias.

Previous studies have identified work schedules, social activities, and family responsibilities as key barriers to following TRE (Antoni et al., 2018; Bjerre et al., 2021; Jefcoate et al., 2023; Lee et al., 2020; O'Connor et al., 2022; Parr, Devlin, Lim et al., 2020, 2020). In our study, a negative correlation was observed between commute time from work to home and the likelihood of adherence to TRE protocols with a 3 to 4 h and >4 h restriction on the eating window on workdays. These findings suggest that longer commute times, as an extension of work-related time commitments, may further constrain post-work eating, thereby reducing the feasibility of TRE adherence. This reinforces the influence of work schedules as a barrier to dietary behaviour (O'Connor et al., 2022) and underlines the need to consider professional and commuting factors when planning practical TRE interventions. Although a greater proportion of participants would be able to adhere to TRE on workdays compared to free days, this apparent advantage may be mitigated by the restrictive impact of extended commute times, underscoring the complexity of aligning TRE with real-life routines.

The observed negative correlation between age and the willingness to adhere to TRE, if there were health benefits, suggests that older individuals may be less inclined to recognise or experience the advantages of TRE. In contrast, Mousavi et al. (Mousavi et al., 2022) reported a positive correlation between age and diet adherence. These discrepancies may be attributed to the relatively young mean age of our sample, as well as the distinction between adherence to a structured and potentially restrictive nutritional strategy, such as TRE, versus adherence to general healthy diet guidelines.

A weak negative correlation was observed between sex and the likelihood of adherence to TRE, suggesting that men were less likely to adhere to this intervention. However, the interpretation of this finding should be approached with caution due to the substantial sex imbalance in the sample, with women comprising approximately 80 % of participants. This disproportion may introduce bias and limit the generalisability of sex-related conclusions. Currently, there is a paucity of human studies exploring sex differences in TRE perception and adherence to these protocols. Nevertheless, our findings are consistent with prior research, indicating that women are generally more likely to engage in dietary interventions (Bärebring et al., 2018; Rose et al., 2024). These results highlight the need for future studies with more balanced sex representation to better understand potential sex-specific factors influencing adherence to TRE.

The percentage of participants who agreed or totally agreed – calculated as the sum of both response categories – that they would be able to restrict their daily eating window by 30 min or 30 min to 1 h ranged from 59.3 % on workdays (30 min to 1 h) to 68.4 % on free days (30 min). However, adherence likelihood decreased as the restriction period increased. When the proposed reduction in the eating window ranged from 3 to 4 h or exceeded 4 h, fewer than 35.0 % of participants agreed or strongly agreed that they would be able to comply (ranging from 22.3 % to 33.8 %). These findings contrast with those reported by Jefcoate et al. (Jefcoate et al., 2021), who observed higher adherence expectations in a sample of staff and students from the University of Surrey, where approximately 59 % of participants with a daily eating window of 12 h or more indicated that they could incorporate a 3-hour restriction into their routine. The discrepancy between these results may be attributed to differences in cultural and social contexts. As mentioned above, notably, Mediterranean countries, including Portugal, typically have later dinner times, which may render larger reductions in the eating window more challenging due to potential interference with family meals and dinner social events.

Furthermore, in the present study, participants consistently reported a higher willingness to follow TRE protocols on free days compared to workdays, suggesting that adherence may be more feasible in the absence of work-related commitments and schedules. Although in our study, time availability was not identified as a significant predictor of TRE adherence, a considerable proportion of participants perceived it as important or extremely important (38.8 % and 36.7 %, respectively). These observations may indicate that while time constraints do not entirely determine adherence, they may still influence the individual's ability to implement dietary modifications, especially on structured workdays. The flexibility of free days may therefore facilitate TRE adherence by allowing individuals to better control meal timing without the constraints imposed by professional obligations. This interpretation is consistent with the findings of Jefcoate et al. (Jefcoate et al., 2021), who reported that time availability was a significant predictor of the motivation to adopt TRE on both workdays and free days. Another study by Jefcoate et al. (Jefcoate et al., 2023) further highlighted time availability as a key determinant of TRE adherence, demonstrating that individual preferences for adopting TRE varied depending on daily schedules. While some participants indicated a preference for TRE on weekdays, and then have flexibility over the weekends, others found it more feasible on free days.

The present study identified moderate positive correlations between the potential health benefits of TRE and the willingness to adhere to TRE on both workdays and free days, suggesting that individuals who recognise the potential health benefits of TRE are more likely to follow this dietary strategy, regardless of their daily schedule. Previous studies have highlighted that perceived benefits play a fundamental role in dietary adherence. Individuals are more motivated to integrate a specific nutritional approach into their routines if they believe that it offers evident health improvements (Cruwys et al., 2020; Wilson et al., 2024). Interestingly, the correlation was slightly stronger on free days compared to workdays, which may reflect the greater flexibility and autonomy individuals have on free days, potentially facilitating adherence to TRE. However, in contrast to our findings, Jefcoate and colleagues (Jefcoate et al., 2023) reported that most participants in their study preferred to follow TRE on weekdays and have more flexibility on the weekends.

Our findings suggest that participants who do not view income/salary as an important factor when considering TRE are significantly more likely to adhere to this dietary approach. A possible explanation is that these individuals may view TRE as a cost-neutral intervention, making affordability concerns less relevant in their decision process. While our study did not assess participants' income, the results highlight the potential role of financial perception in health-related decision-making. Although the predictive model by Jefcoate et al. (Jefcoate et al.,

2021) did not include income/salary, their findings identified cost as a significant predictor of TRE adherence. Therefore, financial considerations, whether real or perceived, may model individuals' willingness or likelihood to follow TRE. This aligns with previous research that indicates that socioeconomic factors influence adherence to dietary recommendations (Bonaccio et al., 2012; Carrasco-Marín et al., 2024; Forray et al., 2023; Kontele et al., 2025), which reinforces the idea that future research should further explore how socioeconomic status and financial perceptions interact with TRE adherence to develop more comprehensive and effective dietary interventions.

Participants who did not perceive body weight management as an important factor in their decision-making process were less likely to adhere to TRE. Previous research has shown that body weight-related motivations are drivers of adherence to dietary strategies, with individuals who prioritise weight management being more likely to adopt and maintain specific eating habits (Mousavi et al., 2022; Xu et al., 2018). Also, in the study by Jefcoate et al. (Jefcoate et al., 2023), participants reported that the main incentive to follow TRE was induced weight loss or the prevention of undesired weight gain.

Lastly, the results of the present study suggest that participants who perceived cooking knowledge as an important factor are more likely to adhere to TRE. This might be explained by the fact that individuals with greater culinary skills tend to have higher confidence in meal preparation, enabling them to plan and organise more effectively (Garcia et al., 2016). Previous research demonstrated that cooking and food preparation skills are positively associated with healthier attitudes and habits towards nutrition (Ducrot et al., 2017; Mengi Çelik et al., 2023). Since TRE involves deliberate meal timing, individuals who have more cooking knowledge and are more comfortable with food preparation may find it easier to adapt to structuring daily eating windows. These findings underscore the potential of cooking education as a supportive component of TRE or, even, other dietary interventions.

Although this study mainly focuses on behavioural aspects of adherence to TRE, these findings might have relevant implications for the food industry and production optimisation. Identifying and understanding the eating patterns of consumers, including the variability between workdays and free days, and the factors influencing dietary adherence, can support the development of effective interventions (Dashti et al., 2019) and, eventually, of food products and services.

Food manufacturers and retailers may consider adjusting the composition and packaging of products to better fit compressed eating windows. The findings of this study may inform the development of time-aligned food products designed to support adherence to TRE protocols. For example, ready-to-eat meals, functional foods, and nutrient-dense snacks optimised for early or late day consumption could enhance convenience and accommodate shortened eating windows. Such product innovations, such as breakfast solutions or evening meals tailored to TRE schedules, may be particularly valuable for individuals looking to improve metabolic health through meal timing strategies. Insights into consumer adherence may also guide packaging innovations (e.g. single-serve options designed for specific TRE windows), which may help consumers self-regulate and improve compliance.

Additionally, insights into motivational and logistical barriers (e.g. commute time, health concerns, or body weight management identified in the present study) can inform direct marketing strategies and drive product innovation aimed at health-conscious consumers (Defraeye et al., 2025; Šálková et al., 2023). From a production and operations perspective, aligning food design and distribution schedules with consumers' preferred eating windows may also contribute to reducing food waste and improving supply chain efficiency (Irani et al., 2018). Moreover, considering variations in eating habits between workdays and free days might assist service providers and manufacturers in coordinating production and delivery with peak consumption times, eventually supporting a more sustainable food system planning.

Furthermore, the identification of key motivators and barriers to TRE adherence is important for the design and development of personalised nutrition tools and services. Digital health platforms, mobile applications, and wearable technologies could incorporate behaviorally relevant factors into algorithm-driven support systems to offer customised TRE counselling, meal suggestions, and motivational content based on user preferences and challenges (Lu et al., 2025; Papastratis et al., 2024). This approach represents a valuable connection between nutritional science, behavioural psychology, and digital innovation, with promising applications for both health technology companies and the food industry.

Therefore, in addition to behavioural and health implications, these insights may support innovation in food product development, personalised nutrition services, and supply chain optimisation, enhancing consumer support and industry responsiveness to time-based dietary practices such as TRE.

Some limitations should be taken into consideration when interpreting the findings of the present study. The study was characterised by limited sex- and age-related variability, and the sample size was relatively small, which may affect the generalizability of the results, as an imbalance in sex and age distribution can impact the analysis of the factors that motivate individuals to adhere to TRE. To enhance statistical robustness and general applicability, future studies would benefit from larger sample sizes. Another limitation of this study sample pertains to the participants' educational background, as all individuals had completed either high school or higher education, which may not accurately reflect the general population. This limitation may be attributed to the study's dissemination primarily within higher education institutions. Future research should expand dissemination strategies to reach the community at large, ensuring greater representativeness. Also, although the current occupation was assessed, the wide heterogeneity of reported professions limited the ability to perform a meaningful analysis of its potential impact on adherence to TRE protocols. Additionally, in future studies, a more detailed assessment of participants' education (i.e. area of education), socioeconomic status and, eventually, other key considerations could provide valuable insights into factors influencing the uptake of TRE.

Theoretically, TRE is a straightforward dietary approach, and sustained long-term adherence is likely to be a key determinant of its effectiveness. However, the results of the present study, along with previous findings, demonstrate the complexities of integrating TRE into daily routines. Collectively, the results of this study indicate that adherence to TRE is more likely when individuals do not perceive income as an important factor, whereas adherence is less likely when body weight management and cooking knowledge are not considered important factors. Notably, the importance attributed to motivation to change and time availability did not influence the likelihood of TRE adherence. Therefore, as emphasised by Jefcoate and colleagues (Jefcoate et al., 2021), further research is needed across diverse population groups to examine the various factors influencing dietary adherence and lifestyle modifications, particularly in the context of TRE interventions. Within this framework, the present findings contribute to evaluating the feasibility of translating TRE from an experimental framework into a sustainable real-world intervention.

5. Conclusions

The potential health benefits of interventions with TRE protocols can only be successfully achieved if individuals can incorporate its principles into their daily routines. This study contributes to the advancement, identification and understanding of key factors that should be considered when implementing TRE interventions, such as the importance of body weight management, as well as providing insights into the eating schedules and eating windows of this sample of Portuguese adults. Future research, guided by the evolving body of scientific evidence on TRE protocols, is required to better understand and enhance the feasibility of these interventions in real-world settings to optimise their translational effect.

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Ethical statement

The study was approved by the Ethics Committee of the Polytechnic University of Leiria (n.° CE/IPLEIRIA/31/2021) and conducted following the principles of the Declaration of Helsinki. The study was designed and implemented in compliance with ethical standards and the General Data Protection Regulation (EU) 2016/679. To fill out the questionnaire, the participants had to provide their consent to participate in the study and accept the terms and conditions of the study, namely, being 18 years old or above and residing in Portugal.

CRediT authorship contribution statement

Marlene Lages: Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Sara Carmo-Silva:** Writing – review & editing, Writing – original draft, Validation, Supervision, Project administration, Methodology, Conceptualization. **Renata Barros:** Writing – review & editing, Writing – original draft, Validation, Supervision, Project administration, Conceptualization. **Maria P. Guarino:** Writing – review & editing, Writing – original draft, Validation, Supervision, Methodology, Conceptualization.

Declaration of competing interest

The authors declare no conflicts of interest.

Data availability

Data will be made available on request.

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