



Full Length Article

Normative scores for the three factor eating questionnaire (TFEQ-R18) in a UK population-based cohort

Cara F. Ruggiero^{*}, Laura Kudlek, Julia Mueller, Simon J. Griffin, Stephen J. Sharp, Nick J. Wareham, Soren Brage, Nita G. Forouhi, Ken K. Ong, Amy Ahern

MRC Epidemiology Unit, University of Cambridge School of Clinical Medicine, Box 285 Institute of Metabolic Science, Cambridge Biomedical Campus, Cambridge, CB2 0QQ, United Kingdom

ARTICLE INFO

Keywords:

Eating behaviour traits

Obesity

Precision prevention

ABSTRACT

Eating behaviour traits (EBTs), individuals' reactions to food, food-related cues, and food intake, play an important role in the development and maintenance of overweight and obesity. We provide population-based norms for cognitive restraint, uncontrolled eating, and emotional eating as measured by the Three Factor Eating questionnaire (short form, TFEQ-18) in a UK cohort of middle-aged adults (the Fenland Study). Participants included 7830 individuals recruited across Cambridgeshire General Practices; 51.8 % identified as female and participants reported a mean BMI of 26.8. Unadjusted linear regression estimated demographic (sex, age) and anthropometric (Body Mass Index, BMI) associations with each EBT to identify subgroups to derive normative scores. Percentiles of each EBT were calculated for the overall population and subgroups. Males scored lower than females on cognitive restraint ($\beta = -7.86$, 95 % CI [-8.69, -7.03], $p < 0.001$), uncontrolled eating ($\beta = -1.03$, 95 % CI [-1.80, -0.26], $p = 0.008$), and emotional eating ($\beta = -13.13$, 95 % CI [-14.28, -11.98], $p < 0.001$). Older age was associated with higher scores on cognitive restraint ($\beta = 0.13$, 95 % CI [0.07, 0.19], $p < 0.001$), and lower scores on uncontrolled eating ($\beta = -0.34$, 95 % CI [-0.39, -0.28], $p < 0.001$) and emotional eating ($\beta = -0.13$, 95 % CI [-0.21, -0.04], $p = 0.002$). Higher BMI was associated with higher emotional eating ($\beta = 1.71$, 95 % CI [1.59, 1.83], $p < 0.001$) and uncontrolled eating ($\beta = 1.05$, 95 % CI [0.97, 1.12], $p < 0.001$). BMI was not associated with cognitive restraint. Normative scores provide context for individual EBT scores and may inform development, refinement, and application of prevention strategies for overweight, obesity, and eating disorders.

1. Introduction

Overweight and obesity remain considerable global health concerns and are associated with leading causes of death, such as diabetes, metabolic diseases, and several types of cancers (World Health Organization, 2021). Approximately 60 % of adults in the United Kingdom (UK) (NHS digital, 2020) and 70 % of adults in the United States (US) (National Institute of Diabetes and Digestive and Kidney Disease, 2021) are living with overweight or obesity. These conditions remain public health priorities, but the causes and factors that predict who will be affected are not completely understood. One key contributor to overweight and obesity is eating behaviour traits (EBTs), the complex interplay of factors that influence how, when, and what individuals eat (Birch, 1999). Specifically, EBTs are defined as individuals' reactions to food, food-related cues, and food intake, and play an important role in

the development and maintenance of overweight and obesity (Llewellyn & Fildes, 2017). EBTs shape how individuals interpret hunger and fullness, respond to external food cues, and regulate intake (Blundell et al., 2005). Although often examined in relation to obesity, EBTs can influence broader dietary patterns and risk for eating-related psychopathology such as binge and loss-of-control eating (Rossi et al., 2024) or cycles of restriction and overeating (Karlsson et al., 2000).

EBTs are commonly assessed using psychometric measures. One of the most common measures of EBTs is the Three Factor Eating Questionnaire (TFEQ) (Stunkard & Messick, 1985). The original TFEQ included 51 items and assessed cognitive restraint, disinhibition, and hunger (Stunkard & Messick, 1985). Revisions have led to shorter versions with 18 (Karlsson et al., 2000) and 21 (Tholin et al., 2005) items that measure three EBT domains: cognitive restraint (i.e., the conscious control of food intake to influence body weight), uncontrolled eating (i.

^{*} Corresponding author.

E-mail address: cfr30@cam.ac.uk (C.F. Ruggiero).

<https://doi.org/10.1016/j.appet.2026.108466>

Received 16 July 2025; Received in revised form 17 December 2025; Accepted 17 January 2026

Available online 23 January 2026

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e., the tendency to overeat in response to feelings of hunger and external stimuli), and emotional eating (i.e., the tendency to overeat in response to negative emotions) (Karlsson et al., 2000). The 18-item version includes improved psychometric properties and has been translated and validated for use in international samples (Awad et al., 2025; Rossi et al., 2024), demonstrating practicality for large, epidemiological studies and clinical practice (Karlsson et al., 2000).

Responses to weight loss treatment are variable (MacLean et al., 2018), and tailoring treatment to an individual's EBTs could potentially improve weight loss outcomes (van Strien, 2018). It is therefore critical to understand how measures of EBTs in individuals compare to similar populations and relevant subgroups in order to more informatively utilize EBTs in the development, refinement, and application of prevention and intervention strategies. One way to understand EBTs is through 'normative data,' which provide details on score distributions and prevalence of scores in a reference sample of the population of interest. Such normative data are necessary to interpret how high or low an individual (or a group) scores compared to this reference sample. This is particularly useful when assigning or stratifying participants into low or high scoring groups in trials and observational studies such as EBT-specific recruitment or exploring effects of different levels of EBTs on the outcome of interest (Lillis et al., 2016). An early study by Stunkard and Messick reported EBT score ranges, however, the sample size was 98 participants, limited to the US and results were not stratified by subgroup, limiting the application of these scores to other samples (Allison & Baskin, 2009; Stunkard & Messick, 1988).

Since TFEQ scores differ by gender, nationality, and weight status, the utility of these reported ranges is limited (Allison & Baskin, 2009). In the absence of robust normative data that consider differences in TFEQ scores across such subgroups, studies often simply assign participants to "high" and "low" EBT groups compared to the population median (Aur lie et al., 2012). Normative TFEQ-R18 data have been published for a German population-based sample ($n = 3144$, 40–79 years of age) (L ffler, Luck, Then, Lupp , et al., 2015), however, none are available for the UK. Therefore, this study aims to provide population-based norms for the TFEQ-R18 based on a large, population-based cohort of the UK population.

2. Methods

2.1. Participants

The Fenland Study aims to investigate the interaction between environmental and genetic factors in determining the risk of obesity, type 2 diabetes, and related metabolic disorders. The Fenland cohort includes 12,435 adults born between 1950 and 1975 recruited from Cambridgeshire general practices for baseline assessment (phase 1) between 2005 and 2015; a comparison of the sample and the population sampling frame has been described elsewhere (Lindsay et al., 2019). Data collection for phase 2 was conducted from 2014 to 2020 and included 7,830 individuals who completed the TFEQ-R18. All participants provided written consent. Ethical approval for the Fenland Study was obtained from the East of England Cambridge Central Health Research Authority National Research Ethics Service Committee (#14/EE/0122). The study followed principles of the declaration of Helsinki.

2.2. Measures

2.2.1. Outcome

The TFEQ-R18 (Stunkard & Messick, 1985) is a self-reported assessment of three EBTs: cognitive restraint (i.e., the conscious control of food intake to influence body weight), uncontrolled eating (i.e., the tendency to overeat in response to feelings of hunger and external stimuli), and emotional eating (i.e., the tendency to overeat in response to negative emotions). The domain of cognitive restraint contains 6

items, uncontrolled eating contains 9 items, and emotional eating contains 3 items (Karlsson et al., 2000). Of the 18 items, 17 are answered on a 4-point Likert scale (never, rarely, sometimes, at least once a week) and one item is answered on an 8-point Likert scale (from no restraint to total restraint), which was converted to a 4-point Likert scale for the Fenland study to match the other items. To generate subscale scores on a 0 to 100 scale, the following equation was used in line with previous studies (de Lauzon et al., 2004; de Lauzon-Guillain, Clifton, Day, Cl ment, Brage, Forouhi, Griffin, Koudou, Pelloux, Wareham, et al., 2017): $[(\text{raw score} - \text{lowest possible raw score}) / (\text{possible raw score range})] \times 100$. Higher scores indicate more restraint, uncontrolled eating, and emotional eating. The TFEQ was completed at the clinic visit initially on paper until July 2015, when it transitioned to electronic data collection at the clinic visit. Participants were fasted before their clinic visit but did consume an oral glucose tolerance test standard drink at the beginning of their visit after consent and the first set of bloods. Participants completed most of the measurements before being taken to complete the questionnaires.

2.2.2. Exposures

Biological sex was self-reported as male or female and was coded as 0 and 1, respectively. Age was self-reported in years. BMI was calculated as weight (kg) divided by the square of height (m^2), measured by study facilitators. Details on anthropometric measures have been previously published (Lindsay et al., 2022).

2.3. Statistical analyses

All analyses were conducted using R Statistical Software (version 4.3.1) R Core Team, 2023) using the ggplot2 (Wickham, 2016), e1071 (Meyer et al., 2019), tidyverse (Wickham et al., 2019), ggsidpanel (Goode & Rey, 2019), and ggally (Schloerke et al., 2025) packages.

2.3.1. Linear regression

Linear regression was used to describe the association of sex, age, and BMI with TFEQ-R18 domains. First, we estimated the unadjusted association of each exposure (i.e., sex, age, BMI) separately with each TFEQ-R18 subscale (i.e., cognitive restraint, uncontrolled eating, emotional eating) (Supplementary Table 1). We entered a dichotomous variable for sex and continuous variables for age and BMI in regression models; significantly associated variables were subsequently categorized in order to generate normative data within population subgroups.

2.3.2. Normative scores

We utilised the following steps to generate normative scores. First, significant continuous variables from the linear regression models above were further tested for second and third order interactions with TFEQ-R18 domains in separate multiple regression models for each interaction term (e.g., sex*age, sex*age*BMI). These models guided decisions on the creation of subgroups for the provision of normative data (i.e., deciles) and are summarized in Supplementary Tables 2–4. Second, for ease of interpretation, age was dichotomised into ≥ 55 and < 55 years using a data informed approach. Given the data did not sufficiently distinguish between the predefined categories of "Middle Age," "Senior," and "Retired", these were collapsed into a two-level variable (i.e., "Middle Age, < 55 years," vs "Senior, ≥ 55 years"). BMI was divided into three categories (i.e., normal ($< 25 \text{ kg/m}^2$), overweight ($25\text{--}29.9 \text{ kg/m}^2$), obesity ($\geq 30 \text{ kg/m}^2$)) based on clinical cutoffs for generating the normative data. Third, using the quantile function in R, we generated sex, age, and BMI specific decile for each domain based on the raw scores of the TFEQ. A person's rank score corresponds to the percentage of individuals who have lower or equal scores in a domain. For example, if a person has a rank score that corresponds to the 90th decile in the domain of emotional overeating, that means that 90 % of the sample has lower or equal scores in that domain.

3. Results

3.1. Demographics

Participants who completed the TFEQ-R18 (n = 7,830) had mean (SD) age 56.0 (7.1) years (Office for National Statistics, 2024), mean (SD) BMI 26.8 (4.8) kg/m², and 51.8 % were female (Table 1). Almost thirty percent (29.6 %) reported household incomes £20,000-<£40,000 per year. The mean (SD) age on completion of full-time education was 19.2 (4.6) years, and 94.1 % identified as White.

3.2. Linear regression

In linear models, males scored lower than females on cognitive restraint ($\beta = -7.86$, 95 % CI [-8.69, -7.03], $p < 0.001$), uncontrolled eating ($\beta = -1.03$, 95 % CI [-1.80, -0.26], $p = 0.008$), and emotional eating ($\beta = -13.13$, 95 % CI [-14.28, -11.98], $p < 0.001$). Older age was associated with higher scores on cognitive restraint ($\beta = 0.13$, 95 % CI [0.07, 0.19], $p < 0.001$), and lower on uncontrolled eating ($\beta = -0.34$, 95 % CI [-0.39, -0.28], $p < 0.001$) and emotional eating ($\beta = -0.13$, 95 % CI [-0.21, -0.04], $p = 0.002$). Higher BMI was associated with higher scores for emotional eating ($\beta = 1.71$, 95 % CI [1.59, 1.83], $p < 0.001$) and uncontrolled eating ($\beta = 1.05$, 95 % CI [0.97, 1.12], $p < 0.001$). There was no evidence that BMI was associated with cognitive restraint ($\beta = 0.03$, 95 % CI [-0.06, 0.12], $p = 0.47$). These results are summarized in Supplementary Table 1. For emotional eating, we identified a statistically significant interaction between sex and BMI ($\beta = -0.32$, 95 % CI [-0.55, -0.09], $p = 0.007$) such that the association between BMI and emotional eating was stronger in females than in males (i.e., as BMI increases, females showed a greater increase in emotional eating compared with males) and between age and BMI ($\beta = -0.02$, 95 % CI [-0.04, -0.003], $p = 0.02$) such that the relationship between BMI and emotional eating was stronger in younger individuals (i.e., as age increases, BMI was less strongly associated with emotional eating). For uncontrolled eating we identified an interaction between sex and BMI ($\beta = 0.24$, 95 % CI [0.08, 0.41], $p = 0.003$) such that the association between BMI and uncontrolled eating was stronger in males than in females (i.e., as BMI increases, uncontrolled eating increased more in males). For cognitive restraint, we identified no statistically significant interactions. Tables 2–6 present the age, sex, and BMI-specific percentile ranks of the TFEQ-R18 domains within the above statistically significant subgroups.

3.3. Normative scores

Based on these results from the regression analyses above, we generated the following subgroups for reporting the normative scores.

Table 1
Demographic characteristics of the Fenland study sample (n = 7830).

Age, mean (SD)	56.0 (7.1)
Females, n (%)	4052 (51.8)
BMI, mean (SD)	26.8 (4.8)
Household Income, n (%)	
<£20,000	972 (12.4 %)
£20,000-<£40,000	2317 (29.6 %)
£40,00-<£60,000	1776 (22.7 %)
£60,000-<£80,000	1087 (13.9 %)
≥£80,000	1477 (18.9 %)
Missing	194 (2.5 %)
Age, Full Time Education Completed, mean (SD) years	19.2 (4.6)
Ethnicity, n (%)	
White	7371 (94.1 %)
South Asian	85 (1.1 %)
Black	30 (0.4 %)
East Asian	37 (0.5 %)
Other	27 (0.3 %)

Table 2

Normative scores Three-factor-Eating-Questionnaire: Cognitive Restraint, by age (n = 7,830).

Decile	Middle age (<55 years)	Older age (≥55 years)
0 %	0.00	0.00
10 %	16.67	16.67
20 %	27.78	27.78
30 %	33.33	33.33
40 %	38.89	38.89
50 %	38.89	44.44
60 %	44.44	50.00
70 %	50.00	55.56
80 %	55.56	61.11
90 %	66.67	66.67
100 %	100.00	100.00

Table 3

Normative scores Three-factor-Eating-Questionnaire: Cognitive Restraint, by sex (n = 7,830).

Decile	Males	Females
0 %	0.00	0.00
10 %	11.11	22.22
20 %	22.22	27.78
30 %	27.78	33.33
40 %	33.33	38.89
50 %	38.89	44.44
60 %	44.44	50.00
70 %	50.00	55.56
80 %	55.56	61.11
90 %	61.11	66.67
100 %	100.00	100.00

We generated subgroups of cognitive restraint by age (Table 2) as well as sex (Table 3), uncontrolled eating by sex and BMI category (Table 4) as well as age (Table 5), and emotional eating by sex and BMI category (Table 6), and by age and BMI category (Table 7). Normative scores are reported for each subgroup in Tables 2–7

4. Discussion

This study aimed to provide sex, age, and BMI-specific normative data for the TFEQ-R18. Our results indicate the need for specific percentile ranks of TFEQ-R18 domains based on sex, age, and BMI. Adults aged ≥55 years scored higher than adults <55 years on cognitive restraint and lower on uncontrolled eating and emotional eating. Males scored lower than females on all domains, i.e. cognitive restraint, uncontrolled eating, and emotional eating. Higher BMI was associated with higher scores for emotional eating and uncontrolled eating. There was no evidence that BMI was associated with cognitive restraint. Normative scores were generated, and rank scores corresponded to the percentage of individuals that had lower or equal scores in a domain.

We found that sex was associated with all three TFEQ-R18 domains, with higher mean scores in females than in males. This is similar to the findings in a German sample (Löffler, Luck, Then, Lupp, et al., 2015) of 3,144 participants (mean age 55 years) that found females scored higher than males in all three domains. Our findings also align with a nationally representative French sample (Lesdéma et al., 2012) of 1,000 adults (mean age 29 years old) that found that women scored significantly higher than men on restraint and disinhibition. Conversely, using a 51-item Thai version of the TFEQ in a Thai sample, only restraint and disinhibition were higher in females than males (Chearskul et al., 2010). However, that study was conducted using the 51-item version of the questionnaire on a small sample of young (range 19–21 years), healthy, medical students and thus may not translate to the general population.

Our findings also showed that adults aged ≥55 years scored higher than adults aged <55 years on cognitive restraint and lower on uncontrolled eating and emotional eating. This is in line with the German

Table 4

Normative scores Three-factor-Eating-Questionnaire: Uncontrolled Eating, by sex and BMI category (n = 7,830).

Decile	Males			Females		
	Normal Weight	Overweight	Obesity	Normal Weight	Overweight	Obesity
0 %	0.00	0.00	0.00	0.00	0.00	0.00
10 %	3.70	7.41	11.11	3.70	7.41	13.70
20 %	7.41	11.11	18.52	11.11	14.81	22.22
30 %	11.11	14.81	22.22	14.81	18.52	25.93
40 %	14.81	22.22	29.63	18.52	25.93	33.33
50 %	18.52	25.93	37.04	22.22	29.63	37.04
60 %	25.93	29.63	40.74	25.93	33.33	40.74
70 %	29.63	37.04	44.44	32.59	40.74	44.44
80 %	37.04	40.74	51.85	37.04	44.44	51.85
90 %	44.44	48.14	62.96	44.44	51.85	59.26
100 %	96.30	96.30	92.59	88.88	88.89	92.59

¹BMI categories defined as Normal Weight: <25; Overweight: 25–29.9; Obesity: ≥30 kg/m.².**Table 5**

Normative scores Three-factor-Eating-Questionnaire: Uncontrolled Eating, by age (n = 7,830).

Decile	Middle age (<55 years)	Older age (≥55 years)
0 %	0.00	0.00
10 %	7.41	7.41
20 %	14.81	11.11
30 %	18.52	14.81
40 %	25.93	18.52
50 %	29.63	25.93
60 %	33.33	29.63
70 %	37.04	33.33
80 %	44.44	40.74
90 %	55.56	48.15
100 %	96.30	92.59

sample that found higher scores in the older age groups than in the younger age groups for cognitive restraint and lower scores in the older age groups compared to younger age groups for disinhibition and hunger (Löffler, Luck, Then, Lupp, et al., 2015). One explanation for these findings is that control in eating increases as people age. This is supported by other studies that have shown an increase in dieting behaviours (Rizvi et al., 1999), awareness of concerns about health (Conrad et al., 2024), and self-discipline (Heckhausen & Schulz, 1995) as people age.

Our associations between BMI and emotional and uncontrolled eating are consistent with previous reports. A systematic review and meta-analysis of 83 studies (mean BMI = 25.20 kg/m², mean age = 27 years, mean sample size = 70) examined cross-sectional associations of EBTs and BMI found that higher emotional and uncontrolled eating were associated with higher BMI, and that uncontrolled eating had the strongest association (Dakin et al., 2022). However, evidence on

Table 6

Normative scores Three-factor-Eating-Questionnaire: Emotional Eating by sex and BMI category (n = 7,830).

Decile	Males			Females		
	Normal Weight	Overweight	Obesity	Normal Weight	Overweight	Obesity
0 %	0.00	0.00	0.00	0.00	0.00	0.00
10 %	0.00	0.00	0.00	0.00	0.00	22.22
20 %	0.00	0.00	11.11	0.00	11.11	33.33
30 %	0.00	11.11	22.22	11.11	22.22	44.44
40 %	0.00	11.11	26.67	22.22	33.33	44.44
50 %	11.11	22.22	33.33	33.33	44.44	55.56
60 %	22.22	33.33	44.44	33.33	44.44	66.67
70 %	33.33	33.33	55.56	44.44	55.56	66.67
80 %	33.33	44.44	66.67	55.56	66.67	77.78
90 %	44.44	55.56	77.78	66.67	77.78	88.89
100 %	100.00	100.00	100.00	100.00	100.00	100.00

¹BMI categories defined as Normal Weight: <25 kg/m²; Overweight: 25–29.9 kg/m²; Obesity: ≥30 kg/m.².**Table 7**

Normative scores Three-factor-Eating-Questionnaire: Emotional Eating by age and BMI category (n = 7,830).

Decile	<55 years of age			≥55 years of age		
	Normal Weight	Overweight	Obesity	Normal Weight	Overweight	Obesity
0 %	0.00	0.00	0.00	0.00	0.00	0.00
10 %	0.00	0.00	11.11	0.00	0.00	0.00
20 %	0.00	0.00	22.22	0.00	0.00	11.11
30 %	11.11	11.11	33.33	11.11	11.11	33.33
40 %	11.11	22.22	44.44	11.11	22.22	33.33
50 %	22.22	33.33	44.44	22.22	33.33	44.44
60 %	33.33	44.44	55.56	33.33	33.33	55.56
70 %	33.33	44.44	66.67	33.33	44.44	66.67
80 %	44.44	55.56	66.67	44.44	55.56	66.67
90 %	55.56	66.67	88.89	55.56	66.67	88.89
100 %	100.00	100.00	100.00	100.00	100.00	100.00

¹BMI categories defined as Normal Weight: <25 kg/m²; Overweight: 25–29.9 kg/m²; Obesity: ≥30 kg/m.².

cognitive restraint and BMI is mixed (Dakin et al., 2022; Dykes et al., 2004; French et al., 2014). Lesdéma and colleagues reported significant associations between BMI and all three TFEQ domains (Lesdéma et al., 2012). However, we did not find associations between BMI and cognitive restraint, but this could be due to the quadratic association between cognitive restraint and BMI that was previously demonstrated in the Fenland and EDEN cohorts (de Lauzon-Guillain, Clifton, Day, Clément, Brage, Forouhi, Griffin, Koudou, Pelloux, & Wareham, 2017). The detection of a linear relationship may depend on the distribution of cognitive restraint and BMI in a specific sample. Another study in Germany on the same sample of 3,144 participants (mean age 55 years) found that uncontrolled eating and emotional eating scores above the median had the highest BMI values and scores below the median in all three domains had the lowest BMI values (Löffler, Luck, Then, Sikorski, et al., 2015). This is similar to our findings in that adults with higher BMIs scored higher than adults with lower BMIs on each of emotional eating and uncontrolled eating, however, we did not find BMI to be associated with cognitive restraint. Previous findings from the Fenland cohort demonstrated that the association between a BMI genetic risk score and BMI was mediated by both emotional and uncontrolled eating. By contrast, cognitive restraint was not a true mediator and was instead found to be an effect modifier of the relationship in the overall sample (de Lauzon-Guillain, Clifton, Day, Clément, Brage, Forouhi, Griffin, Koudou, Pelloux, & Wareham, 2017). Therefore, high levels of cognitive control restraint may attenuate genetic susceptibility to obesity through a different mechanism than emotional and uncontrolled eating.

The normative scores developed in this study have a range of potential uses for future research and clinical practice. In research, normative data can help establish reference ranges by defining what is “typical” or “at risk” eating behaviour for a specific sex, age, or BMI category for tailored interventions. For example, Table 2 indicates that, among participants younger than 55, the 50th decile of cognitive restraint score was 38.89, however, among participants aged 55 and over, the 50th decile score was slightly higher at 44.44. This could aid in targeted recruitment efforts as individuals could be recruited into trials based on their score such as recruiting participants scoring high (e.g., top 20 %) on certain EBTs in comparison to this normative reference sample. Additionally, in clinical care, clinicians can compare a patient's score to normative data to assess clinical relevance and customise guidance based on trends by subgroup. However, there is nuance in how they might be used and interpreted. For example, caution should be exercised so as not to label an individual with obesity who has low emotional eating relative to others with obesity as low on emotional eating overall, as their score may still be higher than someone without obesity. Additionally, an individual could score low but also experience disruptions in their life that may affect their eating behaviours, so clinical judgment is still needed.

In addition to population-based studies, trials of weight management interventions have found that emotional (Chew et al., 2022, 2023; Di Sante et al., 2022) and uncontrolled eating (Chew et al., 2022) decrease after intervention, and a recent systematic review and meta-analysis suggested that behavioural weight management interventions can improve uncontrolled eating and cognitive restraint (Kudlek, Eustachio Colombo, Ahern, et al., 2025). Additionally, changes in EBTs like emotional eating and restraint were found to mediate weight loss outcomes in acceptance and commitment therapy-based weight management interventions targeting these traits (Kudlek, Mueller, et al., 2025). This suggests that EBTs represent key behavioural targets for interventions. Individuals demonstrate a range of responses to weight loss treatments (MacLean et al., 2018) (MacLean et al., 2018), and different levels of EBTs may impact weight loss outcomes (Kudlek, Eustachio Colombo, Mueller, et al., 2025). Thus, matching treatment type to EBTs could improve weight loss outcomes (van Strien, 2018). Our findings that demonstrate how the TFEQ-R18 performs in a UK population and relevant subgroups contribute to an understanding that allows EBTs to be a part of the development, refinement, and application of prevention

and intervention strategies for weight management.

Our study has several notable strengths and limitations. A key strength is that, to our knowledge, this is the first study to provide normative data for the TFEQ-R18 that are specific to sex, age, and BMI categories within a UK population. Establishing such reference values in a large, population-based cohort of middle-aged adults fills an important gap in the literature and enhances the interpretability of future studies using the TFEQ-R18 in similar populations. By positioning our findings within a well-characterised sample drawn from the general population, we contribute valuable benchmarking data that can inform both research and clinical assessment of EBTs. Another strength is the use of the TFEQ-R18, a widely validated and internationally recognised measure of cognitive restraint, uncontrolled eating, and emotional eating. Compared to longer versions of the TFEQ, the R18 imposes a lower participant burden. However, the TFEQ-R18 is known to have a ceiling effect on the emotional eating subscale (Karlsson et al., 2000), which may limit the ability to distinguish between individuals who experience high versus very high levels of emotional eating. For this reason, the TFEQ-21 was developed (Cappelleri et al., 2009), which contains three additional items for the emotional eating subscale. Normative scores derived on the TFEQ-18 may thus not translate to assessments of emotional eating using the TFEQ-21. Additionally, items and constructs in the TFEQ-18 differ from the original 51-item TFEQ's restraint, disinhibition, and hunger scales, and scores cannot be compared across versions as they contain different factor structures and scoring (Karlsson et al., 2000).

Finally, although our cohort included participants from across Cambridgeshire and captures a range of socioeconomic and demographic characteristics, the sample may not be fully representative of the wider UK population. In particular, the Fenland sample was older than the national average (mean of 56 vs 40.7 years of age, respectively) (Office for National Statistics, 2024), and lower in ethnic diversity with 94.1 % of participants identifying as White, compared to 81.7 % in the general population (Office for National Statistics, 2022). Replication in other population-based cohorts, and in samples that include younger adults and individuals from minoritised backgrounds can confirm the robustness and generalisability of the derived reference values.

5. Conclusion

Our study providing normative data of the TFEQ-R18 EBT domains may be useful in research and clinical settings to interpret individual EBT domain scores according to sex, age, and BMI. This nuanced information on EBTs may potentially inform precision approaches for both prevention and treatment of overweight and obesity.

CRedit authorship contribution statement

Cara F. Ruggiero: Writing – original draft, Methodology, Formal analysis. **Laura Kudlek:** Writing – review & editing, Methodology, Data curation, Conceptualization. **Julia Mueller:** Writing – review & editing, Validation. **Simon J. Griffin:** Writing – review & editing, Funding acquisition. **Stephen J. Sharp:** Writing – review & editing, Visualization, Methodology. **Nick J. Wareham:** Writing – review & editing, Funding acquisition. **Soren Brage:** Writing – review & editing, Funding acquisition. **Nita G. Forouhi:** Writing – review & editing, Funding acquisition. **Ken K. Ong:** Writing – review & editing. **Amy Ahern:** Writing – review & editing, Validation, Supervision.

Data sharing

The dataset analysed during the current study is not publicly available. Participant consent allows for data to be shared with appropriate ethical approval, and the host institution has an access policy (https://www.mrc-epid.cam.ac.uk/wp-content/uploads/2019/02/Data-Access-Sharing-Policy-v1-0_FINAL.pdf) so that interested parties can

obtain the data for replication or other research purposes that are ethically approved. Data access is available upon reasonable request (datasharing@mrc-epid.cam.ac.uk). Study documents (statistical analysis plan, analytic code) are available on request.

Rights retention statement

For the purpose of Open Access, the author has applied a Creative Commons Attribution (CC BY) licence to any Author Accepted Manuscript version arising.

Ethical statement

Ethical approval for the Fenland Study was obtained from the East of England Cambridge Central Health Research Authority National Research Ethics Service Committee. The study followed principles of the declaration of Helsinki.

Funding sources

The Fenland Study is funded by the Medical Research Council (MRC), and the study principal investigators acknowledge this support (grant numbers MC_UU_00006/1, MC_UU_00006/3, and MC_UU_00006/6). NGF acknowledges support from the National Institute of Health Research (NIHR*) Cambridge Biomedical Research Centre (NIHR203312) and she is an NIHR Senior Investigator (NIHR202397).

*The views expressed are those of the author(s) and not necessarily those of the NIHR or the Department of Health and Social Care.

Declaration of competing interest

JM is a member of the Operations Committee for the Association for the Study of Obesity (unpaid role) and has organised educational events funded by Boehringer Ingelheim Ltd and Rhythm Pharmaceuticals. SG has received honoraria from Astra Zeneca for contributing to post-graduate education sessions for primary care teams concerning the management of type 2 diabetes. SG is a trustee of the Novo Nordisk UK Research Foundation. KO received funding from Eli Lilly. AA is a member of the WW Scientific Advisory Board, a member of a Trial Steering Committee for Menwell Ltd, and has undertaken consultancy (payment to my institution) for Eucalyptus. Other authors declare no competing interests.

Acknowledgments

We would like to thank the participants in the Fenland Study and the Fenland Study Coordination team, in addition to the Field Epidemiology, Data Management and Anthropometry teams at the MRC Epidemiology Unit.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.appet.2026.108466>.

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