Measurement, prevalence, and psychological risk factors associated with addictive food consumption: Development of a new food addiction scale and evidence from a national largescale sample

KAGAN KIRCABURUN[1,5]* , HÜSEYIN ÜNÜBOL[2],
GÖKBEN H. SAYAR[3], VASILEIOS STAVROPOULOS[4] and
MARK D. GRIFFITHS[1]

[1] International Gaming Research Unit, Psychology Department, Nottingham Trent University, Nottingham, UK

[2] Institute of Social Sciences, Psychology Department, Üsküdar University, Istanbul, Turkey

[3] Institute of Social Sciences, Clinical Psychology Department, Üsküdar University, Istanbul, Turkey

[4] College of Health and Biomedicine, Victoria University, Melbourne, Australia

[5] Educational Sciences Department, Düzce University, Düzce, Turkey

ABSTRACT

Background and aims: To date, a number of studies have investigated the prevalence and correlates of addictive food consumption. However, these studies have mostly relied on models that comprised a narrow range of variables in often small and heterogenous samples. The purpose of the present study was to comprehensively examine the measurement aspects, the prevalence, and the psychological correlates of addictive eating among a largescale national sample of Turkish adults. *Method:* Participants ($N = 24,380$, 50% men, $M_{age} = 31.79$ years, age range = 18–81 years) completed a battery of tests including the Food Addiction Risk Questionnaire (FARQ), the Brief Symptom Inventory, the Toronto Alexithymia Scale, the Positive and Negative Affect Schedule, and the Experiences in Close Relationships-Revised. *Results:* According to analyses conducted, the FARQ had a uni-dimensional factor structure. Based on Item Response Theory (IRT) calculated cut-off scores, 2.3% of the participants were at risk of addictive eating patterns, whilst criteria varied in their discriminating ability. The correlates of addictive food consumption were being male, being younger, having lower education, presenting with higher alcohol use, psychiatric symptoms, alexithymia, positive/negative affect, and anxious attachment. *Conclusion:* These results suggest that a minority of Turkish community are at risk for addictive food consumption and that adverse psychological states promote this problematic behavior.

INTRODUCTION

Some individuals develop addiction-like symptoms for eating food, including impaired control, tolerance, and withdrawal, which among a subset of individuals can become functionally impairing (Schulte, Potenza, & Gearhardt, 2017). There is an ongoing debate regarding the conceptualization of addictive food consumption. For example, it has been argued that some people develop an addiction to food *per se* like a substance addiction (Şengör & Gezer, 2019), whereas an alternative view is that the act of eating itself can be potentially addictive and is more akin to a behavioral addiction (Hebebrand et al., 2014; Schulte et al., 2017). However, addictive eating is susceptible to promoting eating disorders

*Corresponding author.
E-mail: kircaburunkagan@gmail.com

including bulimia nervosa and binge eating disorder (Kakoschke, Aarts, & Verdejo-Garcia, 2018), and eating disorders (i.e. bulimia nervosa and binge eating disorder) are known to facilitate obesity, non-suicidal self-injury, suicide attempts, and mortality (Keski-Rahkonen & Mustelin, 2016; Schmidt et al., 2016).

In the past decade, a growing number of studies have explored the psychosocial correlates and prevalence of addictive food consumption or "food addiction" (Kakoschke et al., 2018; Penzenstadler, Soares, Karila, & Khazaal, 2019). Most of these studies have assessed addictive eating using the Yale Food Addiction Scale (YFAS), which was developed by applying seven symptoms of substance dependence criteria indicated in Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR) to food and eating behaviors (Gearhardt, Corbin, & Brownell, 2009). Crucially, the prevalence rates reported in the literature largely vary because prior studies have mostly relied on small and self-selected samples or heterogeneous groups (i.e., clinical samples with specific eating disorders), meaning that national largescale studies are warranted to better estimate the prevalence of addictive eating among the general population (Penzenstadler et al., 2019; Pursey, Stanwell, Gearhardt, Collins, & Burrows, 2014). Furthermore, the psychometric examination of the measures applied in past food addiction studies (i) was limited by utilizing Classical Test Theory (CTT) and (ii) did not employ Item Response Theory (IRT) techniques which enable the determination of measurement properties at the item level (Gearhardt, Corbin, & Brownell, 2016; Gomez, Stavropoulos, Beard, & Pontes, 2019; Granero et al., 2018; Meule, Müller, Gearhardt, & Blechert, 2017). In the following sections, results obtained by significant studies in this field (conducted in both community and/or clinical samples) are summarized. Most of these studies employed the YFAS, suggested heterogeneous prevalence rates, and did not provide psychometric properties at the item level, as can be done with IRT (Gearhardt et al., 2016; Granero et al., 2018; Meule et al., 2017).

MEASUREMENT OF ADDICTIVE FOOD CONSUMPTION

The 'components model of addiction' (Griffiths, 2005) has been used to assess different behavioral addictions including work addiction (Orosz, Dombi, Andreassen, Griffiths, & Demetrovics, 2016), study addiction (Atroszko, Andreassen, Griffiths, & Pallesen, 2015), exercise addiction (Szabo & Griffiths, 2004), shopping addiction (Andreassen et al., 2015), social media addiction (Andreassen, Torsheim, Brunborg, & Pallesen, 2012), and sex addiction (Andreassen, Pallesen, Griffiths, Torsheim, & Sinha, 2018). However, this model has yet to be used to assess addictive food consumption. The present study developed and validated a new brief food addiction assessment tool, the Food Addiction Risk Questionnaire (FARQ), consisting of items constructed on the basis of core criteria that have been emphasized

across several behavioral addictions and that uses established addiction frameworks to highlight the content validity (Griffiths, 2005). The components of addictive food consumption would be: (i) preoccupation with food and eating (salience), (ii) excessive eating to alter mood (mood modification), (iii) increasing amount of food consumption over time (tolerance), (iv) unpleasant emotional/physical symptoms when not eating (withdrawal), (v) interpersonal problems as a result of excessive food consumption, and (vi) returning to previous patterns after periods with abstinence (relapse).

The FARQ was developed because the present study was a large epidemiological study in which the widely used YFAS was considered overly long to assess addictive food consumption and because the all potentially addictive behaviors in the study were assessed using the same generic questions with specific instructions to respond to the questions in relation to a specific activity (in this instance, eating food). Additionally, the development and validation of a brief new tool for assessing addictive food consumption was expected to contribute to the literature by providing another option of assessment tool for addictive food consumption particularly for studies where researchers want to try and overcome questionnaire fatigue.

ITEM RESPONSE THEORY EVALUATION

Although the Yale Food Addiction Scale has undergone thorough psychometric investigation across different age ranges and cultural populations (Brunault et al., 2017; Imperatori et al., 2016; Meule & Gearhardt, 2014; Pursey et al., 2014; Torres et al., 2017), IRT evaluation of a food addiction scale has (to the best of the authors' knowledge) never previously been attempted. Consequently, the present study assessed food addiction with the use of a scale taking into consideration IRT aspects. It should be noted that IRT is another form of psychometric validation that can be used to evaluate the psychometric properties of measures that is distinct in both theory and form from CTT (Embretson & Reise 2013). IRT provides a contemporary measurement option, which is model-driven, while assessing the associations between an item's scores and the latent trait/factor that the specific item is hypothesized to reflect (Embretson & Reise 2013). Furthermore, it is postulated that IRT outweighs CTT for estimating a scale's psychometric aspects (Embretson & Reise 2013) in the following ways: (i) whilst estimating the latent trait, CTT relies on the sum of the different items reflecting/assessing that latent trait (in this case food addiction), IRT enables its estimation at the item level (e.g., a food addiction presentation could be estimated/evaluated at the item level) and; (ii) whilst CTT estimates one reliability index (such as internal consistency) and one standard measurement error across all the range of scores addressed, IRT can estimate the reliability of each different item, taking concurrently into consideration the different levels of the trait assessed and accounting for the different item characteristics (e.g., difficulty; Embretson & Reise 2013).

The item parameters/estimations provided in the IRT context involve the item-difficulty (or threshold; β) and the item-discrimination (or slope; α). Difficulty (β) indicates the level of latent trait required for one to have a 0.5 probability of responding with a specific rate to an item (e.g., positive in a binary item or a specific point in a Likert scale item). Discrimination (α) describes the capacity of an item to discriminate individuals of various levels of the trait assessed (in this case food addiction) with reference to the item's difficulty/threshold (Embretson & Reise 2013). Depending on the number of these parameters (PLs) estimated IRT models are distinguished into 1PL and 2PL (3PL are models involving the additional parameter of pseudo-guessing, symbolized with C; Cai, Du Toit, & Thissen, 2011). More specifically, IRT models that assume items differ considering their difficulty (β) and discrimination (α) are called 2PL models. IRT models assuming no item differing discrimination power (α) are called 1 PL models (commonly know as Rasch analysis models; Embretson & Reise 2013). These models emphasize only the different item difficulty levels across all the items informing a scale (in this case the food addiction scale). Due to the dearth of past findings and to maximize the understanding of the psychometric properties of items assessing food addiction, a sequence of IRT models were examined in the present study and the results of the model with the optimum fit are reported in detail. Furthermore, to maximize the measurement information retrieved (and given that the items of the newly developed Food Addiction Risk Questionnaire were addressed via a ten-point Likert scale), a sequence of three different polytomous IRT model fit (i.e. graded model, generalized partial credit, and nominal model) was applied (i.e., polytomous models are employed for items with more than two potential responses; Cai et al., 2011).

EPIDEMIOLOGICAL STUDIES EXAMINING ADDICTIVE FOOD CONSUMPTION

Previous research examining the prevalence of addictive food consumption has tended to be carried out mostly utilizing relatively small non-representative samples. For instance, among 178 adult Amercians with obesity seeking treatment for weight loss, 6.7% met the proposed criteria for food addiction (Chao et al., 2017). In a Spanish study, the proposed criteria for food addiction were endorsed by 72.8% of clinical sample presenting with eating disorders compared to 2.4% in a sample of healthy controls (Granero et al., 2014). Among 717 American high school youth, 25.8% of the participants were classified as being characterized by addictive eating patterns (Sussman et al., 2014), and in a Turkish study including 100 overweight and/or obese adult women, 38% endorsed the proposed criteria for addictive food consumption (Özkan, Devrim, & Bilgiç, 2017). Among the few representative and/or large-scale studies, a representative German study with a community sample reported that 7.9% of the participants ($N = 1,034$) as being food

addicts (Hauck, Weib, Schulte, Meule, & Ellrott, 2017). In a nationally representative study among the American community ($N = 986$), 15% of the participants were reported as being food addicts (Schulte & Gearhardt, 2018). In another study, the prevalence of addictive food consumption among a large Brazilian non-clinical sample ($N = 7,639$) was estimated at 4.32% (Nunes-Neto et al., 2018). Finally, another study of Dutch adolescents ($N = 2,653$) reported that 2.6% were addicted to food (Mies et al., 2017). On the whole, previous studies examining addictive food consumption have reported varying prevalence rates from one study to another, and is most likely due to the heterogeneity in the types of sample and population screened.

FACTORS ASSOCIATED WITH ADDICTIVE FOOD CONSUMPTION

Existing studies have reported mixed results with regards to the socio-demographic correlates of addictive food consumption. For instance, a study conducted among adults showed food addiction symptoms to be more prevalent among younger individuals and/or individuals with higher annual income (Schulte & Gearhardt, 2018). In other studies, the prevalence of addictive food consumption was found to be significantly higher among females, emerging adults, and alcohol users in comparison to males, older adults, and non-alcohol users (Fouladi et al., 2015; Nunes-Neto et al., 2018; Schulte & Gearhardt, 2018), although some studies have failed to find any gender differences in addictive eating (Berenson, Laz, Pohlmeier, Rahman, & Cunningham, 2015). Therefore, the specific impact of various socio-demographic factors on addictive food consumption remains unclear (Nunes-Neto et al., 2018).

It is well established that addictive food consumption, compulsive overeating, and eating disorders (e.g., binge-eating disorder) share behavioral and clinical similarities as well as neural and psychological correlates, and they are highly overlapping constructs (Davis, 2017; Gearhardt, White, & Potenza, 2011). General psychiatric distress symptoms that are associated with eating disorder symptoms are strongly related to addictive food consumption (Burrows, Skinner, McKenna, & Rollo, 2017). Similarly, addictive food consumption and disordered eating share several psychological constructs including reward dysfunction, craving, emotion dysregulation, and impulsivity (Schulte, Grilo, & Gearhardt, 2016). A model testing study, using the theory of planned behavior (TPB) and the self-congruity theory, indicated that individual factors (e.g., emotional states, psychopathological problems) and socio-demographic factors (e.g., gender, age, education level) should be associated with food addiction (Farah & Shahzad, 2020).

Most of the studies in the compulsive eating behavior literature have focused on eating disorders (e.g., binge eating disorder) and their correlates. Fewer studies have examined the role of comorbid psychopathology on addictive food

consumption. This is surprising given the specific cognitive, behavioral, and emotion-regulation-related deficits associated to psychopathological disorders favoring the development of emotional overeating (which is a strong predictor of addictive food consumption [Davis et al., 2013]). For instance, interpersonal sensitivity, depression, and hostility were found to positively correlate with addictive food consumption among a large community sample after adjusting for socio-demographic factors (Nunes-Neto et al., 2018). Some studies have focused on eating disorders and problematic eating behaviors. Another study found that compulsive eating symptoms were positively correlated with anxiety among Turkish adolescents (Ünal, Aydın, Gökler, & Ünsal, 2017). Positive correlations were identified between problematic eating behaviors and different psychopathological symptoms in Turkish participants including major depression, generalized anxiety disorder, and social phobia (Vardar & Erzengin, 2011). Positive and negative affect as well as psychiatric distress are also known to promote addictive food consumption (Babayiğit, Alçalar, & Bahadır, 2013; Meule, Lutz, Vögele, & Kübler, 2012), with studies emphasizing the impact of mood on eating and overeating patterns (Sevincer, Ince, Taymur, & Konuk, 2016).

Addictive food consumption has also been associated with specific psychological dysfunctional characteristics. It has been suggested that the ability to identify and describe feelings constitute a preventive factor for individuals to respond to distress. For instance, a preliminary study indicated that individuals with addictive eating patterns had higher scores on two specific alexithymia-related traits related to difficulty in describing and identifying feelings (Brunault et al., 2018). Another potentially relevant psychological correlate of addictive eating is dyfunctional attachment. Despite the little empirical evidence that associates attachment avoidance and anxiety to food addiction, maladaptive attachment is associated with psychopathology and difficulties in identifying and describing feelings (Doina & Ioana, 2015; Lyvers, Edwards, & Thorberg, 2017). Furthermore, it appears that individuals engage in compulsive overeating to deal with their negative emotions that relate to unsuccesful relationships (e.g., insecure attachment) (Hertz, Addad, & Ronel, 2012). A recent meta-analytic study concluded that anxious and avoidant attachment styles were associated with binge eating (Faber, Dube, & Knaeuper, 2018). In line with the aforementioned literature, it has also been suggested that eating disorder symptoms are associated with avoidance over intimacy and abandonment-related anxiety (Faber et al., 2018; Gonçalves et al., 2019). Consequently, the lack of trusting and reliable relationships characterizes compulsive eating behaviors in the general population (Faber et al., 2018).

THE PRESENT STUDY

The present study, conducted using a large Turkish sample, had the following aims: (i) to advance the available knowledge by testing the measurement properties of a newly developed food addiction scale employed at both the scale level and the item level using a combination of CTT, EFA, CFA, and IRT analyses; (ii) to determine the prevalence of addictive food consumption in the large community sample based on the short screening test for addictive food consumption applied and; (iii) to identify specific psychological correlates (psychiatric symptoms, affect, alexithymia, attachment) for addictive food consumption. Relatively few studies have been conducted in Turkey (or internationally) to address these issues, and those that have been published have had significant limitations (e.g., small samples, self-selected participants, niche and non-representative populations) making such findings far from reliable or definitive (e.g., Alpaslan et al., 2015; Özkan et al., 2017; Sevincer et al., 2016; Ünal et al., 2017).

METHODS

Participants and procedure

The study was carried out in 79 different cities (out of 81) all over Turkey. The sample was planned based on the NUTS (nomenclature of territorial units for statistics) classification. The NUTS is a hierarchical system for dividing up the economic territory of the European Union which divided Turkey to 26 regions. Inclusion criteria for participation was being over 18 years of age, and not having a mental illness that prevents the individual from completing the questionnaires. In each city, more than 200 and less than 2,000 individuals (based on the population of the city) were approached and informed about the study and asked for their participation by the research team (in total, 125 postgraduate students participated in the recruitment of participants). Those who were willing to complete the questionnaires participated in the study. Participants were not offered any incentive for participation in the study. Data used in this study were collected as part of a much bigger epidemiological study examining multiple addictive behaviors, some of which have been published elsewhere (Ünübol et al., 2020).

Initially, 24,494 adults from Turkish community completed a series of paper-and-pencil questionnaires. The final sample comprised 24,380 participants (12,249 men and 12,131 women; $M_{age} = 31.79$ years, $SD_{age} = 10.86$; range = 18–81 years) who were deemed to have given reliable responses. Among the sample, 6.2% of the participants had primary education ($N = 1,510$), 5.9% of the participants had secondary education ($N = 1,433$), 26.1% of the participants had high school education ($N = 6,355$), 54.7% of the participants had university education ($N = 13,333$), and 7.1% of the participants had masters education ($N = 1,735$). Although the sample was large, it was not necessarily representative of the Turkish community. The original sample was randomly divided into two independent subsamples. The first sample ($N = 12,096$, 49.6%) was used to carry out exploratory factor analysis (EFA) whereas confirmatory factor analysis (CFA) was applied using the second sample ($N = 12,284$, 50.4%).

Measures

Demographic variables: Participants' demographic characteristics were determined using a sociodemographic information form. This form included gender (men, women), age, education status (high school and/or lower degree, bachelor and/or higher degree), and alcohol use (past 30 days).

Food Addiction Risk Questionnaire (FARQ): The FARQ was developed to assess addictive food consumption (see Appendix). The items were generated and formulated by the research team utilizing the components model of addiction, which is widely accepted and used model in behavioral addictions field. The scale items were not tested using a pilot study given how widely these items have been used in previously published studies. The scale comprises six items that assess components of six addiction-like symptoms (salience, withdrawal, mood modification, conflict, tolerance, relapse) outlined in the components model of addiction (Griffiths, 2005). Items (0 = *never*, 10 = *always*) were averaged to create an index of food addiction. The maximum score obtained from the scale was 60 (Cronbach's $\alpha = 0.90$). The fifth item had the lowest mean score ($M = 2.13$; $SD = 2.96$), following it, Item 6 ($M = 2.62$; $SD = 3.18$), Item 4 ($M = 3.06$; $SD = 3.26$), Item 3 ($M = 3.63$; $SD = 3.27$), Item 2 ($M = 4.50$; $SD = 3.23$), and Item 1 ($M = 4.94$; $SD = 3.10$) from lowest to the highest respectively. Item-total correlations were also high, ranging between 0.65 for Item 1 and 0.79 for Item 3. The deletion of each item would result in the decrease in the internal consistency coefficient of Cronbach's alpha. This scale was designed and implemented in the study for several imperative reasons: (a) to provide a sufficient psychometric examination, as the psychometric properties of 25-item YFAS have never been comprehensively assessed with the combination of both CTT and IRT procedures and; (b) to achieve higher construct validity by better alligning with the six broadly used criteria to describe behavioral addictions because the YFAS does not assess all core components of addiction.

Brief Symptom Inventory (BSI): The Turkish form (Sahin & Durak, 1994) of the 53-item BSI (Derogatis & Spencer, 1993) was used to assess anxiety (e.g., "*Feeling tense or keyed up*"), depression (e.g., "*Thoughts of ending your life*"), negative self concept (e.g., "*Feelings of worthlessness*"), somatization (e.g., "*Pains in the heart or chest*"), and hostility (e.g., "*Temper outbursts that you could not control*"). Originally, the BSI did not contain a negative self-concept subscale. However, after bidirectional translation by bilingual translators, the Turkish adaptation study included this subscale in the Turkish form. Items (1 = *almost never*, 5 = *almost always*) were averaged to create an index of the Global Severity Index (GSI) for the assessment of general psychiatric distress ($\alpha = 0.95$) because there were strong correlations (that were causing multicollinearity in the regression analysis) among anxiety, depression, and negative self-concept ($r > 0.79$).

Toronto Alexithymia Scale (TAS-20): The Turkish form (Güleç et al., 2009) of the 20-item TAS-20 (Bagby, Taylor, & Parker, 1994) was used to assess difficulty identifying feelings (e.g., "*I am often puzzled by sensations in my body*"), difficulty describing feelings (e.g., "*It is difficult for me to reveal my innermost feelings, even to close friends*"), and externally-oriented thinking (e.g., "*I prefer talking to people about their daily activities rather than their feelings*"). Items (1 = *strongly disagree*, 5 = *strongly agree*) for each scale were averaged to create indices of difficulty identifying feelings, difficulty describing feelings, and externally-oriented thinking. Difficulty identifying and describing feelings were grouped as a single dimension ($\alpha = 0.83$) and EOT was excluded from the analyses because of the (i) correlation between the two variables ($r = 0.62$; $P < 0.001$), (ii) the recent studies questioning the usefulness of distinguishing these constructs, and (iii) the arguments on whether EOT represents alexithymia (Müller, Bühner, & Ellgring, 2003). The reliability coefficient for the EOT was adequate ($\alpha = 0.67$).

Positive and Negative Affect Schedule (PANAS): The Turkish form (Gençöz, 2000) of the 20-item PANAS (Watson, Clark, & Tellegen, 1988) was used to assess positive (e.g., "*Inspired*", "*Active*") and negative affect (e.g., "*Nervous*", "*Jittery*") at a given point in time. Participants were instructed to consider their past two weeks before giving their answers. Items (1 = *very slightly*, 5 = *extremely*) were averaged to create indices of positive affect ($\alpha = 0.85$) and negative affect ($\alpha = 0.83$).

Experiences in Close Relationships-Revised (ECR-R): The Turkish form (Selçuk, Günaydın, Sümer, & Uysal, 2005) of 36-item ECR-R (Fraley, Waller, & Brennan, 2000) was used to assess anxious (e.g., "*My romantic partner makes me doubt myself*") and avoidant attachment (e.g., "*I don't feel comfortable opening up to romantic partners*"). Items (1 = *strongly disagree*, 7 = *strongly agree*) were averaged to create indices of anxious ($\alpha = 0.83$) and avoidant attachment ($\alpha = 0.85$).

Statistical analysis

The data-analytic strategy addressed the following steps: (i) validation of the FARQ; (ii) IRT psychometric examination at the scale and item level (considering the food addiction measure employed); (iii) estimation of the prevalence of addictive food consumption; and (iv) investigation of sociodemographic and psychological correlates of addictive food consumption. Initially, psychometric properties of the FARQ were evaluated using CTT, EFA, and CFA. Root mean square residuals (RMSEA), standardized root mean square residuals (SRMR), comparative fit index (CFI), and goodness of fit index (GFI) were checked to determine goodness of fit in CFA. According to Hu and Bentler (1999), RMSEA and SRMR lower than 0.05 indicate good fit and RMSEA and SRMR lower than 0.08 suggest adequate fit; CFI and GFI higher than 0.95 is good and CFI and GFI higher than 0.90 is acceptable.

The psychometric properties of the scale (in addition to CTT, EFA, and CFA means described above) were also assessed with the application of a sequence of polytomous

IRT models. The assumptions of unidimensionality and local independence or the application of IRT models were addressed prior to the implementation of the analysis. Unidimensionality assumes that item correlations are attributed to a single latent factor (and aside of IRT processes, was assessed here via the CTT, EFA, and CFA analyses applied). Local independence requires that item scores are not correlated for the same level of the latent trait, therefore implying the unidimensionality assumption (and was assessed here with item residual correlations <0.1; De Ayala, 2013). The IRT models involved the unidimensional graded model, the generalized partial credit model, and the nominal model (Cai et al., 2011). The graded response model addresses ordered responsed items and is the model of choice for Likert scale instruments (Cai et al., 2011). The generalized partial credit model (GPCM) is similar to the graded model, while it is flexible with both linear and categorical (classes) latent traits (Muraki & Muraki, 2016). Finally, the nominal model addresses item responses as ordered categories and employs polychoric matrices, therefore it is an appropriate alternative for modeling responses to items with more than two categories (DeMars, 2003). The unidimensional 2PL and 1PL IRT modifications of the highest fit polytomous model were then compared using $\chi^{2\text{loglikelihood}}$ difference to assess whether significant parameter variations (α) occurred (Cai et al., 2011; Embretson & Reise 2013). The optimum fit model was determined taking concurrently into consideration: (i) the loglikelihood index of fit (De Ayala, 2013); (ii) the RMSEA (0.05 and lower = sufficient fit; Hu & Bentler, 1999); (iii) the Bayesian Information Criterion (BIC) and; (iv) the Akaike Information Criterion (AIC; smaller values of both BIC and AIC indicate better fit; De Ayala, 2013). These fit indices were preferred given: (i) the high sample of the current study ($N > 20,000$), and (ii) past recommendations suggesting that χ^2 based indices tend to be inflated by large sample sizes (therefore, greater emphasis should be given to fit indices such as RMSEA, AIC, BIC; Stone & Zhang 2003). The item parameters in IRT were then visually examined via the Item Characteristic Curves (ICC; α, β) and the item reliability by the item information function (IIF; IRTPRO; Cai et al., 2011). Similarly, at the scale level, the test reliability was assessed with the Test Information Function (TIF) and the overall test performance via the Test Characteristic Curve (TCC; Cai et al., 2011). The latter concurrently enables the matching of raw-scale and trait scores (i.e., raw scores can be automatically converted into latent scaled scores). Therefore, the TCC may determine cut-off points, without the use of a gold standard, guided by the raw score that corresponds with a level of two standard deviations above the mean of the latent factor (Embretson & Reise 2013).

In the final step, Pearson's correlation and hierarchical regression analyses were applied to explore correlation coefficients among study variables to predict addictive food consumption (dependent variable) based on socio-demographic and psychological variables (independent predictors). In the regression analysis, all variables were included in the model as observed variables. It was confirmed that there were no multicollinearity via examining variance inflation factor (VIF) and tolerance values. Statistical analyses were carried out using SPSS 23.0, AMOS 23.0, and Mplus 7.0 software.

Ethics

Ethical approval for the study was taken from first author's institutional review board and complied with the Helsinki declaration.

RESULTS

Scale development

EFA with Sample 1 ($N = 12,096$) indicated that FARQ had a unidimensional structure. In the EFA, principal axis factoring estimation method was used. Kaiser-Meyer-Olkin measure and Barlett's test of sphericity (0.87; $P < 0.001$) as well as extracted one-factor solution (explaining 65.79% of the variance) suggesting that the results were above the thresholds (Kline, 2011). Extracted communalities (ranged between 0.57 and 0.75) and factor loadings (ranged between 0.69 and 0.85) illustrated that all scale items had high loadings. A one-factor solution was retrieved based on the scree plot in which the factors that had an Eigenvalue higher than 1 were extracted. Next, a CFA with Sample 2 ($N = 12,284$) confirmed the fit adequacy of the one-factor solution. In the CFA, maximum likelihood discrepancy estimation method was used. The observed indicator variables (i.e. items of the scale) of the latent variables were specified as continuous indicators. Goodness of fit indices suggested mostly good fit to the data ($\chi^2 = 971.45$, df = 7, $P < 0.001$, RMSEA = 0.11 CI 90% [0.10, 0.11], SRMR = 0.03, CFI = 0.97, GFI = 0.98). Standardized factor loadings, ranging between 0.66 and 0.87 (Table 1), indicated all items had significant role in the scale.

Psychometric IRT properties

The graded model estimation ($\chi^{2\text{loglikelihood}} = 518269.12$; RMSEA = 0.06; BIC = 518936.13; AIC = 518401.12) showed better fit compared to the generalized partial credit model ($\chi^{2\text{loglikelihood}} = 523426.46$; RMSEA = 0.06; BIC =

Table 1. Communalities, factor loadings and standardized factor loadings of the FARQ items

	Exploratory factor analysis ($N = 12,096$)		Confirmatory factor analysis ($N = 12,284$)
	Communalities	Factor loadings	Standardized factor loadings
Item 1	0.57	0.69	0.66
Item 2	0.68	0.78	0.77
Item 3	0.75	0.85	0.87
Item 4	0.71	0.81	0.81
Item 5	0.58	0.70	0.66
Item 6	0.67	0.78	0.73

524093.47; AIC = 523558.46) and the nominal model ($\chi^{2\text{loglikelihood}}$ = 522662.15; RMSEA = 0.06; BIC = 523874.88; AIC = 522902.15). Significant α parameter variations (as assessed with $\chi^{2\text{loglikelihood}}$ differences) were confirmed. When the item discrimination parameters were restrained to be equal, there was a significant drop of fit ($\Delta\chi^{2\text{loglikelihood}}$ = 2,464.3, df = 5, $P < 0.0001$). Discrimination parameters were later constrained independently for each item (hybrid models) with successive χ^2 differences confirming the initial graded model (with all the item discrimination parameters relaxed) as the one with the optimum fit. Discrimination parameters for all items ranged at the very high range (0 = non discriminative; 0.01–0.34 = very low; 0.35–0.64 = low; 0.65–1.34 = moderate; 1.35–1.69 = high; >1.70=very high; Baker, 2001) between 2.02 (α salience) and 3.8 (α tolerance). Similarly, factor loadings ranged in the high range between 0.76 (λ salience) and 0.91 (λ tolerance; Thompson, 2007). The descending sequence of the items' discrimination power and loadings was "tolerance," "withdrawal," "relapse," "mood modification," "conflict," and "salience" (see Table 2). Considering the item difficulty parameters (β), there was a considerable level of fluctuations between the different thresholds across the six items. Indicatively, for the first threshold the ascending item sequence of difficulty was "salience," "mood modification," "tolerance," "withdrawal," and "relapse." Considering the third threshold, this alternated to "salience," "mood modification," "tolerance," "withdrawal," and "relapse.". Finally, considering the tenth threshold, the ascending difficulty sequence was "conflict," "relapse," "withdrawal," "salience," "tolerance" and "mood modification." Nevertheless, the threshold difficulty parameters progressively increased between the first and the last threshold across all items (see Table 2 and Fig. 1). Conclusively, IRT analyses indicated that: (i) while increasing item scores correctly described increasing levels of addictive food consumption behaviors across all items, the rate of these increases is different across the criteria, and (ii) different thresholds perform differently across items considering their level of difficulty.

Considering the items' reliability across the different levels of the latent trait, controlling concurrently for the different levels of items' difficulty, meaningful variations were confirmed. More specifically, the IIFs of "salience" provided the highest level of information/reliability in the range between minus/plus 1.6 SDs below and above the mean, placing it in the area between minus/plus 0.8 SDs below and above the mean. "Mood modification" provided considerably higher information in the area between −1.2 SDs below the mean to 1.6 SDs above the mean. "Tolerance" resulted to more reliable information for respondents in the area between −0.8 SDs below to 2 SDs above the mean. "Withdrawal" information quality picked in the area −0.4 SDs below to 2 SDs above the mean. "Conflict" provided better information in the area between the mean and 2.4 SDs above the mean. Finally, "relapse" provided better and more reliable information in the area between the mean and 2 SDs above the mean (see Fig. 2).

Considering the performance of the scale as whole, this is visualized by the TCC and the TIF figures. The TCC graph illustrates that the trait of food addiction engagement inclined steeply, as the total score reported increased (in particular from 10 to 50; see Fig. 3). Considering the information provided by the scale as a whole, improved information (TIF) scores were around −1.2 SDs below the mean, up to about +2.4 SDs above the mean (see Fig. 4).

These propose that the scale (as a whole) provides a sufficient and reliable psychometric measure for assessing individuals with high and low levels of the addictive food behaviors. Guided by the TCC, the addictive food consumption behavior at a level of 2 SDs above the mean trait level corresponded with a raw score of 58, and based on this, it could be suggested as a conditional (before clinical assessment confirmation) diagnostic cut-off point.[1] Consequently, 2.3% of the participants were at risk for presenting addictive food consumption pattern.

Correlates of addictive food consumption

Mean scores, standard deviations, and correlation coefficients of the study variables are shown in Table 3. According to Cohen (1988), correlation effect sizes range from small ($r = 0.10$), medium ($r = 0.30$), to large ($r = 0.50$). FARQ scores were weakly correlated with psychiatric distress, anxiety, depression, negative self-concept, somatization, hostility, alexithymia, negative affect, anxious attachment, difficulty identifying feelings, and difficulty describing feelings. The correlation of FARQ with positive affect ($r = 0.06$, $P < 0.001$) and avoidant attachment ($r = 0.06$, $P < 0.001$) most likely achieved statistical significance due to the large sample size.

Hierarchical regression analysis

The results of hierarchical regression analysis are presented in Table 4. Gender, age, education status, and alcohol use were included into the equation in Block 1. Psychiatric distress, positive and negative affect, alexithymia, and adult attachment styles comprised Block 2. Being male ($\beta = -0.06$, $P < 0.001$), being an alcohol user ($\beta = -0.02$, $P < 0.01$), psychiatric distress ($\beta = 0.15$, $P < 0.05$), positive affect ($\beta = 0.10$, $P < 0.001$), negative affect ($\beta = 0.03$, $P < 0.001$), alexithymia ($\beta = 0.04$, $P < 0.001$), and anxious attachment ($\beta = 0.08$, $P < 0.001$) were positively related to FARQ scores, whereas age ($\beta = -0.13$, $P < 0.001$) and having a bachelor and/or higher degree ($\beta = -0.03$, $P < 0.001$) were negatively associated. It should be noted that the predictive effects of education level, alcohol use, negative affect, and alexithymia were very small. These effects might have become statistically significant due to the large sample size. The regression model

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[1]*Note 1:* Participants scoring below a raw score of 58 were considered as not presenting with food addiction behaviors that exceed 2 SDs above the mean (which is deemed as diagnosable by the literature). However, they do present with food addiction behaviors below that level as visualized by Fig. 3. All the exact variations in the dimensional distribution of the latent behavior examined can be captured numerically. See table in Appendix at the end of this paper.

Table 2. Item discrimination, difficulty and loadings of Food Addiction Risk Questionnaire

Item	Criterion	α	β1	β2	β3	β4	β5	β6	β7	β8	β9	β10	Spread	λ (Loadings)
1	Salience	2.02	−1.4	−1.17	−0.86	−0.5	−0.28	0.4	0.65	0.96	1.34	1.61	3.01	0.76
2	Mood Modification	2.71	−1.02	−0.81	−0.54	−0.3	−0.05	0.47	0.68	0.95	1.26	1.5	2.52	0.85
3	Tolerance	3.8	−0.53	−0.38	−0.18	0.04	0.23	0.66	0.86	1.09	1.34	1.55	2.08	0.91
4	Withdrawal	3.23	−0.28	−0.15	0.04	0.24	0.42	0.83	1.03	1.25	1.5	1.69	1.97	0.88
5	Conflict	2.29	0.11	0.26	0.44	0.64	0.83	1.23	1.43	1.67	1.94	2.19	2.08	0.8
6	Relapse	2.82	−0.08	0.04	0.21	0.4	0.57	0.98	1.18	1.4	1.65	1.85	1.93	0.86

Note: α defines the capacity of an item to discriminate between varying levels of food addiction intensity (θ). β defines the level of food addiction intensity, where subsequent response rates are more probable than their previous rate. Spread is the range of difficulty parameters across the different likert points. λ defines the amount of variance of an item explained by the latent factor.

predicted 10% of the variance in addictive food consumption ($F_{10,24,206} = 264.64$, $P < 0.001$).

DISCUSSION

After using CTT, EFA, CFA, and IRT methods testing the psychometric properties of a newly developed short scale assessing addictive food consumption (i.e., Food Addiction Risk Questionnaire; FARQ) and estimated its prevalence in a large sample of Turkish volunteers ($N = 24,380$), the present study investigated the prevalence and psychological correlates of addictive food consumption using a largescale national sample. Being male, being an alcohol user, younger age, psychiatric distress, positive and negative affect, alexithymia,

and anxious attachment were identified as correlates of addictive food consumption. In contrast, having a bachelor and/or higher degree was identified as a protective factor.

Prevalence

Based on the findings, the estimated prevalence of addictive food consumption in the present sample was 2.3%. This is much lower than some studies that have used reasonably sized samples. For instance, 7.9% of a representative German community sample aged 18–65 years were classed as food addicts (Hauck et al., 2017). In a nationally representative sample of an American community aged 18–65+ years, 15% were classified as food addicts (Schulte & Gearhardt, 2018). The prevalence of food addiction in a larger sample of Dutch adolescents was
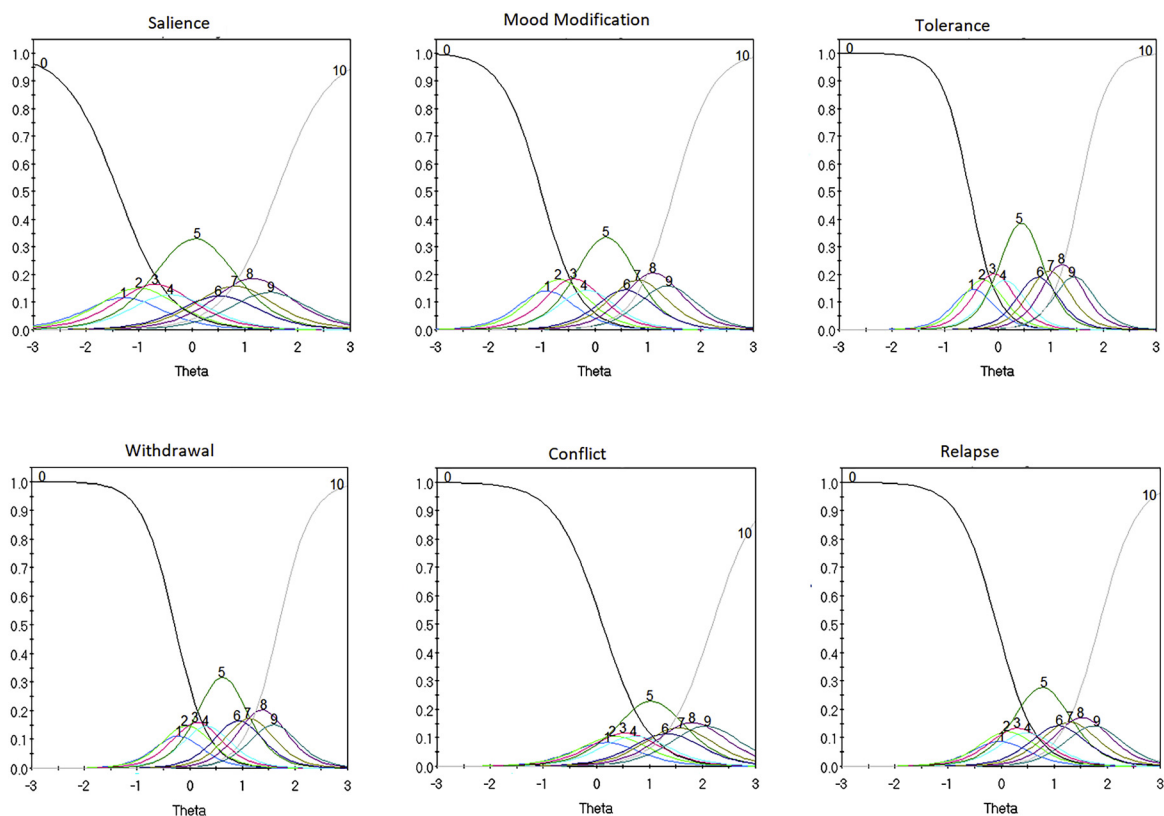

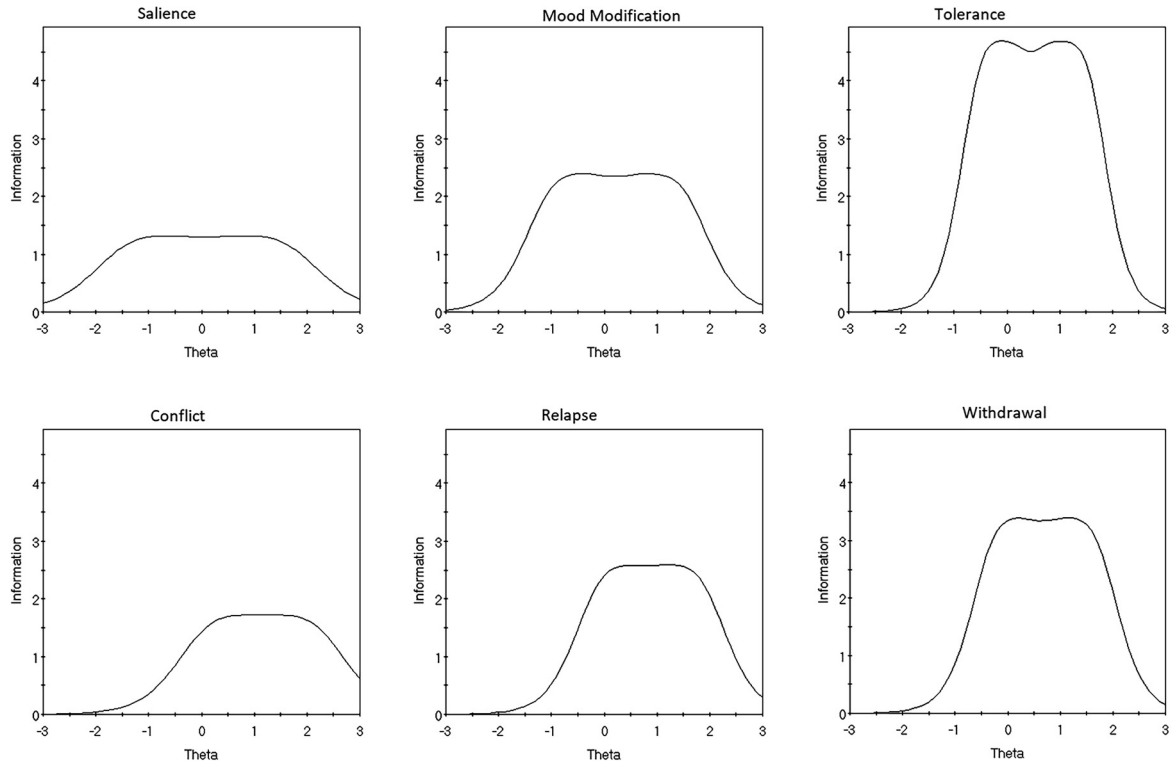*Fig. 1.* Item characteristic curves

Fig. 2. Item information function curves

2.6% (Mies et al., 2017), whereas it was 4.3% in a large Brazilian non-clinical sample aged 18–30+ years (Nunes-Neto et al., 2018). Even though addictive food consumption appears to be present among some individuals in developing countries (e.g., low and middle-income countries), it is not as prevalent as in more developed countries. Moreover, it should be taken into account that the present sample size was much bigger than previous representative and largescale studies, and a possible difference compared to previous studies would have arisen from the different scale used in the present study.
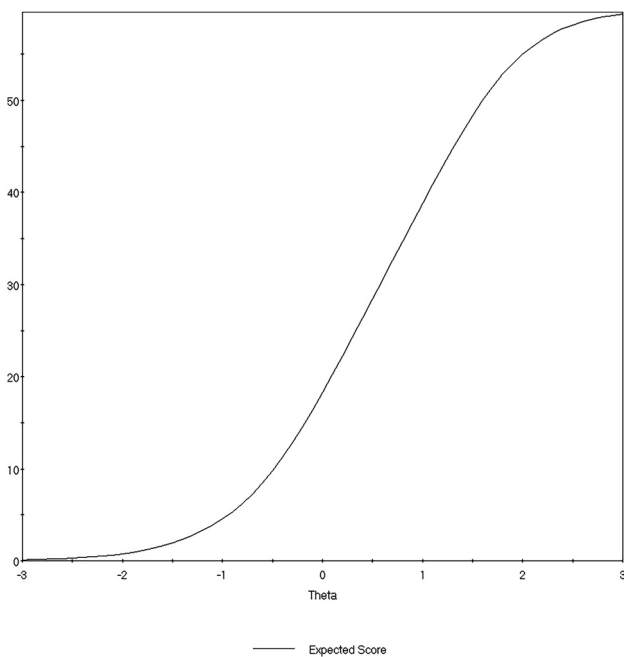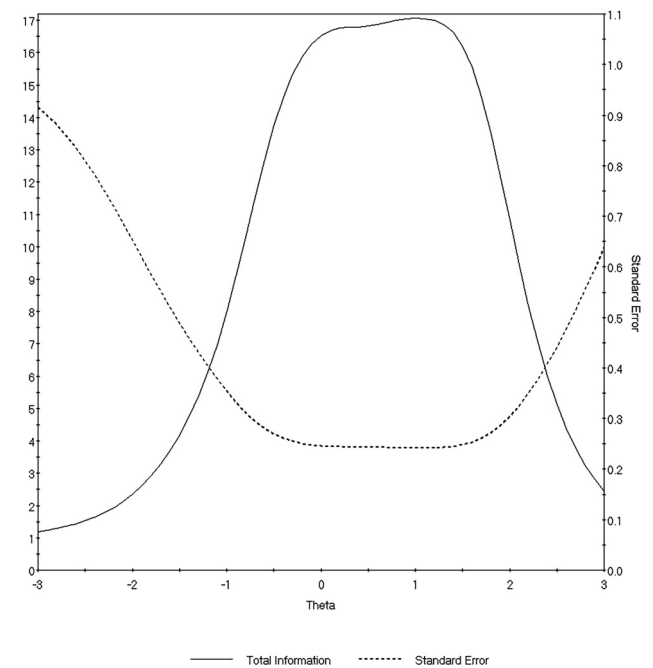

Fig. 3. Test characteristic curve
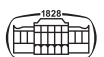

Fig. 4. Test information curve

Table 3. Mean scores, standard deviations, and Pearson's correlations coefficients of the study variables (*N* = 24,380)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. AFC	–													
2. Psychiatric distress	0.24**	–												
3. Anxiety	0.22**	0.93**	–											
4. Depression	0.19**	0.91**	0.79**	–										
5. NSC	0.22**	0.91**	0.82**	0.80**	–									
6. Somatization	0.18**	0.81**	0.73**	0.67**	0.65**	–								
7. Hostility	0.27**	0.80**	0.69**	0.65**	0.67**	0.57**	–							
8. Alexithymia	0.20**	0.65**	0.61**	0.60**	0.61**	0.50**	0.51**	–						
9. DIF	0.21**	0.67**	0.64**	0.61**	0.62**	0.53**	0.52**	0.93**	–					
10. DDF	0.14**	0.50**	0.47**	0.46**	0.49**	0.36**	0.37**	0.74**	0.62**	–				
11. Positive affect	0.06**	−0.15**	−0.14**	−0.17**	−0.13**	−0.12**	−0.04**	−0.10**	−0.14**	−0.18**	–			
12. Negative affect	0.18**	0.58**	0.54**	0.53**	0.52**	0.44**	0.51**	0.46**	0.49**	0.36**	−0.10**	–		
13. Avoidant attachment	0.06**	0.24**	0.23**	0.22**	0.22**	0.20**	0.17**	0.20**	0.25**	0.25**	−0.28**	0.23**	–	
14. Anxious attachment	0.18**	0.44**	0.40**	0.41**	0.44**	0.30**	0.34**	0.41**	0.41**	0.35**	−0.10**	0.37**	0.21**	–
M	20.88	98.20	22.89	24.14	21.58	15.20	14.39	26.78	14.07	12.18	30.42	19.46	60.27	60.21
SD	15.42	29.04	7.57	8.31	7.29	4.94	4.74	7.61	5.36	3.27	7.97	6.83	19.23	18.36

Note. AFC = Addictive food consumption; NSC = Negative self-concept; DIF = Difficulty identifying feelings; DDF = Difficulty describing feelings. *P < 0.01, **P < 0.001

SCALE AND ITEMS: DISCRIMINATION, DIFFICULTY AND RELIABILITY

IRT findings, EFA, and CFA confirmed the uni-dimensionality of the behavior and indicated variations considering the discrimination, difficulty, and information functions of the items across the different thresholds taking into consideration the different levels of the underlying trait. More specifically, the descending succession of the items' discrimination power was "tolerance" "withdrawal," "relapse," "mood modification," "conflict" and "salience." This corresponds with past IRT studies considering different forms of excessive behaviors that also advocated different discrimination power across the criteria assessed (Gomez et al., 2019). Furthermore, whilst the item difficulty parameter gradually increased between the first and the last point of the Likert scale employed across all items, the sequence of items' difficulties differed considering the different item thresholds. Considering the final threshold, which reflected the higher level of the behavior, the ascending difficulty sequence was "conflict," "relapse," "withdrawal," "salience," "tolerance" and "mood modification." Therefore, it is proposed that different items should be interpreted/considered with different clinical importance when it comes to assessment of this potentially problematic behavior.

Furthermore, differences were identified considering the level of information precision provided by each of the criteria. More specifically, findings showed that "salience" provided the highest level of information/reliability in the range between minus/plus 1.6 SDs below and above the mean. "Mood modification" provided considerably higher information in the area between −1.2 SDs below the mean to 1.6SDs above the mean. "Tolerance" resulted in more reliable information for participants in the area between −0.8 SDs below to 2 SDs above the mean. "Withdrawal" provided better information in the area of −0.4 SDs below to 2 SDs above the mean. "Conflict" provided better information in the area between the mean and 2.4 SDs above the mean. Finally, "relapse" provided better and more reliable information in the area between the mean and 2 SDs above the mean. While all the criteria tended to provide better information between the mean and 2 SDs above the mean, the level of information tended to be better for "tolerance" and "withdrawal". Considering the scale, improved information (TIF) performance was found around −1.2 SDs below the mean, and up to about +2.4 SDs above the mean.

Nevertheless, differences occured considering the specific items' information capacity. More specifically, for higher food addiction severity (2 SDs above the latent mean), the following descending three-item sequence should be considered prioritized: (a) tolerance; (b) withdrawal, and (c) relapse. Interestingly, for those with lower level of food addiction severity (2–3 SDs below the latent mean), first salience, and then mood modification, appear to provide more reliable information compared to other items (although their overall item information capacity was more symmetrically distributed across high and low levels), while conflict and relapse should be omitted given their almost zero information potential (for

those with lower levels of food addiction, 2 to 3 SDs below the latent mean). İn relation to the scale as a whole, food addiction behavior inclined steeply, as the total score reported tended to elevate. This favors FARQ as a sufficient psychometric measure for assessing individuals with high and low levels of food addiction behavior.[2]

Food addiction correlates

Psychiatric symptoms were positively related to addictive food consumption. This is consistent with the prior studies asserting that psychiatric distress is positively correlated with addictive food consumption (Nunes-Neto et al., 2018). Addictive food consumption with binge eating may be an indicator of a higher risk of comorbid psychopathology and emotional disturbances (Imperatori et al., 2014). It may be that individuals use addictive food consumption as a means to alleviate negative emotions related to individuals' emotion dysregulation and mood disorder symptoms (Gearhardt et al., 2012).

As expected, negative affect was found to be positively associated with addictive food consumption. Negative affect exacerbating addictive food consumption is consistent with the prior literature reporting that experiencing negative emotional distress elevates food consumption because emotional distress diminishes self-control by enhancing the brain's reward sensitivity to appetitive stimuli (Wagner, Boswell, Kelley, & Heatherton, 2012). Positive affect was positively related to addictive food consumption. This contradicts previous studies suggesting that positive mood is a protective influence in reducing overeating (Cardi, Leppanen, Leslie, Esposito, & Treasure, 2019). However, the present

finding is in line with a number of studies showing that men have higher positive affect-induced smoking than women, and that affective triggers may vary in addictive behaviors (Messer, Siegel, Bertin, & Erblich, 2018). A recent meta-analysis study supported this notion reporting that while negative emotions increased eating in restrained eaters, positive emotions increased eating more generally (Evers, Dingemans, Junghans, & Boeve, 2018). Furthermore, both positive and negative affect being related to elevated addictive food consumption may be explained with age. While emerging adults in the study had higher negative affect, older participants had significantly higher positive affect, indicating that younger and older individuals engaged in higher addictive food consumption with different emotional states.

Results showed that alexithymia was positively and significantly related to addictive food consumption. This is in line with one of the few studies on the subject which indicated that scores on both difficulty describing and identifying feelings were significantly higher among food addicts compared to those without addictive food consumption (Brunault et al., 2018). However, this study did not adjust for the interactions among these subdimensions and other psychopathological factors. The present study found that the ability to identify and describe one's own feelings appeared to be a robust protective factor against developing addictive food consumption.

Anxious attachment (but not avoidant attachment) was positively related to more addictive food consumption. It may be that anxiously-attached individuals attempt to cope with distress and negative emotions by relying on emotion-focused coping, whereas avoidant individuals deal with their negative state by distancing coping, and responding to stress with increased somatization instead of elevated anxiety and depression (Mikulincer & Orbach, 1995). Therefore, the present finding that only attachment anxiety was related to addictive food consumption is supported by the notion that emotional eating and using food for positive mood modification are associated with addictive food consumption (Gearhardt et al., 2012; Gonçalves et al., 2019). Consequently, being unable to form trusting and reliable relationships with significant others appears to predict unhealthy eating behaviors (Faber et al., 2018).

Unlike existing studies which generally identified higher addictive food consumption and eating disorder symptoms in women (Berenson et al., 2015; Fouladi et al., 2015; Nunes-Neto et al., 2018; Schulte & Gearhardt, 2018), men reported higher addictive pattern of eating in the current study. This unexpected finding may be related to the assessment tool used, directly derived from the component model of addiction (Griffiths, 2005), whereas most previous studies reported gender differences based on the YFAS (Pursey et al., 2014) which does not assess all aspect of component model of addiction (e.g., salience).

Limitations

The present study has some limitations that should be considered when interpreting the results. First, even though

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[2]*Note 2:* Item response theory methods allow a more holistic and clinical evaluation of the items/questions asked. In particular, from a clinical perspective, the response that an individual may receive on a question is assumed to depend on the features (properties) of the question itself (i.e., content and phrasing) in conjunction with the characteristics of the participant (i.e., high or low intensity of the behavior assessed; Cai et al., 2011). In that line, IRT-differences considering specifc items' properties are assessed in a psychometric (and therefore unbiased) manner, and distinguishes questions in terms of their level of difficulty and discrimination power/accuracy. Unique item differences considering the participants are also reflected by the reliability variations across the different items, in such a way that an ndicidicals can safely select which questions to ask/(prioritize/rely more for) those with higher and those with lower levels of the behavior exhibited (in this case food addiction). Therefore, IRT (as a method) enables a more person-specific assessment planning, moving from assessment content questions not acknowledging the participant, "What to ask?" and "How much one can rely on the response received?" to "What question(s) should be best addressed by individuals with varying levels of the behavior?" or "How do the responses of individuals differ on the behavior's severity, and should they be weighted differently for different items?" (Cai et al., 2011; Gomez et al., 2019). Item Characteristic Curves and Item Information Function, based on psychometric evidence, maximize the assessment information retrieved by an item, taking concurrently into consideration the level that different participants exhibit/present the behavior assessed. This enables the detection of within scale (inter-item) differences, which are missed by other types of analyses. Given the phrasing of the items (i.e., multiple sentences as one item), the different sentences included in an item cannot be assessed independently here. Participants were instructed to address each item on a Likert scale (0 = never to 10 = always) to capture maximum variability.
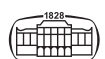
Table 4. Hierarchical regression analysis predicting addictive food consumption ($N = 24{,}380$)

Model	B	SE	β	t	ΔR^2
Block 1					0.04
($R^2_{Adjusted} = 0.04$; $F_{(4,24,212)} = 242.01$; $P < 0.001$)					
Gender[a]	−1.88	0.19	−0.06	−9.77**	
Age	−0.19	0.01	−0.13	−20.87**	
Education[b]	−0.88	0.20	−0.03	−4.37**	
Alcohol use[c]	−0.70	0.21	−0.02	−3.39*	
Block 2 ($R^2_{Adjusted} = 0.10$; $F_{(10,24,206)} = 264.64$; $P < 0.001$)					0.06
Psychiatric distress	0.08	0.01	0.15	16.30**	
Positive affect	0.19	0.01	0.10	15.52**	
Negative affect	0.07	0.02	0.03	3.80**	
Alexithymia	0.09	0.02	0.04	5.32**	
Avoidant attachment	0.12	0.10	0.01	1.22	
Anxious attachment	1.18	0.11	0.08	11.12**	

Note. B = unstandardized regression coefficient; SE = Standard error; β = standardized regression coefficient; (a) Men = 1, Women = 2; (b) High school and lower degree = 1, Bachelor and/or higher degree = 2; (c) Yes = 1, No = 2; *$P < 0.01$, **$P < 0.001$

the sample size was very large, it was not technically a nationally representative of Turkish community (although given the sampling points was a good proxy), which prevents the generalizability of the findings. Future studies should replicate the present findings recruiting more representative study groups from Turkey and/or using samples that represent other developing countries of which food addiction has been less examined. Second, the present study adopted a cross-sectional design, which prevents the determination of causal relationships among variables. Future studies should test the present findings using more in-depth methods including longitudinal and qualitative designs. Third, self-report questionnaires used in the present study for data collection are susceptible to various methodological biases including those relating to social desirability and memory recall. Finally, some of the scale items combine multiple statements, therefore some participants may have had some difficulty in specifically determining whether their given responses related to specific statements. Furthermore, phrasing of the items were deliberately very general (because the same items were used to assess multiple addictive behaviors) and only the instructions at the beginning of the scale stated that these statements were related to food consumption behavior rather than the items themselves. In addition to these, validity of the scale needs to be been determined by examining the association of the new scale and other food addiction scales (e.g., YFAS). These aforementioned limitations should be taken into account when using the newly developed scale.

CONCLUSION

Despite these limitations, the present study is the first to investigate the discrimination power of the different food addiction criteria, alongside the prevalence and the psychological correlates of addictive food consumption using a very large Turkish community sample. A small group of participants were identified as at risk for addictive food consumption (2.3%). Addictive food consumption was associated with psychiatric symptoms (i.e. anxiety, hostility), difficulty identifying feelings, affect, and anxious attachment while adjusting for socio-demographics. These findings indicate that using a wide range of variables is important to have a clearer understanding of the possible mechanisms that may exacerbate individuals' addictive food consumption. Future studies should consider possible mediating and moderating effects of psychological variables to better explain this phenomenon. Even though the present results provide valuable data, further studies are needed to use these findings to develop effective prevention and intervention strategies.

Conflict of interest: The authors declare no conflict of interest.

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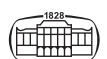
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APPENDIX

Please rate below items considering your food consumption behavior.

1. This behavior has become the centre of my life, often comes to my mind, and I often engage in it. Even if I'm not doing it, I'm thinking about when I can. I get some relief when I plan to engage in the behavior. Sometimes there is an urge that is so powerful, I find a way to engage in the behavior, and I cannot prevent it. (Salience)

2. Sometimes, when I'm bored, sometimes when I'm happy, I think of this behavior and I do it. Many times when my problems increase, my urge to engage in the behavior increases. If I'm unable to do it, my mind doesn't relax. It's like I'm alive. (Mood modification)

3. Even if I engage in the behavior at the same rate, sometimes it's not enough for me, I have to engage in it more. I have to increase the time and amount I engage in the behavior or I won't relax. (Tolerance)

4. When I'm in a place where it's impossible for me to engage in the behavior, or when I try to stop myself, or when someone sees my problem and tries to interfere, I feel symptoms of tension psychologically or physically. (Withdrawal)

5. Engaging in the behavior causes me to have problems in my environment, my social life is badly affected, it can disrupt my work, and I often get criticized about it. (Conflict)

6. If I do stop engaging in the behavior, it can be triggered again and I when it does it's like it never stopped in the first place. (Relapse)

Summed Score	EAP[θ|x]	SD[θ|x]	Modeled Proportion
0	−1.711	0.547	0.0684099
1	−1.294	0.424	0.0225427
2	−1.199	0.417	0.0284462
3	−1.091	0.406	0.0293088
4	−0.974	0.388	0.0261963
5	−0.923	0.392	0.0326204
6	−0.776	0.348	0.0259656
7	−0.703	0.342	0.0264474
8	−0.626	0.332	0.0258018
9	−0.546	0.319	0.0243133
10	−0.488	0.320	0.0247555
11	−0.408	0.300	0.0230077
12	−0.348	0.295	0.0226660
13	−0.288	0.289	0.0221586
14	−0.229	0.284	0.0214857
15	−0.175	0.281	0.0212651
16	−0.119	0.276	0.0206119
17	−0.068	0.273	0.0202930
18	−0.017	0.271	0.0199479
19	0.033	0.269	0.0195443
20	0.082	0.268	0.0192928
21	0.130	0.266	0.0188764
22	0.176	0.266	0.0185736
23	0.223	0.265	0.0182535
24	0.268	0.264	0.0178911
25	0.314	0.264	0.0175916
26	0.359	0.263	0.0171956
27	0.403	0.263	0.0168403
28	0.448	0.263	0.0164660
29	0.492	0.263	0.0160562
30	0.536	0.263	0.0156735
31	0.580	0.263	0.0152335
32	0.624	0.263	0.0148088
33	0.668	0.263	0.0143732
34	0.712	0.263	0.0139157
35	0.756	0.263	0.0134767
36	0.801	0.263	0.0130095
37	0.846	0.263	0.0125552
38	0.891	0.264	0.0121029

(continued)

Continued

Summed Score	EAP[θ|x]	SD[θ|x]	Modeled Proportion
39	0.936	0.264	0.0116420
40	0.982	0.264	0.0112051
41	1.028	0.265	0.0107555
42	1.075	0.266	0.0103258
43	1.123	0.267	0.0099093
44	1.172	0.268	0.0094875
45	1.222	0.270	0.0091076
46	1.272	0.271	0.0087021
47	1.324	0.274	0.0083350
48	1.378	0.277	0.0079901
49	1.431	0.280	0.0076123
50	1.495	0.292	0.0073707
51	1.545	0.287	0.0069158
52	1.609	0.293	0.0066362
53	1.676	0.300	0.0063824
54	1.742	0.304	0.0059971
55	1.838	0.327	0.0060528
56	1.894	0.323	0.0052622
57	1.985	0.334	0.0050944
58	2.090	0.346	0.0049914
59	2.189	0.352	0.0041345
60	2.521	0.450	0.0081162