



Validation of the Turkish version of the power of food scale in adult population

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Abstract

Purpose The Power of Food Scale (PFS) is a tool for measuring the hedonic impact of food environments rich in palatable foods. The purpose of this study was to validate the Turkish version of PFS (PFS-Tr) in a large adult population.

Methods Data were obtained from 505 Turkish adults aged between 19 and 64 years. The PFS-Tr and Dutch Eating Behavior Questionnaire (DEBQ) were completed by all participants.

Results PFS-Tr compared with the original English version of PFS, items 5 and 13, which showed the highest error covariance under the food available factor. To provide general criteria, items 5 and 13 were removed. After these two items were removed, the Cronbach's alpha coefficient was 0.922 for PFS-Tr and Cronbach's alpha values for "food available", "food present", and "food taste" were found to be 0.849, 0.797, and 0.82, respectively. Besides, the Cronbach's alpha coefficient was 0.93 for DEBQ. In addition, a linear association was found between BMI and mean score of PFS-Tr with a model fit ($R^2=0.02$) and PFS-Tr was positively correlated with DEBQ ($r=0.497$, $p<0.001$).

Conclusion This is the first study that validates and reports the Turkish version of PFS and the results of our study show that PFS-Tr is a valid and reliable tool for determining the tendency for the hedonic hunger in Turkish adult population.

Level of evidence Level V, cross-sectional descriptive study.

Keywords Eating behavior · Hedonic hunger · Power of food scale · Turkish population

Introduction

Diet and nutrition play important roles in maintaining health and preventing diseases [1]. A decrease may be achievable in morbidity and mortality associated with lifestyle-related diseases if satisfactory eating behaviors are adopted throughout life [2, 3]. Eating behavior is regulated by two different systems: homeostatic and hedonic pathways [4, 5]. The homeostatic pathway controls energy balance by increasing the motivation to eat after the depletion of energy stores. In contrast, hedonic or reward-based regulation can override the homeostatic pathway during periods of relative energy abundance by increasing the desire to consume foods that are highly palatable [6]. Homeostatic factors (regulated by energy stores and energy demands) that control the amount of food that individual consumers are often exposed to the

effects of a non-homeostatic system (hedonic, i.e. reward system, taste and pleasure) [7].

Increase in the daily energy intake is not only the result of homeostatic requirement but also of environmental and social factors, such as food availability and palatability [8]. It has been reported that the hedonic properties of nutrients may affect eating behavior beyond daily energy requirements and may lead to obesity [4, 9]. The hedonistic desire for palatable food is considered to be reward-related and may result in over-eating behavior that could invalidate homeostatic regulation. It has been observed that reward-related signals can override homeostatic signals and can contribute primarily to the body's consumption of more nutrients than the body's immediate energy needs [9, 10]. For example, frequent exposure to some clues that remind of food, though they are not even close to food, can accelerate psychological processes leading to body weight gain [11]. In this case, the term "hedonic hunger" is used to express the desire to consume food for pleasure in the absence of a person's need for calories [12].

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The relationship between hedonic hunger and body mass index (BMI) remains unclear and has not been adequately quantified [13]. It is also known that elevated hedonic hunger is common among patients with severe obesity [14]. Some studies [13, 15] showed positive relationship between the Power of Food Scale (PFS) scores and BMI. However, despite the evidence supporting a relationship between hedonic hunger and the etiology of weight gain and/or of excess weight maintenance, most studies do not report significant correlations between BMI and PFS scores [13, 16–18]. The potential role of hedonic hunger cannot only be regarded as a characteristic of obese individuals, but also a risk of developing obesity [19]. Therefore, a measurement that can detect such individual variations may be useful in identifying susceptible groups at the risk of over-eating and reducing the risk of obesity [11].

A frequently used tool to measure the hedonic hunger is the Power of Food Scale (PFS). It was developed by Lowe et al. in 2009 to measure individual differences in appetitive responsiveness and to assess the psychological impact of living in food-abundant environments. PFS measures the changes in appetite reactions at three levels when an individual is in close proximity to palatable foods. Food available (FA) is factor 1 and describes the reaction when the palatable food is available, but is not physically present; food present (FP) is factor 2 and describes the reaction when the palatable food is physically present but has not been tasted yet; food tasted (FT) is factor 3 and describes the reaction when the palatable food is tasted first, but not consumed yet [20]. To date, PFS has been validated in four different languages: Japanese, Portuguese, German, and Persian. To the best of our knowledge, there has been any study investigating hedonic hunger in Turkey. In addition, a scale that can objectively evaluate hedonic hunger is needed. Therefore, the present study is the first to validate and report the Turkish version of the Power of Food Scale (PFS-Tr).

Methods

This study is a cross-sectional study. Data were collected using a self-administered questionnaire between April 2019 and September 2019. The questionnaire was sent via e-mail to be filled by participant. The sample was chosen randomly from adult individuals living in Ankara. An informative text about the study was presented prior to the study and the participants agreed to participate in the study. Power analysis was carried out using G power software to determine the number of individuals in the sample before starting the study. Based on power analysis, 159 or more individuals had to be included in the study [error type 1 (α) = 0.05, test power (1-error type 2 (β)) = 0.80 and margin of

error (d) = 0.10]. Thus, 505 (124 male and 381 female) participants, who are Turkish adults aged 19–64 years, were involved in the study.

Participants

A total of 505 individuals aged 19–64 years were included in the study. The mean age of female individuals was 25.7 ± 7.76 years ($n = 381$) while the mean age of male individuals was 29.1 ± 9.23 years ($n = 124$). In addition, 80% of the individuals participating in the study were high school and university graduates. The rate of university graduates was 26.7%, and the rate of high school graduates was 53.3%. The rates of smoking and drinking alcohol were 21.2% and 17.2%, respectively. The mean BMI of female and male individuals were 22.20 ± 3.41 kg/m² ($n = 381$) and 25.06 ± 3.42 kg/m² ($n = 124$), respectively.

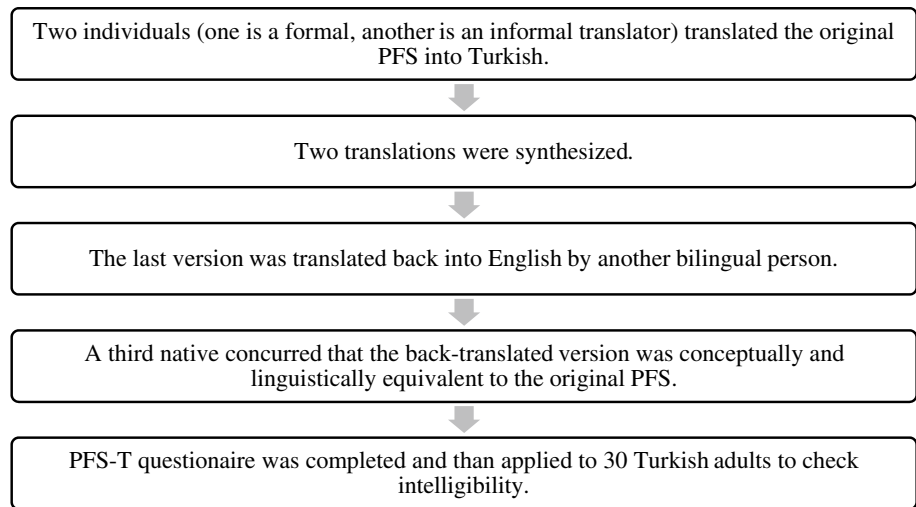
Power of Food Scale (PFS)

The PFS is a self-report questionnaire consisting of 15 items and follows a 5-point Likert-type scale of answers, ranging from ‘don’t agree at all’ to ‘strongly agree’. PFS is used to measure appetite for the assessment of hedonic fasting status. PFS was developed to evaluate the psychological impact of different nutrient environments [21]. PFS is not only a measure of nutrient environments, but it is also a measure of individual differences in appetite-related thoughts, emotions, and aspirations in environments where delicious foods are abundantly and consistently present. Beyond physiological needs, this approach is based on an appetite model that shows individual differences in food motivation, and the presence of delicious foods increases consumption even more [20].

PFS consists of a total score and separate subscales, which are food available (FA), food present (FP), and food tasted (FT). The first is the subscale of food available, which assesses general thoughts about foods (items 1, 2, 5, 10, 11 and 13). Second, the food present subscale assesses attraction to food that is directly available to the individual (items 3, 4, 6, and 7). Finally, food tasted subscale evaluates desire for/pleasure derived from food when first tasted (items 8, 9, 12, 14, and 15). PFS total and subscale scores are obtained by summing the item scores and dividing the sum by the number of items.

Study design

Permission from the author was received to use the original English version of PFS. Power of Food Scale was translated into Turkish using the recommended procedure for translation [22]. The procedure is summarized in the Fig. 1.

Fig. 1 Representation of the adaptation stages

Dutch Eating Behavior Questionnaire (DEBQ)

DEBQ is a self-report questionnaire incorporating 33 items ensuing a Likert-type scale of answers ranging from ‘never’ to ‘very often’. It contains three dimensions: measuring restraint (attempts to avoid food ingestion), emotional eating (over-eating in response to emotions), and external eating (eating in response to food-related stimuli) [23]. DEBQ was validated for the Turkish population by Bozan et al. [24] and they stated that test–retest reliability of DEBQ was 0.90 for Emotional eating, 0.94 for restrained eating and 0.96 for external eating subscales. DEBQ was employed in this study to compare the validity of the PFS-Tr with adults from Turkey. DEBQ measures three different psychologically based eating behaviors (emotional eating, externally induced eating and restrained eating).

Data on body weight and height were provided as self-report, the BMI was calculated using the formula: $BMI = \text{body weight (kg)} / (\text{body height (m)})^2$ [25].

Statistical analyses

In the study, the validity and reliability of the Turkish version of PFS scale (PFS-Tr) were tested. Also, the scale was compared with DEBQ, which is a similar scale. The validity study was examined in IBM SPSS Amos graphics program (Version 23.0, Chicago).

After checking the translations of the scale from English into Turkish, Confirmatory Factor Analysis (CFA) was performed with the AMOS program for validity. Reliability data and other statistical analyses were evaluated in SPSS 23.0 software. Validity is obtained using CFA and reliability is obtained by Alpha. Means and standard deviations (SD) were calculated for the total PFS and DEBQ across the categories of gender, age, and body mass index (BMI). For reliability, all factor and sub-factor scores were analyzed

and interpreted with Cronbach’s alpha values. For structural equation modeling (Model 2), the following criteria were used to assess fit: $GFI > 0.90$, $AGFI > 0.80$, $RMSEA < 0.10$, and $CFI > 0.90$, as described previously [26]. Mean and standard deviation values were given for descriptive statistics related to the scales.

Binary comparison, multiple comparison tests, and interpretations were obtained. Since the skewness of the right and left of the Likert scales does not provide parametric assumptions, they were performed with non-parametric methods. Mann–Whitney *U* and Kruskal–Wallis tests were used for non-parametric tests. The correlations of the overall scores of the scale were examined with the Spearman’s rank correlation coefficients. The level of DEBQ total score and PFS total score explanation were measured by simple linear regression analysis. A *p* value of less than 0.05 was considered statistically significant.

Results

In this section, reliability and validity are investigated. First, reliability scores are obtained for all sub-factors and factors in PFS and DEBQ. Then, factor structure is sought for PFS.

Reliability

To obtain reliability in both questionnaires PFS and DEBQ, reliability analysis is investigated. The Cronbach’s alpha coefficient was over 0.80 in sub-factor and total factor scores for PFS and DEBQ. The Cronbach’s alpha coefficient was 0.922 for PFS-Tr and Cronbach’s alpha values for “food available”, “food present”, and “food taste” were found to be 0.849, 0.797, and 0.820, respectively. These findings support the test–retest reliability of PFS-Tr. Besides, the Cronbach’s alpha coefficient was 0.93 for DEBQ. The Cronbach’s alpha

coefficient of factors of DEBQ measuring restraint, emotional eating, and external eating were 0.970, 0.900, and 0.860, respectively.

Factor structure

After obtaining reliability in both two scales, we also investigated validity of PFS using CFA for Turkish version which is called PFS-Tr. CFA was carried out to corroborate that the factor structure of PFS-Tr was the same as that of the subscales of the original version of PFS. We used maximum likelihood to observe parameter estimation for CFA. Subsequently, model fitness was assessed using chi-squared goodness-of-fit and the following indices: goodness-of-fit index (GFI), adjusted goodness-of-fit index [27], root mean square error of approximation [28], and the comparative fit index [29]. The three factors are food available (items 1, 2, 5, 10, 11, and 13), Food Present (items 3, 4, 6, and 7), and food tasted (items 8, 9, 12, 14, and 15) (Model 1). It was observed that model fitting was not desired levels for the original English version of PFS. Therefore, covariances of error terms under the same factor were analyzed to increase the model fit and make it acceptable [30]. Items 5 and 13, which showed the highest error covariance were removed to provide model-fit indexes [31, 32]. Namely, the FA factor consisted of items 1, 2, 10, and 11 (Fig. 2). After manipulation on the modification indices and excluding items with higher covariance

error, PFS-Tr, Turkish version of PFS, can be achieved as Model 2. Results from CFA of PFS-Tr are presented in Fig. 2. The model-fit statistics for the Model 2 were as follows: $\chi^2 = 234$, $df = 60$; $\chi^2/df = 3.90$; GFI = 0.93, AGFI = 0.90, RMSEA = 0.07, and CFI = 0.94. All criteria were met with the following model-fit conditions: GFI > 0.90, AGFI > 0.80, RMSEA < 0.10, and CFI > 0.90 [26]. Thus, the Turkish version of PFS scale, PFS-Tr, was proved to be valid and reliable to use.

The coefficients for each factor variables were statistically significant (Table 1). All these substances were found to be effective in forming factors. When the standardized coefficients were examined, question 2 was the most explaining factor of FA and question 10 was the least explaining factor. Question 3 was the most significant item of FP and question 4 was the least significant item. When the items for FT factor were examined, it was seen that question 8 was the most important item and question 14 was the least important item. The correlation between the factors of FA and FP was positively obtained as 0.858 while the correlation between the factors of FA and FT was achieved as 0.764. Also, the correlation between the factors of FA and FT was 0.845. All the correlations were statistically significant ($p < 0.001$) 0.085.

There was a linear association between BMI and mean score of PFS-Tr with a model fit ($R^2 = 0.02$) (Fig. 3). PFS-Tr was positively correlated with DEBQ ($r = 0.497$, $p < 0.001$). It was seen that PFS can be explained with DEBQ by simple linear regression ($p < 0.001$) (Fig. 4).

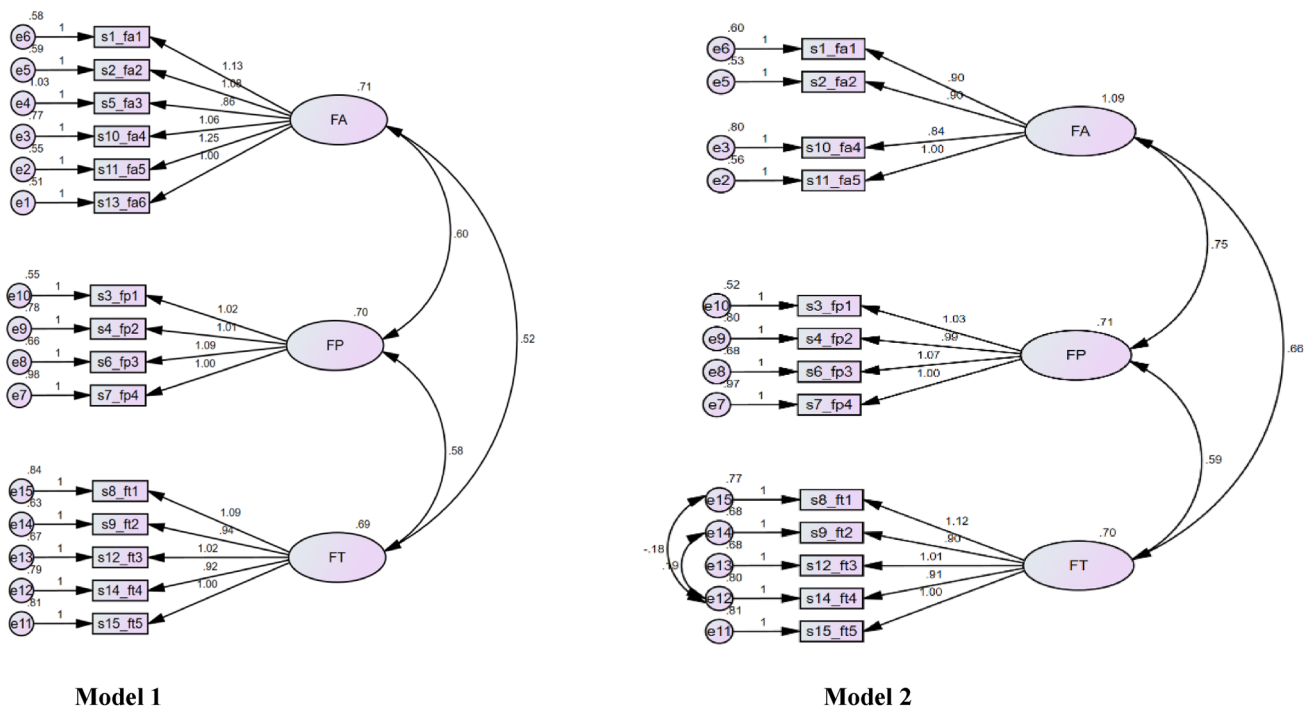


Fig. 2 The confirmatory factor analysis loading

Table 1 The rotated factor loadings

	Eigenvalue (%variance explained)	FA	FP	FT
FA	Q1	7.22 (45.16%)	0.809	
	Q2		0.761	
	Q5		0.666	
	Q10		0.740	
	Q11		0.817	
FP	Q3	0.88 (6.06%)		0.360
	Q4			0.341
	Q6			0.331
	Q7			0.345
FT	Q8	1.4 (12.08%)		0.486
	Q9			0.660
	Q12			0.693
	Q14			0.625
	Q15			0.603

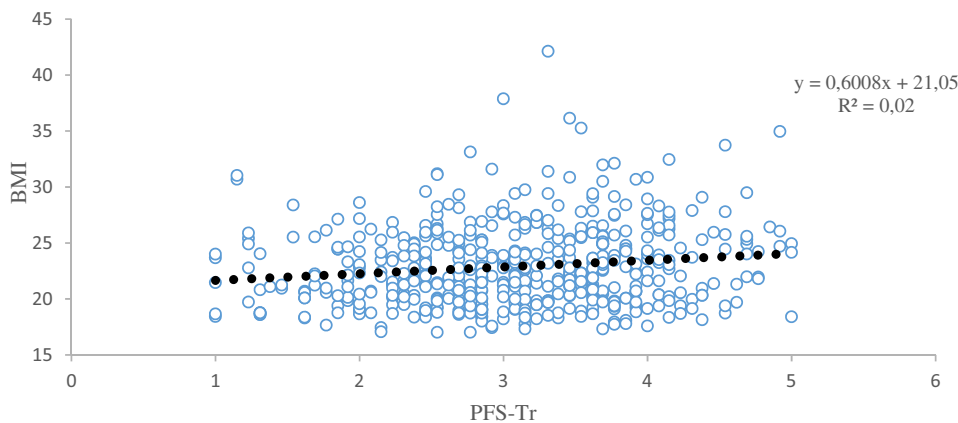
FA food available, FP food present, FT food taste, Q1–15 question numbers of PFS

PFS total score was 3.08 ± 0.85 and DEBQ total score was 2.56 ± 0.65 . The mean scores of PFS-Tr and DEBQ were higher in females ($p = 0.026$ and $p < 0.001$, respectively). While the total score increased with age in PFS ($p = 0.036$), no significant difference was observed between the total scores of DEBQ and PFS-Tr according to age ($p = 0.426$). Total scores of DEBQ and PFS increased with the BMI, but the increase in PFS-Tr score was not statistically significant (data not shown) (Table 2).

Discussion

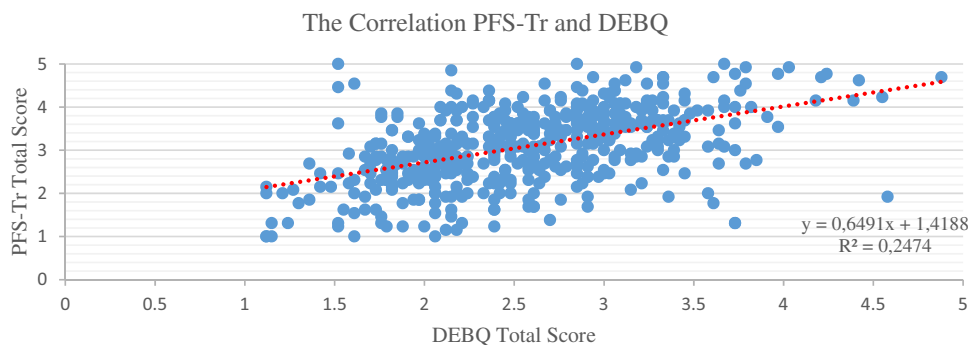
The present study is the first study aiming at the Turkish validation study of PFS (PFS-Tr) in adult population. A total of 505 individuals, aged 19–64 years, were included in this study. PFS was developed to reveal the individual effects of hedonic factors, which have a significant impact on the regulation of food intake and is a useful tool for the measurement of the hedonic impact of food environments surrounded with highly palatable foods. The original English version of PFS was found valid for the measurement of appetite motives on palatable foods by Lowe et al. [20]. As of October 2019, PFS has been validated in four different languages. Japanese

Fig. 3 Relationship between PFS-Tr score and body mass index (BMI). BMI body mass index, PFS-Tr Turkish Version of Power of Food Scale



BMI: Body Mass Index; PFS-Tr: Turkish Version of Power of Food Scale

Fig. 4 Relationship between PFS-Tr and DEBQ. PFS-Tr Turkish Version of Power of Food Scale, DEBQ Dutch Eating Behavior Questionnaire



PFS-Tr: Turkish Version of Power of Food Scale; DEBQ: Dutch Eating Behaviour Questionnaire

Table 2 The coefficients for each factor variables

PFS	Model 1						Model 2					
	Item	Coefficient	Standard error	Standardized coefficient	Test	<i>p</i>	Item	Coefficient	Standard error	Standard coefficient	Test	<i>p</i>
FA	Q13	1		0.762								
	Q11	1.245	0.066	0.817	18.896	*	Q11	1		0.813		
	Q10	1.06	0.065	0.713	16.202	*	Q10	0.837	0.051	0.697	16.395	*
	Q5	0.859	0.067	0.580	12.896	*						
	Q2	1.077	0.061	0.764	17.513	*	Q2	0.896	0.047	0.788	19.052	*
FP	Q1	1.128	0.063	0.781	17.95	*	Q1	0.899	0.048	0.771	18.544	*
	Q7	1		0.644			Q7	1.000		0.649		
	Q6	1.093	0.079	0.747	13.894	*	Q6	1.070	0.077	0.737	13.829	*
	Q4	1.011	0.077	0.690	13.061	*	Q4	0.990	0.076	0.681	12.993	*
	Q3	1.023	0.073	0.755	14.002	*	Q3	1.033	0.072	0.768	14.268	*
FT	Q15	1		0.678			Q15	1.000		0.681		
	Q14	0.919	0.072	0.652	12.803	*	Q14	0.911	0.074	0.647	12.364	*
	Q12	1.017	0.073	0.717	13.903	*	Q12	1.008	0.072	0.714	13.950	*
	Q9	0.945	0.069	0.702	13.657	*	Q9	0.903	0.069	0.674	13.132	*
	Q8	1.086	0.08	0.702	13.66	*	Q8	1.123	0.080	0.729	14.019	*

FA food available, FP food present, FT food tasted, Q1–15 question numbers of PFS

* $p < 0.001$

[16], Portuguese [33], German [15], and Persian [34] validations of PFS were evaluated and it was shown that PFS in four different languages was similar to the original scale and had good internal structure. Cronbach's alpha coefficient of 0.922 demonstrated a high internal consistency of the PFS-Tr, which is similar to other language versions of German (0.92), Japanese (0.87), Portuguese (0.91), and Persian (0.92) [15, 16, 33, 34]. The most important difference from the other studies was that when compared with the original English version of PFS, items 5 and 13, which showed the highest error covariance under the FA factor, were removed (Fig. 2). The strength of this study is that the sample included all subgroups in terms of gender and age in the adult population. In addition, this study had adequate statistical power for factor analysis, according to standard guidelines which recommend a minimum of 10 participants per item in a measure [35]. According to statistical analysis, PFS-Tr is a reliable and valid tool for measuring hedonic hunger in large Turkish-speaking population. Temporal stability was also adequate and supported the use of the PFS-Tr in prospective studies.

Self-report measures are commonly used in research on eating behaviors. DEBQ external eating subscale is a good indicator of measuring eating behaviors stimulated by the presence of food and/or the presence of other people eating. However, PFS is not only a measure of nutrient environments, but it is also a measure of individual differences in appetite-related thoughts, emotions, and aspirations in

environments where delicious foods are abundantly and consistently present. PFS and DEBQ tend to be significantly correlated [12]. In our study similar to the validation of PFS in Portuguese study [33], we also found high positive correlations between the scores of PFS-Tr and the external eating subscale of DEBQ (Fig. 3). Although it was shown that these two different questionnaires measure similar aspects of appetite and eating behavior in our study, further studies are needed to clarify if PFS and DEBQ have similar findings in different study populations.

The relationship between BMI and PFS score is controversial. Komatsu et al. reported that being overweight is positively correlated with food available and food present, but there is no relationship between food tasted and total score [36]. Aliasghari et al. showed that BMI and total score of PFS, food available and food present had a strong relative correlation, whereas BMI and food tasted had moderate relative correlation [34]. Increasing PFS scores across BMI categories have been demonstrated by Andreeva et al. Also, they assumed higher appetitive motivation in overweight individuals [15]. On the other hand, Cappelleri et al. reported a weak relationship between BMI and each of the three subscales in obese samples [21] However, another study by Lowe and Butryn failed to show this relationship using normal weight samples [20]. In the present study, there was a linear association between BMI and mean score of PFS-Tr with a model fit which is in agreement with the studies of Komatsu et al. [36],

Aliasghari et al. [34], and Andreeva et al. [15], ($R^2=0.02$) (Fig. 3). The result of our study indicates that PFS score can be a good predictor value for the tendency for obesity. However, in the present study, the mean BMI of female and male individuals were 22.20 ± 3.41 kg/m² ($n=381$) and 25.06 ± 3.42 kg/m² ($n=124$), respectively. The fewer number of male participants and higher mean values of BMI necessitate further studies based on objective measurement to evaluate hedonic hunger as a predictor of obesity in Turkish adult populations.

Thus, it can be said that PFS-Tr is a useful tool for evaluating hedonic hunger motives in adult populations and further studies can determine hedonic hunger status of individuals in the adult Turkish population using PFS-Tr. This research, however, is subject to several limitations. The number of participants is not equal according to gender, which may be effective in assessing hedonic hunger, and the participants were chosen only from Ankara. In addition, the self-report of weight and height to calculate BMI is a limitation.

What is already known on this subject?

In many studies conducted to date, hedonic hunger has been revealed as an important factor affecting food choices and nutritional intake of individuals. Nutrition is an important factor affecting health. For this reason, determining whether individuals have hedonic hunger tendencies through a scale will enable taking precautions in this direction while creating nutrition programs. In this context, it has been determined in the studies that PFS is a reliable tool. Turkey does not have a tool that assesses validity and reliability in this area.

What does this study add?

Our study was the first to validate and report the Turkish version of the Power of Food Scale and the PFS-Tr showed high reliability and acceptable validity in Turkish adult population. Further studies can determine hedonic hunger status of individuals in the adult Turkish population using PFS-Tr. In addition, it is thought that the use of this scale, could be effective in preventing and treating overweightness and obesity, which are major public health problems in Turkey, just as they are all over the world.

Funding There was no financial support.

Compliance with ethical standards

Conflict of interest Authors of the study declare that they have no conflicts of interest. The authors would like to thank Michael Lowe from the Department of Psychology in Drexel University for providing access to the Power of Food Scale and contributing to the adaptation process. Also, we would like to thank Onur Toka (PhD) who works as a consultant for statistical analysis.

Ethical approval The study protocol was approved by the Ethics Committees at the Gazi University (91610558-604.01.02). All procedures performed were in accordance with the Helsinki declaration and its subsequent amendments or comparable ethical standards.

Informed consent An informative text about the study was presented and the participants agreed to participate in the study.

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