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Original article

Reliability and validity of the food technology Neophobia scale in a Turkish sample

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Summary Food technology neophobia refers to the unwillingness/avoidance and neophobia to foods produced using new food technologies. Identifying this neophobia in a society is significant as it affects the demand for these products in the food industry. In this study, we aimed to evaluate the reliability and validity of the Food Technology Neophobia Scale in a Turkish sample. We conducted this study in two stages. In the first stage, which we conducted with 182 participants, we determined that the scale had high reliability and was suitable for validity testing. In the second stage, which we conducted with 610 participants, we performed exploratory and confirmatory factor analyses. The results of these analyses did not confirm the thirteen-item and four-factor structure, unlike the original scale; however, they pointed to a twelve-item and three-factor structure: 'New Food Technologies Are Unnecessary', 'Perception of Risks', and 'Healthy Choice and Information/Media'. This structure has an acceptable fit and is a valid and useful scale for use in Türkiye.

Keywords Consumer behaviour, food technology, neophobia, validation.

Introduction

Situations including population growth, climate change, and pandemics can affect the food supply and threaten the food system (Siegrist & Hartmann, 2020). The biological resources required for producing food are decreasing, whereas the need to feed a growing world population is rising. Therefore, to improve food production, reduce food waste, and initiate digitalisation in the food system, new food technologies are needed (Valoppi *et al*., 2021). Moreover, this need has emerged because of consumers' orientation to foods with high nutritional and nutraceutical value (Hsieh & Ofori, 2007). Different technologies have been developed in several stages from the harvesting process of food to processing and storage. Among food industry advancements, particularly ultrasound, high hydrostatic pressure, pulsed electric fields, and cold plasma methods have been frequently discussed in recent years (Hameed *et al*., 2018). Additionally, nanotechnology, genetic engineering, in vitro meat, and three-dimensional (3D) food printing are technologies that have become used today and are believed to have positive effects, particularly in terms of sustainability (Sodano *et al*., 2016; Hameed *et al*., 2018; Caulier *et al*., 2020; Baum *et al*., 2021). However, these emerging technologies have caused discussions among the public, and studies have reported on consumers' concerns about food technologies, which affect their demands for food (Cox *et al*., 2007; Chen *et al*., 2013; Vidigal *et al*., 2015). Consumer concerns such as food safety, lack of knowledge, and distrust of these technologies may cause them to reject these technologies. This situation may affect the acceptance of innovations and their permanence in the food market (Chen *et al*., 2013; Vidigal *et al*., 2015).

The connotations of a food technology affect its perceived naturalness and consumer acceptance (Siegrist & Hartmann, 2020). Neophobia toward food technology arises because of the complex effect of cultural values, individual differences, and environmental factors. Sex is one of these factors. Males may have a more positive attitude toward food technologies than females (Cardello, 2003; Sajdakowska *et al*., 2018). Furthermore, sociodemographic factors, including having a lower education level and living in a smaller town or rural area, are reportedly the driving forces for a more positive approach to new technologies (Sajdakowska *et al*., 2018). Additionally, individuals' food knowledge levels and sustainability attitudes are significant issues for the approach to food technologies. According to a related study, increased food knowledge increases acceptance; however, increased interest

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in sustainability causes individuals to reject technology (Cavaliere & Ventura, 2018). However, it has been reported that food technology neophobia is not limited to upper middle or high-income countries; even in a low-income country, neophobia directs the perspective on technology (De Steur *et al*., 2016). Therefore, food technology neophobia is a global value that affects consumers' approval of technology.

The Food Technology Neophobia Scale (FTNS) was developed by Cox & Evans (2008) in response to the requirement for a psychometric tool to define food technology neophobia. In 2010, although the internal reliability among the thirteen components of the scale had already been assessed, the FTNS was retested to assess its reliability owing to the need for additional tests, particularly test–retest measurements (Evans *et al*., 2010). There is no psychometric tool developed yet to evaluate food technology neophobia in Türkiye. In this study, we hypothesised that the FTNS would be an appropriate tool for defining this neophobia in Türkiye. Additionally, compared to the FNS (Pliner & Hobden, 1992), the FTNS has been far more successful in predicting willingness to try novel food technologies because it focuses on technology rather than just food (Bäckström *et al*., 2004; Evans *et al*., 2010). Therefore, we hypothesised that FTNS would be positively related to the Food Neophobia Scale (FNS). We explained the aims and methodology to test these hypotheses, and then continued with the results and discussion section where we interpreted our findings with previous studies in the literature.

Aims and goals

We aimed to evaluate scale's reliability and validity to identify consumers who are open or not open to new food technologies in Türkiye in this study. Additionally, our goals in this study were to evaluate the level of food technology neophobia in this sample and the convergent validity of the scale with FNS.

Methods

Study design and participants

This study was conducted between March and April 2023 and was planned in two stages. Initially, a pilot study (Study 1) was carried out to make necessary design corrections. Then, we carried out Study 2 to perform exploratory and confirmatory factor analyses. The group selected for the study was formed online using the snowball method (Noy, 2008) through social media. In a previous study, it was advised that the sample size should be at least ten times the number of items on the scale (Akgül, 2005). In this direction, the number of participants of the thirteen-item scale was determined as 130, and 182 people completed the pilot study and 610 people completed Study 2. We conducted exploratory factor analysis with 305 people and confirmatory factor analysis with the other 305 people. Individuals who volunteered to participate in the study and were over the age of 18 were included in this survey, which was prepared using Google Forms. Before study initiation, participants were asked to approve the informed consent form. Additionally, ethical approval numbered ATADEK-2023/04 was received from the Acibadem Mehmet Ali Aydinlar University Medical Research Ethics Committee. The survey used in this study consisted of the following three parts: a questionnaire about the sociodemographic characteristics of the participants, the FTNS (Cox & Evans, 2008; Evans *et al*., 2010), and the FNS (Pliner & Hobden, 1992; Duman *et al*., 2020).

Materials

FTNS

The FTNS, a scale developed by Cox & Evans (2008), defines neophobia for foods produced using new technologies. To assess its reliability, the FTNS was retested in 2010. This 13-item scale is scored on a 7-point Likert scale (Evans *et al*., 2010). It consists of the following four subscales: 'Perception of Risks', 'New Food Technologies Are Unnecessary', 'Information/Media', and 'Healthy Choice'. Items 1–6 are categorised under 'New Food Technologies Are Unnecessary', items 7–10 are categorised under 'Perception of Risks', items 11–12 are categorised under 'Healthy Choice', and item 13 is categorised under 'Information/Media Subscale'. Additionally, items 11, 12, and 13 are reverse coded. The scale total score varies between 13 and 91. Although there is no cut-off score for the scale, higher scores mean that food technology neophobia increases (Cox & Evans, 2008). Modifications have been made to the original scale since its development. Since there was no evidence of validity for the original scale and the data did not fit well, the Abbreviated Food Technology Neophobia Scale, whose items and subscales have been revised, was also used in the literature previously (Schnettler *et al*., 2017). Additionally, some authors converted the original 7-point Likert scale into a 5-point scale (Matin *et al*., 2012; Chen *et al*., 2013), and in another study (Verbeke, 2015), thirteen items were reduced to four. However, since there is no study testing the validity and reliability of the Food Technology Neophobia Scale in Türkiye yet, the original version of the scale was preferred in this study (Evans *et al*., 2010). This scale is used to estimate people who are concerned about food that is produced with new food technologies (Evans *et al*., 2010).

Turkish adaptation of FTNS. The Turkish translation of the scale was carried out using back translation techniques. For this, a standardised procedure suggested by Brislin (1986) was used, in which a bilingual researcher translated the text from English into the target language. Then, an independent, bilingual researcher backtranslated the translated inventory. Inconsistencies, errors, and biases during the translation process were discussed, and until the translations were exact, the backtranslation comparison procedure was repeated, as suggested by Bracken & Barona (1991). All translators agreed on the final version of the scale.

FNS

The FNS is used for measuring food neophobia, which is defined as avoidance and aversion to new foods. The scale, which was developed by Pliner & Hobden (1992), was adapted into Turkish by Duman *et al*. (2020). This scale, which consists of ten items, is scored on a 7-point Likert-type scale. It was used to evaluate convergent validity in this study.

Data analysis

Statistical Package for the Social Sciences (IBM Corp Released, 2019) and R Project v3.6.1 software (R Core Team, 2019) were used for data analysis. The Shapiro–Wilk test was used to perform normality test of numerical variables. To determine reliability on the basis of item variances, Cronbach's alpha coefficient was used. To evaluate the sample size's suitability, the Kaiser–Mayer–Olkin (KMO) test was used; to evaluate the scale's suitability for factor analysis, the Bartlett test of sphericity was used. Exploratory factor analysis and principal component analysis were used to confirm the factor structure of the scale. Additionally, confirmatory factor analysis for the construct and component validity of scale factors and the varimax rotation technique were used as factor retention method. The suitability of the model performed using the maximum likelihood technique was tested using the goodness-of-fit index (GFI), adjusted goodness-of-fit index (AGFI), comparative fit index (CFI), normed fit index (NFI), root mean square error of approximation (RMSEA), and square root of mean square residual. The relationships between the scales were examined using the Pearson correlation coefficient.

Results

Study 1–pilot study

One hundred and eighty-two individuals completed a pilot study. 15.9% of the participants were males, and 84.1% were females. The mean age of males was 33.26 ± 10.19, and the mean age of females was 38.32 ± 73.87. The majority of both males (41.4%) and females (53.6%) had a bachelor's degree (Table 1). The Cronbach's alpha value of the FTNS was 0.854, and the scale was found to have high reliability. The Cronbach's alpha values of the thirteen scale items were between 0.824 and 0.870, and since there were no items with a value <0.30, it was determined that it was not necessary to remove any items from the scale and that the FTNS was suitable for validity analysis (data unshown).

Study 2

Descriptive statistics of study 2

Of the 610 individuals participating in the second stage of the study, 14.9% and 85.1% were males and females, respectively. Male and female participants had a mean age of 30,70 ± 1,24 and 27,94 ± 0,38 years, respectively. The majority of males were at the high school education level (45.1%), whereas most females were at the bachelor degree level (42.8%) (Table 1).

Reliability and validity analyses

Cronbach's alpha value of the thirteen-item FTNS was 0.856, and the scale had high reliability (Table 2). Additionally, when item total statistics were examined, it was found that it varied between 0.824 and 0.878, and it was determined that it was not necessary to remove items from the scale (Table 3).

The sample size was sufficient at a good level, as shown by the KMO value of 0.783. The dataset was appropriate for exploratory factor analysis based on the significant $P < 0.001$ and $\chi^2 = 2938{,}421$ found in the Bartlett test of sphericity Chi-square value (Table 2).

Exploratory factor analysis

No item was removed from the scale during the principal components analysis, as no items with factor loads below 0.30 were noted; however, the difference between two factor loads with low loading values was at least 0.10 after one item (M10) was removed from the scale. The process was repeated on the remaining 12 items.

Repeated reliability and validity analyses. Cronbach's alpha value for FTNS with twelve items was 0.826 (Table 2). Moreover, the item total statistics ranged between 0.785 and 0.848 (Table 3).

Following item removal, the KMO value obtained was 0.778, suggesting that the size of the sample was sufficient at a good level. The Bartlett test of sphericity Chi-square value was significant at $\chi^2 = 2818{,}888$ and $P < 0.001$ level (Table 3).

Exploratory factor analysis showed a three-factor structure with factor loads of >0.30 and eigenvalues of >1 that explained 74.175% of the total variance.

Table 1 Demographic characteristics of the study-1 and study-2 participants

	Study 1						**Study 2**					
	Males (n = 29) (15,9 %)		**Females (n = 153) (84,1 %)**		**Total**		**Males (n = 91) (14 9%)**		**Females (n = 519) (85.1 %)**		**Total (610)**	
	n	**%**	***n***	**%**	***n***	**%**	***n***	**%**	***n***	**%**	***n***	**%**
Age (year) ($\overline{X} \pm SS$)	33,26 ± 10,19		38,32 ± 73,87		37,52 ± 67,84		30,70 ± 1,24		27,94 ± 0,38		28,36 ± 9,27	
Education status												
Primary school	1	3,5	2	1,3	3	1,6	3	3,3	4	0,8	7	1,1
High school	5	17,2	15	9,8	20	11,0	41	45,1	173	33,3	214	35,1
Associate degree	2	6,9	5	3,3	7	3,8	8	8,8	22	4,2	30	4,9
Bachelor degree	12	41,4	82	53,6	94	51,6	25	27,5	222	42,8	247	40,5
MSc and PhD	9	31,0	49	32,0	58	31,9	14	15,4	98	18,9	112	18,4
Marital status												
Married	15	51,7	57	37,3	72	39,6	32	35,2	124	24,9	161	26,4
Single	14	48,3	96	62,8	110	60,4	59	64,8	390	75,1	449	73,6
Job												
Civil servant	7	24,1	38	24,9	45	24,7	11	12,1	84	16,2	95	15,6
Retired	1	3,5	2	1,3	3	1,6	6	6,6	5	1,0	11	1,8
Unemployed/ Student	7	24,1	47	30,7	54	29,7	40	43,9	290	55,8	330	54,1
Private sector employee	9	31,0	49	32,0	58	31,9	25	27,5	97	18,7	122	20,0
Self-employed	5	17,3	17	11,1	22	12,1	9	9,9	43	8,3	52	8,5

Table 2 Food technology neophobia scale reliability and validity analyses with thirteen and twelve item

Reliability and validity analyses with thirteen item		
Cronbach's alpha	*N* (item)	
0,856	13	
KMO and Bartlett test		
Kaiser–Meyer–Olkin measure of sampling adequacy		0,783
Bartlett test of sphericity	Approx. Chi-square	2938,421
	df	78
	Sig.	<0,001***
Repeated reliability and validity analyses with twelve item		
Cronbach's alpha	*N* (item)	
0,826	12	
KMO and Bartlett test		
Kaiser–Meyer–Olkin measure of sampling adequacy		0,778
Bartlett test of sphericity	Approx. Chi-square	2818,888
	df	66
	Sig.	<0,001***

KMO, Kaiser–Meyer–Olkin, Sig, Significant.
***$P < 0{,}001$.

Table 3 Cronbach's Alpha coefficients of all items before and after removal of item

	Cronbach's Alpha coefficients of thirteen items	**Cronbach's Alpha coefficients of twelve items after removal of item**
I1	0,840	0,809
I2	0,824	0,795
I3	0,829	0,795
I4	0,827	0,815
I5	0,824	0,785
I6	0,824	0,786
I7	0,837	0,807
I8	0,838	0,800
I9	0,841	0,814
I10	0,861	Item removed
I11	0,870	0,840
I12	0,877	0,848
I13	0,878	0,847

I, Item.

Factors were named as 'New Food Technologies Are Unnecessary', 'Perception of Risks', and 'Healthy Choice and Information/Media'. Consistent with these results, it was determined that the FTNS had a 7-point Likert type and a twelve-item and three-factor structure; the total score to be obtained from the scale was between 12 and 84 (Table 4).

Confirmatory factor analysis

The three-factor structure of the FTNS that exploratory factor analysis had revealed was confirmed by

Table 4 Dimensions of the scale obtained as a result of exploratory factor analysis

Item	English and Turkish versions of items	NFTU	PR	HCIM
I2	The benefits of new food technologies are often grossly overstated/Yeni gıda teknolojilerinin faydaları genellikle aşırı derecede abartılır.	0,875		
I6	New food technologies are something I am uncertain about/Yeni gıda teknolojileri emin olmadığım bir konu.	0,795		
I1	There are plenty of tasty foods around so we don't need to use new food technologies to produce more/Etrafta bir sürü lezzetli yiyecek var, bu yüzden daha fazlasını üretmek için gıda teknolojisini kullanmamıza gerek yok	0,763		
I5	New foods are not healthier than traditional foods/Yeni yiyecekler geleneksel yiyeceklerden daha sağlıklı değil.	0,756		
I4	There is no sense trying out high-tech food products because the ones I eat are already good enough/Yüksek teknolojili gıda ürünlerini denemenin bir anlamı yok çünkü yediklerim zaten yeterince iyi.	0,722		
I3	New food technologies decreases the natural quality of food/Yeni gıda teknolojileri, gıdanın doğal kalitesini düşürmektedir	0,721		
I8	New food technologies may have long term negative environmental effects/Yeni gıda teknolojilerinin uzun vadeli olumsuz çevresel etkileri olabilir		0,907	
I7	Society should not depend heavily on technologies to solve its food problems/Toplum, gıda sorunlarını çözmek için büyük ölçüde teknolojilere güvenmemelidir		0,901	
I9	It can be risky to switch to new food technologies too quickly/Yeni gıda teknolojilerine çok hızlı geçiş yapmak riskli olabilir		0,764	
I11	New products produced using new food technologies can help people have a balanced diet/Yeni gıda teknolojileri kullanılarak üretilen yeni ürünler, insanların dengeli beslenmesine yardımcı olabilir			0,872
I12	New food technologies gives people more control over their food choices/Yeni gıda teknolojileri, insanlara yiyecek seçimleri üzerinde daha fazla kontrol sağlıyor			0,838
I13	The media usually provides a balanced and unbiased view of new food technologies/Medya genellikle yeni gıda teknolojileri hakkında dengeli ve tarafsız bir görüş sunar.			0,739
RVE		44 095	17 994	12 085
EV		5291	2159	1450

EV, Eigenvalue; HCIM, Healthy Choice and Information/Media; I, Item; NFTU, New Food Technologies Are Unnecessary; PR, Perception of Risks; RVE, Ratio of Variance Explained.

confirmatory factor analysis. In the first model constructed using confirmatory factor analysis, criterion values were provided, and no items were required to be removed from the scale as no items with a factor load of <0.3 were observed (Fig. 1).

The following were the fit values of the model obtained using confirmatory factor analysis to the structural equation model: χ^2/df value, 1.772; RMSEA value, 0.050; NFI value, 0.972; CFI value, 0.988; standardised root mean square residual (SRMR) value, 0.071; GFI value, 0.986; and AGFI value, 0.978. Since the data obtained were within the threshold values, the model had a good fit index (Table 5).

The items' standardised factor loads were between 0.721 and 0.907, their average variance extracted values were >0.5, and their composite reliability values were >0.7, according to the confirmatory factor analysis (Table 6).

Mean and median values of the FTNS

The mean scores of the 'New Food Technologies Are Unnecessary', 'Perception of Risks', and 'Healthy Choice and Information/Media' subscales were 20.50 ± 9.25, 14.38 ± 4.83, and 12.75 ± 4.52, respectively. The scale's total score varied from 13 to 84, and the mean was 47.63 ± 12.95 (Table 7).

Correlation between the FTNS and FNS

As the total FTNS score increased, the FNS total score increased ($P = 0{,}004$). Additionally, as the FNS score increased, the 'New Food Technologies Are Unnecessary' ($P < 0{,}001$) and 'Perception of Risks' ($P < 0{,}001$) subscales of the FTNS increased, whereas the 'Healthy Choice and Information/Media' ($P < 0{,}001$) subscale decreased (Table 8).

Discussion

In this study, we first aimed to translate FTNS into the Turkish version and then validate it. In this respect, it was the first study to examine the validity and reliability of FTNS in a Turkish sample. The findings of our study indicated a twelve-item and three-factor structure, unlike the original scale with thirteen items and four factors (Cox & Evans, 2008; Evans *et al.*, 2010). The resulting three factors explained 74.175% of the variance.

The internal consistency of the scales with a Likert rating is estimated using Cronbach's alpha coefficient. Coefficients of 0.90 and above, 0.80–0.89, and 0.70–0.79 indicated excellent, good, and acceptable reliability, respectively (George & Mallery, 2003). Initially, we removed the tenth item from the scale because the

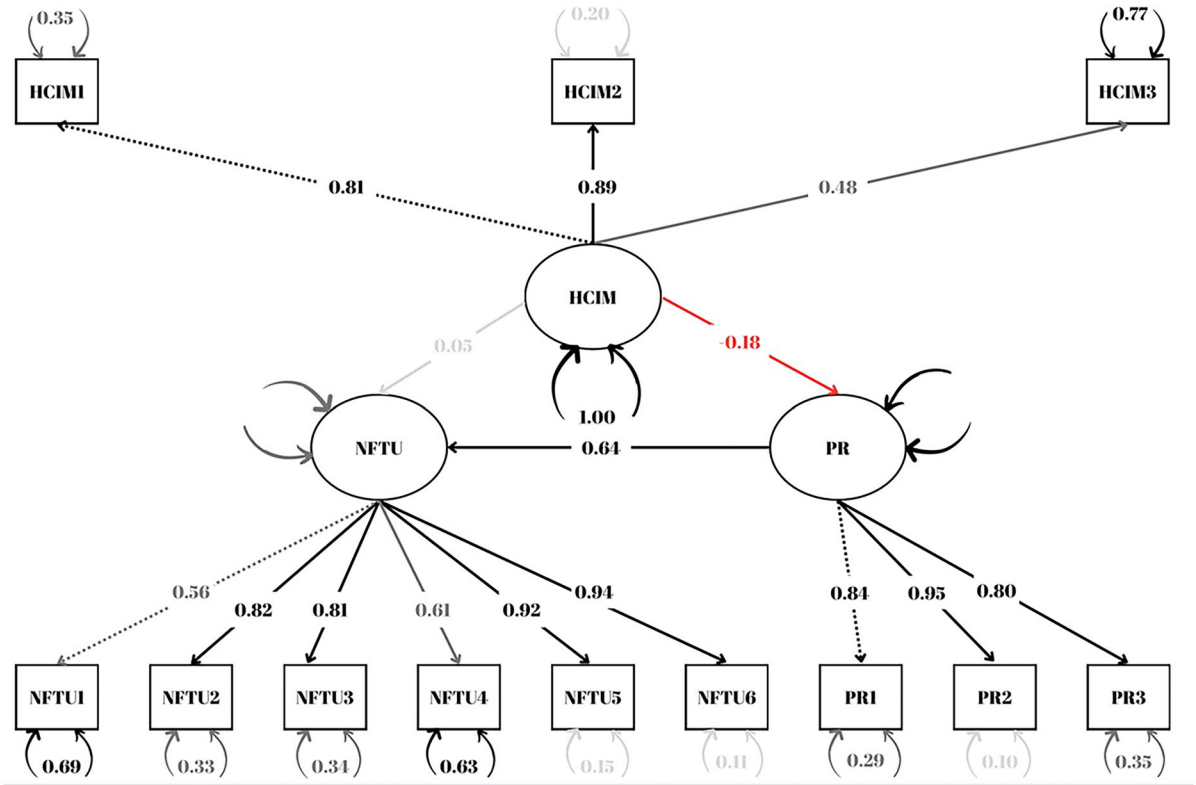

Figure 1 Confirmatory factor analysis model of the study.

Table 5 Goodness-of-fit values of the scale

Fit index	Threshold values	Analysis results
Degree of freedom	–	51
Chi-square/sd	0 ≤ Chi-square/sd ≤2	1772
RMSEA	RMSA ≤0,08	0,050
NFI	0,90 ≤ NFI ≤1,00	0,972
CFI	0,90 ≤ CFI ≤1,00	0,988
SRMR	SRMR <0,08	0,071
GFI	0,85 ≤ GFI ≤1,00	0,986
AGFI	0,85 ≤ AGFI ≤1,00	0,978

AGFI, adjusted goodness-of-fit index; CFI, comparative fit index; GFI, goodness-of-fit index; NFI, normed fit index; RMSEA, root mean square error; SRMR, standardised root mean square residual.

difference between the two factor loads with low load values was at least 0.10. Then, we observed that Cronbach's alpha value of the FTNS with 12 items was 0.826, and the items ranged between 0.785 and 0.848. Similarly, in the original scale study conducted by Cox and Evans, Cronbach's alpha coefficient of FTNS was 0.84 (Cox & Evans, 2008). This value was 0.909 in the Chinese adaptation of the FTNS (McKenzie *et al.*, 2021). This finding was similar to the original scale and those of other studies and indicated that the scale had high reliability (Cox & Evans, 2008; McKenzie *et al.*, 2021).

We confirmed the following three factors: 'New Food Technologies Are Unnecessary', 'Perception of Risks', and 'Healthy Choice and Information/Media'. Unlike the original scale with 4 factors (Cox & Evans, 2008; Evans *et al.*, 2010), we collected items 11, 12, and 13 under the 'Healthy Choice' and 'Information/-Media' factor. Because when we did explanatory factor analysis, we saw that these items were under the 'Healthy Choice' and 'Information/Media' factor. In a study conducted in the Chilean sample, thirteen items were reduced to nine and four factors to one (Schnettler *et al.*, 2016). Vidigal *et al.* (2015) defined three factors for the scale that they translated into Portuguese and validated it (Vidigal *et al.*, 2015). In their study in Uganda, De Steur *et al.* (2016) reduced the four factors to three, and Wang et al. (2023) reduced them to two factors. In a study conducted in Belgium, thirteen items were reduced to four (Verbeke, 2015). These findings highlight the significance of the population wherein the scale was validated. Also noteworthy is the culture of the country where the validation was made. Moreover, the translation of the scale into the

Table 6 Component values of factors and items as a result of confirmatory factor analysis

Factors and items	SFL >0,5	CR >0,7	AVE >0,4/0,5	Cronbach's $\alpha > 0,7$
New Food Technologies Are Unnecessary		0,899	0,599	0,902
NFTU1	0,763			
NFTU2	0,875			
NFTU3	0,721			
NFTU4	0,722			
NFTU5	0,756			
NFTU6	0,795			
Perception of Risks		0,894	0,739	0,894
PR1	0,901			
PR2	0,907			
PR3	0,764			
Healthy Choice and Information/Media		0,858	0,670	0,762
HCIM1	0,872			
HCIM2	0,838			
HCIM3	0,739			

AVE, average variance extracted; CR, composite reliability; HCIM, Healthy Choice and Information/Media; NFTU, New Food Technologies Are Unnecessary; PR, Perception of Risks; SFL, standardised factor loading.
*$P < 0,05$. All standardized factor loadings have been reached significantly.

Table 7 Mean and median values of the food technology neophobia scale

Scale/Subscale	$\overline{X} \pm SS$	Median (min–max)
NFTU	20,50 ± 9,25	19 (6–42)
PR	14,38 ± 4,83	15 (3–21)
HCIM	12,75 ± 4,52	13 (3–21)
FTNS-T	47,63 ± 12,95	47 (13–83)

Table 8 Correlation between the food technology neophobia scale and the food neophobia scale

		NFTU	PR	HCIM	FTNS-T
PR	*r*	0,556	–		
	P	<0,001***			
HCIM	*r*	−0,154	−0,152	–	
	P	0,007**	0,008***		
FTNS-T	*r*	0,902	0,717	0,253	–
	P	<0,001***	<0,001***	<0,001***	
FNS-T	*r*	0,251	0,331	−0,382	0,166
	P	<0,001***	<0,001***	<0,001***	0,004**

FNS-T, Food Neophobia Scale Total Score; FTNS-T, Food Technology Neophobia Scale Total Score; HCIM, Healthy Choice and Information/Media; NFTU, New Food Technologies Are Unnecessary; PR, Perception of Risks; *r*, Pearson correlation coefficient.
**$P < 0,01$.
***$P < 0,001$.

target language may cause different interpretations. In the validation study conducted in the Chinese sample, eleven items showed acceptable fit, and items 4 and 10 were removed from the scale. It was stated that item 10 was removed from the scale because it had a low commonality, a very low correlation with all other items, and a low factor loading (McKenzie *et al.*, 2021). Our findings regarding the removal of item 10 were in line with the study by McKenzie *et al.* (2021).

The minimum acceptable value for factor loading was 0.40 (Matsunaga, 2010). We found that the items' standardised factor loadings ranged from 0.721 to 0.907 in our study. In the original scale, the factor loadings were between 0.5612 and 0.8541 (Cox & Evans, 2008). In the study by McKenzie et al. in China, the factor loadings ranged between 0.367 and 0.816 (McKenzie *et al.*, 2021). In this case, we confirmed that the factor loadings of the items in our scale were above the minimum acceptable value and that each item had a satisfactory relationship with the score of its subscale. Moreover, we suggest that our study is largely similar to other studies.

In our study, we noted that the total mean score of the FTNS was 47.63 ± 12.95. Considering that the maximum score on this 12-item scale is 84, this population's neophobia of food technology may be moderate. The attitude toward new food technologies varies according to the population. Studies reported that attitude differs with respect to factors including age, sex, income status, education level, place of residence, food technology neophobia, and environmental attitude (Matin *et al.*, 2012; Chen *et al.*, 2013; Jezewska-Zychowicz & Królak, 2015; De Steur *et al.*, 2016; Salgado-Beltrán *et al.*, 2018; Cattaneo *et al.*, 2019; Rabadán, 2021; Wendt & Weinrich, 2023). As the approach to new food technologies shapes the food industry and market, defining neophobia in a society is significant.

As there may be overlapping concepts with each other, the FNS was used in this study to assess convergent validity. Significant relationships were noted between the FNS total score and FTNS subscale scores. Additionally, we observed that there was a significant but weak relationship between the FTNS total score and the FNS score ($r = 0.166$, $P = 0.004$). The original scale and FNS had a low correlation ($r = 0.184$), according to Cox & Evans (2008). McKenzie *et al.* (2021) reported a much larger association ($r = 0.537$) between the FTNS and FNS and suggested that the two structures differed less in this population (McKenzie *et al.*, 2021). These findings suggest that our scale is comparable to the original scale developed by (Cox & Evans, 2008; Evans *et al.*, 2010), which more specifically measures neophobia toward food produced using new technologies than food neophobia.

Limitations

We conducted this study through online platforms. Therefore, all data were based on participants' statements. Furthermore, we included participants who volunteered to participate in the study and over the age of eighteen. Considering the sociodemographic findings, our findings represent a sample with a high education level. However, in our study, we did not evaluate food technology neophobia levels according to sociodemographic factors, including education level, income status, and living in rural/urban areas. Therefore, studies need to discuss these problems and must be conducted in more specific populations in Türkiye.

Conclusion

This is the first study wherein the reliability and validity of the FTNS was conducted in a Turkish sample. Unlike the original scale, we validated twelve instead of thirteen items. Additionally, we categorised the items into the following three factors instead of four: 'New Technologies Are Unnecessary', 'Perception of Risks', and 'Healthy Choice and Information/Media'. Additionally, we found that our sample had moderate levels of food technology neophobia. When we evaluated convergent validity with the FNS, we confirmed that the FTNS more specifically measures neophobia toward foods produced using new technologies rather than food neophobia. In conclusion, we suggest that this structure is a valid and useful scale for Turkish population.

Author contributions

Meryem Kahriman: Conceptualization; writing – original draft; methodology; investigation; project administration. **Murat Baş:** Conceptualization; methodology; writing – review and editing; supervision.

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Conflict of interest statement

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Ethical approval

Ethical approval numbered ATADEK-2023/04 was received from the Acibadem Mehmet Ali Aydinlar University Medical Research Ethics Committee.

Declaration of generative AI in scientific writing

During the writing process of this article, 'QuillBot', an artificial intelligence program, was used to improve the language of the article.

Peer review

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Data availability statement

Data will be made available on request.

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