The Food Technology Neophobia Scale: A Validity and Reliability Study in Turkish

Gıda Teknolojisi Neofobi Ölçeği Türkçe Geçerlik ve Güvenirliği

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ABSTRACT

As expected, technology is an inevitable part of the contemporary food industry, and consumers may adopt diverse individual and cultural attitudes toward food products produced using new technology and technological methods. In this regard, the literature offers a previously introduced 13-item instrument, the Food Technology Neophobia Scale (FTNS), to measure such consumer attitudes. Thus, the present study sought the validity and reliability of the FTNS in the Turkish context. Accordingly, we performed relevant analyses on the data of 410 participants using the SPSS and LISREL programs. The findings revealed relatively high item-total correlations (0.65-0.74), Cronbach's alpha coefficient (0.92), and test-retest correlation coefficient (0.81). Thus, we concluded consistent and reliable scale items. Furthermore, the confirmatory factor analysis (CFA) yielded the fit indices indicating acceptable to good model-data fit. The error variances of the items are low, while there are no items with poor factor loading. In conclusion, the 13-item FTNS is a valid and reliable scale to measure food technology neophobia in the Turkish context.

Keywords: Food technology neophobia scale, Reliability, Turkish, Validity

ÖZ

Günümüzde teknolojiden her alanda yararlanıldığı gibi, gıda sektörü de teknolojik yeniliklere açık bir alandır. Yeni teknoloji ve teknolojik yöntemler kullanılarak üretilen gıda ürünlerine karşı tüketicilerin tutumları bireysel ya da kültürel açıdan farklılık gösterebilmektedir. Bu tutumun belirlenmesi için orijinali İngilizce olan Food Technology Neophobia Scale geliştirilmiştir. Özgün ölçek 13 maddeden oluşmaktadır. Bu çalışmada belirtilen ölçeğin Türkçe geçerlik ve güvenirliği çalışılmıştır. Çalışmaya katılan 410 kişinin verileri SPSS ve LISREL programlarıyla analiz edilerek değerlendirilmiştir. Ölçek maddelerinin toplam korelasyonu (0,65-0,71), Cronbach alfa değeri (0,92) ve test tekrar test korelasyonu (0,81) yüksek bulunmuştur. Bu sonuçlar ölçek maddelerinin tutarlı ve güvenilir olduğunu göstermektedir. Ölçeğin geçerlik tespitinde Doğrulayıcı Faktör Analizi kullanılarak incelenen uyum indeksleri, kabul edilebilir ya da mükemmel uyum düzeyindedir. Maddelerin hata varyansları düşüktür ve faktör yük değeri zayıf olan madde bulunmamaktadır. Sonuç olarak, 13 maddelik Food Technology Neophobia Scale ölçeği Türk toplumunda gıda teknolojisi neofobisinin ölçülmesinde kullanılabilecek, geçerli ve güvenilir bir ölçektir.

Anahtar Kelimeler: Geçerlik, Gıda teknolojisi neofobi ölçeği, Güvenirlik, Türkçe

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INTRODUCTION

Innovations in food technology seer the development of the food industry. Even many food items in the market can never be produced enough without food technologies.[1] Food technology refers to the application of the principles and techniques of food science in the processes of growing, processing, packaging, labeling, quality management, and distribution of food products.[2] The growing scholarly interest in food with the help of technology brings significant contributions to food science (e.g., nanofood produced with nanotechnology, microwave applications, and foods produced with genetically modified organism (GMO) technology).[3-5] Besides, individuals' approaches to such novel food technologies and products are increasingly becoming the subject of research.

Fear arising in different situations may be among the frequently experienced negative emotions. Even it may get more severe and cause panic and avoidance, which is called phobia.[6] Neophobia, also known as 'fear of novelty,' is one's inability to leave their old habits and to be extremely afraid of everything new.[7] The fear of food that has not been consumed before is known as 'food neophobia' and may vary by environmental factors (e.g., age, educational attainment, income, and culture). In this sense, Pliner and Hobden (1992) developed the Food Neophobia Scale (FNS) to measure one's attitudes toward food, and Duman et al. adapted the scale into Turkish.[8, 9]

A systematic review investigating the previous research that utilized the FNS concluded that the literature hosts review, methodological, and theme-oriented (health, diet, sensory, socioeconomic, and product or process) studies.[10] Previously, high food neophobia was discovered among patients with phenylketonuria and celiac patients.[11, 12] Soucier et al. (2019) reported that individuals over 65 years often have a high level of food neophobia and are reluctant to try new foods.[13] In a similar study, it was found that the participating undergraduate students were not willing to try foods from different ethnic cultures.[14] Another study exploring food neophobia among the pregnant suggested that high age and potent educational background are reversely correlated with neophobic attitudes.[15]

Acceptability of products produced using food technologies may differ by individual and cultural variables, geographical location, and religion. In this regard, Cox and Evans developed the Food Technology Neophobia Scale (FTNS) to assess one's fear of innovations in food technologies.[16] The present study then aimed to explore the validity and reliability of FTNS in the Turkish context.

MATERIAL AND METHODS

Research design

This is a methodological study. In this section, the study group of the research, data collection tools, data collection method and techniques used in data analysis are mentioned.

Translation

An expert in Turkish-English translation and interpretation initially carried out the translation work of the FTNS. Next, the two authors independently translated the scale into Turkish. We then went through the three forms of the FTNS in Turkish and generated the first draft. It was submitted to the views of two public health specialists, and we made minor revisions in the draft accordingly. Following linguistic evaluations by an academic in Turkish language and literature, we generated the final draft of the FTNS to be deployed in the research. Turkish-English meaning integrity of the items included in the scale has been checked at every stage for translation. For this reason, the scale was not

translated from Turkish to English again at the last stage.

Pilot study

Prior to the pilot study, we re-examined the intelligibility and appropriateness of the items. Then, we carried out the pilot study with the final draft with 20 individuals residing in the city center of Burdur and not included in the research sample.

Sample

We conducted the research with 420 individuals aged 18 years and over residing in the city center of Burdur-Turkey. Cokluk et al. (2014) specified that the sample size of 300 people is 'good' in validity and reliability studies, while Alpar (2012) pointed out a sample size of 400 people to perform reliability analysis of a Likert-type scale.[17, 18] Therefore, we targeted a sample size of 400 people, but we collected the data from 420 individuals considering possible missing data. We selected the sample using the quota sampling technique.[19] Besides, we informed the potential participants about the second phase of the research and requested their personal information (full name, address, telephone number, etc.) to readminister the data collection tool in the second phase. The inclusion criteria of the study were determined as follows: the participants' place of residence was Burdur city center, their ages were between 18-65, they were competent to understand the questions and express their thoughts, and they agreed to participate in the second stage of the research. Individuals who did not meet these criteria were excluded. No specific place or venue was determined for data collection. The study was conducted with volunteer individuals in public places.

Data collection tools

We collected the data using a questionnaire booklet covering a demographic information form (10 questions), the FNS (as parallel form), and the FTNS. The FNS was developed by Pliner and Hobden in 1992 and adapted into Turkish by Duman et al. (2020).[8, 9] In this 10-item 7-point Likert-type scale, items 1, 4, 6, 9, and 10 are reverse coded. One may get a minimum score of 10 points and a maximum score of 70 points on the scale, and the higher scores indicate increased food neophobia.[9]

Cox and Evans developed the FTNS in 2008 to assess one's fear of innovations in food technologies. The original version of the scale is in English and consists of 13 items. This 7-point Likert-type scale consists of no reverse-coded item. One may get a minimum score of 13 points and a maximum of 91 on the scale, and higher scores refer to greater fear of food technologies.[16]

Data collection

We collected that data from 420 participants between November 15, 2021 and February 01, 2022. The data were collected in public places in the city center and thought to be accessible to the participants (streets, squares, parks, workplaces, and cafes). We distributed the questionnaire booklets to the participants and stayed with them for assistance (e.g., clarifying any items they did not comprehend) till they filled out the scales. The procedure took 20-25 minutes. Furthermore, in the retest phase, we readministered the questionnaire booklet to 102 participants sampled in the first phase after two weeks of the first data collection.

Data analysis

While some participants left the instruments missing, and some were reluctant to provide their contact information; thus, we excluded the data of these participants (ten people) from the analyses. Accordingly, we analyzed the data of 410 in the first phase and of 102 people in the second phase using SPSS and LISREL programs.

For reliability of the FTNS (item statistics, internal consistency reliability, test-retest reliability, and parallel forms reliability) analyzes were made. And CFA (confirmatory factor analysis) was performed for validity of the scale. After CFA analysis, fit index values were calculated to evaluate construct validity (p, χ^2, df, χ^2/df, Root Mean Square Error of Approximation (RMSEA), Root Mean Square Residual (RMR), Standardized

Root Mean Square Residual (SRMR), Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI), Normed Fit Index (NFI), Non-Normed Fit Index (NNFI), and Comparative Fit Index (CFI) values).

Ethical considerations of the study

The Research Ethics Committee of Burdur Mehmet Akif Ersoy University granted ethical approval to this study (Meeting No.: 2021/11, Decision No.: GO 2021/369). In addition, we obtained written consent from the participants regarding their voluntary participation in the study. Besides, the corresponding authors granted us relevant permission to utilize the instruments.

RESULTS AND DISCUSSION

Sample characteristics

The mean age of the participants was found to be 28.03 years (1.23), and 66.1% (n = 271) were females. While 77.1% (n = 316) of the participants were single, 22.2% (n = 91) had a child. Moreover, 57.3% (n = 235) attained high school education, while 50.0% (n = 205) reported their socioeconomic status as good.

The 21st century witnesses a concern of global problems in the accessibility of food and water due to the rapid increase in the world population, which further accelerates technological integration in food production, processing, and packaging.[20, 21] Meanwhile, individuals can exhibit positive or negative attitudes toward novel foods and those introduced using new technologies; the FTNS, thus, may be a valuable tool to measure such attitudes and behaviors. The present study attempted to test the psychometric properties of the Turkish version of the FTNS through relevant reliability and validity analyses.

The sample of the original study consisted of South Australian individuals aged 18-65 years. The authors generated the 13-item FTNS through a three-way validity analysis and submitted it to the participants by e-mail. A total of 294 people, 203 (69%) females and 91 (31%) males, participated in their study. About half (47.3%) of their participants held an undergraduate or postgraduate degree.[16] In this study, we selected our sample with similar ages to the participants in the original research.

Suitability of data to validity and reliability analysis

We discovered the inter-item correlations to vary between 0.36 and 0.71, corresponding to poor to moderate correlations. The lack of high inter-item correlations, fortunately, proved the absence of a multicollinearity problem.

Reliability analyses

We sought the reliability of the FTNS considering item statistics, internal consistency reliability, test-retest reliability, and parallel forms reliability on the SPSS program. Table 1 presents the item statistics of the FTNS. Accordingly, we found item-total correlations to vary between 0.57-0.74. Furthermore, we calculated the internal consistency coefficient (Cronbach's alpha) of the FTNS to be 0.93. Moreover, we discovered a positive, robust, and significant correlation between the test and retest data (r = 0.81; $p < 0.001$). Finally, we concluded a positive, moderate, and significant correlation between the measurements with the FTNS and the FNS (r = 0.42; $p < 0.001$; Table 2).

We first evaluated the item statistics and found the item-total correlations to vary between 0.57-0.74, which are all acceptable since being above the cut-off value of 0.25 proposed in the literature.[22] The lowest item-total correlation belongs to item 6 (0.57), while items 2 and 13 yielded the highest item-total correlation coefficient (0.74). A high item-total correlation indicates that the scale measures the intended construct and that the items are highly consistent.[19, 23] Yet,

other adaptation studies did not mention the item-correlations of the FTNS items.[1, 24, 26]

The internal consistency reliability of the FTNS was found to be 0.93. It is often uttered in the literature that a Cronbach's alpha value between 0.80-1.00 refers to the high reliability of the instrument and the items' measuring the same construct.[27, 28] In the original study, the internal consistency of the FTNS was found to be 0.84.[16] Since FTNS is considered a robust instrument to determine the anxiety of and attitudes toward food products manufactured using novel technologies, the scale has been translated into different languages and subjected to many psychometric analyses so far. For example, internal consistency was calculated to be 0.73 in the Portuguese version of the FTNS.[1] In this study, none of the items adversely affected the reliability. Considering the Chinese version of the scale, the authors discovered that Cronbach's alpha value, calculated to be 0.876 for all items, increased to 0.909 when discarding two items.[26] In addition, a study exploring the psychometric properties of the scale in South America concluded a lower Cronbach's alpha value, 0.621.[24]

We sought the test-retest reliability, accepted as a robust reliability criterion, of the FTNS with 102 participants two weeks after the first data collection. Accordingly, we concluded determined a positive, high, and significant correlation between ($p < 0.001$; $r = 0.81$) the data collected for the test-retest phase. A test-retest correlation between 0.70-0.89 is often proposed to be robust.[18] Evans et al. (2010) evaluated the test-retest reliability of the FTNS scale with the intraclass correlation coefficient and reported the correlation coefficients of the items to vary between 0.466-0.701 ($p < 0.001$).[29] The authors uttered that such robust test-retest reliability indicates that the FTNS is helpful in measuring one's attitudes toward foods produced using new technologies.

Table 1. **FTNS Item Statistics and Reliability Values**

Sample			
Items	*M**±*SD***	Item-Total Correlation	Alpha If Item Removed
1. There are a plenty of tasty foods around, so we don't need to use new food technologies to produce more.	4.31±1.28	0.68	0.92
2. The benefits of new food technologies are often grossly overstated.	4.40±1.29	0.74	0.92
3. New food technologies decrease the natural quality of food.	4.78±1.43	0.68	0.92
4. There is no sense trying out high-tech food products because the ones I eat are already good enough.	4.22±1.35	0.67	0.92
5. New foods are not healthier than traditional foods.	4.60±1.38	0.68	0.92
6. New food technologies are something I am uncertain about.	4.56±1.31	0.57	0.92
7. Society should not depend heavily on technologies to solve its food problems.	4.68±1.36	0.65	0.92
8. New food technologies may have long term negative environmental effects.	4.82±1.39	0.72	0.92
9. It can be risky to switch to new food technologies too quickly.	4.99±1.38	0.73	0.92
10. New food technologies are unlikely to have long term negative health effects.	4.38±1.28	0.65	0.92
11. New products produced using new food technologies can help people have a balanced diet.	4.59±1.25	0.65	0.92
12. New food technologies give people more control over their food choices.	4.65±1.25	0.66	0.92
13. The media usually provides a balanced and unbiased view of new food technologies.	4.59±1.22	0.74	0.92
Total	59.61±12.68		

*Mean. **Standard Deviation

Another reliability-seeking method, parallel forms reliability, aims to evaluate the consistency between two different instruments developed to measure similar constructs.[30] As a parallel form, we utilized the FNS inquiring about one's consumption of foods from different countries or totally new to them.[8] FTNS, on the other hand, aims to measure the attitude towards food produced using new food technologies; hence, it was thought to show a positive relationship with FNS. The findings revealed a positive, moderate, and significant relationship between the measurements with the FNS and FTNS (r = 0.42; p < 0.001; Table 2). However, Cox and Evans found it to have a poor correlation with the FNS (r = 0.184) and asserted that the FTNS actually measures a different and specific construct. Similarly, Deegan et al. (2015) concluded a poor correlation between the said instruments (r = 0.140) and proposed that the two scales attempt to measure different aspects of neophobia.[31] Nevertheless, the correlation between the two scales was found to be higher in the Chinese context with 947 participants (r = 0.537; p < 0.001). In that study, food neophobia explained 28.0% of the variance in food technology neophobia, and there was a lower differentiation between the instruments in the Chinese population.[26] Our findings suggested higher parallel forms reliability of the Turkish version of the FTNS than that of the original scale, sufficient for mentioning its reliability.

Table 2. Correlation Coefficients of the FTNS and FNS Parallel Form Reliability

Sample†		FNS
FTNS	Correlation	0.420
	p-value	0.001

†Measurements of 410 participants included in the main study.

Validity analyses

For validity concerns, we performed CFA on the LISREL. On the data of 410 participants, the CFA findings revealed the following fit indices: p < 0.001; χ^2 = 210.25, df = 62, χ^2/df = 3.39, Root Mean Square Error of Approximation (RMSEA) = 0.07, Root Mean Square Residual (RMR) = 0.07, Standardized Root Mean Square Residual (SRMR) = 0.04, Goodness of Fit Index (GFI) = 0.93, Adjusted Goodness of Fit Index (AGFI) = 0.89, Normed Fit Index (NFI) = 0.94, Non-Normed Fit Index (NNFI) = 0.94, and Comparative Fit Index (CFI) = 0.96 (Table 3). It is an analysis utilized to evaluate construct validity and test the versatility of a previously defined or restricted construct as a model.[17] Although the FTNS was adapted to different countries and cultures, only two adaptation studies performed CFA to examine the validity of the relevant construct. On the South America (Chile) sample, the authors reduced the number of items to 9 upon discovering low fit indices in the adapted model (RMSEA = 0.073, CFI = 0.944, and Turker-Lewis Index (TLI) = 0.950).[25] The other study reported acceptable fit indices after reducing the number of items to 11 (p < 0.001, RMSEA = 0.078, GFI = 0.941, TLI = 0.943, CFI = 0.955).[26] Table 3 present the fit indices obtained in this study. Accordingly, the p-value for the scale is < 0.001, and χ^2/df was calculated to be 3.39, indicating an acceptable fit since remaining below 5. SRMR, CFI, and Incremental Fit Index (IFI) were calculated to be 0.04, 0.96, and 0.96, respectively, pointing out the perfect model-data fit. The other fit indices were found to be within acceptable limits and can be presented as follows: RMSEA = 0.07, RMR = 0.07, GFI = 0.93, AGFI = 0.89, NFI = 0.94, NNFI = 0.94, and Expected Cross Validation Index (ECVI) = 0.66.[22, 32] Thus, the findings documented that the FTNS has a valid structure to be used in the Turkish context.

Table 3. Fit Indices of the FTNS

		Reference Fit Indices[§]				
No.	Index	Weak Fit	Acceptable Fit	Perfect Fit	Finding	Fit
1	*p*-value[†]		$p > .05$	$p > .05$	$p < .05$	**Suitable**[†]
2	χ^2/df		Value <5 Value <3	Value < 3 Value <2	3.39	**Acceptable fit**
3	RMSEA	Value <0.10	Value <0.08	Value < 0.05	0.07	**Acceptable fit**
4	RMR	Value <0.10	Value < 0.08	Value < 0.05	0.07	**Acceptable fit**
5	SRMR	Value <0.10	Value < 0.08 Value < 0.10	Value < 0.05	0.04	**Perfect fit**
6	GFI[‡]	Value > 0.85	Value > 0.90	Value > 0.95	0.93	**Acceptable Fit**
7	AGFI[‡]	Value > 0.80	Value > 0.90 Value > 0.85	Value > 0.95 Value > 0.90	0.89	**Acceptable Fit**
8	NFI[‡]	Value > 0.85 Value > 0.80	Value > 0.90	Value > 0.95	0.94	**Acceptable Fit**
9	NNFI[‡]	Value > 0.85 Value > 0.80	Value > 0.90	Value > 0.95	0.94	**Acceptable Fit**
10	CFI[‡]	Value > 0.85	Value > 0.90	Value > 0.95	0.96	**Perfect Fit**
11	IFI[‡]		Value > 0.90	Value > 0.95	0.96	**Perfect Fit**
12	ECVI[‡]		No fixed range, Smaller is better	No fixed range, Smaller is better	0.66	**Suitable**

Bold emphasis in Table 3 shows the suitability of the fit indices found (perfect, acceptable, or weak)
[†]χ^2 is desired to be insignificant; however, it generally appears significant with small sample sizes. Thus, it is more appropriate to consider χ^2/df. [‡]Takes a value between 0 and 1.
[§]For reference fit indices: (Ilhan & Cetin, 2014; Secer, 2015)[22, 32]

Considering the path diagrams (standardized solutions and *t*-values) and recommended modifications in CFA, we replicated the analysis to obtain a better model. Thus, we connected the error covariances of items 1, 2, 8, 9, 11, and 13 and obtained a model with standardized regression weights of the items varying between 0.61-0.76. Following the modifications, we detected no items with item error variance above 0.90 (Figure 1).

Figure 1 presents the standardized solution findings obtained from the path diagrams. Path analysis is a method frequently utilized in settling and interpreting the direct and indirect associations between variables. Accordingly, we discovered the error variances of the items were all below 0.90, and the items with the least and highest error variances were item 9 (0.42) and item 6 (0.63). The high error variance often points out a non-exploratory characteristic of the item.[33] Besides, we concluded the standardized regression weights of the items varied between 0.61 and 0.76. According to Harrington (1999), a factor loading value below 0.32 is considered weak, while a value of 0.71 and above is accepted as excellent.[34] Since no item had a weak factor loading, we continued the study without removing any item from the scale. The factor loadings on the 9-item South American FTNS ranged from 0.47-0.74 among undergraduate students and 0.43-0.67 among employed adults.[26]

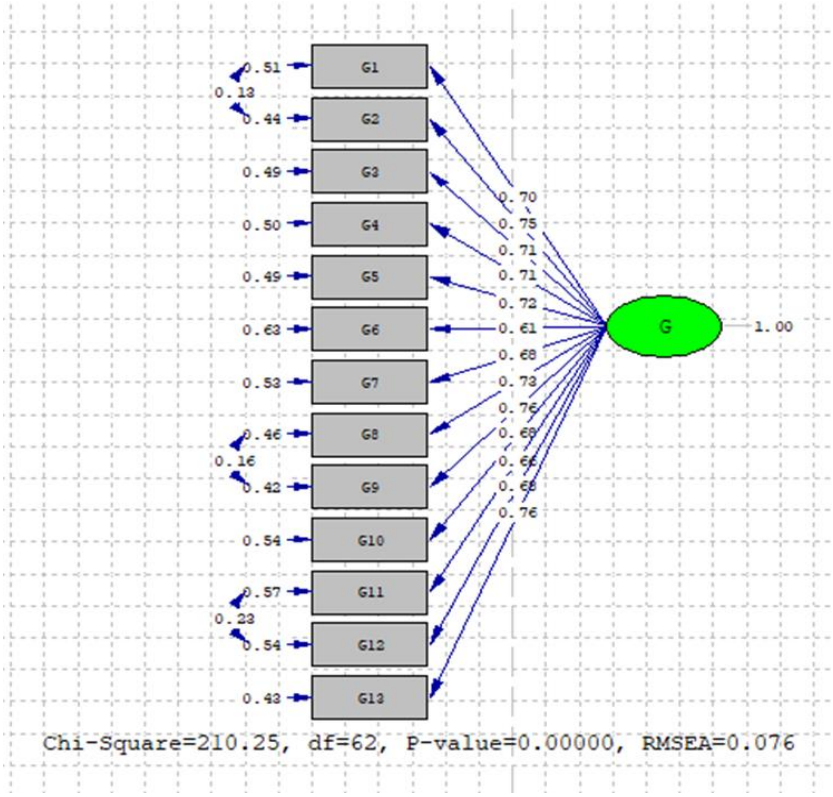

Figure 1. CFA Results for the FTNS: Standardized Solutions

Another significant criterion in examining model-data fit may be *t*-values. Figure 2 presents the CFA-yielding *t*-values of the items. Accordingly, we discovered that the t-values of the items before and after the modifications were all above 1.96. In general, items with a *t*-value below the mentioned cut-off value are highlighted with a red arrow and need to be removed from the model. In other words, *t*-values above 1.96 and 2.56 are statistically significant at 0.05 and 0.01, respectively.[35, 36] In our study, the *t*-values of the items varied between 13.10-25.79, and there was no item highlighted with a red arrow. In summary, we explored the fit indices, item loadings (regression weights), error variances, and *t*-values of the items to seek the validity of the FTNS and concluded overlapping findings with the literature, implying that the FTNS is a valid instrument to be utilized in the Turkish context.

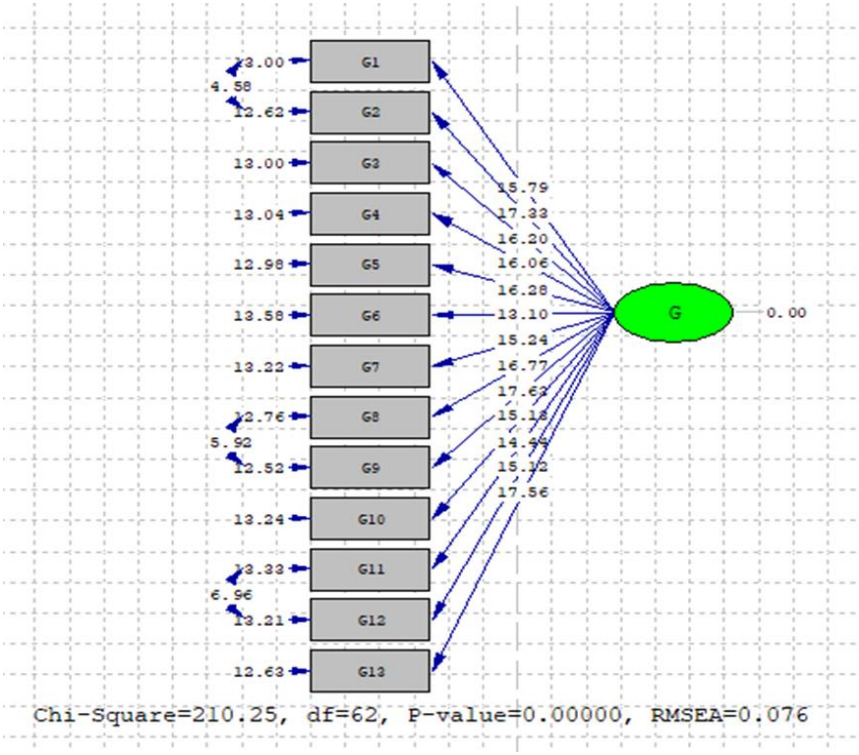

Figure 2. CFA Results for the FTNS: *t*-values

Apart from the research investigating the psychometric properties of the FTNS, the literature hosts a plethora of studies scrutinizing the neophobia for food/food groups produced using new technologies. In a study, the author examined consumers' attitudes toward genetically modified foods in Taiwan and reported that the FTNS scale efficiently helped predict the participants' willingness or resistance to consuming genetically modified foods and determine their levels of neophobia.[37] We believe such studies would help facilitate people's acceptance and use of emerging technologies. Vidigal et al. (2015) also determined a sample of Brazilian people's consumption of yogurt produced using different technologies with the help of the FTNS.[1] Their findings yielded a mean neophobia score of 47.0 and revealed that the rate of preference for yogurts produced using genetic modification and nanotechnology was low and that socioeconomic factors affected the participants' level of neophobia. The level of development of countries is also considered an influencing factor in choosing state-of-art technology food products. In this regard, it was previously reported that genetically modified foods are more acceptable in the USA than in Europe and Japan.[38] Besides, consumers' knowledge levels of nanotechnology may remain insufficient since being a hot development for the food industry. However, we estimate that nanotechnology would become more apparent in the industry in the near future. De Steur et al. (2016) examined the participants' preference for flour obtained by processing matooke, a local banana variety native to Uganda, using the FTNS.[39] Their findings revealed the neophobic attitudes of the Ugandan participants. It was also stated that the primary factors affecting their preferences were health, risk perception, and needs. Another study investigated the consumers' willingness to consume fiber-fortified cereal products (e.g., white bread, cake, and biscuits) and revealed that gender, educational attainment, and sociodemographic factors affected their attitudes toward foods produced with new technologies. Neophobic attitudes were mostly detected among men, those with poor educational attainment, and older adults. Besides, those aged 25-36 years and female participants were reported to be more willing to consume fiber-fortified cereal products.[40] Previously, it was also stated that health-

promoting modifications to foods would positively affect the acceptability of foods among consumers.

The previous studies often indicated that the FTNS is an efficient tool for measuring neophobia for foods produced using new technologies in different cultures. In addition, we believe that the measurements with the scale would be useful in disseminating the concept of conscious consumerism by steering individuals to acquire relative awareness of food preferences.

CONCLUSIONS

Overall, we sought the reliability and validity of the Food Technology Neophobia Scale developed by Cox and Evans in 2008 for individuals aged 18-65. In the adaptation, we investigated the extent/content, face, and construct validity (Turkish adaptation, language equivalence of the scale, and CFA), item statistics, internal consistency reliability (Cronbach's alpha), test-retest reliability, and parallel forms reliability. In parallel with the previous results in the literature, our findings suggested that the Turkish version of the 13-item FTNS is a valid and reliable measurement tool to be used in the Turkish context for individuals aged 18-65 years.

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