

## THE VALIDITY AND RELIABILITY OF THE TURKISH VERSION OF THE THREATS OF ARTIFICIAL INTELLIGENCE SCALE

### YAPAY ZEKA TEHDİTLERİ ÖLÇEĞİNİN TÜRKÇE FORMUNUN GEÇERLİK VE GÜVENİRLİĞİ

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**Keywords:** Artificial Intelligence, fear, health, risk, psychometrics

**Anahtar Sözcükler:** Yapay zeka, korku, sağlık, risk, psikometrik

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## SUMMARY

**Introduction:** The integration of artificial intelligence (AI) into healthcare and the increased data exchange have raised concerns about potential risks to individuals. This study aimed to examine psychometric properties of the Turkish adaptation of the Threats of Artificial Intelligence Scale.

**Material and Methods:** The research sample included 300 nursing students enrolled in the faculty of health sciences at a university between May and July 2022. To assess the construct validity, both exploratory and confirmatory factor analyses were conducted. Reliability was evaluated using Cronbach's alpha coefficient and a test-retest method.

**Results:** Exploratory factor analysis revealed a single-factor structure consisting of 12 items. Confirmatory factor analysis showed acceptable model fit indices: CMIN/DF = 4.991, GFI = 0.901, CFI = 0.951, RMSEA = 0.079, RFI = 0.958, RMR = 0.053, and NFI = 0.940. The internal consistency of the scale was high, with a Cronbach's alpha of 0.964. Item-total correlation coefficients ranged from 0.715 to 0.849. Upon item deletion, the scale mean ranged between 27.176 and 27.586, and Cronbach's alpha values varied slightly between 0.959 and 0.963. Test-retest analysis, conducted with a two-week interval, showed no statistically significant difference ( $t = .007$ ,  $p = 0.994$ ), confirming temporal stability.

**Conclusion:** Findings indicate that the Turkish version of the Threats of Artificial Intelligence Scale is a psychometrically sound tool for assessing perceived AI-related threats in healthcare contexts.

## ÖZ

**Giriş:** Sağlık sektöründe yapay zekanın kullanımı ve verilerin hızlı paylaşımı bireyler açısından bir tehdit oluşturmaktadır. Bu çalışmada, Yapay Zeka Tehditleri Ölçeğinin Türkçe formunun psikometrik özelliklerinin incelenmesi amaçlandı.

**Gereç ve Yöntem:** Araştırmanın örneklemini, Mayıs ve Temmuz 2022 tarihleri arasında bir üniversitenin sağlık bilimleri fakültesi hemşirelik bölümünde öğrenim gören 300 öğrenci oluşturdu. Geçerlilik analizinde; Açıklayıcı Faktör Analizi ve Doğrulayıcı Faktör Analizi kullanıldı. Güvenilirlik analizinde ise Cronbach's  $\alpha$  katsayısı ve test-tekrar test yöntemi kullanıldı.

**Bulgular:** Açıklayıcı faktör analizine göre, ölçeğin tek faktör ve 12 maddeden oluştuğu belirlendi. Doğrulayıcı faktör analizinde uyum iyiliği değerleri; CMIN/DF ( $X^2/Sd$ ) = 229,586/46 = 4,991; GFI = 0,901; CFI = 0,951; RMSEA = 0,079; RFI = 0,958; RMR = 0,053 ve NFI = 0,940 olarak bulundu. Ölçeğin Cronbach's  $\alpha$  değeri 0,964 olarak

tespit edildi. Bir madde çıkarıldığında ölçek ortalaması 27,176 ile 27,586 arasında bulundu. Madde-toplam korelasyonu 0,715 ile 0,849 arasında değişmektedir. Bir madde çıkarıldığında Cronbach's  $\alpha$  değeri 0,959 ile 0,963 arasında belirlendi. İki hafta arayla yapılan test-tekrar test ölçümleri arasında anlamlı bir fark bulunmadı ( $t = 0,007$ ,  $p = 0,994$ ).

**Sonuç:** Yapay Zeka Tehditleri Ölçeğinin Türkçe formunun, sağlık alanında yapay zeka tehditlerini belirlemede geçerli ve güvenilir bir ölçme aracı olduğu belirlendi.

## INTRODUCTION

Ten scientists, led by Alan Turing in 1956 and followed by Martin Minsky, John McCarty, and Claude Shannon, became the pioneers of artificial intelligence (AI) with the Dartmouth Artificial Intelligence Research Project (1, 2). AI is the oldest field of computer science and considers functions such as thinking, learning, and problem-solving, similar to humans. For this reason, it is often referred to as machine intelligence, in comparison with human intelligence (3, 4). AI has become an important part of our lives with advances in technology (4). In recent years, AI has gained popularity in society as well as in science. Generally, AI has many positive effects on different social fields, such as medicine and economics (5-7).

The health sector is among the main fields in which AI is used, and AI solutions have now become indispensable in health applications (1). Artificial intelligence in medicine is applied virtually and physically. While virtual applications include electronic recording systems, physical applications include robots that perform surgical interventions (2). AI in medicine has played an important role in data storage and the diagnosis and treatment of diseases. In addition, some routine business applications have been replaced by AI (1, 8, 9). AI applications used in health care services provide messages as part of the clinical workflow, make recommendations and help apply new knowledge obtained by analyzing patient-specific clinical variables to patient care. Nursing care plans using AI offer evidence-based diagnoses through clinical decision support systems and provide a comprehensive care service. AI is also used in drug warnings, drug interactions, food interactions, medical malpractice prevention systems, visual/audible warning systems, and statistics and reporting systems (9, 10).

Recently, as a result of AI analyzing big data in the digital environment, it can suggest actions and predict future developments. AI-based applications are used for the automated detection of diseases.

For example, AI systems can identify hereditary and metabolic diseases or cancer. Based on this data, the AI can independently develop therapeutic measures (5). It is probable that in the future, AI will be used in all fields to detect and define disease, predict its development, and recommend and choose medical treatment (2, 11-14). The use of AI in every field and the rapid sharing of data may, however, cause increased anxiety, fear, or perception of a threat to society and individuals (5, 15-19).

## Hypotheses

H1: The Turkish version of the Threats of Artificial Intelligence Scale is a valid instrument.

H2: The Turkish version of the Threats of Artificial Intelligence Scale is a reliable instrument.

## MATERIALS AND METHODS

### Aim

The study was planned as a methodological study to determine psychometric properties of the Turkish version of The Threats of Artificial Intelligence Scale.

### Place and time of research

The research was carried out with students Department of Nursing, Faculty of Health Sciences of a university in Türkiye between May and July 2022.

### Population and Sample of the Research

The study population comprised students from the Department of Nursing within the Faculty of Health Sciences at a university located in Istanbul, Türkiye, during the period from May 2022 to July 2022. In validity and reliability studies involving factor analysis, it is generally advised that the sample size should be at least five to ten times the total number of items included in the scale (20, 21). Since the scale consisted of 12 items, the target sample size was set at a minimum of 120 students, based on the recommendation of having 10 participants per

item. Ultimately, the study was conducted with a total of 300 students. In the study, students were selected using a convenience sampling method. Only those who agreed to participate during the data collection process were included.

### **Inclusion and Exclusion Criteria**

Inclusion criteria;

- Voluntary participation in the study
- No communication problems.

Exclusion criteria;

- Students who want to quit voluntarily during the study process

### **Data Collection Method and Instruments**

The General Information Form (11 items) and Turkish version of The Threats of Artificial Intelligence Scale (12 items) were used to collect data. Questionnaire forms were hand-delivered to the students at the beginning of the lesson or the end of the lesson. The response time of the questionnaires is 5-10 minutes.

### **General Information Form**

It consists of a total of 11 questions about the sociodemographic status of nursing students (such as economic status, age, high school education, and smoking status) and technology use (such as following technological and artificial intelligence innovations).

### **The Threats of Artificial Intelligence Scale**

The scale developed by Kieslich et al. is a 12-item instrument structured as a 5-point Likert-type scale. Scores range from 1 ("not threatening") to 5 ("very threatening"), with higher scores indicating greater perceived threats associated with artificial intelligence (AI). The scale comprises four sub-dimensions: Recognition, Prediction, Recommendation, and Decision Making, each assessed through three items. Each subdimension of the scale yields a score between 3 and 15. Each item begins with the prompt: "If you now think of the use of AI in medicine, how threatening do you think computer applications of artificial intelligence are that..." The internal consistency of the scale was found to be high, with Cronbach's alpha values ranging from 0.80 to 0.92. Confirmatory factor analysis supported the validity of the model, yielding a

significant model fit ( $\chi^2(144) = 207.091, p < .001$ ). Fit indices indicated a good model fit: TLI = .989, RMSEA = .038, and SRMR = .026 (5)

### **Statistical Analysis**

The Threats of Artificial Intelligence Scale was first translated from English to Turkish by two professional linguists. The resulting translations were reviewed and compared by two academic staff members, leading to the development of a preliminary draft. This draft was then evaluated by a panel of eight subject-matter experts, and their feedback was used to revise and improve the scale items. To assess clarity and comprehensibility, a pilot study was conducted with a sample of 10 students. Subsequently, the revised Turkish version was back-translated into English by two independent linguists to ensure linguistic accuracy and conceptual equivalence. The finalized Turkish version of the scale was then used in the main study (21, 22).

The research data were analyzed using IBM SPSS Statistics and AMOS (IBM) software. Descriptive statistics—including frequency, percentage, mean, standard deviation, and median—were used to summarize the data. To evaluate the construct validity of the scale, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy, Bartlett's test of sphericity, and confirmatory factor analysis (CFA) were employed. The reliability of the scale was assessed using Cronbach's alpha coefficient and the test-retest method, with the latter conducted via a paired samples t-test. For the test-retest procedure, the scale was administered to 50 students in a face-to-face setting, with a two-week interval between the two applications. A p-value of less than 0.05 was considered statistically significant.

### **Ethical Aspect of Research**

Prior to the commencement of the study, both oral and written informed consent were obtained from all participants. Permission to use the Threats of Artificial Intelligence Scale was granted by its developer, Kimon Kieslich. Ethical approval for this study was obtained from the Non-Invasive Clinical Research Ethics Committee of the Faculty of Health Sciences at Marmara University (Ethics No: 28.04.2022/59). Throughout the study, the principles outlined in

the Declaration of Helsinki were strictly followed to ensure the protection of participants' rights and well-being.

## RESULTS

It was determined that 82% of the individuals participating in the study were women, 98% were single, 24.3% were in the third and 17.7% were in the fourth class. It was found that 82.7% of the individuals never smoked. It was observed that 63% of them had a mid-level economic status and 9.7% had a chronic disease. It was found that 72% of individuals kept up with technological innovations, and 37% followed research on artificial intelligence. The mean age of the individuals was found to be 20.63±1.66 (Table 1).

### Validity

#### Exploratory Factor Analysis

The Kaiser-Meyer-Olkin (KMO) sample adequacy value of the scale was found to be 0.94. Results of Bartlett's Test of Sphericity were found as Approx. Chi Square=3921.52, df=66 p<0.01. According to exploratory factor analysis (EFA), it was determined that the scale consisted of one factor and 12 items. The explained variance and explained total variance of the scale were found

to be 71.68% and the eigenvalue was 8.60. Factor loadings of the items were found to be between 0.756-0.884 (Table 2).

### Confirmatory factor analysis

Figure 1 presents the first-order confirmatory factor analysis (CFA) results for the Threats of Artificial Intelligence Scale, which comprises 12 items. Factor loadings ranged from 0.69 to 0.89, indicating strong item-factor relationships. The model's goodness-of-fit indices were as follows: CMIN/DF ( $\chi^2/df$ ) = 229.586/46 = 4.991, GFI = 0.901, CFI = 0.951, RMSEA = 0.079, RFI = 0.958, RMR = 0.053, and NFI = 0.940. These results suggest that the factor structure demonstrated an acceptable to good fit with the data (Figure 1).

### Reliability

Cronbach's  $\alpha$  value of the scale was found to be 0.964. When one item was deleted, the scale mean was found to be between 27.176 and 27.586. Item-total correlation was between 0.715-0.849. When an item was deleted, Cronbach's alpha value was determined between 0.959-0.963. There was no significant difference in test-retest reliability between measurements taken two weeks apart ( $t=.007$ ,  $p=0.994$ ) (Table 3).

**Table 1.** Sociodemographic Characteristics of the individuals (N=300)

Variables	n	%	
Gender	Female	246	82
	Male	54	18
Marital status	Single	294	98
	Married	6	2
Class	First	51	17
	Second	123	41
	Third	73	24.3
	Fourth	53	17.7
Smoking	Never used	248	82.7
	Active	34	11.3
	Left	18	6
Economic Status	Upper level	90	30
	Mid-level	189	63
	Upper level	21	7
Chronic disease	Yes	29	9.7
	No	271	90.3
Keeping up with technological innovations	Yes	216	72
	No	84	28
Follow research on artificial intelligence	Yes	111	37
	No	189	63
Age mean±sd (min-max)	20.63±1.66 (18-30)		

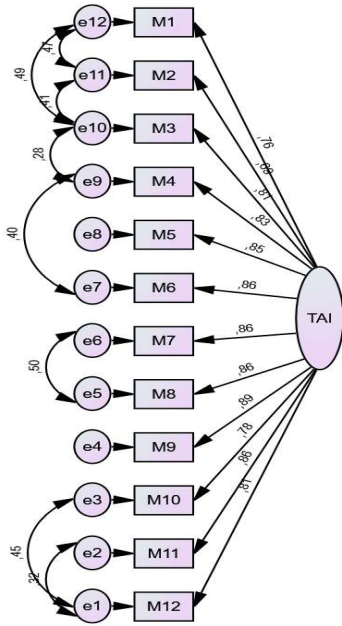


Figure 1. Confirmatory factor analysis path diagram

Table 2. Variance Values and Factor Loadings of the Scale According to Exploratory Factor Analysis

Items	Factor Loadings
M1	.813
M2	.756
M3	.851
M4	.869
M5	.866
M6	.876
M7	.865
M8	.871
M9	.884
M10	.798
M11	.875
M12	.827
<b>Explained variance (%)</b>	71.68
<b>Explained Total Variance (%)</b>	71.68
<b>Eigenvalue</b>	8.60
<b>Kaiser-Meyer-Olkin (KMO)</b>	0.94
<b>Bartlett X<sup>2</sup>(p)</b>	3921.52(<0.01)
<b>Determinant</b>	0.006

Table 3. Test-retest score Analysis and Results of the Items of the Threats of Artificial Intelligence Scale

Item	Mean	Std. Deviation	Scale Mean if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
M1	2.45	1.191	27.516	.778	.961
M2	2.43	1.184	27.533	.715	.963
M3	2.38	1.122	27.586	.822	.960
M4	2.39	1.159	27.570	.840	.960
M5	2.51	1.149	27.456	.836	.960
M6	2.38	1.116	27.586	.849	.959
M7	2.50	1.149	27.466	.833	.960
M8	2.50	1.107	27.466	.841	.960
M9	2.46	1.104	27.500	.857	.959
M10	2.79	1.179	27.176	.758	.962
M11	2.48	1.131	27.483	.848	.959
M12	2.67	1.193	27.290	.791	.961
<b>Comparison of test-retest score (n= 50)</b>					
	First Measurement Mean±Sd	Second Measurement Mean±Sd	t	p	
Scale score	2.62± .974	2.62± 1.08	.007	.994	

t=Paired Samples Test

## DISCUSSION

This study aimed to evaluate the validity and reliability of the Threats of Artificial Intelligence Scale (TAI-Scale). The findings demonstrated that the scale is both a valid and reliable measurement tool. For factor analysis, the Kaiser-Meyer-Olkin (KMO) measure should exceed 0.60, and Bartlett's test of sphericity must yield a statistically significant result (21, 23, 24).

In this study, the Kaiser-Meyer-Olkin (KMO) coefficient was calculated as 0.94, and Bartlett's test of sphericity was statistically significant ( $\chi^2 = 3921.52$ ,  $p < 0.001$ ) (Table 2). These results indicate that the dataset used for the validity and

reliability assessment of the Turkish version of the TAI-Scale was appropriate and adequate for conducting factor analysis. Exploratory factor analysis revealed that the Turkish adaptation of the TAI-Scale consisted of a single factor, whereas the original scale included four distinct subscales (5). The factor structure of the Turkish version differed from that of the original scale, which is believed to stem from cultural differences. Participants in this study appeared to perceive all items as reflecting a single underlying dimension. Notably, a unidimensional factor structure was also identified in the Chinese adaptation of the scale (25). This scale is similar to the Chinese version with its single-factor structure.

The model's adequacy in representing the data was evaluated through multiple goodness-of-fit indices. In the confirmatory factor analysis (CFA) of the Turkish version of the TAI-Scale, the fit indices were as follows: CMIN/DF ( $\chi^2/df$ ) = 229.586/46 = 4.991, GFI = 0.901, CFI = 0.951, RMSEA = 0.079, RFI = 0.958, RMR = 0.053, and NFI = 0.940. Factor loadings ranged from 0.69 to 0.89 (see Figure 1). Generally, a  $\chi^2/df$  ratio below 3 suggests a good model fit, whereas values between 3 and 5 are considered acceptable. Given the sensitivity of the chi-square statistic to sample size, this ratio offers a more reliable measure. Additionally, a GFI value exceeding 0.95 is indicative of a good fit, while values above 0.90 are deemed acceptable, as this index assesses model fit regardless of sample size. Similarly, Comparative Fit Index (CFI) values above 0.95 are regarded as excellent, while values exceeding 0.90 are considered acceptable. The CFI evaluates model fit by comparing the specified model to a baseline model, taking into account degrees of freedom and sample size. Root Mean Square Error of Approximation (RMSEA) values below 0.05 indicate a close fit, whereas values up to 0.08 suggest an acceptable fit; this index measures how well the model reproduces the population covariance matrix, adjusted for model complexity. Root Mean Square Residual (RMR) values under 0.05 are preferred, with values less than 0.08 deemed acceptable, reflecting the average discrepancy between observed and predicted covariances. Finally, Normed Fit Index (NFI) values above 0.95 indicate good fit, while those above 0.90 are acceptable. Unlike CFI, NFI assesses model fit without depending on chi-square distribution assumptions (26). Confirmatory factor analysis results showed that the Turkish version of the TAI-Scale demonstrated good model fit according to the CFI, RMR, and RFI indices, while the  $\chi^2/df$ , GFI, RMSEA, and NFI values indicated an acceptable fit. Comparatively, the original scale also exhibited strong model fit, with reported indices of  $\chi^2(144) = 207.091$ ,  $p < .001$ , TLI = .989, RMSEA = .038, and SRMR = .026(5). In the Chinese

version of the scale, a single-factor model was tested, yielding the following fit indices:  $\chi^2 = 1088.91$ , degrees of freedom (df) = 54,  $p < 0.001$ ,  $\chi^2/df = 20.17$ , RFI = 0.92, TLI = 0.93, IFI = 0.94, RMSEA = 0.116, CFI = 0.94, and SRMR = 0.03. Factor loadings ranged from 0.83 to 0.86 (25). The fit indices of this study show that this scale is valid.

Cronbach's alpha provides an estimate of the internal consistency among the scale items (27). A Cronbach's alpha value above 0.70 is considered acceptable, values above 0.80 indicate good reliability, and values exceeding 0.90 reflect excellent internal consistency (28). In this study, the overall Cronbach's alpha coefficient for the scale was 0.964, indicating excellent internal consistency. When individual items were removed, Cronbach's alpha values ranged from 0.959 to 0.963. These results demonstrate that the Turkish version of the Threats of Artificial Intelligence Scale is a highly reliable instrument. By comparison, the original scale reported Cronbach's alpha values between 0.80 and 0.92 (5). The medical treatment subscale of the Chinese adaptation demonstrated a Cronbach's alpha of 0.97, indicating excellent reliability (25) The reliability results of this study are similar to the other studies.

## CONCLUSION

The Turkish version of the Threats of Artificial Intelligence (TAI) Scale was found to be appropriate and effective for identifying perceived threats related to artificial intelligence in the healthcare sector. The one-factor, 12-item structure of the Turkish version demonstrated strong validity and reliability. The total score on the scale ranges from 12 to 60. Higher scores indicate greater perceived threats. The findings of this study aim to shed light on the potential threats posed by the rapidly expanding use of artificial intelligence in healthcare. The scale is user-friendly and can be readily applied in healthcare settings across Türkiye.

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