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Development of the Earthquake Anxiety Scale: Validity and Reliability Study[1]

Deprem Kaygısı Ölçeğinin Geliştirilmesi: Geçerlik ve Güvenirlik Çalışması

Research Article

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Abstract

In this study, it was aimed to develop a new, valid and reliable measurement tool to measure general earthquake anxiety (EAS). For this purpose, firstly, the literature on earthquake was reviewed and an item pool was created. Then, two separate samples were taken for EFA and CFA. In order to determine the factor structure of the measurement tool, EFA was applied on the data obtained from the first sample group and a structure with single factors and 9 items was reached. In order to test the accuracy of this structure, data were collected from a different sample group and CFA was applied on these data. The results revealed that the scale has evidence of construct validity, discriminant validity and internal consistency reliability. In addition, earthquake anxiety scale items can be used to assess anxiety levels in different age groups.

Keywords: Earthquake, earthquake anxiety, reliability, scale development, validity

Özet

Bu araştırmada genel deprem kaygısını ölçmeye yarayacak yeni, geçerli ve güvenilir bir ölçme aracı geliştirilmesi amaçlanmıştır. Bu amaç doğrultusunda öncelikle deprem konusunda literatür taranarak madde havuzu oluşturulmuştur. Daha sonra AFA ve DFA için iki ayrı örneklem alma yoluna gidilmiştir. Ölçme aracının faktör yapısını belirlemek adına ilk örneklem grubundan alınan veriler üzerinde AFA uygulanmış ve tek faktörlü 9 maddeli bir yapıya ulaşılmıştır. Bu yapının doğruluğunu test etmek üzere farklı bir örneklem grubundan veri toplanmış ve bu veriler üzerinde DFA uygulanmıştır. Sonuçlar, ölçeğin yapı geçerliği, ayırt edicilik geçerliği ve iç tutarlık güvenirliğine ilişkin kanıtlara sahip olduğunu ortaya koymuştur. Ayrıca deprem kaygısı ölçeği maddeleri farklı yaş gruplarında kaygı düzeylerini değerlendirmek için kullanılabilir.

Anahtar kelimeler Deprem, deprem anksiyetesi, geçerlik, güvenirlik, ölçek geliştirme

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[1] Note: It is not necessary to obtain written permission to use the General Earthquake Anxiety Scale (EAS) in scientific studies and to adapt it to a different culture. It can be used in scientific research and adaptation to different cultures without written permission, provided that the necessary references are made to this article.

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Bu çalışma Kırgızistan Türkiye Manas Üniversitesi, Bilimsel Araştırma ve Yayın Etiği Kurulu'nun 04.05.2023 tarih ve R.30.2023/BAYEK-6829 sayılı Etik Kurul Onayı alınarak gerçekleştirilmiştir.

INTRODUCTION

Today, earthquake is perceived as a natural disaster that can occur at any time as a part of daily life, especially in countries with seismic fault lines. According to the Richter scale, an average of 12,000 to 14,000 earthquakes occur every year in the world (Seismological Facility for the Advancement of Geoscience (SAGE)). Especially in developing countries, large-scale destructions occur due to the low quality of structures, lack of durability and lack of earthquake preparedness (Naeem et al., 2011).

It has become commonplace to live with this fear in the society. There is a close relationship between earthquake and psychological distress (Aksaray et al., 2006; Bal & Jensen, 2007; Başoğlu et al., 2002, 2004; Kane et al., 2018; Karanci & Rüstemli, 1995; Liao et al., 2002). In the literature on earthquakes, the rates of post-traumatic stress disorder (PTSD) due to earthquakes vary between 3% and 87% (Carr et al., 1995; de la Fuente, 1990; McMillen et al., 2000; Niaz et al., 2007).

Of course, it is difficult for people living in countries such as Western Europe, where fault lines are not densely located, to understand the horror of earthquakes. Because it is only possible to understand the feelings of a human being when a severe tremor occurs on the earth surface on which he/she stands. Perhaps even scientists interested in seismology can experience great fear during an earthquake (Rikitake, 1968). In addition to such fears caused by earthquakes, countries have also suffered from the material damages caused by earthquakes. For example, in the Kanto earthquake that occurred in Tokyo on 1 September 1923, Japan's largest industrial zone was destroyed and more than 100 thousand lives were lost (Orihara & Clancey, 2012.; Schencking, 2008; Schenking, 2013).

In Turkey, the earthquake that occurred on 17 August 1999 caused a great destruction and traumatic distress for approximately 20 million people. According to official figures, nearly 50 thousand people lost their lives in the last earthquake in Turkey in February 2023, which was effective in a large geography. Turkey's 11 cities were almost completely destroyed by this earthquake. The problems experienced by the earthquake victims are not only limited to the buildings they lost, but also cause a decline in their psychological and spiritual conditions. Anxiety disorder, post-traumatic stress disorder, panic and phobias may develop especially in children and adolescents after the earthquake (Güler Aksu & İmrek, 2023). In addition, it also has a negative effect on the learning and teaching process. Because anxieties such as earthquakes are one of the factors affecting a student's academic success (Basri, 2020).

Anxiety disorder, also known as anxiety, is an internal distress experienced by individuals similar to fear, as if something bad will happen (Rachman, 2013; Tamam & Demirkol, 2019; Ünalsever & Balcıoğlu, 2006). Anxiety disorder may sometimes occur in the absence of any concrete danger and may negatively affect the daily life of the person (Türkçapar, 2004; Crasce, et al. 2011). Earthquake anxiety can be defined as a fear and inner distress that develops in the individual after an earthquake and gives the feeling that an earthquake will occur at any moment.

Since earthquake is a very limited field, the number of studies in the literature is also low. Studies investigating the effect of earthquake anxiety are also quite limited. However, when the studies in the literature are examined; Baloğlu, Harris and Karagözoğlu (2005) investigated the psychological effects of earthquake on high school students, Güler Aksu and İmrek (2023) investigated the psychological effects of long-term earthquake on children and adolescents, Dorahy et al. (2016) investigated the effects of earthquake-related anxiety on psychological symptoms (anxiety, depression and acute stress) and daily life, Başoğlu et al. (2001) developed a measurement tool on traumatic stress and earthquake. This research aims to develop a measurement tool that aims to measure earthquake anxiety in order to empirically contribute to the theoretical studies on earthquake.

METHOD

Model of the Study

Since a measurement tool to determine earthquake anxiety will be developed in the study, a quantitative research approach was adopted in which statistical techniques based on quantitative data are generally used to test validity and reliability (Aliaga & Gunderson, 2002; Creswell, 2002). In addition, since it is aimed to generalize the feature measured from a certain sample unit to the main mass (Ali et al., 2022; Gül, 2023), the survey model was determined as the model of the research.

Study Group

The study group will consist of university students. In the process of determining the earthquake anxiety scale of the study, sampling will be done with two separate applications. This is because it is stated in the literature (Fabrigar et al., 1999) that the sample groups selected for exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) should be different from each other. The first sample group consisted of 176 people, 129 (73.3%) females and 47 (26.7%) males, with an average age of 25.07, and the second sample group consisted of 161 people with an average age of 22.14. In the study, simple random sampling technique, which is suitable for the nature of the quantitative research paradigm and is important for validity and reliability in quantitative studies, was used.

Table 1.
Sampling Groups and Statistical Procedures

Working Groups	*Scale Applied*	*Statistical procedures*	
First Working Group	EAS validity and reliability	Ensuring construct validity and application of EFA	Calculation of Cronbac's Alpha reliability coefficient over the data set resulting from the combination of the first and second study groups
Second Working Group		CFA to test construct validity and calculation of composite reliability coefficients	

Ethical Statement in Research

All participants were informed about the beneficial and risky aspects of the research. In addition, ethics committee approval for the research, which is based on volunteering, was received in 2022 from the Scientific Research Publication Ethics Committee of Kyrgyzstan Turkey Manas University at its meeting numbered 2023-4, with the decision number R.30.2023/BAYEK-6829.

Scale Development Process

This section includes the procedures applied within the scope of the validity and reliability of the Earthquake Anxiety Scale developed by the researchers.

Creating the Item Pool

This scale was developed by the researchers. For this purpose, firstly, a literature review was conducted and the item pool to be included in the draft form of the measurement tool intended to measure the target construct was created. On the basis of alternative assumptions about earthquake anxiety in this field, it was paid attention that the target attribute could exemplify the contents including all aspects. This is because the item pool should be more comprehensive than the theoretical framework in the area to be measured (Clark & Watson, 1995). In the first stage, 16 items were included in the item pool. Then, interviews were conducted with 3 people who had experienced 7 or more earthquakes in their lives on the psychological and mental state that occurred in them after the earthquake. As a result of the interviews, the number of items in the item pool increased to 24. The prepared statements were presented to 3 experts from the fields of educational sciences, measurement and evaluation, and psychological counselling and guidance. Opinions were obtained from the experts about whether the statements measure the target construct or not. In line with the expert opinions, the items that were thought not to measure the target construct or to measure it poorly were removed from the scale expressions and 17 items remained. The draft scale was designed in 5-point Likert type and was graded as never, rarely, occasionally, frequently, and always.

FINDINGS

Exploratory Factor Analysis (EFA)

In order to determine the factor structure of the EAS, EFA was applied without determining any factor number. EFA is used to find an appropriate and dense representation of data relationships for a given situation (Harshman, 1970). Before the EFA process, KMO and Bartlett test results were examined to determine whether the data were compatible with factor analysis. While KMO value was determined as .892, Bartlett's test result was statistically significant ($\chi 2=632.541$, sd=36). As a result of the first EFA process, a 3-factor structure explaining 61.391 of the total variance was reached. However, it was determined that five of the scale items loaded on more than one factor and three items formed a separate factor on their own and these eight items were removed from the scale. After one item was removed, the EFA process was repeated. During the EFA process, the Direck Oblimin orthogonal rotation technique (Harshman, 1970) was used to transform the factors into mathematically equivalent alternative factor sets consecutively. The reason for using this technique is that it allows factor relationships (Carpenter, 2018). After the direct oblimin technique (delta=0, kappa=4), a one-factor structure explaining 50.879% of the total variance was reached.

Table 2.
Factor Structure and Factor Loadings of EAS

Item	*Factor Loadings*
12. Deprem olacağını düşündükçe kalbim hızla çarpıyor	.773
11. Deprem nedeniyle hayatımı kaybetmekten korkuyorum	.759
4. Deprem korkusu yaşam kalitemi olumsuz şekilde etkiliyor	.756
1. Herhangi bir binaya girdiğimde deprem olacakmış kaygısı taşıyorum	.728
7. Evlere bakarken deprem olduğunda nasıl yıkılacağını hayal ediyorum	.727
16. Deprem korkusu beni o kadar gerginleştiriyor ki normalde yaptığım şeyleri yapamıyorum	.721
2. Yüksek binalara girerken yıkılacağını düşünüp korkuyorum	.695
8. Birisi depremle ilgili konuştuğunda huzursuz oluyorum	.637
10. Ailemi deprem konusunda bilgilendiriyorum	.606
Total Variance Explained	*50.879*

Table 3.
Inter Item Correlation

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
1	1.000								
2	.538	1.000							
3	.533	.483	1.000						
4	.522	.392	.535	1.000					
5	.268	.390	.327	.377	1.000				
6	.384	.380	.296	.419	.411	1.000			
7	.487	.461	.533	.442	.410	.403	1.000		
8	.423	.402	.554	.462	.584	.379	.614	1.000	
9	.482	.426	.519	.497	.390	.326	.467	.494	1.000
Skewness	.780	1.74	.881	.951	.412	.360	.238	.454	1.628
Kurtosis	.181	.791	.312	.130	-.619	-.548	-.1.016	-.939	2.646
Mean	1.85	2.02	2.09	2.01	2.56	2.60	2.76	2.55	1.64
S.d.	.895	1.050	1.068	1.139	1.203	1.191	1.332	1.330	.922

The table above shows the correlation between the items. Accordingly, the correlation between the items varies between .268 and .584. In addition, skewness and kurtosis values for each item are given.

Discriminant Validity

Discriminant validity assumes that items should have higher correlations among themselves than their correlations with other items from other constructs that are theoretically assumed to be unrelated (Zait & Bertea, 2011). To ensure discriminant validity, a test of difference is usually performed that allows comparing two models in which constructs are and are not related (Segars, 1997). When the test is significant, the constructs offer discriminant validity. For this purpose, in addition to the scale items, the respondents were asked whether they had experienced earthquakes with a magnitude of 7 and above before, and it was aimed to compare the test scores of those who had and those who had not. As a result of the independent samples t-test, it was concluded that the t2.100 value (sd = 174, $p \leq 0.05$) was significant, in other words, the test results of those who had experienced earthquakes of magnitude 7 and above and those who had not were statistically differentiated. This result showed that the measurement tool has discriminant validity.

Confirmatory Factor Analisis (CFA)

CFA was conducted on the data obtained from the second sample group to verify the 13-item and 2-factor structure. Firstly, the parameter estimates and results of whether the data followed a normal distribution were calculated and tested, and it was concluded that the data followed a normal distribution (Skewness= .183 and Kurtosis = -.141). The fit index values of the WECS were calculated as $\chi 2/sd=2.554$, GFI=.920, AGFI=.867, CFI=.931, NFI=.893, PNFI=.670, IFI=.932, RMSEA=.094, RMR=.069 and PGFI=.552. It was determined that the factor loadings of the single-factor model created after CFA varied between .98 and .66, respectively.

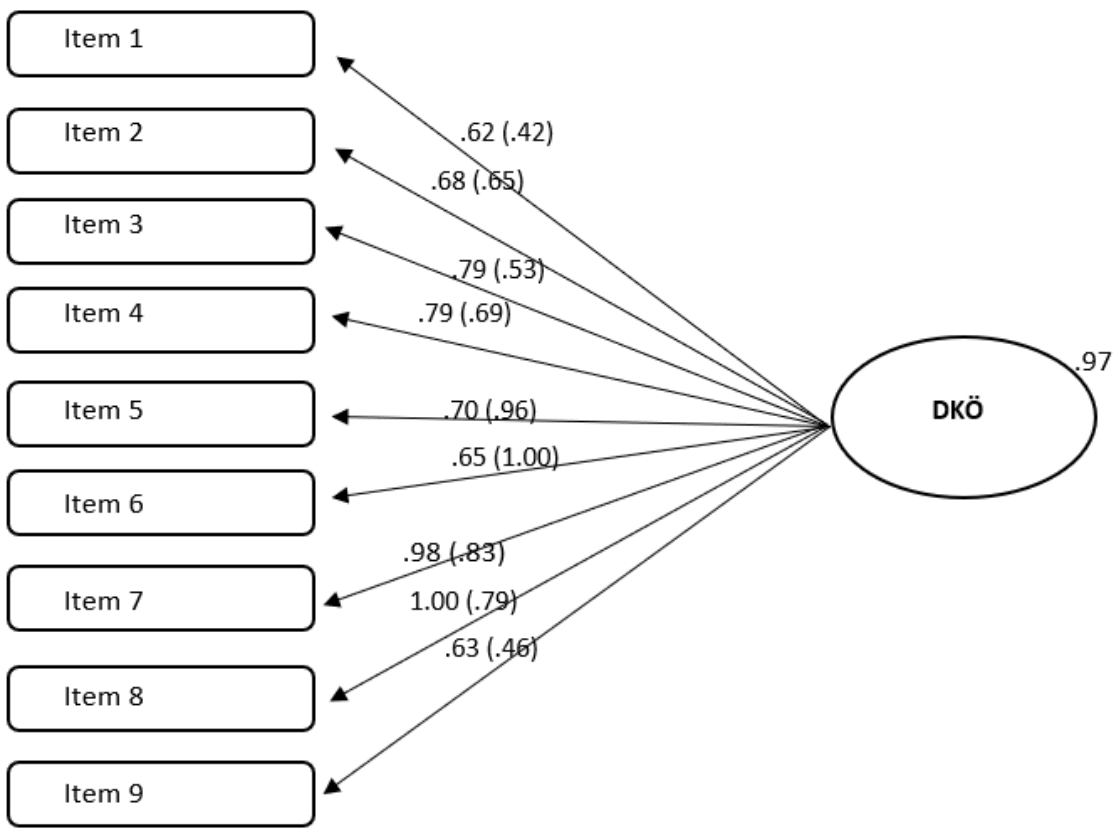

Figure 1. Standardised Factor Loadings Obtained After CFA for the EAS

Internal Reliability and Convergent Validity

Cronbach Alpha, average variance extracted (AVE), composite reliability (CR) techniques were used to analyse the reliability of the EAS. The Cronbach Alpha reliability coefficient calculated for the overall measurement tool was .875. Values of .7 and above are accepted for Cronbach Alpha reliability (Nunnaly, 1967). The CR and AVE values of the scale are calculated according to the factor loadings obtained from CFA. In order for the CR value calculated for the measurement tool to be accepted as reliable, it should be calculated as ≥0.70 and AVE value should be calculated as ≥0.50 (Claes, 1981).

Table 4.

Test Results Regarding Scale Reliability

Factors	*Cronbach Alpha*	*CR*	*AVE*
Factor 1	.875	0.90	.67

CONCLUSION AND DISCUSSION

This study on earthquake anxiety and fear was developed and validated as a 5-point Likert-type questionnaire with 12 items and a 2-factor structure to measure earthquake anxiety in individuals in a wide age range. All items in the measurement tool are evaluated on a 5-point scale ranging from "never" (1) to "always" (5). The findings obtained provided evidence that the WECS can be used for panic disorder and extreme anxiety factors. The structure reached in the first sample group (n = 176) was confirmed in the second sample group (n = 190).

The results obtained within the scope of the validity analyses conducted later confirmed that the scale showed discriminant validity and internal consistency. The internal consistency coefficient of the single-factor structure of the scale was found to be .875. In addition, the results of the null hypothesis test showed that the scale discriminated between the subjects who experienced earthquakes with a magnitude of 7 and above and the subjects who did not experience earthquakes or experienced earthquakes with low magnitude. However, since the effect size of the difference is minimal (Ferguson, 2009), it should be interpreted with caution.

In conclusion, the findings provided evidence that the scale is valid and reliable. However, the study has some limitations. Most importantly, although the sample group was heterogeneous, it was assumed that the subjects in both sample groups were individuals who had not been previously diagnosed with any anxiety or anxiety disorder. Therefore, these measures should be tested with individuals who have been clinically diagnosed with anxiety disorders.

Finally, the baseline proportion of subjects with 7 or more earthquake experiences (26/337 = 7.71%) did not allow any classification analysis (logistic regression or CART analysis) to be conducted. Future studies can be repeated on groups with clinically proven results and culturally diverse characteristics.

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