

## RESEARCH ARTICLE

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Received: 24.02.2020  
Acceptance: 12.09.2020  
DOI: 10.18521/ktd.693711

Konuralp Medical Journal  
e-ISSN1309-3878  
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## Development of Valid and Reliable Scale of Vaccine Hesitancy in Turkish Language

### ABSTRACT

**Objective:** Anti-vaccine movement has been increasing in recent years, leading to poor health outcomes. There are some scales to measure the vaccine hesitancy but most of them have limitation and may not be proper for Turkey. The aim of this study is to develop a Turkish scale of vaccine hesitancy.

**Methods:** Two cross sectional studies were conducted. Purposive sampling method was used to reach participants in hospital and its surroundings. Study1: Explanatory factor analysis involved 315 participants, whose 61.3% were female mean age was 33.3±11.6 years. The draft scale with 36 items were applied face to face. Study 2: Confirmatory factor analysis involved 214 participants for the long form and 200 for short form. Of the participants, 62.0% was female and the mean age was 33.9±11.3 for short form. Of the participants, 65.4% was female and the mean age was 34.5±11.4 for the long form. Goodness of fit indexes of both forms were compared with literature.

**Results:** The long form with 21 items in 4 factors and the short form with 12 items in 3 factors were selected as they best explained the data. Explained variance by long form and short form were 57.4% and 65.3% respectively. Cronbach Alpha values for long form and short form were 0.905 and 0.855, respectively.

**Conclusions:** It is important to understand vaccine hesitancy at local levels because differences in sociocultural structure have major effect. In this study, two forms of reliable vaccine hesitancy scale were presented in Turkish as first in literature.

**Keywords:** Vaccine Refusal, Antivaccination Movement, Reliability And Validity, Scale, Turkey

## Geçerli ve Güvenilir Türkçe Aşı Karşıtlığı Ölçeği Geliştirilmesi

### ÖZET

**Amaç:** Aşı karşıtlığı son yıllarda artarak kötü sağlık sonuçlarına neden olmaktadır. Literatürde aşı karşıtlığı ölçekleri bulunsa da bunlar Türkiye için uygun olmamakla birlikte kısıtlılıkları bulunmaktadır. Bu çalışmanın amacı, Türkçe aşı karşıtlığı ölçeğini geliştirmektir.

**Gereç ve Yöntem:** İki farklı kesitsel çalışma yürütüldü. Hastane ve çevresindeki katılımcılara ulaşmak için amaçlı örnekleme yöntemi kullanıldı. Çalışma 1: Açıklayıcı faktör analizi, %61,3'ü kadın ve ortalama yaşı 33,3±11,6 yıl olan 315 katılımcıyı içermektedir. Otuz altı maddeli taslak ölçek yüz yüze uygulanmıştır. Çalışma 2: Doğrulayıcı faktör analizi, uzun form için 214 katılımcı ve kısa form için 200 katılımcıdan oluşmaktadır. Kısa form katılımcılarının %62,0'ı kadındı ve ortalama yaş 33,9±11,3 idi. Uzun form katılımcılarının %65,4'ü kadındı ve ortalama yaş 34,5±11,4 idi. Her iki formun uyum iyiliği indeksleri literatürle karşılaştırıldı.

**Bulgular:** Yüksek açıklayıcılıkları nedeniyle 4 faktörde 21 maddeden oluşan uzun form ve 3 faktörde 12 maddeden oluşan kısa form seçilmiştir. Uzun formun ve kısa formun açıkladığı varyans sırasıyla %57,4 ve %65,3 idi. Uzun form ve kısa form için Cronbach Alpha değerleri sırasıyla 0,905 ve 0,855 idi.

**Sonuç:** Sosyokültürel yapıdaki farklılıkların büyük etkisi olduğu için aşı karşıtlığını yerel düzeylerde anlamak önemlidir. Bu çalışmada literatürde ilk kez, geçerli ve güvenilir olarak iki farklı Türkçe aşı karşıtlığı ölçeği geliştirilmiştir.

**Anahtar Kelimeler:** Aşı Reddi, Aşı Karşıtlığı Hareketi, Güvenilirlik Ve Geçerlilik, Ölçek, Türkiye

## INTRODUCTION

Vaccination is one of the greatest achievements of public health interventions (1). But when vaccination has been started at early 1800s, concurrently vaccine hesitancy has also started (2). Anti-vaccine movement has been increasing in recent years, leading to poor health outcomes as well as waste of resources (3,4). Strategic Advisory Group of Experts on Immunization work group of World Health Organization has described vaccine hesitancy as “delay in acceptance or refusal of vaccines despite availability of vaccine services. Vaccine hesitancy is complex and context specific, varying across time, place, and vaccines” (5). There are studies commenting that it would be wrong to express the vaccine hesitancy by just behaviors, namely “vaccine refusal” (6), because even some of the vaccine recipients may have vaccine hesitancy (7). Vaccine hesitancy is a continuum between accepting and rejecting all vaccines (8). Five different groups were identified in this spectrum; 1) Immunization Advocate, 2) Go Along to Get Along, 3) Health Advocate, 4) Fence-sitter and 5) Worried. The group of fence sitters has the largest variance, including people that have higher level of vaccine advocacy than those in the Immunization Advocate group or higher level of vaccine hesitancy than those in the Worried group (9). Directly targeting the people who refuse vaccine can result in backfire, so it seems more effective to target the fence sitters (10,11). If we can measure vaccine hesitancy even in vaccine recipients, we can find true fence sitters and take the necessary interventions. In addition, by measuring the vaccine hesitancy, factors related to vaccine hesitancy can be revealed, the current status of vaccine hesitancy can be determined objectively, and the effectiveness of intervention strategies can be monitored.

The vaccine hesitancy scales in the literature have limitations such as involving only parents (12-17), studying in specific age groups (18), measuring vaccine hesitancy in terms of specific vaccines (19-22), or studying only one aspect of vaccine hesitancy (23). Recently, holistic scales of vaccine hesitancy have been arising (24,25), but Horne et al.'s scale has received structural criticism (26). In addition, socio-cultural characteristics that vary among countries affecting vaccine hesitancy, so it isn't a good way to evaluate vaccine hesitancy in developing / undeveloped countries by criterion of developed countries where most of vaccine hesitancy studies are conducted (27).

The aim of this study is to develop a valid and reliable Turkish scale that will be used to measure the level of vaccine hesitancy of individuals.

## MATERIAL AND METHODS

Revealing the technical features of a measurement tool is only possible by describing these features. Descriptive research serves the

descriptive purpose of science and at the same time provides insight into generating experiments for subsequent research.

This is a descriptive study revealing the technical features of presented measurement tool. The development process of scale was completed by following the path suggested in the literature (28). Study consisted of two major parts, Explanatory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA).

This study was conducted in accordance with Declaration of Helsinki - Medical Research Involving Human Subjects. Ethical approval was taken from the Clinical Research Ethics Committee of Canakkale Onsekiz Mart University with the number of 2019-07. Informed consents were obtained from every participant before surveys.

### Explanatory Factor Analysis

**Sample and Design:** First, the desired issue to be revealed with the scale was defined. For this purpose, literature and social media were examined in the context of vaccine hesitancy and items were identified. These items were presented to the opinion of three experts in the field of family medicine and vaccination and one expert in the field of measurement and scale development. Following the determination of the aim and target group, 36 items were listed in the draft scale. The responses of the participants to the items in the measurement tool were obtained with a 5-point Likert scale including “exactly disagree”, “disagree”, “partially agree”, “agree” and “exactly agree”.

Everitt (29) states that the number of participants should be at least ten times the number of items that included in survey. So, in this study, it was taken care that the number of samples was ten times the number of items in the scale. The form with 36 items was applied to 315 individuals in May and June 2019. Participants were selected by purposive sampling method, in the hospital and surroundings (canteen, street, garden, bus stop) with the appropriate characteristics of target group of the scale. The participants' mean age was 33.3±11.6 years and 61.3% of them were female. Sociodemographic characteristics of the participants of EFA is shown in Table 1 with details.

**Data Analysis:** A few missing values were tested with EM Missing Value Analysis which showed that the missing values were randomly distributed. The missing data were completed with the most preferred (mode) values. Kaiser Meyer Olkin (KMO) and Bartlett's Test of Sphericity tests were used to determine whether the data file was suitable for factor analysis. KMO is a test for adequacy of sampling (30). In addition, Doornik-Hansen Multivariate Normality Test was applied to the items in the scale by the STATA statistics software.

**Table 1.** Sociodemographic characteristics of participants

Variables	EFA		CFA (Short Form)		CFA (Long Form)		
	n	%	n	%	n	%	
Gender	Female	193	61.3	124	62.0	140	65.4
	Male	122	38.7	76	38.0	74	34.6
	<b>Total</b>	315	100	200	100	214	100
Education	None	1	0.3	2	1.0	4	1.9
	Primary	32	10.2	22	11.0	23	10.7
	Secondary	135	42.9	64	32.0	63	29.4
	University	124	39.4	90	45.0	109	50.9
	Postgraduate	20	6.3	22	11.0	14	6.5
	Unspecified	3	1.0	0	0.0	1	0.5
	<b>Total</b>	315	100	200	100	214	100
Marital status	Married	172	54.6	108	54.0	134	62.6
	Single	134	42.5	79	39.5	67	31.3
	Widow	8	2.5	13	6.5	12	5.6
	Unspecified	1	0.3	0	0.0	1	0.5
	<b>Total</b>	315	100	200	100	214	100
Income Status	Good	59	18.7	42	21.0	47	22.0
	Moderate	220	69.8	124	62.0	136	63.6
	Poor	30	9.5	32	16.0	29	13.6
	Unspecified	6	1.9	2	1.0	2	0.9
	<b>Total</b>	315	100	200	100	214	100
Child Status	No	147	46.6	98	49.0	59	27.6
	Yes	168	53.4	102	51.0	155	72.4
	<b>Total</b>	315	100	200	100	214	100

CFA: Confirmatory factor analysis, EFA: Explanatory factor analysis, n: Number

As a result of the test, it was determined that the items do not violate the multivariate normality ( $p > .05$ ). The possible factorization in the EFA was tested with Varimax Axis Rotation. There are many methods (such as test-retest) to determine the reliability of the scales. Cronbach Alpha reliability coefficient can be used for measuring reliability for Likert type-items that include more than two level. So, Cronbach Alpha reliability coefficient, which gives information about reliability in terms of internal consistency, was calculated in this study.

All analysis was performed on Stata Statistical Software: Release 15. College Station, TX: StataCorp LLC. and IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp. softwares.

#### Confirmatory Factor Analysis

**Sample and Design:** As a result of EFA, two forms were selected as they best explained the data, the long form with 21 items in 4 factors and the short form with 12 items in 3 factors.

In this study, it was considered that the number of samples was ten times the number of items in the scale in accordance with the literature. In August and September 2019, 200 individuals for short form and 214 individuals for long form were reached. Purposive sampling method was used, and the participants were selected from the hospital and surroundings (canteen, street, garden, bus stop). The scale developed after EFA was applied face-to-face.

Of the participants of the short form, 62.0% was female and the mean age was  $33.9 \pm 11.3$  years. Of the participants of the of the long form, 65.4% was female and the mean age was  $34.5 \pm 11.4$  years. Sociodemographic characteristics of the participants of CFA is shown in Table 1 in details.

**Data Analysis:** A few missing values were tested with EM Missing Value Analysis which showed that the missing values were randomly distributed. The missing data were completed with the most preferred (mode) values. The CFA

statistics in this study were examined with the goodness of fit indexes. Accepted reference values

according to literature for a scale were given in Table 2.

**Table 2.** Goodness of Fit Index in literature

Goodness of Fit Index	Limits of Acceptance	Limits of Excellence	Reference
RMSEA	$0.050 \leq \text{RMSEA} \leq 0.080$	$0.000 \leq \text{RMSEA} \leq 0.050$	(38,39)
RMR	$0.050 < \text{RMR} \leq 0.080$	$0.000 \leq \text{RMR} \leq 0.050$	(38–40)
GFI		0.900 and above	(39,40)
AGFI		0.900 and above	(39,40)
NFI		0.950 and above	(38,40)
IFI	$0.900 \leq \text{IFI} \leq 0.940$	0.950 and above	(38)
CFI	$0.900 \leq \text{CFI} \leq 0.940$	0.950 and above	(38,39)
$\chi^2/\text{df}$	$2.000 < \chi^2/\text{df} \leq 5.000$	$0.000 \leq \chi^2/\text{df} \leq 2.000$	(30,33,40)

**AGFI:** Adjusted Goodness of Fit Index, **CFI:** Comparative Fit Index, **df:** Degree of freedom, **GFI:** Goodness of Fit Index, **IFI:** Incremental Fit Index, **NFI:** Normed Fit Index, **RMR:** Root Mean Square Residual, **RMSEA:** Root mean Square Error of Approximation,  **$\chi^2$ :** Chi square

All analysis was performed on Stata Statistical Software: Release 15. College Station, TX: StataCorp LLC. and IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp. softwares.

## RESULTS

**Explanatory Factor Analysis:** In EFA, it was tested whether the draft scale of vaccine hesitancy would show a structural integrity. Thirty-six items were handled together, and then the structure was tested. As a result of the exploratory factor analysis conducted with principal axis factoring method (31), the scale revealed a structure of 7-factor. KMO value was over 0.500 and Bartlett's Test of Sphericity value was found to be significant ( $p < 0.05$ ). These results showed that the dataset was appropriate for factor analysis (32,33). The scree plot was examined to obtain a simpler solution. It was decided to repeat the factor analysis with the four factors that have the highest slope at the scree plot. The KMO value was 0.903 for the EFA which was conducted as four factors. Bartlett's Test of Sphericity value is 2785.318 ( $df = 210.0$ ,  $p < 0.05$ ). As previously mentioned, these values were good enough according to the literature.

As a next step, item total correlations and factor loadings were examined. Before the EFA, item total correlations were examined in order to determine the contribution of the items to the scale. As a result of the examination, it was found that the item total correlations for items 4, 9, 12, 22, 23, 25, 26, 29, 34, 35 and 36 were low (below 0.300). So, these items were excluded out of the vaccine hesitancy scale because of low contribution.

According to item total correlations, it was determined that items 11 and 20 correlated with multiple factors. It was appropriate to remove these items from the scale. There were four factors with eigenvalue greater than 1. Varimax Axis Rotation resulted in four factors. These factors and the loading values of the items were summarized in Table 3. As can be seen in Table 3, the remaining

21 items were grouped under four factors. Of these items;

- 1, 2, 3, 5 and 8 formed first factor. These items were related to the “benefit and protective value of vaccine”.
- 10, 14, 16, 17, 18 and 19 formed second factor. These items were related to the “vaccine repugnance”.
- 27, 28, 30, 32 and 33 formed third factor. These items were related to the “solutions for non-vaccination”.
- 6, 7, 13, 15 and 21 formed fourth factor. These items were related to “legitimization of vaccine hesitancy”.

The Cronbach's alpha reliability coefficients was calculated to determine internal consistency of the four factors and were presented in Table 3. The Cronbach's alpha reliability coefficients of the four factors and the total scale ranged between 0.75 and 0.91 and correspond to high reliability levels (33). After these analyses, the researchers conducted another EFA to obtain a shorter, more useful form for ease of application with the items that gave the highest correlation value and the highest contribution to the scale. As a result of the analysis conducted in this direction, a short form consisting 12 items in three factors were reached. The statistics are shown in Table 4 As can be seen in Table 4; the 12 items were grouped under three factors. Of these items;

- 1, 2, 3 and 5 formed first factor, related to the “benefits and protective value of vaccines”.
- 14, 16, 17, 18 and 19 formed second factor, related to the “vaccine repugnance”.
- 32, 33 and 34 formed third factor, related to the “solutions for non-vaccination”.

The Cronbach's alpha reliability coefficients were calculated to determine internal consistency of the three factors. The reliability values are summarized in Table 4. The Cronbach's alpha reliability coefficients of the three factors and the total scale ranged between 0.71 and 0.86 and correspond to high reliability levels (33).

**Table 3.** Factors and item total correlations with loading values of items (long form)

Item (English translation)	Corrected Item-Total Correlation	Factor			
		1	2	3	4
2 Herkes aşılanırsa hastalıklar azalır. (If everyone is vaccinated, the diseases will decrease.)	0.613	0.859			
1 Aşı sağlığı korumak için etkili bir yöntemdir. (Vaccination is an effective method to maintain health.)	0.587	0.846			
3 Devlet tarafından önerilen aşılar güvenirim. (I trust the vaccines supplied by the government.)	0.517	0.753			
5 Salgın hastalıklara karşı en güçlü önlem aşıdır. (The most powerful measure against epidemics is the vaccine.)	0.542	0.695			
8 Aşı sağlığımız için önemli bir güvencedir. (Vaccination is an important guarantee for our health.)	0.603	0.585			
16 Aşıların yan etkileri beni endişelendiriyor. (I worry about the side effects of the vaccines.)	0.492		0.757		
19 Aşının otizm veya öğrenme bozukluğuna yol açmasından korkuyorum. (I am afraid the vaccine will cause autism or learning disability.)	0.575		0.697		
17 Aşı birçok hastalığa neden olabilir. (The vaccine can cause many diseases.)	0.542		0.676		
14 Aşı insanların sağlığından çok aşı üreticilerine kazanç sağlar. (Vaccination is more beneficial for pharmaceutical industry than for human health.)	0.494		0.638		
10 Aşıların yararı kadar zararı da vardır. (Vaccines have disadvantages as much as their advantage)	0.406		0.614		
18 Aşıların içeriğinde zehirli maddeler vardır. (Vaccines contain toxic substances.)	0.576		0.526		
27 Atadan kalma yöntemler aşıdan daha iyi korur. (Ancestral methods protect health better than the vaccines.)	0.533			0.723	
30 Bağışıklık kazanmak için aşı yaptırmaktansa hastalığı geçirmeyi tercih ederim. (To gain immunity, I would rather having the disease instead of getting the vaccine.)	0.578			0.697	
28 Elimden gelse aşı zorunluluğunu kaldırırım. (If I can, I will remove the vaccination obligation.)	0.585			0.606	
32 Aşı zorunlu değil isteğe bağlı olmalıdır. (The vaccine should be optional, not mandatory.)	0.471			0.588	
33 Çocukluğuma dönsem aşı olmazdım. (If I were a child, I would not get vaccinated.)	0.614			0.552	
15 İğneden korktuğum için aşı olmam. (I may refuse vaccination because I am afraid of injections.)	0.449				0.759
21 Dini inancım nedeniyle aşı olmam. (I may refuse vaccination because of my religious belief.)	0.534				0.735
13 Aşılar kalıcı hastalık yapabileceğinden çocuğumu aşılatmam. (I do not make my child vaccinated because vaccines can cause permanent illness.)	0.518				0.666
6 Diğer çocuklar aşılandığı için benim çocuğumun aşılanmasına gerek yok. (My child does not need to be vaccinated because other children are vaccinated.)	0.542				0.495
7 Bulaşıcı hastalıklar az görüldüğü için aşılanmak gereksizdir. (Since infectious diseases are rare, vaccination is unnecessary.)	0.482				0.493
Explained variance		16.296	14.163	14.014	12.958
Cronbach Alpha		0.866	0.809	0.780	0.753
Variance explained by all factors together =57.431					
Cronbach Alpha value of 21 items =0.905					
KMO = 0.903. Bartlett's Test of Sphericity = 2785.318 (df = 210.0, p <0.05)					

**Table 4.** Factors and total item correlations with loading values of items (short form)

Item (English translation)	Corrected Correlation	Item-Total Factor		
		1	2	3
1 Aşı sağlığı korumak için etkili bir yöntemdir. (Vaccination is an effective method to maintain health.)	0.571	0.877		
2 Herkes aşılanırsa hastalıklar azalır. (If everyone is vaccinated, the diseases will decrease.)	0.602	0.895		
3 Devlet tarafından önerilen aşılar güvenirim. (I trust the vaccines supplied by the government.)	0.537	0.762		
5 Salgın hastalıklara karşı en güçlü önlem aşıdır. (The most powerful measure against epidemics is the vaccine.)	0.516	0.722		
14 Aşı insanların sağlığından çok aşı üretenlere kazanç sağlar. (Vaccination is more beneficial for pharmaceutical industry than for human health.)	0.495		0.741	
16 Aşıların yan etkileri beni endişelendiriyor. (I worry about the side effects of the vaccines.)	0.526		0.710	
17 Aşı birçok hastalığa neden olabilir. (The vaccine can cause many diseases.)	0.534		0.766	
18 Aşıların içeriğinde zehirli maddeler vardır. (Vaccines contain toxic substances.)	0.548		0.693	
19 Aşının otizm veya öğrenme bozukluğuna yol açmasından korkuyorum. (I am afraid the vaccine will cause autism or learning disability.)	0.576		0.716	
32 Aşı zorunlu değil isteğe bağlı olmalıdır. (The vaccine should be optional, not mandatory.)	0.446			0.640
33 Çocukluğuma dönsem aşı olmazdım. (If I were a child, I would not get vaccinated.)	0.574			0.835
34 Aşı sırasında çocuğum ağladığı için çocuğuma aşı yaptırmam. (I do not make my child vaccinated because my child cries during the vaccination.)	0.511			0.850
Explained variance		23.951	24.089	17.287
Cronbach Alpha		0.863	0.809	0.712
Variance explained by all factors together=65.327				
Cronbach Alpha value of 12 items =0.855				
KMO=0.836. Bartlett's Test of Sphericity=1652.255. df=66. p<.05				

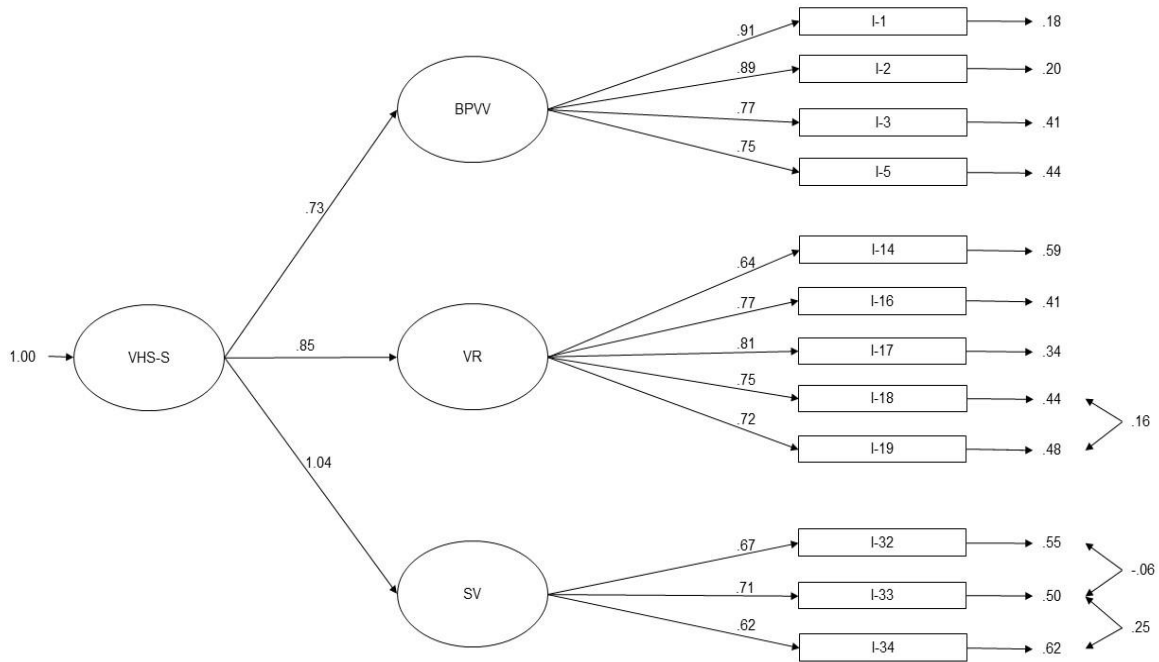
**Confirmatory Factor Analysis:** CFA was performed to determine whether the structures of the scale's long and short forms indicated by EFA were valid. Goodness of fit indexes provide important information about the validity of the structure in CFA. Goodness of fit indexes calculated in the CFA were summarized in Table 5

in comparison with the literature. Diagrams of CFA were given for long form in Figure 1 and for short form in Figure 2. Observed Goodness of Fit Indexes of vaccine hesitancy scale (long and short form) were at the desired level. So, it can be considered as an evidence for the validation of structures revealed previously by EFA.

**Table 5.** Goodness of Fit Index of Confirmatory factor analysis

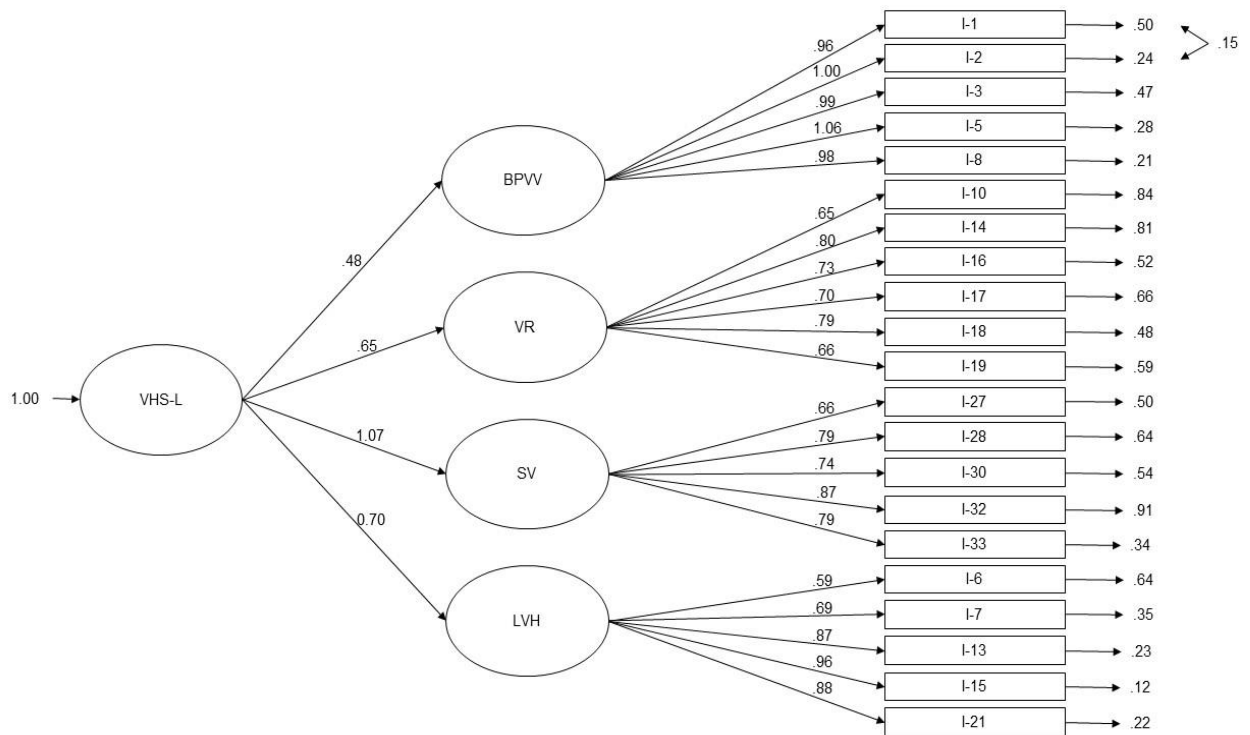
Goodness of Fit Index	Limits of Acceptance	Limits of Excellence	Observed Value (long form)	Observed Value (short form)	Reference
RMSEA	0.050≤RMSEA≤0.080	0≤RMSEA≤0.050	0.077	0.070	(38,39)
RMR	0.050<RMR≤0.080	0≤RMR≤0.050	0.076	0.070	(38-40)
GFI		0.900 and above	0.840	0.930	(39,40)
AGFI		0.900 and above	0.800	0.880	(39,40)
NFI		0.950 and above	0.940	0.970	(38,40)
IFI	0.900≤IFI≤0.940	0.950 and above	0.960	0.980	(38)
CFI	0.900≤CFI≤0.940	0.950 and above	0.960	0.980	(38,39)
X <sup>2</sup> /df	2.000<X <sup>2</sup> /df≤5.000	0.000≤X <sup>2</sup> /df≤2.000	2.260	1.980	(30,33,40)

**AGFI:** Adjusted Goodness of Fit Index, **CFI:** Comparative Fit Index, **df:** Degree of freedom, **GFI:** Goodness of Fit Index, **IFI:** Incremental Fit Index, **NFI:** Normed Fit Index, **RMR:** Root Mean Square Residual, **RMSEA:** Root mean Square Error of Approximation, **X<sup>2</sup>:** Chi square



**Figure 1.** Path diagram of confirmatory factor analysis (standardized values) of vaccine hesitancy scale-long form (Chi-Square= 416.37, df= 184, p value< 0.001, RMSEA= 0.077)

**BPVW:** Benefits and protective value of vaccines, **df:** Degree of freedom, **I:** Item, **LVH:** Legitimization of vaccine hesitancy, **RMSEA:** Root mean Square Error of Approximation, **SV:** Solutions for non-vaccination, **VHS-L:** Vaccine hesitancy scale-long form, **VR:** Vaccine repugnance.



**Figure 2.** Path diagram of confirmatory factor analysis (standardized values) of vaccine hesitancy scale-short form (Chi-Square= 95.23, df= 48, p value< 0.001, RMSEA= 0.070)

**BPVW:** Benefits and protective value of vaccines, **df:** Degree of freedom, **I:** Item, **RMSEA:** Root mean Square Error of Approximation, **SV:** Solutions for non-vaccination, **VHS-S:** Vaccine hesitancy scale-short form, **VR:** Vaccine repugnance.

## DISCUSSION

The World Health Organization states that the extent and nature of vaccine hesitancy needs to be better understood at local levels (34). In this study, a Turkish vaccine hesitancy scale in two forms were developed in order to better understand and objectively measure the vaccine hesitancy. The long form was constituted by 21 items and 4 factors: 1) benefit and protective value of the vaccine 2) vaccine repugnance 3) solutions for non-vaccination and 4) legitimize vaccine hesitancy; the short form was constituted by 12 items and 3 factors: 1) benefit and protective value of the vaccine: 2) vaccine repugnance and 3) solutions for non-vaccination. The scales developed in our study had remarkably high internal consistency and explained a significant part of the variance. As Gorsuch (35) strongly recommends, each factor of our scales contains at least 3 items. The scales we developed are not specific to any predefined group (parents, etc.) (12-17), or to age group (18), or to vaccine (19-22) such as many other vaccine hesitancy scales in the literature. Our scales measure the vaccine hesitancy holistically.

The long form has four factors and provides more multidirectional information about vaccine hesitancy than the three-factor short form. While, short form can be easily used in the measurement of vaccine hesitancy by explaining the higher variance with less items.

Strategic Advisory Group of Experts on Immunization of the World Health Organization supports the development of different scales in high, middle- or low-income countries (36). This study was conducted in Turkey that is a developing country. According to our knowledge, our scales are the first vaccine hesitancy scales that were developed in Turkey. After considering that the socio-cultural structure highly influences the vaccine hesitancy; for Turkey it will be more accurate to use our scale instead of using the scales prepared with the data of developed countries. As shown previously (37), it may be appropriate to use our scales in other Turkish speaking countries and countries that have sociocultural structure similar as Turkey.

The items address emotions or perceptions and beliefs work well in the scale. It was seen that excluded items mostly contain gerunds or long sentences which make the item obscure. One of the general principles in the scale development literature is that the items should be as simple as possible with single meaning. When we evaluate

some excluded items, it was seen that they have structures that question technical information

For scoring the scale, each item is scored as 1 point for “exactly disagree”, 2 point for “disagree”, 3 point for “partially agree, 4 point for “agree” and 5 point for “exactly agree”. Then scores of all items are added up to get total score of scales. Total score of the long form can vary between 21 and 105, while total score of the short form can vary between 12 and 60. The higher score on the scales means the higher vaccine hesitancy of participants. The issue that should be considered while scoring and interpretation of the scales is that for both the long form and the short form, a factor represents attitudes favorable to vaccination, not opposing vaccine. However, other factors and whole scales measure the vaccine hesitancy. Therefore, when scoring the scale, “Benefit and protection of vaccine” factor of the long form and the short form should be coded and interpreted in reverse way. Because getting higher score in both the long form and the short form of the scale will imply the higher level of vaccine hesitancy.

In our study, purposive sampling method was used as in other studies of vaccine hesitancy scale. So, results should be generalized cautiously. While this scale is used for future research in different samples, researchers can repeat factor analysis or reliability analysis in their own study groups. By this way, they can provide additional evidence for the validity and reliability of the scales and contribute to evolution process of the scales.

## CONCLUSION

In summary, two Turkish vaccine hesitancy scales were developed, one of which was a long form (21 items) and one was a short form (12 items). Vaccine hesitancy challenge must be coped in order to achieve the required level of vaccination. The long form provides more detailed information about the multiple dimensions of vaccine contrast by its four factors, while the short form is easily applicable as it consists of less items with a higher rate of explained variance. With the scales we developed, it has become possible to measure the level of vaccine hesitancy, to determine related factors, to plan intervention studies for these related factors, and to observe the effectiveness of intervention studies in our country also as well as other Turkish speaking countries or countries that have sociocultural structure similar as Turkey after necessary validity and reliability studies will done.

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