# The Vaccine Attitude Scale: Psychometric Properties and Validation

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## ABSTRACT

In this study, it was aimed to develop a vaccine attitude scale. This scale has the potential to aid in the advancement of research and immunization policy. We carried out exploratory factor analysis (EFA) to discover the uncovered dimensions and confirmatory factor analysis (CFA) to validate the obtained structures in vaccine attitude scale. Also, we checked the reliabilities with Cronbach Alpha coefficients for each factor. The results revealed that the vaccine attitude scale can be represented with three factors such as the benefits, acceptance and hesitation of the vaccine. We observed positive relationship between benefits-acceptance and an acceptance-hesitation factor but there is negative relationship between benefits-hesitation in vaccine attitude scale. The dimension of the vaccine attitude scale was found reliable and valid as the results of the statistical analysis. This improved scale was found fairly high in terms of validity and reliability. Besides, it is found that it is a valid and reliable measurement tool to determine vaccine attitude of the individuals.

**Keywords:** Vaccine; Scale; Vaccine acceptance; Vaccine rejection; Vaccine attitude scale

## INTRODUCTION

The main purpose of health services is to protect the health of individuals and prevent diseases. One of the most important public health practices in the prevention of infectious diseases is vaccination. Immunization programs prevent diseases that could result in fatal or permanent disabilities in the field of health. Yet, for many individuals, this is not a sufficient basis with which to embrace vaccination whole-heartedly. They doubt the benefits of vaccines, worry over their safety and question the need for them, an attitude we refer to as vaccine hesitancy. An attitude of hesitancy differs from an action of vaccine refusal. Even those who are vaccinated can harbour hesitancy towards certain aspects of vaccination [1].

Attitudes to vaccination can be seen as a continuum ranging from total acceptance to complete refusal. Vaccine-hesitant individuals are a heterogeneous group within this continuum. Vaccine-hesitant individuals may refuse some vaccines, but agree to others, delay vaccination or accept vaccination although doubtful about doing so [2].

Understanding vaccine attitude has become an international priority. The Global Vaccine Action Plan, endorsed by 194 Member States of the World Health Assembly, outlined goals for the 'decade of vaccines (2011–2020)' in order to increase vaccine coverage (WHO, 2013). In addition, the World Health Organization Strategic Advisory Group of Experts on Immunization established a working group to specifically address vaccine hesitancy [3-7].

An "Extended Immunization Program" is implemented in Turkey; vaccination services are provided for the control and complete elimination of pertusis, diphtheria, tetanus, measles, rubella, mumps, tuberculosis, poliomyelitis, hepatitis B, and H. influenza type b, and currently, all children are vaccinated free of charge. Owing to the successful vaccination programs, Turkish children became polio-free in 2002, and newborn tetanus, which caused a high mortality, was eliminated in 2009 [8]. It has been shown in studies conducted in Turkey that the rate of vaccine rejection has increased, with parents not providing their children with vaccinations within the scope of such programs. According to the Ministry of Health's public health data, the Turkish Medical Association announced that the number of families

who signed a vaccine rejection form in 2017 reached 23,000, a figure that was 183 in 2011 and 12,000 in 2016 [9].

In recent years, many countries and my country have reported an increase in the incidence of diseases protected by vaccines. The most common reason for this situation is refusal of vaccination by families [10]. Therefore, examination of the causes that may affect vaccine acceptance may contribute to reinforcing vaccination practices and alleviate hesitancy against vaccination. However, there is no scale to evaluate vaccine acceptance and hesitation in our country.

In this study, it was aimed to develop a vaccine attitude scale. This scale has the potential to aid in the advancement of research and immunization policy.

## METHODS

### Participants and study design

The study was done in a cross-sectional type. Research data was collected between 01.03.2019 and 30.03.2019. Students attending Manisa Celal Bayar University in the 2018-2019 academic year formed the population of the research (n=19.301). The research was conducted on a sample group. One branch from each department of faculties was randomly selected. The sample size was at a 95% confidence border with a 50% prevalence and 0.05 error level, the design effect was 2, and the minimum sampling size was determined as 754. The study included 800 people. Which departments to be included in the study were determined randomly (Faculty of Economics and Administrative Sciences-Department of Economics, Faculty of Arts and Sciences-Mathematics, Faculty of Health Sciences-Department of Nursing and Faculty of Sports Sciences-Department of Coaching Education).

### Item selection (first draft)

A review of the literature about "vaccine attitude/ vaccine rejection, vaccine acceptance" was conducted via systematic search in libraries and databases BIREME, PubMed, OVID Web, Scopus, Web of Science and Sci ELO with the following strategy: ("methodological studies" OR "validation studies" AND "vaccine". Published in the last 5 years in the English language were included. Then, through application of Delphi method to refine an initial list of items, an expert panel comprised of five public health professional and one biostatistician suggested the items and domains from which to build the construct of "vaccine attitud / vaccine rejection, vaccine acceptance" on the literature review and their personal experience.

### Content validation (second draft)

Content validity was defined as the extent to which a measure represents all facets of a given construct. It requires the use of recognized subject matter experts to evaluate whether test items assess defined content. An alphanumeric order was given and the second draft was created. Four researchers (a public health worker, a statistician, an infectious diseases specialist, a psychologist) evaluated this draft. All of them had experience in the field (with masters or doctoral degrees). The experts assessed the relevance of each item with a 1– 5 Likert scale and provided comments to improve the instrument.

### Piloting

The initial version of the questionnaire was distributed for piloting and feedback to three experts in the field of survey research in applied linguistics and 10 current Turkish language teachers. The pilot version of the questionnaire included entry fields for feedback after each item as well as one at the end for general feedback. Based on the feedback received, the instrument was revised; this included improving the visual format of the questionnaire, reordering the sections, and clarifying the language in certain items.

### Data collection

The data were collected by the researchers between 01.03.2019 and 30.03.2019. They were contacted directly in their classroom. Detailed information was given to the students about the research and verbal consent was obtained. The questionnaires were distributed to students in their classroom. It took approximately 20 min to fill out a survey in a single session. After the students filled out the questionnaires in the classroom, the questionnaires were collected by researchers in a box.

### Scale description

In this study, we used the 15 items of the Vaccine Attitude Scale (VATS) that are measured on a five-point Likert-type rating scale ranging from 'strongly disagree' to 'strongly agree'. The scale consists of three sub-dimensions; Vaccine acceptance, side effect attitude, vaccine rejection. The high score on the scale indicates that the attitude is positive.

### Statistical analysis

We carried out exploratory factor analysis (EFA) to discover the uncovered dimensions and confirmatory factor analysis (CFA) to validate the obtained structures in vaccine attitude scale. Also, we checked the reliabilities with Cronbach Alpha coefficients for each factor.

### Ethical implementations

Ethical committee permission for the study was granted by Celal Bayar University Local Ethics Committee (ethic no: 20478486-050.04.04). Verbal permission was obtained from the Celal Bayar University where the study was carried out and verbal approval was obtained from the students. Students' names were not used.

## RESULTS

### Sample characteristics

According to the results, 69, 8% of the research group was women and the age distribution was 25,1±7,4 (18-46). Of the research group, 75.6% had a core family structure, 53.8% were

in the upper social class and 62,0% had an income perception equal to or greater than their income.

## Structure, model fit and internal consistency

Firstly, we applied the exploratory factor analysis for 15 items to discover the dimensional structure. After EFA, we checked the internal consistencies of the items using Cronbach Alpha coefficients. Then, we evaluated the validity of the structures using Confirmatory Factor Analysis (EFA). The applications were carried out using R Software [11] with and psych [12] and lavaan packages [13].

While implementing the EFA, we used principal axis method for the extraction and varimax technique for the rotation part. Since the items are in ordinal scale, we used with Polychoric correlation matrix during the EFA process, which is more suitable for the ordinal data [14]. In the first step of EFA, we conducted the Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity to assess the main requirements. The KMO value of the sampling adequacy 0.856>0.8 is acceptable and according

to the Bartlett's test, inter-correlation is significant among the items ($x^2$=7166.059, p=0.000).We utilized the Kaiser rule to extract the number of factors in EFA. The EFA results revealed that the items can be grouped on three dimensions, since there are three eigenvalues greater than 1. The percentage of the explained variance is 0.67, which is adequate for the factor structure. These results point out to the appropriateness of the EFA results.

Table 1 shows the factor loadings and the communalities of the items obtained from the EFA results. Also, the Cronbach Alpha reliability coefficients are given to check the internal consistency levels of the related factor structures in Table 1. All the factor loadings are greater than 0.5 and communalities are greater than 0.4 for each item. We also checked the corrected-item correlations and Cronbach Alpha values when the item is excluded from the analysis. According to the internal consistency results, we include all the items in our analysis since there is no necessity. The Cronbach Alpha values are rather appropriate () for all the obtained factors.

**Table 1:** EFA and internal consistency results

| Item | F1 | F2 | F3 | Communality | Alpha |
|------|-------|-------|-------|-------------|-------|
| i3 | 0.882 | | | 0.808 | |
| i4 | 0.841 | | | 0.714 | |
| i2 | 0.807 | | | 0.737 | |
| i1 | 0.803 | | | 0.695 | 0.757 |
| i5 | 0.777 | | | 0.612 | |
| i6 | 0.776 | | | 0.639 | |
| i14 | | 0.834 | | 0.726 | |
| i13 | | 0.827 | | 0.702 | |
| i12 | | 0.759 | | 0.578 | |
| i15 | | 0.751 | | 0.596 | 0.718 |
| i11 | | 0.75 | | 0.66 | |
| i10 | | 0.709 | | 0.644 | |
| i9 | | 0.653 | | 0.495 | |
| i8 | | | 0.819 | 0.742 | 0.692 |
| i7 | | | 0.789 | 0.704 | |

As a final step of the EFA, we assigned the proper names to the factors by examining the contents of the items. We entitle the first factor (F1) as the benefits of the vaccine, the second factor (F2) as the acceptance of the vaccine and the third factor (F3) as the hesitation of the vaccine. After the naming part, we evaluated the validity of our factor structures using CFA with

Diagonally Weighted Least Squares (DWLS) estimation method which is designed to construct the CFA model with ordinal items 13.

Figure 1 denotes the graphical representation of the CFA results which include the standardized factor loadings and

correlations among the factors. When looking at the plot, it is seen that all the loadings are positive and greater than 0.40 and the correlations are significant (p<0.05).

We observe that there is a moderate and positive correlation between the benefits and acceptance the vaccine; low and positive correlation between the acceptance and hesitation of the vaccine; while there is a low and negative correlation between the benefits and hesitation of the vaccine. Table 2 shows the test statistics of each item. According to the statistics, we revealed that the items are significantly grouped on each factor (p<0.05).



**Figure 1:** The graph of the CFA results
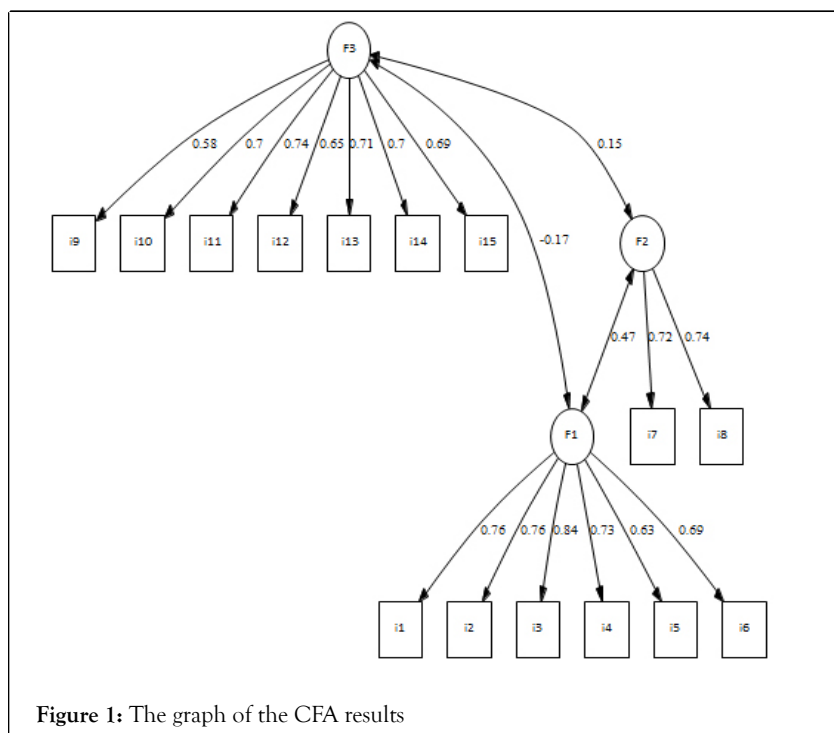
Table 2: The statistics of the coefficients for CFA

| Item | Coefficient | z-value | p |
|---|---|---|---|
| i1 | 0.757 | - | - |
| i2 | 0.76 | 17.288 | <0.001 |
| i3 | 0.837 | 18.22 | <0.001 |
| i4 | 0.733 | 17.575 | <0.001 |
| i5 | 0.629 | 17.074 | <0.001 |
| i6 | 0.689 | 17.376 | <0.001 |
| i7 | 0.718 | - | - |
| i8 | 0.737 | 10.64 | <0.001 |
| i9 | 0.583 | - | - |
| i10 | 0.696 | 17.98 | <0.001 |
| i11 | 0.735 | 18.275 | <0.001 |
| i12 | 0.647 | 17.601 | <0.001 |
| i13 | 0.709 | 18.335 | <0.001 |

| | | | |
|---|---|---|---|
| i14 | 0.702 | 18.325 | <0.001 |
| i15 | 0.686 | 17.96 | <0.001 |

Table 3 reports the goodness of fit index values of the CFA. The index values of GFI, AGFI, GFI, NFI, CFI, RFI and IFI demonstrate the perfectness fit of the CFA results, since they are greater than 0.90 and rather close to 1. [15]. Also, RMSEA is lower than 0.05 and 3.606 is lower than 5. Generally, the fit indexes provide the validity of our factor structures.

**Table 3:** The goodness of fit indexes of CFA

**Goodness of fit indexes**

| $x^2$ | sd | GFI | AGFI | NFI | CFI | RFI | IFI | RMSEA |
|---|---|---|---|---|---|---|---|---|
| 313.684 | 87 | 0.977 | 0.968 | 0.948 | 0.961 | 0.99 | 0.962 | 0.057 |

### DISCUSSION

The present study found that, in recent years, vaccine refusal and hesitancy have increased in developing countries such as Turkey to the same extent as in developed countries. From 2016 to 2018, there was a 2% decrease in the vaccine rate in Turkey1, ??? and vaccine researchers and non-government organizations have started to investigate the causes of this decline. One of the most important reasons for the decrease in immunization rates as reported by the recent literature is vaccine rejection and hesitation [16], and it is imperative to identify who is rejecting vaccines in order to prevent further declines.

In this study, it was aimed to develop a vaccine attitude scale. This scale has the potential to aid in the advancement of research and immunization policy. The results of the developed scale denote that the scale comprises of three sub-dimensions. The Cronbach Alpha values of the dimensions are pretty acceptable and there is no need to extract any items, according to the internal consistency results. The validity of the developed scale is proven with CFA results, since the goodness of the fit measures are quite well. Also, we obtained significant correlations among the factors about the vaccine attitudes. Finally, we observed the negative relationships between the benefits-hesitation and positive relationship between the benefits-acceptance and acceptance-hesitation about the vaccine attitudes.

### CONCLUSION

This improved scale was found fairly high in terms of validity and reliability. Besides, it is found that it is a valid and reliable measurement tool to determine vaccine attitude of the individuals.

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