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Measuring level of knowledge about zoonoses: A scale development study

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Abstract
Aim: The scope validity was provided as the first step in the development of the scale in this methodological and cross-sectional study.
Material and Methods: Item difficulty and discriminatory power index were calculated for each item. Exploratory factor analysis was used to determine the construct validity. The Cronbach alpha internal consistency coefficient was calculated to determine the reliability of the scale. The number of public health professionals working in the field, of which 403 (participation rate of 82%) could be reached, was 491.
Results: The mean difficulty levelof the Zoonotic Knowledge Level Scale (ZKLS) , with a Cronbach alpha value of 0.910, in which item-removed values varied between 0,903-0,908, was found as 0.68. Besides, it was observed that knowledge scores increased as the duration of public health professionals' expertise and their working time in the infectious diseases branch increased. The knowledge level of those who worked in the infectious diseases branch was significantly higher than those who did not.
Discussion: As a result, this scale, developed on zoonoses, was found to be valid and reliable. However, its reliability in particular groups needs to be tested with more extensive studies to elucidate and prove its impact further and apply it to society's other fields.

Keywords
Zoonoses, Level of Knowledge, Scale Development, ZKLS, Reliability

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Introduction

Zoonoses, constituting the 75% of diseases considered a public health concern, continue their evolution in nature by passing from animals to humans and from humans to animals [1-3]. Most importantly, these diseases, which have caused significant human losses in history, remain a major global health threat. Nowadays, some zoonotic infections such as swine flu, Crimean-Congo hemorrhagic fever disease, Ebola hemorrhagic fever, West Nile virus, SARS have been noticed to reach levels that commonly threaten public health in a short time. Hence, in recent years, the subject of zoonotic diseases has become much more critical nationally and especially internationally [2].

According to their etiologies, zoonoses are divided into eight groups: bacterial, viral, parasitic, fungal, rickettsial, protozoal, helminthic, and arthropod-borne zoonoses [4].

It is imperative to know how and under what conditions it is transmitted, what prevention measures, and which treatment options should be applied to avoid zoonoses. To do this, as a next step, it is also necessary to determine people's knowledge levels and organize training accordingly. Public health professionals have been trained on zoonoses in the process of both medical school education and specialty training. They are more likely to be exposed to zoonoses since they frequently work in public health-related areas in the field. Therefore, their level of knowledge is expected to be sufficient for quality and proper health management. Many studies in the literature have measured the level of knowledge of different society segments, though not public health professionals [1,5,6]. However, in these studies, literature-based questions have been asked, and the level of knowledge tried to be measured. We suggest that common question patterns in studies will be useful for standardization. To achieve this, in the present study, we aimed to develop a scale related to zoonoses.

Material and Methods

This methodologically planned research was conducted on public health professionals working in the field.

To provide scope validity of a draft question pool, created after the literature review, a total of 13 expert opinions, including six public health specialists, two microbiologists, an infectious diseases specialist, three veterinarians who were experts in microbiology fields, and a measurement/assessment specialist, were consulted. Scope Validity Index (SVI), desired to be greater than 0.67 for the validation, is the mean of the remaining questions' scope validity rates in the assessment tool [7]. The Turkish linguist checked the questions that constitute ZKLS, where SVI was calculated as 0.89, whether they were correctly expressed and distorted, and made corrections. The data collection phase was started to make the 56-item ZKLS question pool validity-reliability study prepared due to the scope validity.

The approval dated 06 May 2019 and numbered 326712 from the Non-Interventional Clinical Research Ethics Committee of Firat University Faculty of Medicine and written permission dated 15 Nov 2019 and numbered 49654233-604.02 from the Ministry of Health Public Health Directorate was obtained to carry out the study.

In developing a new assessment tool, the recommended sample size is 5-10 times as much as the number of questions [8]. Our study's sample size should be between 280-560 since the number of questions of ZKLS is 56. Of the 491 public health professionals working in the field, 403 were reached (participation rate of 82%).

Considering that public health professionals work scattered in almost all Turkey cities, the questionnaire form was sent to them via e-mail.

Statistical analysis

SPSS (Statistical Package for Social Sciences; SPSS Inc., Chicago, IL) 22 package program was used for statistical analysis. The study's descriptive data were denoted by n, % values in categorical data and mean ± standard deviation (Mean ± SD) and median and interquartile range (25th 75th percentiles) values in continuous data. The Chi-square analysis was applied to compare categorical variables between groups. Conformity of the measurement data to normal distribution was tested with the Kolmogorov-Smirnov test. The Mann-Whitney U test was applied to compare variables not normally distributed between the two groups, and the Kruskal Wallis test was used between more than two groups. The Spearman correlation test was utilized to examine the relationship of continuous variables with each other. The statistical significance level in the analyses was considered $p<0.05$.

Results

56.8 % of the study group were women, and the mean age was 37.8 ± 7.5 (min=25-max=67). 63.3% of the participants were married, 36.7% of the participants were single, 38.5% lived in a metropolitan city, 26.1% in the city, and 26.1% in the county. Again, 46.7% worked or were working in the infectious diseases branch.

The mean difficulty level of ZKLS was found as 0.68, and difficulty levels ranged from 32% to 98%, with no item excluded according to the item difficulty index. Twenty-three questions whose coefficients were less than 0.20, ranged between 0,21-0,83 were removed from the ZKLS 's item discrimination coefficient (Mean 0.56).

The mean of remaining items, excluding those removed due to their item discrimination power, were compared between the lower-upper 27%. As a result, a significant difference was observed in all items between the upper and lower 27% groups ($p<0,001$).

In EFA, KMO was found as 0.829, and the Barlett test results as $p <0.001$. While the KMO-MSA value of an item was determined to be 0.479, another item's common factor variance value was 0.452. On the other hand, both KMO-MSA and common factor variance values of other items were calculated to be greater than 0,50.

After excluding 12 items with a factor load below 0.50, those above 0.50 remained on the scale. Based on the factor analysis, the one-dimensional scale explained 36.1% of the total variance. The percentage of items' correct answers with loads between 0.521 and 0.740 varied between 47.9% and 74.2% (Table 1).

Whereas the item-total correlation values of items with an in-test consistency coefficient (Cronbach alpha) of 0.910 ranged between 0,533-0,722, item-excluded Cronbach alpha values were 0,903-0,908 (Table 1).

The mean score obtained by the public health professionals included in the study from the scale was 27.8 ± 10.7, and the median was 29.0 (IQR = 21-37). There was a significant difference between the age groups in terms of scale total scores

Table 1. The factor loads, percentage of correct answers, item-total correlations of ZKLS items, and Cronbach's alpha value if the item is excluded

Scale Items	Factor load	Percentage of correct answers	Item-total correlation	Cronbach alpha if item is excluded
1. The most effective way to prevent zoonotic diseases is to control the illness in animals.	.538	53.8	.556	.907
2. Legionnaires' disease is a zoonotic disease.	.568	47.9	.579	.907
3. Transmission by vectors is not seen in brucellosis.	.639	65.5	.616	.906
4. The most common finding in brucellosis is arthritis.	.581	50.1	.598	.906
5. The ELISA method is the most commonly used test in the serological diagnosis of brucellosis	.539	57.8	.556	.907
6. Brucella bacterium maintains its viability for up to 6 months if cheese is stored in cold conditions (refrigerator) in soft cheeses prepared from sheep or goat milk	.550	58.6	.552	.907
7. Brucella bacteria can survive for 15 days in pickled cheese containing 17% salt	.644	52.1	.640	.905
8. Slaughterhouse workers are in the CCHF risk group.	.573	48.1	.587	.906
9. Ticks stuck to the body should be killed and removed by pouring a tick-lethal substance on it.	.615	53.1	.620	.905
10. Anthrax is mostly seen in the spring and winter months in our country.	.674	55.6	.657	.904
11. Flies can transmit anthrax to humans by biting them and carrying spores or vegetative forms from dead animals or humans.	.641	61.3	.633	.905
12. Lesions are painful in skin anthrax.	.598	50.6	.613	.906
13. The anthrax case, compatible with the clinical definition and with a history of contact with an animal or animal products that are certain or suspected to be sick, is called a "definitive case."	.611	62.5	.606	.906
14. Penicillin is the first choice of antibiotic in the treatment of anthrax.	.601	74.2	.579	.906
15. Intestinal anthrax is 100% fatal if not treated early.	.740	57.8	.722	.903
16. Administration of antibiotics in anthrax does not affect the development of the skin lesion.	.602	67.2	.593	.906
17. Physicians are in the group to be applied rabies prophylaxis before contact.	.589	70.5	.585	.906
18. The clinical course type of rabies in which there is no aggression period is called calm rabies.	.621	66.0	.606	.906
19. The application of vaccination and immunoglobulin is recommended after clinical signs developed in the rabies case.	.595	51.1	.607	.906
20. The rabies vaccination scheme is applied unchanged in pregnant women.	.530	68.2	.535	.907
21. There is no need to vaccinate for rabies in snake bites.	.521	60.3	.533	.908

Table 2. Comparison of the total scale score for various parameters

		Total scale score		p
		Median	IQR	
Gender	Female	29	20-37	0.703*
	Male	30	22-37	
Age	<35	27a	17-34	0.001**
	35-45	31b	23-37	
	>45	33b	26-40	
Marital status	Married	30	20-37	0.453*
	Single	28	21-36	
Living place	Metropolitan city	29	20-36	0.402**
	City	32	22-37	
	County	28	22-37	
The perceived level of the economic status	Low	26	14-32	0.247**
	Middle	29	22-37	
	High	32	16-36.5	
Expertise duration	Less than one year	26	16-33	<0.00*
	More than one year	33	24-39	
Working status in infectious diseases department	Yes	33	22-38	0.008*
	No	28	20-36	
Working duration in infectious diseases branch	Less than one year	29,5	17.05.1936	0.003*
	More than one year	34	26-38	
Do you think you have enough knowledge about zoonoses?	Yes	33a	24-38	<0.001**
	No	28b	20-35	
	Undecided	20c	8.24	

*Mann-Whitney U test, **Kruskal-Wallis was performed. a, b, c The group from which the difference originated. IQR: Interquartile range

(p=0,001). This difference resulted from the difference between the <35 age group and 35-45 age group and the <35 age group and >45 age group. The score of those with more than one year of expertise duration was significantly higher than those with less than one year, those who worked in the infectious diseases branch than those who did not, and those with more than one year of working duration in the infectious diseases branch than less than one year (p <0.001, p = 0.008 and p = 0.003, respectively) (Figure 1). The answers given about thinking that they have enough knowledge about zoonoses differed significantly in terms of the total scale scores (p<0,001), with this difference being due to the difference between all answers. No statistically significant difference was observed in terms of scale score between age, marital status, living place, and the perceived level of the economic status (p>0,05) (Table 2).

A positive significant relationship was found between the scale total score and age (r=0,183, p<0,001), expertise duration (r=0,280, p<0,001), and working duration in the infectious diseases branch (r=0,253, p<0,001) (Figure 2).

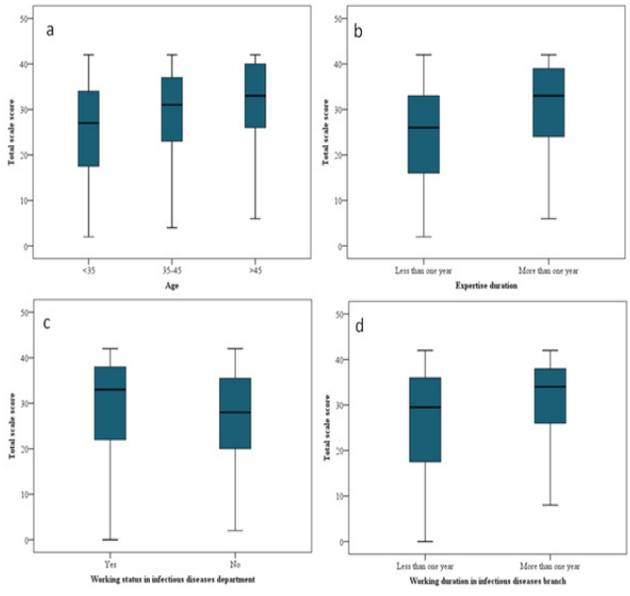

Figure 1. a. Comparison of scale scores by age, b. Comparison of scale scores by expertise duration, c. Comparison of scale scores by working status in the infectious diseases branch, d. Comparison of scale scores by working duration in the infectious diseases branch

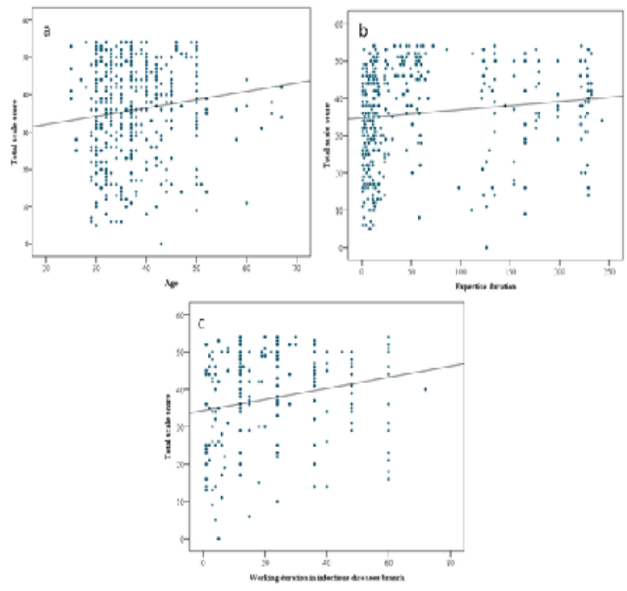

Figure 2. a. Correlation between age and the scale score, b. Correlation between expertise duration and the scale score, c. Correlation between working duration in the infectious diseases branch and the scale score

Discussion

When developing a new assessment tool, the items to be found in this tool should not be too easy or too difficult. If the simplicity or complexity of the assessment tool is important rather than each item, then the mean difficulty level must be considered, which has been desired to be around 0.50 so that it is not too easy or too difficult [9]. Additionally, each item has been accepted as difficult if the difficulty level is less than 30% [10]. Our study found the item difficulty index of all items greater than 0.30, while the mean difficulty level of ZKLS was 0.68 with no item exclusion according to the item difficulty index.

The items of measurement tools, evaluating traits such as talent and achievement, which require people to show their maximum performance, should distinguish between persons who know and who do not. While developing a new assessment tool, it is desirable that the item discrimination coefficient should be at least 0.19 and below so that items can be distinctive and fit for purpose [9,11]. In the present study, 23 items with an item discrimination power of 0.19 or less were excluded. The item discrimination coefficient of ZKLS has been observed to range from 0,21 to 0,83 in several previous studies (mean 0.56). In our study, item distinctiveness was also evaluated by comparing the lower-upper 27% groups' scores, and all items in ZKLS were determined to be discriminatory. As a result, ZKLS is composed of items, which are relatively easy (0,68) but highly discriminating. Many published studies have been reported in the literature, where item distinctiveness was prioritized in item selection, stating that items are not removed from the scale if their distinctiveness is sufficient, even if they are too easy or difficult [11-14].

Barlett's test of sphericity, where a p-value less than 0.05 means that the correlation matrix is suitable for factor analysis, has been used to evaluate the correlation matrix's overall significance detected by exploratory factor analysis [7]. Therefore, the Keiser-Meyer-Olkin (KMO) number has been calculated to decide whether the sample size is suitable for factor analysis. The KMO number usually ranges between 0-1 and must be close to 1 to perform factor analysis. Although the KMO coefficient above 0.60 has been considered sufficient, it is desired to be above 0.80 [7]. KMO was found to be 0.829 and determined using the Barlett test as p <0.001 in the current study. This shows that the prepared scale items are suitable for EFA.

The anti image correlation matrix shows the effectiveness of

the scale items on the scale. Major axis elements of the anti image correlation matrix show the ability of each item to be in the scale (KMO-MSA). The KMO-MSA value must be greater than 0.5 for each item; when it is lower than 0.5, this means that the relevant item does not contribute adequately to the scale. Another issue related to factor extraction is calculating the variance explained by the factors, called the communality, which is the sum of the squares of the factor loads of all factors. It gives the percentage variance of the variables that explain the factors and explains each item's contribution to its factor variance. Besides, with this analysis, a common factor variance value is created, and this value means the measurement value of the variables. The higher the values, the better the variables are measured, with low ones that are excluded from factor analysis.

Meanwhile, the common factor variance value should be at least 0.50 [15]. In our study, the KMO-MSA value of one item was 0.479, and the common factor variance value of another item was 0.452. These values were below 0.50 but close to 0.50, so we did not remove them from the scale. In contrast, both KMO-MSA and common factor variance values of other items were greater than 0.50.

In the exploratory factor analysis, each item's factor load has been calculated in many different trials. According to Hair et al. [16], each item's factor load value, which was considered to be included in the scale above 0.50 was a suitable criterion. Büyüköztürk et al. [17] stated that this value should be at least 0.45. However, for a small number of practice items, this limit has been lowered to 0.30 [18,19]. In our study, we obtained factor loads above 0.50. Despite the distribution of items to 10 different factors resulting from the EFA, the scale was forced into a single factor due to the number of items in these factors was below three, and the items in the factors that occurred are not logically fit into a common heading. In this case, 12 items (2 were KMO-MSA with a common factor variance value below 0.50) with a factor load below 0.50 were excluded from the scale. Other items remained on the scale as their factor loads were above 0,50. As a result of the factor analysis, the scale consisting of one dimension explained 36.1% of the total variance. It, moreover, seems sufficient for the variance explained in social sciences to be at least 40% [20]. Our study also revealed that forcing the scale to a single factor caused a decrease in the total variance explained.

Nevertheless, since the result we found was very close to 40%, it was considered sufficient. In scales that are forced to a single factor in this way, a low total variance is the expected result. Indeed, in the study by Demirtaş et al. [10], it was found that the single-item scale explained 21.6% of the total variance.

Internal consistency, expressed by an internal consistency coefficient, denotes the consistency of items on a scale with each other and whether they form integrity to explain the same conceptual structure. Whereas Cronbach's alpha coefficient was calculated to determine the scale's internal consistency, Cronbach's alpha reliability coefficient was defined as a weighted standard mean of change obtained by dividing the sum of all items' variances in the scale by general variance. Cronbach's alpha coefficient, which in our study was found to be 0.915, was accepted as "acceptable" between 0.70-0.80, "well reliable" between 0,80-0,90, "highly reliable" above 0,90 (Gliem JA, Gliem RR. Calculating, interpreting, and reporting Cronbach's alpha reliability coefficient for Likert-type scales. Midwest Research to Practice Conference in Adult, Continuing, and Community Education; 2003). On the other hand, its item extracted values vary between 0,909-0,915.

One of the methods used for the developed scale's construct validity is "separation between groups. It is primarily based on the hypothesis that it is different concerning the to-be-measured area. The proper analysis method should be selected according to the data's characteristics obtained from the scale to prove this difference [7]. For this, those who were in our study group but worked in the infectious diseases branch were presumably considered more knowledgeable. Besides, it was hypothesized that zoonotic knowledge would increase with raising expertise duration. Our results showed that the knowledge level of those who worked in the infectious diseases branch was significantly higher than those who did not. Also, it was observed that the higher the expertise duration and the higher the working duration in the infectious diseases branch, the higher the knowledge score. This situation indicates that construct validity is ensured for the segregation between groups.

Conclusion

Based on our study findings, 23 of 56 items were applied as questionnaires after the expert opinion was removed due to their low discrimination power and 12 due to insufficient factor loading. The reliability coefficient of the remaining 21 items was found to be 0.910, and the scale was considered easy to apply, valid and reliable in its current form. Correct answers to scale questions "2 points", wrong answers, "0 points," and answers of I do not know were evaluated as "1 point," and the scores that can be obtained from the scale ranged from 0 to 42 points. These results should moreover be interpreted with caution and supported by further studies on this topic. Most importantly, we consider that testing the scale's reliability in special groups is paramount in its application to society's other spheres.

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Scientific Responsibility Statement
The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement
All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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Conflict of interest
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