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Mask Use Scale: A Scale Development Study

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Abstract

Background: The correct use of face masks is one of the most effective ways to prevent the transmission of COVID-19 and other respiratory infections.

Objectives: The present study aimed to develop a valid and reliable measure to assess attitudes and behaviors related to face mask use in social settings.

Methods: This methodological study was conducted online between July 23, 2021, and September 24, 2021. The inclusion criteria entailed an age range of ≥18 years, literacy in Turkish, use of face masks, and willingness to participate in the study. The participants of the study included 489 cases who met the inclusion criteria. Data were collected using a sociodemographic information form and the Mask Use Scale. The data were evaluated using descriptive statistics, exploratory and confirmatory factor analysis, dependent-samples t-test, Pearson correlation analysis, and Cronbach's alpha internal consistency coefficients.

Results: Based on the results, 36 items of the Mask Use Scale had positive and significant item-total correlation coefficients ($P<0.001$). Mean scores in the test and retest demonstrated no significant difference ($P>0.05$). Cronbach's alpha coefficients were .76 for the mask use subscale, .77 for the hygiene subscale, .78 for the cloth mask subscale, .77 for the requirement subscale, .80 for the mask selection subscale, and .93 for the entire scale.

Conclusion: As evidenced by the obtained results, the Mask Use Scale is a valid and reliable tool and can be used to determine adults' attitudes and behavior related to the use of face masks in social settings.

Keywords: Attitude, Communicable disease control, Community health, Face masks, Respiratory tract infections

1. Background

The 21st century has been marked by major epidemics and pandemics, with several of them affecting the lung (1). Respiratory infections, especially acute viral respiratory infections, are transmitted primarily through droplets created by sneezing, coughing, and even talking, and to a lesser extent through aerosols (2). Contact with infected surfaces is another route of transmission (3). Therefore, recommended preventive measures include vaccination, frequent hand washing, social distancing, and the use of face masks (2, 4, 5). The results of previous studies on influenza and COVID-19 have demonstrated that face masks are one of the most effective nonpharmaceutical methods for preventing droplet, aerosol, and contact infections (5, 6). As a result, face masks have become the symbol of the current COVID-19 pandemic (7).

Although face mask use has never been a global necessity, historical sources show that face masks were known and used in the Middle Ages and even earlier (8). Some of the first face masks consisted of silk shawls, lace veils, or beaks made of cotton and containing aromatic substances. These different forms of face masks were worn by servants serving food to emperors, miners, factory workers, or city-dwellers, shielding themselves from dust, and also by doctors visiting patients during epidemics (7, 9). Nonetheless, although it has been understood since the mid-1800s that some infectious agents spread via the respiratory route, based on literature, face mask use in hospitals was first discussed in the 1910s, and face masks have been required in operating rooms since 1935 (8).

The first major test of social face mask use in history came with the Spanish flu in 1918. Failures in controlling that pandemic centered around the slow and inconsistent establishment of policies regarding the use of face masks. Another criticism concerned public misconceptions and wrong behaviors related to face mask use. Publications in that era revealed that people wore face masks until they were completely dirty. The same publications emphasized that face masks were worn incorrectly; therefore, they provided little or no protection. Consequently, emphasis was placed on the conclusion that face masks were ineffective "as used" (7). Based on these experiences, face masks are considered effective if they are worn correctly, used appropriately, and applied together with other disease control methods (7, 10).

With modern industrial capabilities, the face masks produced today are functional, comfortable, and have various features. During the COVID-19 pandemic, the use of standard medical face masks in social settings was considered adequate for everyone other than people working in hospitals or providing direct care to COVID-19 patients (11). Information about the necessary features of commercially available face masks and their proper use are regularly shared by all national and international health institutions, especially the World Health Organization (12).

Attitude is defined as the possible behavior that an individual is expected to display in the face of a phenomenon or situation. Attitude can be either positive or negative. Individuals may sometimes have a negative attitude towards recommendations, such as vaccination, healthy nutrition, and the use of masks, which are necessary for their health. For this reason, it is important to evaluate individuals' attitudes toward the subject in order to improve health behaviors. Considering the literature, it is observed that studies examined people's knowledge of face mask use and barriers to face mask use (13-16). On the other hand, despite remarkable evidence of the role of face mask use in controlling the community spread of Covid-19, only a few scales exist for measuring attitudes towards face mask use (6,10,17-19). Nevertheless, these existing scales do not evaluate the attitudes and behaviors of individuals, such as face mask selection, donning and doffing, and storage in detail (6, 17-19).

2. Objectives

In this study, we developed and evaluated the validity and reliability of the Mask Use Scale (MUS) for the assessment of adults' attitudes and behaviors related to the use of face masks in social settings.

3. Methods

3.1. Study design and setting

A methodological study was conducted. Data were collected via online survey between July 23, 2021, and September 24, 2021.

3.2. Study Sample

The study population consisted of the families and relatives (mother, father, aunt, sister, and uncle) of students enrolled in the Nursing Departments of Health Sciences University, Hamidiye School of Nursing and Eastern Mediterranean University, School of Health Sciences. No sampling method was used; all participants who met the inclusion criteria during the study period and agreed to participate in the study were included in the sample.

A sample size of 5-10 times the number of scale items is recommended for scale adaptation and development studies (20, 21). Based on the original 48-item MUS draft, we sought a sample of 489 participants for validity and reliability analyses. Inclusion criteria were: an age range of ≤18 years, literacy in Turkish, use of face masks, and willingness to participate in the study. Participants who did not meet the sampling criteria or did not complete more than half of the questionnaire were excluded.

3.3. Data collection tools

Data were collected using the MUS and a sociodemographic information form we prepared based on the literature and similar studies (6,13-19, 22-32).

3.3.1. Sociodemographic information form

This 11-item form was used to determine the participants' sociodemographic characteristics, including their gender, age, education level, employment status, marital status, number of children, family type, income level, place of residence, any medical diagnoses, and history of COVID-19 infection (13-19).

3.3.2. Creating the Mask Use Scale items pool

During the development of the scale items, previous studies on the use and selection of face masks and the recommendations of the World Health Organization and the National Ministry of Health were considered. A theoretical framework was determined by reviewing the literature on the stages of scale development, and an item pool was prepared in consultation with experts in the field (6, 22-32). Moreover, the scale was designed in a five-point Likert type as; 1 "strongly disagree," 2 "I disagree," 3 "I partially agree," 4 "I agree," and 5 "I strongly agree." There is no reverse-coded item in the calculation of the scale. The lowest score to be obtained from this five-point Likert scale is 36, and the highest score is 180. High scores obtained from the total scale indicate a positive attitude toward the use of face masks.

3.4. Data collection

Participants were recruited via e-mail and social networking platforms, such as Facebook, Instagram, Twitter, and WhatsApp. Google Forms was used to provide information about the study, obtain participants' informed consent, and administer the sociodemographic form and MUS. We continued to send invitations until the target sample size was reached.

3.5. Data analysis

The data were analyzed using SPSS version 21.0 (IBM Corp, Armonk, NY) and SPSS version 6.0 (Analysis of Moment Structures). Descriptive statistics, including frequency, median, minimum, maximum, mean, and standard deviation, were used in the analysis of the data. In reliability analyses, internal consistency was evaluated using Pearson's moment product correlation coefficient to calculate item-total correlation coefficients, and Cronbach's alpha reliability coefficient was calculated for the internal consistency coefficient. In addition, stability over time was evaluated with Pearson correlation coefficients using the test-retest method. For the content validity of the scale, the Lawshe technique was used to evaluate expert opinions. Construct validity was evaluated by confirmatory factor analysis (CFA).

4. Results

The participants' mean age was 33.08±12.67 years (range: 18-69), most were female (75.7%), and 80% of them were university graduates. Marital status was reported as single by 62.2% of the participants, nearly half (45.6%) were not employed, and 56.4% of them stated their income was equal to their expenses. A majority (71.2%) of the participants lived in urban areas, 42.7% had at least one child, 78.9% reported their family structure as a nuclear family, and 21.9% had a chronic disease, such as asthma, hypertension, or heart disease. A history of COVID-19 infection was reported by 18.2% of the participants. Nearly all participants (99%) had information about the use of face masks, and 90.4% of them asserted that they were very knowledgeable about face mask use. Reported sources of information about face mask use were health care professionals, such as physicians, nurses, and midwives (33.7%), and the Ministry of Health website (31.3%).

4.1. Content and construct validity analysis

With a panel of eight field experts, two specialist physicians, and three assessment and evaluation experts, a detailed analysis of the scale was carried out in terms of item comprehensibility, quality, instruction, usefulness, relevance, and response options. Experts were asked to evaluate each item as *not relevant* (1), *somewhat relevant* (2), *not sure* (3), *relevant* (4), or *very relevant* (5). Differences in experts' opinions were examined using the Lawshe technique. The results were used to calculate the content validity index (CVI). The CVI of the MUS items was determined to be 96%. Based on the results of the content validity analysis, 48 items in the item pool were revised to eliminate any redundancy and ambiguity. A consensus was reached on the resulting scale, which was then piloted with 30 participants who were randomly selected from among the families of the university students in the research population and were not included in the study sample. Necessary revisions to the scale were made based on the pilot test.

4.2. Item analysis

In the reliability analysis of the first draft with 48 scale items, items with item-total correlation coefficients that were negative or lower than 0.30 were removed from the scale (items 2, 4, 5, 16, 18, 19, 43, 45, 46, 48). Thereafter, in the examination made in the Exploratory factor analysis section, items 42 and 47 were also excluded from the study due to their low load. Therefore, in the end, the scale took its final form with 36 items. Item-total correlations of the remaining 36 items varied between .38 and .69, and all were statistically significant (p<0.001) (Table 1).

After factor analysis, analysis of item-subscale correlations in each subscale of the MUS showed that all items had acceptable correlation coefficients (*mask use* subscale: .49 to .73 (9 items); *hygiene* subscale: .53 to .75 (9 items); *cloth mask* subscale: .58 to .77 (7 items); *necessity* subscale: .58 to .72 (7 items); and *mask selection* subscale: .62 to .66 (4 items); p<0.001 for all) (Table 1).

4.3. Internal consistency reliability

In internal consistency reliability analysis, Cronbach's alpha coefficients were .76 for the *mask use* subscale, .77 for the *hygiene* subscale, .78 for the *cloth mask* subscale, .77 for the *necessity* subscale, 80 for the *mask selection* subscale, and .93 for the entire scale.

4.4. Exploratory factor analysis

Construct validity of the MUS was evaluated by first performing exploratory factor analysis. Although study data were obtained from 489 people to evaluate construct validity (10 times the original number of items; n=48), factor analysis was performed for 38 items after the removal of 10 items during item analysis. Kaiser-Meyer-Olkin (KMO) test was used to determine whether the data were suitable for factor analysis, and Bartlett's test was used to determine the significance and difference from zero of relationships between variables. We determined that the KMO value was .91, and the chi-square value of the Bartlett test (X^2= 9535.723; df=666) was highly significant (P<.001), indicating the data were suitable and sufficient for factor analysis. The maximum likelihood method and oblique rotation method were used in factor analysis. Factor analysis conducted by removing two items with multiple loadings too close to distinguish and factor loadings below .30 (items 42, 47) revealed a five-factor structure with 36 items and an eigenvalue above 1.00 that explained 55.4% of the total variance (Table 2).

The items remained as they were in the original scale and as recommended, and the factors were named as follows:

1. *Mask Use* Subscale (items 1, 6, 7, 8, 9, 20, 21, 24, and 30)
2. *Hygiene* Subscale (items 15, 17, 22, 23, 25, 26, 27, 28, and 29)
3. *Cloth Mask* Subscale (items 11, 12, 31, 32, 33, 34, and 35)
4. *Necessity* Subscale (items 36, 37, 38, 39, 40, 41, and 44)
5. *Mask Selection* Subscale (items 3, 10, 13, and 14).

Table 1. Mask Use Scale Item-Subscale and Item-Total Score Correlations (N=489)

Scale Subscales and Items	Item-Subscale Score Correlation Coefficients		Item-Total Score Correlation Coefficients		Cronbach's Alpha
	r	p	r	p	α
Mask use subscale					
Item 8	.73	<.001	.57	<.001	
Item 1	.49	<.001	.43	<.001	
Item 21	.72	<.001	.55	<.001	
Item 20	.71	<.001	.53	<.001	
Item 6	.65	<.001	.43	<.001	.76
Item 9	.67	<.001	.52	<.001	
Item 7	.65	<.001	.54	<.001	
Item 30	.50	<.001	.38	<.001	
Item 24	.55	<.001	.56	<.001	
Hygiene subscale					
Item 23	.75	<.001	.61	<.001	
Item 25	.69	<.001	.51	<.001	
Item 17	.66	<.001	.49	<.001	
Item 29	.71	<.001	.63	<.001	
Item 15	.60	<.001	.49	<.001	.77
Item 22	.69	<.001	.69	<.001	
Item 27	.59	<.001	.52	<.001	
Item 26	.68	<.001	.69	<.001	
Item 28	.53	<.001	.52	<.001	
Cloth mask subscale					
Item 34	.74	<.001	.58	<.001	
Item 31	.77	<.001	.61	<.001	
Item 32	.71	<.001	.50	<.001	
Item 33	.74	<.001	.60	<.001	.78
Item 35	.58	<.001	.47	<.001	
Item 12	.66	<.001	.53	<.001	
Item 11	.60	<.001	.47	<.001	
Necessity subscale					
Item 37	.72	<.001	.48	<.001	
Item 38	.68	<.001	.44	<.001	
Item 39	.66	<.001	.43	<.001	
Item 40	.64	<.001	.48	<.001	.77
Item 41	.65	<.001	.49	<.001	
Item 36	.65	<.001	.58	<.001	
Item 44	.58	<.001	.47	<.001	
Mask selection subscale					
Item 14	.66	<.001	.47	<.001	
Item 13	.63	<.001	.44	<.001	
Item 3	.62	<.001	.51	<.001	.80
Item 10	.63	<.001	.62	<.001	

4.5. Test-retest reliability

Test-retest at an interval of 2 weeks was conducted with 30 participants, and the results were analyzed using Pearson's moment product

Table 2. Exploratory factor analysis: Factor loadings (N=489)

Item	Scale	I	II	III	IV	V
8. I make sure that the mask I use/choose has no tears, holes, or detached ear loops.	A	.694				
1. I prefer to use a disposable surgical/medical mask.	A	.666				
21. I wear the mask covering my nose, mouth, and chin.	A	.656				
20. I place the mask with the metal strip over the bridge of my nose and press it down firmly so that it fits the contour of my face.	A	.651				
6. I make sure that the mask I use/choose has a metal or wire strip in the top/nose edge.	A	.641				
9. I make sure that I use/choose adult-size masks.	A	.597				
7. I make sure that the elastic loops/bands and wires of the mask I use fit my face.	A	.574				
30. Only I use my mask; I don't share it with anyone else.	A	.469				
24. I replace my mask when it is damp/wet or visibly dirty.	A	.401				
23. If I need to touch my mask, I wash my hands/use hand sanitizer before and after.	B		.738			
25. I wash my hands/use hand sanitizer before removing a mask.	B		.727			
17. I always wash my hands/use hand sanitizer before wearing a mask.	B		.692			
29. I wash my hands/use hand sanitizer immediately after throwing away a mask.	B		.648			
15. I make sure the mask I use/choose is nationally/internationally certified.	B		.559			
22. I avoid touching the mask after fixing it to my face.	B		.528			
27. I do not reuse disposable (surgical/medical) masks.	B		.521			
26. I touch only the elastic loops/ties when removing a mask.	B		.519			
28. After using a disposable (surgical/medical) mask, I throw it in a plastic/paper bag or a trash can with a lid.	B		.407			

Table 2. Exploratory factor analysis: Factor loadings (N=489)

Item	Scale	I	II	III	IV	V
34. If I use a cloth mask, I take care not to contaminate my environment when washing the dirty masks.	C			.729		
31. If I use a cloth mask, I wash it every time I take it off.	C			.707		
32. If I use a cloth mask, I wash those without washing instructions with soap and water at a temperature of at least 60°C for 1 minute, then rinse thoroughly.	C			.702		
33. If I use a cloth mask, I carry clean and dirty masks in separate, sealed bags.	C			.698		
35. If I use a cloth mask, I throw it away when the mask is visibly worn out or the elastic loops are loose.	C			.626		
12. If I use a cloth/fabric mask, I make sure to buy those that can withstand high temperatures (60°C and higher).	C			.593		
11. If I use a cloth/fabric mask, I make sure that the mask I use/choose has washing instructions.	C			.532		
37. During outbreaks of influenza, COVID-19, etc., I wear a mask when I go to the hospital to protect myself from disease.	D				.740	
38. I wear a mask in public places when I have symptoms of the flu, COVID-19, etc.	D				.730	
39. When I present to the hospital, I wear a mask if I have symptoms of the flu, COVID-19, etc.	D				.697	
40. I wear a mask at home when I have symptoms of the flu, COVID-19, etc.	D				.599	
41. I wear a mask if there are any family members with symptoms of the flu, COVID-19, etc.	D				.582	
36. During outbreaks of the flu, COVID-19, etc., I always wear a mask in public places to protect myself from disease.	D				.580	
44. I think that mask use is effective and necessary to prevent epidemic diseases such as flu, COVID-19, etc.	D				.525	
14. I make sure that the mask I use/choose is pleated or beak-shaped.	E					.615
13. If I use a cloth/fabric mask, I make sure to buy a mask made of woven (non-stretchy) fabric.	E					.603
3. I make sure that the mask I use/choose has at least three layers.	E					.582
10. I make sure that the mask I use/choose has been tested for filtration efficiency.	E					.535
Percentage of Variance Explained by the Factors				**Eigenvalue**		
Factor I	**13.034**			4.823		
Factor II	**12.259**			4.536		
Factor III	**11.031**			4.081		
Factor IV	**9.962**			3.686		
Factor V	**9.128**			3.377		
Total variance explained	**55.414%**					

Bold = salient (> .30) loading, A=*Mask use* subscale, B=*Hygiene* subscale, C=*Cloth mask* subscale, D=*Necessity* subscale, E=*Mask selection* subscale

correlation and t-test to evaluate the stability of MUS scores. Test and retest scores were not significantly correlated, except for the total score (r=.367, P=.46) and subscale 3 (r=0.605, P<0.001; Table 3). Nonetheless, a comparison of test and retest scores using a dependent-samples t-test revealed no significant differences (P>0.05; Table 3).

Table 3. Test-Retest Analysis of the Mask Use Scale (n=30)

Mask Use Scale scores	First Evaluation Mean ± SD	Second Evaluation Mean ± SD	t	p	r	p
Total score	159.33±14.90	159.63±14.13	-.100	.921	**.367**	**.046**
Mask use subscale	42.93±2.89	42.92±3.23	.044	.965	.080	.673
Hygiene subscale	38.33±6.19	38.46±5.34	-.099	.922	.190	.315
Cloth mask subscale	29.76±4.85	30.20±4.27	-.580	.566	**.605**	**.000**
Necessity subscale	31.93±3.40	31.40±3.46	.558	.581	-.162	.392
Mask selection subscale	16.36±2.87	16.66±2.72	-.412	.683	-.015	.938

t: Paired samples t-test, r: Pearson correlation test, SD: Standard deviation

5. Discussion

This validity and reliability study demonstrated that the Turkish MUS has good psychometric properties and can be used to assess face mask use in the general adult population. The reliability of the MUS was evaluated using test-retest, internal consistency, and item analyses. Test-retest reliability refers to the ability of a measurement tool to yield consistent results between applications and show stability over time. The results of the test-retest correlation analysis of the MUS demonstrated that there was no statistically significant relationship between the subscales; however, there was a strong relationship for the whole scale (33, 34). Nevertheless, the paired samples analysis illustrated no significant differences in mean scores obtained at a two-week interval. The assessment of test-retest reliability is recommended for measures of continuous constructs (33). The absence of statistically significant differences in the MUS subscales indicates that they are not affected by time.

Another finding that supports the reliability of the scale is a statistically significant internal consistency coefficient. We evaluated the internal consistency of the MUS using Cronbach's alpha, which is suitable for Likert-type scales. Higher alpha coefficients indicate consistency among the scale items. The alpha coefficient, which is determined as a value between 0 and 1 by averaging the sum of item variances by the general variance, determines whether the items in the scale form a homogeneous whole that explains the construct (21, 33). According to our analysis of internal consistency, Cronbach's alpha was acceptable for the five MUS subscales.

Item-total correlation coefficients are expected to be high when scale items are equally weighted and represent independent units. The higher the correlation coefficient, the stronger the relationship between the item and the characteristic being measured (21, 33). Although there is no specific standard regarding the item-total correlation threshold below which items are considered unreliable, values greater than .25 or .30 are recommended (35). Higher correlation coefficients indicate better item reliability (21, 33). In our item analysis performed to assess item reliability, all items displayed an acceptable correlation with subscale and the total scores (r>.30), indicating that all items measure the same construct (35).

In terms of validity analyses, when content and construct validity were evaluated, it was observed that field experts reported a high agreement (96%) regarding the items in the original draft version of the MUS. A high level of agreement among experts is an important sign of the scale's content validity (21, 33, 35). Therefore, we concluded that the items in the MUS are understandable and relevant in terms of content.

According to the results of exploratory factor analysis conducted to determine the construct validity of the MUS, items with factor loading values below .40 and those that loaded onto two factors with a difference of less than .20 between factor loading values were eliminated, resulting in 36 items, as in the original scale. Factor loadings of the items in the scale ranged between .40 and .74. The results of our analyses indicated that the scale items conformed to a five-factor structure with eigenvalues greater than 1. These five factors explained 55.4% of the total variance. The literature states that over 50% total variance explained suggests that the scale items are acceptable (36). In exploratory factor analysis, the adequacy of a sample is evaluated by determining the Kaiser-Meyer-Olkin (KMO) value (35). A KMO value of .90-1 is regarded as excellent, .80 to .89 as very good, .70 to .79 as good, .60 to .69 as moderate, and below .50 as weak (37). Exploratory factor analysis in our study yielded a KMO value of .91, signifying that the sample was suitable for factor analysis, and the Barlett test was significant (P<.001), indicating that the correlation matrix of the scale items was suitable for factor analysis.

5.1. Strengths and limitations

In the present study, a valid and reliable scale has been developed that can serve to protect public health in epidemics or pandemics related to respiratory tract infections. In the literature, there are few scale reflecting the attitude towards mask use in other countries. The original aspect of MUS is that it examines the face mask selection, donning, doffing, and storage. The second strength of this study is that it included individuals from different demographics with a large sample. On the other hand, this study is limited to the results obtained for the items selected from the pool based on the experience of the experts and literature review.

6. Conclusion

As evidenced by the results of the present study, the MUS developed in Turkish had adequate validity and reliability. The internal consistency coefficients and validity indicators of the scale are consistent with the literature. Therefore, the MUS offers a practical, understandable, and reliable measure of face mask use attitudes and behavior in social settings among individuals over 18 years of age. For further research, it is recommended to conduct studies in populations where face mask use is neglected using the MUS. The validity and reliability study of this scale should also be conducted in other countries and in different languages.

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Footnotes

Conflicts of Interest: The authors declare no conflict of interest.

Author's contributions: Study design: RM, MD

Data collection / analysis: RM, MD

Study Supervision: RM, MD

Manuscript writing: RM, MD

Critical revisions of important intellectual content: RM, MD

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