TÜBİTAK

Turkish Journal of Medical Sciences

http://journals.tubitak.gov.tr/medical/

Research Article

Turk J Med Sci
(2021) 51: 898-911
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doi:10.3906/sag-2005-243

Development, validity and reliability study of a compliance scale for the COVID-19 outbreak prevention recommendations

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Received: 19.05.2020 • **Accepted/Published Online:** 09.12.2020 • **Final Version:** 28.06.2021

Background/aim: During the intense periods of the COVID-19 pandemic, legal measures were taken for its containment. However, since legal precautions cannot be implemented continuously, hand washing, mask usage and obeying social distance rules are important in combating the pandemic. Complying with these rules is mostly individual decisions. The behavior of individuals has a prominent place in the course of the pandemic. In this study, we aimed to develop a scale which could measure compliance with outbreak measures.

Materials and methods: This study was conducted in two stages after evaluation of the content validity of the item pool formed by the research group by experts. For construct validity, the scale subdimensions were determined in 250 people between the ages of 18-70 years at the first stage and the definitive version of the 20-item scale was constructed. In the second stage, exploratory factor analysis was repeated in a group of 484 people, and confirmatory factor analysis was performed. Cronbach's alpha coefficients, Spearman-Brown coefficients, test-retest methods were used to determine reliability.

Results: The variance explanation of the scale consisting of 20 items and two subdimensions in the explanatory factor analysis is 63.434% (n = 484). Confirmatory factor analysis resulted in CMIN/DF = 3.540, RMR = 0.043, NFI Delta 1 = 0.928, TLI rho 2 = 0.939, CFI = 0.947, RMSEA = 0.072, SRMR = 0.0368. Cronbach's alpha value of the scale is 0.95; and the Spearman Brown coefficient equal length analysis resulted in 0.928. The temporal consistency of the scale was evaluated with the test-retest method (P = 0.893). The structure, content validity, temporal consistency, item discrimination, and internal consistency were evaluated and found to have acceptable valid, reliable properties.

Conclusion: The outbreak prevention recommendation compliance scale is a valid and reliable tool with which compliance with the prevention plans can be evaluated.

Key words: Outbreak, outbreak prevention, prevention recommendations, reliability, validity

1. Introduction

A new respiratory disease first occurred in Wuhan city of Hubei province, China, in December 2019. These cases, frequently presenting with cough, high fever, and shortness of breath, were initially detected in the seafood and animal market employees and visitors in this region. Afterwards, the cause of the disease spread, primarily to other cities in Hubei province, especially Wuhan, then to other provinces of People's Republic of China and other countries of the world [1].

Coronaviruses are a large family of viruses with diverse types that can cause disease in animals and humans. Several types are known to cause a range of diseases in humans, from simple upper respiratory infections to severe acute respiratory syndrome (SARS) and middle east respiratory syndrome (MERS). The disease spreading to the world from Wuhan was found to be a new type of coronavirus and called SARS-CoV-2. The clinical condition caused by this virus was named COVID-19 by the World Health Organization (WHO) [2].[1]

COVID-19 is mainly transmitted by droplets, and carrying the droplets scattered by the sick individuals' coughing and sneezing to the mouth and nasal mucosa

[1] World Health Organization (2020). Laboratory testing of human suspected cases of novel coronavirus (nCoV) infection Interim guidance 10 January 2020 [online]. Website https://apps.who.int/iris/bitstream/handle/10665/330374/WHO-2019-nCoV-laboratory-2020.1-eng.pdf. [accessed 14 March 2020].

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[1,3]. For this reason, being in crowded environments increases the spread of the disease. These forced countries to take quarantine and social isolation measures in the fight against the pandemic. In order to prevent crowded environments from occurring in many countries, schools have been closed and distance education has been initiated, curfews have been put into practice, and some sectors have been given the opportunity to work from home [4].[2,3]

In Turkey, particularly those under 20 and over 65 years of age were forced to enter lockdown, and this was applied to all age groups on weekends and public holidays from time to time. In addition to these collective measures, individual measures and hygiene rules were announced to the public through various communication channels.[4,5]

The long prodromal period, the fact that contagiousness begins before the symptoms and high transmission rates are of significance in the spread of the disease. Compliance with individual hygiene rules and rules set for the society (such as staying at home, social distancing, wearing a mask) are of foremost importance in preventing spread [4].

Hand washing, using a mask, and complying with social distancing, isolation and quarantine measures when necessary are highly significant in the combat against this outbreak. Complying with these rules is mostly individual. The behavior of individuals has a major place in the course of the outbreak. It is the individuals' decisions to comply with the stay at home warnings except for periods of prohibition. Characteristics, responsibilities at home, work, and psychological management of the process have been effective in complying with the rules. However, it is possible to prevent the spread of the outbreak, regardless of what variables are found in the end, with behaviors that comply with hygiene and social distancing rules.

Health promotion is defined as gaining the power of the individual to improve his own health and increase his control over his own health. Health promotion can be improved by evaluating behaviors.[6] Personal characteristics such as age, sex, sociocultural factors (ethnic origin, education, socioeconomic status), psychological factors (self-esteem, self-motivation, personal meaning of health) are effective in the formation of health-enhancing behaviors, as well as previous behaviors have a direct effect on current behaviors. Although the precautionary behaviors to be taken during the COVID-19 epidemic process do not create similarities with our past habits, they can be evaluated within the areas of fulfillment of the demands and preferences in the health promotion model and the responsibility of the action plan [5].

The ability of the society to control the behaviors that must be followed in the COVID-19 process, may vary depending on the individuals' belief in the proposed prevention recommendations, the severity of the disease and their level of knowledge. A valid and reliable scale can be used as a tool for measuring behavior and determining the current situation. Since the spread of the epidemic is also related to the social patterns of societies, local behavior may differ.

This scale can direct managerial interventions by enabling evaluation in small groups. The intermittent application of the scale during the epidemic process, where individual behaviors have importance in the health of the society, may guide interventions such as increasing the warning in cases of complacency during the epidemic process that takes a long time.

Uncertainty and rate of spread of the outbreak are expected to cause concerns. Indeed, the worldwide emergence of COVID-19 has resulted in physical and psychological health consequences, such as fear and anxiety, and the development of related new scales in many different languages [6–9].

WHO has prepared a checklist, which is called the Operational Readiness Checklist for COVID-19, will help national authorities to identify main gaps, perform risk assessments and plan control, and response actions.[7]

[2] World Health Organization (2020). Disability considerations during the COVID-19 outbreak [online]. Website https://apps.who.int/iris/bitstream/handle/10665/332015/WHO-2019-nCov-Disability-2020.1-eng.pdf?sequence=1&isAllowed=y. [accessed 14 May 2020].

[3] World Health Organization (2020). Critical preparedness, readiness and response actions for COVID-19 [Interim guidance 22 March 2020]. Website https://apps.who.int/iris/bitstream/handle/10665/331511/Critical%20preparedness%20readiness%20and%20response%20actions%20COVID-10%202020-03-22_FINAL-eng.pdf?sequence=1&isAllowed=y. [accessed 14 May 2020].

[4] Türkiye Cumhuriyeti İçişleri Bakanlığı (2020). 65 Yaş ve Üstü ile Kronik Rahatsızlığı Olanlara Sokağa Çıkma Yasağı Genelgesi [online]. Website https://www.icisleri.gov.tr/65-yas-ve-ustu-ile-kronik-rahatsizligi-olanlara-sokaga-cikma-yasagi-genelgesi. [accessed 21 March 2020].

[5] Türkiye Cumhuriyeti İçişleri Bakanlığı (2020). 65 Yaş ve Üzeri/20 Yaş Altı/Kronik Rahatsızlığı Bulunan Kişilerin Sokağa Çıkma Kısıtlaması İstisnası Genelgesi [online]. Website https://www.icisleri.gov.tr/65-yas-ve-uzeri20-yas-altikronik-rahatsizligi-bulunan-kisilerin-sokaga-cikma-kisitlamasi-istisnasi-genelgesi [accessed 6 March 2020].

[6] Ottawa Charter for Health Promotion First International Conference on Health Promotion [Ottawa, 21 November, 1986-WHO/HPR/HEP/95.1]. Website https://www.healthpromotion.org.au/images/ottawa_charter_hp.pdf [accessed 1 October 2020].

[7] WHO. Operational Readiness Checklist; 2020. [online]. https://www.euro.who.int/data/assets/pdf_file/0004/428863/Operational-Readiness-Checklist_final-version_Feb-13.pdf [accessed 2 October 2020].

WHO prepared a very comprehensive checklist named "Checklist for influenza epidemic preparedness" in 2005 during the influenza epidemic period and recommended to countries. The checklist is a practical tool to ensure that countries take into account all the essential pandemic response capacities when planning for national pandemic influenza preparedness. This plan was later revised in 2009, 2013, 2017, and 2018.[8]

However, when we searched for the words "scale" or "guide", and "compliance with outbreak measures" or "compliance with action plans" and "prevention" and "pandemic" in Google scholar, PubMed, and Scopus databases (in both Turkish and English for validity and reliability), we were not able to detect an existing scale. There was no time restriction in the literature search. In the set of databases analyzed, the search was done inclusively in "Any Field". Around 10,000 studies were screened. It was found that, there is no scale in the literature regarding compliance with outbreak measures according to our search until now.

During the intense periods of the COVID-19 pandemic, legal precautions were taken all around the world for its containment. It is not known exactly how long the pandemic will last regionally and how long it will remain in circulation. The historical Spanish flu outbreak lasted for about two years. Many countries have begun to enter a normalization process, as constant curfews may have economic implications for countries.[9] Therefore, need for individual measures and our individual responsibility to the society will continue for a long time. During the outbreak, governments and researchers need studies for identifying groups that need support, adjusting prevention recommendations, managing the outbreak, and predicting possible increases and a scale evaluating compliance with outbreak measures will be a tool for present situation evaluations during these studies.

As of March 11, 2020, a health mobilization against coronavirus has been initiated all over the world. The main objective case for Turkey to keep the number to a minimum, thus to reduce the rate of transmission of the virus. In this context, each country has put its own national outbreak recommendations into effect. In this respect, Turkey implemented a National Preparedness Plan for the Pandemic Influenza, which was prepared in 2019 under the leadership of the WHO practice [10]. The action plans to be taken are also explained on the website of the Ministry of Health.[10]

Our goal was to obtain an easily applicable measurement tool with a single score, although there are many subheadings related to compliance. The distribution of the frequency of responses given to individual scale items may also direct the interventions to be made. However, when a person is wearing a mask, he or she may not pay attention to social distance. So, it would be useful to have a scale as it would be important to follow the measures taken one by one, as well as how many recommendations were followed in total.

In this study, we aimed to develop a scale that includes knowledge, attitudes and behaviors related to outbreak prevention recommendations which can be applied over the age of 18.

2. Materials and methods

This study is a methodological and descriptive research. Figure shows a flowchart summarizing work order and time process The ethical approval of Sakarya University Non-Invasive Ethics Committee dated 20.4.2020 and numbered E.4167/154 was obtained.

A scale was developed by our research team to evaluate compliance with the prevention recommendations implemented to prevent the outbreak. The scale form created in this two-step study was transferred to online use and applied online.

Preliminary information about the validity and reliability of the scale was evaluated with 250 individuals in the first stage, and its validity and reliability were confirmed on 484 individuals in the second stage. Sociodemographic questions and those related to the outbreak were asked to an entire group of 734 people.

Individuals who were at least primary school graduates, without additional cognitive impairment preventing them from completing the study, dementia, head trauma, intracranial- infection and delirium, who were aged between 18–70 years were included in this study. The study was conducted in accordance with the principles of Helsinki Declaration and ethics committee approval was obtained from the University Ethics Committee.

This study consists of the following steps:

Step 1. Review of the scale item: The online self-reported questionnaire developed by the investigators contained the following three concepts related to knowledge, attitude, and behavior about the COVID-19.

[8] WHO. A checklist for pandemic influenza risk and impact management: building capacity for pandemic response. Geneva: World Health Organization (WHO); 2018 [online]. Website (http://www.who.int/influenza/preparedness/pandemic/PIRM_Checklist_update2018.pdf). [accessed 2 October 2020].

[9] The Economic Policy Research Foundation of Turkey (TEPAV) (2020). What If Turkey Imposes a Curfew Due To COVID-19 [online]. Website https://www.tepav.org.tr/upload/files/1586766187-1. What_If_Turkey_Imposes_a_Curfew_Due_To_COVID_19_N202008.pdf. [accessed 10 May 2020].

[10] COVID-19 Koronavirüs Acil Durum Eylem Plan [online]. Website https://hsgm.saglik.gov.tr/depo/birimler/calisan_Sagligi_db/haberler/Corona_eylem_plan-svc/Corona_Eylem_Plani.pdf [accessed 28 September 2020].

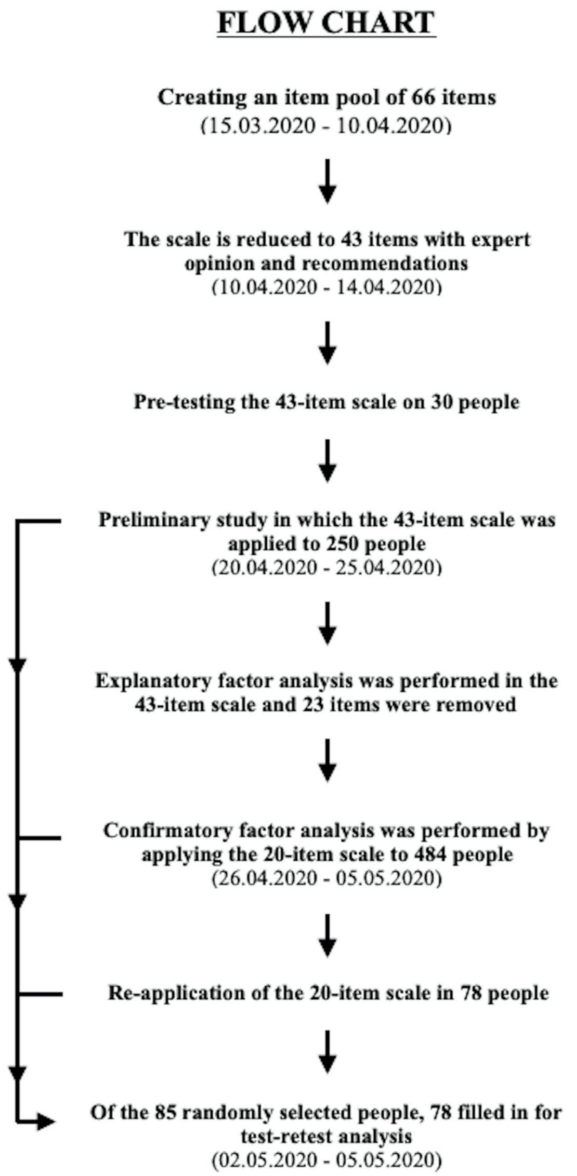

Figure. Study design and time periods with flow chart.

Item production has been made by the core research group in accordance with the literature, the Ministry of Health and WHO prevention recommendations. Thus, 66 item has been created initally. The core research group consists of two public health experts, two psychiatrists, an infectious disease specialist, and a family health physician. After the interviews in research group, the scale was reduced to 50 items. It is a 5-point Likert type scale with a score of 1 corresponding to "I strongly disagree", 2: "I disagree", 3: "I am not certain", 4: "I agree" and 5: "I strongly agree". The data collection process of the study took place online. Participants with access to the internet could participate in the study. Respondents were clearly informed about the background and objectives of the study, on the first page of the online questionnaire.

Step 2. Expert opinion for scope/content validity: Since the measurement of behavior, attitude and knowledge is important in the development of the scale, an expert group consisting of public health experts, psychiatrists and psychologists was studied. Opinions of a group of 10 experts consisting of public health specialists, psychiatrists and a psychologist were taken. The language and scope of the scale were first evaluated by this group of experts.

Two experts suggested that questions related to attitude be reviewed for compliance with the measure recommendations. Six questions were excluded, which left 44 questions. Afterwards, "I think I am sufficiently knowledgeable about the outbreak" was removed with the suggestion that they contained a relative element. "I am spending more time on exercise after the outbreak" was removed with the suggestion that it is not included in the measures to be taken. "I follow the news about the outbreak on the official website of the Ministry of Health or the official statements of the ministry" was added, leaving 43 questions on the scale [11].

Step 3. Pilot implementation and review of the comprehensibility of the scale: the preliminary trial of the (43 items) scale was applied to a group of 30 people. These people, who were chosen from easily accessible people, were selected to be in a wide age range. The average age was 34.45 ± 7.84, min-max (27–68). As it would be applied online, its preliminary test was conducted with the same method. After completing the survey, people were interviewed one by one and their opinions and suggestions were taken. Feedback indicated that one question was incomprehensible, which was changed, and the scale was finalized with 43 questions to evaluate construct validity.

Step 4. Transferring the scale online and filling of the form: The scale was transferred online with a sociodemographic data form, which the participants were asked to fill. At this stage, up to 5 times the scale items were reached via e-mail and telephone numbers. The link to the Google questionnaire was sent to the telephone numbers of the authors, in addition to neighbors, friends, relatives, coworkers of all levels and departments, friends of friends, thus to different WhatsApp groups. The reason for conducting the survey online was to reduce direct contact with participants during the outbreak.

Participants were informed about the study at the beginning of the questionnaire and it was enlightened. The scale form consisting of 43 items was filled in after entering an email address and telephone number, thus preventing duplicate entries.

Step 5. The preliminary evaluation of construct validity and reliability of the scale: Reliability and item analyses were performed with approximately 5 times the scale items, along with item total statistics and internal consistency analyses. The Kaiser–Meyer–Olkin (KMO) and Bartlett's test measure of sampling adequacy were used to examine the appropriateness of factor analysis. The sample size was considered sufficient with KMO measure of sampling adequacy of 0.943, and the approximate of Chi-square of 543.556 with 153 degrees of freedom, and $P < 0.001$. It was applied to 250 people online to determine the factor distribution. The sample size was deemed sufficient for exploratory factor analysis (EFA), and principal component analysis was performed, as a result of which 23 items were removed on the grounds that they were included in more than one subdimension and disrupted the scale integrity. The scale was grouped in two subdimensions: "compliance with collective rules" and "compliance with individual hygiene rules". It was also reviewed in terms of logic and integrity. The explained variance of the scale was 68.538%, with "compliance with collective rules" factor constituting 61.503% of the variance and the "compliance with the individual hygiene rules" factor constituting 7.035%. Direct oblimin rotation was performed in the factor analysis with the principal method.

Reliability analysis of the study with 250 people revealed a Cronbach alpha value of 0.965. If an item was deleted, the Cronbach's Alpha ranged from 0.960 to 0.965. Internal consistency analysis of the scale resulted in a Spearman Brown coefficient equal length of 0.923. After the preliminary study, the scale consisting of 20 items took its final form.

Step 6. Testing the scale with confirmatory factor analysis CFA is used to test whether there is a sufficient relationship between these determined factors, which variables are related to which factors, whether the factors are independent from each other, and whether the factors are sufficient to explain the model. CFA is a structural equation model and is used to test items and subdimensions obtained with EFA. After the scale questions were determined by EFA, CFA was applied. CFA was performed to verify the items and factors obtained with EFA [12].

2.1. Statistical Analysis

Statistical analysis were performed using SPSS software version 21.0. The variables were investigated using analytical methods (the Kolmogorov–Smirnov test) to determine whether they were normally distributed. Descriptive analyses were presented using tables of frequencies for the categorical variables, and medians and interquartile range (IQR) for the non-normally distributed variables. The Mann–Whitney U and Kruskal–Wallis tests were utilized for comparing two and more than two (education) nonnormally distributed variables, respectively. Spearman correlation analysis was performed for evaluations of the test-retest scale scores. Categorical variables were evaluated by chi-square analysis. A P value of less than 0.05 was considered statistically significant.

Exploratory and confirmatory factor analyses were employed to determine the validity of the scale. The adequacy of the sample size of the study and the suitability of the data for factor analysis were evaluated with the KMO sample sufficiency measure and the Bartlett Sphericity test. In the study, the construct validity of the scale was evaluated with the principal components analysis and exploratory factor analysis using the Direct Oblimin rotation method. Factor structure obtained by exploratory factor analysis x^2, x^2 /df, comparative fit index (CFI), root mean square error of approximation (RMSEA), goodness of fit index (GFI), adjusted goodness of fit index (AGFI), root mean square residual (RMR), standardized root mean square residual (SRMR), normed fit index (NFI), Trucker Lewis index (TLI), consistent Akaike information criteria (CAIC), Akaike information criteria (AIC), expected cross–validation index (ECVI) fit indexes were evaluated using confirmatory factor analysis [13]. The reliability of the Scale of Compliance Recommendations was determined by Cronbach alpha coefficient, split-half reliability was estimated using Spearman–Brown coefficients equal length and by the test-retest method after re-applying the scale to 78 persons [11].

3. Results

The mean age of the individuals participating in the study was 35.54 ± 10.22 (min-max, 18–70) years, and 26.6% were males. The sociodemographic data of the participants are presented in Table 1.

The provinces with high participation in the Marmara region were Sakarya (222 individuals, 30.2%), Istanbul (147 individuals, 20.0%), Bursa (42 individuals, 4.4%), and Kocaeli (25 individuals, 3.4%).

The sociodemographic characteristics of the participants, in the second study were found to be similar except for age with the pilot study of the scale (Table 2).

3.1. Validity of the scale

3.1.1. Construct validity

Exploratory factor analysis: The scale was conducted on 250 individuals to determine factor distribution, after which it was conducted on 484 individuals. In the second stage, Kaiser–Meyer–Olkin (KMO) of sampling adequacy was 0.958, and Bartlett's test of Sphericity approximation.

Table 1. Sociodemographic characteristics of participants.

Characteristics		Count (n)	Percentage (%)
Sex	Male	195	26.6
	Female	539	73.4
Age (mean ± SD) (median, (IQR))		35.54 ± 10.22 36, (27–42)	
Marital status	Married	409	55.7
	Single	282	38.4
	Divorced/widowed	43	5.9
Children	None	355	48.4
	One child	127	17.3
	Two children	181	24.7
	Three children and above	71	9.7
Education level	Elementary school	6	0.8
	Middle school	12	1.6
	High school	163	22.2
	Undergraduate	418	56.9
	Postgraduate	135	18.4
Is there a healthcare worker in the family?	Yes	225	30.7
	No	509	69.3
At least one of the family members is away during the outbreak	Yes	307	41.8
	No	427	58.2
Regions	Marmara	453	61.7
	Central Anatolia	66	9.0
	Southeast Anatolia	58	7.9
	Aegean Region	54	7.4
	Black Sea	49	6.7
	Mediterranean	28	3.8
	Eastern Anatolia	26	3.5
Chronic diseases	None	581	79.2
	One	128	17.4
	Two and more	25	3.4
Diagnosed with COVID-19	Yes	11	1.5
	No	723	98.5
Someone close diagnosed with COVID-19	Yes	115	15.7
	No	619	84.3
Place of residence during the outbreak	Home	702	95.6
	Hospital	11	1.5
	Hotel	5	0.7
	House of a friend	6	0.8
	Other	10	1.4

Table 1. (Continued).

The amount of non-compulsory time spent in the current location	One week	288	39.2
	Two weeks	78	10.6
	Three weeks	119	16.2
	Four weeks	61	8.3
	More than four weeks	188	25.6
Referral to a physician with any other disease than the outbreak during the outbreak process	Yes	86	11.7
	No	648	88.3
Channels to follow developments related to the outbreak*	News channels in the television	417	56.81
	Social media	415	56.54
	World Health Organization Webpage	82	11.2
	News site on the web	215	29.3
Time spent during the day on developments regarding the outbreak	Half an hour	159	21.7
	One hour	271	36.9
	Two hours	178	24.3
	Three hours and more	126	17.2
Total		734	100.0

*Individuals have followed developments from more than one channel.
SD = standard deviation.

Table 2. Comparison of sociodemographic characteristics of study groups.

Characteristics Count (n)		Pilot study (n = 250)		Second study (n = 484)		P
		Percentage (%)	Count (n)	Percentage (%)		
Sex	Male	62	24.8	133	27.5	0.436*
	Female	188	75.2	351	72.5	
Age (mean ± SD) (median, (IQR))		37.10 ± 10.87 38 (29–43)		34.73 ± 9.79 34.5 (26–40)		0.002**
Age group	18-29 30-39 40-49 50-59 60-70	67 83 67 25 8	26.8 33.2 26.8 10.0 3.2	159 186 103 29 7	32.9 38.4 21.3 6.0 1.4	0.022*
Education level	Elementary or middle school	6	2.4	12	2.5	0.308*
	High school	64	25.6	99	20.5	
	Undergraduate	141	56.4	277	57.2	
	Postgraduate	39	15.6	96	19.8	
Is there a healthcare worker in the family?	Yes	76	30.4	149	30.8	0.915*
	No	174	69.6	335	69.2	
Chronic diseases	None	195	78.0	386	79.8	0.773*
	One	47	18.8	81	16.7	
	Two and more	8	3.2	15	3.5	

SD=standard deviation, IQR=interquartile range
* Chi-square test, ** Mann–Whitney U Test

The Chi square value was 8025.484, with a degree of freedom of 190, P < 0.001.

The distribution and factorization of the scale items are shown in the table below (Table 3). The results of the exploratory factor analysis performed in the 250-person group in the first stage of the study and the 484-person group in the second stage were similar. The variance explanation of the exploratory factor analysis performed on 484 people was 63,434% with "compliance with collective rules" constituting %57.545 of the variance and "compliance with individual rules of hygiene" constituting 5.889%. In both subdimensions, clustered items in the first stage (n = 250) gathered and factored.

Discrimination validity: Item analysis based on difference of lower-upper group means for discriminant validity.

There was a statistically significant difference between item discrimination power index, which was 27% between the lower (mean ± SD, 69.33 ± 21.20) and upper values (mean ± SD, 97.59 ± 1.76) (P < 0.001).

Confirmatory factor analysis: The structure of the scale designated by the exploratory factor analyses determined in both stages was assessed by the confirmatory factor analysis in the second stage including 484 people, which revealed the below-mentioned results,

In confirmatory factor analysis of the scale, the fit indices were found as:

CMIN/DF = 6.692, GFI = 0.809, AGFI = 0.763, RMR = 0.051, NFI Delta 1 = 0.861, TLI rho 2 = 0.864, CFI = 0.879, RMSEA = 0.108, AIC = 1212.975, CAIC = 1425.525, BIC = 1384.525, ECVI = 2.206, SRMR = 0.0449. Four modifications were made among the items in the confirmatory factor analysis of the scale. After establishing covariance analysis for correlated item term errors between the first and the second items in the factor "compliance with the collective rules" between the 11th and 12th items, 48th and 49th items, 16th and 17th items, 39th and 40th items, the fit indices were found as below:

CMIN/DF = 3.540, which shows moderate fit, [14] GFI = 0.888, which shows a poor fit [15]. AGFI = 0.858 shows acceptable fit [16], RMR = 0.043 shows a good fit [12], NFI Delta 1 = 0.928 shows acceptable fit [13], TLI rho 2 = 0.939 shows acceptable fit [17], CFI = 0.947 good fit [13], RMSEA = 0.072 good fit [18], AIC = 674.089, CAIC = 907.375, BIC = 862.375, ECVI = 1.393 all show acceptable fit [18], and SRMR = 0.0368 shows good fit.

CMIN/DF = 3.540, GFI = 0.888, AGFI = 0.858, RMR = 0.043, NFI Delta 1 = 0.928, TLI rho 2 = 0.939, CFI = 0.947, RMSEA = 0.072, AIC = 674.089, CAIC = 907.375, BIC = 862.375, ECVI = 1.393, SRMR = 0.0368 (Table 4).

3.2. Reliability of the scale:

Internal consistency: In the second stage of the study, the Cronbach's alpha value of the scale was 0.958 and Cronbach's Alpha if item deleted ranged between 0.952 and 0.958 (Table 5). The Spearman Brown coefficient equal length analysis for the internal consistency of the scale was 0.928.

Cronbach's alpha values for "compliance with collective rules" and "compliance with individual rules of hygiene" were 0.963 and 0.779, respectively. The scale consists of two subdimensions, the correlation between which were determined as r = 0.557, P < 0.001. The amount of points obtained from the scale increases with the score of compliance with the prevention recommendations.

Test-retest reliability: Test-retest, which is another method for evaluating reliability, was performed and the Scale of Compliance to Outbreak Prevention recommendations was reapplied to 78 participants randomly selected after two weeks. Fifty three (67.9%) of the participants were female, 25 (32.1%) were male, mean age ± standard deviation was 37.13 ± 10.56 in test-retest group [19].

The correlation of the total score of the scale between the first and second applications was evaluated with the Spearman correlation coefficient, which was 0.683. Whether there is a difference between two measurements performed at 2-week intervals was evaluated by Wilcoxon paired sample tests and no significant difference was found between the two measurements (P = 0.893).

Females were determined to better comply with the epidemic prevention recommendations. Compliance increased with education, and the older age group was not sensitive about complying with the measures. Although healthcare workers' compliance scale scores were higher, no statistically significant difference was found. Evaluation of the professions revealed that the students scored the lowest. Compliance in the private sector was also low. Those diagnosed with COVID-19 complied very well with the prevention recommendations, while the prediagnosis compliance status was unknown. The scores of the participants who followed the developments related to COVID-19 (such as the number of healed and deceased individuals) were significantly higher than those who did not. There was no difference between the Marmara region, where the outbreaks were most experienced in our country and the other regions, in terms of compliance with the prevention recommendations (Table 6).

In the 20-item scale, 14 items measure behavior, 3 items measure attitude, and 3 items measure knowledge. Items that measure knowledge in the scale are 1, 3, 4; items that measure attitude in the scale are 2, 10, 12; items that measure attitude in the scale are 5, 6, 7, 8, 9, 11, 13, 14, 15, 16, 17, 18, 19, 20. Adaptation behaviors may vary depending on the process of the outbreak. Therefore, without specifying a cut-off point, the scale is evaluated as compliance behaviors increase as the score increases.

Table 3. First and second stage factor analysis results.

No.	Items	Component N = 250		Component N = 484	
		1	2	1	2
1	40 [People without complaints of fever, respiratory distress, or cough can also carry the disease.]	1.006		0.916	
2	41 [We need to ventilate indoor environments frequently.]	0.984		0.983	
3	39 [Handshakes are risky during the outbreak.]	0.961		0.960	
4	38 [COVID-19 is transmitted by droplets scattered around during coughing, sneezing, and laughing]	0.929		0.864	
5	27 [During the outbreak, I wore a mask when going to venues like a marketplace or a market.]	0.841		0.802	
6	17 [I follow the suggestions of staying at home.]	0.821		0.752	
7	42 [I avoid social activities with other people due to the risk of transmission of the outbreak disease.]	0.805		0.773	
8	10 [I wear a mask when I go out to protect myself and the people around.]	0.799		0.699	
9	16 [After touching the objects I suspect to carry disease, I wash my hands with soap if possible, or use a disinfectant or cologne for hand hygiene.]	0.777		0.814	
10	12[I would be careful to eat separately from other individuals at home if I suspected the outbreak disease in myself.]	0.750		0.703	
11	43[I do not meet my friends face to face due to the risk of outbreak disease]	0.749		0.685	
12	11 [I would be careful to stay in a separate room or in a separate house from family members at home or other individuals if I suspected the outbreak disease in myself.]	0.745		0.734	
13	26 [In the course of the outbreak, I followed social distancing rules (three steps)]	0.691		0.730	
14	36 [I follow the news about the outbreak from the official website of the Ministry of Health or from their official statements.]	0.596		0.653	
15	1 [I wash my hands frequently with soap and water for at least 20 seconds.]	0.551		0.564	
16	5 [I pay attention to cleaning the frequently used surfaces like door handles, fixtures, sinks at home with water and detergent every day.]		0.892		0.907
17	9 [I take care not to share my personal belongings such as towels with other people at home.]		0.630		0.570
18	13 [I close my mouth with a disposable handkerchief while coughing and sneezing.]		0.577		0.546
19	3 [I avoid touching my eyes, face, mouth, and nose with my hands.]		0.555		0.461
20	28 [I take a bath as soon as I got home from places that were risky during the outbreak (hospital, marketplace, market, public transportation.]		0.413		0.568

Extraction method: Principal component analysis.
Rotation method: Oblimin with Kaiser normalization.

Table 4. Confirmatory factor analysis of compliance to outbreak prevention recommendations scale.

Compliance index	Ideal compliance	Acceptable compliance	Research findings	Interpretation
x^2	$0 \leq x^2/2df$	$2df \leq x^2/3df$	584.89	Rejection
P value	$0.05 \leq p \leq 1.00$	$0.01 \leq p \leq 0.05$	$P < 0.001$	
x^2/df	$0 \leq x^2/df \leq 2$	$2 \leq x^2/df \leq 5$	3.540	Acceptable
RMSEA	$0 \leq RMSEA \leq 0.05$	$0.05 \leq RMSEA \leq 0.08$	0.072	Acceptable
CFI	$0.97 \leq CFI \leq 1$	$0.95 \leq CFI \leq 0.97$	0.947	Acceptable
NFI	$0.95 \leq NFI \leq 1.00$	$0.90 \leq NFI \leq 0.95$	0.928	Acceptable
GFI	$0.95 \leq GFI \leq 1$	$0.90 \leq CFI \leq 0.95$	0.888	Poor fit
AIC	Lower than the independent model value		674.089	Acceptable
CAIC	Lower than the independent model value		907.375	Acceptable
ECVI	Lower than the independent model value		1.393	Acceptable

Table 5. Item-total statistics.

	Scale mean if item deleted	Scale variance if item deleted	Corrected item-total correlation	Squared multiple correlation	Cronbach's Alpha if item deleted
1	82.26	222.445	0.748	0.599	0.953
3	82.65	224.276	0.622	0.426	0.955
5	83.24	226.467	0.480	0.378	0.958
9	82.65	225.723	0.534	0.380	0.956
10	82.14	222.281	0.815	0.728	0.953
11	82.20	221.535	0.786	0.813	0.953
12	82.24	222.089	0.742	0.777	0.953
13	82.55	223.459	0.642	0.456	0.955
16	82.14	221.392	0.836	0.787	0.952
17	82.21	221.433	0.785	0.713	0.953
26	82.27	221.649	0.792	0.682	0.953
27	82.12	220.456	0.835	0.790	0.952
28	82.66	222.940	0.571	0.401	0.956
36	82.55	224.148	0.565	0.365	0.956
38	82.31	222.871	0.716	0.618	0.954
39	82.05	221.266	0.852	0.836	0.952
40	82.17	221.974	0.769	0.726	0.953
41	82.04	222.294	0.861	0.847	0.952
43	82.32	221.149	0.697	0.607	0.954
42	82.27	221.039	0.725	0.645	0.954

The scale scores a minimum of 20 and a maximum of 100 points.

The scale consists of two subdimensions. The "compliance with collective rules" subdimension consists of 15 items. Subdimension of "compliance with collective rules" measure knowledge, attitudes and behaviors related to the epidemic in the community, consist of nine items about behavior, three items about attitude, three items about knowledge. Subdimension of "compliance with individual rules of hygiene" measures to be taken individually, consists of five items about five behaviors (Appendix.1).

4. Discussion

This study was conducted during the COVID-19 outbreak and aimed to measure compliance with preventive measures.

First, a 66-item question pool was created by the research team, out of which a 43-item scale was obtained and validated with expert opinion and pilot applications [11]. In the first phase of the research, during the pilot study, it was applied to 250 people, approximately five times the number of items. During validity analysis, the scale consisting of 43 items transformed into one comprising 20 items. Determining the number of factors more or less may cause serious problems. When determining the subdimensions, the items with eigen values greater than 1 were used as factors [20]. Among items loaded onto more than one factor, those below 0.30 in the correlation table were eliminated [11].

The 20-item scale with construct validity was reexamined in a larger group (484 individuals) consisting of participants about 20 times the number of items. In the selection of the sample, care was taken to ensure diversity of variables such as different sex, education level and employment status. Since the outbreak is a threat to our entire country and everyone should take the same precautions, the universe was not limited, and the scale sent to everyone who could be reached through social media and messages. We managed to reach a wide audience from many provinces in Turkey. We think that reaching

Table 6. Distribution of scale scores according to sociodemographic features.

Variables	Median (IQR)	P
Sex		
Male	87.0 (77.0–94.0)	<0.001*
Female	92.0 (85.0–96.0)	
Marital status		
Married	92.0 (83.5–96.0)	0.172**
Single	90.0 (83.0–94.0)	
Divorced/widowed	91.0 (81.0–95.0)	
Children		
0 children	90.0 (83.0–95.0)	0.554**
1 child	92.0 (81.0–95.0)	
2 children	92.0 (85.0–95.0)	
3 and more children	92.0 (84.0–96.0)	
Level of education		
Elementary school	82.5 (20.0–94.0)	0.008**
Middle school	88.0 (82.75–94.0)	
High school	90.0 (83.0–94.0)	
Graduate degree	92.0 (84.0–96.0)	
Postgraduate degree	89.0 (81.0–94.0)	
Age		
18–29	90.0 (84.0–94.0)	0.012**
30–39	91.0 (83.0–95.0)	
40–49	90.0 (80.0–95.0)	
50–59	94.0 (87.5–97.5)	
60–70	83.0 (76.0–94.0)	
Whether the participant is a healthcare worker		
Healthcare worker	92.0 (84.0–96.0)	0.086*
Not a healthcare worker	91.0 (83.0–95.0)	
Profession		
Not working (retired, homemaker)	92.0 (84.0–97.0)	0.023**
Student	90.0 (83.0–93.0)	
Civil servant (such as a teacher)	92.0 (85.0–96.0)	
Civil servant (such as a healthcare worker)	92.0 (84.0–96.0)	
Private sector (engineer, lawyer)	87.5(80.0–94.25)	
Other	91.0 (81.25–94.0)	
Smoking		
Yes	91.0 (83.0–95.0)	0.857**
No, I never smoked	91.0 (83.0–95.0)	
No, I quit smoking	92.0 (83.0–96.0)	
Chronic diseases		
None	91.0 (83.0–95.0)	0.150*
One	92.0 (85.0–96.0)	
Two or more	87.0 (79.0–95.0)	
Region		
Marmara region	91.0 (84.0–95.0)	0.699*
Outside of Marmara region	90.0 (82.75–95.0)	
Referral to the doctor with suspicion of COVID-19		
Yes	92.0 (86.5–99.5)	0.073*
No	91.0 (83.0–95.0)	
Referral to the doctor with a disease other than COVID-19		
Yes	92.0 (85.0–95.0)	0.582*
No	91.0 (83.0–95.0)	

Table 6. (continued)

Variables	Median (IQR)	P
Someone close diagnosed with COVID-19 Yes No	 91.0 (84.0–96.0) 91.0 (83.0–95.0)	0.449*
A healthcare worker in the family Yes No	 92.0 (83.0–96.0) 90.0 (83.0–95.0)	0.139*
Separation from acquaintances Yes No	 91.0 (83.0–95.0) 91.0 (83.0–95.0)	0.958*
Diagnosed with COVID-19 Yes No	 98.0 (93.0–100.0) 91.0 (83.0–95.0)	0.003*
Referral to a psychiatrist No Yes, for the first time Yes, not for the first time	 91.0 (83.0–95.0) 90.0 (83.0–95.0) 90.0 (85.0–96.0)	0.752**
Following the news of healed and deceased number of individuals from COVID-19 Yes No	 91.0 (83.0–95.0) 87.0 (79.25–93.0)	0.004*

*The Mann–Whitney U; **Kruskal–Wallis tests.

a remarkably diverse audience is an advantage since compliance with outbreak prevention recommendations may be affected by personal and cultural differences. Owing to the sample age range (18–70), this study can be used in further studies (18–70). This was thought to contribute positively to the validity of the scale [20]. Before factor analysis was performed to evaluate the structural validity of the scale, Kaiser–Meyer–Olkin and Barlett analysis were performed, which revealed a KMO value of 0.958, and it was concluded that the sample was sufficient and the data was suitable for further analysis. KMO values between 0.90–01.00 are considered highly sufficient. Bartlett Sphericity test showed that the scale had at least two subdimensions and included correlation levels to reflect a certain structure among the items. The data used in the research were interrelated and found suitable for factor analysis [11].

Then, Exploratory Factor Analysis was performed to determine the structural validity of the scale. "Basic components" analysis was chosen as the factor determination method and one of the oblique rotation techniques, "Direct Oblimin" technique was used. Exploratory factor analysis revealed 68.538% variance explanation in the first stage and 63.434% in the second. A variance explanation value of 0.50–0.70 in the factor analysis is deemed sufficient [11].

The factor loads of "compliance with collective rules" and "compliance with individual rules of hygiene" subdimensions ranged between 0.916–0.564 and 0.907–0.568, respectively, as determined with "Direct Oblimin with Kaiser normalization". All these results show that the structural validity of the scale is sufficient [11].

Item discrimination was valid in the upper-lower group discriminatory analysis. A significant difference found in this analysis proves the discriminatory properties of the items in a scale.

In confirmatory factor analysis of the scale, the fit indices were found as:

CMIN/DF which shows moderate fit [14], GFI which shows a poor fit [15], AGFI shows acceptable fit [16], RMR shows a good fit [12], NFI Delta 1 shows acceptable fit [13], TLI rho 2 shows acceptable fit [17], CFI shows good fit [21], RMSEA shows good fit [15], AIC, CAIC, BIC, ECVI all show acceptable fit [18], and SRMR shows good fit [18].

A high correlation between the subdimensions is not favored in scales [9]. In this study, the correlation between the two subdimensions was determined as < 0.60.

Reliability analysis of the scale was conducted on 20 items obtained after item eliminations in the factor analysis. The Cronbach alpha values were 0.965 and 0.958 in the reliability analyses performed on 250 and 484 individuals, respectively, and whether there was any item that would increase reliability if removed from the scale was investigated. No such item was identified, and the scale was preserved as is. In this case, the Cronbach Alpha value is above 0.80, which is considered to have high

reliability with a value of 0.956. Split half reliability shows the correlation coefficient between the two variables obtained by summing the items in the two equivalent halves of the scale. Values of 1 and very close to 1 indicate a perfect fit [11]. There was no statistically significant difference between the total scores of the scale performed on 78 people at two-week intervals as determined with the test-retest method to assess the temporal consistency [11].

It has been shown that the scale prepared in this study and its subdimensions can be used as a unique scale in determining the level of compliance with outbreak-related prevention recommendations. One of the strengths of this study is that it has been developed in accordance with the rules of scale development since the beginning, and it is a scale suitable for our own society and language. Another strong aspect of the study is that it was conducted with approximately twice the number of people predicted during the validity phase of the study. The widespread use of the scale will also be useful in terms of comparability of different research results. Although the scale was developed in Turkish, it can be adapted and used in countries with similar action recommendations in terms of cultural, social and linguistic aspects during the outbreak that surrounded the whole world. It is a scale that has the potential to be used by people living abroad and speaking Turkish. In this context, a platform can be established where international joint research, development and prevention activities related to compliance with outbreak precaution recommendations can be carried out. It can raise awareness about the importance and necessity of precautionary activities while applying the scale in society.

As a limitation, the scale can be counted as using the Google questionnaire, so only the smartphones owners participated in the study. Also, the sex distribution of the participants was not similar, as participation was on a voluntary basis. The high number of educated population in the study can be considered as a limitation. There is a need for validity and reliability studies in groups with low education levels.

5. Conclusion

The scale of compliance with the Outbreak Prevention Action Recommendations, consisting of 20 items and two subdimensions, was proven valid and reliable. It can be used as a tool to compare differences between the sexes, age groups and regions during the outbreak process and observe differences with time.

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Table S1. Covid-19 salginini önleme tavsiyelerine uyum ölçeği.

Maddeler		Tamamen katılmıyorum	Katılmıyorum	Kararsızım	Katılıyorum	Tamamen katılıyorum
1	Ateş, solunum sıkıntısı, öksürük şikayeti olmayan kişiler de hastalığı taşıyabilir.					
2	Bulunduğumuz kapalı ortamları sık sık havalandırmalıyız.					
3	Salgın döneminde el sıkışmak risklidir.					
4	Covid 19 öksürme, hapşırma, gülme ile ortama saçılan damlacıklar yolu ile bulaşır.					
5	Salgın sürecinde pazaryeri, market gibi yerlere giderken maske takarım.					
6	Evde kalma önerilerine uyuyorum.					
7	Salgın hastalık bulaşma riski nedeniyle diğer insanlarla bir arada yapılan sosyal aktivitelerden kaçınıyorum.					
8	Kendimi ve çevredeki kişileri korumak için dışarı çıkarken maske takıyorum.					
9	Hastalık etkeni olduğundan şüphelendiğim nesnelere dokunduktan sonra mümkünse ellerimi sabunla yıkıyorum, mümkün değilse dezenfektan ya da kolonya kullanarak el temizliğimi sağlıyorum.					
10	Kendimde salgın hastalıktan şüphelenseydim evdeki diğer bireylerden ayrı yemek yemeye özen gösteririm.					
11	Salgın hastalık bulaşma riskinden dolayı arkadaşlarımla yüz yüze görüşmüyorum.					
12	Kendimde salgın hastalıktan şüphelenseydim evdeki aile bireyleri ya da diğer bireylerden ayrı odada ya da ayrı evde kalmaya özen gösteririm.					
13	Salgın sürecinde sosyal mesafe (üç adım mesafe) kurallarına uydum.					
14	Salgınla ilgili haberleri Sağlık Bakanlığı'nın resmi internet sayfasından ya da yine bakanlığın resmi açıklamalarından takip ediyorum.					
15	Ellerimi sık sık su ve sabunla en az 20 saniye boyunca ovarak yıkıyorum.					
16	Evde kapı kolları, armatürler, lavabolar gibi sık kullanılan yüzeylerin su ve deterjanla her gün temizlenmesine dikkat ediyorum.					
17	Havlu gibi kişisel eşyalarımı evdeki diğer kişilerle ortak kullanmamaya dikkat ediyorum.					
18	Öksürüp aksırırken ağzımı tek kullanımlık mendille kapatıyorum.					
19	Ellerimle gözüme, yüzüme, ağzıma ve burnuma dokunmaktan kaçınıyorum.					
20	Salgın sürecinde riskli olan (hastane, pazaryeri, market, toplu taşıma araçları gibi) yerlerden eve gelir gelmez banyo yapıyorum.					