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Adaptation and psychometric evaluation of the COVID-19 stress scales in Turkish sample

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Abstract: This study aimed to adapt the COVID-19 Stress Scales (CSS) into Turkish and provide evidence for construct validity. For this purpose, firstly, Confirmatory factor analysis (CFA) was applied for the 5-factor model obtained during the development of CSS and the theoretically expected 6-factor model with total of 546 respondents. The findings revealed that the 6-factor model of CSS had a better fit in the Turkish sample. Factor loadings varied between .62 - .95 and correlations between subscales were between .44 - .76. Cronbach's Alpha and McDonald's ω coefficients for each subscale indicated good-to-excellent internal consistency. To evaluate the criterion-related validity, the Turkish version of The Fear of COVID-19 Scale (FCV-19S) was administered to the participants and the correlation coefficients between this scale and the six subscale of CSS were calculated. We also conducted the Rasch analysis with related items to provide psychometric evidence for their unidimensional structure of each of the six subscales. Lastly, Differential item functioning (DIF) analysis was performed across subgroups by gender, having COVID-19, and being a student. Overall, the results of both CFA and Rasch analyses provided evidence to support the substantive aspect of validity and the appropriateness of the CSS as a measure of COVID-19 stress level in a Turkish sample.

1. INTRODUCTION

World Health Organization (WHO, 2020) announced COVID-19 as a novel coronavirus disease outbreak of international importance in January 2020, shortly after the first case in Wuhan, China, and subsequently declared it a pandemic in March 2020. With this announcement, WHO (2020) made a statement based on the experiences from the previous pandemics, emphasizing that individuals may suffer from stress and mental health problems.

The COVID-19 pandemic has been affecting individuals' mental health since its beginning. While the virus has been spreading worldwide, people's fear of contracting the disease and dying has increased (Valiente et al., 2021). However, getting the disease and dying have not been the only sources of people's fear and anxiety during the pandemic. Various stressors that may affect individuals economically and socially have emerged, including economic problems

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due to loss of employment or changes in work life, loved ones' health problems and the possibility of losing them, being socially labeled, and experiencing social exclusion due to catching the disease, restriction of freedom, and staying away from loved ones due to being kept in quarantine or social isolation. The collapse of the health system and scarcity of food and other necessities are among the stress sources of the COVID-19 pandemic that may have long-term effects (Liu et al., 2021; Mertens et al., 2020; Porcelli, 2020; Wang et al., 2021).

Theoretical and empirical studies have confirmed that stress and anxiety due to COVID-19 have a strong association with emotion and behavior problems, such as dis-functionality, depression, health anxiety (Gallagher et al., 2020; Mertens et al., 2020); generalized anxiety disorder and death anxiety (Lee et al., 2020); obsessive-compulsive disorder (Seçer & Ulaş, 2020); post-traumatic stress disorder (Boyraz & Legros, 2020); eating disorder (Baenas et al., 2020); panic buying and coping challenges (Taylor et al., 2020a) and sleeplessness and acute stress (Wang et al., 2021). The studies also revealed that COVID-19 related anxiety and stress have a more severe effect on those who already had a mental problem before the pandemic. For example, Asmundson et al. (2020) showed that individuals who had anxiety or mood disorders showed the symptoms of psychological distress, xenophobia, and traumatic stress to a greater extent compared to those who did not have anxiety or mood disorders. This study points out that the stress and anxiety associated with COVID-19 may increase the vulnerability of individuals to various mental health disorders and behavioral problems.

Research has demonstrated a high prevalence of mental health problems worldwide due to COVID-19. For example, a study with about 53,000 participants in China indicated that 35% of the participants experienced psychological distress (Qiu et al., 2020). In Italy, 27% of the participants had high stress levels, 32% had high depression levels, and 18% had high anxiety levels (Mazza et al., 2020). A study in Spain reported that 22.1% of the participants had depression, and 19.6% had anxiety. Later studies reported increases in these percentages compared to former studies (Valiente et al., 2021).

Furthermore, a meta-analysis of twelve large-scale studies showed that the pooled prevalence of depression was 25% during the COVID-19 outbreak (Bueno-Notivol et al., 2021). Finally, another study revealed that 16% of the participants had COVID-19 related stress syndrome at a level requiring mental health services (Taylor et al., 2020a). These results demonstrated the severity of the negative effects of COVID-19 on mental health.

Both mental health professionals and World's governments have essential duties to prevent or minimize the mental health and behavioral problems due to COVID-19 related stress and anxiety (Wang et al., 2020). Therefore, the first step is to examine people's COVID-19 related stress and anxiety levels and evaluate their change over time at specific sessions. In addition, when the COVID-19 outbreak will end is uncertain. Hence, people's hope that the COVID-19 outbreak will end is gradually decreasing while their anxiety and stress levels are increasing (Bernardo & Mendoza, 2020). Moreover, it is predicted that the effects of economic and social problems caused by the outbreak will continue for a long time, even after the pandemic (Gavin et al., 2020; Valiente et al., 2021). Hence, COVID-19 will certainly threaten individuals' physical and mental health for a while. In this sense, while the outbreak continues to develop and progress, the potential effects of factors specific to COVID-19 on mental health should be constantly monitored (Gallagher et al., 2020). As a result, we need valid and reliable measurement instruments to assess COVID-19 related stress and anxiety.

Various instruments assessing COVID-19 related stress and anxiety have been developed shortly after the emergence of the outbreak. One of these was The Fear of COVID-19 Scale (FCV-19S), developed by Ahorsu et al. (2020). The scale has seven items and a single factor. The FCV-19S was originally developed in Iran, and it was adapted to Turkish by Satici et al. (2020). Another scale was Coronavirus Anxiety Scale (CAS), containing five items measured by a single factor. Developed by Lee (2020), the scale assesses individuals' dysfunctional anxiety levels, and two different research teams adapted it to Turkish (see, Biçer et al., 2020; Evren et al., 2020). Finally, COVID-19 Stress Scales (CSS) was developed by Taylor et al. (2020b) using Canadian and US samples to better understand COVID-19 related distress. CSS comprises 36 items and five factors. It was previously adapted for use with Persian (Khosravani et al., 2021) and Arabic (Abbady et al., 2021) populations.

Selecting the most appropriate instrument that researchers and mental health practitioners can use to identify the COVID-19 related stress and anxiety levels and support the aims of their studies is of particular importance in research. Pakpour et al. (2020) stated that FCV-19S is more advantageous when data need to be collected in a short time since it is a single factor instrument with few items. However, CSS would be more appropriate for assessing individuals' anxiety and stress levels more comprehensively. Taylor et al. (2020b) mentioned that they developed CSS because no other comprehensive instrument existed to measure COVID-19 related distress symptoms, such as fear of being infected, fear of contacting things and surfaces, xenophobia towards people who may have an infection, fear due to socio-economic results of the outbreak, traumatic stress symptoms, and compulsive checking and reassurance-seeking about possible threats related to the pandemic.

In conclusion, various scales are available to measure COVID-19 related stress and anxiety symptoms in Turkish culture; however, none of them comprehensively assess individuals' COVID-19 related stress and anxiety levels. Most of the previous scale validation studies on COVID-19 related stress scale validation studies have been conducted using only factor analytic methods (Abbady et al., 2021; Khosravani et al., 2021; Taylor et al., 2020b). Thus, the purpose of the current study was to address these two gaps in the literature by adapting the CSS (Taylor et al., 2020b) into the Turkish language (CSS-T) using confirmatory factor analysis (CFA) and Rasch analysis. Several other psychometric properties of the Turkish version of CSS were also examined. To this end, the present study examined the following research questions:

1. Does CSS-T yield sufficient validity evidence supported by Rasch model and CFA?
2. Do CSS-T items function differently for persons who have been tested positive for COVID-19?
3. Do CSS-T items function differently across gender groups?
4. Do CSS-T items function differently between students and non-students?

2. METHOD

2.1. Sample

A total of 546 adult volunteers participated in an online survey through a non-probability convenience sampling. The survey included demographic questions, questions about the participants' COVID-19 history, and CSS-T. After the Anadolu University ethics committee approved the project, the survey was disseminated using different platforms, such as cell phones, e-mails, and social networks (e.g., Twitter). The data were collected from participants located in different regions of Turkey in the same month, from March 16 to April 2, 2021. Based on the boxplot created to detect outliers, one participant was removed, and the analyses were conducted with 545 participants. Respondents were 18 to 64 years of age (M = 30.1 years, SD = 9.8). Most participants (69.9%) were women. About half of the participants were students (50.6 %).

Furthermore, 13.95% stated that they had previously tested positive for COVID-19. Twelve percent of the participants answered "no" to whether there is anyone other than themselves who has tested positive for COVID-19 in their family, relatives, friends, or family friends. Twenty-two percent stated that someone in their nuclear family had this disease. Sixty-six percent of them stated that their close relatives, family friends, or friends had this disease. The descriptive information of the respondents is presented in Table 1.

Table 1. *Demographics of the participants.*

Age ($\overline{X}$)	Gender		Student Status		COVID-19 History		Infected People in Your Close Circle?	
	Female	Male	Student	Non-Student	Yes	No	Yes	No
30.1 (SD=9.8)	69.9%	%0.1%	50.6%	49.4%	13.95%	86.05%	12%	88%

2.2. Instrument

2.2.1. *Demographic Information*

The demographic questionnaire contained items assessing the participants' age, gender, student status, and COVID-19 history. Items assessing COVID-19 history inquired about whether the participants themselves tested positive for COVID-19 disease. Subsequent questions asked whether someone in their nuclear family had COVID-19 and whether other relatives, family friends, or friends had this disease.

2.2.2. *The COVID-19 Stress Scales (CSS)*

The CSS is a self-report measure developed by Taylor et al. (2020b) to measure COVID-19 related stress symptoms and based on five factors associated with perceived threat and fear of disease. The first 24 items of the 36-item scale evaluate the extent to which individuals have experienced various kinds of worries over the last seven days on a 5-point scale ranging from "not at all" to "extremely." Five of the remaining items assess the frequency with which they have experienced the situations described by the items in the last seven days, and seven items measure the frequency with which they have experienced the situations mentioned in the items in the last seven days. These 12 items were also rated on a 5-point scale ranging from "never" to "almost always."

CSS theoretically consists of six domains, the dangerousness of COVID-19 (danger), fears about sources of COVID-19-related contamination (contamination), COVID-19-xenophobia (xenophobia), fears about the personal social and economic consequences of COVID-19 (socio-economic consequences), COVID-19-related checking (compulsive checking), and traumatic stress symptoms related to COVID-19 (traumatic stress), assessed with six items. On the other hand, a parallel analysis conducted through the same measurement tool revealed five factors in a Canadian sample revealed five factors (Taylor et al., 2020). Specifically, danger and contamination loaded on the same factor, while all other items worked theoretically as expected. The researchers preferred to preserve all 12 items underlying the two factors instead of reducing the number of items. The authors explained that keeping the number of items for each domain would allow subsequent studies to measure them separately (Taylor et al., 2020b). The researchers concluded that the theoretically expected 6-factor model should also be tested together with the 5-factor model in future studies.

In a follow-up study, the 5-factor structure was tested in the US sample (Taylor et al., 2020b). The fit statistics for the CFA were acceptable, RMSEA = .05, SRMR = .042, CFI = .93, and it was concluded that the model fit the data well. Internal consistency values, assessed by Cronbach's alpha, were above .80 for all subscales of the scale in both samples.

To determine the convergent validity, Taylor et al. (2020b) examined the correlations between the subscales of the CSS and pre-COVID health anxiety, obsessive-compulsive checking, and contamination symptoms. Moderate significant correlation coefficients supported the convergent validity of the CSS. First, for discriminant validity, the correlations of five CSS subscales with the social desirability scale were all close to 0. On the other hand, correlations between most CSS subscales and current anxiety were significantly higher compared to correlations with current depression, supporting the discriminant validity of CSS.

To validate the Turkish version of the CSS, the existing translation that take place in the developers' web page (Psychology of Pandemics Network, n.d.) was examined first. However, since this translated version had many misconceptions, we decided to translate the CSS again with the permission of the scale developers. Two psychometricians and a psychological counselor who were the primary investigators of this study carried out the translation process. The researchers first translated the original version into Turkish independently, and subsequently, they came together and tried to reach an agreement on the different translated items. An English language expert was consulted for items that could not be agreed upon. This expert was given the original version of the articles, the researchers' translations, and the issues with which they disagreed. The translation was finalized according to this expert's opinions. A Turkish language expert also approved the resulting CSS-T.

2.3. Data Analysis

The analyses to determine the validity of the CSS-T in the Turkish sample were carried out in two parts. The CFA was conducted first to compare the fit indices for the theoretical 6-factor model of the scale and the 5-factor model obtained during the development phase. The goodness-of-ft indices were based on conventional guidelines introduced by Hu and Bentler (1998). We used Hu and Bentler's (1999) empirically derived cut-off values to interpret whether a given factor model fit the data well. Accordingly, RMSEA < .06, SRMR < .08 and CFI & TLI > .90 were interpreted as good fit values. CFAs were performed with Mplus 7.0 (Muthen & Muthen, 2017). To establish the criterion-related validity, a one-dimensional Fear of COVID-19 Scale (FCV-19-S) developed by Ahorsu et al. (2020) and adapted into Turkish by Satici et al. (2020) was used. The correlations between the FCV-19-S and each subscale of CSS-T supported the CSS-T's criterion-related validity.

To determine internal consistency, Mc Donald's Omega was reported for each dimension along with Cronbach's Alpha. Stratified Alpha coefficient was also reported for the entire scale.

Another round of Rasch analyses was conducted to determine which items contribute to measurement of the scale dimensions identified through CFA. Analyses were conducted for each dimension separately. Construct unidimensionality was also checked for each dimension before proceeding to other Rasch-related analyses. A principal components analysis (PCA) of standardized residual correlations was conducted to determine if the extra variance was explained after the Rasch construct was extracted. The Rasch construct should account for at least 40% of the total variance, and the value of the first contrast in the "unexplained variance" (residual variance) should be less than or equal to 2.0 (Linacre, 2004).

We also evaluated the CSS-T using the following rating scale guidelines suggested by Linacre (1999, 2004).

#1: At least ten frequencies should be observed for each category.

#2: Observation distribution should be regular.

#3: Average measures should advance monotonically with each category.

#4: Outfit mean-squares should be less than 2.0.

#5: Step calibrations should advance monotonically with each category.

#6: Ratings should imply measures, and measures should imply ratings.

#7: Step difficulties should advance by at least 1.4 logits and by less than 5.0 logits.

WINSTEPS Version 3.68.2 software (Linacre, 2009) was used to analyze Likert-type responses by calibrating a Rasch Rating Scale model (Andrich, 1978). The response distribution of the 36 items across six agreement options and their association with overall item variance (i.e., point-biserial correlation [PTMEA]) were analyzed. PTMEA correlations should all be positive and higher than .50. In addition to response category frequencies and distributions, the Rasch model was used to estimate item location parameters, step parameters, average measures, and fit statistics to evaluate the first five criteria of Linacre's guideline. Two item fit values (outfit and infit mean square statistics) were examined to determine which items should be flagged for revision due to misfit between items and the Rasch model (Bond & Fox, 2007; Sick, 2010). The acceptable range for infit (information-weighted fit) or outfit (outlier-sensitive fit) mean square statistics included values between 0.5 and 1.5 (Linacre, 2004; Sick, 2010). The values within this range indicate the fit between the item and model. Values below 0.5 may indicate less productive items, and items with values greater than 1.5 may indicate unproductive measurement construction. Person and item reliability indices along with separation indices were computed to determine the internal consistency of ratings. The "person reliability" obtained from WINSTEPS is equivalent to the traditional "test" reliability. Low values of the person and item reliability statistics may indicate a narrow range of person and item measures, respectively. Reliability values greater than .80 and separation indices greater than 2.0 are considered adequate (Crocker & Algina, 1986).

An item/person map (aka Wright map) was also created for each dimension to examine the item severity. This map shows the relationships between respondents' abilities (on the left side) and item difficulties (on the right side) on a linear scale in a unit logit to help us see whether the item difficulties were appropriate for the targeted respondents. Finally, differential item functioning (DIF) analyses were employed to examine the functioning of items across subgroups, including respondents' gender, student status, and COVID-19 history (having COVID-19 or not). When assessing DIF, two values (DIF contrast and *p*-value) were used to assess whether an item can be flagged as showing significant DIF. DIF contrast is calculated by taking the difference in item locations (item difficulty) between subgroups. Values greater than 0.5 logits may indicate a DIF situation (Linacre, 2006; Bond and Fox, 2015). The Rasch-Welch and the Mantel-Haenzsel tests that are available in WINSTEPS software can be used to obtain a *p*-value for DIF analysis. Due to many items being compared, alpha (set at .05) was controlled when making comparisons using a Bonferroni correction. Therefore, *p*-values had to be less than .008 (i.e., .05 divided by six items) with a contrast greater than 0.5 logits to show evidence of DIF.

3. RESULT / FINDINGS

3.1. CFA and Criterion Related Validity Results

To evaluate the construct validity of CSS-T, the fit values of the theoretically predicted 6-factor model and the fit values of the 5-factor model obtained during the development process were compared. Since maximum likelihood (ML) requires multivariate normality assumption to be met, robust-maximum likelihood (MLR) was used as the estimator. The results obtained are shown in Table 2.

Table 2. *Fit indices obtained for five- and 6-factor model.*

Model Solution	Modification Status	RMSEA	CFI	TLI	SRMR
5 Factors	Before Modification	.082 (.078 -.085)	.829	.816	.064
	After Modification	.063 (.060 .067)	.898	.889	.057
6 Factors	Before Modification	.072 (.069 .075)	.869	.857	.058
	After Modification	.056 (.053 .059)	.921	.913	.047

*Applied modifications: 3-4; 7-8; 22-23

As shown in Table 2, the values obtained for the 6-factor model were slightly better, but the fit indices obtained for both structures were not acceptable. Therefore, three theoretically valid modifications based on correlating the error terms that significantly reduced the chi-square value in both models were conducted. These items, which are very similar in expression, are indicated at the bottom of the table. Item 3 and Item 4 assess worries about the healthcare system (Item 3: "I am worried that our healthcare system won't be able to protect my loved ones;" Item 4: "I am worried that our healthcare system is unable to keep me safe from the virus."). Item 7 and Item 8 assess worries about grocery stores (Item 7: "I am worried about grocery stores running out of food;" Item 8: "I am worried that grocery stores will close down."). Finally, Item 22 and Item 23 assess monetary transactions (Item 22: "I am worried about taking change in cash transactions;" Item 23: "I am worried that I might catch the virus from handling money or using a debit machine."). While only SRMR indicated that the 5-factor model had a good fit after modification, all fit indices obtained for the 6-factor model had good fit values when the same modifications were applied. These findings confirmed the theoretical 6-factor model of CSS-T in the Turkish sample. The results for the 6-factor model are given in Appendicies. Factor loadings are between .62 - .95 (see Table 1A in Appendices), and correlations between subscales are between .44 - .76 (see Table 2A in Appendices).

Cronbach's Alpha and McDonald's ω coefficients for each CSS-T subscale are shown in Table 3. As shown, all values are greater than .80, indicating good-to-excellent internal consistency (Tavakol & Dennick, 2011). Stratified Alpha calculated for the whole scale is .97.

Table 3. *Internal consistency measures of CSS-T.*

Subscale	Cronbach's Alpha	Mc Donald's ω
COVID Danger (D)	.87	.85
COVID Socio-Economic Consequences (SEC)	.91	.91
COVID Xenophobia (X)	.93	.93
COVID Contamination (C)	.93	.93
COVID Traumatic Stress (TS)	.92	.92
COVID Compulsive Checking (CH)	.89	.89

To evaluate the criterion-related validity of CSS-T, the Turkish version of unidimensional FCV-19-S was administered to the participants. The correlation coefficients between this scale and the six subscale of CSS-T were calculated. Accordingly, five of the CSS-T subscales showed a moderate and statistically significant relationship with FCV-19-S and a relatively stronger relationship between Traumatic Stress. The obtained results support CSS-T's criterion-related validity.

3.2. Rasch Analysis

We also conducted Rasch analysis for each subscale's items to provide additional psychometric evidence for unidimensional structures. The Rasch analysis enables us to obtain different information that cannot be obtained with CFA. The Rasch analysis process included the evaluation of the rating scale functioning analysis, item fit, reliability, dimensionality, and differential item functioning analysis.

Table 4. *Dimensionality results.*

	D	SEC	X	C	TS	CH
Raw variance explained by measures	11.9 (66.4%)	7.5 (55.4%)	15.3 (71.9%)	13.3 (68.8%)	10.2 (63.1%)	7.2 (54.7%)
Raw variance explained by persons	7.3 (40.6%)	5.4 (40.0%)	10.6 (49.8%)	9.5 (49.5%)	5.5 (33.8%)	3.7 (28.0%)
Raw Variance explained by items	4.6 (25.8%)	2.1 (15.4%)	4.7 (22.1%)	3.7 (19.3%)	4.8 (29.3%)	3.5 (26.7%)
Raw unexplained variance (total)	6.0 (33.6%)	6.0 (44.6%)	6.0 (28.1%)	6.0 (31.2%)	6.0 (36.9%)	6.0 (45.3%)
Unexplained variance in 1st contrast	1.5 (8.5%)	2.0 (14.7%)	1.8 (8.4%)	2.5 (13.1%)	1.5 (9.0%)	2.2 (16.8%)
Unexplained variance in 2nd contrast	1.4 (7.7%)	1.2 (9.1%)	1.2 (5.7%)	1.2 (6.1%)	1.4 (8.5%)	1.8 (13.7%)

Note. D = Danger, SEC = Socio-Economic Consequences, X = Xenophobia, C = Contamination, TS = Traumatic Stress, CH = Compulsive Checking

3.2.1. *Dimensionality analysis*

For the present investigation, the dimensionality of six individual CSS-T subscales was assessed first by employing a PCA of standardized residual correlations. Individual PCAs were performed to determine whether another dimension is present in the residuals after estimating the primary measurement dimension. The amount of variance explained by each extracted principal component was computed based on separate PCAs, which is presented in Table 4 for each subscale. In all instances, the Rasch construct explained more than 50% of the variance. As shown in Table 4, the variance explained by the six subscales of CSS ranged from 54.7% (Compulsive Checking) to 71.9% (Xenophobia), just meeting the recommended level. The variance explained by the persons ranged from 28.0% to 49.8%, and the variance explained by the items ranged from 15.4% to 29.3%. In all instances, the eigenvalues of the first contrast were between 1.5 and 2.5. Only two subscales had values (2.2 and 2.5) greater than 2.0. These are above the cut-off value (i.e., 2.0) but not substantially higher than 2.0. The unexplained variances in the first extracted component were higher than the recommended lower bound of 5% for all subscales and less than 15%, except for Compulsive Checking. Dimensionality analyses showed that all six subscales had >50% of the variance explained by the Rasch dimensions, and that first contrasts of four subscales had eigenvalues less than 2. Therefore, it is concluded that all subscales could be considered as unidimensional.

3.2.2. *Reliability analysis*

Consistency and spread of persons or items on the measured variable were evaluated with reliability and separation indices. These measures were used to examine the degree to which measures are reproducible. Two different reliability and separation indices were estimated for each subscale, as presented in Table 5.

Table 5. *Reliability and separation estimates.*

Scale	Real Reliability	Model Reliability	Real Separation	Model Separation
D				
Persons	.85	.87	2.37	2.54
Items	.99	.99	8.22	8.79
SEC				
Persons	.70	.71	1.51	1.58
Items	.96	.96	5.11	5.17
X				
Persons	.84	.86	2.32	2.51
Items	.99	.99	12.32	12.77
C				
Persons	.88	.90	2.72	2.95
Items	.99	.99	8.38	8.68
TS				
Persons	.82	.85	2.14	2.34
Items	.99	.99	11.20	11.49
CH				
Persons	.81	.83	2.05	2.22
Items	.98	.98	7.64	7.79

Real reliability refers to reliability at its worst. Model reliability refers to reliability at its best. True reliability falls somewhere in between. As shown in Table 5, model reliability estimates ranged from .71 to .99, while real reliability estimates varied between .70 and .99. Item reliability estimates were found to be higher than person reliability estimates (see Table 5). Socio-Economic Consequences appeared to have the smallest person and item reliability estimates. The item reliability values in Table 5 indicate high internal consistency, while person reliability values indicate moderate consistency, except for Socio-Economic Consequences. As shown in Table 5, separation estimates for persons ranged from 1.51 (Socio-Economic Consequences) to 2.72 (Contamination). Item separation estimates varied between 5.11 (Socio-Economic Consequences) and 12.32 (Xenophobia). Item separation indices were higher than person separation indices. Except for Socio-Economic Consequences, person separation estimates indicated a reasonable spread and the scale's ability to separate persons into different levels of ability. According to Bond and Fox (2015), an instrument with separation estimates greater than 1.0 can be considered minimally useful. All item and person separation measures exceeded cut-off in this study, indicating a sufficient spread of items across subscales.

3.2.3. *Rating scale category effectiveness*

Rasch-based estimates were computed to determine whether the rating scales are functioning properly according to Rasch model assumptions. Table 6 shows the rating scale's effectiveness, including the frequency and percentage values for each rating scale category and the scale's inferential values such as infit and outfit, mean-square fit statistics, structure calibration, and category measure.

Table 6. *Rating scale effectiveness.*

Category	Count	%	Infit MNSQ	Outfit MNSQ	Structure Calibration	Category Measure
D						
1	452	16	1.38	1.40	NONE	-3.03
2	595	21	0.76	0.77	-1.75	-1.29
3	660	23	0.89	0.94	-0.56	0.00
4	617	22	0.84	0.87	0.57	1.30
5	532	19	1.06	1.05	1.73	3.02
SEC						
1	704	33	1.03	0.98	NONE	-3.44
2	842	39	0.73	0.82	-2.26	-1.31
3	379	18	0.95	1.04	-0.15	0.23
4	148	7	0.97	1.07	0.89	1.39
5	75	3	1.49	1.80	1.51	2.90
X						
1	936	32	1.01	1.01	NONE	-3.62
2	787	27	0.81	0.80	-2.39	-1.68
3	628	22	0.89	0.99	-0.82	0.04
4	341	12	0.97	1.00	0.94	1.68
5	206	7	1.54	1.56	2.28	3.54
C						
1	191	7	1.24	1.26	NONE	-4.27
2	502	18	0.96	0.94	-3.10	-2.04
3	740	26	0.97	1.02	-0.88	-0.02
4	934	33	0.84	0.86	0.84	2.04
5	501	17	1.08	1.05	3.14	4.31
TS						
1	732	24	1.14	1.14	NONE	-2.69
2	625	20	0.87	0.84	-1.31	-1.19
3	658	22	0.95	0.91	-0.65	-0.11
4	664	22	0.84	0.86	0.23	1.14
5	381	12	1.16	1.11	1.73	2.98
CH						
1	452	16	1.38	1.40	NONE	-3.03
2	595	21	0.76	0.77	-1.75	-1.29
3	660	23	0.89	0.94	-0.56	0.00
4	617	22	0.84	0.87	0.57	1.30
5	532	19	1.06	1.05	1.73	3.02

Counts and percentages were investigated to determine the extent to which survey respondents utilized the various rating scale categories. Infit and outfit mean square (MNSQ) fit statistics are used to determine if any rating scale category is "noisy" or produces calibrations that are not desirable for a productive measurement value. Structure calibration shows the transition between categories and how difficult it is to observe each category. As shown in Table 6, most of the criteria proposed by Linacre (2002) appeared to hold for the current scale: (a) each response category had a frequency count greater than 10, (b) average measures by each rating scale category advanced from smallest to largest, (c) most response categories (except for Xenophobia and Contamination) had outlier- outfit MNSQ values less than 2, (d) step calibrations (distance between ratings) increased monotonically, and (e) advance in step difficulties between step calibrations were at least one logits (for a five-category rating scale) and less than five logits. Based on the collective evidence, we can conclude that the scale is functioning properly.

3.2.4. *Item fit*

Item quality of each subscale was investigated with several item parameter estimates as presented in Table 7, including item difficulty calibrations, standard errors, fit statistics (infit and outfit), and point–measure correlations. As can be seen in Table 7, item difficulty calibrations ranged from −0.82 to 0.78 logits for Danger, from −0.82 to 0.78 logits for Socio-Economic Consequences**,** from −1.30 to 1.25 logits for Xenophobia, from −1.15 to 0.81 logits for Contamination, from −0.71 to 1.04 logits for Traumatic Stress and from −0.68 to 0.58 logits for Compulsive Checking. These ranges indicated a good amount of spread in the item locations, which is desirable for Rasch measurement scales to cover the full theoretical range of the construct's continuum. Standard errors ranged in size from 0.05 to 0.08. Concerning the present data, the estimated infit and outfit MNSQ values were within the acceptable range, ranging from 0.52 to 1.55 (Table 7). As shown in Table 7, only two items measuring Danger and Xenophobia (Items 13 and 30) were identified as misfitting (infit MNSQ values >1.5, Wright & Linacre, 1994). The remaining 34 items fit the criteria for noise-free calibrations. All the infit MNSQ values were within the suggested guidelines, illustrating an acceptable fit to the Rasch RSM. Infit is a weighted index while the outfit is unweighted. Thus, large outfit values are generally considered less problematic than large infit values (Bond & Fox, 2007). As shown in Table 7, point–measure correlations ranged from .68 to .89. All point-measure correlations were positive and above the suggested .3 cut-off for all 36 items, supporting item-level polarity and unidimensionality of each subscale. All scenarios demonstrated good properties based on the criteria proposed by Wright and Linacre (1994).

Table 7. *Item fit statistics.*

Item #	Logit (δ)	SE	Infit MNSQ	Outfit MNSQ	PTMEA
CH					
1	-0.07	0.06	1.06	1.08	.74
2	-0.68	0.05	1.09	1.10	.71
3	-0.26	0.05	0.95	0.92	.74
4	-0.01	0.05	0.80	0.79	.78
5	0.58	0.05	1.01	1.03	.76
6	0.45	0.05	1.09	1.12	.74
SEC					
7	0.74	0.08	1.01	1.05	.74
8	0.30	0.08	0.98	0.98	.76
9	-0.13	0.07	0.86	0.93	.82
10	-0.22	0.08	0.98	1.01	.82
11	-0.24	0.07	1.07	1.13	.78
12	-0.45	0.07	1.07	1.11	.82
D					
13	-0.37	0.06	1.38	1.51	.77
14	0.47	0.06	1.14	1.16	.81
15	-0.07	0.06	0.60	0.59	.88

Table 7. *Continues.*

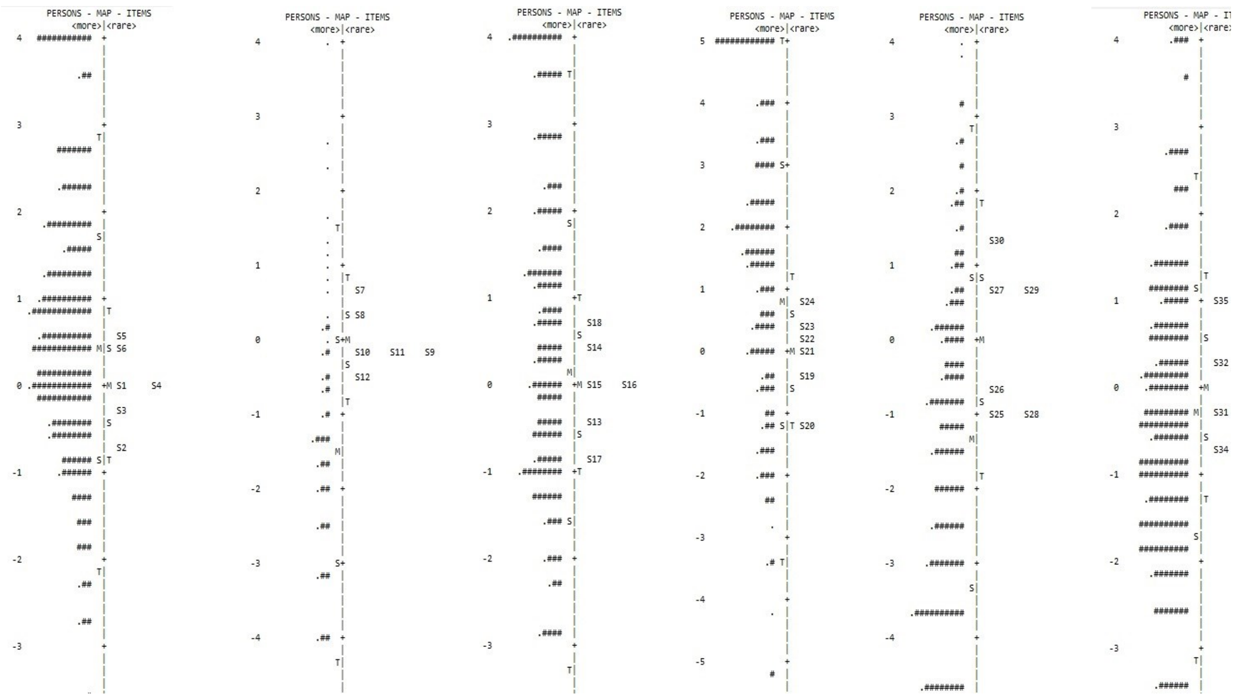
16	0.00	0.06	0.52	0.52	.89
17	-0.82	0.06	1.17	1.20	.80
18	0.78	0.06	1.17	1.11	.81
C					
19	-0.32	0.07	1.07	1.15	.83
20	-1.15	0.07	1.20	1.15	.81
21	0.03	0.07	1.14	1.16	.83
22	0.29	0.07	0.81	0.79	.87
23	0.34	0.07	0.77	0.76	.88
24	0.81	0.07	0.97	0.97	.87
X					
25	-1.30	0.07	0.97	0.96	.86
26	-0.60	0.07	0.97	0.96	.85
27	0.60	0.07	0.69	0.64	.83
28	-0.93	0.07	0.93	0.94	.86
29	0.70	0.07	1.12	1.45	.75
30	1.25	0.07	1.28	1.55	.68
TS					
31	-0.22	0.05	0.81	0.82	.81
32	0.28	0.05	1.03	1.03	.76
33	0.32	0.05	0.93	0.91	.79
34	-0.71	0.05	0.99	0.96	.78
35	1.04	0.06	1.17	1.05	.72
36	-0.71	0.05	1.11	1.11	.76

3.2.5. *Results of person-item map*

Figure 1 presents a person–item map in which information about the relation between item difficulty (easiest at the bottom to hardest at the top) and construct is shown on the right side. On the left side of the map are the person ability measures, showing the placement of respondents along the latent dimension. The map is centered at a score of 0 for the items, and because both sets of measures are on the same scale, meaningful comparisons can be made based on the map between items and persons. For person and item distributions, the mean (M) is provided in the center of the distribution with one (S) and two (T) standard deviations from the mean noted. The left side of the Wright map reports the distribution of measure scores for respondents, while the right side of the Wright map reports the calibrated scores for items of each subscale.

As shown in Figure 1, items are distributed mostly along the trait dimension, and the items appeared to be well-targeted to the sample. Most of the items align vertically across the logit scale. As shown in Table 7, Item 30 (item difficulty of 1.25) was the most difficult item for respondents to endorse, whereas Item 20 (item difficulty of -1.15) was the easiest to endorse (see Table 7). The mean of the person ability measures was close to the mean of the item difficulty measures for Subscales 1, 3, 4, and 6. As expected, the ability scores of each subscale were distributed normally, and the variance among the participants indicated a heterogeneous mix of responses.

Figure 1. *Item/Person map.*



3.2.6. *Differential item functioning*

The Rasch-Welch and the Mantel Haenzsel tests, as well as the DIF contrast, were examined to detect DIF across subgroups by gender, having COVID-19 history and school enrollment status. Items that were problematic in terms of both *p*-values (<.008) and contrast (>0.5) were flagged, indicating bias between different subgroups. The *p*-value was nonsignificant, and DIF contrasts were less than 0.50 logits for all items across gender, suggesting the absence of DIF or invariance of the items across the subgroups. DIF results for gender showed that CSS-T items could be considered invariant based on the criteria used. We explored DIF for matched ability levels for the following variables: COVID-19 (having COVID-19 before vs. not having COVID-19 yet) and enrollment status (student vs. non-student). DIF was observed between students and non-students for Item 7 ("*I am worried about grocery stores running out of food*.") and Item 13 ("*I am worried that foreigners are spreading the virus in my country*."). For Item 7, the estimated item location parameter was higher for students compared to non-students, illustrating higher levels of stress ($p = .0034$, contrast = 0.50). For Item 13, the estimated item location parameter was lower for students compared to non-students, illustrating lower stress levels ($p < .0001$, contrast = −0.61). DIF was also observed between respondents who tested positive for COVID-19 and not tested positive for COVID-19 before for Item 7. For Item 7, the estimated item location parameter was higher for COVID-19 patients compared to non-patients, illustrating higher levels of stress ($p = .0150$, contrast = 0.62).

Overall, the results of Rasch analyses provided evidence to support the substantive aspect of validity and the appropriateness of the CSS-T as a measure of COVID-19 stress level in a Turkish sample.

4. DISCUSSION and CONCLUSION

In this study, the English version of the CSS developed using American and Canadian samples was adapted into Turkish culture. In addition to CFA-related analyses, Rasch analysis was performed to provide additional evidence for the validity of the Turkish form. Within the scope of the study, translation and back-translation were performed, and subsequently, the CSS-T was administered online to an adult Turkish sample. Its validity and reliability were examined with several methods.

The internal consistency coefficients for each subscale and the overall scale were relatively high. While the reliability coefficients of the original scale varied between .85 and .95 (Taylor et al., 2020b), the CSS-T in this study varied between .85 and .93.

To reveal the construct validity of CSS-T, the results of CFA and criterion-related validity findings were reported. In addition, Rasch analysis was performed to determine the contribution of the items to relevant dimensions as well as the entire scale.

As Taylor et al. (2020b) suggested testing both the proposed 6-factor model and the 5-factor model that emerged in their study, this study compared the 5-factor structure of the original CSS found for the Canadian and American samples with the expected 6-factor model. The CFAs revealed acceptable item fit statistics for the 6-factor model but not for the 5-factor model.

In the original form of CSS, COVID Danger and COVID Contamination subscales formed a single factor (Taylor et al., 2020b). This 5-factor model was confirmed in Persian (Khosravani et al., 2021) and Arabic (Abbady et al., 2021). However, in this study, the theoretical 6-factor model showed a better fit. While the items related to COVID Danger measure the person's concerns about getting infected directly, COVID Contamination, on the other hand, measures the sensitivity to factors that may cause transmission of the disease. Therefore, it was expected that these items would load on two different scales. It is noteworthy that the predicted 6-factor model was confirmed in the Turkish sample but not in the US and Canadian samples. It appears that the items of these two factors are more comprehensible in the Turkish Language.

The Turkish version of FCV-19-S (Satici et al., 2020) was used for criterion-related validity. The results indicated a moderate correlation between five of the CSS-T subscales and FCV-19S, but a relatively higher correlation was observed with Traumatic Stress. A meta-analysis showed a strong relationship between fear of COVID-19 and traumatic stress (Şimşir et al., 2021). Based on this finding, it can be concluded that the Traumatic Stress subscale and FCV-19S measure constructs are more similar, unlike the other subscales. Overall, the study proved that CSS-T is a valid measurement tool that can be used to assess COVID-19 anxiety more comprehensively compared to FCV-19S.

Rasch analysis was performed separately for each dimension to further support the validity of the CSS-T. First, the unidimensionality of each dimension of CSS-T was tested using PCA results. In the next step, reliability analysis was performed, and it was observed that all item and person separation measures exceeded cut-off values, indicating a sufficient spread of items across subscales. Item fit analysis was performed by evaluating item difficulty calibrations, standard errors, fit statistics (infit and outfit), and point–measure correlations. These values indicated a good amount of spread in the item locations, which is necessary for Rasch measurement scales to cover the full theoretical range of the construct's continuum. While the infit values of all items indicated a good fit, the outfit values were high only for Item 13 ("I am worried that foreigners are spreading the virus in my country.") and Item 30 ("I had bad dreams about the virus.") (1.51 and 1.55, respectively). However, these values are close to the 1.50 cut-off value suggested by Wright and Linacre (1994). Moreover, since infit is a weighted index while the outfit is unweighted, large outfit values are generally considered less problematic than large infit values (Bond & Fox, 2007).

Point–measure correlation values supporting were all above the cut-off point, supporting item-level polarity and unidimensionality of each subscale. When the person-item map was examined, the person's ability scores for each subscale appeared to be distributed normally, and the between-person variance indicated a heterogeneous mix of responses. Finally, Rasch-Welch and the Mantel Haenzsel tests were applied to determine whether any items showed DIF according to gender, student status, and COVID-19 history. The results indicated that no item showed DIF by gender, but DIF was observed for COVID-19 history Item 7. This Item's location parameter was higher for persons who had COVID-19 before compared to non-patients, illustrating higher stress levels. The fear of catching the virus and the fear of losing one's life due to COVID-19 brings are exacerbated by being separated from loved ones due to quarantine, withdrawal from social life, and exclusion. These situations can have traumatic effects on individuals. A previous study revealed that individuals who experience quarantine experience show more symptoms of anxiety and depression compared to those who were not quarantined (Wang et al., 2021). Therefore, the possibility of running out of food in the markets may affect individuals who tested positive for COVID-19 more compared to those who did not.

DIF was also observed between students and non-students for Item 7 ("I am worried about grocery stores running out of food.") and Item 13 ("I am worried that foreigners are spreading the virus in my country."). Accordingly, for Item 7, the item location parameter indicated a higher stress level for students compared to non-students. One of the most important concerns related to COVID-19 is the possibility of running out of basic needs, such as food and cleaning materials in the markets, and not being able to meet these needs. This anxiety can also lead to panic buying (Mertens et al., 2020). Individuals can easily communicate disaster scenarios to others, especially through social media, which can increase panic. University students participating in the study were among the youngest participants. Therefore, they are likely to use social media more actively compared to their older counterparts (see Turkish Statistical Institute, 2020).

Finally, for Item 13, the item location parameter had higher stress levels for non-students than for students. This item measures the level of hostility towards foreigners. This finding can also be explained by the difference in attitudes and behaviors between generations, as in item 7. As individuals age, they may not tolerate change and thus develop more negative attitudes towards individuals who differ from them, such as immigrants and foreigners. Indeed, a previous study reveals that today's youth may be more tolerant of strangers compared to middle age and older age groups (Janmaat & Keating, 2019). Therefore, the finding that university students, who are the youngest participants, had lower stress levels compared to non-students in this study would be expected.

4.1. Strengths, Limitations, and Future Directions

There are many strengths and some limitations of this study. An obvious strength is that the study sample comprised individuals from a wide age range living in different regions of Turkey. Another strength of the study is that compared to the original CSS (Taylor et al., 2020b) and other adaptation studies (Abbady et al., 2021; Khosravani et al., 2021), more sophisticated analyses were utilized in this study to support the validity of CSS-T.

This study validated a 6-factor model of the CSS-T. This finding shows that CSS-T is more compatible with the originally proposed structure rather than the 5-factor one that was supported in different cultures. Despite this strength, there is a need to compare the differences between cultures with further analysis, such as cross cultural measurement invariance and DIF.

As a result, a reliable and valid measurement tool was obtained in this study to measure adults' anxiety about COVID-19 across different factors. Another important strength of the CSS-T is that it can measure the long-term effects of COVID-19 that researchers and mental health practitioners can use to determine the long-term effects of COVID-19 on individuals. Taylor et al. (2020b) stated that the original CSS could be easily adapted to future pandemic situations. In this respect, the Turkish version of the scale could be used in future pandemics.

Declaration of Conflicting Interests and Ethics

The authors declare no conflict of interest. This research study complies with research publishing ethics. The scientific and legal responsibility for manuscripts published in IJATE belongs to the authors. **Ethics Committee and Protocol No:** Anadolu University Ethics Committee, 50194.

Authorship Contribution Statement

Murat Dogan Sahin: Investigation, Scale Translation, Data Collection, Resources, Methodology, Software, Formal Analysis and Writing-original draft. **Sedat Sen**: Investigation, Scale Translation, Data Collection, Resources, Methodology, Software, Formal Analysis and Writing-original draft. **Deniz Guler**: Investigation, Literature Review, Data Collection, Scale Translation and Writing-original draft.

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APPENDIX

Table 1A. STDYX Estimate of the items according to CFA results.

Subscale	Item #	STDYX Estimate	SE
D	1	.772	.030
	2	.731	.034
	3	.614	.035
	4	.677	.032
	5	.719	.036
	6	.689	.038
SEC	7	.704	.040
	8	.726	.041
	9	.831	.028
	10	.839	.023
	11	.778	.032
	12	.816	.023
X	13	.733	.027
	14	.788	.021
	15	.921	.012
	16	.945	.008
	17	.786	.021
	18	.769	.023
C	19	.836	.021
	20	.820	.019
	21	.859	.017
	22	.811	.024
	23	.816	.024
	24	.810	.024
TS	25	.828	.021
	26	.840	.019
	27	.862	.015
	28	.844	.017
	29	.750	.027
	30	.686	.032
CH	31	.823	.020
	32	.744	.024
	33	.769	.024
	34	.758	.024
	35	.693	.028
	36	.715	.026

All p values < .001

Table 2A. Correlations among the CSS-T dimensions.

Subscale	D	SEC	X	C	TS
D	-				
SEC	.54				
X	.51	.43			
C	.76	.43	.64		
TS	.66	.47	.47	.60	
CH	.53	.32	.37	.54	.64

All p values < .001