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Development of the COVID-19-Specific Obsessive Compulsive Symptoms Scale with Various Validity and Reliability Proofs

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Abstract
The COVID-19 epidemic, which spread rapidly around the world, has had a significant negative impact on mental health. Obsessive–compulsive disorder (OCD) issues are among the main mental health effects of COVID-19. The purpose of this study is to develop a brief measurement tool that reliably and validly measures obsessive–compulsive (OC) symptoms in people with COVID-19. A total of 483 people took part in the research online. Individuals with aberrant item scores were excluded, and a series of validity and reliability analyses were performed to determine the psychometric properties of the COVID-19-specific obsessive compulsive symptoms scale (C19-OCS). C19-OCS was found to be a valid and reliable measure for assessing OC symptoms in relation to COVID-19. Mental health professionals could use C19-OCS to develop evidence-based intervention strategies and programs.

Keywords COVID-19 · Obsessive–compulsive symptoms · Scale development · Validity · Reliability

The global outbreak of novel coronavirus disease (COVID-19) has had a devastating effect in various areas from health to economy, from education to social life. One of the main destructive effects of COVID-19 has been on physical and mental health. In Turkey, more than 16 million people were diagnosed with COVID-19 while more than 100,000 people died of it (WHO, 2022a). Because COVID-19 is transmitted through respiratory secretions, contact with contaminated surfaces or close contact of people with each other (WHO, 2022b) can cause it to rapidly spread.

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Since the onset of COVID-19, individuals have taken many measures to prevent or slow down its transmission, such as frequent washing of hands or using disinfectants, using masks, paying attention to social distance, isolation, and quarantine of infected individuals, monitoring and testing of potential contacts (Adhikari et al., 2020). However, the high rates of transmission and death of COVID-19, the significant damage to health by the infection, the uncertainties about the course of the disease, its negative consequences on daily life, and the measures taken to prevent its transmission have fueled the development of pandemic-specific fear and anxiety among people (Khan et al., 2022; Pacitti et al., 2022; Theberath et al., 2022; Wang et al., 2021).

Fear is an adaptive emotion that usually arises in the event of a concrete and real threat or danger that develops suddenly in the time and environment in which the person is in, informing the person that they are in danger, and enabling them to act quickly to protect themselves and survive (Tompkins, 2013). During the COVID-19 pandemic, fear may have a functional role in encouraging people to engage in less risky behavior and take preventative measures such as masks, social distancing, and hand hygiene (Harper et al., 2021; Idrees et al., 2022). However, when fear is excessive or disproportionate, it becomes harmful to the person and becomes a key component in the development or exacerbation of mental health problems (Garcia, 2017). In other words, while fear of COVID-19 can help people stay safe, when fear leads to excessive worry and distress, it can harm one's mental health (Alimoradi et al., 2022; Belen, 2022; Fitzpatrick et al., 2020; Simsir et al., 2022).

Obsessive–compulsive disorder (OCD) is one of the key mental health problems most affected by fear of COVID-19 (Guzick et al., 2021; Linde et al., 2022). According to the American Psychiatric Association, OCD is characterized by obsessions and compulsions. While obsessions are characterized by unwanted, recurrent, and persistent intrusive thoughts, images, or urges, complications are characterized by repetitive behaviors or mental acts aimed at reducing one's anxiety provoked by obsessions (APA, 2013). Extreme and excessive fear of COVID-19 may help drive the onset or increase of obsessive–compulsive symptoms by causing irrational and unclear thoughts (Khan et al., 2022; Matsunaga et al., 2020; Pacitti et al., 2022). Moreover, fear of COVID-19 may exacerbate contamination/cleaning and obsessions/checking symptoms (Mataix-Cols et al., 2005). These are likely to be affected because COVID-19 is a virus-transmitted disease and numerous health messages have called for frequent hand washing, paying attention to hygiene, using disinfectants, paying attention to social distancing, or minimizing contact with others to reduce the risk of transmission (Grant et al., 2022). In addition, contamination, cleaning, and the thought and fear of contracting a disease are major concerns for people with OCD (Silva et al., 2021). Thus, due to fear of contamination, people with OCD may spend hours worrying about the possibility of coming into contact with a contagious disease, avoiding potential contaminants (e.g., not touching certain surfaces or reducing social contacts), and/or various compulsive washing behaviors (e.g., washing or disinfecting their hands) (Demaria et al., 2022; Fontenelle & Miguel, 2020).

Studies analyzing the effect of COVID-19 on OCD have obtained different results. While some studies have shown that people with OCD cope well with COVID-19 in the early stages of the pandemic that there is no significant exacerbation or even reduction in Obsessive-Compulsive (OC) symptoms (Moreira-de-Oliveira et al.,

2022; Schwartz-Lifshitz et al., 2021; Sharma et al., 2021), others found exacerbated level of symptoms during the pandemic (especially in contamination and washing symptoms) (Fontenelle et al., 2021; Grant et al., 2022; Guzick et al., 2021; Jelinek et al., 2021a), development of new symptoms related to COVID-19 (Nissen et al., 2020), or the onset of OC symptoms in people who did not have OCD prior to the pandemic (Alateeq et al., 2021; Fontenelle et al., 2021; Pan et al., 2021).

Assessing such COVID-19-related symptoms is complicated by several factors. First, according to Fischer et al. (2021), the first months of the lockdown during the pandemic may have caused a temporary decrease in some symptoms, as it led people with OCD to avoid potential contamination situations. This may have been reinforced by the alignment of the existing OCD rituals with recommended social practices, such as quarantining, avoiding contact with other people and objects, frequent handwashing, and using disinfectants (Pan et al., 2021). Moreover, this alignment of OC symptoms and social practices likely helps to minimize feelings of stigma, self-blame, and shame due to rituals that might otherwise induce these feelings (Aardema, 2020). Finally, even believing that they will be protected from COVID-19 thanks to their current obsessions and compulsions may have contributed to the decrease of the severity of some individuals' symptoms. A second factor that may limit the assessment and interpretation of past results is the evaluation of OC symptoms with measurement tools that were developed before COVID-19; as such, they do not include specific items related to COVID-19 and this likely to have impacted the results.

Despite these constraints, it is important to identify OC symptoms linked with COVID-19. If the adverse psychological effects of COVID-19 in inducing or intensifying OC symptoms are not identified and responded to quickly, there is a risk of long-term negative consequences for mental health. Moreover, dealing with these psychological effects will become more difficult and expensive as time goes on (Zhou et al., 2020). Furthermore, understanding people's psychological reactions to COVID-19 contamination will be critical in preventing and controlling the pandemic's spread (Taylor, 2019).

Several measures have been developed of fear, worry, anxiety, stress, perception of threat, phobia, and obsessions that develop as a result of COVID-19. These measures include the Fear of Coronavirus-19 Scale (Ahorsu et al., 2022), the COVID-19 Phobia Scale (Arpaci et al., 2020), the Coronavirus Anxiety Scale (Lee, 2020a), the Questionnaire on Perception of Threat from COVID-19 (Pérez-Fuentes et al., 2020), the COVID-19 Impact Battery (Schmidt et al., 2022), Obsession with COVID-19 Scale (OCS) (Lee, 2020b), and the COVID Stress Scales (CSS) (Taylor et al., 2020). Among these measures, the OCS and CSS assess obsessions related to COVID-19. The OCS is a unidimensional measurement tool for obsessive thinking about COVID-19. The CSS has a five-dimensional structure and was designed to measure COVID-19 stress and anxiety symptoms. Two of these dimensions assess OC symptoms ("COVID danger and contamination fears," "compulsive checking"). It is said that COVID-19 causes fear of contamination and obsessive thoughts, and cleaning standards advocated by organizations such as the WHO, such as washing, become compulsive rituals (Jelinek et al., 2021b; Silverman et al., 2022; Tanir et al.,

2020). A problem with the OCS and CSS measures is that they are limited in not assessing compulsive cleaning and washing. Another problem with most studies examining the effect of COVID-19 on OC symptoms is that they use clinical interviews or previously developed measurement tools that contain no COVID-19-related items (e.g., Grant et al., 2022; Pacitti et al., 2022; Sharma et al., 2021).

Based on these considerations, it is critical that a measure be developed that includes items related to COVID-19 and evaluates OC symptoms in the dimensions of contamination/cleaning and obsessions. The goal of this study was to create a brief measurement tool that assesses the effect of COVID-19 on these key OC symptoms in a valid and reliable manner.

Method

Participants

This study, performed at the beginning of the COVID-19 pandemic (July 2020), was approved by the Recep Tayyip Erdoğan University Social and Humanities Ethics Committee (Approval No: 2020/104). A total of 438 volunteers participated in this online study. At the beginning of the study, all participants were informed about the purpose of the study, that their answers were handled anonymously, and that the collected answers would only be used for research purposes. A total of 438 people who gave informed consent and volunteered were included in the study. Participants filled out the measurement tools used in the research via Google Forms.

This research was conducted with participant data excluding individuals with aberrant item scores. In the literature, it has been stated that individuals with aberrant item scores have negative effects on validity results (Şengül Avşar, 2021). Individuals with aberrant item scores may respond the items in the measurement tools carelessly, and respond randomly or with an incomplete motivation without reading the items (Meijer, 1996; Sijtsma & Molenaar, 2002). Removing individuals with aberrant item scores before the analysis increases the accuracy of the analysis results in terms of validity (de Vroege et al., 2018; Liu et al., 2019).

In order to determine individuals with aberrant item scores, person-fit statistics (PFS) is utilized (Emons, 2008). In this study, the average normed number of Guttman errors ($G_N{}^P$), which is one of the non-parametric PFS, which is easier to apply and more advantageous in many respects than parametric methods, was taken into account in determining individuals who have aberrant item scores. A total of 51 people who have aberrant item scores according to $G_N{}^P$ were identified. These individuals were excluded from the data set, and validity and reliability studies were carried out on data from 387 participants. Information on the demographic characteristics of the participants in the study is given in Table 1.

When Table 1 is examined, it is seen that the number of female participants in the study is greater (69.3%), and the participants are mostly university students (44.7%). While 17.8% of the participants stated that they received psychological support,

Table 1 Demographic characteristics of the study sample

Characteristics	*N*	%
Gender		
Female	268	69.3
Male	119	30.7
Age		
18–30	226	58.4
31–45	134	34.6
46–65	27	7.0
Educational level		
Graduated from primary school	2	0.5
Graduated from high school	17	4.4
Graduated from university	135	34.9
University student	173	44.7
Graduated from advance research programs	60	15.5
Psychological support		
Yes	69	17.8
No	318	82.2
Psychological diagnosis		
Yes	20	5.2
No	367	94.8
Status of leaving home		
I am definitely not leaving home	41	10.6
In mandatory situations, I go out of the house	307	79.3
for a short time	26	6.7
I am not limiting myself about going out of the house	13	3.4
I go out because I work		
Total	387	100.0

5.2% stated that they had a psychological diagnosis. Psychological diagnoses of the participants are respectively social anxiety (0.3%), attention deficit hyperactivity disorder (0.8%), depression (1.0%), panic attack (1.3%), and anxiety (1.6%). Most of the participants (79.3%) stated that they went out for a short time in mandatory situations during the COVID-19.

Measures

In this study, which aims to develop C19-OCS, various measurement tools were used. A demographic information form was developed by the researchers to determine the demographic characteristics of the participants. The criterion-related validity of C19-OCS was evaluated using Beck Anxiety Inventory (BAI) and Dimensional Obsessive–Compulsive Scale (DOCS). General information about these measurement tools and the psychometric properties of this research obtained from the study group are given below, respectively.

Demographic information form In this form, the participants are asked about their gender, age, educational level, whether they have received psychological support, whether they have a psychological diagnosis, and their status of leaving home during the COVID-19 pandemic.

COVID-19-specific obsessive compulsive symptoms scale Various steps have been followed in the development of the C19-OCS. First of all, a detailed literature review has been made. The scales developed specifically for the COVID-19 process were examined in detail, and later on, the item writing process started. For C19-OCS, 49 items were written. In the evaluation of the items written, the method suggested by Lawshe (1975) was followed. The items written were evaluated by a team of experts consisting of a psychiatry professor, two associate professors specialized in psychological counseling and guidance, and two psychometrists. Each item was evaluated by the expert team in three categories (unnecessary, useful but not sufficient, necessary). Then, content validity ratio and content validity index were calculated. Considering both the results of the Lawshe (1975) method and the warnings of experts that some items have similar content or explanation, it was decided to leave 17 items in the scale. The remaining items were applied to six female and four male university students with an average age of 19.40, and as a result of the application, it was determined that all the item expressions were clear and understandable. Based on their experiences in the last month, the participants indicate how much they agree with each item using one of the 5 ratings (*1 strongly disagree to 5 strongly agree*). All the items in C19-OCS are included in the Appendix.

Beck Anxiety Inventory The validity and reliability studies for the Turkish version of BAI developed by Beck et al. (1988) were carried out by Ulusoy et al. (1998). In the study, it was stated that BAI has a construct with two factors: "Subjective Anxiety (SA)" and "Somatic Symptoms (SS)." In addition to this, Cronbach alpha of BAI was calculated as 0.93. In this study, confirmatory factor analysis (CFA) was applied for the validity of the structure of BAI, which is determined according to Turkish culture. The goodness-of-fit values obtained for the two-factor structure are as follows: $\chi^2_{(188)} = 1105.00$, $p = 0.00$; $\chi^2/188 = 5.87$; **CFI = 0.93**; GFI = 0.79; **NFI = 0.92**; **RFI = 0.91**; RMSEA = 0.11; **SRMR = 0.07** (bold values indicate that the model is acceptable).

According to the values obtained, it can be said that BAI gives valid results in the sample of the research. In addition, Cronbach alpha reliability of the scores obtained from BAI was calculated as 0.91 for the SA factor, 0.81 for the SS factor, and 0.93 for the whole BAI. So, it can be said that BAI offers valid and reliable results in the sample of the research.

Dimensional Obsessive–Compulsive Scale The validity and reliability studies for the Turkish version of DOCS developed by Abramowitz et al. (2010) were carried out by Şafak et al. (2018). In the study, it was determined that DOCS consists of four subscales, which are "Contamination," "Responsibility," "Unacceptable thoughts," and "Symmetry," and Cronbach alpha reliability of the scores obtained from each

subscale are respectively 0.87, 0.93, 0.93, and 0.92 for the whole scale. The contamination (DOCS-C) subscale was used in this study. Within the scope of the research, CFA was performed for the scores obtained from the DOCS-C. The goodness-of-fit values achieved for the DOCS-C subscale are as follows: $\chi^2_{(5)} = 44.54$, $p = 0.00$; $\chi^2/5 = 8.91$; **CFI = 0.92**; **GFI = 0.96**; **NFI = 0.91**; RFI = 0.82; RMSEA = 0.14; **SRMR = 0.06** (bold values indicate that the model is acceptable).

In addition to this, Cronbach alpha reliability of the scores obtained from the DOCS-C subscale was calculated as 0.70. According to these values, it can be said that the DOCS-C subscale gives reliable and valid results in the sample of the research.

Procedure

A series of various validity and reliability analysis have been implemented to determine the psychometric properties of C19-OCS. In validity studies, Mokken Scale Analysis (MSA), exploratory factor analysis (EFA)-parallel analysis (PA), convergent and discriminant validity, criterion-related validity (CRV), and upper/lower group differences were investigated for construct validity.

Scaling is performed according to various test theories in determining the psychometric properties of measurement tools. One of the non-parametric Item Response Theory (NIRT) models, the Mokken Model, allows items and persons to be ordered in measuring instruments with small sample sizes or a small number of items (Meijer & Baneke, 2004).

The purpose of the Mokken Model is to order the individuals along their latent traits by using their scores (Stochl et al., 2012). According to the Mokken Model, automated item selection procedure (AISP) is taken into account in the selection of the item. AISP creates unidimensional Mokken Scales (MS) by separating items that do not scale according to Mokken Model (van der Ark et al., 2020).

In MSA, scalability coefficient H is taken into account. In the evaluation of H coefficients, also known as item discrimination index, for $0.30 \leq H < 0.40$ weak, for $0.40 \leq H < 0.50$ medium, and for $H \geq 0.50$, high criteria are used (Meijer & Baneke, 2004; Sijtsma & Molenaar, 2002; Sijtsma & van der Ark, 2017).

In this study, scaling was carried out according to Mokken Homogeneity Model (MHM), which can be considered as an explanatory model (Sodano et al., 2014), and initial analysis of the data was performed with AISP. Since the sample of this research was not large, MHM that is concordant with small samples was used. In data sets scaled according to MHM, respondents can be ordered reliably and validly based on their total scores (Sijtsma & Molenaar, 2002).

The reliability of the scores obtained from C19-OCS was investigated with Cronbach alpha (α), Guttman lambda 2 (λ), latent class reliability coefficient (*LCRC*), composite reliability (*CR*), McDonald's omega (ω), and test–retest reliability.

R Studio 4.0.2, LISREL 8.71, and JAMOVI 1.1.9 programs were used in the analysis of the data in this study. "PerFit Package" (for determining aberrant item scores), "Mokken Package" (for Mokken analysis), and "Psych Package" (for PA)

were used. While CFA for factor structures of BAI and DOCS-C measurement tools was investigated with LISREL 8.71 program, JAMOVI 1.1.9 program was used for EFA, CRV, and McDonald's omega (ω).

Statistical analyses for construct validity in this study are MSA, EFA, PA, CRV, and upper/lower group differences. Statistical analysis for the reliability of the scores obtained from the scale is the determination of internal consistency reliability coefficients (Cronbach alpha (α), Guttman lambda 2 (λ), latent class reliability coefficient (LCRC), composite reliability (CR), McDonald's omega (ω)), and the correlations between the scores obtained as a result of the test re-test.

Results

Initial validity analysis of C19-OCS

As a first step, it was determined whether C19-OCS was scaled according to MHM. For this, the *H* coefficients of the items and the standard error values calculated for these coefficients were obtained. The results obtained are given in Table 2.

When the evaluation criteria of *H* are taken into account, it is seen that the scalability coefficient of item 3 (I am tired of watching the news about COVID-19) is below 0.30: that is to say, it is not scaled to MHM. As it was not scaled to MHM, this item was removed from the scale and MHM analyses were repeated. The results obtained are given in Table 3.

When Table 3 is examined, it is seen that the scalability coefficients of the items increase after item 3 was removed. Based on the *H* evaluation criteria, generally, items have medium and strong fit levels to MHM. The *H* value for the whole scale was calculated as 0.497 (0.022). Accordingly, C19-OCS has a medium level of fit to MHM. As seen in Table 3, all items were scaled according to MHM. Additionally, the results of monotonicity assumptions are included in Table 4.

Table 4 contains the *crit* value, which is an important criterion in MHM. When interpreting the *crit* value, $crit < 40$, suitable; $40 \leq crit < 80$, suspicious; and $crit > 80$, seriously

Table 2 *H* coefficients and standard error (*SE*) of *H* for C19-OCS items

Items	*H*	SE	Items	*H*	SE
Item 1	0.429	0.034	Item 10	0.420	0.035
Item 2	0.490	0.029	Item 11	0.472	0.027
Item 3*	0.208	0.039	Item 12	0.467	0.028
Item 4	0.503	0.031	Item 13	0.538	0.026
Item 5	0.357	0.033	Item 14	0.553	0.024
Item 6	0.470	0.029	Item 15	0.512	0.026
Item 7	0.482	0.029	Item 16	0.542	0.027
Item 8	0.455	0.031	Item 17	0.536	0.029
Item 9	0.459	0.028			
Scale	0.461	0.022			

*$H < 0.30$

Table 3 *H* coefficients and standard error (*SE*) of *H* for C19-OCS items-excluded item 3

Items	*H*	SE	Items	*H*	SE
Item 1	0.450	0.034	Item 10	0.447	0.035
Item 2	0.505	0.029	Item 11	0.498	0.028
Item 4	0.515	0.031	Item 12	0.484	0.028
Item 5	0.375	0.033	Item 13	0.557	0.027
Item 6	0.481	0.030	Item 14	0.574	0.024
Item 7	0.503	0.030	Item 15	0.537	0.027
Item 8	0.474	0.031	Item 16	0.553	0.028
Item 9	0.478	0.028	Item 17	0.553	0.029
Scale	0.497	0.022			

Table 4 Monotonicity assumptions of C19-OCS

	Active comparisons	Violations	Significant violations	Crit
Item 1	24	0	0	0
Item 2	21	0	0	0
Item 4	7	0	0	0
Item 5	24	0	0	0
Item 6	15	0	0	0
Item 7	19	0	0	0
Item 8	18	0	0	0
Item 9	21	0	0	0
Item 10	20	0	0	0
Item 11	18	0	0	0
Item 12	19	0	0	0
Item 13	9	0	0	0
Item 14	16	0	0	0
Item 15	16	0	0	0
Item 16	12	0	0	0
Item 17	19	0	0	0

incompatible criteria are taken into account (Crișan et al., 2019). When Table 4 is examined, it is seen that there is no item that violates monotonicity assumption.

It is stated that MHM can be used as an exploratory model in scale development processes (Sijtsma et al., 2008). It can be said that MHM is useful in determining the items that give valid measurement results. In that regard, all items except for item 3 were decided to be included in the scale.

The number of unidimensional MS in C19-OCS was determined using AISP. The threshold for the cutoff (lower bound) values are used in determining unidimensional MS. It is stated that these values should be interpreted with an increase by 0.05 (Stochl et al., 2012). In this research, as in similar studies (Chou et al., 2017; Vaughan & Grace, 2018), the cutoff values were created in different values

starting from the default value of 0.30 and increasing by 0.05 (0.30–0.65). The unidimensional MS obtained are shown in Table 5.

When Table 5 is examined, it is seen that the cutoff has one MS for 0.30, 0.35, 0.40, and 0.45 lower bounds, two MS for 0.50 and 0.65 lower bounds, and three MS for 0.55 and 0.60 lower bounds. There are different number of items in the MS. It is stated that MS should not have a small number of items, i.e., that it should consist of at least four items (Chou et al., 2017; Stochl et al., 2012). Based on this, it is seen from Table 5 that the cutoff values can be selected as 0.35 or 0.45. Generally, all or 15 of the 16 items create a single MS. If the cutoff value is taken as 0.40 or 0.45, it is recommended that item 5 (I am afraid of having infected someone with COVID-19 unknowingly) is removed from the scale. Based on the relevant item's content and its high *H* value, it was decided by the researchers that it is kept it in the scale.

In summary, the number of MS obtained according to AISP gave information about the number of dimensions of the scale. Based on this information, it was predicted that a scale with a dominant factor was obtained from the results of the MSA.

Validity studies

For C19-OCS validity studies, EFA-PA, convergent and discriminant validity, CRV, and upper/lower differences were investigated, and the findings obtained are given

Table 5 Determination of unidimensional MS for the C19-OCS

	Lower bounds							
Items	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65
Item 1	1	1	1	1	2	2	2	0
Item 2	1	1	1	1	1	1	0	0
Item 4	1	1	1	1	1	1	1	2
Item 5	1	1	0	0	0	0	0	0
Item 6	1	1	1	1	1	0	0	2
Item 7	1	1	1	1	1	1	3	0
Item 8	1	1	1	1	2	2	0	0
Item 9	1	1	1	1	2	2	2	0
Item 10	1	1	1	1	0	0	0	0
Item 11	1	1	1	1	1	3	0	0
Item 12	1	1	1	1	1	3	0	0
Item 13	1	1	1	1	1	1	1	1
Item 14	1	1	1	1	1	1	1	1
Item 15	1	1	1	1	1	1	3	0
Item 16	1	1	1	1	1	1	1	1
Item 17	1	1	1	1	1	1	1	1
Number of ıtems for scale 1	16	16	15	15	11	8	5	4
Number of ıtems for scale 2	0	0	0	0	3	3	2	2
Number of ıtems for scale 3	-	-	-	-	-	2	2	-

below, respectively. First of all, descriptive statistics related to the items of C19-OCS are given in Table 6.

When Table 6 is examined, it is seen that item scores mean vary between 1.64 and 3.90, standard deviation between 0.78 and 1.29, skewness value between − 1.01 and 1.49, and kurtosis value between − 1.25 and 2.87. Considering that the skewness and kurtosis values are between − 3.0 and 3.0, it can be stated that the distribution of item scores does not deviate from the normal distribution (Kline, 2011). Also, West et al. (1995) stated that when the absolute value of the skewness coefficient is greater than 2 and the absolute value of the kurtosis coefficient is greater than 7, the normal distribution is not achieved.

Findings of EFA

We conducted EFA with principal axis factoring (PAF) method and PA for construct validity. The sample size for EFA should be sufficient. While determining the sample size for the data collected on a voluntary basis, the widely accepted ratio of 1:10 in the literature, in other words, the need to reach people at least 10 times the number of items, was taken into account (Hair et al., 2019). Data from 387 participants who responded to 16 items were used in this study. According to literature, the number of participants is sufficient for EFA. In addition, Kaiser measure of sampling adequacy for EFA was 0.942, and Bartlett test of sphericity was significant, $\chi^2_{(120)} = 3011.465$, $p < 0.01$. These values show that the sample size is statistically sufficient as well. Table 7 shows communalities, item-total correlations, and the factor loadings obtained from the direct oblimin rotation method.

Table 6 Descriptive statistics of items

	Minimum	Maximum	Mean	Std. deviation	Skewness	Kurtosis
Item 1	1	5	3.67	1.01	− 0.84	0.22
Item 2	1	5	2.40	1.11	0.63	− 0.51
Item 4	1	5	1.64	0.78	1.49	2.87
Item 5	1	5	2.95	1.29	0.01	− 1.25
Item 6	1	5	2.10	1.05	0.85	− 0.04
Item 7	1	5	2.26	1.08	0.73	− 0.33
Item 8	1	5	3.90	1.04	− 1.01	0.42
Item 9	1	5	3.00	1.18	0.10	− 1.02
Item 10	1	5	2.27	0.96	0.78	0.05
Item 11	1	5	3.00	1.16	− 0.06	− 1.16
Item 12	1	5	2.67	1.14	0.26	− 1.09
Item 13	1	5	1.97	0.95	1.16	1.10
Item 14	1	5	2.48	1.18	0.42	− 0.99
Item 15	1	5	3.16	1.18	− 0.26	− 1.08
Item 16	1	5	1.78	0.88	1.32	1.78
Item 17	1	5	2.03	0.97	0.96	0.41

According to the PAF method, the communalities of all items except item 5 (0.29) were higher than the threshold of 0.30. Since the factor loading of item 5 is higher than 0.40, it was decided to keep it in the scale. It is seen that item-total correlations ranged between 0.561 and 0.792. Also, the total variance explained by the first factor is 43.78%, the total variance explained by the second factor is 5.52%, and the total variance explained is 49.30%. Scree plot graphics obtained as a result of PAF and PA are given in Fig. 1.

When Fig. 1 is examined, it is seen that the data obtained from C19-OCS has a dominant factor. Considering the clustering of the items, it was determined that the items in the first dimension are related to obsessive thoughts, and the items in the second dimension are related to contamination fears and washing compulsion.

Findings of convergent and discriminant validity

Average variance extracted (AVE) values are calculated for convergent validity. The factor loadings required to calculate the AVE values were obtained from CFA. Since this research was studied with a single sample, the CFA results of C19-OCS were taken into account only in the calculation of AVE values. In other words, the goodness-of-fit values obtained from the CFA were not directly presented as proof of construct validity for C19-OCS. The most important reason for this is that searching EFA and CFA in the same data set will give biased results in favor of CFA.

AVE values of C19-OCS were calculated as 0.53 for the first factor, and as 0.63 for the second factor. These values are higher than the cutoff point of 0.50 for

Table 7 PAF results of C19-OCS

Factors	Items	Communalities	1	2	*r*
Obsessive thoughts (1)	Item 17	0.668	0.887	−0.120	0.745*
	Item 16	0.606	0.842	−0.109	0.719*
	Item 13	0.577	0.753	0.010	0.738*
	Item 4	0.478	0.741	−0.084	0.652*
	Item 14	0.637	0.724	0.110	0.792*
	Item 6	0.440	0.619	0.067	0.673*
	Item 7	0.459	0.581	0.139	0.699*
	Item 10	0.367	0.568	0.057	0.619*
	Item 2	0.458	0.503	0.236	0.705*
	Item 12	0.411	0.479	0.220	0.676*
Contamination fears and cleaning (2)	Item 8	0.636	−0.141	0.878	0.613*
	Item 1	0.436	0.044	0.631	0.597*
	Item 15	0.522	0.345	0.453	0.732*
	Item 9	0.452	0.296	0.446	0.683*
	Item 5	0.292	0.144	0.438	0.561*
	Item 11	0.449	0.334	0.408	0.690*

*$p < 0.01$, *r*, item-total correlations

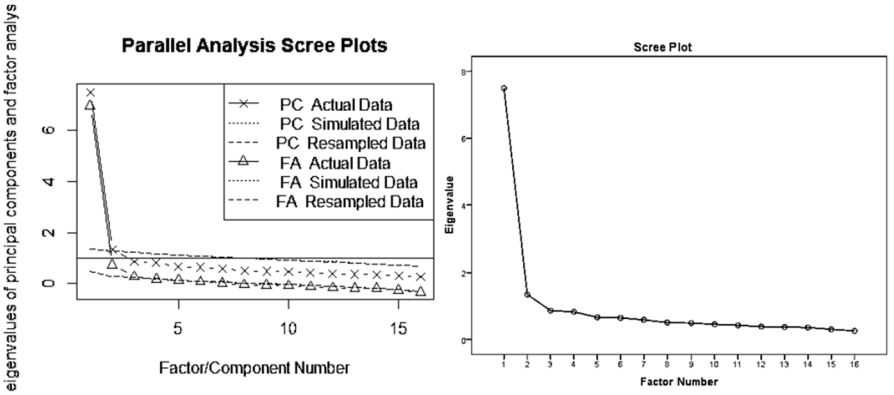

Fig. 1 Scree plots of C19-OCS

convergent validity, and this finding shows that convergent validity is provided (Hair et al., 2019). For discriminant validity, the calculated AVE values and the correlation between the dimensions of C19-OCS were considered. The fact that the square roots of the AVE values calculated for the dimensions (0.73 and 0.79, respectively) are higher than the correlation values between the dimensions (0.71) can be presented as evidence of discriminative validity (Fornell & Larcker, 1981).

Findings of CRV

Table 8 shows the Pearson's Product-Moment correlations between C19-OCS, BAI, and DOCS-C scale scores of the participants. It is determined that CF19-OCS has a significant, moderate, and positive trending relationship between BAI and DOCS-C. Significant correlation coefficients can be presented as evidence for the CRV of C19-OCS.

Findings of lower–upper group differences

As an additional proof of construct validity, upper and lower group differences were tested. In the data set, the first 27% group with the highest score from C19-OCS and the last 27% group with the lowest scores were determined. Whether there was a significant difference between the scores that these groups got from C19-OCS was determined by independent sample *t*-test. The results obtained are given in Table 9.

When Table 9 is examined, the scores of the participants in the upper group in the obsessive thoughts with contamination fears and washing compulsion dimensions of the C19-OCS scale and the whole scale are statistically significantly higher than the scores of the participants in the lower group. When the *Cohen's D* effect size is taken into account, it is seen that the difference between upper and lower groups is in large effect size.

Table 8 Correlations between C19-OCS, BAI, and DOCS-C

	1	2	3	4	5	6	7
C19-OCS-obsessive thoughts (1)	1						
C19-OCS-contamination fears and cleaning (2)	0.71** (0.67, 0.76)	1					
C19-OCS-total (3)	0.95** (0.94, 0.96)	0.89** (0.87, 0.91)	1				
BAI-SA (4)	0.54** (0.45, 0.62)	0.45** (0.37, 0.52)	0.54** (0.46, 0.61)	1			
BAI-SS (5)	0.41** (0.32, 0.50)	0.37** (0.29, 0.44)	0.42** (0.34, 0.50)	0.78** (0.73, 0.82)	1		
BAI-total (6)	0.52** (0.44, 0.60)	0.44** (0.37, 0.51)	0.53** (0.45, 0.59)	0.98** (0.97, 0.98)	0.90** (0.87, 0.92)	1	
DOCS-C (7)	0.47** (0.39, 0.53)	0.49** (0.42, 0.56)	0.51** (0.44, 0.58)	0.36** (0.27, 0.44)	0.31** (0.23, 0.39)	0.36** (0.29, 0.44)	1

**$p < 0.01$, Bootstrap 95% confidence intervals reported in brackets

Table 9 Independent sample *t*-tests of C19-OCS scores for lower–upper groups

	Groups	*N*	Mean	Sd	Q25	Q50	Q75	*t*	*p*[a]	Effect size
C19-OCS/obsessive thoughts	Lower	104	13.53	2.49	12.00	13.00	15.00	− 31.01	0.00**	4.45
	Upper	104	31.69	5.20	28.00	31.00	36.00			
C19-OCS/contamination fears and cleaning	Lower	104	14.01	3.31	11.00	14.00	17.00	− 26.91	0.00**	3.87
	Upper	104	25.17	2.38	24.00	25.00	27.00			
C19-OCS/total	Lower	104	27.54	4.37	24.00	29.00	31.00	− 37.23	0.00**	5.34
	Upper	104	56.86	6.41	51.50	56.00	61.00			

[a]*p* value for the independent samples *t*-test

**$p < 0.01$

Reliability studies

The results obtained from various reliability analyses made for the reliability of the scores obtained from C19-OCS are given in Table 10.

When the values given in Table 10 are examined, it is seen that the scores obtained for C19-OCS give reliable results. Reliability values obtained from different reliability coefficients are very close to each other. The lowest reliability estimation in Table 10 was obtained from the test–retest reliability estimation method. For test–retest reliability, C19-OCS was reapplied to 50 participants 2 weeks later. The correlation coefficients between pre-test and post-test scores of these participants were calculated. Although these values are lower compared to other reliability estimation methods, they are generally acceptable (>0.70).

According to the results obtained, C19-OCS is a measurement tool that provides valid and reliable results. While the lowest scores that can be obtained from this measurement tool are 10 for the obsessive thoughts dimension, six for the contamination fears and washing compulsion dimension, 16 for the whole scale, the highest scores that can be obtained from this measuring tool are 50 for the obsessive thoughts dimension, 30 for the contamination fears and washing compulsion dimension, and 80 for the whole scale. It can be said that as the scores obtained from the scale increase, the levels of obsessive thoughts with contamination fears and washing compulsion for COVID-19 increase in individuals.

Discussion

Due to the prevalence and persistence of the epidemic, peoples' anxieties and fears of contamination are exacerbated because they are repeatedly exposed to anxiety provoking information about COVID-19. If the adverse psychological effects caused by COVID-19 are not identified and responded to quickly, there is a risk of long-term negative consequences for mental health. The C19-OCS was developed in the present study to measure obsessive thoughts associated with contamination fears and washing compulsions observed in people in relation to COVID-19. A series of psychometric analyses were performed to determine whether the scores obtained from the C19-OCS provide valid and reliable results. Individuals with aberrant item scores within the scope of NIRT were identified

Table 10 Reliability findings of C19-OCS

	Cronbach α	Guttman 2 λ	LCRC	**CR**	***ω***	***r***
C19-OCS/obsessive thoughts	0.90	0.91	0.91*	0.92	0.90	0.76**
C19-OCS/contamination fears and cleaning	0.82	0.82	0.81*	0.91	0.82	0.74**
C19-OCS	0.92	0.92	0.92	0.95	0.92	0.78**

*The coefficient was calculated separately for dimensions generated after EFA; *r*, test–retest reliability

**$p<0.01$

and excluded from the study. As a result of the investigation, a two-dimensional C19-OCS with a dominant factor was discovered.

There are scales developed in the literature to determine the effects of COVID-19 on OC symptoms (Lee, 2020b; Taylor et al., 2020). The C19-OCS differs from other existing scales in the literature in that it measures both obsessive thoughts associated with contamination fears and washing compulsion associated with COVID-19, using a single scale and brief items in a valid and reliable manner. This feature of C19-OCS allows us to investigate the multidimensional effect of COVID-19 (Khosravani, et al., 2021) on OC symptoms in general. At the same time, the fact that the C19-OCS items are specifically related to COVID-19 will provide a more accurate representation of the severity of OC symptoms that began or worsened as a result of the pandemic.

It is important to determine individuals' psychological characteristics using measurement tools that provide valid and reliable results (Ransing et al., 2020). The investigation of the psychological effects of COVID-19, whose physiological effects on humans are well studied, is facilitated by the development of new COVID-19 measurement tools (Gasparro et al., 2020; Harper et al., 2021; Lee et al., 2021; Parlapani et al., 2020).

During COVID-19, OC symptoms can to some extent serve a protective function as well as become a psychological problem (Meșterelu et al., 2021). When COVID-19-related OC symptoms worsen and have negative consequences, they become a permanent problem if not treated (Abba-Aji et al., 2020; Knowles & Olatunji, 2021). C19-OCS can be used to determine the severity of OC symptoms associated with COVID-19 in order to make preventive interventions or prevent symptom deterioration.

There are some limitations of the study. First, the study group of the research is composed of mostly university students, although they are in a wide age range. In that respect, it is recommended that the factor structure of the scale in large groups is investigated, and the scale is monitored. Second, the data of the study was obtained from the non-clinical group. It is recommended that clinical groups are contacted. Third is the C19-OCS self-report measurement tool. When responding to self-report measurement tools, several factors such as social desirability can be influential. In this study, individuals with aberrant item scores were identified and excluded from the analysis. Future studies can include measures of social desirability responding.

Despite these limitations, the study's findings show that C19-OCS produces reliable and valid results when measuring obsessive thoughts associated with contamination fears and washing compulsions associated with COVID-19. C19-OCS can assist mental health professionals in identifying COVID-19-related OC symptoms. Furthermore, the C19-OCS can be used to develop evidence-based intervention strategies and programs. We also anticipate that C19-OCS may be useful in the future to evaluate OC symptoms associated with COVID-19-like outbreaks (e.g., mode of transmission, rate of spread). Evidence for the construct validity of the C19-OCS should be obtained after the items have been updated to reflect the new outbreak.

Appendix

Table 11 Items of C19-OCS

This measurement tool includes items related to the anxieties experienced after the COVID-19 pandemic. Please read each item carefully and answer how much you agree with the statement in the relevant item based on your experiences in the last month.		Strongly disagree	Disagree	Undecided	Agree	Strongly agree
Item 1	I am afraid of catching COVID-19 myself	1	2	3	4	5
Item 2	The thought of getting COVID-19 prevents me from doing my work	1	2	3	4	5
Item 4	I lose sleep thinking that I will catch COVID-19	1	2	3	4	5
Item 5	I am afraid of having infected someone with COVID-19 unknowingly	1	2	3	4	5
Item 6	I am experiencing physical symptoms (e.g., heart palpitations, difficulty breathing, sweating) when I think I will get COVID-19	1	2	3	4	5
Item 7	I avoid places where people are not even present thinking I may get COVID-19	1	2	3	4	5
Item 8	I am terrified that someone I know will get COVID-19	1	2	3	4	5
Item 9	I am afraid that I will not be able to cope with it if I get COVID-19	1	2	3	4	5
Item 10	I constantly research about COVID-19	1	2	3	4	5
Item 11	I wash my hands excessively for fear of catching COVID-19	1	2	3	4	5
Item 12	I feel overwhelmed from using chemical products such as cologne, bleach, disinfectant frequently to avoid catching COVID-19	1	2	3	4	5
Item 13	I do not feel at ease no matter how much I clean	1	2	3	4	5
Item 14	I am tired of the negative thoughts about COVID-19 that come to my mind inadvertently during the day	1	2	3	4	5
Item 15	I am afraid that I will get COVID-19 when I go out even if I avoid any contact	1	2	3	4	5
Item 16	I spend most of my time thinking whether I caught COVID-19 during the day	1	2	3	4	5
Item 17	I often find it difficult to keep negative thoughts about COVID-19 away from my mind	1	2	3	4	5

Data Availability The datasets analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics Approval Ethics approval to conduct the study was received from the Recep Tayyip Erdoğan University Social and Humanities Ethics Committee (Reference Number: 2020/104).

Conflict of Interest The authors declare no competing interests.

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