Journal of Evidence-Based Psychotherapies,
Vol. 23, No. 2, September 2023, 99-118.

10.24193/jebp.2023.2.12

PSYCHOMETRIC EVALUATION OF THE TURKISH VERSION OF THE THREE-DOMAIN DISGUST SCALE IN OBSESSIVE COMPULSIVE DISORDER AND NON-CLINICAL SAMPLES

Esengul Ekici[1], Kadir Ozdel[2]*

[1] MD, Memorial Ankara Hospital, Yüksek Ihtisas University Faculty of Medicine, Department of Psychiatry, Ankara 06520, Turkey, tel.: +90 312 253 6666, email: gulekici09@gmail.com; ORCID iD: https://orcid.org/0000-0002-5227-798X

[2] MD, Ankara Diskapi Yildirim Beyazit Training and Research Hospital, Department of Psychiatry, Ankara, Turkey, tel.: +90 312 596 20 00, email: kadirozdel@gmail.com; ORCID iD: http://orcid.org/0000-0002-3712-9444

Abstract

The Three-Domain Disgust Scale (TDDS) contains three subscales assessing disgust sensitivity that may contribute to research on developing and maintaining psychopathology and treating psychopathologies related to disgust. This study aimed to adapt and evaluate the psychometric properties of the TDDS Turkish version. Two hundred and thirty-six participants responded to the scale consisting of 131 individuals with Obsessive Compulsive Disorder (OCD) and consisting of 105 non-clinical samples. Confirmatory Factor Analyses (CFAs) and multigroup CFAs were performed to evaluate the factor structure and the measurement invariance across clinically disordered TDDS. Reliability analyses were calculated with Cronbach's alpha and a one-month retest. Besides, the convergent and discriminant validity of the TDDS were examined with the Beck Depression Inventory, Disgust Scale-Revised, Guilt Inventory, and State-Trait Anxiety Inventory. The study found that the three-factor structure of the TDDS was the best fit for the data, with high item-factor loadings, which proved invariant across clinically disordered. Convergent and discriminative validity of the TDDS was provided, and the reliability analysis results were satisfactory (all ≥ 0.70) in two samples. The TDDS presented high cross-

* Correspondence concerning this article should be addressed to Esengul Ekici, MD, Memorial Ankara Hospital, Yüksek Ihtisas University Faculty of Medicine, Department of Psychiatry, Ankara 06520, Turkey.
Telephone: + 90 312 253 6666.
E-mail: gulekici09@gmail.com
ORCID iD: https://orcid.org/0000-0002-5227-798X

language replicability and seemed an effective instrument for research in Turkish adults.

Keywords: disgust sensitivity, TDDS, validation, reliability, invariance.

Disgust is a basic protective emotion and characterized by its specific facial expression, behavioral responses, physiological sensations, and affective states elicited by noxious, offensive, or unpleasant stimuli (Ekman et al., 2002; Rozin et al., 2008). The understanding of disgust has expanded beyond food-related elicitors to include interpersonal contamination and sociomoral violation as repugnant stimuli in various cultures (Haidt et al., 1997). Disgust is classified into four categories: core, interpersonal, animal-reminder, and moral disgust (Rozin & Fallon, 1987). This classification system was developed and widely used to understand better the emotion of disgust and its different elicitors (Rozin et al., 2008). Core disgust is elicited by foods, body products, and animals and protects the body from disease or infections with an actual or perceived threat of oral intake of infections. Animal reminder disgust is related to death, hygiene, envelope violations, sex (e.g., particular sexual practice, injury), and violations to the body and outer envelope, and protects body and soul with deny of mortality. Interpersonal disgust is evoked by contact with a stranger who is unknown, diseased, and misfortuned and saves the soul and social order. Moral disgust is elicited by moral offenses, which suggest that an individual lacks typical human motives, protects social order, or is morally sick. There are some distinctions among disgust dimensions other than elicitors, such as core disgust is early gained in development, but other disgust dimensions are later achieved (Stevenson et al., 2010).

Rozin and colleagues (1994) developed the Disgust Scale (DS) as a classification system to measure disgust in eight domains using 32 items. The DS measures the affective, cognitive, and physical dimensions of disgust elicited by animals, food, body-envelope violations, hygiene, bodily products, death, sex, and sympathetic magic (Haidt et al., 1994). DS is considered the gold standard for evaluating disgust, but its usage has diminished due to a lack of internal consistency in its eight subscales (Olatunji & Sawchuk, 2005). The DS was revised as the Disgust Scale-Revised (DS-R) to address disgust sensitivity and improve its psychometric properties. The DS-R has 25-item and has three parts: core disgust (DSR-core), animal reminder disgust (DSR-AR), and contamination (DSR-C) (Olatunji et al., 2008; Olatunji et al., 2007). Disgust proneness is another concept relevant to individual differences, which depend on an individual's disgust propensity and sensitivity. Disgust sensitivity is how displeasing the experience of disgust is perceived and disgust propensity is how someone easily is disgusted (Fergus & Valentiner, 2009). To assess sensitivities for sexual and moral disgust, the Three-Domain Disgust Scale (TDDS) was designed as a measurement of disgust sensitivity

in three domains: pathogen disgust (TDDS-P) which drives the avoidance of infectious microbes, sexual disgust (TDDS-S) which drives avoidance of sexual acts which could venture individuals' reproduction, and moral disgust (TDDS-M) which drives the avoidance of social norm violator (Tybur et al., 2009).

Factorial invariance is a statistical method used to assess the equivalence of measurement items between different groups (Bowen & Masa, 2015; Brown, 2015). It is used to determine if there are any inherent differences between the groups being compared (in this case, OCD and non-clinical samples) in the evaluated measure. If factorial invariance is established, it can be concluded that any observed differences between the groups are due to inherent differences. However, if there is a lack of invariance, there may be measurement bias in groups, which can jeopardize the research results (Byrne & Van de Vijver, 2010). Research suggests that cognitive processing plays a role in how individuals respond differently to disgust-relevant cues in memory, attention, and interpretation, both in non-clinical individuals and individuals with anxiety and OCD (Armstrong et al., 2014; Chapman et al., 2013; Ferré et al., 2018; Liu et al., 2015; Van Hooff et al., 2013; Whitton et al., 2013). An interbehavioral theory proposes that there is an interaction between the stimulus (measure items) and the participant's response (response function) (Kantor & Smith, 1975). To evaluate the comparability of TDDS, it is critical to demonstrate that it is psychometrically equivalent in terms of response across clinically disordered.

A few studies have evaluated the validity and reliability of the original TDDS. Tybur et al. (2009) evaluated TDDS's psychometric properties with undergraduate psychology students. They demonstrated good Cronbach's alphas for all three domains (TDDS-P= 0.84, TDDS-S= 0.87, TDDS-M= 0.84) with no test-retest reliability. Factor analyses established that disgust sensitivity of individual differences might be classified across three dimensions. TDDS-P score was correlated with the core, animal reminder, and contamination disgust (r= 0.92, 0.61, and 0.66, respectively), while TDDS-S score moderately correlated (r= 0.49, 0.29, and 0.45, respectively), and TDDS-M score unrelated (r=0 .13, –0.01, and 0.19, respectively) (Tybur et al., 2009). In another study, Olatunji et. al (2012) found adequate internal consistency (TDDS-P= 0.85, TDDS-S= 0.90, TDDS-M= 0.88) with good stability for TDDS-P and TDDS-S over the interval of 12 weeks (>0.70). They demonstrated a three-factor model of the TDDS rather than a single-factor one, which was not acceptable to data via CFA. TDDS-P score significantly correlated with all three dimensions of DS-R: a core, animal reminder, and contamination disgust (r= 0.75, 0.51, and 0.51, respectively). Still, TDDS-S was only associated with the animal reminder subscale (r= 0.37), and the TDDS-M score did not associate with any DS-R subscales (Olatunji et al., 2012). Individuals with OCD often encounter situations that challenge their self-perception of moral integrity, even if only imaginative, and many experience intense guilt, anxiety and self-disgust (Rachman et al., 2012). Within this context, guilt has been conceptualized as a self-conscious moral emotion that acts as a signal for anticipatory and consequential

responses directed towards oneself (Tangney et al., 2007). Furthermore, concurrent validation involved assessing correlations with Guilt Inventory (GI), which revealed significant associations with TDDS-P, TDDS-S, and TDDS-M scores (r= 0.26, 0.23, and 0.22, respectively) and Depression Anxiety Stress Scales (DASS)-anxiety, which is established significant correlations with TDDS-P and TDDS-S scores (r= 0.18 and 0.15) (Poli et al., 2019). Previous studies proposed that the original English version of TDDS has good internal consistency and concurrent validity, strong test-retest reliability with three factors (Olatunji et al., 2012; Poli et al., 2019; Rokvic & Jovović, 2022; Tybur et al., 2009; Xiang et al., 2021).

In light of the literature, findings beyond disgust, disgust sensitivity with moral disgust is the essential component and their measurement that should be considered to understand the etiology and treatment of OCD better. Differences in cognitive processing can affect how individuals respond to measure items, and this interaction may differ between OCD patients and non-clinical individuals. TDDS was developed to evaluate disgust sensitivity, but its validity and reliability have yet to be examined in Turkiye. This study aims to adapt the TDDS to Turkish and examine its psychometric properties in OCD patients and non-clinical individuals by examining test-retest reliability, confirmatory factor analysis (CFA), and relations to other scales, as well as performing multi-group CFA to assess factorial invariance. This study might contribute to understanding disgust sensitivity and its role in OCD research further.

Method

Participants and procedure

Our clinical sample consisted of 131 individuals with OCD, and the non-clinical sample (NCS) consisted of 105 individuals. The OCD sample included 88 females (67.2%), and NCS had 76 females (72.4%). The participants range in age 18-64 in the OCD group (M= 31.26, SD= 11.66) and NCS (M= 33.16, SD= 11.69). The mean years of education were 12.50 years (SD = 3.77) in the OCD group and 12.31 years in NCS (SD= 3.16). Regarding treatment status, 64.1% of OCD (N = 84) were currently received psychiatric treatment, and 71% of OCD (N = 93) in the past. Besides, 89.4% (N = 93) of the NCS had received no psychiatric treatment. The sociodemographic and obsessive compulsive symptom characteristics showed in Table 1.

Table 1: Sociodemographic data of OCD and NCS.

		OCD (*N*=131)	**NCS (*N*=105)**	***p***
Age; year *M (SD)*		31.26 (11.66)	33,16 (11.69)	0.215
Years of education; year *M (SD)*		12.50 (3.77)	12,31 (3.16)	0.693
Sex	Female	88 (67.2 %)	76 (72.4 %)	0.398
	Male	43 (32.8 %)	29 (27.6 %)	
Marital status	Single	71 (54.2 %)	44 (41.9 %)	
	Married	53 (40.5 %)	56 (53.3 %)	
	Other	7 (5.3 %)	5 (4.8 %)	
Current treatment	Yes	84 (64.1 %)	0 (0 %)	
	No	47 (35.9%)	105 (100 %)	
Past treatment	Yes	93 (71 %)	11 (10.6 %)	
	No	38 (29 %)	93 (89.4 %)	
YBOCS-obsession *M (SD)*		11.18 (4.70)	1.77 (2.10)	0.00
YBOCS-compulsion *M (SD)*		10.79 (4.95)	1.35 (2.01)	0.00

Note: YBOCS= Yale-Brown Obsessive Compulsive Scale

Patients were obtained from hospital psychiatry outpatient polyclinics. After routine outpatient admittance, individuals diagnosed with OCD were further evaluated by one of the researchers via a Structured Clinical Interview for DSM 5-Clinician Version (SCID 5-CV) assessment for one month (Elbir et al., 2019). Inclusion criteria were the presence of a DSM-5 OCD diagnosis based on a structured diagnostic interview and written informed consent. Individuals with OCD had comorbid disorders such as anxiety disorders (26.7%), major depressive disorder (30.5%), eating disorders (3.8%), social phobia (13.7%), somatoform disorders (5.3%), specific phobia (22.9%), OCD-related disorder (20.6%). We excluded patients with substance use disorders, mental retardation, psychotic disorders, bipolar disorders, and neurological disorders according to DSM-5. NCS included hospital staff with no current psychiatric complaints and did not meet the diagnostic criteria for any psychiatric disorders after undergoing a psychiatric examination.

After obtaining the necessary permissions from the original developers of the TDDS, the questionnaire was translated into Turkish by two independent bilingual psychiatrists (one translator was a psychiatrist, while the other was a psychiatrist and an expert native speaker of the Turkish language). A single version was then developed from these two translations. It was back-translated into English by another psychiatrist who is an expert in English and a native speaker of the Turkish language (Brislin et al., 1973). After translating the questionnaire into Turkish, we administered it to a preliminary sample of 15 people to identify any ambiguous items. Based on the feedback we received, we made some slight changes to the translated scale. We created four sets of scales to control for order effects, each with a different order of items. Participants received one of these sets, which took approximately 20-25 minutes to complete. To assess the reliability of the questionnaire, we administered a second measurement of the TDDS to a smaller

subgroup of the first sample one month after the first measurement. This study was conducted according to the 2013 Helsinki Declaration with approval by the local ethics committee (Dec 13th, 2021, numbered 126/09).

Measures

Yale-Brown Obsessive Compulsive Scale (Y-BOCS; Goodman et al., 1989): The Y-BOCS is a widely used and validated measure of OCD symptoms via two parts related to obsessions and compulsions. It is a 19-item scale, with scores calculated by summing the first ten questions (Goodman et al., 1989). The Y-BOCS was adapted to Turkish by Karamustafalıoğlu et al. (1993), and the Turkish version of the scale has similar psychometric properties as the original version (Karamustafalıoğlu et al., 1993). In this study, Cronbach's alpha values of Y-BOCS for OCD and the NCS were calculated as 0.95 and 0.91, respectively.

Three-Domain Disgust Scale (TDDS; Tybur et al., 2009): The TDDS was developed to measure disgust sensitivity which contains a pathogen, sexual, and moral disgust.

State-Trait Anxiety Inventory (STAI; Spielberger et al., 1983): The STAI was developed to evaluate anxiety which contains state and trait anxiety with good validity and internal consistency (Spielberger et al., 1983). This 40-item scale was translated into Turkish by Oner and LeCompte (1985) in clinical and non-clinical groups (Öner & LeCompte, 1985). The item-remainder reliability for trait and state anxiety ranged from 0.34 to 0.72; and 0.42 to 0.85, respectively. The test-retest reliability for trait and state anxiety ranged from 0.71 to 0.86 and 0.26 to 0.68, respectively. In the current study, Cronbach's alpha values for the state and trait anxiety were calculated as 0.93, 0.90 for the OCD group and 0.90, 0.82 for the NCS.

Disgust Scale-Revised Form (DS-R; Haidt et al., 1994): The DS-R was developed to measure disgust with three dimensions: core, animal reminder, and contamination with a 27-item (Haidt et al., 1994). This self-reported scale's validity, factor structure, and reliability (all ≥ 0.70) of the adapted scale were found to be satisfactory (İnözü & Eremsoy, 2013). The Cronbach's alpha coefficient for the translated version of the DS-R was reported as 0.85 for the OCD group and 0.89 for the NCS in our study.

Beck Depression Inventory (BDI; Beck, 1961): The BDI was developed to measure depression symptoms with a 21-item and self-reported (Beck et al., 1961). Hisli et al. (1988) translated this scale into Turkish and found that the Turkish version's psychometric properties were comparable to the original questionnaire. The Cronbach alpha values of BDI, split-half, and test-retest were calculated as 0.80, 0.74, and 0.78, respectively (Hisli, 1988).

Guilt Inventory (GI; Kugler and Jones, 1992): The GI was developed to measure guilt which includes state, trait, and moral guilt feelings with 45-item (Kugler & Jones, 1992). GI was translated to Turkish by Altin (2009) with the original design of the questionnaire, high reliability (all ≥ 0.70), strong validity, and

comparable psychometric properties (Altin, 2009). In our study, Cronbach alpha coefficients of trait, state, and moral guilt were calculated as 0.90, 0.81, and 0.54 for the OCD sample and 0.85, 0.77, and 0.69 for the NCS, respectively.

Data Analysis

Preliminary analysis was conducted using SPSS software version 26.0. The sample size of the study was determined based on different guidelines for factor analysis. MacCallum et al. (1999) refer to Gorsuch (1983) and Kline (1979), who suggested that N should be at least 100 for factor analysis (MacCallum et al., 1999). However, some investigators proposed focusing on the N:p ratios, which indicate a ratio of 3 to 10 to provide an appropriate sample size (Bryman & Cramer, 2002; Cattell, 1978; Everitt, 1975; Gorsuch, 2014). This study's sample size was 131 for the OCD group and 105 for the NCS. Since the study used a 21-item scale, the sample size was sufficient for the statistical analyses.

Descriptive statistics were used to summarize participant sociodemographic features. CFAs were computed using LISREL 8.8 to test the TDDS factor structure further. All analyses were separately conducted for both samples. Convergent and discriminant validity analyses were also performed. Reliability and test-retest reliability was evaluted.

Before conducting CFAs, missing values were replaced using the Expectation Maximization (EM) algorithm. This method effectively estimates parameters and reduces bias when missing data is low if less than 5% of the responses are missing (Enders, 2013). The data did not contain extreme values, and the multivariate skewness (Zs) and kurtosis (Zk) values, $\chi 2$ value for multivariate skewness and kurtosis, and relative multivariate kurtosis (RMK) were calculated. Therefore, the test results did not support multivariate normality and robust maximum likelihood (MLR) was used for the analysis (Satorra & Bentler, 1994). Data analysis confirmed that there was no multicollinearity, linear relationships between the variables, and that the variables were not highly associated with each other (<0.80).

In the CFA, several fit indices were used to evaluate the model's goodness of fit: Satorra-Bentler (S-B) chi-square/standard deviation (sd) ratio, comparative fit index (CFI), goodness-of-fit index (GFI), normed fit index (NFI), non-normed fit index (NNFI), adjusted goodness-of-fit index (AGFI), root mean square error of approximation (RMSEA), and standard root mean square residual (SRMR). The chi-square value is sensitive to sample size, and as sample size increases, an S-B chi-square/sd ratio of 2, 3, or even 5 can indicate that the model is at an acceptable level. The CFI, GFI, AGFI, NFI, and NNFI values should be close to 0.95 for a good fit, with values between 0.90 and 0.95 indicating an acceptable fit. For the RMSEA, values less than 0.05 indicate a good fit, and values between 0.05 and 0.1 indicate an acceptable fit. For the SRMR, values between 0.05 and 0.1 indicate an acceptable fit, and values less than 0.05 suggest a good fit (Browne & Cudeck, 1992; Hu &

Bentler, 1999; Kline, 2005). We finally perform multigroup CFAs for factorial invariance analyses in a hierarchical manner using restrictive CFA models: configural, metric, scalar, and strict invariance (Byrne & Van de Vijver, 2010; Van de Schoot et al., 2012). The prerequisite reference model is configural invariance, which assesses whether the factorial structure is identical among the compared groups. Metric invariance examines the initial configural model with equal factorial loads by restricting the covariances among the items. Scalar invariance assesses a model with equal intercepts and factorial loads. Strict invariance tests a model in which residues, intercepts, and factorial loads are equal. For measurement invariance, invariance between the least and most restrictive models is verified through differences in CFI, with values equal to or less than 0.01, implying that the invariance hypothesis must be established (Cheung & Rensvold, 2002; Meredith, 1993).

Results

Descriptive Statistics

Means and standard deviations for all measurements of the OCD and NCSs are showed in Table 1.

Validation

To test the multivariate normal distribution assumption of the data set, Zs, Zk, $\chi 2$ values for multivariate skewness and kurtosis, and RMK values were examined. The results for the NCS were Zs = 16.55 (p = 0.000), Zk = 8.95 (p = 0.000), $\chi 2$ = 353.92 (p = 0.000), and RMK = 1.194. For the OCD group, the results were Zs = 23.70 (p = 0.000), Zk = 11.80 (p = 0.000), $\chi 2$ = 701.08 (p = 0.000), and RMK = 1.279. These values indicate that the data did not meet the criteria for a multivariate normal distribution (Field, 2009). So, our findings did not provide multivariate normality, and MLR was conducted for the analysis (Satorra & Bentler, 1994).

Confirmatory Factor Analysis

The three-factor solution provided an acceptable fit by examining the fit statistics and factor interpretability. The overall model fit the data adequately, except for GFI and AGFI values (S-B$\chi 2$/sd =1.25, AGFI= 0.76, GFI= 0.81, CFI= 0.99, NFI= 0.93, NNFI= 0.98, RMSEA = 0.043, SRMR= 0.067). However, because the data did not meet multivariate normality, it was suggested that CFI and NNFI indexes should be used instead of GFI and AGFI, which were low in our sample (Cheung & Rensvold, 2002).

The factor loadings and error variances ranged from 0.58 to 0.82 and 0.33 to 0.66 on one of the two factors for OCD, respectively (see Figure 1). The factor loading of each item was a score of 0.30 and above, and error variances of each item were a score of 0.90 and below, indicating that they fit the latent constructs (Kline, 2011). This factor structure was identical to the original version (Tybur et al., 2009). Additionally, local fit assessments were conducted. There were only low values of 10 and above in the modification indices, and the standardized residual values were less than 5%, which indicates that the model provided an adequate local fit. Based on these findings, we can conclude that empirical support for the construct validity of the TDDS for the OCD group.

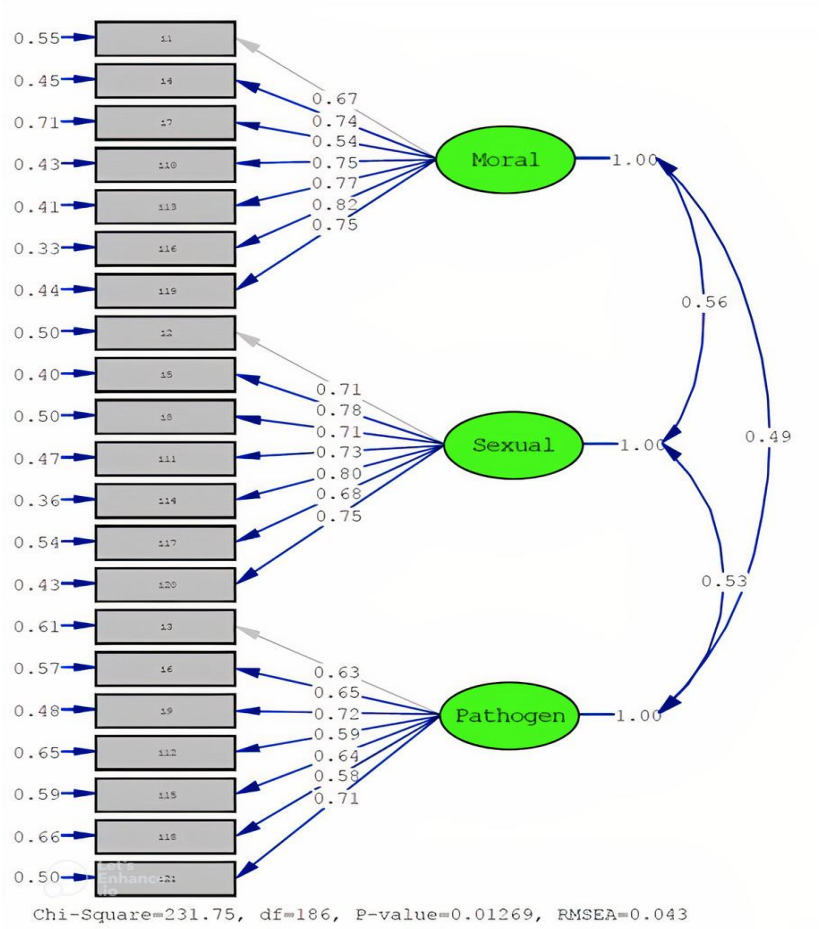

Figure 1. Factor loadings of the TDDS for the 21-factor model in the OCD group (Standardized path coefficients)

Note: RMSEA: Root Mean Square Error of Approximation; df: degrees of freedom.

CFA was also performed for the healthy group to determine the validity of the TDDS. A three-factor solution was found to fit NCS. The overall model provided an adequate fit except for the GFI, AGFI, and SRMR values (S-Bχ2/sd =1.54, AGFI= 0.68, GFI= 0.74, CFI= 0.97, NFI= 0.91, NNFI= 0.96, RMSEA = 0.072, SRMR= 0.078). As the data did not meet multivariate normality, the GFI and AGFI values were low.

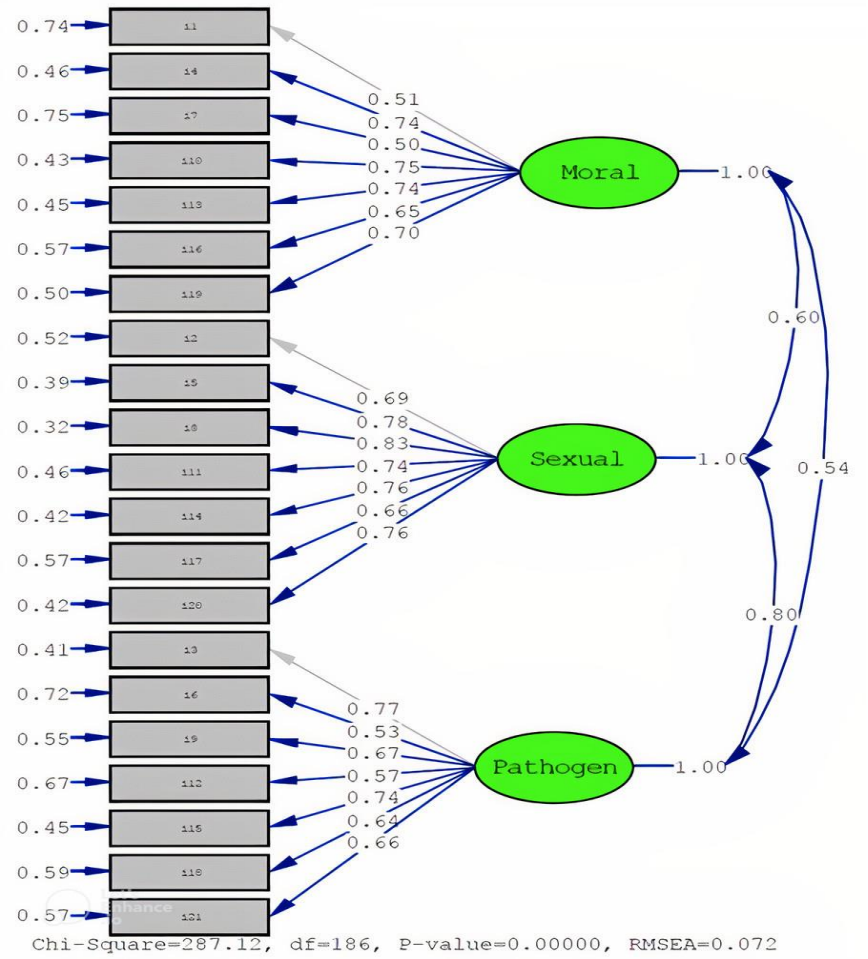

Figure 2. Factor loadings of the TDDS for the 21-factor model in the healthy group (Standardized path coefficients)

Note: RMSEA: Root Mean Square Error of Approximation; df: degrees of freedom.

The factor loadings and error variances ranged from 0.50 to 0.83 and 0.32 to 0.75, respectively (see Figure 2) for the NCS, and they were within the acceptable range (Kline, 2011). There were only low values of 10 and above in the modification indices, and the standardized residual values were less than 5%, which indicates that the model provided an adequate local fit. Based on these findings, we can conclude that empirical support for the construct validity of the TDDS for the NCS.

Factorial Invariance

The results of the model for measurement invariance of TDDS between individuals with OCD and NCS are shown in Table A configural invariance model provided an acceptable fit to the data (S-Bχ2 /*df* = 1.37, CFI = 0.98, RMSEA= 0.056) (Browne & Cudeck, 1992). This proposes that the TDDS symbolizes the same psychological structure between the OCD and NCSs, and serves as a baseline for further models. Additionally, we tested the metric invariance by restricting the items' covariances. This model had an acceptable fit to the data, while the ΔCFI between the metric invariance and the unconstrained model was 0.00 due to CFI values being within the established cut-off (ΔCFI≤0.01) (S-Bχ2 /*df* = 1.39, CFI = 0.98, RMSEA = 0.058) (Meredith, 1993). Scalar invariance was tested by restricting the regression constants between the two groups to be equal. This model had an acceptable fit of the data while the ΔCFI between the scalar invariance and the unconstrained model was 0.01, which is within the established cut-off (ΔCFI≤0.01) (S-Bχ2 /*df*=1.44, CFI= 0.97, RMSEA = 0.061) (Meredith, 1993). As scalar invariance was provided, the researchers could test for strict invariance. Strict invariance assumes that the items' specific variances are equal across groups. This model had an acceptable fit of the data while the ΔCFI between the strict invariance and the unconstrained model was 0.00, which is within the established cut-off (ΔCFI≤0.01) (S-Bχ2 /*df* = 1.43, CFI = 0.97, RMSEA = 0.061) (Meredith, 1993). Therefore, it can be proposed that the TDDS has factorial invariance between the groups of OCD and NCS. (see Table 2)

Table 2. Goodness of fit testing the measurement invariance of TDDS for OCD and NCS.

	S-Bχ2 /*df*	CFI	NFI	NNFI	RMSEA (90 % Cl)
Configural invariance	1.37	.98	.92	.98	.056
Metric invariance	1.39	.98	.92	.97	.058
Scalar invariance	1.44	.97	.91	.97	.061
Strict invariance	1.43	.97	.91	.97	.061

Convergent and Discriminant Validity

The study results showed that TDDS-P had a negligible positive correlation with depression levels in the OCD sample ($r = 0.28$, $p < 0.05$). In contrast, the TDDS-S and TDDS-M did not correlate with depression levels in the OCD group ($r= 0.05$, $p > 0.05$; $r = -0.04$, $p > 0.05$, respectively). Additionally, there were no correlations between TDDS domains (TDDS-P, TDDS-S and TDDS-M) and depression levels in the NCS ($r = -0.05$, $p > 0.05$; $r= 0.02$, $p > 0.05$; $r = 0.04$, $p > 0.05$, respectively). These results support the discriminant validity of the scale, as it indicates that TDDS is measuring a different construct than depression. The researchers also examined the convergent validity of TDDS by examining the correlations between the subscales of TDDS and the DS-R, STAI, and GI. The results showed positive relationships among the subscales of these questionnaires, specifically TDDS-P was correlated in the expected direction with DSR-core, DSR-AR, and DSR-C ($r = 0.37$, $p < 0.05$; $r = 0.35$, $p < 0.05$; $r = 0.25$, $p < 0.05$, respectively) TDDS-S also had a positive correlation with DSR-core, and DSR-AR ($r = 0.25$, $p < 0.05$; $r = 0.37$, $p < 0.05$, respectively), but there was no correlation between TDDS-M and DS-R dimensions ($r = -0.06$, $p > 0.05$; $r = 0.13$, $p > 0.05$; $r = -0.12$, $p > 0.05$, respectively) in the OCD group, which is consistent with the original study (Tybur et al., 2009). The researchers found that the TDDS-P subscale positively correlated with DSR-core, DSR-AR, and DSR-C ($r = 0.47$, $p < 0.05$; $r = 0.45$, $p < 0.05$; $r = 0.43$, $p < 0.05$, respectively) in the NCS. This supports the convergent validity of the TDDS in the OCD and NCS. The TDDS-S also had a positive correlation with DSR-core, DSR-AR, and DSR-C ($r = 0.39$, $p < 0.05$; $r = 0.41$, $p < 0.05$; $r = 0.43$, $p < 0.05$, respectively), and TDDS-M was virtually unrelated to DS-R subdimensions ($r = 0.15$, $p > 0.05$; $r = 0.17$, $p > 0.05$; $r = 0.18$, $p > 0.05$, respectively) in NCS parallel to the original study (Tybur et al., 2009). Additionally, the researchers found that the TDDS-P had positive correlations with STAI total, STAI-trait anxiety ($r = 0.29$, $p < 0.05$; $r = 0.23$, $p < 0.05$; $r = 0.30$, $p < 0.05$, respectively) and GI-total ($r = 0.27$, $p < 0.05$) in the OCD group, but TDDS-S had positive correlations only with GI-moral subdimensions ($r = 0.20$, $p < 0.05$) in the OCD group and TDDS-P, TDDS-S, TDDS-M had positive correlations with GI-moral ($r = 0.31$, $p < 0.05$; $r = 0.33$, $p < 0.05$; $r = 0.25$, $p < 0.05$, respectively) in the NCS, further supporting the convergent validity of the TDDS. (see Table 3)

Table 3. Correlation coefficients between TDDS and its subscales, and BDI, DS-R, STAI, GI and Y-BOCS in OCD and NCS.

OCD (*N*=131)				
Variables	Pathogen	Sexual	Moral	Total
DS-R total	.38*	.29*	-.01	.26*
DSR-core	.37*	.25*	-.06	.22*
DSR-AR	.35*	.37*	.13	.35*
DSR-C	.25*	.08	-.12	.07
STAI total	.29*	.03	-.02	.10
Trait anxiety	.23*	.02	.01	.08
State anxiety	.30*	.03	-.06	.10
Beck D	.28*	.05	-.04	.19
Y-BOCS	.25*	.50	.58	.14
GI-total	.27*	.78	.51	.38
GI-trait	.26*	-.06	-.07	.06
GI-state	.24*	-.06	-.08	.04
GI-moral	.01	.20*	.16	.18*
Control (*N*=105)				
Variables	Pathogen	Sexual	Moral	Total
DS-R total	.49*	.44*	.18	.44*
DSR-core	.47*	.39*	.15	.40*
DSR-AR	.45*	.41*	.17	.41*
DSR-C	.43*	.43*	.18	.44*
STAI total	.21	.18	.05	.19
Trait anxiety	.18	.17	.04	.17
State anxiety	.20	.16	.04	.17
Beck D	-.05	.02	.04	.16
Y-BOCS	.09	.06	.08	.09
GI-total	.04*	.08	.06	.02*
GI-trait	.06	.08	.06	.10
GI-state	.14	.05	.10	.12
GI-moral	.31*	.33*	.25*	.36*

note: DS-R= Disgust Scale-Revised, STAI= State Trait Anxiety Inventory, BDI= Beck Depression Inventory, YBOCS= Yale-Brown Obsessive Compulsive Scale, GI= Guilt Inventory.

Reliability

The stratified Cronbach's α values for 21 items were 0.93 and 0.94 in OCD and healthy groups, respectively (see Table 4). Test–retest was conducted on 38 participants (28 females and ten males, aged 18-65) over one month. Pearson's *r* correlation for the total score and the subscales of the pathogen, sexual, and moral were 0.72, 0.71, 0.71, and 0.77, respectively; all values were statistically significant ($p < 0.05$). These results provide empirical support for the reliability of the TDDS (Salvucci et al., 1997).

Table 4. Results of reliability analyses of the Turkish version of the TDDS.

OCD			
TDDS	Cronbach α	McDonald ω	Tabakalı Cronbach α
TDDS-P	.83	.83	--
TDDS-S	.89	.89	--
TDDS-M	.88	.88	--
Total	--	--	.93
Control			
TDDS-P	.83	.84	--
TDDS-S	.90	.90	--
TDDS-M	.84	.84	--
Total	--	--	.94

note: TDDS-P= Three Dimensional Disgust Scale-pathogen, TDDS-P= Three Dimensional Disgust Scale-pathogen, TDDS-S= Three Dimensional Disgust Scale-sexual, TDDS-M= Three Dimensional Disgust Scale-moral.

Discussion

The results of this study indicated that the psychometric properties of the Turkish version were largely consistent with those found in the original research. The TDDS was a valid, reliable, and invariant measure of disgust sensitivity in OCD and NCSs.

Validity and Reliability

We examined the reliability of TDDS subscales by estimating Cronbach's alpha coefficient as a measure of internal consistency and test-retest reliability. The Cronbach's alpha levels for the OCD and NCSs were consistent with the original study. Additionally, the test-retest reliability for the TDSS-P, TDDS-S, and TDDS-M was found to be high, with correlation coefficients that were very similar to other studies at one month. The domains fell in the range of what is typically considered good stability of test scores (Nunnally Jr, 1970). Therefore, we can conclude that the TDDS scales have acceptable internal and test-retest reliability.

The correlation analyses established relationships between the total scores and subscales of the TDDS and anxiety symptoms and disgust, supporting the concurrent validity of TDDS. Similar to previous research, this study found that the emotional traits relevant to disgust positively correlated with TDDS-P and TDDS-S for OCD and NCSs (Olatunji et al., 2012; Tybur et al., 2009). In addition, only TDDS-P positively correlated with anxiety (state and trait) in OCD and NCS. However, depression scores were not associated with disgust in OCD (only negligible correlation with TDDS-P) and healthy groups, consistent with previous

research (Olatunji et al., 2012). Overall, these results contribute to the convergent and discriminative validity of the Turkish version of TDDS.

Factor Structure

The study found that the three-factor structure of the TDDS was the best fit for the data, with high item-factor loadings (all ≥ 0.30). This structure was in line with previous research and suggested that it is appropriate to use the TDDS in the current cultural context (Olatunji et al., 2012; Tybur et al., 2009). However, item 7 shows the lowest factor load in both samples, which might indicate that it is less notionally related to its purported factor and may be associated with another dimension of repugnance. The study provides evidence for the factorial validity of the TDDS, and preserving its original design could allow for intercultural group comparisons in future studies.

Factorial Invariance

In this study, we evaluated the factorial invariance of the TDDS based on Kantor's theory, which emphasizes the importance of stimulus-response reactions among groups (Kantor & Smith, 1975). Our results showed the presence of configural invariance in both the clinical OCD and NCSs, indicating that the same latent factor of disgust is present in both groups. This suggests that these two samples have similar conceptualizations of disgust domains, despite possible differences in their cognitive processing (Armstrong et al., 2014; Chapman et al., 2013; Ferré et al., 2018; Liu et al., 2015; Van Hooff et al., 2013; Whitton et al., 2013). This is crucial for making meaningful comparisons between the two groups and helps support the validity of the TDDS as a measure of disgust sensitivity in Turkish populations. Metric invariance means equal factor loadings, implicating that the groups adjust their measures similarly across the two samples. The following restriction encounters intercepts that are scalar invariance, which proposes no systematic differences in the measurement items receptions and residuals that are strict invariance, which implies equivalency of intercept terms and tests whether OCD and NCSs similarly utilize response way resulting in an acceptable fit to data. There is no study on TDDS invariance between OCD and NCSs, but there are studies on the measurement invariance of TDDS across gender (Tybur et al., 2011). Factor invariance evaluates whether a measurement tool examines a measured property with the same construct between different groups, regardless of a group membership. Our study established TDDS has factor invariance with these results. Thus, this measurement is considered invariant across clinically disordered.

It is the first study to test Turkiye's TDDS psychometric properties and examine the invariance across clinically disordered. However, there are some limitations of the present study that should be noted, such as the gender distribution,

limited age and education level of the sample, and the sample of heterogenous OCD regarding the duration of disorder and treatment, comorbid conditions with OCD, which influence the emotion of disgust measurement, and the use of self-report scales. Moreover, participants in this study did not include anxiety disorders other than OCD. Further studies should use larger and more representative samples in both groups to achieve generalizability. Examination of other invariance models to determine the differences among age, gender, and race is also suggested. The study on this scale is vibrant and continuously presents opportunities for improvement to determine the measured constructs more uniquely, so further longitudinal examinations with bigger samples are necessary.

We tested the factor structure, reliability, validity, and factor invariance of the TDDS in and among clinical OCD and NCS. The item-factor structure of the TDDS was consistent with its original English version. Both subscales of TDDS had adequate internal consistency and test-retest reliability. The findings of this study demonstrated the construct validity for both clinical OCD and NCSs. The three-domain model of disgust sensitivity provided by TDDS may encourage researchers to investigate individual differences in disgust sensitivity, which is heterogenous and relate to the different functional disgust domains. Previous studies found a contradiction in relationships between disgust sensitivity and only pathogen disgust with different disgust measurement scales but not sexual or moral disgust or vice versa. Given that previous disgust, measurement scales have not adequately evaluated these three domains; such issues have yet to be fully explored. The three factorial structures for the Turkish culture might put forward a culture-specific concept of processing, recognizing, conceptualizing, and verbalizing the disgust sensitivity, especially sexual and moral disgust domains. The findings demonstrated that differences in the TDDS scores in disgust sensitivity across clinically-disordered or not groups could be attributed to actual distinctions caused by another reason from scale properties, such as understanding, cognizance, and interpretation of questionnaire items or response formats, could not cause these distinctions. An identified culturally specific aspect may be used to prefer diagnosing and treat psychiatric syndromes that are assumed to be associated with abnormal disgust processing.

Authors' note

Ethical considerations: The participants were informed in detail, and informed consent was obtained. Local ethics committee approval was received for this study (Dec 13th, 2021, numbered 126/09) which was conducted under the ethical standards set out in the 2013 Helsinki declaration.

Acknowledgments: None.

Funding: None.

Declaration of interest statement: On behalf of all authors, the corresponding author states that there is no conflict of interest.

Data Availability Statement: All relevant data are within the paper and they are available from the corresponding author on reasonable request.

References

Altin, M. (2009). A cross-cultural investigation of obsessive compulsive disorder symptomatology: The role of religiosity and religious affiliation. Unpublished doctorate thesis, Middle East Technical University, Turkey.

Armstrong, T., McClenahan, L., Kittle, J., & Olatunji, B. O. (2014). Don't look now! Oculomotor avoidance as a conditioned disgust response. *Emotion, 14*(1), 95.

Beck, A., Ward, C., Mendelsohn, M., Mock, J., & Erbaugh, J. (1961). An inventory for measuring depression Arch Gen Psychiatry 4: 561–571. *Find this article online*.

Bowen, N. K., & Masa, R. D. (2015). Conducting measurement invariance tests with ordinal data: A guide for social work researchers. *Journal of the Society for Social Work and Research, 6*(2), 229-249.

Brislin, R. W., Brislin, R. W., Lonner, W. J., & Thorndike, R. M. (1973). *Cross-cultural research methods* (Vol. 11): New York: J. Wiley.

Brown, T. A. (2015). *Confirmatory factor analysis for applied research*: Guilford publications.

Browne, M. W., & Cudeck, R. (1992). Alternative ways of assessing model fit. *Sociological methods & research, 21*(2), 230-258.

Bryman, A., & Cramer, D. (2002). *Quantitative data analysis with SPSS release 10 for Windows: A guide for social scientists*: Routledge.

Byrne, B. M., & Van de Vijver, F. J. (2010). Testing for measurement and structural equivalence in large-scale cross-cultural studies: Addressing the issue of nonequivalence. *International Journal of Testing, 10*(2), 107-132.

Cattell, R. B. (1978). Fixing the number of factors: The most practicable psychometric procedures. In *The scientific use of factor analysis in behavioral and life sciences* (pp. 72-91): Springer.

Chapman, H. A., Johannes, K., Poppenk, J. L., Moscovitch, M., & Anderson, A. K. (2013). Evidence for the differential salience of disgust and fear in episodic memory. *Journal of Experimental Psychology: General, 142*(4), 1100.

Cheung, G. W., & Rensvold, R. B. (2002). Evaluating goodness-of-fit indexes for testing measurement invariance. *Structural equation modeling, 9*(2), 233-255.

Ekman, P., Friesen, W. V., & Hager, J. C. (2002). *Facial Action Coding System: Facial action coding system: the manual: on CD-ROM*: Research Nexus.

Elbir, M., Alp Topbaş, O., Bayad, S., Kocabaş, T., Topak, Z., Çetin, Ş., Özdel, O.,Ateşçi, F. Ç., & Aydemir, Ö. (2019). Adaptation and reliability of the

structured clinical interview for DSM-5-disorders-clinician version (SCID-5/CV) to the Turkish language, *30*(X), 51-56.

Everitt, B. S. (1975). Multivariate analysis: The need for data, and other problems. *The British Journal of Psychiatry, 126*(3), 237-240.

Fergus, T. A., & Valentiner, D. P. (2009). The Disgust Propensity and Sensitivity Scale–Revised: An examination of a reduced-item version. *Journal of anxiety disorders, 23*(5), 703-710.

Ferré, P., Haro, J., & Hinojosa, J. A. (2018). Be aware of the rifle but do not forget the stench: Differential effects of fear and disgust on lexical processing and memory. *Cognition and emotion, 32*(4), 796-811.

Field, A. (2009). Discovering statistics using SPSS, 3rd Edn London. *UK: SAGE [Google Scholar]*.

Goodman, W. K., Price, L. H., Rasmussen, S. A., Mazure, C., Fleischmann, R. L., Hill, C. L., . . . Charney, D. S. (1989). The Yale-Brown obsessive compulsive scale: I. Development, use, and reliability. *Archives of general psychiatry, 46*(11), 1006-1011.

Gorsuch, R. L. (1983). Factor analysis (2nd ed.). New York: McGrawHill.

Haidt, J., McCauley, C., & Rozin, P. (1994). Individual differences in sensitivity to disgust: A scale sampling seven domains of disgust elicitors. *Personality and Individual Differences, 16*(5), 701-713.

Haidt, J., Rozin, P., McCauley, C., & Imada, S. (1997). Body, psyche, and culture: The relationship between disgust and morality. *Psychology and Developing Societies, 9*(1), 107-131.

Hisli, N. (1988). Beck Depresyon Envanterinin gecerliligi uzerine bit calisma (A study on the validity of Beck Depression Inventory.). *Psikoloji Dergisi., 6*, 118-122.

Hu, L. t., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural equation modeling: a multidisciplinary journal, 6*(1), 1-55.

İnözü, M., & Eremsoy, C. E. (2013). Tiksinme Ölçegi ile Bulasma/Kirlenme Bilisleri Ölçegi'nin Türkçe Versiyonlarinin Psikometrik Özellikleri. *Turk Psikoloji Yazilari, 16*(31), 1.

Kantor, J. R., & Smith, N. W. (1975). *The science of psychology an interbehavioral survey*: University of Akron.

Karamustafalıoğlu, K., Üçışık, A., Ulusoy, M., & Erkmen, H. (1993). Yale-Brown obsesyon-kompulsiyon derecelendirme ölçeği'nin geçerlilik ve güvenilirlik çalışması. *Bursa Savaş Ofset, 86*.

Kline, R. B. (2005). Principles and practice of structural equation modeling 2nd ed. *New York: Guilford, 3*.

Kline, R. B. (2011). Principles and practice of structural equation modeling (3. Baskı). *New York, NY: Guilford*.

Kugler, K., & Jones, W. H. (1992). On conceptualizing and assessing guilt. *Journal of personality and Social Psychology, 62*(2), 318.

Liu, Y., Zhang, D., & Luo, Y. (2015). How disgust facilitates avoidance: an ERP study on attention modulation by threats. *Social Cognitive and Affective Neuroscience, 10*(4), 598-604.

MacCallum, R. C., Widaman, K. F., Zhang, S., & Hong, S. (1999). Sample size in factor analysis. *Psychological methods, 4*(1), 84.

Meredith, W. (1993). Measurement invariance, factor analysis and factorial invariance. *Psychometrika, 58*(4), 525-543.

Nunnally, J. (1970). *Introduction to psychological measurement.* New York, NY: McGraw-Hill.

Olatunji, B. O., Adams, T., Ciesielski, B., David, B., Sarawgi, S., & Broman-Fulks, J. (2012). The Three Domains of Disgust Scale: Factor structure, psychometric properties, and conceptual limitations. *Assessment, 19*(2), 205-225.

Olatunji, B. O., Haidt, J., McKay, D., & David, B. (2008). Core, animal reminder, and contamination disgust: Three kinds of disgust with distinct personality, behavioral, physiological, and clinical correlates. *Journal of Research in Personality, 42*(5), 1243-1259.

Olatunji, B. O., & Sawchuk, C. N. (2005). Disgust: Characteristic features, social manifestations, and clinical implications. *Journal of Social and Clinical Psychology, 24*(7), 932-962.

Olatunji, B. O., Williams, N. L., Tolin, D. F., Abramowitz, J. S., Sawchuk, C. N., Lohr, J. M., & Elwood, L. S. (2007). The Disgust Scale: item analysis, factor structure, and suggestions for refinement. *Psychological assessment, 19*(3), 281.

Öner, N., & LeCompte, W. A. (1985). *Durumluk-sürekli kaygı envanteri el kitabı*: Boğaziçi Üniversitesi Yayınları.

Poli, A., Melli, G., & Radomsky, A. S. (2019). Different disgust domains specifically relate to mental and contact contamination fear in obsessive-compulsive disorder: Evidence from a path analytic model in an Italian clinical sample. *Behavior therapy, 50*(2), 380-394.

Rachman, S., Radomsky, A. S., Elliott, C. M., & Zysk, E. (2012). Mental contamination: The perpetrator effect. *Journal of Behavior Therapy and Experimental Psychiatry, 43*(1), 587-593.

Rokvic, N., & Jovović, R. (2022). Serbian translation of the Three Domains of Disgust Scale (TDDS): a pilot study. *Engrami, 44*(2).

Rozin, P., & Fallon, A. E. (1987). A perspective on disgust. *Psychological Review, 94*, 32-41.

Rozin, P., Haidt, J., & McCauley, C. R. (2008). Disgust. In M. Lewis, J. M. Haviland-Jones, & L. F. Barrett (Eds.), *Handbook of emotions* (3rd ed., pp. 757–776). New York, NY: Guilford Press.

Salvucci, S., Walter, E., Conley, V., Fink, S., & Saba, M. (1997). Measurement Error Studies at the National Center for Education Statistics.

Satorra, A., & Bentler, P. M. (1994). Corrections to test statistics and standard errors in covariance structure analysis. Thousand Oaks, CA: Sage.

Spielberger, C., Gorsuch, R., & Lushene, R. (1983). State-trait anxiety inventory STAI (Form Y). *Redw City Mind Gard*.

Stevenson, R. J., Oaten, M. J., Case, T. I., Repacholi, B. M., & Wagland, P. (2010). Children's response to adult disgust elicitors: Development and acquisition. *Developmental psychology*, *46*(1), 165.

Tangney, J. P., Stuewig, J., & Mashek, D. J. (2007). Moral emotions and moral behavior. *Annu. Rev. Psychol.*, *58*, 345-372.

Tybur, J. M., Bryan, A. D., Lieberman, D., Hooper, A. E. C., & Merriman, L. A. (2011). Sex differences and sex similarities in disgust sensitivity. *Personality and Individual Differences*, *51*(3), 343-348.

Tybur, J. M., Lieberman, D., & Griskevicius, V. (2009). Microbes, mating, and morality: individual differences in three functional domains of disgust. *Journal of personality and social psychology*, *97*(1), 103.

Van de Schoot, R., Lugtig, P., & Hox, J. (2012). A checklist for testing measurement invariance. *European journal of developmental psychology*, *9*(4), 486-492.

Van Hooff, J. C., Devue, C., Vieweg, P. E., & Theeuwes, J. (2013). Disgust-and not fear-evoking images hold our attention. *Acta psychologica*, *143*(1), 1-6.

Whitton, A. E., Grisham, J. R., Henry, J. D., & Palada, H. D. (2013). Interpretive bias modification for disgust. *Journal of Experimental Psychopathology*, *4*(4), 341-359.

Xiang, Y., Chen, D., & Zhao, J. (2021). How is childhood abuse associated with moral disgust? The mediating role of social support and gratitude——Based on the theory of mind. *Journal of Aggression, Maltreatment & Trauma*, *30*(8), 1028-1040.