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Abstract

Many studies have been conducted on psychological distress but the question of how to conceptualize and assess this phenomenon still remains a controversial issue. Clinimetrics, the science of clinical measurements, may pave the ground for a substantial revision of the clinical conceptualization and assessment of this construct. A Rasch analysis was performed to evaluate whether the SCL-90-R and its subscales were valid indices of underlying dimensions of psychological distress. Based on the clinimetric validation of the SCL-90-R, as well as on a critical review of the available literature, a concept analysis of psychological distress was performed. The SCL-90-R total score misfitted the Rasch model but it was found to have a Person Separation Reliability Index of 0.94. Model fit was achieved after the exclusion of six misfitting items. Paired t-tests indicated that all the subscales of the SCL-90-R were unidimensional. Psychological distress was defined as a subjective, unifying, dimensional, and trans-diagnostic construct consisting in a unique experience of discomfort, which may involve a sense of demoralization, the experience of feeling broken or mental pain, a sense of anguish, symptoms of somatization and ADHD, feelings of anger, self-perceived lack of control, and self-criticism. Our findings also showed that the SCL-90-R could reliably differentiate healthy stress from psychological distress, and identify individuals at risk of psychiatric disorders. The total score of the 84-item version of the SCL-90-R may be used as an overall indicator of psychological distress. The subscales are recommended to assess the severity of specific symptomatic manifestations of psychological distress.

Keywords: assessment, clinimetrics, concept, psychological distress, SCL-90-R

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The term distress has its etymological roots in a variety of sources. It has been argued (Ridner, 2004) that it has a Latin origin and derives from the word *distringo*, which results from the combination of two words, *dis* meaning apart (i.e., asunder) and *stringere*, which means both tight (i.e., feeling tense) and strain (i.e., injured by overuse or to be stretched beyond a proper limit). The Latin term *distringo* was, therefore, originally used to describe a complex and dynamic process consisting in an initial phase of tension and straining followed by a state that involves the experience of feeling broken or wounded (Ridner, 2004; Rhodes & Watson, 1987). In medieval language, particularly in old French, the word *districtia*, which means restraint or narrowness, was consistently used as a noun to indicate the process of distraining or the condition of being distrained (Rhodes & Watson, 1987). In the Middle English the word *stresse*, which itself is a derivative of *destresse*, was used to denote circumstances that may lead to pathological consequences (Wagner, 1990; Young, 1980). Later, the term distress was used to indicate a sore pressure that has the potential to produce or restrain actions (Armstrong, 2003; Rhodes & Watson, 1987).

Controversial Issues

Despite the widespread use of the term in a variety of clinical and non-clinical settings (Carolan et al., 2015; Ridner, 2004; Rhodes & Watson, 1987; Young, 1980), as a concept, psychological distress is seldom defined and without any clear definitional boundaries (Phillips, 2009), implying that criteria for its assessment remain poorly operationalized (Carolan et al., 2015; Phillips, 2009; Rhodes & Watson, 1987). In addition, psychological distress was also often confused with psychiatric disorders such as depression and anxiety (Phillips, 2009) or with stress, which is a non-specific, general adaptation syndrome and biological/physiological response of the body to any demand of the environment (Selye, 1956). Another controversial issue has to do with the fact that there have been various definitions in the literature, particularly in the psychiatric field, where, in addition to psychological distress, terms such as affective distress, bodily distress, emotional distress, interpersonal distress, moral distress, subjective distress, neurotic distress, psychogenic distress, psychosocial distress, somatic distress, symptom distress,

and many others have been used to refer to this construct (Carolan et al., 2015; Kellner & Sheffield, 1973; Lipowski, 1987; Morley et al., 2019; Rhodes & Watson, 1987; Ridner, 2004; Sonino & Fava, 1998; Turner et al., 1999; Young, 1980). There is, therefore, a need for a unifying concept since this lack of clarity led to considerable confusion as to which conceptualization is the most appropriate to use when conducting research on psychological distress (Ridner, 2004).

The Conceptual Framework

One of the most widely used definitions of psychological distress was provided by Lazarus and Folkman (1984) who conceived it as a peculiar relationship between the individual and the environment that is appraised as taxing or exceeding his or her resources and endangering his or her well-being. The first definition of subjective distress is, however, generally ascribed to the Roman philosopher Cicero who described it as a shrinking together of the soul in conflict with reason (Buch-Hansen, 2010). It took a long time before this concept was approached in clinical terms, when Parloff et al. (1954) defined psychological distress as a very subjective state characterized by specific feelings of discomfort. They emphasized that the subjective perception of discomfort is a key factor in the development of psychological distress (Parloff et al., 1954). McCorkle and Young (1978) provided a similar definition conceiving distress as the degree of psychological discomfort reported by patients in relation to their perceptions of the symptoms being experienced. Consistently, Bech (1990) defined psychological distress as a subjective experience covering a wide range of unpleasant feelings of discomfort such as feeling hopeless about the future, irritable, blue, lonely, and low in energy. Ridner (2004) proposed a similar definition conceptualizing psychological distress as a unique discomforting and emotional state experienced by an individual in response to a specific stressor or demand that results in harm, either temporary or permanent, to the person. He also stated that, to experience psychological distress, an individual must perceive an inability to cope with a stressor (Ridner, 2004). This is in line with Frank's characterization of demoralization, a state of mind of a person deprived of spirit, disheartened, and bewildered (de Figueiredo & Frank, 1982). The clinical hallmark of demoralization is a sense of subjective incompetence consisting in a self-perceived incapacity of the individual to perform tasks and express feelings deemed appropriate in a stressful situation (de Figueiredo & Frank, 1982). As Bech

(1993) noted, Frank (1974) preferred the term demoralization to discomfort emphasizing that individuals with psychological distress are conscious of having failed to meet their own expectations or those of significant others as they feel unable to cope with some pressing problems and powerless to change the situation or themselves. The National Comprehensive Cancer Network proposed a similar definition conceptualizing psychological distress as a multidimensional unpleasant emotional experience that extends along a continuum (Carolan et al., 2015). This unpleasant emotional experience may interfere with the ability of the individual to cope effectively with cancer and daily life problems (Carolan et al.,2015). Psychological distress has also been linked to mental pain, an internal state of intense suffering associated with feelings of guilt, anguish, fear, panic, loneliness, and helplessness (Fava et al., 2019; Rhodes & Watson, 1987; Shneidman, 1993). According to Rhodes and Watson (1987), psychological distress can be defined as a state of physical or mental suffering or as a feeling of anguish of the individual. Cassel (1998) proposed a similar conceptualization defining psychological distress as an intense experience of suffering that occurs when an impending destruction of the person is perceived. Conducting qualitative and quantitative studies, Massé (2000) provided a comprehensive definition of psychological distress. He identified the following six characteristic ways of expressing psychological distress (Massé, 2000): 1) demoralization and pessimism toward the future consisting in a deep conviction that, in the future, things can only get worse; 2) anguish and stress conceived as an internal suffering entailing preoccupations, nervous tension, and feelings of powerlessness; 3) self-depreciation consisting in the tendency of some people to be very self-critical and to put the blame on themselves; 4) social withdrawal and social isolation when people do not want to socialize with others, preferring to escape from social life; 5) somatization characterized by common signs such as physical exhaustion, loss of energy, and fatigue; 6) withdrawal into oneself, which was conceptualized as a core idiom of psychological distress and consists in the individual's perceived incapacity to control his or her life and to adjust to his or her social environment. According to Ilfeld (1976), psychological distress is defined as a nonspecific syndrome that covers psychiatric disturbances such as anxiety, depression, cognitive problems, irritability or anger, and obsession-compulsion. Similarly, Wheaton (2007) provided a psychiatric definition of psychological distress arguing that it is an underlying component of anxiety and

depression. Keyes et al. (2010) found a significant relationship between psychological distress and languishing, an intermediate state between mental health and illness that involves the subjective experience of not feeling good and not functioning well in life. Over the years, a wide range of alternative definitions have been proposed (Drapeau et al., 2010; Gadalla, 2009; Goldberg, 1992; Higginson et al., 2011; Horwitz, 2007; McEwen & Stellar, 1993; O'Grady et al., 2012; Phillips, 2009) but there is still little consensus as to the adequacy of existing definitions and the question of how to conceptualize psychological distress remains a controversial issue (Phillips, 2009; Ritter, 2007). Similar problems apply to the evaluation of this construct. In the literature, there is still little consensus about the clinical process of assessment of psychological distress (Bech, 1990; de Figueiredo, 2013; Phillips, 2009; Wagner, 1990).

The Assessment of Psychological Distress

Consistent with the basic assumption that psychological distress is a very subjective experience that no one can judge it but the patient (Parloff et al., 1954; Ridner, 2004), a number of Patient-Reported Outcome Measures (PROMs), self-rated scales or indices coming directly from patients about how they feel in relation to a health condition or its therapy (Carrozzino et al., 2021; Fava et al., 2019), have been developed to improve the detection of psychological distress (Andrews & Slade, 2001; Cohen et al., 1983; Kellner, 1987; Kellner & Sheffield, 1973; Kessler et al., 2002; Lovibond & Lovibond, 1995; Poulin et al., 2005; Roth et al., 1998; Sonino & Fava, 1998; Veit & Ware, 1983; Zung, 1983). The Symptom Questionnaire (SQ) is one of the first comprehensive measures of psychological distress that was developed by Robert Kellner in 1976 (Benasi et al., 2020). It was found to be a highly sensitive instrument (Benasi et al., 2020) but the dichotomous response format of items and the inclusion of negatively and positively worded questions does not facilitate the clinical distinction between symptoms of psychological distress and aspects of subjective well-being (Timmerby et al., 2017). A similar problem applies to the Mental Health Inventory, the MHI, which was designed to assess both general psychological distress and subjective well-being (Veit & Ware, 1983). In the same year, Cohen et al. (1983) developed the Perceived Stress Scale, the PPS, a 14-item self-rated scale specifically designed to measure the degree to which situations in one's life are appraised as stressful. Studies, however, showed that the PPS is a two-dimensional measure of perceived stress and coping/resilience (Andreou et al.,

2011; Golden-Kreutz et al., 2004). Lovibond and Lovibond (1995) developed the Depression, Anxiety and Stress Scales, the DASS. As Henry and Crawford (2005) reported, while there is strong evidence that the DASS subscales of depression and anxiety are valid measures of the underlying dimensions under evaluation, it remains unclear whether the DASS subscale of stress should be regarded as a measure of general psychological distress or instead as a measure of stress that is related to a dimension of negative affectivity. Sonino and Fava (1998) developed the Psychosocial Index, the PSI, which is another highly sensitive measure of psychological distress. It should be noted, however, that the PSI includes a self-rated and an observer-rated part requiring a clinician, who is experienced in the use of the PSI, to assess the degree of psychological distress and its impact on the patient's life (Sonino & Fava, 1998). Kessler et al. (2002) developed the K10 and the K6, two highly sensitive screening measures of nonspecific psychological distress. However, given the small number of items included in these two screening measures, they should be supplemented by comprehensive scales of psychological distress (Kessler et al., 2010). The Hopkins Symptom Checklist (HSCL) is a comprehensive measure of psychological distress and, in spite of its many items, is an easy-to-use instrument that can be completed in about 10-15 minutes (Bech, 2016). Compared to other self-reported questionnaires of psychological distress, the HSCL consists of items that are less invasive, implying that general population studies are easy to perform (Carrozzino et al., 2016). This is probably the main reason why the HSCL is one of the most widely used PROMs of psychological distress (Bech, 2016; Carrozzino et al., 2016; Parloff et al., 1954). It also should be noted that the HSCL was originally designed to detect pure symptoms of psychological discomfort (Bech, 2016; Carrozzino et al., 2018). In addition, the HSCL is one of the few PROMs of psychological distress in which each item is negatively worded and rated on a Likert-scale, thus allowing clinicians and researchers to more accurately assess the degree of psychological distress (Bech, 2016; Carrozzino et al., 2018).

The HSCL

The HSCL takes its name from the Johns Hopkins University Hospital in Baltimore, where more than 60 years ago this rating scale was used as an outcome measure for evaluating the efficacy of psychotherapy in neurotic patients presenting with symptoms of psychological distress (Bech, 2016). The

first version of the HSCL was developed by Parloff et al. (1954) and consisted of 41 items only. Over the years, a number of modifications and several versions of the HSCL have been introduced (Derogatis et al., 1974; Lipman et al., 1979; Mollica et al., 1987; Schmalbach et al., 2021). The versions that are available differ not only in the number and wording of items but also from a clinical perspective. The ultimate version of the HSCL, the SCL-90-R, is the most comprehensive from a clinical point of view as it has been found to cover a wide range of self-reported symptoms of psychological distress (Bech & Timmerby, 2018; Carrozzino et al., 2016). Many studies have been conducted to investigate the measurement properties of the SCL-90-R but in most of them the validation process relied on classical psychometrics (Müller et al., 2010; Prunas et al., 2012; Vassend & Skrondal, 1999). It has been shown that the exclusive reliance on classical psychometrics is likely to clash with the complexity of clinical reality, because of its quest for homogeneity of components and inadequate attention to clinimetric properties of assessment instruments (Charlson et al., 2022; Cosci, 2021; Fava, 2022; Fleck et al., 2019).

The Clinimetric Approach

It was Alvan R. Feinstein (1982, 1987), who joined the terms "clini" (which stands for clinical) and "metrics" (which refers to the process of assessment), to coin the word "clinimetrics", a scientific domain, which is concerned with rating scales and indices, as well as with the assessment of clinical phenomena (e.g., severity and staging) that demarcate major prognostic and therapeutic differences among patients. This innovative approach has later been defined as the science of clinical measurements (Fava et al., 2012). The science of clinimetrics has a set of conceptual and methodological principles that apply to the evaluation of measurement properties (e.g., dimensionality), which did not find room in classical psychometrics (Bech, 2012; Fava et al., 2018). Such principles have been recently refined with the introduction of Clinimetric Patient-Reported Outcome Measures (CLIPROM) criteria, which challenge the traditional views of how new and existing PROMs should be developed, improved, and validated (Carrozzino et al., 2021). According to CLIPROM criteria (Carrozzino et al., 2021), Item Response Theory (IRT) models (i.e., Rasch and Mokken analyses) are needed to evaluate the construct validity or dimensionality of PROMs. The clinimetric analysis of construct validity refers not only to the examination of the extent to which a rating scale is a valid measure of severity of the construct under

evaluation but also to the assessment of whether each item included in a rating scale belongs to an underlying dimension and provides unique/distinctive clinical information (Carrozzino et al., 2021).

Previous Studies

Bech and his research group provided an outstanding contribution to the validation process of the SCL-90-R (Bech et al., 1992; Carrozzino et al., 2016; Olsen et al., 2004). They conducted one of the first clinimetric analyses of the SCL-90-R (Carrozzino et al., 2016). It should be noted, however, that CLIPROM criteria (Carrozzino et al., 2021) were partially addressed by investigators, who only used the Mokken analysis to test the construct validity of the SCL-90-R (Carrozzino et al., 2016). Mokken analysis is a weaker test than the Rasch one since external factors such as age and gender of participants are not included as part of the analysis in the same way as in the Rasch model (Bech, 2012). According to CLIPROM criteria (Carrozzino et al., 2021), Rasch analysis also allows to estimate the clinimetric sensitivity of PROMs, testing the ability of rating scales to detect changes in clinical (i.e., drug or psychotherapy) trials, to differentiate an active treatment from placebo, and to distinguish patients from healthy controls (Kellner & Sheffield, 1973). There is, therefore, a need for a clinimetric reanalysis of the SCL-90-R using the Rasch measurement model (Carrozzino et al., 2021).

Aims

A Rasch analysis was conducted according to CLIPROM criteria (Carrozzino et al., 2021) to evaluate the construct validity and clinimetric sensitivity of the SCL-90-R. Construct validity or dimensionality was tested to determine whether the SCL-90-R and its clinical subscales were valid indices of the underlying dimensions or conceptualizations of psychological distress that they intended to measure. Based on the clinimetric validation of the SCL-90-R, as well as on a critical synthesis of the available literature, a concept analysis of psychological distress was performed. The clinimetric sensitivity of the SCL-90-R total score and clinical subscales were also assessed, particularly to evaluate the ability of these indices to differentiate between participants with different levels of psychological distress. On this background, the following research questions and hypotheses were addressed: first, to what extent is the SCL-90-R a valid measure of psychological distress? The research hypothesis of the total score of the SCL-90-R as a comprehensive measure fitting the Rasch measurement model expectations will be tested.

Second, to what extent are the clinical subscales of the SCL-90-R valid indices of psychological distress? The research hypothesis of the SCL-90-R subscales as unidimensional indices of severity of specific symptomatic manifestations of psychological distress will be evaluated. Third, what are the main clinical applications of the SCL-90-R total score and subscales? The research hypothesis that the SCL-90-R total score and subscales have different clinical applications will be examined. Fourth, based on the clinimetric analysis of the SCL-90-R, as well as on the critical review of the available literature, what are the distinctive features of psychological distress?

Methods

Sample

A non-probabilistic convenience sample of 1000 participants was used in the present study. Demographic characteristics (e.g., age, gender) of the sample are reported in Table 1. Trained clinical psychologists collected the data in five different Italian universities of which two were located in Southern Italy (i.e., University of Catania, and "G. d'Annunzio" University of Chieti-Pescara), one was in Central Italy (i.e., University of Perugia), and the other two were in North West (i.e., the University of Turin) and Eastern Italy (i.e., Padua University). Participants, mainly students, professors, researchers, and administrative employees with an age range of 18-89 years, were approached in public places such as Universities classrooms, laboratories, libraries, and administrative offices, and invited to take part in this cross-sectional and multicenter survey by an investigator, who explained the aims of the study (Carrozzino et al., 2016). Participants were excluded if they had cognitive deficits or other impairments affecting their reading and understanding abilities. Further details on sample characteristics and recruitment procedures are reported elsewhere (Carrozzino et al., 2016; Pignolo et al., 2018). Respondents had to sign a written informed consent for study participation. The study was conducted in compliance with APA ethical standards (American Psychological Association, 2002) and in accordance to the Declaration of Helsinki. The study also received the ethical approval by the Institutional Review Board of the University of Perugia, Perugia, Italy.

Measure

The SCL-90-R (Derogatis, 2008) is a self-reported questionnaire consisting of 90 items with responses rated on a 5-point Likert scale ranging from 0 (i.e., not at all) to 4 (i.e., extremely). All items are negatively phrased to assess symptomatic manifestations of psychological distress (Bech, 2016). The respondent is asked to report how much a given item (i.e., symptom) distressed or bothered him/her during the last week (Derogatis, 2008). The SCL-90-R includes a total score and 7 clinical subscales that were selected and validated by Carrozzino et al. (2016). The specific dimensions of psychological distress, which were analyzed in the present study, were the SCL-90-R subscales of somatization, hostility, interpersonal sensitivity, and attention deficit hyperactivity disorder (ADHD), as well as the SCL-90-R indices corresponding to the items of the Major Depression Inventory (MDI), to the six-item version of the Hamilton Rating Scale for Depression (HAM-D$_6$), and to the 8-item version of the Anxiety Symptom Scale (ASS$_8$). The items of these clinical subscales (Carrozzino et al., 2016) are reported in the supplemental material (Table S1). In the present study, the Italian version of the SCL-90-R, which was translated by Prunas et al. (2012), was used. The Italian version of the SCL-90-R was found to entail the clinimetric properties of construct and concurrent validity (Carrozzino et al., 2016).

Statistical Analyses

Given the polytomous structure of the SCL-90-R, including more than two response categories, the unrestricted partial credit model, which assumes the distance between item thresholds to be different across all items (Christensen et al., 2019), was used. Rasch analysis was performed using the Rasch Unidimensional Measurement Models (RUMM2030) software (Andrich et al., 2010) to analyze the following clinimetric properties: 1) the overall fit, which was tested with the chi-square item-trait interaction statistics (Pallant & Tennant, 2007; Tennant & Conaghan, 2007). The overall fit is a summary measure of the extent to which the SCL-90-R total score and clinical subscales match the assumptions of the Rasch model (Nielsen et al., 2017). A non-significant chi-square probability value indicates a good level of fit (Pallant & Tennant, 2007; Tennant & Conaghan, 2007). 2) Standardized fit residuals for items and persons were evaluated for any indication of misfit (i.e., values outside ± 2.5) (Christensen et al., 2017). 3) Construct validity was tested to determine whether the SCL-90-R total score and clinical subscales were valid indices of the underlying dimensions of psychological distress that they intended to

assess. According to methodological recommendations on the assessment of dimensionality in the Rasch measurement model (Smith, 2002), Principal Component Analysis (PCA) of standardized residuals was run to identify characteristics shared in common among items of the SCL-90-R. This test of unidimensionality was originally introduced by Smith (2002) and is aimed at examining the patterning of items in the residuals by evaluating the correlation between items and the first residual factor. This patterning is used to define the two most different subsets of items (i.e., the most positively and negatively factor-loading items on the first component). These two subsets of items are then used to make separate person estimates and, when conducting independent *t*-tests for the difference in these estimates for each person, the number of such tests should not exceed 5% (Smith, 2002). Therefore, if more than 5% of *t*-tests were significant, the SCL-90-R total score and clinical subscales were not unidimensional (Christensen et al., 2019). This is a widely used statistical approach that appears to give a test of strict unidimensionality and is robust enough to detect multidimensionality (Conaghan et al., 2007; Forkmann et al., 2013; Raman et al., 2017; Smith et al., 2009; Tennant & Conaghan, 2007). As Smith (2002) also noted, this PCA test of undimensionality is particularly useful under conditions in which the aim of the study is to produce a unidimensional assessment or several unidimensional subscales to be analyzed separately. This is the main reason why this specific approach was used in our clinimetric validation, which is aimed at evaluating the construct validity or dimensionality not only of the total score but also of the clinical subscales of the SCL-90-R. 4) Local dependency was tested for assessing the extent to which the response on one item determined the response on another (Tennant & Conaghan, 2007). 5) Differential Item Functioning (DIF), which was investigated to evaluate whether participants within the same sample (e.g., males and females) respond in a different way to an individual item despite equal levels of the underlying trait under assessment (Pallant & Tennant, 2007). 6) Person Separation Reliability Index (PSI) was performed to estimate the clinimetric sensitivity of the SCL-90-R (Carrozzino et al., 2021).

Results

Fit to the Rasch Model for the SCL-90-R

The initial analysis of the SCL-90-R revealed a significant item-trait interaction statistic (χ^2 = 27126.73, degrees of freedom [df] = 810, $p < 0.001$), demonstrating misfit to the Rasch measurement model (Table 2, Analysis 1). Standardized fit residuals for items ($SD = 3.43$) were not within acceptable limits. Standardized fit residuals for persons ($SD = 1.01$) were found to be within acceptable limits. Rescoring all items, ordered response categories were achieved for 89 of the 90 items of the SCL-90-R (i.e., responses to item no. 16 remained disordered) but without significantly improving the overall fit to the Rasch model (Table 2, Analysis 2). Even after adjusting the sample size (Table 2, Analysis 3) to reduce the occurrence of Type I errors (Hagell & Westergren, 2016), fit to the model was not achieved (χ^2 = 1060.37, df = 810, $p < 0.001$). Model fit was achieved after the exclusion of misfitting items (Table 2, Analysis 5-8). Item Characteristic Curves (ICC) for the six misfitting items are shown in the supplemental material (Figures S1-S6). All the misfitting items had low discrimination parameters (Figures S1-S6). Rasch fit statistics for the retained 84 items of the SCL-90-R are reported in Table 3. This analysis indicated that the item 40 was the most problematic in terms of fit residuals (Table 3). Table 3 also showed that the easiest to endorse was item 2 (i.e., nervousness or shakiness inside), while the most difficult was item 35 (i.e., other people being aware of your private thoughts).

Fit to the Rasch Model for the SCL-90-R clinical subscales

Model fit statistics of the SCL-90-R subscales are reported in Table 4. The initial analysis of the SCL-90-R somatization subscale showed a significant item-trait interaction statistic (χ^2 = 158.40, df = 96, $p < 0.001$), suggesting misfit to the Rasch model (Table 4). The fit to the Rasch model was achieved (χ^2 = 107.69, df = 88, $p = 0.08$) after the exclusion of the misfitting symptom (i.e., item no. 1). Standardized fit residuals for items ($SD = 1.46$) and persons ($SD = 1.51$) were found to be within acceptable limits. The analysis of the SCL-90-R hostility subscale revealed a significant item-trait interaction statistic (χ^2 = 96.72, df = 24, $p < 0.001$), demonstrating misfit to the Rasch measurement model (Table 4). The initial analysis of the SCL-90-R interpersonal sensitivity subscale showed a significant item-trait interaction statistic (χ^2 = 221.69, df = 63, $p < 0.001$), indicating misfit to the Rasch model (Table 4). Even after the exclusion of the misfitting symptom (i.e., item no. 6), fit to the Rasch model was not achieved (χ^2 = 80.34, df = 56, $p = 0.02$). Rasch analysis of the subscale covering the items of the MDI showed a non-

significant item-trait interaction statistic ($\chi^2 = 92.40$, df = 80, $p = 0.16$), which indicated adequate fit to the model, with no misfitting items. Standardized fit residuals for items ($SD = 1.73$) and persons ($SD = 1.56$) were found to be within acceptable limits. Rasch analysis of the SCL-90-R subscale corresponding to the items of the HAM-D$_6$ revealed a non-significant item-trait interaction statistic ($\chi^2 = 46.37$, df = 36, $p = 0.12$), which resulted in an adequate fit to the model. Standardized fit residuals for items ($SD = 1.77$) and persons ($SD = 1.67$) were found to be within acceptable limits. Rasch analysis of the SCL-90-R subscale covering the items of the ASS$_8$ showed a significant item-trait interaction statistic ($\chi^2 = 135.54$, df = 48, $p < 0.001$), indicating misfit to the Rasch model (Table 4). The analysis of the SCL-90-R subscale covering symptoms of ADHD revealed a significant item-trait interaction statistic ($\chi^2 = 59.14$, df = 30, $p = 0.001$), suggesting misfit to the Rasch model (Table 4).

Dimensionality

Testing for dimensionality revealed significant t-tests outside the critical value of 5%, suggesting that the total score of the SCL-90-R was multidimensional (Table 2, Analysis 1-8). As to the SCL-90-R somatization subscale, even after the exclusion of the misfitting symptom (i.e., item no. 1), less than 5% of t-tests were significant, indicating that this index was unidimensional (Table 4). Concerning the hostility subscale, less than 5% of t-tests were significant, suggesting that this measure was unidimensional (Table 4). As to the SCL-90-R interpersonal sensitivity subscale, even after the exclusion of the misfitting symptom (i.e., item no. 6), less than 5% of t-tests were significant, indicating that this subscale was unidimensional. Regarding the SCL-90-R subscale covering the items of the MDI, less than 5% of t-tests were significant, showing that this index was unidimensional (Table 4). As to the SCL-90-R subscale corresponding to items of the HAM-D$_6$, less than 5% of t-tests were significant, suggesting that this measure was unidimensional (Table 4). Concerning the SCL-90-R subscale covering the items of the ASS$_8$, less than 5% of t-tests were significant, showing that this subscale was unidimensional. As to the SCL-90-R subscale reflecting symptoms of ADHD, less than 5% of t-tests were significant, suggesting that this index was unidimensional (Table 4).

Local Dependency

Indication of local dependency was found between items 67 (i.e., having urges to beat, injure or harm someone) and 81 (i.e., shouting or throwing things) of the SCL-90-R with a residual correlation > 0.30.

DIF

Items 5 (i.e., loss of sexual interest or pleasure), 20 (i.e., crying easily), 49 (i.e., hot or cold spells), 74 (i.e., getting into frequent arguments), and 84 (i.e., having thoughts about sex that bother you a lot) showed a statistically significant uniform DIF for gender with males and females responding systematically differently despite equal levels of the underlying characteristic being measured. A statistically significant uniform DIF for age was detected on items 1 (i.e., headaches) and 5 (i.e., loss of sexual interest or pleasure) with older and younger participants responding systematically different despite equal levels of the underlying characteristic being evaluated. There was no indication of statistically significant DIF for education.

PSI

PSI was 0.94 (Table 2, Analysis 1), indicating that the total score of the SCL-90-R could reliably differentiate between individuals displaying different levels of the underlying trait under examination. PSI of the SCL-90-R somatization subscale was 0.71 (Table 4), showing that this measure could reliably distinguish between different groups but not between different individuals. PSI indices of the SCL-90-R hostility, interpersonal sensitivity, depression (MDI), depression (HAM-D$_6$), anxiety (ASS$_8$), and ADHD subscales were found to range from 0.44 to 0.69 (Table 4), suggesting that these indices could not be reliably used to distinguish between groups of participants with different levels of the underlying construct.

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Discussion

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The findings of the present study indicate that the SCL-90-R is a comprehensive measure of psychological distress. This is in line with previous studies showing that the total score of the SCL-90-R was a multidimensional index (Carrozzino et al., 2018; Olsen et al., 2004; Paap et al., 2011). This implies that caution should be paid when using the SCL-90-R as an outcome measure in clinical trials since its total score was found to cover more than one dimension of psychological distress. Multidimensionality of the total score of the SCL-90-R was therefore a significant source of misfit to the Rasch model.

Disordered response categories were also found. This is indicative of the fact that there are too many response options in the SCL-90-R or the labeling of response categories is potentially confusing or open to misinterpretation (Pallant & Tennant, 2007). Ordered response categories were achieved for 89 of the 90 items after collapsing the original 5-point Likert scoring system of the SCL-90-R into a 3-point response format, but without improving the overall fit to the Rasch model. DIF, which is a form of item bias, was found to be an additional source of misfit. DIF was observed for items 1, 5, 20, 49, 74, and 84. The fit to the Rasch model was achieved only after the exclusion of the six misfitting items (i.e., items 1, 6, 27, 42, 60, and 64) not being related to the underlying construct of psychological distress. The resulting 84-item version of the SCL-90-R, which fitted the Rasch model, may therefore be used as an overall index of psychological distress. Future studies are, however, needed to further investigate the fit of the observed data using alternative IRT analyses such as the Samejima's graded response model, which is particularly indicated when each item of the instrument under assessment had three or more response categories (Samejima, 1969; Stover et al., 2019). As to PSI, our findings indicate that the total score of the SCL-90-R is a highly sensitive clinimetric index, which can be used to reliably differentiate between individuals with various levels of psychological distress. This is in accordance with previous studies (Carrozzino et al., 2019; Olsen et al., 2006; Rugulies et al., 2010), which suggested using the SCL-90-R as a screening measure not only to differentiate healthy stress from symptoms of psychological distress but also to identify individuals at higher risk for psychiatric disorders. The clinical distinction between psychological distress and psychiatric disorders, as well as the differentiation between healthy stress and distress reactions that can result in maladaptive functioning of the individual have been a longstanding controversial issue in psychiatry and clinical psychology (Horwitz, 2007; Mulder, 2008; Wheaton, 2007). In an editorial published in one of the most influential journals of psychiatry, Michael R. Phillips (2009) noted that neither the DSM-IV nor the ICD-10 provided criteria for determining when psychological distress becomes clinically significant, making the distinction between normal and maladaptive distress quite difficult. Our findings indicate that the total score of the SCL-90-R can be used to support clinicians and investigators in defining clinical boundaries between eustress and psychological distress. Previous studies consistently suggested that a T-score of 63 or more on the SCL-90-R total score or on two or more

subscales of the SCL-90-R may be used to detect the presence of clinically significant levels of psychological distress (Bech et al., 2018; Carrozzino et al., 2019; Norup et al., 2010; Olsen et al., 2006).

In the same editorial, Michael R. Phillips (2009) also noted that psychiatric diagnostic systems did not assess the degree of psychological distress, suggesting that a method for rating its severity should be developed. Findings of the present study indicate that the clinical subscales of the SCL-90-R entailed the clinimetric property of construct validity or dimensionality: each item provided unique/distinctive clinical information and belonged to an underlying dimension of psychological distress. Such subscales that can be used as dimensional measures for assessing the degree of specific manifestations of psychological distress were the SCL-90-R indices of somatization, hostility, and interpersonal sensitivity, as well as those subscales covering the items of the MDI, HAM-D$_6$, ASS$_8$, and ADHD.

The SCL-90-R Dimension of Somatization

The findings of our clinimetric analysis are in line with those reported in previous studies and suggest that the SCL-90-R subscale of somatization is a valid measure of the tendency of some individuals to experience and communicate somatic symptoms in response to life events and internal situations that are personally stressful (Carrozzino et al., 2018; Carrozzino et al., 2019; Gylvin et al., 2018). It has been argued (Carrozzino et al., 2017) that this subscale covers the concept of somatization that has been originally introduced by Lipowski (1987; 1988). This clinimetric index can thus be used in different clinical and research settings not only to assess the severity of somatic distress but also to differentiate somatic manifestations of psychological distress from somatic symptoms related to physical problems (Belli et al., 2008; Bernstein et al., 1994; Carrozzino et al., 2018; Carrozzino et al., 2019; Kovács et al., 2010; Lizer et al., 1991; Wallis et al., 1998). This SCL-90-R subscale may therefore improve the detection of somatization particularly in patients with medical conditions, where this psychosomatic syndrome is often unrecognized or incorrectly interpreted as a physical disorder (Carrozzino et al., 2017).

The SCL-90-R Dimension of Hostility

Our results are in line with previous studies and indicate that the SCL-90-R hostility subscale is a valid measure of the individual tendency to react with anger in response to psychological distress (Arrindell et al., 2017; Carrozzino et al., 2018). Such a subscale may cover the concept of irritability that has been

introduced by Slater and Roth (1969) who defined it as a tendency to anger, a mode of response to psychological stimuli of a particular kind, such as those in which the individual is threatened in some way or is frustrated in a purposive course of action. O'Grady et al. (2012) considered anger as a common form of psychological distress, particularly in patients at the end of life. Left unrecognized and untreated in a patient, anger can amplify physical symptoms and have a negative effect on quality of life (O'Grady et al., 2012). The SCL-90-R hostility subscale can thus help clinicians and researchers not only to assess the impact of anger on the patient's life but also to differentiate healthy anger from manifestations of anger that deserve clinical attention.

The SCL-90-R Dimension of Interpersonal Sensitivity

Our findings are consistent with those reported by Olsen et al. (2004) and suggest that the SCL-90-R interpersonal sensitivity subscale is a valid measure of the tendency of some individuals to feel lonely, inferior to others, shy or inadequate with the opposite sex, and to be easily hurt, and often critical, especially during interpersonal interactions (Bech, 2018). Gillespie et al. (2001) found a significant relationship between the psychological distress dimension of interpersonal sensitivity and the Eysenck's construct of neuroticism, which is a personality trait of individuals who feel personally inadequate and are often self-critical and very sensitive to the criticism of others (Lahey, 2009; Thomas, 2009; Watson et al., 1994). Similarly, Bech et al. (2014) noted that the items of the SCL-90-R interpersonal sensitivity subscale overlap with the Eysenck's concept of neuroticism. This SCL-90-R subscale may therefore be used to assess not only the degree of interpersonal sensitivity but also its clinical relationship to a personality dimension of vulnerability. Important sources of information may also derive from the use of the SCL-90-R interpersonal sensitivity subscale as an outcome measure in psychotherapy trials for patients with personality disorders (Bech, 2016).

The SCL-90-R Dimensions of Demoralization

Our results are in line with previous findings (Carrozzino et al., 2016) and indicate that the SCL-90-R subscale covering the items of the MDI is a valid measure of the tendency of some individuals to experience demoralization in response to life events and situations that are personally stressful. Similar findings were observed for the SCL-90-R subscale corresponding to the items of the HAM-D$_6$

(Carrozzino et al., 2020). This index was found to be a valid measure of the individual tendency to experience demoralization in response to psychological distress. The SCL-90-R subscales of MDI and HAM-D$_6$ may therefore be used as dimensional measures to assess the degree of demoralization. Since some of the items of the SCL-90-R subscales of MDI and HAM-D$_6$ cover symptoms of depression (e.g., feeling no interest in things, feeling low in energy and slowed down), these clinimetric indices may also be used to detect the tendency of some individuals to experience and communicate psychological distress with symptoms of major depression (Goldberg, 1992).

The SCL-90-R Dimension of Anguish

As to the SCL-90-R subscale covering the items of the ASS$_8$, our findings are consistent with those reported in previous studies (Bech et al., 2014; Carrozzino et al., 2016) and indicate that this is a valid measure of the tendency of some individuals to experience and communicate psychological distress in the form of symptoms of anguish or anxiety. The SCL-90-R ASS$_8$ subscale can also be used to detect subclinical symptoms of anxiety, particularly in individuals, who do not meet diagnostic criteria for anxiety disorders (Carrozzino et al., 2016; Goldberg, 1992). Since some of the items of the SCL-90-R ASS$_8$ subscale (e.g., having to check and double-check what you do, having to repeat the same actions such touching, counting, washing) cover symptoms of obsessive-compulsive disorder (OCD), this clinimetric index may also be used in individuals with an OCD presentation of psychological distress. The experience and manifestation of psychological distress through symptoms of OCD may be viewed as a maladaptive way of coping with self-perceived lack of control, which is a core component of psychological distress (Higginson et al., 2011; Massé, 2000).

The SCL-90-R ADHD Dimension

Concerning the SCL-90-R ADHD subscale, our findings are in line with those reported in previous studies (Abbass et al., 2021; Eich et al., 2012) and suggest that this is a valid measure of the tendency of some individuals to experience and communicate psychological distress in the form of symptoms of ADHD. This clinimetric index may therefore be administered to assess the severity of psychological discomfort in individuals with an ADHD presentation of psychological distress.

The Unifying Concept of Psychological Distress

As a result of the present clinimetric analysis, as well as on the basis of a critical review of the available literature, the following core/distinctive features of psychological distress were identified: 1) this is a subjective state characterized by a unique perception of discomfort that has a central role in the development of psychological distress. Subjectivity is therefore the first clinical requirement that implies that no one can evaluate psychological distress but the individual. Consistent with this assumption, which considers the individual as an expert given the very subjective nature of psychological distress, PROMs (i.e., self-reported questionnaires or indices) rather than clinician-rated scales (e.g., interviews) should be used to improve the detection of this clinical phenomenon; 2) this is a unifying construct, which include the varying ways individuals may perceive, evaluate, and react to psychological distress; there is indeed strong evidence that individuals experience and express their psychological distress in a variety of ways, which may include a sense of demoralization, the experience of feeling broken or mental pain, a sense of anguish, symptoms of somatization and ADHD, manifestations of anger, self-perceived lack of control, and a tendency to self-criticism associated with feelings of inferiority. The intensity of specific manifestations of psychological distress can be detected by the SCL-90-R indices of hostility, interpersonal sensitivity, and somatization, as well as using the SCL-90-R subscales corresponding to the items of the MDI, HAM-D$_6$, ASS$_8$, and ADHD; 3) this is a dimensional construct that extends along a continuum, where initial healthy feelings of vulnerability, sadness, fatigue, and fear may be followed by an intermediate state characterized by symptoms of psychological discomfort that may lead to psychiatric disorders such as depression and anxiety. Symptoms of psychological distress do not necessarily reach the diagnostic thresholds of DSM-5 or ICD-11 categories. This implies that clinical assessment of psychological distress requires dimensional evaluation methods based on clinimetric principles (Bech, 2012; Carrozzino et al., 2021; Fava, 2022) rather than a categorical approach following DSM or ICD diagnostic classification systems; such dimensional evaluation methods need to involve repeated assessments using the SCL-90-R and a qualitative or idiographic approach based on the clinimetric method of staging (Cosci & Fava, 2022) to identify unique individual trajectories and examine the longitudinal development of psychological distress from the prodromal phase to its acute manifestation. Bilsbury and Richman (2002) presented a four-level staging model of psychological distress and

described the following trajectories of increasing discomfort and disability: Level 1 of balanced stress when the person is well rested in the morning, can reflect on work issues, allowing unfinished tasks to wait, and is still able to enjoy leisure time. Level 2 of busy stress when the individual can cope reasonably well despite excessive demands but work issues intrude into personal life affecting the ability to properly enjoying leisure activities. Level 3 defined as the stressed condition when the person feels increasingly time-pressured and is constantly worried about unfinished work and problems. Level 4, the overwhelmed experience, when personal needs such as breaks, meals, exercises, and recreation times are neglected since the person engages in frantic activities to deal with unfinished work and feels so overburdened that can scarcely cope with problems. The use of this staging model (Bilsbury & Richman, 2002) in a clinimetric perspective that includes the administration of the SCL-90-R may allow researchers and clinicians not only to assess problems of functional capacity and the extent to which psychological distress interferes with the individual's ability to function effectively in different life domains (e.g., family, health, social relationships, work) but also to better characterize the borderland between normal and pathological stress reactions; 4) psychological distress can be regarded as a trans-diagnostic construct of discomfort. The term trans-diagnostic, which means "across disorders", is used to indicate that psychological distress is neither a disorder nor a diagnostic category and does not always imply that an individual with psychological distress must suffer from a psychiatric disorder (Lipowski, 1988). In other terms, psychological distress may lead to different clinical complications but it may also occur independently from psychiatric disorders (Cosci & Fava, 2016; Fava et al., 2019). Such a unifying concept of psychological distress, which encompasses a broad spectrum of clinical phenomena that are not included in current diagnostic formulations, may yield new insights into the process of assessment and treatment of this unique experience of discomfort in the individual patient.

Limitations

The present study has some limitations. First, a non-probabilistic and convenience sampling approach was used to enroll participants, thus limiting the generalizability of findings. Future research is needed to replicate these findings in clinical and general population studies. Second, a cross-sectional design was used, precluding the evaluation of predictive and incremental validity of the SCL-90-R. Future studies

using a longitudinal design are thus needed to explore whether psychological distress represents a state or a stable trait of the individual. Third, only a self-reported measure was used. Future studies, making use not only of other PROMs but also of clinician-rated scales, are needed, particularly to evaluate the concurrent and clinical validity of the SCL-90-R. Fourth, the statistical null hypothesis test of fit relied on p-values that are largely dependent on sample size with Type I errors, which tend to increase with very large sample sizes (Hagell & Westergren, 2016). According to Hagell and Westergren (2016) and as previously suggested by Hobart and Cano (2009) and many others (e.g., Bergh, 2015), the downward algebraic sample size adjustment, a procedure that was found to reduce the risk of falsely detecting significant misfit, was therefore used. Given the limitations of p-values (Halsey et al., 2015), future studies should, however, consider alternative ways of assessing model fit using, for example, the estimation of effect size with associated class intervals (Hagell & Westergren, 2016). Similar recommendations apply to DIF where an approach, which is driven by effect size statistics rather than by p-values, is preferable (Guilera et al., 2013; Henninger et al., 2022; Zwick et al., 1997). Future studies applying sample size independent measures such as the Mantel-Haenszel effect size-based statistic (Guilera et al., 2013; Henninger et al., 2022; Zwick et al., 1997) should therefore be performed to improve the detection of DIF.

Conclusions

In recent years, there has been a reappraisal of the major clinical implications related to the process of assessment of psychological distress (e.g., the number of studies exceeds 40,714 on Web of Science, accessed on June 30, 2022), yet simple reference to psychological distress without providing a clear conceptualization of this construct is no longer acceptable (Burnette et al., 2020; Grund et al., 2022; Kusi-Appiah et al., 2021; Phillips, 2009). The clinimetric approach (Fava, 2022) and its CLIPROM criteria (Carrozzino et al., 2021) may provide an innovative methodological framework for a substantial revision of the clinical conceptualization and assessment of psychological distress. In this clinimetric analysis of the SCL-90-R, psychological distress was defined as a subjective, unifying, dimensional, and trans-diagnostic construct consisting in a unique experience of discomfort, which may involve a sense of demoralization, the experience of feeling broken or mental suffering, a sense of anguish, symptoms of

somatization and ADHD, feelings of anger, a perception of lack of control, self-criticism or interpersonal sensitivity. The findings of the present study also indicate that the SCL-90-R total score and its clinical subscales displayed different clinimetric properties. The total score was found to entail the clinimetric property of sensitivity and it may be suitable in the initial process of clinical assessment, particularly when used as a first-line screening measure not only to differentiate eustress from psychological distress but also to identify individuals at increased risk of psychiatric complications. However, when a global measure is needed, the 84-item version of the SCL-90-R, which was found to fit the Rasch model expectations, can be used as an overall indicator of psychological distress. This global index of psychological distress should be supplemented with the SCL-90-R clinical subscales. These subscales were found to be unidimensional indices and can therefore be used as dimensional and outcome measures to evaluate the degree of specific symptomatic manifestations of psychological discomfort.

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Table

Table 1

Demographic characteristics of the sample under study

	Sample (*n* = 1000)
Age M ± SD	48 ± 17.30
Gender *n* (%)	
Male	489 (48.90%)
Female	511 (51.10%)
Marital status *n* (%)	
Single	320 (32%)
Married	459 (45.90%)
Non-marital relationship	85 (8.50%)
Separated	31 (3.10%)
Divorced	21 (2.10%)
Widower	48 (4.80%)
Missing	36 (3.60%)

Note. M = Mean; SD = Standard Deviation

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Table 2

Model fit statistics for SCL-90-R items (n = 1000)

Action	Analysis	Model fit (overall)	Item fit residual, mean (SD)	Person fit residual, mean (SD)	PSI	Dimensionality, significant *t*-tests (%)
Original sample	1	$\chi2(810) = 27126.73, p < 0.001$	-0.57 (3.43)	-1.83 (1.01)	0.94	27.58
Rescoring all items (01112)	2	$\chi2(810) = 2078.33, p < 0.001$	-0.73 (2.56)	-2.96 (1.35)	0.94	24.44
Adjusted sample, n = 500	3	$\chi2(810) = 1060.37, p < 0.001$	-0.73 (2.56)	-2.96 (1.35)	0.94	24.44
Delete item 64	4	$\chi2(801) = 923.24, p = 0.002$	-0.70 (2.34)	-3.00 (1.38)	0.94	24.04
Delete item 1	4	$\chi2(792) = 867.61, p = 0.03$	-0.70 (2.24)	-3.03 (1.39)	0.94	21.52
Delete item 6	5	$\chi2(783) = 821.03, p = 0.17$	-0.66 (2.14)	-3.06 (1.41)	0.94	21.72
Delete item 27	6	$\chi2(774) = 766.38, p = 0.57$	-0.66 (2.06)	-3.09 (1.43)	0.94	21.52
Delete item 60	7	$\chi2(765) = 726.94, p = 0.83$	-0.63 (1.96)	-3.11 (1.45)	0.94	20.30
Delete item 42	8	$\chi2(756) = 670.71, p = 0.99$	-0.61 (1.92)	-3.15 (1.47)	0.94	19.80

Note. $\chi2$: chi-square; *p*: probability; SD: standard deviation; PSI: person separation index (with extremes)

Table 3

Rasch fit statistics for the retained 84 items

Item	Logit location	Fit residual	χ^2 statistics	$p < 0.0001$
2	-1.812	0.613	8.003	0.533875
3	-0.772	-2.003	6.726	0.665628
4	0.978	0.174	4.982	0.8359
5	-1.097	2.547	19.472	0.021463
7	0.895	-1.076	4.193	0.898271
8	-0.348	1.667	4.987	0.835428
9	-1.066	2.764	13.552	0.139173
10	-0.229	0.713	3.264	0.952915
11	-1.297	-0.134	4.703	0.859392
12	0.295	2.565	13.25	0.15162
13	1.563	-0.141	3.264	0.952914
14	-1.036	2.681	16.876	0.050694
15	1.294	-0.795	4.766	0.854232
16	0.923	0.813	7.88	0.546239
17	0.789	-0.361	3.101	0.960176
18	-0.908	1.875	10.587	0.305115
19	1.541	1.779	11.087	0.269797
20	-0.75	-0.066	4.363	0.885967
21	0.155	0.075	3.876	0.919387
22	0.64	-2.652	10.748	0.293387
23	0.605	-3.992	15.703	0.07335
24	0.012	-1.695	3.906	0.917472
25	1.991	-0.778	3.686	0.930841
26	-0.049	-2.692	6.243	0.715395
28	-0.316	-2.747	13.821	0.128852
29	-0.897	-1.347	3.565	0.937651
30	-1.767	-2.558	11.799	0.224907
31	-1.386	-3.166	8.455	0.489047
32	-0.266	-1.773	8.014	0.532698
33	0.201	-3.208	10.432	0.316671
34	-0.626	-2.388	7.691	0.565516
35	3.556	-1.019	9.242	0.415217
36	-0.164	-2.919	8.163	0.517763
37	0.065	-1.185	6.178	0.721975
38	-0.164	1.338	7.42	0.593489
39	0.114	-0.535	1.211	0.998779
40	-0.264	4.327	27.971	0.000964
41	-0.064	-2.869	8.184	0.515724
43	0.014	-2.127	7.1	0.626665
44	-1.135	2.785	19.533	0.021023
45	-0.48	0.177	3.686	0.930838
46	-0.883	-1.567	8.621	0.472934

47	0.879	0.383	5.443	0.794124
48	0.241	-0.727	3.828	0.922334
49	-0.268	1.774	10.224	0.332641
50	1.224	-3.067	12.602	0.181443
51	0.494	-3.026	13.463	0.142758
52	-0.218	2.289	8.888	0.447705
53	0.308	-2.025	8.285	0.505692
54	-1.048	-1.24	1.621	0.996149
55	-0.709	-1.674	5.42	0.796249
56	-0.422	1.275	12.418	0.190782
57	-0.85	-3.297	6.917	0.645748
58	-0.684	2.031	10.789	0.290435
59	0.307	-1.837	3.834	0.92201
61	-0.585	-1.693	11.657	0.233355
62	0.875	-1.598	4.761	0.854653
63	0.729	-0.212	3.617	0.934774
65	0.052	1.614	7.066	0.630299
66	-0.822	0.955	5.437	0.794656
67	0.467	-0.186	2.571	0.978899
68	-0.593	0.381	6.483	0.690736
69	0.076	-3.072	13.115	0.157492
70	1.041	-0.117	5.934	0.746489
71	-0.857	-2.314	4.693	0.860215
72	0.745	-1.475	18.726	0.027625
73	0.425	-1.188	6.15	0.724774
74	-0.586	1.99	18.007	0.035094
75	0.866	-0.919	3.163	0.95746
76	-0.515	-0.323	1.519	0.997004
77	0.03	-3.771	12.396	0.191876
78	0.958	-1.389	7.975	0.536714
79	-0.278	-3.252	7.312	0.604639
80	-0.35	-1.798	5.391	0.799019
81	0.557	-0.099	2.335	0.985007
82	1.111	-1.403	4.84	0.848006
83	-0.451	3.923	11.008	0.275149
84	-0.048	1.125	13.987	0.122805
85	-0.101	-1.533	2.643	0.97679
86	0.79	-1.951	5.686	0.770843
87	-0.379	1.203	5.616	0.777635
88	0.634	-1.696	3.422	0.945185
89	-0.837	-1.432	4.094	0.905113
90	-0.058	-2.931	7.071	0.629696

Note. $\chi 2$: chi-square; *p*: probability (Bonferroni-adjusted alpha level)

Table 4

Model fit statistics for the SCL-90-R clinical subscales (n = 500)

SCL-90-R subscales	K	Model fit (overall)	Item fit residual, mean (SD)	Person fit residual, mean (SD)	PSI	Dimensionality, significant *t*-tests (%)
Somatization	12	$\chi 2(96) = 158.40, p < 0.001$	-0.58 (2.60)	-2.82 (1.43)	0.71	3.64
- Item 1	11	$\chi 2(88) = 107.69, p = 0.08$	-0.45 (1.46)	-2.9 (1.51)	0.69	2.63
Hostility	6	$\chi 2(24) = 96.72, p < 0.001$	-2.14 (1.67)	-3.39 (1.67)	0.44	1.41
Interpersonal sensitivity	9	$\chi 2(63) = 221.69, p < 0.001$	-2.06 (3.01)	-2.95 (1.52)	0.63	3.03
- Item 6	8	$\chi 2(56) = 80.34, p = 0.02$	-0.39 (1.74)	-3.10 (1.52)	0.55	2.12
Depression, MDI	10	$\chi 2(80) = 92.40, p = 0.16$	-0.66 (1.73)	-3.09 (1.56)	0.69	1.92
Depression, HAM-D6	6	$\chi 2(36) = 46.37, p = 0.12$	-0.55 (1.77)	-2.28 (1.67)	0.61	2.53
Anxiety (ASS8)	8	$\chi 2(48) = 135.54, p < 0.001$	-1.69 (2.07)	-3.09 (1.62)	0.62	3.33
ADHD	6	$\chi 2(30) = 59.14, p = 0.001$	-0.46 (1.15)	-2.80 (1.61)	0.55	1.92

Note. K: number of items; $\chi 2$: chi-square; *p*: probability; SD: standard deviation; PSI: person separation index (with extremes)
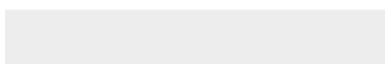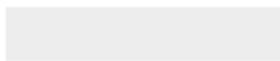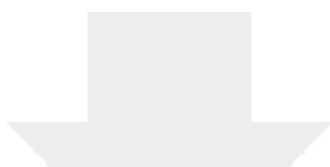
Table S1

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Figures S1-S6