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Measuring psychological distress using the K10 in Kenya

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Abstract

Background—The Kessler psychological distress scale (K10) is a brief screening tool that assesses psychological distress in both clinical and epidemiological settings. Despite wide applicability of the K10 globally, there are no data on psychometric properties of the K10 in Kenya. This study investigated the reliability, factor structure, and construct validity of the K10 as a measure of psychological distress among adults in Kenya.

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CRediT authorship contribution statement

Linnet Ongeri: Writing – original draft, Writing – review & editing, Formal analysis. **Amantia Ametaj:** Formal analysis, Writing – original draft, Writing – review & editing. **Hannah Kim:** Formal analysis, Writing – review & editing. **Rocky E Stroud:** Writing – review & editing. **Charles R. Newton:** Conceptualization, Visualization, Writing – review & editing. **Symon M Kariuki:** Conceptualization, Visualization, Writing – review & editing. **Lukoye Atwoli:** Conceptualization, Visualization, Writing – review & editing. **Edith Kwobah:** Conceptualization, Visualization, Writing – review & editing. **Bizu Gelaye:** Conceptualization, Visualization, Writing – original draft, Writing – review & editing.

Declaration of Competing Interest

All authors declare that they have no conflicts of interest.

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Methods—A total of 2556 adults attending 11 outpatient clinics in the western and coastal regions of Kenya without a history or clinical diagnosis of psychotic disorders were included. Data were collected on demographic characteristics of the participants and the K10. Internal consistency was evaluated using Cronbach's alpha. Construct validity and factor structures of the K10 were evaluated using both exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) approaches.

Results—The mean K10 score was 3.4 and Cronbach's alpha was 0.85, indicating good internal consistency (reliability). EFA resulted in a two-factor solution that accounted for 67.6% of variance. CFA results indicated that a unidimensional model with correlated errors best fit the data.

Limitations—The K10 was only administered to a control group of our study population, which had low levels of psychological distress.

Conclusion—The K10 has good construct validity and reliability for use as a broad measure of psychological distress in Kenyan adults and may be useful in general medical setting to assess anxiety and depressive disorders.

Keywords

Psychological distress; K10; Exploratory factor analysis; Confirmatory factor analysis; Kenya; Psychometric properties

1 Introduction

Psychological distress is an important indicator of mental health and is characterized by symptoms of anxiety and depression that lead to impaired functioning (Drapeau and Beaulieu-Prévost, 2012; Ridner, 2004). Psychological distress may be a marker of common mental health disorders such as depression, anxiety, and post-traumatic stress disorders (Kessler et al., 2003). For example, one physiological response observed during psychological distress is hyperactivity of the hypothalamic–pituitary–adrenal pathway (Abe et al., 2007), which is dysfunctional in about 70% of patients with depression (Holsboer, 2000). Psychological distress is common in the general population, ranging 5–27% (Benzeval and Judge, 2001; Chittleborough et al., 2011; Gispert et al., 2003; Kuriyama et al., 2009; Phongsavan et al., 2006), and can be as high as 60% in some hospital populations (Ayana et al., 2019). Unfortunately, psychological distress is poorly recognized or managed at the primary care level despite its negative impact on patients' health outcomes, including lowering adherence to treatment (Mutumba et al., 2016), prolonging recovery from physical illness (Presciutti et al., 2019), and even leading to suicidal behaviors (Tang et al., 2018). Screening, assessment, and intervention to reduce patients' psychological distress may improve their overall health outcomes (Haverkamp et al., 2015; Krebber et al., 2016; Lee et al., 2010).

In many low-resource settings, comprehensive assessment of psychological distress in outpatient care may not be feasible due to strains in human resources and very short durations of outpatient consultation (Peters et al., 2008; Standing et al., 2004). Therefore, a brief tool that is easy to administer may be helpful in detecting psychological distress

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and informing decisions about referral for specialized care. One such tool is the Kessler Psychological Distress Scale (K10; (Kessler et al., 2002), a 10-item scale assessing nonspecific symptoms of psychological distress. The scale is designed for both community screening and clinical use (Ayana et al., 2019; Kessler et al., 2003; Uddin et al., 2018).

The development of scales used to measure psychological and behavioral constructs is often costly and requires a high level of expertise, for this reason, many of these scales are developed in highly resourced settings thereby lacking a global representation (Boateng et al., 2018). Social and cultural variations in underrepresented populations, may influence face and construct validity of an instrument (Gonzalez-Calvo et al., 1997). This underscores the importance of scale validation in underrepresented populations where mental disorders are known to be highly prevalent.

The K10 has been used globally for both general populations and those such as pregnant women (Spies et al., 2009) and military personnel (Sampasa-Kanyinga et al., 2018), with moderate to excellent psychometric properties. In sub-Saharan Africa, several studies have reported psychometric properties of K10. For example, a study in South Africa administered the K10 to pregnant women and compared validity to the Structured Clinical Interview for DSM Disorders as a reference. The measure displayed good sensitivity and specificity with an area under the receiver operating characteristic (ROC) curve of 0.66 for depression, 0.69 for post-traumatic stress disorder, and 0.71 for panic disorder (Spies et al., 2009). A second study in South Africa that focused on a general population found that the K10 had moderate discriminant ability in detecting depression (ROC, 0.73) and anxiety (ROC, 0.72) (Andersen et al., 2011). In Burkina Faso in West Africa, evaluation of a translated K10 for ability to detect postnatal depression found satisfactory reliability (Cronbach's alpha coefficient, 0.87) and an area under the curve score of 0.77 (Baggaley et al., 2007). In Tanzania, a Swahili translated version of the K10 had good reliability among 192 hospitalized patients with traumatic brain injury, with a composite reliability of 0.82 for depression and 0.97 for anxiety dimensions (Vissoci et al., 2018).

Despite use of the K10 for epidemiological studies in Kenya (Gust et al., 2017), to the best of our knowledge, there are no data on psychometric properties of the K10 in Kenya. Therefore, this study addressed this knowledge gap by providing data on the factor structure of the K10 in Kenya from a large outpatient sample population.

2 Methods

2.1 Study setting and sample

The K10 was administered as part of a large multisite study, Neuropsychiatric Genetics of African Populations-Psychosis (NeuroGAP-Psychosis), which explored potential genetic polymorphisms associated with schizophrenia spectrum and bipolar disorders (referred to as psychotic disorders here; (Stevenson et al., 2019). The NeuroGAP-Psychosis study recruited adult participants (18 years or older) from Kenya, Ethiopia, South Africa, and Uganda, who served as cases (had a diagnosis of psychosis) or controls (i.e., individuals without a history of psychosis). This validation work was specific to data collected among Kenyan adults (N = 2556), who were controls in the main NeuroGAP-Psychosis study. Our study

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was restricted to controls because they were the only group that was administered the K10. Inclusion criteria for controls consisted of being from the same geographic location as cases and without a clinical diagnosis of psychosis (Stevenson et al., 2019). Exclusion criteria for controls included acute levels of alcohol or substance abuse as demonstrated by being treated in inpatient setting or under acute medical care for one of these conditions. Data for this study were collected March 2018–March 2020. In Kenya, study participants were recruited from general outpatient clinics of the following medical facilities in the western and coastal regions: Moi Teaching and Referral Hospital in Eldoret and affiliated sites in Webuye, Kapenguria, Kitale, Kapsabet, Iten, and Kakamega; and the Kenya Medical Research Institute (KEMRI) Wellcome Trust Research Programme with recruiting sites in Kilifi County, Malindi sub-County, Port Reitz, and Coast General Provincial Hospitals.

Ethics approval to conduct this study was obtained from all participating sites, including the Institutional Research and Ethics Committee at Moi University School of Medicine (#IREC/2016/145, IREC #1727), Kenya National Council of Science Technology and Innovation (NACOSTI/P/17/56,302/19,576), KEMRI center Scientific Committee (KEMRI/CGMRC/CSC/070/2016), KEMRI Scientific and Ethics Review Unit (KEMRI/SERU/CGMR-C/070/3575) in Kenya, and Harvard T.H. Chan School of Public Health (#IRB17–0822) in the United States.

2.2 K10

The K10 is a 10-item questionnaire assessing the presence of general psychological distress experienced in the 30 days prior to administration (Kessler et al., 2002). Symptoms commonly associated with depressive and anxiety symptoms are rated on a five-point scale from 0 to 4, whereby 0 indicates none of the time and 4 represents all the time. The total score is derived by summing all items, ranging 0–40. Items are introduced with the statement, “The following questions ask about how you have been feeling during the past 30 days. For each question, please identify the best answer that describes how often you had this feeling.” The self-report version of the K10 items and responses were read to all study participants by study staff due to barriers of limited literacy and unfamiliarity with format of questionnaires.

2.3 Demographic characteristics

All participants enrolled in the study provided information on demographic variables including age, level of education, marital status, current living situation, and sex assigned at birth. Similar to K10, a standard form was read to participants to elicit demographic information.

2.4 Statistical analyses

We first explored the frequency distributions of demographic and lifestyle characteristics of the whole sample and of participants in two regions, Western Kenya and Coastal Kenya. Participants’ characteristics are expressed as mean ± standard deviation (SD) for continuous variables that were normally distributed, or counts and percentages for categorical variables. For variables with non-normal distribution as assessed using the Shapiro–Wilk test, we report the median [inter-quartile range (IQR)]. A comparison of two samples from each

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region was conducted with chi-square tests for sex assigned at birth, marital status, and living arrangements because these variables were nominal, and the Cochran–Armitage test was used for trends in age and education as both variables were ordinal. Internal consistency for the measure was analyzed with Cronbach's alpha (Cronbach, 1951).

We explored factor structures of the K10 using both exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) approaches. Prior to performing EFA, we assessed suitability of the data for performing factor analysis through Bartlett's test of sphericity and Kaiser–Meyer–Olkin measure of sampling adequacy (Kaiser, 1974, 1970). These analyses showed that it was appropriate to proceed with factor analysis (Bartlett's test of sphericity, $p < 0.001$ for Kenya; Kaiser–Meyer–Olkin measure of sampling adequacy, 0.87). We conducted the EFA using principal component analysis with oblique rotation. We used the scree plot, presenting eigenvalues associated with each factor, to determine factor structure. Factors with eigenvalues >1 were assumed to be meaningful and were retained for rotation. Rotated factor loadings >0.4 were considered sufficient, while items with factor loadings ≥ 0.4 on more than one factor were considered cross-loading. Higher values for factor loadings were used to assign items to one of the factors.

Next, we conducted CFA to examine the results from this study's EFA and three theoretical models informed by the literature (Sunderland et al., 2012). Unidimensional Model 1 comprised one factor, psychological distress, onto which all K10 items loaded. Model 2 consisted of the same unidirectional structure as Model 1and incorporated correlated errors between the following pairs: depressed and so depressed, restless and so restless, nervous and so nervous. Model 3 comprised two factors, depression and anxiety (Sunderland et al., 2012). Finally, Model 4 was based on results from the EFA. The first three theoretical models were applied to the entire dataset. The other random split-half sample (n = 1278) was used to test factor structures of the EFA model. To compare CFA models and identify the best fit model, we used the following metrics: (i) root mean square error of approximation (RMSEA) close to 0.06 or below; (ii) comparative fit index (CFI) close to 0.90 or above; and (iii) Tucker-Lewis index (TLI) close to 0.90 or above. Based on these, we selected a single final model. All statistical analyses were performed using STATA. The level of statistical significance was set at $p < 0.05$, and all tests were two-sided.

3 Results

The socio-demographic characteristics of study participants (N = 2556) are summarized in Table 1. The mean age of participants was 36.7 years (SD: 12.2 years). Study participants were predominantly married and with at least some post-secondary level of education. Participants in the Western Kenya region were slightly older and were somewhat more likely to have completed some college or to live with a spouse or partner than those living in Coastal Kenya.

Fig. 1 shows distribution of the global K10 score. Among this population, the global K10 score ranged 0–40, with a mode of 0. The mean score was 3.4 and the median score was 2, marking minimal distress (see Table 2). Higher scores (> 25) were found in 0.5% of study

participants, with 0.2% of scores 25 and above from Western Kenya and 0.3% from Coastal Kenya.

The Cronbach's alpha (α = 0.85; 95% confidence interval: 0.84–0.86) indicates good internal consistency (reliability) for the K10 scale. The item total correlation and Cronbach's alpha if the item was excluded are presented in Table 2. Removal of any question from the K10 scale resulted in a lower Cronbach's alpha, indicating that all items appeared worthy of retention. The highest item-total correlation coefficient was for item 8 (so depressed), and the lowest was for item 9 (lack of energy).

3.1 EFA

To conduct both the EFA and CFA, we randomly split the sample into two datasets. Using EFA in the first sub-sample (n = 1278), we examined the data to assess scale dimensionality and item factor loadings. From a visual observation of a scree plot, we extracted components on the steep slope (or the "elbow") and concluded that two factors would be adequate for factor analysis (Table 3). Most items of the K10 loaded on Factor 1, with "so depressed," "worthless," and "so restless" loading most strongly. Two items both related to energy levels ("fatigue" and "lack of energy") loaded highly on Factor 2, and "nervous" and "restless/ fidgety" cross-loaded on both factors. We assigned "nervous" to Factor 1 and "restless/ fidgety" to Factor 2 based on the highest factor loading for each.

3.2 CFA

Fig. 2 shows path diagrams of the three tested theoretical structure models for the K10.

Two of the tested models, Models 2 and 3, reached the ≥ 0.9 threshold of an acceptable fit for CFI and TLI fit indices (Table 4). Model 2, which incorporated correlated errors, was the best fitting model compared to all others tested (CF1 = 0.91; TLI = 0.88; RSEA = 0.10). However, all four models showed fair to poor fit in relation to RMSEA. Fig. 2 shows good factor loadings for Model 2 with values ranging 0.50–0.66.

4 Discussion

To the best of our knowledge, this is the first study to examine validity and reliability of the K10 in a Kenyan population. The K10 showed good internal consistency (Cronbach's alpha = 0.83). Our EFA revealed a two-factor structure, with the majority of item loading on one factor accounting for both depressive and anxiety symptoms. By contrast to the EFA results, our CFA findings support previous studies that describe a unidimensional structure of the K10 with correlated errors for specific symptoms. Finally, the majority of study participants reported a mild level of distress (K10 global scores of 0–5), with only 2% of the study sample reporting high levels of psychological distress.

Although the K10 was initially developed as a unidimensional screening tool, several studies have reported a varied factor structure of the K10 (Brooks et al., 2006; Kessler et al., 2002; Sunderland et al., 2012; Thelin et al., 2017). In an Australian study among clinical and population samples, Sunderland et al. (2012) found a two-factor structure model with correlated latent factors representing depression and anxiety as the best fit for

a clinical sample, while a single-factor structure model with correlated errors best fit a population-based sample. Other studies support these interpretations—Bougie et al. (2016) found that a unidimensional structure was the best fit model in a population-based study among Aboriginal people, while Arnaud et al. (2010) found that a multifactorial structure offered the best fit in a clinical population in France. Our study was limited to controls with low levels of severity and variability in mental distress, which is more consistent with a population sample.

However, dissimilar to the CFA finding, EFA revealed a two-factor solution with the first factor including items related to depressive and anxiety symptoms and a second factor having items related to energy levels. Somatic symptoms related to energy levels did not group with core anxiety and depressive symptoms, hence constituting a distinct construct. Somatic symptoms manifest commonly in depression and anxiety disorders in the African population (Rasmussen et al., 2011; Sweetland et al., 2014). Similar to other studies comparing the weight of somatic symptoms to core depressive and anxiety symptoms, somatic symptoms account for only a small proportion of the total variance for depression and anxiety (Okulate et al., 2004), as was evident in our study.

This study provides the first validity data on the K10 questionnaire in a Kenyan population. A limitation of this study is that the K10 tool was only administered to the control group of our study population, which explains the low levels of identified psychological distress. However, the relatively large sample size of participants in the two geographically diverse regions in Kenya is a strength of this study that allows for generalization of the findings. Future studies may examine differential item functioning to determine if measurement properties of the K10 are different by study site, education, and sex. In addition, future studies would benefit from comparing the K10 to a reference measurement tool to establish criterion validity (i.e., agreement with a “gold-standard”) and to determine cut-offs and clinical severity ranges that could vary significantly in the Kenyan population.

5 Conclusion

The K10 is a suitable and reliable measure of psychological distress in Kenyan adults. Our findings provide evidence toward reliability and construct validity of the K10 in this Kenyan population. The scale was validated in a general outpatient population that excluded persons with psychotic disorders. Future studies can compare these findings in patient populations that do not have this exclusion criterion. Future psychometric research that incorporates a diagnostic tool alongside the screening tool may help identify optimal cut-off scores relevant to this study population.

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Abbreviations

K10	Kessler psychological distress scale
ROC	receiver operating characteristic
NeuroGAP-Psychosis	neuropsychiatric genetics of African populations-psychosis
SD	standard deviation
IQR	interquartile range
EFA	exploratory factor analysis
CFA	confirmatory factor analysis
RMSEA	root mean square error of approximation
CFI	comparative fit index
TLI	tucker-Lewis index

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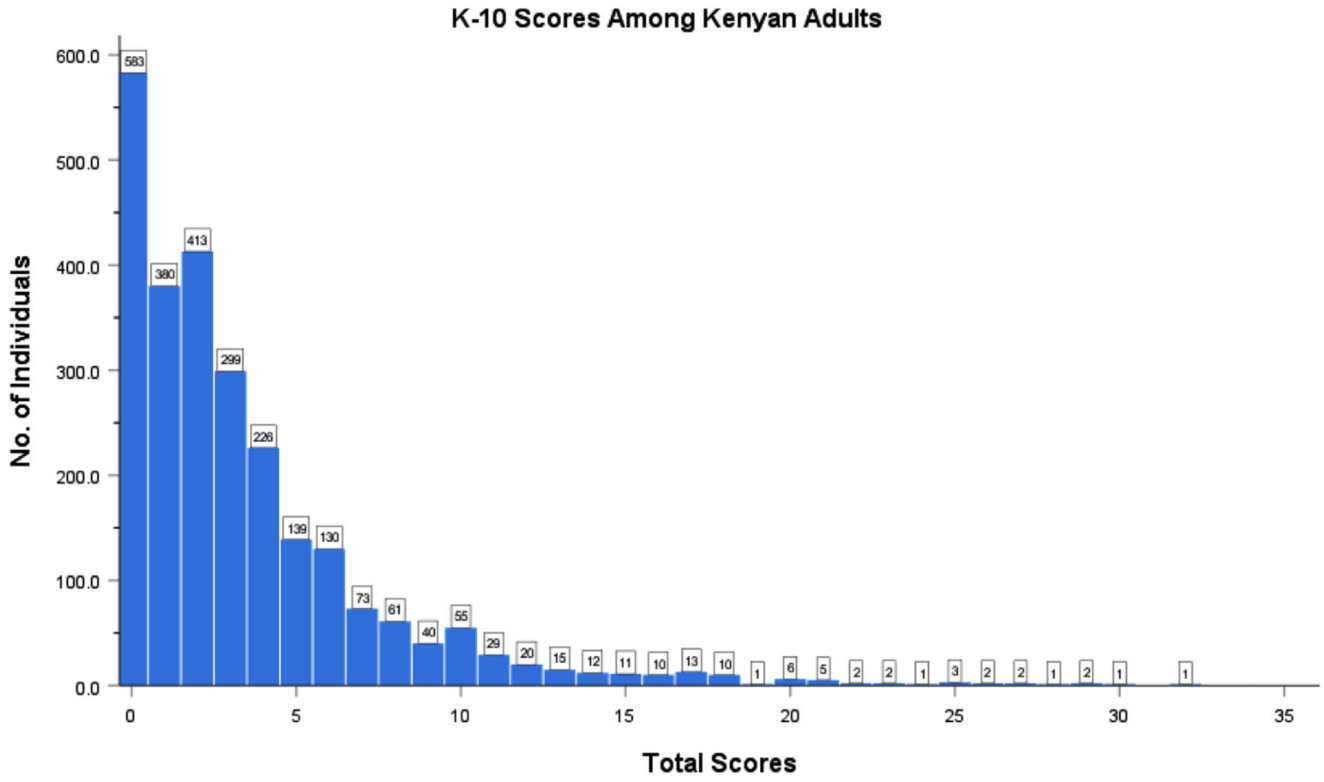

Fig. 1. Distribution of global scores of the Kessler psychological distress scale (K10; score range: 0–40) (*n* = 2548).

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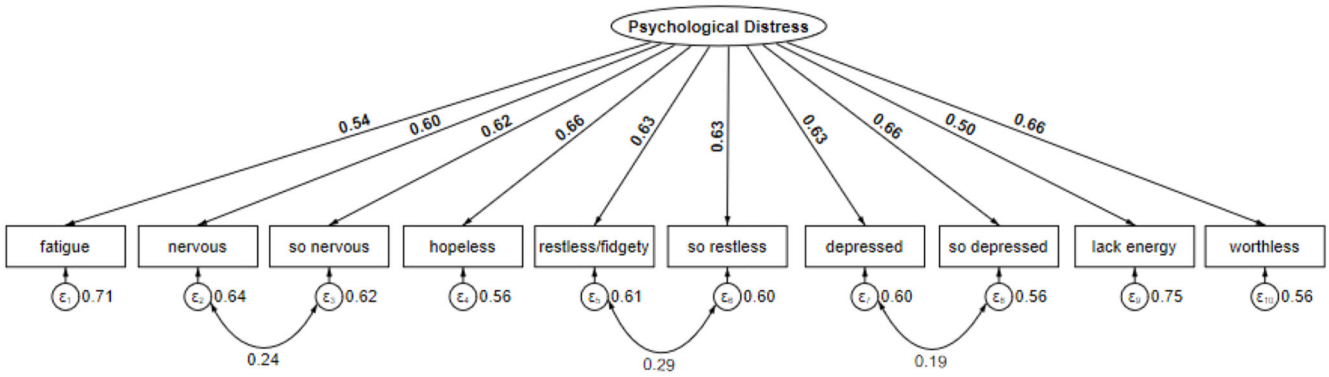
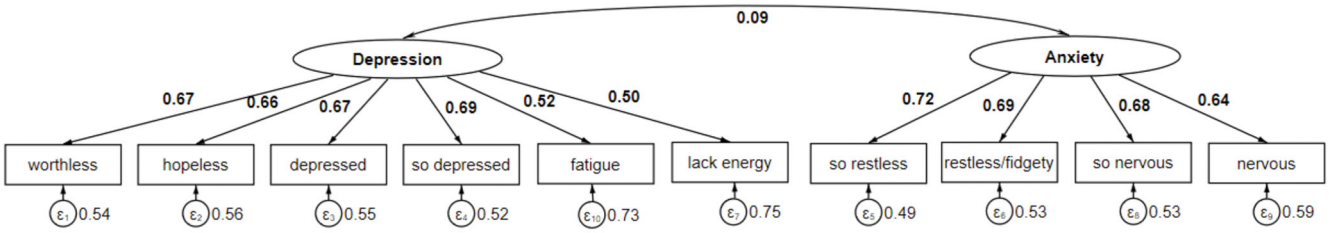
Model 2: Unidimensional structure with correlated errors



Model 3: Two factor depression/anxiety structure



Model 4: Two factor structure from EFA

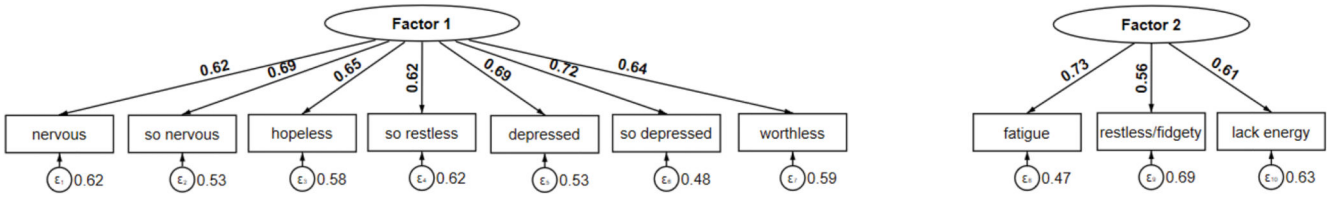


Fig. 2. Path diagrams of four tested theoretical structure models for the Kessler psychological distress scale (K10). Factor loadings are standardized estimates.

Table 1

Participant demographics for Kenya*.

	Count	All sites *n* = 2556	Coastal Kenya *n* = 1238	Western Kenya *n* = 1318	*p*
Age [median (IQR)]		34.0 (18.0)	34.0 (17.3)	35.0 (18.0)	
Sex (%)	1239	48.5			0.056
Female			46.5	50.3	
Male	1317	51.5	53.5	49.7	
Age categories (%)					0.012
18–29 years	809	31.7	29.2	33.9	
30–44 years	1101	43.1	43.9	42.3	
45–59 years	518	20.3	21.9	18.7	
≥60 years	128	5.0	5.0	5.1	
Marital status (%)					0.056
Single	841	32.9	33.2	32.6	
Married or cohabitating	1367	53.5	53.3	53.6	
Widowed	112	4.4	3.4	5.3	
Divorced or separated	235	9.2	10.1	8.3	
Level of education (%)					0.000
No formal	44	1.7	3.3	0.2	
Primary	602	23.6	31.7	15.9	
Secondary	753	29.5	33.3	25.9	
University	1156	45.2	31.7	57.9	
Living arrangements (%)					0.000
Lives alone	532	20.8	21.8	19.9	
Lives with parental family	447	17.5	19.4	15.7	
Lives with spouse or partner	1194	46.7	43.1	50.2	
Lives with friends or other relatives	381	14.9	15.8	14.1	

Note: Counts may not add up to the total due to missing information for some participants.

IQR = interquartile range.

Table 2

Item characteristics, item-total correlations, α if item deleted of the Kessler psychological distress scale (K10) (*n* = 2548).

K10 item	Mean	SD	Median	IQR	Corrected item-total correlation	α if item deleted
Fatigue	0.66	0.79	0	1	0.52	0.84
Nervous	0.55	0.71	0	1	0.58	0.83
So nervous	0.13	0.44	0	0	0.58	0.84
Hopeless	0.33	0.65	0	0	0.59	0.83
Restless/fidgety	0.31	0.61	0	0	0.60	0.83
So restless	0.11	0.41	0	0	0.58	0.84
Depressed	0.55	0.76	0	1	0.58	0.83
So depressed	0.15	0.47	0	0	0.61	0.83
Lack of energy	0.44	0.76	0	1	0.47	0.84
Worthless	0.21	0.53	0	0	0.58	0.83
Global K10 score [a]	**3.42**	**4.10**	**2.0**	**4**	–	**0.85**

Note: Data from eight participants were missing for the K10. SD = standard deviation; IQR = interquartile range.

[a]Overall Cronbach's alpha.

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Tables 3

Standardized loadings using factor analysis with oblique rotation for the Kessler psychological distress scale (retained factors = 2) for split sample (*n* = 1278).

	Factor 1	Factor 2
Fatigue		0.85
Nervous	0.47	0.30
So nervous	0.73	
Hopeless	0.59	
Restless/fidgety	0.41	0.44
So restless	0.75	
Depressed	0.68	
So depressed	0.80	
Lack of energy		0.77
Worthless	0.75	
Variance	4.10	2.66
Proportion	41.0%	26.6%

Bartlett test of sphericity: $\chi^2(45) = 4190.46$, $p < 0.001$; Kaiser–Meyer–Olkin measure of sampling adequacy: 0.87.

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Table 4

Confirmatory factor analysis fit statistics for each model.

Model	X^2	df	*p*	CFI	TLI	RMSEA
Model 1	1179.60	35	<0.001	0.87	0.83	0.11
Model 2	785.87	32	<0.001	0.91	0.88	0.10
Model 3	957.51	34	<0.001	0.89	0.86	0.10
Model 4	1338.81	35	<0.001	0.72	0.64	0.17

Model 1 = unidimensional structure

Model 2 = unidimensional structure with correlated errors

Model 3 = two factor depression/anxiety structure

Model 4 = model from EFA

X^2 = chi-square; df = degree of freedom; *p* = significance level; CFI = comparative fit index; TLI = Tucker-Lewis fit index; RMSEA = root mean square error of approximation