A Systematic Review of Validated Screening Tools for Anxiety Disorders and PTSD in Low to Middle Income Countries

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Abstract

Background: Anxiety and post-traumatic stress disorder (PTSD) contribute significantly to disability adjusted life years in low- to middle-income countries (LMICs). Screening has been proposed to improve identification and management of these disorders, but little is known about the validity of screening tools for these disorders. We conducted a systematic review of validated screening tools for detecting anxiety and PTSD in LMICs.

Methods: MEDLINE, EMBASE, Global Health and PsychINFO were searched (inception-January 10, 2019). Eligible studies (1) screened for anxiety disorders and/or PTSD; (2) reported sensitivity and specificity for a given cut-off value; (3) were conducted in LMICs; and (4) compared screening results to diagnostic classifications based on a reference standard. Screening tool, cut-off, disorder, region, country, and clinical population were extracted for each included study. We asessed quality using a modified version of Greenhalgh’s ten item checklist. Accuracy results were organized based on screening tool, cut-off, and specific disorder. Accuracy estimates for the same cut-off for the same screening tool and disorder were combined via meta-analysis.

Results

Of 5343 unique citations identified, 57 articles including 75 screening tools were included. There were 44, 20 and 11 validations for anxiety, PTSD, and combined depression and anxiety, respectively. Continentally, Asia had the most validations (34). Regionally, South Asia (10) had the most validations, followed by West Asia (9) and South Africa (9). The Kessler-10 (7) and the Generalized Anxiety Disorder-7 item scale (GAD-7) (6) were the most commonly validated tools for anxiety disorders, while the Harvard Trauma Questionnaire (3) and Posttraumatic Diagnostic Scale (3) were the most commonly
validated tools for PTSD. Most studies (27) had the lowest quality rating (unblinded) followed by good (21). Due to incomplete reporting, we combined only two sets of accuracy values in meta-analysis (GAD-7 cut-off ≥10; sensitivity: 76%, specificity: 64%).

**Conclusion**

Use of brief screening instruments can bring much needed attention and research opportunities to various at-risk LMIC populations, yet many have been validated in inadequately designed studies. Locally validated screening tools for anxiety and PTSD need further evaluation and well-designed studies, including clinical trials, to determine whether their use can reduce the burden of disease.

PROSPERO registry number: CRD42019121794

**Introduction**

Mental health disorders, including anxiety and post-traumatic stress disorder (PTSD) are among the leading contributors to global disability adjusted life years, comprising five of the top twenty contributing disorders [1]. The World Health Organization International Classification of Disease (ICD-11) defines anxiety as a disorder in which there is an extreme and excessive focus on an “anticipated threat” and defines PTSD as a disorder that results from exposure to one or more “horrific events” [2]. The global prevalence for both anxiety disorders and PTSD is sizeable, 7.3% and 2.1–2.3% respectively. [3–4]. Both anxiety and PTSD are widespread common mental disorders (CMDs) that have been shown to cause significant negative health outcomes within various populations and contribute to a large portion of the global disease burden [5–6]. There are noteworthy discrepancies in quality of life between people diagnosed with anxiety and/or PTSD and those who are not diagnosed with either, such as increased years lived with disability and decreased life
expectancy [7-9]. Additionally, there is evidence suggesting that the presence of an anxiety disorder or PTSD increases the likelihood of comorbidity with other severe health conditions, such as major depressive disorder and substance use disorder [10-11].

Anxiety and PTSD are common in low to middle income countries (LMICs) and are traditionally overlooked and especially stigmatized. Prevalence of these disorders is higher within LMICs; roughly 83% of people with mental illnesses globally are living within LMICs [12]. In many LMICs, there is no robust mental healthcare system in place and the number of mental health professionals is sparse [13]. Assessment and diagnosis of psychiatric illnesses thus often falls to primary care and general practitioners who have little training in mental health [13]. Use of brief screening tools have been proposed as a way to improve identification and management of mental health problems, and may be useful in LMICs, especially among populations with elevated risk (e.g., pregnant women, refugees/displaced persons, and youth) within LMIC communities [14-16].

Despite multiple screening instruments for CMDs, there are significantly fewer screening instruments for anxiety and PTSD that have been validated in LMIC populations. Screening instruments that have been validated exclusively in high-income countries may not perform equivalently in LMIC populations, as anxiety and PTSD often present differently in different cultural contexts. For example, in sub-Saharan Africa, anxiety and PTSD are described through somatic symptoms as well as spiritual descriptions [17]. Furthermore, differences in clinical presentation may render screening tools less accurate in LMICs. Thus, optimum cut-off scores validated in high income populations may not apply in LMIC populations. For instance, in a sample of 75 participants from Tajikistan [18], the optimal cut-off of 1.88 for the Harvard Trauma Questionnaire (HTQ), a measure of PTSD, was substantially lower than the standard cut-off score of 2.5 that has been recommended in previous studies in high-income countries [19]. Failure to apply suitable cut-off scores
may lead to an imbalance of positive and negative screening results. If chosen cutoffs are too high, actual cases of anxiety and PTSD may not reach the threshold for further assessment and diagnosis; thus, cases will be missed. Conversely, if chosen cutoffs are too low, there may be a very large number of positive screens requiring substantial resources for further assessment, and healthcare systems may not be able to manage the load.

Although there has been an increasing interest in studying mental health within LMICs, there are still large gaps related to screening tools to assess mental health disorders, especially anxiety and PTSD. The most recent systematic review investigating screening tools for CMDs in LMICs was published in 2016 [20]. Of the 273 validations included, 236 were validated tools for CMDs or depressive disorders while only 24 and 13 validated tools for anxiety and PTSD, respectively. Therefore, the objective of this study was to conduct a systematic review of screening tools for anxiety and PTSD within LMIC populations.

Methods

Aim: To validate screening tools for anxiety disorders and PTSD in LMICs

We published a study protocol in advance in the PROSPERO registry (CRD42019121794).

Search Strategy and Study Selection

We systematically searched four databases (MEDLINE, EMBASE, Global Health and PsychINFO) from inception to January 10, 2019 (see Fig. 1).

Inclusion Criteria

Our eligibility criteria required that studies: (1) screen specifically for anxiety (generalized anxiety disorder or anxiety disorders not otherwise specified) and/or PTSD; (2) provide estimates of sensitivity and specificity for a given cut-off value for one of the included disorders; (3) were conducted in a LMIC (based on the World Bank Classification) [21]; and (4) compare screening results to a validated reference standard. Reference standards
included unstructured clinical diagnostic interviews as well as structured clinical interviews including the Mini International Neuropsychiatric Interview (MINI and MINI-KID) [22], Structured Clinical Interview for DSM (SCID, SCID-1 and NetSCID) [23–24], Composite International Diagnostic Interview (CIDI and CIDI-PHCV) [25], Clinical Interview Schedule-Revised (CIS-R) [26], Psychiatric Assessment Schedule (PAS) [27], Kiddie Schedule for Affective Disorders and Schizophrenia (K-SADS and K-SADS-PL) [28] and Clinician-Administered PTSD Scale (CAPS and CAPS-5) [29–30]. LMIC populations residing in a LMIC at the time of study were included. No search restrictions were put on age, gender or comorbidities.

Exclusion Criteria

We excluded papers that did not report sensitivity, specificity and cut-off value; that were not published in English; and that involved populations originally from an LMIC residing outside a LMIC at the time of the study. Persons from an LMIC residing in another LMIC at the time of the study were included (e.g., refugee populations and displaced persons).

Literature Review

Abstracts returned from the search were reviewed separately by two independent reviewers for inclusion, with any discrepancies resolved by discussion and use of a third senior reviewer as needed. For abstracts meeting inclusion criteria, full-text articles were retrieved and reviewed by two separate reviewers for final inclusion, with discrepancies resolved by discussion and use of a third senior reviewer as needed. We also searched the reference lists of relevant systematic reviews for additional articles to add to our full-text review.

Quality Appraisal

To assess study quality, we used a modified version of Greenhalgh’s ten item checklist
previously used in a study by Ali et al [20] Elements of the quality checklist are provided in Fig. 2. Credit was given for translation if a previously validated translated version of the tool or reference standard was used, or if the tool was administered in English. Studies of ‘very good quality’ fulfilled all the quality criteria. Studies deemed ‘good’ quality fulfilled criteria 1 through 3 in addition to at least one other criterion from 4 to 5. ‘Fair’ quality studies did not avoid work-up bias and ‘acceptable’ quality studies did not perform receiver operating characteristic curve (ROC) analysis to determine a normal range from the results. ‘Unblinded’ studies include studies that reported the interviewers were not blinded to the screening results or did not specify whether the screening tool administrators and interviewers were blinded to each other’s results.

Data abstraction and analysis

Numerical data was abstracted by one reviewer and checked by a separate reviewer to ensure quality extraction. Data abstraction sheets included extraction of the screening tool and disorder, number of participants, DSM version, screening tool administrator, language, region, population study characteristics and age, country, gold standard, area under the curve (AUC), cut-off score, sensitivity and specificity. If multiple screening tools and/or cut-offs were used, data was extracted for each cutoff, for each tool, separately. If values were split by population, the value most representative of the total was chosen (e.g., community values for data split by hospital inpatient unit). If multiple cut-offs were given without AUC, we extracted the set of values for the cutoff that maximized Youden’s J [31]. Results were presented separately by disorder, screening tool and cutoff-value. As anxiety and depression were combined in many screening tools, a third category of mixed anxiety and depression was included.

For validations of screening tools for the same disorder that used identical cut-off values, bivariate random-effects meta-analytic models were fitted to provide estimates of pooled
sensitivity and specificity for the cut-off value.

Results

Study Selection

Of 5343 unique citations identified from the database search, 5236 were excluded after title and abstract review and five additional papers from the reference lists of relevant systematic reviews were added. Of 113 included for full-text review, 56 were excluded, leaving 57 eligible articles inclusive of 75 screening tools (see Figure 3). The most common reasons for exclusion were not screening for the disorder of interest, not comparing to a gold standard, and failing to provide either sensitivity/specificity data or a threshold for screening.

Quality Appraisal

Two studies met all the criteria of the modified Greenhalgh's ten item checklist and deemed ‘very good’ quality while 21 studies were deemed to be ‘good’ quality, due to lack of reporting the confidence intervals for sensitivity, specificity or AUC. Two studies were ‘fair’ quality for not avoiding work-up bias and five were deemed ‘acceptable’ for failing to perform ROC analysis. A total of 28 studies were labelled ‘unblinded’ for failing to specify if they blinded the researchers or for explicitly stating they were not blinded (see Table 1).

Description of included studies

The final 57 studies selected included a total of 75 screening tools. There were 44 validations of screening tools for anxiety disorders, 20 for PTSD and 11 for anxiety and depression (see Table 2).

A minority of studies accounted for children and adolescent validations (9) despite a relatively young demographic present in LMICs [32]. The majority of validations studied adults (42), with a select few including adolescents and adults (6) (see Table 3).
Particularly well-represented groups included the general population and clinical outpatients (13), perinatal populations (9), psychiatric patients (7) and those with another psychiatric comorbidity (7) (see Table 3). Of the 20 validations for PTSD, only four studied children and adolescents.

The majority of screening tool validations were in Asia (34) followed by Africa (22), the Americas (8) and Europe (1) (see Table 4). The best represented regions include South and West Asia, as well as South and East Africa, with a noticeable gap in Middle and Northern Africa. There were no studies from the Oceanic region.

The most commonly used tools to screen for generalized anxiety disorder were the Kessler-10 (K-10) and the Generalized Anxiety Disorder-7 item scale (GAD-7), totaling seven and six validations respectively. The Hopkins Symptom Checklist-25 item scale (HSCL-25), Hospital Anxiety and Depression Scale (HADS) and Hospital Anxiety and Depression Scale anxiety subscale (HADS-A) were validated almost equally while the majority of tools only had one validation (see Table 5). PTSD had far fewer validations (20) with a wide range of tools receiving between one and three validations, similar to the screening tools validated for both anxiety and depression.

The sensitivity, specificity and cut-off for each disorder and its respective screening tool are shown in Table 6.

Discussion

This review aimed to examine the screening tools that have been validated to detect anxiety and PTSD in LMICs. The most commonly validated tools were the K-10 and GAD-7 for anxiety and the HTQ and the Posttraumatic Diagnostic Scale (PDS) for PTSD. It is difficult to recommend one screening tool for anxiety and PTSD respectively, as sensitivities and specificities varied based on region, country and screening tool. Future research is needed to evaluate whether locally validated tools can be used to improve
detection and management of anxiety and PTSD.

A total of 44 validated screening tools were found for anxiety disorders. The most common tool used to screen for anxiety disorders was the Kessler-10 followed by the GAD-7, which had wide ranges of sensitivities (57%-94%) and specificities (53%-94%) varying by region and sample size. While previously the HADS-A was recommended [20], our updated review found that it was not as widely validated as the GAD-7 and Kessler-10, although it had consistent specificities (72%-79%) with a range of sensitivities (38%-86%). The Kessler may have an added time-efficiency component, as it is possible to screen for multiple common mental disorders, whereas screening tools such as the HADS-A target anxiety specifically. The GAD-7 reported some of the highest sensitivities for detection of generalized anxiety disorder. Other anxiety disorders, including agoraphobia, panic disorder and social anxiety disorder were less commonly validated. Our results are consistent with a previous systematic review [20] and indicate using the GAD-7, K-10 or HAD-A yield good sensitivities and specificities while taking population-specific characteristics into account. Future research is needed to validate screening tools for these anxiety disorders in more regions.

The number of validations for PTSD increased from 10 to 20 since 2013 [20]. The HTQ and PDS were the most commonly validated tools for PTSD, and sensitivities were generally high. Our findings add that in addition to the previously recommended HTQ, the PDS should be considered in screening for PTSD [20]. Unfortunately, many tools were validated only once, preventing our combining them for analytic purposes. Only four PTSD validations describe children and adolescents, despite a recent events that have displaced thousands of youth [34]. The prevalence of PTSD remains high in LMICs and is expected to rise given increasing civil unrest and war [35, 36]. The year 2018 saw the highest recorded number of displaced persons globally leading the authors to emphasize more
attention into detection and treatment of PTSD [37].

Anxiety and depression had the fewest validations across our search [11] though were not the target of our validation given the existing literature on depression alone [20]. All tools with the exception of the HSCL-25 had only one validation. The only independently developed screening tool of all the studies was for anxiety and depression, developed in Zambia. These disorders commonly occur together and further research is needed to determine which tools are best suited to a region’s mental health screening needs.

We searched four databases with a robust library of psychiatric publications available. We also placed minimal exclusion criteria on our searches so as to maximize the number of studies returned, and we additionally reviewed relevant systematic reviews for additional relevant papers. At every stage of the process from title/abstract screen to data abstraction, two reviewers assessed each article and numerical data point to reduce human error. Our search strategy and protocol were published in PROSPERO and were not altered from the time of submission, with the exception that we did not calculate diagnostic odds ratios (DORs), as they provide no guidance to clinicians on what screening tool and cutoff threshold would be most appropriate to use in clinical practice. Rather, we reported sensitivity and specificity of each screening tool and cutoff separately, to better describe the accuracies of individual tools and cutoffs.

Our extraction was limited by the individual papers’ specific data reporting. The majority of studies did not provide sensitivities and specificities for multiple cut-off values. Reporting multiple cut-off values and their respective sensitivity and specificity estimates would allow providers to decide which cut-off they would choose to optimize screening for their setting. A lower cut-off with a higher sensitivity may be desired if cases are not to be missed and false negatives reduced. A higher cut-off with a higher specificity may be desired if false positives are to be minimized. Furthermore, reporting multiple cut-off
values and their respective sensitivity and specificity estimates would also allow researchers to better synthesize accuracy results across multiple studies in meta-analysis. In the present study, only two validations with identical cut-off scores for the GAD-7 could be combined via meta-analysis as no other validations of the same disorder with identical cut-off values provided sufficient information to conduct a meta-analysis (i.e., 2 x 2 table numbers).

Our review was also limited by the available publications on mental health screenings in LMICs. The entire region of Middle and North Africa, constituting over 300 million people, was not represented by a single validation while other regions such as South-East Asia were fairly well-represented. Cultural and linguistic factors may influence screening tool validation yet further discussion may be best served for individual validation papers. Most studies were rated in the lowest quality category of the modified Greenhalgh scale as they were unblinded. This is a severe limitation in the design of studies that may impact validation results; future studies should ensure adequate blinding in addition to the remainder of the quality checklist.

Our study did not look at CMDs or depression specifically, although we did consider anxiety and depression when screened for together. We chose to focus on anxiety and PTSD as they are less well-represented in the realm of LMIC validated screening tools. Additionally, anxiety and PTSD are becoming more important with the current displacement of millions of people due to civil unrest, socioeconomic upheaval and war.

The number of validated screening tools for mental health disorders as a whole has increased since 2013[20]. However, no large increase in the number of validations for specific disorders was seen, and most screening tools from our search were validated only once. We advise researchers and providers to refer to Table 6 for a summary of validations for locations and disorders of interest.
Conclusions And Future Research

Mental health disorders are highly prevalent yet are frequently stigmatized and disregarded as medical diseases. Validated screening tools for anxiety and PTSD in LMIC have made considerable progress, with validations for both disorders almost doubling since the prior systematic review completed in December 2013 [20]. The increase in validated screening tools generally followed a regional pattern, with more emerging in countries already represented. For example, more tools have been validated in South Africa without an increase in validations in Botswana, Lesotho, Namibia or Swaziland. Middle and Northern Africa were also not well-represented by either anxiety or PTSD screening tools. The authors recognize that it may be near impossible to validate screening tools in areas of intense conflict and instability but acknowledge the need to evaluate screening tools in these areas.

The age distribution among screening tools was heavily biased towards the adult population. Children and adolescents accounted for only four of 20 validations for PTSD and six of 55 for anxiety and anxiety and depression. Given that age is skewed towards a younger population in LMICs [32], it is imperative that more research focuses on identifying anxiety and PTSD disorders in a pediatric population, especially in areas of increased civil war and conflict.

Use of brief screening instruments can bring much needed attention and research opportunities to various at-risk populations in LMICs. Many screening tools for anxiety and PTSD have been validated in LMICs, but there remain regions and subgroups of individuals for which more research is needed. Locally validated screening tools for anxiety and PTSD should be further evaluated in clinical trials to determine whether their use can reduce the burden of disease.
Declarations

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**Competing interests**: The authors declare that they have no competing interests.

**Availability of data and materials**: All data generated or analysed during this study are included in this published article [and its supplementary information files].

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**Authors’ contributions**

All authors listed below have read and approved the manuscript.

1. AM: Design of systematic review, search criteria and primary reviewer, wrote manuscript
2. JD: Primary reviewer, aided in introduction and editing of manuscript
3. EA: Primary reviewer, aided in manuscript writing and editing
4. BL: Data analysis, aided in manuscript writing and editing
5. VFG: Manuscript writing and editing
6. BNG: Design of systematic review, development of methods, manuscript writing and editing

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Abbreviations

Post-traumatic stress disorder (PTSD); Low to middle income countries (LMICs); Common mental disorders (CMDs); Mini International Neuropsychiatric Interview (MINI and MINI-KID); Structured Clinical Interview for DSM (SCID, SCID-1 and NetSCID); Composite International Diagnostic Interview (CIDI and CIDI-PHCV); Clinical Interview Schedule-Revised (CIS-R); Psychiatric Assessment Schedule (PAS); Kiddie Schedule for Affective Disorders and Schizophrenia (K-SADS and K-SADS-PL); Clinician-Administered PTSD Scale (CAPS and CAPS-5); Area under the curve (AUC); Receiver operating characteristic curve (ROC); Diagnostic odds ratios (DORs); HADS: Hospital Anxiety and Depression Scale; DASS: Depression Anxiety Stress Scales; Zung SAS: Zung Self-Rating Anxiety Scale; STAI: State Trait Anxiety Inventory; EPDS: Edinburgh Postnatal Depression Scale; HAM-A: Hamilton Anxiety Rating Scale; K10/K6: Kessler 10/6; GAD: Generalized Anxiety Test; HDRS: Hamilton Depression Rating Scale; HSCL: Hopkins Symptom Checklist; MINI-SPIN: Mini-Social Phobia Inventory; PHC: Primary Health Care Screening Tool; GHC: General Health Questionnaire; SCARED: Screen for Child Anxiety Related Disorders; PASS: Perinatal Anxiety Screening Scale; RCADS: Revised Children’s Anxiety and Depression Scales; BAI: Beck Anxiety Inventory; HTQ: Harvard Trauma Questionnaire; CL: ; PDS: Posttraumatic Diagnostic Scale; PCL-C: PTSD Checklist-Clinician Version; CPSS: Child PTSD Symptom Scale; TSSC: Traumatic Stress Symptom Scale; CAPS: Clinician-Administered PTSD Scale; YSR: Youth Self-Report; AKUADS: Aga Khan University Anxiety and Depression; SRQ: Self-Reporting Questionnaire; AYMH: Arab Youth Mental Health Scale; HEI: Huaxi Emotional-Distress Index

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Tables

Table 1. Quality rating statistics

| Quality Rating | Number of Studies |
|----------------|-------------------|
| Very good      | 2                 |
| Good           | 21                |
| Fair           | 2                 |
| Acceptable     | 5                 |
| Unblinded      | 27                |
| Total          | 57                |

Table 2. Screening tool validation by disorder category
| Disorder Category                | Specific disorders | Total |
|---------------------------------|-------------------|-------|
| Anxiety Disorders               |                   |       |
| Generalized Anxiety Disorder    |                   | 44    |
| Panic Disorder                  |                   |       |
| Social Anxiety Disorder         |                   |       |
| Anxiety Disorder NOS            |                   |       |
| PTSD                            | PTSD              | 20    |
| Anxiety and Depression          |                   | 11    |
| Generalized Anxiety Disorder    |                   |       |
| Major Depressive Disorder       |                   |       |
| **Total**                       |                   | 75    |

Table 3. Distribution by age a population characteristic

| Population Descriptors                        | Number of studies |
|-----------------------------------------------|-------------------|
| **Adults (42)**                               |                   |
| Outpatients                                   | 5                 |
| General population                            | 7                 |
| **Medical comorbidity (7)**                   |                   |
| HIV                                           | 4                 |
| Other                                         | 3                 |
| Psychiatric patient                           | 7                 |
| Conflict area/refugee                         | 5                 |
| Students                                      | 1                 |
| **Perinatal (9)**                             |                   |
| HIV                                           | 1                 |
| Other                                         | 8                 |
| **Children and Adolescents (9)**              |                   |
| Psychiatric patient                           | 2                 |
| Trauma survivor                                | 2                 |
| Other                                         | 5                 |
| **Adults and Adolescents (6)**                |                   |
| Survivor of natural disaster                  | 2                 |
| Other                                         | 4                 |
## Table 4. Number of Studies by Region and Country

| Continent | Region | Country (Number of Studies) | LMICs with no studies |
|-----------|--------|-----------------------------|-----------------------|
| Africa (19) | North | None | 6 (Sudan, Algeria, Morocco, Tunisia) |
|           | Middle | None | 9 (Angola, Cameroon, Democratic Republic, Central African Republic, Congo, Democratic Republic, Equatorial Guinea, Gabon, São Tome and Principe) |
| East (8) | Zimbabwe (2), Somalia (1), Uganda (1), Burundi (1), Tanzania (1), Zambia (1), Kenya, Madagascar | 10 (Comoros, Djibouti, ...) |
| Region       | Disorder | Screenings Tool | Number of Validations |
|--------------|----------|-----------------|-----------------------|
| Africa       | Anxiety disorders | HADS-A          | 3                     |
|              |          | HADS           | 3                     |

*The country total is 60 instead of 57 as one study [33] involved four countries (Mexico, China, Brazil and Pakistan)

**Table 5. Screening Tool by Disorder and Number of Validations**
| DASS-A       | 1 |
|-------------|---|
| Zung SAS    | 2 |
| STAI        | 1 |
| EPDS        | 2 |
| HAM-A       | 1 |
| K10         | 7 |
| K6          | 3 |
| GAD-7       | 6 |
| HDRS        | 1 |
| HSCL-25     | 4 |
| MINI-SPIN   | 1 |
| PHC         | 1 |
| GHQ-12      | 2 |
| SCARED/SCARED-C/-P | 1/1/1 |
| PASS        | 1 |
| RCADS-GAD scale | 1 |
| BAI         | 1 |
| Total       | 44 |

### PTSD

| HTQ/-R      | 1 |
| HTQ         | 3 |
| CL          | 1 |
| K10         | 2 |
| PDS         | 3 |
| PCL-C/-5    | 1/2 |
| CPSS        | 2 |
| TSSC        | 1 |
| UCLA PTSD Index | 1 |
| PTSD Screening Tool | 2 |
| CAPS        | 1 |
| Total       | 20 |

### Anxiety and Depression

| HSCL-25     | 2 |
| Independently developed (Zambia) | 1 |
| YSR         | 1 |
| HADS        | 2 |
| AKUADS      | 1 |
| SRQ-20      | 1 |
| AYMH        | 1 |
| Disorder Type | Screening Tool | Gold Standard | Subregion | Country | No. Participants | Cut-Off Score | Sensitivity |
|---------------|----------------|---------------|-----------|---------|-----------------|---------------|-------------|
| BAI           | DSM-IV criteria | Asia South | Nepal    | 363     | ≥14             |               |             |
| DASS-A        | SCID            | Asia South East | Vietnam | 221     | ≥10             |               |             |
| EPDS          | MINI            | Africa South | South Africa | 376     | ≥5              |               |             |
| EPDS-anxiety subscale | NetSCID | Africa South | South Africa | 145     | ≥7              |               |             |
| GAD-2         | MINI            | Africa South | South Africa | 376     | ≥2              |               |             |
| GAD-7         | CIDI            | Asia South East | Malaysia | 895     | ≥8              |               |             |
| GAD-7         | Interview       | Asia West | Lebanon | 186     | ≥10             |               |             |
| GAD-7         | SCID            | Africa East | Zimbabwe | 264     | ≥10             |               |             |
| GAD-7*        | NA              | NA          | NA       | NA      | ≥10             |               |             |
| GAD-7         | CIDI            | South America | Peru     | 956     | ≥7              |               |             |

Abbreviations: HADS: Hospital Anxiety and Depression Scale; HADS-A: Hospital Anxiety and Depression Scale Anxiety subscale; DASS: Depression Anxiety Stress Scales; Zung SAS: Zung Self-Rating Anxiety Scale; STAI: State Trait Anxiety Inventory; EPDS: Edinburgh Postnatal Depression Scale; HAM-A: Hamilton Anxiety Rating Scale; K10/K6: Kessler 10/6; GAD: Generalized Anxiety Test; HDRS: Hamilton Depression Rating Scale; HSCL: Hopkins Symptom Checklist; MINI-SPIN: Mini-Social Phobia Inventory; PHC: Primary Health Care Screening Tool; GHC: General Health Questionnaire; SCARED: Screen for Child Anxiety Related Disorders; PASS: Perinatal Anxiety Screening Scale; RCADS: Revised Children’s Anxiety and Depression Scales; BAI: Beck Anxiety Inventory; HTQ: Harvard Trauma Questionnaire; CL: ; PDS: Posttraumatic Diagnostic Scale; PCL-C: PTSD Checklist-Clinician Version; CPSS: Child PTSD Symptom Scale; TSSC: Traumatic Stress Symptom Scale; CAPS: Clinician-Administered PTSD Scale; YSR: Youth Self-Report; AKUADS: Aga Khan University Anxiety and Depression; SRQ: Self-Reporting Questionnaire; AYMH: Arab Youth Mental Health Scale; HEI: Huaxi Emotional-Distress Index

Table 6. Screening tool by disorder and region with sensitivity, specificity and cut-off value
| Instrument | Mini | Region | Country | Total | Threshold |
|------------|------|--------|---------|-------|-----------|
| GAD-7      | MINI | Asia East | China   | 213   | ≥6        |
| GHQ-12     | CIDI | Africa West | Nigeria | 1590  | ≥3        |
| GHQ-12     | CIDI-PHCV | Asia West | Turkey  | 65    | ≥5        |
| HADS       | Interview | Asia South | India   | 70    | ≥7        |
| HADS       | Interview | Asia West | Kuwait   | 135   | ≥13       |
| HADS       | CIDI-PHCV | Asia West | Turkey  | 65    | ≥12       |
| HADS-A     | MINI | Africa South | South Africa | 70 | ≥11 |
| HADS-A     | MINI | Asia East | China   | 80    | ≥6        |
| HADS-A     | MINI | Asia East | China   | 100   | ≥6        |
| HAM-A      | MINI | Africa South | South Africa | 70 | ≥22 |
| HDRS       | DSM-IV criteria | Asia South East | Malaysia | 120 | ≥9 |
| HSCL       | PAS | Asia South | Afghanistan | 116 | ≥2 |
| HSCL-25    | Interview | Asia Central | Tajikistan | 75 | ≥1.6 |
| HSCL-25    | CIDI | Asia South | Nepal   | 290   | ≥1.75     |
| HSCL-25    | MINI | Asia South | India   | 290   | ≥1.75     |
| K-10 (agoraphobia) | MINI | Africa South | South Africa | 429 | ≥26 |
| K-10       | MINI | Africa South | South Africa | 376 | ≥11 |
| K-10       | MINI-KID | Asia South East | Indonesia | 196 | ≥18 |
| K-10       | MINI | Africa South | South Africa | 429 | ≥30 |
| K-10       | MINI | Africa South | South Africa | 429 | ≥30 |
| K-10       | MINI | Africa South | South Africa | 429 | ≥28 |
| K-10 (SAD) | MINI | Africa South | South Africa | 429 | ≥30 |
| K-6        | MINI | Africa South | South Africa | 376 | ≥8 |
| K-6        | CIDI | Africa West | Nigeria  | 1590  | ≥4        |
| K-6        | MINI-KID | Asia South East | Indonesia | 197 | ≥12 |
| MINI-SPIN (SAD) | SCID | America South | Brazil | 2320 | ≥6 |
| PASS       | SCID-1 | Asia West | Turkey  | 312   | ≥16       |
| PHC        | CIS-R | South America, Asia South, Asia East, Central America | Brazil, Pakistan, China, Mexico | 1488 (all countries) | ≥3 |
| RCADS-     |      |          |         |       |           |
| Anxiety disorders | GAD scale | K-SADS | Asia West | Turkey | 483 | ≥7.5 |
|-------------------|-----------|--------|-----------|--------|-----|------|
| SCARED            | K-SADS-PL | Asia South | India | 500 | ≥21 |
| SCARED-C          | Interview | Asia West | Lebanon | 82 | ≥26 |
| SCARED-P          | Interview | Asia West | Lebanon | 82 | ≥24 |
| STAI              | MINI      | Africa South | South Africa | 70 | ≥40 |
| Zung SAS          | Interview | Asia South East | Vietnam | 364 | ≥38 |
| Zung SAS          | Interview | Asia South East | Vietnam | 231 | ≥36 |
| CAPS              | SCID      | South America | Brazil | 98 | ≥46 |
| CL                | CIDI      | Asia South | Nepal | 290 | ≥50 |
| CPSS              | K-SADS-PL | Africa East | Burundi | 65 | ≥26 |
| CPSS              | K-SADS    | Asia South | Nepal | 162 | ≥20 |
| HTQ               | SCID      | Europe Southern | Bosnia and Herzegovina | 180 | ≥2.06 |
| HTQ               | MINI      | Africa South | South Africa | 465 | ≥62 |
| HTQ               | SCID      | Asia South East | Thailand | 118 | ≥2 |
| HTQ-R             | Interview | Asia Central | Tajikistan | 75 | ≥1.73 |
| K-10              | MINI      | Africa South | South Africa | 429 | ≥29 |
| K-10              | MINI      | Africa South | South Africa | 429 | ≥29 |
| PCL-5             | CAPS-5    | Africa East | Zimbabwe | 204 | ≥33 |
| PCL-5             | DSM 5 interview | Asia West | Iraq | 206 | ≥23 |
| PCL-C             | CAPS      | South America | Peru | 3289 | ≥26 |
| PDS               | CIDI      | Africa East | Somalia | 6073 | ≥3 |
| PDS               | CAPS      | Africa East | Uganda | 68 | ≥16 |
| PDS               | CIDI      | Africa South | South Africa | 85 | ≥15 |
| PTSD screening tool | DSM-IV PTSD criteria | Asia East | China | 27267 | ≥3 |
| PTSD screening tool | DSM-IV PTSD criteria | Asia East | China | 135 (62 for CIDI) | ≥14 |
| PTSD screening tool | DSM-IV PTSD criteria | Asia East | China | 27267 | ≥3 |
| TSSC              | CAPS      | Asia West | Turkey | 130 | ≥2 |
| UCLA PTSD         | Interview | Asia South | Iran | 50 | ≥38 |
| AKUADS            | Interview | Asia South | Pakistan | 487 | ≥19 |
| AYMH              | Interview | Asia West | Lebanon | 153 | ≥39 |
| Anxiety and depressive disorders | HADS | Interview | Africa West | Nigeria | 1078 | ≥8 |
|-----------------------------------|------|-----------|-------------|---------|------|----|
| HEI                               | MINI | Asia East | China       | 763     | ≥11  |    |
| HSCL                              | PAS  | Asia South | Afghanistan | 116     | ≥2   |    |
| HSCL-25                           | SCID | Africa East | Tanzania    | 100     | ≥1.06|    |
| K-10                              | CIDI | Africa South | South Africa | 4077     | ≥16  |    |
| K-6                               | CIDI | Africa South | South Africa | 4077     | ≥10  |    |
| self-made                         | Interview | Africa East | Zambia     | 575     | ≥17  |    |
| SRQ-20                            | MINI | Africa South | South Africa | 200     | ≥5   |    |
| YSR                               | Interview | Africa East | Ethiopia   | 134     | ≥6.5 |    |

*Pooled GAD-7 accuracy values were based on data from the bolded values

Italicized rows contain the same data published separately in more than one study

Abbreviations: HADS: Hospital Anxiety and Depression Scale; DASS: Depression Anxiety Stress Scales; Zung SAS: Zung Self-Rating Anxiety Scale; STAI: State Trait Anxiety Inventory; EPDS: Edinburgh Postnatal Depression Scale; HAM-A: Hamilton Anxiety Rating Scale; K10/K6: Kessler 10/6; GAD: Generalized Anxiety Test; HDRS: Hamilton Depression Rating Scale; HSCL: Hopkins Symptom Checklist; MINI-SPIN: Mini-Social Phobia Inventory; PHC: Primary Health Care Screening Tool; GHC: General Health Questionnaire; SCARED: Screen for Child Anxiety Related Disorders; PASS: Perinatal Anxiety Screening Scale; RCADS: Revised Children’s Anxiety and Depression Scales; BAI: Beck Anxiety Inventory; HTQ: Harvard Trauma Questionnaire; CL:; PDS: Posttraumatic Diagnostic Scale; PCL-C: PTSD Checklist-Clinician Version; CPSS: Child PTSD Symptom Scale; TSSC: Traumatic Stress Symptom Scale; CAPS: Clinician-Administered PTSD Scale; YSR: Youth Self-Report; AKUADS: Aga Khan University Anxiety and Depression; SRQ: Self-Reporting Questionnaire; AYMH: Arab Youth Mental Health Scale; HEI: Huaxi Emotional-Distress Index

Figures
Figure 1

Search strategy

1. Was expectation bias avoided?
   (Were people administering the diagnostic interview blind to the results of the screening tool, and vice versa?)

2. Was work-up bias avoided?
   (Did positive and negative screens have an equal chance of receiving the full diagnostic interview?)

3. Was a sensible 'normal range' derived from the results?
   (Was ROC analysis used to identify the most appropriate cut-off point?)

4. Was the tool appropriately translated, adapted and/or designed for the study setting and population?
   (If using an existing tool, did authors employ the standardized WHO translation protocol?)

5. Were confidence intervals given for AUC, sensitivity, specificity and other psychometric features of the test?

6. Was the tool shown to be reproducible both within and/or between observers?
   (Was test-retest and/or inter-rater reliability assessed?)

Figure 2

A modified Greenhalgh's ten item checklist, adapted from Ali et al [20]
5343 papers returned from four database searches and included for title and abstract review. A total of 107 papers from the search included for full-text review after initial screening.

An additional 5 papers included from the reference section of included systematic reviews

113 studies included for full-text review

Excluded an additional 55 studies
Unable to access 2 articles
6 unavailable in English
4 not conducted in LMIC
9 no sensitivity/specificity or cutoff
11 were not assessed against gold standard
3 systematic reviews
20 did not screen for disorder of interest

A final count of 57 studies/75 screening tools included for data abstraction

Figure 3
Flow chart of study selection

Supplementary Files
This is a list of supplementary files associated with the primary manuscript. Click to download.

Appendix File 1 Systematic Review.xlsx
PRISMA checklist Systematic Review Mughal et al.docx