

Domains and Psychometric Properties of Scales Measuring Disaster Preparedness among General Population: A Systematic Literature Review

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Abbreviations:

BPPS: Bushfire Psychological Preparedness Scale
CFI: Comparative Fit Index
COSMIN: Consensus-Based Standards for the Selection of Health Measurement Instruments
CRED: Center for Research on the Epidemiology of Disasters
DPI: Disaster Preparedness Index
EFA: Exploratory Factor Analysis
EPS: Earthquake Preparedness Scale
ERI: Earthquake Readiness Index
ERS: Earthquake Readiness Scale
GDPB: General Disaster Preparedness Belief Scale
HDPI: Household Disaster Preparedness Index
HEPPT: Household Earthquake Persian Preparedness Tool
IGDPB: Improved General Disaster Preparedness Belief Scale
LDPT: Livelihood Disaster Preparedness Tool
PPDTS: Psychological Preparedness for Disaster Threat Scale

Abstract

Introduction: There is no universal tool for measuring disaster preparedness in the general population. This study aimed to provide a summary of the domains and psychometric properties of the available scales that assess preparedness for disasters, or one of its main types, among individuals or households.

Methods: This study is a systematic review of the literature on disaster preparedness tools. Studies published up to December 2022 were identified through a systematic search of four databases: Google Scholar, PubMed, Scopus, and Web of Science. Consensus-Based Standards for the Selection of Health Measurement Instruments (COSMIN) were used to review and evaluate the psychometric properties. The Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) guidelines were used to report this article. **Results:** Twelve articles met the inclusion criteria. Among them, five scales measured general disaster preparedness, five measured earthquake preparedness, one measured flood preparedness, and one measured bushfire preparedness. The scales had a number of dimensions ranging from one to six. The most common item topics in the included scales were as follows: having an evacuation plan ($n = 7$), information source ($n = 7$), fire extinguisher ($n = 6$), and emergency kit ($n = 5$). The scales were rated sufficient for content validity ($n = 10$), structural validity ($n = 5$), internal consistency ($n = 5$), and test-re-test reliability ($n = 6$). One scale was checked for criterion validity and was rated as insufficient according to the COSMIN guidelines.

Conclusion: The findings suggest the need to improve the psychometric properties of the scales, expand their contents, and develop scales relevant to target populations. This study provides useful information for researchers to develop comprehensive assessment tools and valuable sources of items for future scales.

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Introduction

Disasters are defined by the United Nations (New York, USA) as serious disruption to the functioning community at any scale due to hazardous events that interact with factors of exposure and vulnerability, resulting in human health, environmental, social, material, and/or economic losses.¹ Disasters have impacted the lives of millions of people around the world in recent years. They are increasing in frequency and intensity, owing to phenomena such as climate change, poorly planned urban development, and other disaster risk drivers.^{2,3} The year 2022 witnessed the occurrence of 387 natural disasters, resulting in a total death of

PRISMA: Preferred Reporting Items for Systematic Review and Meta-Analysis
RMSEA: Root Mean Square Error of Approximation
SRMR: Standardized Root Mean Square Residual
VIFPS: Vested Interest Flood Preparedness Scale

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30,704 people, which is three-times higher than the number of deaths in 2021. The most common types of disasters in 2022 were floods, storms, and earthquakes, and the deadliest natural disasters in that year were heat waves, followed by droughts.⁴ The year 2023 was initiated by devastating earthquakes in Türkiye and Syria that resulted in more than 50 thousand deaths; that is more than the total number of deaths caused by natural disasters in 2022. These earthquakes have resulted in thousands of injured people, in addition to huge social and economic impacts.⁵

Disasters are generally classified as natural or man-made. Natural disasters are further classified by the Center for Research on the Epidemiology of Disasters (CRED; Brussels, Belgium) into groups in which the main types of disasters fall. These groups are geophysical disasters (including earthquakes and volcanoes); meteorological (including storms); hydrological (including floods and wet mass movements); climatological (including extreme temperature, drought, and wildfire); biological (including epidemics, insect infestations, and animal stampedes); and extra-terrestrial (including meteorites/asteroids).⁶

Modern approaches to disaster risk management prioritize pre-event measures of prevention, mitigation, and preparedness over post-event measures of response, recovery, and rehabilitation.⁷ Preparedness is defined as the knowledge and capacities developed to effectively predict, respond to, and recover from disasters. Preparedness actions are required by governments, organizations, institutions, communities, and individuals.⁸ Preparedness can decrease the mortality of some disasters by 50% or more.⁹ It is the key factor in determining the efficiency of early warning systems and has a significant impact on decreasing disaster losses.¹⁰ In both all-hazards and top-hazard approaches to disaster risk management, many disasters share the same measures of household preparedness, such as having an emergency kit and household emergency plan, and staying informed. In addition, other measures are needed, specifically, for each disaster type.^{11,12}

As evidenced by recent disasters, populations are not yet prepared for the hazards and face dire consequences in the form of loss of lives and economic losses. Measuring preparedness is essential for preparing and evaluating campaigns that aim to increase preparedness levels. There is no tool or single variable that can describe preparedness. Accordingly, the use of scales is very beneficial in providing conclusions about relevant and important contributors to disaster preparedness.^{13–15} Disaster preparedness scales are a growing field of study in which valid and reliable tools are developed or adapted to measure disaster preparedness. This systematic review aims to explore the domains and psychometric characteristics of the available disaster preparedness scales in the literature that measure preparedness among the general population, either at the household or individual level, and provides a summary of them. The general population was selected as the target group of the articles included in this review because there was an observed knowledge gap among this group. A similar review addressed the preparedness scales available for nurses,¹⁶ and other reviews addressed the scales measuring preparedness of hospitals.^{17,18} These scales provide one of the best sources of valid, reliable items that can help individuals to measure their own preparedness, and the researchers in measuring preparedness in surveys and in awareness campaign evaluation, or in generating new scales for measuring preparedness in different settings.¹³

Methodology

This study was conducted using the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) Guidelines (Supplementary Material; available online only).

Criteria of Inclusion and Exclusion

Studies that met the following criteria were considered eligible and were included: (1) methodological studies that aimed to develop or adapt tools to measure preparedness or readiness to disaster, or one of the main types of disasters, namely animal stampede, drought, earthquake, epidemic, extreme temperature, flood, fire, insect infestation, mass movement, meteorite and asteroid, storm, and volcano;⁶ (2) studies that reported the methodology of the validation study and reported at least one psychometric property of the developed or adapted scale; (3) the main text of the article must be in English; and (4) the scale aims to measure preparedness among the general population, not a specific group such as nurses, teachers, patients, or hospitals, or state preparedness.

Search Strategy

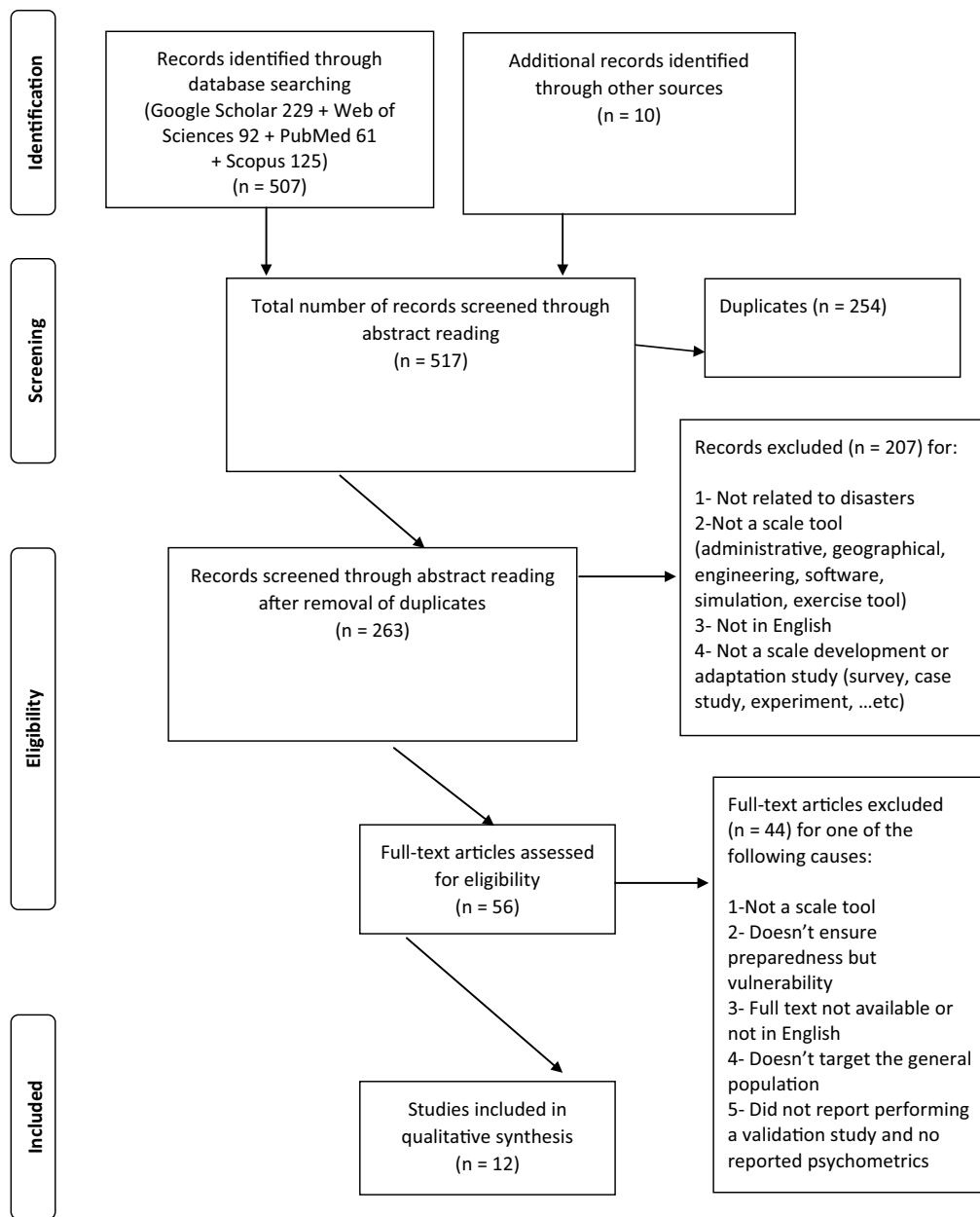
The databases used to identify relevant studies were: Google Scholar (Google Inc.; Mountain View, California USA); PubMed (National Centre for Biotechnology Information, National Institute of Health; Bethesda, Maryland USA); Scopus (Elsevier; Amsterdam, Netherlands); and Web of Science (Thomson Reuters; New York USA). The keywords used were the main types of disaster terminology published by CRED.⁶ The following search strategy was used to retrieve studies from each database:

((Preparedness OR Readiness) AND (disaster* OR earthquake* OR volcano* OR mass* OR movement* OR storm* OR flood* OR extreme* OR temperature* OR drought* OR fire* OR epidemic* OR insect* OR infestation* OR animal* OR stampede* OR meteorit* OR asteroid) AND (scale OR tool OR instrument OR measure* OR questionnaire OR index).

Search was conducted on the titles of the relevant studies, and articles published up to December 2022 were retrieved. For grey literature, the authors used a Google search engine (Google Inc.; Mountain View, California USA) bibliography of related publications. The retrieved articles were imported into EndNote X7.7 library version 17.5.0.9325 (Thomson Reuters; New York, New York USA). Duplicates were removed using the EndNote program and manually. The abstracts of the remaining articles were screened by two reviewers. The full articles of relevant studies were reviewed. The domains, dimensions, and psychometric properties of the included tools were reported.

Search Process

A total of 517 articles relevant to the objectives of the systematic review were identified using the search strategy (229 from Google Scholar, 125 from Scopus, 92 from Web of Science, 61 from PubMed, and 10 from the grey literature search). Removed duplicates were 254 in number. Screening of the abstracts of the remaining articles resulted in the elimination of 207 articles based on the following facts: (1) they were not related to disaster, but belonged to other items of the keywords (eg, body mass index); (2) they were not a scale tool, instead they included either administrative, geographical, engineering, software, simulation, or an exercise tool; (3) they were not written in English; or (4) they were not a scale development or adaptation study (eg, survey, case study, or experiment). The full texts of the 56 articles were checked for eligibility for inclusion. An additional 44 articles were excluded based on the following criteria: (1) they were not a scale tool, instead they included either administrative, geographical, engineering, software, simulation, or an exercise tool; (2) they did not measure preparedness but vulnerability; (3) the full text was not in English; (4) they did not target the general population but nurses', patients', hospitals', or states' preparedness; and (5) they did not report carrying out a methodological validation study and did not



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Figure 1. PRISMA Flow Chart of the Search Process of Systematic Review of Domains and Psychometric Properties of Scales Measuring Disaster Preparedness among General Population.

report psychometrics. The final assessment included 12 studies. The bibliographies of these 12 articles were reviewed, and all the scales included in the bibliographies were already included using the search strategy. Figure 1 shows the selection process.

Results

Twelve studies were included in this systematic review. All of them presented scales developed to measure preparedness for a disaster, or one of its main types, in the general population. Five of the articles presented scales for measuring disaster preparedness in general. These scales, in alphabetical order of their abbreviations, were as follows: Disaster Preparedness Index (DPI),¹⁹ General Disaster Preparedness Belief Scale (GDPB),²⁰ Household Disaster Preparedness Index (HDPI),²¹ Improved General Disaster Preparedness Belief Scale

(IGDPB),²² and the Psychological Preparedness for Disaster Threat Scale (PPDTS).²³ Five studies presented earthquake preparedness scales. These were the Earthquake Preparedness Scale (EPS),²⁴ Earthquake Readiness Index (ERI),²⁵ Earthquake Readiness Scale (ERS),²⁶ Household Earthquake Preparedness Persian Tool (HEPPT),²⁷ and Livelihood Disaster Preparedness Tool (LDPT).²⁸ One article presented Vested Interest Flood Preparedness Scale (VIFPS)²⁹ and another article presented Bushfire Psychological Preparedness Scale (BPPS).³⁰

The scales were developed and validated in Australia (n = 2), India (n = 2), Iran (n = 2), New Zealand (n = 2), Türkiye (n = 2), and the United States (n = 2). Information regarding the included studies and scales is shown in Table 1. The publication period of these articles ranged from 1990 through 2022. The number of

Study Title Scale Abbreviation	Disaster Type	Country Language Year	Participants	Sample Size	No. of Items No. of Points Type	Dimensions of the Scale
1. Vested Interest: Developing Scales for Assessing Flooding Preparedness (VIFPS)	Flood	United States English 2016	2 Samples: 1. University Course Participants 2. Residents of Oklahoma City	363 + 229	40 (5+7+ 6+8+ 6+8) (7-Point Scale) Attitude	Six: 1. Perceived Susceptibility 2. Perceived Response Efficacy 3. Perceived Self-Efficacy 4. Perceived Certainty 5. Perceived Immediacy 6. Perceived Salience
2. Assessing Household Preparedness for Earthquakes: An Exploratory Study in Development of a Valid and Reliable Persian-Version Tool (HEPPT)	Earthquake	Iran Persian 2016	Households Living in Three Provinces in Iran	450	18 No. of Points Not Reported Measures Knowledge & Practice	Six: 1. Actions at Time of Earthquake 2. Non-Structural Safety 3. Structural Safety 4. Drill 5. Hazard Map and Communication 6. Safety Skills
3. The Development and Validation of the Bushfire Psychological Preparedness Scale (BPPS)	Wildfire	Australia English 2020	Residents in Bushfire-Prone Areas in Australia	661	33 Five-Point Likert Scale Measuring Knowledge, Attitude, & Practice	One for Knowledge, Four for Psychological Coping Capacity Scale: 1. Social Support 2. Coping Self-Efficacy 3. Optimism 4. Proactivity
4. The Development of a General Disaster Preparedness Belief Scale Based on Health Belief Model (GDPB)	General Disaster	Türkiye Turkish 2018	Yalova University Staff	286	31 Five-Point Likert Scale Measuring Attitude	Six: 1. Susceptibility 2. Severity 3. Benefits 4. Barriers 5. Cue to Action 6. Self-Efficacy
5. Improvement of General Disaster Preparedness Belief Scale Based on Health Belief Model (IGDPB)	General Disaster	Türkiye Turkish 2018	Participants from Yalova Province	973	45 Five-Point Likert Scale Measuring Attitude	Six: 1. Susceptibility 2. Severity 3. Benefits 4. Barriers 5. Cue to Action 6. Self-Efficacy
6. Development of Earthquake Readiness Index Tool to Assess Individual Earthquake Preparedness Level (ERI)	Earthquake	India English 2018	Indian Residents in City of Coimbatore	540	27 Three-Point Scale Measuring Practice	Six: 1. Emergency Needs 2. Personal Safety 3. Outdoor Safety 4. Indoor Safety 5. Structural Safety 6. Mitigation

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Table 1. Characteristics of the Included Studies (n = 12) (continued)

Study Title Scale Abbreviation	Disaster Type	Country Language Year	Participants	Sample Size	No. of Items No. of Points Type	Dimensions of the Scale
7. A Tool to Assess Livelihood Preparedness for Disasters: A Study of Kaikoura Earthquake in New Zealand (LDPT)	Earthquake	New Zealand English 2022	Working Individuals Living in Kaikoura at the Time of 2016 Earthquake	140	4 Five-Point Likert Scale Measuring Attitude	One: Livelihood Preparedness
8. Conceptualizing and Measuring Psychological Preparedness for Disaster: The Psychological Preparedness for Disaster Threat Scale (PPDTS)	General Disaster	Australia English 2020	Australian Residents who are Members of Central Queensland University Health and Social Science Panel	1,253	18 Four-Point Likert Scale Measuring Attitude & Knowledge	Two: 1. Knowledge and Management 2. Anticipation Awareness and Management
9. Reliability and Validity of Household Disaster Preparedness Index (HDPI)	General Disaster	Iran 2020	Families from Counties of Isfahan Province	200	15 No. of Points Not Reported Measuring Practice	Five: 1. Reduction of Vulnerability 2. Planning for Disasters 3. Family Empowerment 4. Procurement Resources 5. Specialized Programs
10. Disaster Preparedness Index: A Valid and Reliable Tool to Comprehend Disaster Preparedness in India (DPI)	General Disaster	India 2018	Online and Distributed to Flats, Malls, Parks in the City of Chennai	445	14 Knowledge (Yes, No) Two-Point Scale Measuring Practice	Four: 1. Indoor Safety 2. Document Preparation 3. Collection Efficacy 4. Escape Plan
11. Effects of a Large Destructive Local Earthquake on Earthquake Preparedness as Assessed by an Earthquake Preparedness Scale (EPS)	Earthquake	United States English 1990	4 Samples: Sample 1, 2, 4 from Undergraduate Students at Two California Universities Sample 3 of Homeowners in Placentia	179 + 154 + 81 + 36	27 Three-Point Scale Measuring Practice	Not Reported
12. The Earthquake Readiness Scale: The Development of a Valid and Reliable Unifactorial Measure (ERS)	Earthquake	New Zealand English 2005	Wellington City Residents	652	23 (Yes, No) Two-Point Scale Measuring Practice	One Dimension

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Table 1. (continued). Characteristics of the Included Studies (n = 12)

Abbreviations: BPPS, Bushfire Psychological Preparedness Scale; DPI, Disaster Preparedness Index; EPS, Earthquake Preparedness Scale; ERI, Earthquake Readiness Index; ERS, Earthquake Readiness Scale; GDPB, General Disaster Preparedness Belief Scale; HDPI, Household Disaster Preparedness Index; HEPPT, Household Earthquake Persian Preparedness Tool; IGDPB, Improved General Disaster Preparedness Belief Scale; LDPT, Livelihood Disaster Preparedness Tool; PPDTS, Psychological Preparedness for Disaster Threat Scale; VIFPS, Vested Interest Flood Preparedness Scale.

items on the scales ranged from four to 45, and the number of dimensions of the scales ranged from one to six. Five scales (GDPB, IGDPB, LDPT, PPDT, and VIFP) aimed mainly to measure attitudes towards preparedness. Two of them (GDPB and IGDPB) relied on the health belief model. The VIFP relied on vested interest theory. The components of these models were the

domains or the dimensions under which the items fell. These dimensions were susceptibility, severity, benefits, barriers, cues to action, and self-efficacy for GDPB and IGDPB; and perceived susceptibility, response efficacy, self-efficacy certainty, immediacy, and salience for VIFP (Table 1). The other two scales (LDPT and PPDT) did not adopt a model or a theory. The LDPT had one

dimension with four items, and PPDT had two dimensions: (1) knowledge and management and (2) anticipation, awareness, and management. Two scales (DPI and HEPPT) were developed to measure the practice and knowledge of preparedness. The DPI had four dimensions: (1) indoor safety, (2) document preparation, (3) collection efficacy, and (4) escape plan. On the other hand, HEPPT reported six dimensions: (1) actions at the time of an earthquake, (2) non-structural safety, (3) structural safety, (4) drill, (5) hazard map and communication, and (6) safety skills. Four scales (ERI, EPS, ERS, and HDPI) mainly measured the practice of preparedness. The ERS was a unifactorial scale, and the EPS did not report dimensions. The ERI reported six dimensions: (1) emergency needs, (2) personal safety, (3) outdoor safety, (4) indoor safety, (5) structural safety, and (6) mitigation. The HDPI reported five dimensions: (1) reduction in vulnerability, (2) planning, (3) family empowerment, (4) procurement resources, and (5) specialized programs. The bushfire scale (BPPS) measured the knowledge, attitude, and practices of bushfire preparedness. The BPPS had a knowledge scale and psychological coping capacity scale with four dimensions: (1) social support, (2) coping self-efficacy, (3) optimism, and (4) proactivity.

All included articles were written in English. Most of the presented scales were in English, except for three scales, of which two (GDBP and IGDPB) were in Turkish and one (HEPPT) was in Persian. The study participants were residents of one city, university students, or university personnel. Mixed samples had been used in some studies (Table 1). Ten studies used convenience sampling, while the other two used multistage sampling (HDPI and HEPPT). The participants or sample sizes of the validation studies ranged from 140 to 1,253.

Some item topics were shared on more than one scale. The most common shared item topic was the emergency or evacuation plan, which was included in seven scales (DPI, EPS, ERI, ERS, GDPB, HDPI, and VIFPS). This was followed by having a fire extinguisher among the items of six scales (DPI, EPS, ERI, ERS, GDPB, and HDPI). Items related to the emergency kit were included on five scales (DPI, ERI, GDPB, HDPI, and VIFPS). Storing water and food were specified in items on three earthquake scales (EPS, ERI, and ERS). Receiving early warning messages of anticipated disasters was referred to among items of four scales (DPI, HDPI, PPDTs, and VIFPS). Earthquakes cannot be predicted, which is why this topic had not been addressed by the five earthquake scales. Having a radio was specified in four scales (DPI, EPS, ERI, and ERS), three of which were earthquake scales. Having a source of information that included receiving warning messages and having a radio was addressed on a total of seven scales. An item related to emergency contact numbers (eg, police, support, and medical emergency) was included among the items of four scales (DPI, ERI, PPDTs, and VIFPS). An item related to first aid was present in five scales (EPS, ERI, ERS, GDPB, and VIFP), in which two scales included a separate item about keeping essential medicines (ERI and ERS). Items related to the fixation of furniture as a measure to prepare for earthquakes were presented on five scales (DPI, EPS, ERI, ERS, and GDPB). Items related to considering the risk of an earthquake while choosing the place of living and strengthening the building were included on two scales (ERI and ERS). These two scales also included items about measures to be done at work or institute, and measures of having an alternative cooking source and extra toilet paper. Items related to the valves of electricity, water, and gas were included in three scales (DPI, EPS, and ERI). Having a torch was included in the items of

Shared Item Topic	Scales Included the Item Topic
Evacuation or Emergency Plan	Seven Scales (DPI, EPS, ERI, ERS, GDPB, HDPI, VIFPS)
Having Source of Information (Receiving Warning Messages + Having Radio)	Seven Scales (DPI, EPS, ERI, ERS, HDPI, PPDTs, VIFPS)
Fire Extinguisher	Six Scales (DPI, EPS, ERI, ERS, GDPB, HDPI)
Emergency Kit	Five Scales (DPI, ERI, GDPB, HDPI, VIFPS)
First Aid	Five Scales (EPS, ERI, ERS, GDPB, VIFP)
Fixation of Furniture	Five Scales (DPI, EPS, ERI, ERS, GDPB)
Receiving Early Warning Messages	Four Scales (DPI, HDPI, PPDTs, VIFPS)
Having Radio	Four Scales (DPI, EPS, ERI, ERS)
Emergency Contact Numbers	Four Scales (DPI, ERI, PPDTs, VIFPS)
Storing Water and Food	Three Earthquake Scales (EPS, ERI, ERS)
Shutting Off Valves of Electricity, Water, and Gas	Three Scales (DPI, EPS, ERI)
Essential Medicines	Two Scales (ERI and ERS)
Considering Risk of Earthquake while Choosing Place of Living and Strengthening the Building	Two Scales (ERI and ERS)
Measures Done at Work/Institute, Measures of Having Alternative Cooking Source and Extra Toilet Paper	Two Scales (ERI and ERS)
Having Torch	Two Scales (EPS and ERS)

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Table 2. Item Topics which were Shared by More than One Scale

Abbreviations: DPI, Disaster Preparedness Index; EPS, Earthquake Preparedness Scale; ERI, Earthquake Readiness Index; ERS, Earthquake Readiness Scale; GDPB, General Disaster Preparedness Belief Scale; HDPI, Household Disaster Preparedness Index; PPDTs, Psychological Preparedness for Disaster Threat Scale; VIFPS, Vested Interest Flood Preparedness Scale.

two scales (EPS and ERS). Table 2 summarizes the shared item topics and the scales that included them. Both LDPT and BPPS tended to be specific scales, so they did not share item topics with the other scales.

The psychometric properties of the scales were evaluated according to Consensus-Based Standards for the Selection of Health Measurement Instruments (COSMIN) criteria.³¹ A summary of the reported psychometric properties and sufficiency of the scales is presented in Table 3. Most of the scales reported assessment of content validity or consideration of expert comments, except for the LDPT and VIFP. Content validity index (CVI) ≥ 0.8 was reported in three studies (HDPI, HEPPT, and IGDPB). Structural validity was assessed and reported in all of the studies except EPS and VIFP, with sufficient Kaiser-Meyer-Olkin/KMO and Bartlett tests and factor loadings of more than 0.3. However, COSMIN criteria judge the structural validity according to Root Mean Square Error of Approximation (RMSEA) or Tucker-Lewis Index/TLI, or Comparative Fit Index (CFI) or Standardized Root Mean Square Residual (SRMR). That was why the scales for which only

Scale Abbreviation	Content Validity	Structural Validity	Internal Consistency	Reliability (Test-Re-Test)	Criterion Validity
1- VIFPS	(?)	(?)	0.799-0.874 (+)	(?)	(?)
2- HEPPT	(+)	Only EFA was Carried Out (?)	0.7 (?)	Spearman Correlation (?)	(?)
3- BPPS	(+)	RMSEA 0.03 RMSEA 0.04 (+)	0.85 0.89 -0.64 (-)	?	Pearson's Correlation (0.09 – 0.41) (-)
4- GDPB	(+)	Only EFA was Carried Out (?)	0.74 -0.90 (+)	Pearson's Correlation (0.73) (+)	?
5- IGDPB	(+)	RMSEA 0.05 (+)	Stratified Alpha 0.93 (+)	?	?
6- ERI	+	RMSEA 0.05 (+)	0.78 (?)	Spearman Correlation (0.8-1) (+)	?
7- LDPT	?	RMSEA 0.000 (+)	0.65 Supported by Inter Item Correlation (+)	?	?
8- PPDTS	+	SRMR 0.045 (+)	0.70 – 0.96 (+)	?	?
9- HDPI	+	Only EFA was Carried Out (?)	0.76 – 0.368 (-)	Pearson's Correlation (0.981) (+)	?
10- DPI	+	Only EFA was Carried Out (?)	0.91 (?)	?	?
11- EPS	+	?	0.78 (?)	Correlation (0.78) (+)	?
12- ERS	+	CFI 0.98 (+)	0.78 (+)	?	?

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Table 3. Psychometric Properties of the Included Tools (n = 12)

Note: (+) = sufficient, (?) = indeterminate that is not all information for being (+) is reported, (-) = insufficient according to COSMIN criteria. Abbreviations: BPPS, Bushfire Psychological Preparedness Scale; CFI, Comparative Fit Index; COSMIN, Consensus-Based Standards for the Selection of Health Measurement Instruments; DPI, Disaster Preparedness Index; EFA, Exploratory Factor Analysis; EPS, Earthquake Preparedness Scale; ERI, Earthquake Readiness Index; ERS, Earthquake Readiness Scale; GDPB, General Disaster Preparedness Belief Scale; HDPI, Household Disaster Preparedness Index; HEPPT, Household Earthquake Persian Preparedness Tool; IGDPB, Improved General Disaster Preparedness Belief Scale; LDPT, Livelihood Disaster Preparedness Tool; PPDTS, Psychological Preparedness for Disaster Threat Scale; RMSEA, Root Mean Square Error of Approximation; SRMR, Standardized Root Mean Square Residual; VIFPS, Vested Interest Flood Preparedness Scale.

Exploratory Factor Analysis (EFA) was performed and appeared as “indeterminate (?)” in Table 3. Reported in five scales was CFI with sufficient psychometrics (BPPS, ERS, IGDPB, LDPT, and PPDTS). Internal consistency using Cronbach's alpha was reported in all the 12 scales. However, three scales (DPI, ERI, and HEPPT) reported a Cronbach's alpha coefficient for the whole scale, although EFA proved more than one dimension, and one-dimensionality of the scale was not proved. Indeterminate internal consistency is reported in Table 3 for these scales, although the single reported Cronbach alpha was more than 0.7 for not proving one-dimensionality. One-dimensionality was proved in ERS and IGDPB, for which Cronbach's alpha was considered sufficient (Table 3). Inter-item correlation of more than 0.2 was reported in LDPT in addition to Cronbach alpha. Two scales (BPPS and HDPI) reported a Cronbach's alpha of less than 0.7 in some of their dimensions, which was considered insufficient. Test-re-test reliability was assessed in five scales. The findings were reported in terms of Spearman or Pearson's correlation coefficient of more than 0.7 in EPS, ERI, GDPB, and HDPI, which was considered sufficient, and without reporting a value in HEPPT. Criterion validity was assessed on one scale (BPPS), and the coefficient was less than 0.7, which is why it was considered insufficient according to the COSMIN criteria.

Discussion

This study aimed to evaluate and provide a summary of the domains and psychometric properties of the available scales in the literature that measure the general population's preparedness for disasters, or one of the main types of disasters. Developing scales

to measure disaster preparedness is a growing research field internationally. This is reflected by the different countries where the included scales were developed and the increase in the number of studies compared to the years of publication. Five of the 12 included scales addressed general disaster preparedness that is consistent with the all-hazards approach. Five scales addressed earthquakes, which are one of the deadliest natural disasters. One scale addressed flood, which is the most prevalent natural disaster.⁴

The definition of preparedness includes the knowledge and capacities that governments, organizations, communities, or individuals develop for effective anticipation, response, and recovery from the impacts of disasters. According to this definition, measuring preparedness is expected to include measures of anticipation of disasters, if possible (before the onset of the disaster); measures that allow effective response (during the disaster); measures related to effective recovery (after the onset of the disaster); and knowledge related to them. The scales reviewed within the scope of this study examined preparedness in various dimensions, ranging from one to six. Knowledge as a dimension was included in four of the 12 scales. Seven scales addressed the practice of preparedness, and five focused on attitude as a factor that affects knowledge and behavior of preparedness. Despite the different wording of the dimensions of the scales, they shared many item topics, and the most common topics were those that were specified as measures needed to prepare for all the hazards in the all-hazards approach. These items are the trilogy of: (1) having a plan, (2) getting a kit, and (3) staying informed.¹¹

Scales in general tend to include items that are relevant to the place and culture of where they were developed. The reason for this may be to improve the validity and utility of the scale in the places where it was developed. For example, the ESP contains an item related to voting on bills that deal with earthquake-resistant buildings. This item is not applicable to places other than the United States. This may explain why researchers tend to develop scales rather than adapt other scales.

Ten of the 12 scales used convenience sampling. This can be explained by the ease of the method and its consistency with what is recommended by Clark, et al that preliminary application of the newly developed scale can be carried out in convenience samples of 100–200 individuals.³² Almost all scales fulfilled the condition of heterogeneity of the validation study sample, as recommended by Clark, et al³² and Morgado, et al.³³ The sample size, which is an important factor in improving the generalizability of the scale³⁴ and enabling carrying out factor analyses, was adequate in all studies, as most of the studies had a sample size of more than 200 or more than 5:1 respondents to item ratio.^{35,36}

Most articles reported sufficient content validity for the developed scales. Two scales, however, did not report expert consultation or judgement about the representativeness, comprehensiveness, and clarity of the items. The COSMIN guidelines consider checking content validity as the most important measurement among all psychometric properties of the developed scale.³¹

Structural validity expresses the relationship between items and explores the factorability of the items or the presence of latent variables that link groups of items. Structural validity was checked on ten of the 12 scales that reported sufficient psychometrics using exploratory factor analysis.³⁶ However, only five scales reported carrying out confirmatory factor analysis, which revealed the psychometrics required in the COSMIN guidelines. These five scales reported sufficient RMSEA or SRMR psychometric values of less than 0.06 or CFI more than 0.95.

Internal consistency using Cronbach's alpha was the most common psychometric tool used in the scales. This is consistent with the findings of Morgado, et al.³³ All the 12 included scales reported Cronbach's alpha, which should be reported at the level of the subscales for multi-dimensional scales. Reporting one Cronbach's alpha for the whole scale necessitates proving one-dimensionality, which was proven only by two scales (ERS and IGDP). The four scales which did not prove one dimensionality of the scale and appear as indeterminate in Table 3. Cronbach's alpha is sensitive to the number of items. Scales with a small number of items are recommended to carry out inter-item correlation.³⁶ This psychometric test was performed in the LDPT. The two scales HDPI and BPPS reported Cronbach's alpha of some subscales far less than 0.7, which appears in Table 3 as insufficient. All six scales

that reported carrying out test-re-test reliability checking reported a correlation coefficient of more than 0.7, which is considered sufficient (Table 3). Criterion validity involves a comparison of the scores of the tested scale with those obtained from a gold standard scale. It was checked in one scale (BPPS) that was found less than 0.7 and reported as insufficient in Table 3 as per the COSMIN criteria.

There is a continuous need for comprehensive, valid, reliable, relevant, and utilizable tools to measure preparedness. The best source of items for these tools is the previous scales. This review provides a summary of these scales and their psychometrics, which can also be directly used or adapted for use in settings similar to the settings of their development. The use of valid and reliable tools for measuring preparedness can result in accurate results that can assist in decision making regarding preparedness.

Limitations

The review did not include articles in languages other than English. Future studies are recommended to include articles published in other languages. In addition, this review findings are limited by the nations in which the research was conducted and the events that the scales focused upon. Published studies were limited by study design flaws and were found to be heterogenous in design, definitions, and outcomes.

Conclusion

This paper presented a summary of the domains and psychometric properties of the scales that measure disaster preparedness among the general population. Twelve articles presenting 12 scales developed in six countries were included in this review. Among them, five scales measured general disaster preparedness, five measured earthquake preparedness, one measured flood preparedness, and one measured bushfire preparedness. Number of items of the scales ranged from four to 45, while number of dimensions ranged from one to six. The most common item topics in the included scales were: having an evacuation plan, information source, fire extinguisher, and emergency kit. Number of scales which were found sufficient for content validity (n = 10), structural validity (n = 5), internal consistency (n = 5), and test-re-test reliability (n = 6).

Scales had both sufficient and insufficient aspects. Scale tools generally need to be relevant to the target population for which preparedness is to be measured. Therefore, there will be a continuous need to develop relevant, valid, and reliable comprehensive tools to measure preparedness. The results of this study can provide an important reference that will contribute in improvement of scale development and adaptation studies internationally.

Supplementary Materials

To view supplementary material for this article, please visit <https://doi.org/10.1017/S1049023X23006386>

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