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Mindfulness Measurement Instruments: A Systematic Review

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ABSTRACT

Background: *Scientific evidence points to the benefits of mindfulness practice to provide holistic health care in several contexts. Mindfulness represents a refreshing field of caring practices and research in nursing. Identifying studies that evaluate psychometric properties of mindfulness measuring instruments are essential for finding the best evidence to support nursing research in this field. This study is aimed to evaluate the evidence produced about the properties of the mindfulness measurement instruments to identify it and describe the most frequently used study population.*

Method: *Research was conducted in February 2018, using the databases PsycINFO, Embase and PubMed, and the terms: "Mindfulness," "Questionnaire," "Instruments," and "Scale".*

Results: *16 studies that answered the question of this revision were selected. The included studies identified the scales/inventories/questionnaires demonstrated in the literature. The most used instrument was the Five Facet Mindfulness Questionnaire (FFMQ). Other instruments identified were: State Mindfulness Scale, Mindful Attention Awareness Scale (MAAS), Athlete Mindfulness Questionnaire (AMQ), Comprehensive Inventory of Mindfulness Experiences (CHIME), Mindfulness in Teaching Scale (MTS), and Mindfulness Process Scale (AMPS).*

Conclusion: *This study offered support to researchers and health professionals to choose instruments of mindfulness that best suits their research or practice. The produced knowledge can allow the expansion of scientific evidence on the subject, contributing to advance the holistic care by nurses and other professionals.*

Keywords

Mindfulness, Holistic Nursing, Instruments, Questionnaire, Scale, Systematic Review.

Introduction

The use of mindfulness-based interventions as a holistic practice is promising for improving nursing care, both from the perspective of self-care [1] and the provision of holistic health care to clients [2]. Researchers have pointed out that it is necessary to invest more in studies that investigate the implementation of these interventions, than in the practice of advanced care in nursing, which seeks the development of the best practices [3]. A burgeoning field of study has grown out of interest for the benefits of Mindfulness-based interventions in various health care settings and research

in nursing. Therefore, the appropriation of concepts and research instruments that can support nursing in the development of studies on the subject is essential.

The awareness that emerges from cultivating attention in the present moment, from being open to new experiences without judgments, is a definition of the term mindfulness [4]. Mindfulness is considered a human cognitive ability that can be accessed naturally and trained through some practices, which aim at paying attention to the experiences that are occurring in the present moment, interested in the ongoing stream of internal and external stimuli to the body without judging or criticizing these experiences [5,6].

The term mindfulness stems from philosophical and contemplative traditions, such as Buddhism, in which the maintenance of moment-to-moment awareness and non-judgment are primordial aspects [4,7]. In this context, informal and formal meditation practices, aimed at observing the individual's internal aspects, are striking characteristics [8]. Concerning to the Western scientific aspect, it presents a social-cognitive approach linked to the idea of openness to novelty, constructed by the individual [9]. The inclusion of external, material and social resources to engage in problem-solving and learning is the main focus [8-11].

In the mental health field, scientific evidence has highlighted mindfulness practices for reducing symptoms and improving quality of life. The practice of mindfulness in the Western clinical context does not necessarily imply following a specific philosophy or religion. The clinical perspective uses the original concept of mindfulness in standardized interventions to reach different health benefits [12].

The literature presents a robust amount of evidence that higher levels of ability to access and/or improve this cognitive state are related to better physical and mental health indicators [13-20]. Scientific evidence has also revealed the benefits of this practice for individuals with symptoms of post-traumatic stress disorder (PTSD). The effectiveness of mindfulness practice for the treatment of this disorder is related to increased acceptance, increased compassion, and decreased judgment [21-24].

Still, in the field of mental health, other programs based on mindfulness were developed for the intervention of specific psychiatric disorders. Among these programs, Mindfulness-Based Cognitive Therapy is a therapy model used mainly for the treatment of depression. Also, Mindfulness-Based Relapse Prevention is a program developed for relapse prevention in people undergoing treatment for the dependence of psychoactive substances [25-28]. There is strong evidence that the use of mindfulness practice had beneficial results for the patients participating in the studies for the treatment of pathologies such as anorexia, obesity, bulimia, stroke, and coronary diseases [29-33].

Scientific literature establishes that the state of mindfulness is present in the essence of an individual and is positively associated with the quality of health. Therefore, the forms of measurement of mindfulness are essential to acquire parameters or inferences of confidence. It has been reported instruments to measure or access a range of constructs in different cultures and contexts [14,34-36].

A systematic review that identified 10 different types of instruments, with a sample of 79 studies that investigated the psychometric measures of the tools used to measure mindfulness [37]. The instruments reviewed were: Mindfulness Attention Awareness Scale (MAAS), Kentucky Inventory of Mindfulness Skills (KIMS), Freiburg Mindfulness Inventory (FMI), Cognitive and Affective Mindfulness Scale-Revised (CAMS-R), Southampton Mindfulness Questionnaire (SMQ), Five Facet Mindfulness Questionnaire (FFMQ), Toronto Mindfulness Scale (TMS), Experiences Questionnaire (EQ), Mindfulness/Mindlessness Scale (MMS), Philadelphia Mindfulness Scale (PHLMS) [37]. After this study, there was an explosion of research on this subject in the last five years, providing new research tools for the evaluation of mindfulness.

The identification of studies that have evaluated the psychometric properties of instruments that measure mindfulness through its constructs becomes vital to identify the best evidence to support nursing research. The present systematic review is aimed to evaluate the evidence produced about the properties of the mindfulness measurement instruments to identify it and describe the most frequently used study population.

The research question was organized using the PICO (Patient; Intervention, prognostic indicator or index test; Comparison or reference standard; Outcome or target condition) framework to answer the following questions: what are the properties of the instruments used to measure mindfulness and in what populations were these properties analyzed?

Methods

Search strategy

This review was performed based on recommendations of Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) [38]. The searches were carried out during the period from January to February 2018. The following databases were: Psychological Information Database (PsycINFO), Excerpta Medica Database (Embase), and Public/Publisher MEDLINE (PubMed). We utilized Embase and PubMed because they are considered the major medical databases for health care intervention studies. We combined those two databases because they are medically oriented searches; and the coverage and recall of Embase were superior to those of PubMed. This combination showed an overall recall of 92.8% [39]. PsycINFO was also used for studies in the field of mental health [40].

The original articles published in Portuguese (Brazil), Spanish and English from May 2012 were selected. Until April 2012, studies based on the previous publications of the temporal limitation were used [37]. Thus, this review is an update of all self-report mindfulness instruments studies published after the study [37].

Eligibility criteria

The inclusion criteria used were empirical articles in which the main objective was to evaluate the properties of the mindfulness measurement instruments in their original version, their reliability, structure, or functionality in adult samples. Studies that did not evaluate the psychometric properties of the questionnaire; adaptations or translations of the original version into a secondary language or culture; non-original or reduced versions of questionnaires; studies that presented as main objective to measure the effectiveness of mindfulness practice as intervention; studies that evaluated a single integrative construct of mindfulness, such as compassion and non-judgment; reviews, thesis; annals; books and dissertations; studies with a qualitative approach; studies with samples of children and adolescents were excluded.

The researchers built the search strategy with the support and collaboration of a librarian to review and evaluate its precision and sensitivity. The terms that best fit were "Mindfulness" and "Questionnaire" OR "Instruments" OR "Scale." In the Embase database, the keywords used were "Mindfulness" AND "Questionnaire," with 28 articles found. In the Pubmed database, the most appropriate strategy represented by the following keywords: "Mindfulness" AND "Scale" OR "Instruments" OR "Questionnaire" resulted in 1,111 articles. In the PsycINFO database, crossing the terms "Mindfulness" AND "Questionnaire" AND "Mindfulness" AND "Scale" performed the search. In this way, a total of 1,773 articles were selected in these databases for critical analysis.

Results

Article selection strategies

The selection strategy identified a total of 1,773 studies. 1,447 were excluded according to the following criteria: 160 review articles; 857 exclusively evaluated the intervention of mindfulness but they did not address the instrument; 135 validations from the original version to another language; 245 did not use the original version of the scales; 47 did not wholly evaluate isolated integrative mindfulness constructs; 30 used a subject not related to the variable of interest; two dissertations and two articles were written in languages other than those selected for this study. After this first step, 297 abstracts were selected for reading.

After reading the abstracts, 252 studies were excluded because of the following criteria: 18 repeated, 7 used a qualitative approach, and 226 used adolescent or child populations in their sample. Two evaluators performed this process. After the agreement of the evaluators, 35 articles were selected for reading in full, and 16 studies were chosen for this systematic review.

The following figure shows the article selection strategy used and describes the exclusion criteria used at each stage (Figure 1).

Descriptive analysis of articles

This review identified five new self-report mindfulness instruments: State Mindfulness Scale - (SMS), Comprehensive Inventory of Mindfulness Experiences (CHIME), Applied Mindfulness Process

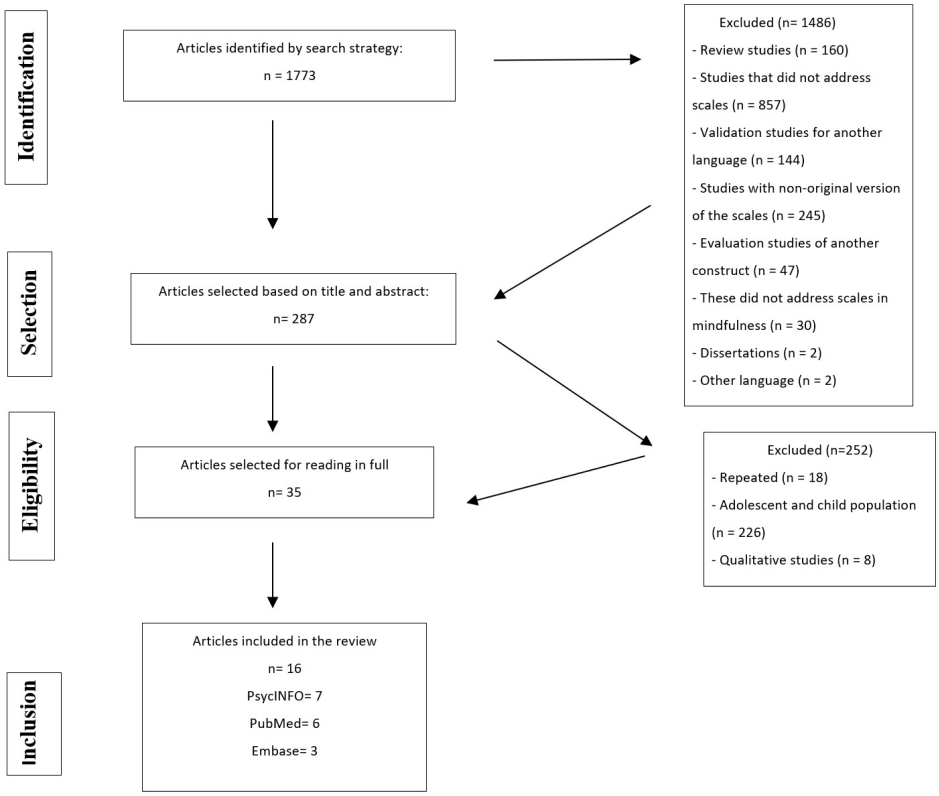

Figure 1: Flowchart of study selection procedure according to recommendations of the Preferred Reporting Items for Systematic Review and Meta-Analysis- PRISMA.

Scale (AMPS), Mindfulness in Teaching Scale (MTS), Athlete Mindfulness Questionnaire (AMQ) and included two instruments built before April 2012 (FFMQ and MAAS) because those new studies reexamined its factor structure and psychometric properties.

From the 16 studies included, a total of 14 (87.5%) had mixed samples predominantly female, and only two studies presented women exclusively [41,42]. Table 1 summarizes the studies by scale, author, country/language, research design, objective, and population.

In 12 studies (75%) the samples were composed of people 18 to 50 years old (mean of 31.6 years). The populations of the studies were composed of urban [42-49], university students samples [50,51], and a sample from both urban and rural areas [52,53].

All the studies were published in English. Eight of them were developed in the United States of America, followed by two in the United Kingdom, two in New Zealand and Australia. China, Israel, and Switzerland had one each. Most of the studies used a descriptive and exploratory design.

The recruitment strategy most used by the researchers was the Internet, ten precisely, through the dissemination of research by emails, ads and forums online [41-43,48-51,53-55]. In only one study the authors opted for disclosure through newspapers and print ads [46].

Scale	Author (Year)	Citations (n)†	Country/ Language	Research design	Objective	Population
Five Facet Mindfulness Questionnaire (FFMQ)	Curtiss & Klemanski (2014) [56]	60	USA English	Descriptive and exploratory	To assess the facet structure and psychometric properties of the FFMQ.	153 adults in treatment for mood and anxiety disorder Age from 18 to 71 years old.
	Williams & Dalgleish (2014) [53]	211	United Kingdom English	Observational	To examine the factor structures of the FFMQ and SCS in three samples relevant to mindfulness research.	1599 adults Mean age = 40.7 years old. Convenience sample: meditation practitioners, individuals with recurrent depression, and who were chosen to participate in mindfulness-based cognitive therapy - MBCT.
	Goldberg et al. (2016) [46]	59	USA English	Randomized Controlled Trial -RCT	To test the construct validity of the FFMQ, within the context of an active- controlled randomized trial.	130 adults: 43 MBSR participants, active control group with no instruction in mindfulness, and a waiting list control group.
	Gu et al. (2016) [57]	79	United Kingdom English	RCT	To examine the stability of the factor structure of the FFMQ-39 before and after MBCT.	238 adults with recurrent depression in MBCT. Mean age = 49.18 years old.
	Taylor et al. (2016) [47]	9	Australia English	Observational	To test the factor structure of the FFMQ and to test how often participants have to meditate to lead to a significant change in mindfulness.	381 workers. Mean age = 28 years old.
	Medvedev et al. (2017) [48]	16	New Zealand English	Descriptive and exploratory	To use Rasch analysis to assess the psychometric properties of the FFMQ, to improve its precision.	200 university students and 96 individuals from the general population. Mean age = 33 years old.
	Kantrowitz-Gordon (2017) [42]	2	USA English	Descriptive and exploratory	To provide normative data on levels of mindfulness ascertain the external validity of the FFMQ through correlations with measures of depressive symptoms and anxiety.	857 pregnant women. Age 25 to 34 years old.
	Watson-Singleton et al. (2018) [49]	8	USA English	RCT	To examine the FFMQ's psychometric properties in low-income African Americans with a history of a suicide attempt.	283 participants self-identified as African American made a suicide attempt within the past year. Mean age = 37.24 years old.
Mindful Attention Awareness Scale (MAAS)	Osman et al. (2016) [51]	41	USA English	Descriptive and exploratory	To reexamine the factor structure and psychometric properties of the items using modern psychometric methods.	1200 students and university staff Age: 18 to 26 years old.
	Medvedev et al. (2016) [50]	38	New Zealand English	Descriptive and exploratory	To apply Rasch analysis to explore strategies to improve the psychometric properties.	125 university students and 125 randomly selected participants from a postal survey in New Zealand.
State Mindfulness Scale (SMS)	Tanay & Bernstein (2013) [43]	155	Israel English	Descriptive and exploratory	To develop and test a novel conceptual model and corresponding measure of state mindfulness.	353 adults. Mean age = 24.5 years old. Participants were from community and students from the University of Haifa.

	Cox et al. (2016) [45]	16	USA English	Descriptive and exploratory	To revise the SMS and provide score validity evidence for the measure in a physical activity context.	199 adults aged 18 to 77 years old, and 185 individuals from a university, participating in a yoga course.
Comprehensive Inventory of Mindfulness Experiences (CHIME)	Bergomi et al. (2013) [44]	101	Switzerland English	Descriptive and exploratory	To contribute to the development of a new measure of mindfulness.	313 adults (men and women). Mean age = 41.0 years old. Community sample and MBSR participants
Applied Mindfulness Process Scale (AMPS)	Li M.J et al. (2015) [55]	26	USA English	Descriptive and exploratory	To develop a psychometric process measure, which captures the use of applied mindfulness practice.	Study 1: six women and two men. Study 2: 134 participants with experience in some form of meditation. Study 3: 180 students, teachers, and staff participating in a Mindfulness Intervention.
Mindfulness in Teaching Scale (MTS)	Frank et al. (2016) [54]	31	USA English	Descriptive and exploratory	To develop and psychometrically validate a new self-report measure of teacher mindfulness.	526 teachers from elementary-level public schools Sample 1: 95% women, 5% men, mean age of age 39.8 years old. Sample 2: 97% women, 3% men, mean age 40.4 years old.
Athlete Mindfulness Questionnaire (AMQ)	Zhang et al. (2017) [41]	14	China English	Descriptive and exploratory	To develop and validate a sport-specific mindfulness measure.	Study 1: interviews with and feedback from athletes, coaches, and mindfulness experts Study 2-5: athletes of different sports: swimming, synchronized swimming, gymnastics table tennis, and wushu Age: 18 to 27 years old

Table 1: Panorama of the articles by scale, author, country/language, research design, objective and population.

Google scholar, July 2019.

Scale	Authors	Sample (n)	Scale characteristics		Reliability†		Structural validity	
			Items (n)	Factors (n)	Internal consistency (α)‡	Test-retest (r)	Factor analysis	Fit indices
FFMQ	Curtiss & Klemanski [56]	153	39	5	.80 – .92	N/A	CFA	CFI=.942, RMSEA= 088, NNFI=.906
	Williams & Dalgleish [53]	940/235/424	39	4	.77 – .93	N/A	CFA	SRMR=.053/.046/.066, RMSEA= 079/.093/.087, CFI=.953/948/.935, NNFI=.935/.928/.911
	Williams & Dalgleish [53]	940/235/424	39	5	.77 – .93	N/A	CFA	SRMR=.058/.047/.074, RMSEA=.074/.083/.093, CFI=.09/.09/.09, NNFI=.942/922/.882
	Goldberg et al. [46]	130	39	5	.80 – .92	N/A	N/A	N/A
	Gu et al. [57]	238	39	4	.78 – .88	82 - .90	CFA	SRMR=.052 - .042, RMSEA= 086 - .047 CFI=.950 - .986, NNFI=.931 - .981
	Gu et al. [57]	238	39	5	.78 – .88	.82 - .90	CFA	SRMR=.050 - .037, RMSEA= .071 - .040 CFI=.951 - .987, NNFI=.050 - .037
	Taylor et al. [47]	381	39	5	.81 – .92	N/A	PCA	N/A
	Medvedev et al. [48]	200/96	39	5	.76 – .89	N/A	PCA	N/A
	Kantrowitz-Gordon [42]	857	39	5	.75 – .89	N/A	CFA	SRMR=.080, RMSEA= .067, CFI=.819 TLI=.807
	Kantrowitz-Gordon [42]	857	24[a]	5	.86	N/A	CFA	SRMR=.096, RMSEA= .070, CFI=.863 TLI=.847
	Kantrowitz-Gordon [42]	857	24[b]	5	.86	N/A	CFA	SRMR=.073, RMSEA= .064, CFI=.891, TLI=.875
	Kantrowitz-Gordon [42]	857	24[a]	4	.86	N/A	CFA	SRMR=.081, RMSEA=.071, CFI=.890, TLI=.874
	Kantrowitz-Gordon [42]	857	24[b]	4	.86	N/A	CFA	SRMR=.075, RMSEA= .069, CFI=.898 TLI=.882
	Watson-Singleton et al. [49]	283	20	5	.78-.70	.22–.54	EFA CFA	SRMR=.060, RMSEA=.050, CFI=.93
	Watson-Singleton et al. [49]	283	20[a]	5	.78-.70	.22–.54	EFA CFA	SRMR=.090, RMSEA=.060, CFI=.890
MAAS	Osman et al. [51]	1200	5	1	.88	N/A	EFA CFA	RMSEA= .050, CFI= .990, TLI= .980
	Medvedev et al. [50]	125/125	15	1	.87	N/A	PCA	N/A
SMS	Tanay & Bernstein [43]	353	21	2	.95	.59–.65	EFA CFA	RMSR=.080, RMSEA=.079, CFI=.920, TLI=.910
	Cox et al. [45]	199/185	12	2	.80	N/A	EFA CFA	SRMR = .060, CFI = .950, WRMR= 1.42

CHIME	Bergomi et al. [44]	313	41	4	.85	N/A	PCA CFA	SRMR=.060, RMSEA=.080, CFI=.870
AMPS	Li M.J et al. [55]	134/180	15	3	.91 - .94	N/A	EFA CFA	SRMR=.060, RMSEA=.110, CFI=.890, TLI=.870
MTS	Frank et al. [54]	526	14	2	.71 - .86	.42 - .49	EFA CFA	RMSEA=.038, CFI=. 974, TLI=.969
AMQ	Zhang et al. [41]	271/357 295/379	16	3	.76		EFA CFA	RMSEA = .060, WRMR = 1.040, CFI = .950 TLI = .940

Table 2: Descriptions of psychometric characteristics and assessments of each reviewed scale

Note: †Reliability based on an average of subscales rather than full scale. ‡α coefficient values above .70 reflect sufficient reliability. CFA: confirmatory factor analysis, CFI: comparative fit índex, (acceptable level, CFI and NNFI: ≥.95 (conservative) or ≥.90 (liberal)), EFA: exploratory factor analysis, PCA: principal component analysis, RMSEA: root mean square error of approximation (acceptable level: ≤.06 (conservative) or ≤.10 (liberal)), RMSR: root mean square of residuals. NNFI: non-normed fit índex, TLI: Tucker Lewis index, SRMR: standardized root mean square residual ≤.05 (conservative) or ≤.10 (liberal)). RMSR: root-mean-square residual. WRMR: weighted root mean square residual. [a] Hierarchical factor model. [b] Correlated factor model. N/A: not available.

In four studies the population had already had previous contact with meditative practices [44,45,53,55]. Of these, three studies compared the results between individuals who had and had no previous contact with meditation [3,45,55]. In another 12 studies, the participants did not present any previous contact with meditative practices [41-43,46,48-51,54,56,57].

The Five Facet Mindfulness Questionnaire (FFMQ) instrument was the most tested in the selected sample. It was present in eight of the 16 selected studies [42,46,47,49,53,56-58].

Other instruments also identified were: State Mindfulness Scale (SMS) [43,45], Mindful Attention Awareness Scale (MAAS) [50,51], Athlete Mindfulness Questionnaire (AMQ) [41], Comprehensive Inventory of Mindfulness Experiences (CHIME) [44], Mindfulness in Teaching Scale (MTS) [54], Applied Mindfulness Process Scale (AMPS) [55], and Applied Mindfulness Process Scale (AMPS) [55]. (Table 1).

The main characteristics of the identified instruments are described below. Statistical measures such as internal consistency, reliability, and validation construct of the articles selected were evaluated and outlined in Table 2.

Five Facets Mindfulness Questionnaire (FFMQ)

Baer and collaborators in 2006 built the FFMQ of 39 items in English developed from an exploratory factor analysis of the items of the five main scales that assessed mindfulness, KIMS, FMI, MAAS, CAMS, and SMQ. Thus, the authors concluded that within the construct of mindfulness there would be five factors: observing, describing, acting with awareness, non-judging internal experience and non- reactivity to internal experience [59].

The questionnaire also consists of seven domains: "do not judge internal experience", "act with awareness-autopilot," "observe," "describe-positive formulation," "describe-negative formulation," "not react to internal experience" and "act with distraction-awareness." The "describe" and "act with awareness" facets are subdivided into "positive and negative formulation," "autopilot" and "distraction" respectively.

The questionnaire presents a five-point Likert-type response scale, ranging from one (1) Never to five (5) Always, with a score from zero to 195 [59]. The authors suggest that the facets should be analyzed independently of each other [59,60]. Most of the identified studies analyzed the factorial model and the internal consistency of the instrument; only one study evaluated its construct validity [46]. Eight studies investigated the psychometric properties of FFMQ [42,46,48,49,53,56].

The factorial analysis of the four facets of FFMQ was considered adequate in three studies [53,56,57]. The first study presents the Kaiser-Meyer-Olkin (The factor analysis showed good fit) = .903 [47]. Subsequently, the second research elucidates that through Rash Analysis, the model is better adjusted when items 24 - "usually when I have bad images or thoughts, I feel calm soon after" and 32 - "my natural tendency is to put my experiences in words," were removed. Regarding internal consistency, all studies showed statistically significant and reliable facet results. Except for the "describe" facet in the studies [48,57], who demonstrated Cronbach's alpha values of 0.57 and 0.39, respectively.

Mindful Attention Awareness Scale (MAAS)

The MAAS is a 15-item inventory with a six-point Likert-type response scale developed by Brown and Ryan [7] in the English language to measure the extent to which individuals pay attention during several tasks. From the studies included, two evaluated the MAAS scale [50,51]. Both studies had university samples, (n)= 125 [50] and (n)= 1200 [51].

In the 2016 study conducted by Medvedev and collaborators, the internal consistency was good, they used the Rasch model to test the general model through the detection of mislaid items. The results showed that the person separation index (PSI) was equal to 0.88, which means good reliability. However, it did not fit the factorial model proposed by MAAS (χ^2 (45) = 146.71, $p < 0.001$). Mislaid was found in items 2- "I break or drop things by carelessness, lack of attention or think of something else", 5- "I do not feel feelings of physical tension or discomfort until they really catch my attention", 12- "I drive in places on autopilot and then ask, why did I go there?" and 15- "I think I'm aware that I'm eating".

The other study that evaluated MAAS found a satisfactory result for the exploratory factor analysis (EFA) = (.95), using the Kaiser-Meyer-Olkin test [51]. Confirmation of the factorial analysis revealed that one factor was adequate to meet all pre-established criteria. Positive correlations were found after the Self-Monitoring Scale (SCMS) which measures self-control and self-management skills, Adaptive Expression Scale (SAEI), which assesses risk and protective responses in the expression of anger, and the Future Disposition Inventory (FDI) which is a measure of future related thoughts and feelings that are based on the cognitive-behavioral conceptualization of hopelessness.

Negative correlations were also found with depression severity based on Beck's cognitive model of depression assessed by the Beck Depression Inventory (BDI-II), the subscales "maladaptive expression of anger" (SAEI) and "negative focus on the future". The value of p = .90 corresponds to the optimal internal consistency.

State Mindfulness Scale (SMS)

Two studies used SMS as a research object Tanay and Bernstein [43], aimed at the initial development and validation of the scale developed in the Hebrew language. Subsequently, Cox et and collaborators [45], reviewed in English the scale created by Tanay and Bernstein and also proposed the validation of the instrument in the sporting context. The objective scale is to measure the state of mindfulness in ordinary individuals without previous experience in meditative practices. It presents a quantitative approach and is composed of 22 items divided into two levels.

The first level relates to the nature of the events in which the person is attentive, to observe the physical sensations and mental events they are most responsive. The second level corresponds to the quality of the mindfulness, how the individual participates in these experiences. The first study had a sample of 293 individuals from the community and the Haifa University in Israel [43].

Cox and collaborators [45] conducted two independent cohort studies within their research, including samples of 103 and 86 individuals selected from the community. As for the evidence of the validation structure, the value was EFA r = .58. The two-factor model was the most adequate, with good internal consistency [45].

Comprehensive Inventory of Mindfulness Experiences (CHIME)

The CHIME elaborated by Bergomi and collaborators in the German language is a quantitative inventory that evaluates mindfulness in individuals in the community without previous contact with meditative practices or mindfulness. According to the study's authors, the purpose of the inventory is to assess mindfulness as a "near-trait." This terminology is used because the authors understand that mindfulness is a human capacity, happening continuously in daily life, and that is subject to changes [44].

The inventory is composed of 41 questions, subdivided into four different factors: Factor 1: acceptance, non-reactivity, and insightful orientation. Factor 2: current awareness. Factor 3: experience description. Factor 4: opening and avoidance. The inventory response scale is a six-point Likert-type, ranging from 1: fully applies to 6: does not apply at all. The study was performed in a community sample, composed of 142 individuals who participated in the Mindfulness-Based Stress Reduction (MBSR) program. Participants answered the questionnaire between the first and second week and in the penultimate week of the program. Individuals who completed the scale were instructed to list items for the last seven days before the interview date.

The four CHIME factors correlated with the FFMQ subscales. Factor 1 (CHIME) X "non-judgment" and "non-reactivity" (FFMQ), Factor 2 (CHIME) X "observe" and "act with awareness" (FFMQ), Factor 3 (CHIME) X "describe" (FFMQ) and finally, Factor 4 (CHIME) X "do not avoid" and "observe" (FFMQ). It showed a good internal consistency, a principal component analysis (PCA) and a confirmatory factor analysis (CFA) showed that four factors were the most appropriate. This instrument had positive correlations with the FFMQ domains.

Applied Mindfulness Process Scale (AMPS)

Li and collaborators built the AMPS in 2015 with quantitative and qualitative characteristics directed to individuals who participated in intervention strategies based on mindfulness. This instrument (written in English) aims to verify how the techniques learned are being inserted into everyday practice [55].

The scale consists of 15 items, with four-point Likert-type response options ranging from zero (never) to four (almost always). It presents three domains: decentering (items 1, 3, 12, 13 and 15), positive emotional regulation (items 4, 7, 9, 11 and 14), negative emotional regulation (items 2, 5, 6, 8 and 10). The internal consistency evaluation presented values between .91 and .94. According to the authors, the scores of the instrument can be calculated considering each domain individually, with scores ranging from 0 to 20 points. Or by the sum of the three domains, which can range from 0 to 60 points.

The selected study that evaluated the AMPS scale included 322 individuals in its sample. 71.3% were women with a mean age of 32.3 years old. Besides, it was performed in three steps and with different samples. All participants had previous contact with contemplative practices (Zen Buddhist meditation, Vipassana, and Goenka) or had practices through the MBSR program as part of the study. Recruitment was conducted in the mindfulness-training program in universities, including both undergraduate and graduate students' levels of education.

As part of the process of constructing the AMPS instrument, the first step used the cognitive interview for the qualitative analysis of domains. The results pointed out: the need to clarify the meaning of some questions, options of answers, improvement of the writing, and redundancy of items. In the second step, a quantitative analysis of the instrument was performed and found a good internal consistency, with EFA composed of three factors.

The incremental validity showed a positive correlation with MAAS and FMI for mindfulness traits. Positive correlation with meditation practice at different time intervals. Positive correlation with World Health Organization Wellbeing Index-5 (WHO-5) that assesses subjective wellbeing as an indicator of overall perceived quality of life experienced in the past 2 weeks and Personal Wellbeing Index (PWI) that is a one-item measure in global life satisfaction. Differing from the other results, it presented a negative correlation with Depression, Anxiety, Stress (DASS-21).

The third and final step of the study was a replica of the previous study aiming to verify consistency in the statistical analyses. The instrument presented a good internal consistency and the factorial model of three factors was also confirmed. The construct validity showed a positively correlated with MAAS, inversely with PSS-4, GAD-7, and CESD-10. The questions of the instrument correspond to the last 7 days, in other words, how mindfulness-based strategies have been applied in the last week.

Mindfulness in Teaching Scale (MTS)

In 2016**,** Frank and collaborators developed (in the English) MTS with the purpose of measure domain-specific mindfulness among teachers. It is composed of 2 factors and 14 items answered on a 5-point Likert-type scale, indicating how true each statement is for the respondent focused on mindfulness as it applies to classroom interactions. The scale emphasizes the dual notion of a teacher's intra-personal and interpersonal mindfulness [54].

In the studies validation, experts in mindfulness and educational research developed a pool of 20 items. These first items were written to reflect aspects of mindfulness believed to be most relevant to the teaching context, on teacher's focus during instruction, and daily school activities. Emotional awareness, self-regulation, responsiveness and sensitivity during student-teacher interactions were also considered.

The initial item pool was subjected to an EFA with 263 elementary school teachers resulting in a two-factor structure that were confirmed using CFA in another sample of 263 elementary school teachers and this structure was found to be perfectly compatible with the data. Thus, the finalized MTS consists of 14 items measuring 2 factors, which were "intrapersonal" (9 items) and "interpersonal" (5 items) mindfulness.

For criterion validity, Maslach Burnout Inventory (MBI) to assess the risk of burnout, Teacher Socio-Emotional Self-Efficacy Scale (TSESES) to measure teacher's perceived efficacy in helping children develop pro-social behaviors, and Behavior Management Self-Efficacy Scale (BMES) to evaluate the teacher perception of their efficacy in behavior management. As a result, it was discovered that the scale was significantly correlated with all of these constructs. 6-month test-retest reliability was also indicated to be statistically significant.

Athlete Mindfulness Questionnaire (AMQ)

In 2017, the AMQ was an instrument designed (in Chinese) by Zhang and collaborators specifically for athletes to analyze the level of mindfulness of the individual in the sporting context [41]. The questionnaire construction and validation study included five steps. The population of the study was composed of athletes and coaches of various sports, individual and collective. The sports included: synchronized swimming, table tennis, gymnastics, diving, wushu, basketball, handball, soccer, volleyball, water polo athletics, badminton, boxing, judo, and others. The sample was predominantly male; corresponding to 744 (56%), mean age was 21.5 years old (ages 16 to 45) [41].

The first step analyzed item generation and content validity. Initially, 64 items were generated. Subsequently, athletes and coaches totaling 87 added 63 more items under the suggestions. After a new analysis regarding the clarity and relevance of this set by the same, 18 items were changed and 41 items were excluded, totaling 46, presenting validity content (CVI) = 0.86. A final analysis was performed, and eight items were excluded, totaling 38 final items with CVI value = 0.96. The second study analyzed the factorial structure of AMQ. The results pointed to a three-factor model, which proved adequate according to the authors' proposal. The third one aimed at validating the factorial structure and providing evidence of convergent and concurrent validities. The results showed good adjustments of the factorial model. Concerning to convergent validity, the domains "attention at the present moment" and "awareness" presented a significant correlation with MAAS [41].

The fourth study aimed at cross-validation and evidence of additional and concurrent validity, in addition to the development of AMQ with modifications. The CFA value indicated a good adjustment of the data with 12 items and three factors. Inverted sentences did not prevent the answer bias, meaning that the athletes had a misinterpretation of the questions. Therefore, the items of the "acceptance" domain were changed from inverted words to words of direct words. In the end, the questionnaire consisted of 17 items [41].

The fifth, and last study, sought the validation and evidence of the factor structure of the AMQ, modified CFAs and competitive and convergent validities. The CFA results showed that the three-factor structure composed of 17 items is adequate, but item five still showed an inadequate factor (<0.30). After item removal, there was improvement in the model ($\chi 2(104) = 359.87$, $p < 0.001$, CFI = 0.89, TLI = .87, WRMR = 1.35, RMSEA = .079 (90%CI: .070–.088) [41].

The convergent validity of the three domains (attention at the present moment, awareness and acceptance) was established by creating positive, statistically significant correlations with mindfulness ascertained by MAAS. The concurrent validity of the three attention factors was also established through negative correlations with "experiential avoidance" and "burnout" (reduced sense of accomplishment, emotional/physical exhaustion, and devaluation) and statistically positive correlations with "positive affect," "flow dispositional" and "well-being." However, the results did not present significant correlations between the

domains "attention at present," "awareness" and "negative affect," or between "awareness" and MASS experience avoidance" [41].

The final instrument was composed of 16 items, subdivided into three dimensions: attention at the present moment, awareness and acceptance with good internal consistency. The analysis identified positive and statistically significant correlation test values from AMQ sub-scales with the instruments: Acceptance and Action Questionnaire-II (AAQ-II) that is designed to measure the levels of experiential avoidance; Athlete Burnout Questionnaire (ABQ), aimed to assess the syndrome of burnout in athletes of different sports; Mindful Attention Awareness Scale (MAAS); Short Dispositional Flow Scale (SDFS) with 1 item measures each of the 9 flow dimensions; and Training and Competition Well-being Scale (TCWS) used to assess Chinese athletes' subjective well-being in their training and competition. Positive correlation values ranged from .38 to .18, and inversely from -.40 to -.13 for p values <.05 and p <.01. The factorial model (CFA) composing three factors was the most appropriate [41].

Discussion

The purpose of the present review was to identify through a systematic review of the literature, studies that evaluated instruments, questionnaires, scales or inventories that measured mindfulness in adult samples. After a systematic search and application of eligibility criteria, 16 studies were part of the sample. The results pointed out the following findings: predominantly urban, university and female target population, different application contexts of the instruments, varied psychometric analysis, but demonstrating the reliability of the instruments and, finally, the predominance of studies that evaluated the FFMQ questionnaire.

Apart from the widely used mindfulness scale (MAAS and FFMQ), we found 5 other new scales. These scales may provide useful alternatives for researchers who would like to study mindfulness levels in different types of population and evaluate the effect of mindfulness-based interventions.

The samples selected were mostly women (chosen for convenience), with a predominance of urban or university samples and with a college education. This finding corroborates the systematic review by Park and collaborators [61] on the same subject that identified 94% of the samples as female and 84% coming from the university scope. Mindfulness measurement instruments were applied in different contexts, such as sports, education, and everyday life. They also included individuals with meditative practices, participants in programs such as the MBSR, and laypeople on the subject [41,42,51,53,55–57,43–50].

When we analyze the essence of the subject, experts consider that strategies based on mindfulness can be applied to all individuals, just as mindfulness traits can be considered as inherent characteristics of the individual [4,14,34-36]. Researchers have identified in their results positive effects of mindfulness practice, such as increasing the ability to access and improve components of awareness, compassion, equanimity, and stress reduction [4,62,63]. In this way, mindfulness would provide several benefits for various individuals, regardless of social, cultural, and educational level. Future studies could fruitfully explore this issue further by considering in their samples the low-income rural population and individuals with a lower education level in the evaluation of instruments.

According to the citation numbers, the FFMQ was the most evaluated instrument in the last five years, followed by MAAS. This finding differs from Park's study [61], in which MAAS was the most used by the authors because they estimated a longer temporal interval for studies inclusion. Currently, FFMQ is considered one of the most cited measures to evaluate mindfulness due to the possibility of measuring levels of awareness in a wide range of populations, with or without meditation experience [60].

The selected studies considered that the FFMQ showed good internal consistency and adequate correlations with other constructs related to mindfulness [42,46-49,53,56,57]. Regarding the format of the questions, all identified instruments use the Likert-type scale. This format is the most used model of research in the context of the behavioral sciences. It is a scale considered easy to handle which contributes positively to its application in several research studies [64]. With correlation analyzes, most studies use domains or subscales, except for the MAAS, which uses the total score in the instrument to evaluate the results.

Mindfulness constructs differed on each instrument selected. It is observed that the authors included different components, among them acceptance, non-reactivity, insightful orientation, emotional regulation, and awareness. The only common construct on all instruments was "attention." This finding differs from an integrative review study that also evaluated the mindfulness construct evaluation instruments. The authors identified that the elements based on a meditative perspective (acceptance, non-reactivity, and awareness) were the most frequent among the selected studies [65]. The fact that the concept of mindfulness is based on different theoretical references causes disagreements in the constructs of each instrument, since mindfulness can be considered as a perspective of psychological trait [66], perspectives of contemplative practices focused on the present moment and not reactive [9] or a set of practices and programs structured in the context of health [4].

The results demonstrate the reliability of the measurement methods. It takes into account the values presented in the studies regarding the internal structure and the evidence of validity through correlation with other instruments, especially MAAS and FFMQ. The use of the test-retest method was frequent to estimate the accuracy among the included instruments and a single study did not analyze the factorial model of the questionnaire [46]. Thus, the findings point to mindfulness evaluation instruments of high reliability and adequate psychometric properties.

Considering that programs based on mindfulness have been tested and that researchers have recommended the need to investigate

whether trained holistic nurses can perform the application of such protocols [67], the articles analyzed in this review point to characteristics that may favor the choice the most appropriate instrument.

Finally, the study presents as a limitation the choice of three languages (English, Spanish, and Portuguese) and only the instruments in their original version, interfering in the analysis of trans-cultural validity.

Conclusion

The present study identified a range of instruments that presented validity and reliability for mindfulness research in the adult population. Besides, it offered a set of information to other researchers to choose the most appropriate instrument. This knowledge allows the expansion of scientific evidence on the subject, as well as providing tools for researchers and health professionals interested in the area under investigation, especially those committed to holistic health practice and research.

It is necessary to expand studies that include different target populations, to expand the knowledge produced on mindfulness in other contexts, besides the urban and university. There are many definitions of mindfulness and also a variation in the types of practice. That being considered, it is suggested that further studies should be performed to reach a consensus on the concept to support the advancing of research and practice of mindfulness.

Authors' Contributions

Gherardi-Donato and Moraes devised the project, the main conceptual ideas and proof outline. Gherardi-Donato and Zanett were involved in planning and supervised the work. Moraes, Fernandes, and Esper wrote the manuscript in consultation with Gherardi-Donato and Zanetti. All the authors contributed to the interpretation of the results. Gherardi-Donato, Fernandes and Zanetti gave final approval of the version to be submitted and any revised version.

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