

WHAT DO WE EVALUATE IN SPORT MINDFULNESS INTERVENTIONS? A SYSTEMATIC REVIEW OF COMMONLY USED QUESTIONNAIRES

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ABSTRACT: Interest of the study: mindfulness is a concept describing the focus on the present moment, intentionally and without judgement. This approach has only recently been applied to sport psychology. Objectives: the aim of the current review is to investigate which indicators and questionnaires are used in mindfulness research in sport, being specifically interested in mindfulness assessment. Methods: PRISMA guidelines for systematic reviews and the recommendations of the Cochrane Collaboration were used. Literature searches were conducted in Psychinfo, PubMed, EMBASE and the Cochrane Library. Results: From 2,203 records initially retrieved, 17 articles were included. The results show that mindfulness, anxiety and acceptance are the most commonly studied psychological indicators. The Five Facet Mindfulness Questionnaire is the most frequently used mindfulness scale. We also discuss the possibility of using physiological indicators as complementary assessment. Conclusions: It is recommended to specifically adapt some questionnaires, such as already done with the Sport Anxiety Scale or the Mindfulness Inventory for Sport, for their use in sport psychology.

KEYWORDS: Mindfulness, Psychology, Sport, Assessment, Systematic Review

RESUMEN: Interés del estudio: Mindfulness o conciencia plena es un concepto que describe la capacidad de estar en el momento presente, de forma intencional y sin juzgarlo. Este enfoque no se ha utilizado hasta hace poco en la psicología del deporte. Objetivos: El objetivo de la presente revisión es investigar qué variables y cuestionarios se usan en las intervenciones basadas en mindfulness en el deporte, centrándonos especialmente en la evaluación de la conciencia plena. Metodología: se usaron las directrices PRISMA para revisiones sistemáticas y las recomendaciones del centro Cochrane. Resultados: De los primeros 2,203 artículos, se eligieron finalmente 17 artículos. Los resultados muestran que mindfulness, ansiedad y aceptación son las variables psicológicas más estudiadas. El cuestionario Five Facet Mindfulness Questionnaire es el más utilizado

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para evaluar la conciencia plena. Se habla también sobre la potencialidad de la evaluación de variables fisiológicas como complemento a las variables psicológicas. Conclusiones: Se recomienda la creación de cuestionarios específicos, como ya ha sucedido con la Sport Anxiety Scale o el Mindfulness Inventory for Sport, para su uso en psicología del deporte.

PALAVRAS-CHAVE: *mindfulness*; psicología; deporte; evaluación; revision sistemática

SUMARIO: Interesses de estudo: Mindfulness ou mindfulness é um conceito que descreve a capacidade de estar no momento presente, intencionalmente e sem julgamento. Essa abordagem não foi usada até recentemente na psicologia do esporte. Objetivos: O objetivo da revisão é investigar quais variáveis e questionários são usados em intervenções baseadas no mindfulness no esporte, com foco especial na avaliação do mindfulness. Metodologia: Foram utilizadas as diretrizes do PRISMA para revisões sistemáticas e as recomendações do Cochrane Center. As pesquisas bibliográficas foram realizadas na Psychinfo, PubMed, EMBASE e na biblioteca Cochrane. Resultados: Dos 2.203 primeiros artigos, 17 foram escolhidos. Os resultados mostram que a atenção, ansiedade e aceitação são as variáveis psicológicas mais estudadas. O Five Facet Mindfulness Questionnaire é o mais amplamente usado para avaliar a consciência plena. O potencial de avaliar variáveis fisiológicas como complemento de variáveis psicológicas também é discutido. Conclusões: Recomenda-se a criação de questionários específicos, como já ocorreu com a Escala de Ansiedade Esportiva ou o Inventário de Atenção Plena para o Esporte, para uso em psicologia do esporte.

PALAVRAS-CHAVE: atenção plena; psicología; esporte; avaliação; revisão sistemática

INTRODUCCIÓN

Mindfulness is defined as awareness that comes from paying attention to experience as it is at the present moment, in a non-judgmentally way, without evaluating or reacting to it (Kabat-Zinn, 1990). Mindfulness is, however, a complex construct that comprises different facets and nuances. Some authors include one component of "awareness" (Brown & Ryan, 2003), others add the "acceptance" component in mindfulness construct (Dimidjian & Linehan, 2003).

Baer and her group talk about five facets in the construct: observe, describe, act with awareness, without reacting, without judgement (Baer et al., 2006). There are several self-report instruments to assess the mindfulness construct as reflected in some reviews (Bergomi, Tschacher, & Kupper, 2013; Sauer et al., 2013) where the authors explain the complexity of this construct and the variety of questionnaires, depending on which kind of mindfulness facets they are assessing.

Mindfulness is often described as a form of meditation and a psychological process. The meditation is a practice designed to cultivate full attention. This is generally associated with *Vipassana* meditation which focuses on respiratory awareness and the simultaneous perception of the internal and external processes which occur, without these being either judged or assessed (Germer, et al., 2005). The psychological process refers to the regular practice of mindfulness allowing the cognitive-emotional processes of daily life to be confronted in another way: through helping people to become more aware of the here and now. In this way it is possible to people to develop a greater understanding of their mental patterns and provide them with the skills required to respond to stressful situations (Germer, et al., 2005).

Mindfulness based interventions (MBIs) are considered to improve the welfare and quality of life of the individual and have proven effective in the treatment of different populations with such issues as chronic pain (Bawa et al, 2015; Veehof, Trompetter, Bohlmeijer, & Schreurs, 2016), anxiety and depression in oncology patients (Zhang, Xu, Wang, & Wang, 2016), or improving physiological and psychological measures (Howarth, Smith, Perkinings-Porras, & Usher, 2019)

MBIs in sport have mainly focused in performance enhancement. The first program was done by Kabat-Zinn with the Olympic team of rowers (Kabat-Zinn, Massion, & Rippe, 1985). After that, there were a number of years without any further interventions. More recently, interventions involving mindfulness-related approaches have been applied and studied in the context of sport (Birrer, Röthlin, & Morgan, 2012; Gardner & Moore, 2004; Kaufman, Glass, & Arnkoff, 2009). They have been useful for a better performance of athletes (Doron, Roualt, Jubeau, & Bernier, 2019; Carraça et al., 2019; Joseffson et al., 2017), recovery from burnout (Jouper & Gustafsson, 2013), sport injuries prevention (Ivarsson et al, 2015) and on injured athletes (Mohammed, Pappous, & Sharma, 2018; Palmi, Planas, & Solé, 2018). Two different

mindfulness programs have been created specifically for sport: Mindfulness Sport Performance Enhancement (MSPE), with elements of Mindfulness Based Stress Reduction (MBSR) and Mindfulness and Acceptance Commitment (MAC), with elements of Mindfulness based Cognitive Therapy (MBCT) and Acceptance and Commitment Therapy (ACT) (Solé, et al., 2014). Some authors even use the concept of mindfulness and acceptance interventions in sport. In this sense, several reviews have been published on the effectivity of Mindfulness-Based- Interventions in the context of sport (Gardner & Moore, 2012; Bühlmayer, Birrer, Rothlin, Faude, & Donath, 2017; Noetel, Ciarrochi, Van Zanden, & Lonsdale, 2017), giving an idea of the growing importance of this research. In this reviews mindfulness interventions have been found useful to improve sport performance. Better levels of acceptance, mindfulness, anxiety and experiential avoidance have also been achieved. Despite the number of publications of mindfulness research in sport psychology and reviews about their efficacy, there has, to our knowledge, been no significant review about which indicators are evaluated in MBIs in sport and which questionnaires are used for it. The assessment of mindfulness is a necessary component of MBIs interventions and it is important to identify and promote evidence-based assessment and instruments in the sport field for being able to assess mindfulness levels of athletes in a reliable way.

With this background in mind, the aim of the current study is to analyze the kind of psychological and physiological variables analyzed in MBIs in sport. Besides, we summarized which were the most frequently used self-report instruments in these interventions. Once identified, our intent was to focus specifically on mindfulness assessment and analyze the quality of the studies found.

METHOD

We followed PRISMA guidelines (Shamseer et al., 2015) and recommendations of the Cochrane Collaboration (Higgins et al., 2011). PRISMA is an evidence-based, minimum set of items for reporting on systematic reviews. It can also be used as a basis for reporting systematic reviews of other types of research, particularly the evaluations of interventions. The *Cochrane Handbook for Systematic Reviews of Interventions* is the official guide that describes in detail the process of preparing and maintaining Cochrane systematic reviews into the effects of healthcare interventions. The Handbook includes guidance on the standard methods applicable in each review, such as planning, searching and selecting studies, data collection, risk of bias, statistical analyses, GRADE, and interpreting results.

This protocol has been registered with the International Prospective Register of Systematic Reviews (PROSPERO), under registration number CRD42017068703.

Search strategy

A systematic search was conducted using PubMed, EMBASE, PsycINFO and the Cochrane library. It was completed by an expert in this field (MP) and focused on studies published between January 1985 and December 2019. The starting date was chosen because the first paper on mindfulness in sport was published in 1985 (Kabat-Zinn, 1985).

The search terms were as follows: ("Surveys and Questionnaires"[Mesh] OR assess* OR evaluate* OR measure* OR test OR questionnaire* OR inventor* OR survey* OR scale* OR tool*) AND ("Mindfulness"[Mesh] OR mindfulness[tiab] OR meditation[tiab] OR MBCT[tiab] OR MBSR[tiab] OR (MAC[tiab] AND mindfulness[tiab]) OR MSPE[tiab]) AND ("Sports"[Mesh] OR "Athletes"[Mesh] OR "Exercise"[Mesh] OR sport[tiab] OR athlete[tiab] OR "physical activity"[tiab] OR "physical activities"[tiab] OR "exercise training"[tiab] OR "exercise trainings"[tiab] OR "physical exercise"[tiab] OR "physical exercises"[tiab]).

Search results were imported into an electronic bibliography after the removal of duplicated citations. Reference lists corresponding to the articles and reviews originally identified were also manually screened and other experts in the field were contacted in order to identify additional studies. The last search was conducted on 30 December 2019. The inclusion and exclusion criteria are shown in Table 1. The participants were professional athletes, interventions were mindfulness based protocols, and mindfulness was the studied outcome. No restrictions were placed on the study design, follow-up, or type of data analysis employed.

Data Extraction and Coding Procedure

Two co-authors (SS and MP) independently screened the titles and abstracts retrieved from the electronic databases. From the original list, they selected the full texts of each article according to the inclusion and exclusion criteria. Any disagreements were resolved by discussion and consensus and when any doubts remained, a final decision was made in consultation with the other co-authors (MD, DM, CB, FR, CC, JG, RR, JP). The literature identified was coded and the data extracted using a pre-defined data extraction form. The review focused on the following variables: mindfulness, other psychological or physiological variables that were assessed, the mindfulness questionnaire used, the authors, the total number of items, the different aspects assessed, the target population, study limitations, examples of specific items, and the

Table 1. Study eligibility criteria.

	Inclusion Criteria	Exclusion Criteria
Participants	Subjects playing any sport at a professional level. No restrictions regarding either age or the number of participants.	Paralympic sports Injured subjects.
Interventions	Any form of mindfulness based sports psychology intervention was included.	
Outcome	Mindfulness	
Study design	The types of study design included: RCTs, Non-RCTs, open trials with a pre-post analysis and case-studies.	
Publications	Published in English, French or Spanish and as full-text articles in peer reviewed scientific journals between January 1980 and December 2019.	Published in other languages and as reviews, case reports, or letters. Books

Non-RCTs: non-randomized controlled trials; RCTs: randomized controlled trials.

provision of a definition of the mindfulness construct.

Assessment of Study Quality

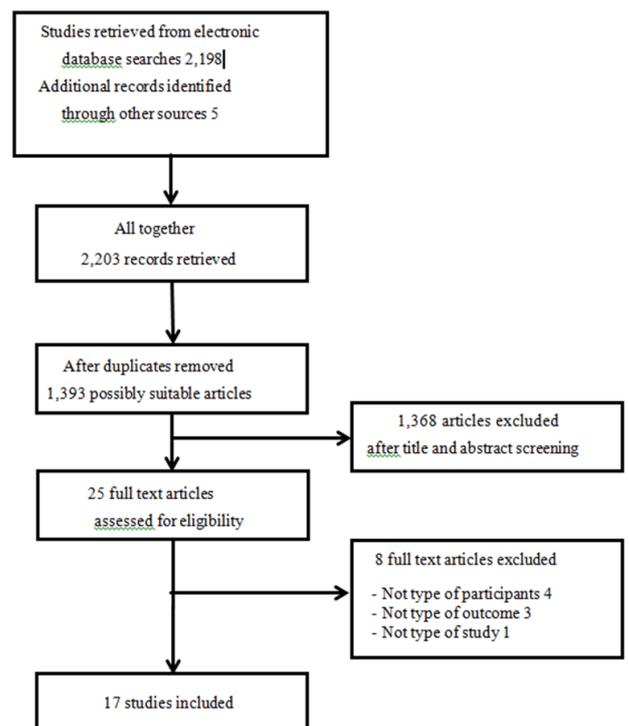
The risk of bias in the studies included was assessed using the Cochrane risk-of-bias tool (Sterne, Higgins, Reeves, & ACROBAT-NRSI, 2014). This risk of bias was assessed using four criteria from the Cochrane Collaboration tool (Higgins, et al., 2011): adequate generation of allocation sequence, concealment of allocation to conditions, prevention of knowledge of the allocated intervention, and dealing with incomplete outcome data. We considered studies meeting three or more criteria to be of high quality and those meeting fewer criteria to be low quality (Cuijpers et al., 2014). The assessment of quality was independently performed by two reviewers (SS and MP) and any discrepancies were resolved through discussion or consultation with the other reviewers (MD, DM, CB, FR, CC, JG, RR, JP).

RESULTS

Figure 1 shows the flowchart illustrating the process conducted in the current review. The initial search involved 2,203 records, which included 810 duplicates, 1,368 were excluded after title and abstract screening, while 25 articles were assessed by full text. There were three main reasons for excluding articles:

1. The participants did not meet inclusion criteria;

Figure 1: Study selection flowchart.



2. The study was not related to the targeted intervention;
3. The study was a protocol.

After a full reading of the 25 full texts articles, we finally included 17 articles. As far as the study design was concerned, we included eight randomized controlled trials (RCTs), while the remaining articles were non-RCTs.

Analysis of the psychological variables assessed

The variables assessed by different authors were mainly: acceptance, anxiety, self-confidence, recurrent thoughts, mindfulness and flow levels. The variables and questionnaires used to evaluate each item are listed in Table 2.

From this summary table, it can be deduced that the most frequently assessed variables are mindfulness (12 studies), anxiety (6 studies), flow (5 studies) and acceptance (5 studies). The most commonly used questionnaires are the Sport Anxiety Scale (SAS) developed by Smith, Smoll e Shultz (1990) in 6 studies, and multiple versions of the Action and Acceptance Questionnaire (AAQ) of Hayes, Strosahl e Wilson (1999) in 5 studies. Two main questionnaires are generally used to assess flow levels: the Dispositional Flow Scale-2 (DFS-2), in 3 studies and the Flow State Scale-2 (FSS-2), both of Jackson e Eklund (2002) in 3 studies.

Mindfulness questionnaires used in studies

The validated mindfulness questionnaires used in these studies are compared in Table 3.

The most used, in three of the studies, is the Five Facet Mindfulness Questionnaires (FFMQ) of Baer et al. (2006). The Mindfulness Attention Awareness Scale (MAAS) of Brown & Ryan (2003), the Kentucky Inventory of Mindfulness Scale (KIMS) of Baer et al. (2004) and the Toronto Mindfulness Scale (TMS) of Lau et al. (2006) in two of them. The Philadelphia Mindfulness Scale (PHMS) of Cardaciotto et al. (2008), and Cognitive and Affective Mindfulness Scale Revised (CAMS-R) of Feldman, Hayes, Kumar, Greeson, e Laurenceau, (2007) have been used in one study each other. Finally, two specific scales for sport, the Mindfulness Inventory Scale (MIS) of Thienot et al. (2014) and the Athlete Mindfulness Questionnaire (AMQ) of Zhang et al. (2016) were also used in one study each one of them.

Apart from the validated questionnaires, two different scales were used:

The 'mindfulness scheme' consists of recording thoughts, emotions, body

awareness, stress, and energy levels on an hourly basis for three separate days within a two-week period (Jouper & Gustafsson, 2013). It is focused on increasing awareness of the here and now and the ability to turn off one's 'autopilot' mode of action.

The "own scale" is a questionnaire that assessed 20 items (Likert scale 1-6). It was inspired by the MAAS and KIMS questionnaires, whose items were adapted to the characteristics of athletes. It measured self-awareness and acceptance specifically focusing on the study intervention (Bernier, Thienot, Pelosse, & Fournier, 2014).

Quality of the Studies Included

According to the Cochrane Collaboration tool for assessing the risk of bias, only three studies (Scott-Hamilton et al., 2016; Zhang et al., 2016) achieved a "high quality" qualification (Table 4). Many items were observed, about the study quality (adequate generation of allocation sequence, concealment of allocation to conditions or dealing with incomplete outcome data) and the intervention quality (if the study referred to the use of a treatment manual or the treatment integrity was checked during the study). These items were evaluated as high, low or unclear. The highest quality was found in one article with six "high" items (Zhang et al, 2016). A high quality was also found in three more articles, with three "high" items (Joseffson et al., 2019; Kachanathu et al., 2011; Scott-Hamilton et al., 2016). The rest of the articles were evaluated with two or less "high" items, what is a low quality qualification.

According to this evaluation, it seems necessary to improve quality of future studies for a better consistency of findings.

DISCUSSION

As many reviews have been written about the effectivity of MBIs in sport, this is the first study to systematically review the different assessment variables and self-report questionnaires used.

Mindfulness Assessment

Mindfulness was the most assessed indicator in 12 of the 17 final articles. Its definition, as well as its different facets has been the subject of various studies (Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006; Bishop, et al., 2004), with the result of it having been analyzed on several different scales. In summary, eight different validated questionnaires and two own scales have been used in this review to measure mindfulness. These results reflect the general difficulty

Table 2. Type of used variables and questionnaires.

	Acceptance	Anxiety	Self-Confidence	Recurrent Thoughts	Flow	Mindfulness	OTHERS
Aherne et al., 2011					FSS-2	CAMS-R	
Bernier et al., 2009							OMSAT-3
Bernier et al., 2014						OWN SCALE	
De Petrillo et al., 2009		SAS		TOQS		KIMS, TMS	MPS, CEM
Doron et al, 2019				TOQS		MIS	
Franco, 2009							IBD, PVS
Gardner & Moore, 2004	AAQ-16	PSWQ, SAS					
Goodman et al., 2014	AAQ-2					MAAS	TNASS, AHS, PSS, VLQ, GRIT-S, DSS, DASS-21
Haase et al., 2015						FFMQ	MAIA, TAS
Joseffson et al, 2019						AMQ	DERS
Jouper & Gustafsson, 2013						MINDFULNESS SCHEMA	ABQ
Kachanathu et al, 2011							Cortisol levels
Kaufman et al., 2009		SAS	CSCI	TOQS	FSS-2	KIMS, TMS	MPS
Lutken house, 2007	AAQ-R	PSWQ, SAS					
Schwanhausser, 2009	AAQ-2	SAS			DFS-2, FSS-2	PHMS, MAAS	
Scott-Hamilton et al., 2016		SAS-2			DFS-2	FFMQ	SASS
Zhang, 2016	AAQ-2				SDFS	FFMQ	

FSS-2 (Flow State Scale-2), CAMS-R (Cognitive and Affective Mindfulness Scale-Revised), OMSAT-3 (Ottawa Mental Skills), SAS (Sport Anxiety Scale), TOQS (Thought Occurrence Questionnaire for Sport), KIMS (Kentucky Inventory of Mindfulness Skills), TMS (Toronto Mindfulness Scale), MPS (Multidimensional Perfectionism Scale), CEM (Credibility and Expectations Measure), MIS (Mindfulness Inventory Scale), IBD (Inventory of Burnout in Sportspeople), PVS (Personal View Survey), AAQ-16 (Acceptance and Action Questionnaire-16), PSWQ (Penn State Worry Questionnaire), AAQ-2 (Acceptance and Action Questionnaire-2), MAAS (Mindfulness Attention Awareness Scale), TNASS (Tolerance of Negative Affect States Scale), AHS (Adult Hope Scale), PSS (Perceived Stress Scale), VLQ (Valued Living Questionnaire), Grit-S (Short Grit Scale), DSS (Drexel Defusion Scale), DASS-21 (Depression Anxiety Stress Scale-21), FFMQ (Five Facets Mindfulness Questionnaire), MAIA (Multidimensional Assessment of Interoceptive Awareness), TAS (Toronto Alexithymia Scale), AMQ (Athlete Mindfulness Questionnaire), DERS (Difficulties in Emotion Regulation Scale), ABQ (Athlete Burnout Questionnaire), CSCI (Carolina Sport Confidence Inventory), AAQ-R (Acceptance and Action Questionnaire-Revised), DFS-2 (Dispositional Flow Scale-2), PHMS (Philadelphia Mindfulness Scale), SAS-2 (Sport Anxiety Scale-2), SASS (Sport Attribution Style Scale), SDFS (Short Dispositional Flow Scale)

Table 3. Comparison of Mindfulness questionnaires.

AUTHORS	SCALE	ITEMS	DIMENSIONS (number of items)	INTERNAL CONSISTENCY (Alpha Cronbach)	LIMITATIONS	EXAMPLE OF AN ITEM
Baer, Smith & Allen, 2004	Kentucky Inventory of Mindfulness Scale (KIMS)	39	4: observing (12), describing (8), acting consciously (10) and accept without judging (9)	0.72 - 0.97	It is not clear how to assess mindfulness with the items described. The same authors proposed the <i>Five Facet Mindfulness Questionnaire</i>	<i>"I'm good at thinking of words to express my perceptions, such as how things taste, smell, or sound."</i>
Baer et al., 2006	Five Facet Mindfulness Questionnaire (FFMQ)	39	5: observing (8), acting (8) consciously (8), describing (8), not judging (7)	0.67 - 0.93	Understanding it emsvaries between subjects with or without experience inmeditation	<i>"I observe my feelings without getting lost in them."</i>
Brown & Ryan, 2003	Mindfulness Attention Awareness Scale (MAAS)	15	1: attention (15). There have been later new versions.	0.78 - 0.92	Phrasing some sentences in the negative could lead to confusion.	<i>"It seems I am 'running on automatic' without much awareness of what I'm doing."</i>
Cardacciotto et al., 2008	Philadelphia Mindfulness Scale (PHMS)	20	2: awareness (10) and acceptance (10)	0.75 - 0.91	This needs to be validated in larger samples and there is a problem with the understanding of the items written in a negative way.	<i>"There are things I'd rather not think about"</i>
Feldman et al., 2007	Cognitive and Affective Mindfulness Scale Revised (CAMS-R)	12	4:attention (4), focus on the present (4),awareness (4), acceptance (4).	0.61 - 0.81	It needs to be validated in larger populations	<i>"It is easy for me to concentrate on what I am doing"</i>
Lau et al., 2006	Toronto Mindfulness Scale (TMS)	13	2: curiosity (6), decentering (7)	0.85 - 0.91	Self-regulation assessment has not demonstrated sufficient internal validity	<i>"I was surprised by my reaction to things"</i>
Thienot et al, 2014	Mindfulness Inventory for Sport (MIS)	15	3: awareness (5), non-judgemental (5), refocusing (5)	0.77-0.78	It needs to be validated in more and different samples	<i>"I pay attention to the type of emotions I am feeling"</i>

Table 4. Quality of Studies Included.

	Study quality				Intervention quality		
	AS	AC	PK	IO	Man	Trai	Inte
Aherne et al., 2011	?	?	?	+	+	?	?
Bernier et al., 2009	-	-	-	-	+	+	?
Bernier et al., 2014	-	-	-	-	+	+	?
De Petrillo et al., 2009	-	-	-	-	+	?	?
Doron et al, 2019	-	-	-	-	+	?	+
Franco, 2009	?	?	?	-	+	-	?
Gardner & Moore, 2009	-	-	-	-	+	?	?
Goodman et al., 2014	-	-	-	-	+	+	?
Haase et al., 2015	-	-	-	-	+	?	?
Joseffson et al, 2019	+	?	?	-	+	+	+
Jouper & Gustafsson, 2013	-	-	-	-	+	+	?
Kachanathu et al, 2011	+	?	?	-	?	+	+
Kaufman et al., 2009	-	-	-	-	+	-	?
Lutken house, 2007	-	-	-	-	+	?	?
Schwanhausser, 2009	-	-	-	-	+	?	?
Scott-Hamilton et al., 2016	+	?	?	-	+	?	+
Zhang, 2016	+	+	+	-	+	+	+

Study quality: AS, adequate generation of allocation sequence; AC, concealment of allocation to conditions; PK, prevention of knowledge of the allocated intervention; IO, dealing with incomplete outcome data; Intervention quality: Man, the study referred to the use of a treatment manual; Trai, the therapists who conducted the therapy were trained; Inte, treatment integrity was checked during the study; +, high; -, low; ?, unclear.

in measuring mindfulness. Some authors have mentioned it (Chiessa, 2012) and this is also found in sport MBIs.

On reviewing the definitions of mindfulness, we see there are several common aspects or facets where the majority of authors agree: awareness, attention and acceptance. In the scales discussed in this review, we found assessments that ranged from analyzing only one aspect of mindfulness (attention, the Mindfulness Attention Awareness Scale, MAAS) to others assessing as many as five different aspects (observing, acting, consciousness, describing, not judging, the Five Facets Mindfulness Questionnaire-FFMQ). On the other hand, Kentucky Inventory of Mindfulness Scale (KIMS) assesses four facets (observing, describing, acting consciously and accepting without judgment), as well as Cognitive and Affective Mindfulness Scale Revised (CAMS-R): attention, focus on the present, awareness and acceptance. The Mindfulness Inventory

for Sport (MIS) and the Athlete Mindfulness Questionnaire (AMQ) evaluate three aspects: awareness, non-judgemental attitude and refocusing the first and present moment, awareness and acceptance the second one.

Finally, The Toronto Mindfulness Scale (TMS) and Philadelphia Mindfulness Scale (PHMS) assess two facets: curiosity and decentering (TMS) and awareness and acceptance (PHMS). These results give an idea of the complexity of mindfulness construct.

The MAAS questionnaire is considered the most used tool for assessing mindfulness (Sauer et al., 2013) and the FFMQ is been the best evaluated with COSMIN Checklist in a recent review of mindfulness questionnaires (Park, Reilly-Spong, & Gross, 2013). According to this and their confirmed internal and external validity, these questionnaires can be considered appropriate for

mindfulness assessment in general population.

However, none of these scales had been specifically created for studying athletes, and this was a clear limitation. Focusing on the assessment of mindfulness, it is very important to use language that is relevant to the world of sport. That refers to situations which athletes can recognize and relate to. It should be considered that these concepts could be difficult to understand for an athlete, as they are different from the concepts with which they habitually work. It would therefore be useful to clarify which facets of mindfulness can be more relevant to athletes and to develop specific scales for analyzing them. Given the specific characteristics of athletes, the scales designed for the general, or clinical, population may not be as reliable and valid as those specifically created for and focusing on athletes or specially adapted to study different sports.

There has already been a first attempt to achieve this with the creation of the Mindfulness Inventory for Sport (Thienot et al., 2014) and Athlete Mindfulness Questionnaire (Zhang et al., 2015) for assessing mindfulness in sport. To analyze these questionnaires and their internal consistency and quality in more studies will be important to find appropriate ways to evaluate mindfulness in sport.

Other Psychological Variables

Anxiety was the second most assessed indicator, found in six of the articles. A specific scale was used to measure it, the Sport Anxiety Scale, which may make the outcomes more generalizable to this population.

Flow construct was studied in five of the 17 reference studies. Flow is defined as a state in which people are so involved in an activity that nothing else seems to matter (Csikszentmilyi, 1990) and it is associated with a better performance in sport (Kimiecik & Stein, 1992). Authors such as Kee e Wang (2008) have studied the relationship between flow and mindfulness and it seems that athletes with higher mindfulness levels reach flow state in an easier way than other colleagues. In future studies, it is necessary to differentiate between flow and mindfulness constructs because sometimes they are confused. Flow is considered a psychological state and so is mindfulness. They are similar in this base but they are also different in the way that mindfulness can be trained through different programs and protocols. More research is needed about this two constructs. Their definitions, characteristics, similarities, differences, and interrelations must be clearly distinguished for researchers and professionals to gain a better understanding of these states and be able to help the athletes to perform better (Swan, Keegan, Piggott, & Crust, 2012).

And finally, acceptance was found also in five of the articles. It is also considered a specific facet within the mindfulness construct. Some authors have even talked about Mindfulness and Acceptance Interventions (Gardner & Moore, 2012; Noetel et al., 2017). As explained before, it is one part of Mindfulness and Acceptance Commitment (MAC) programs in some interventions. In future studies, it will be necessary to distinguish between mindfulness and acceptance in sport psychology. The acceptance scale used was the Action and Acceptance Scale, in its different versions. No specific acceptance scale was found for the sport context.

On the other hand, the "recurrent thoughts" variable was assessed with the Thought Occurrence Questionnaire for Sport, which is again a specific questionnaire for measure thought occurrence in sport.

Physiological Assessment

Only one study (Kachanathu et al., 2011) evaluated physiological variables; in this case, the cortisol levels in saliva. The results showed a significant improvement after the mindfulness intervention (with a 50% lower post-test measurement and they remained 20% lower one week later, in the follow up).

Other examples of articles including physiological measures of mindfulness are: variability in heart rate, in a sample of individuals with symptoms of high and low generalized anxiety (Mankus, Aldao, Kerns, Mayville, & Mennin, 2013); heart rate, in a sample of healthy men (Bullis, Boe, Asnaani, & Hofmann, 2014); the electrical conductance of the skin, in a sample of female students (Feldman, Dunn, Stenke, Bell, & Greeson, 2014); and other neuroendocrine responses, in a mixed group of students (Creswell, Pacilio, Lindsay, & Brown, 2014). It has been observed that improvements in psychological stress attributable to mindfulness tend to produce improvements in physiological markers too. However, research in this field is still in its infancy and even more so in sport context. As most of the studies published so far have used questionnaires and have the limitation of subjectivity, we recommend that physiological markers might be used more frequently

CONCLUSION

Mindfulness is a relatively new concept in sport psychology. This review analyzed psychological and physiological variables and the questionnaires used in Mindfulness-Based-Interventions in this field. A specific focus on mindfulness assessment was also done.

Considering the very limited number of studies that have been used to

evaluate mindfulness in sport, no restrictions were placed on study design. This resulted in the inclusion of 17 studies of which only eight were RCTs and only four were considered to be of high quality. This is a clear limitation and more robust designed studies will be required in the future.

Mindfulness was the most frequently identified indicator, followed by anxiety, flow and acceptance. However, few of the questionnaires used were regarded as specific enough for athletes; it is therefore recommended to validate different scales for use across different sports. It will also be necessary to clarify which facets of mindfulness are most relevant in athletes and to differentiate between different constructs such as mindfulness, acceptance and flow.

Finally, the use of physiological markers could be helpful to confirm the benefits of mindfulness based interventions within the field of sport psychology.

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Ethical Approval

This article does not contain any studies with human participants or animals performed by any of the authors

Conflict of Interest

The authors declare that they have no conflict of interest

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