

Measuring Mindfulness in Youth: Review of Current Assessments, Challenges, and Future Directions

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Abstract Interest in mindfulness-based interventions (MBIs) for youth continues to grow across academic, clinical, educational, and community settings. Conclusions regarding the effects of mindfulness training with youth are tempered by methodological issues. One common limitation is the availability of reliable and valid ways to measure mindfulness. This review identifies existing youth mindfulness measures, discusses key challenges to measurement, and offers suggestions for improving assessment research. A search of electronic databases, consultation with colleagues, and data from professional meetings yielded seven self-report measures: (a) Child and Adolescent Mindfulness Measure (CAMM); (b) Mindful Attention Awareness Scale for Adolescents (MAAS-A); (c) Mindful Attention Awareness Scale for Children (MAAS-C); (d) Comprehensive Inventory of Mindfulness Experiences-Adolescents (CHIME-A); (e) Mindful Thinking and Action Scale for Adolescents (MTASA); (f) Mindfulness Scale for Pre-Teens, Teens, and Adults (MSPTA); and (g) Mindfulness Inventory for Children and Adolescents (MICA). All seven assess trait mindfulness through self-report. We discuss methodological concerns regarding the near-exclusive use of self-report measures to assess youth mindfulness and offer suggestions for validating new

measures and improving research studies that incorporate the assessment of mindfulness in youth.

Keywords Mindfulness · Assessment · Measurement · Children · Adolescents

Introduction

Research on mindfulness-based interventions (MBIs) in youth has grown substantially over the past decade. MBIs appear to be helpful to children and adolescents, especially in clinical populations, and may enhance cognitive performance and stress resilience in general classroom students (Zenner et al. 2014; Zoogman et al. 2014). Mindfulness is also associated with attention, emotion regulation, executive functions, academic success, and prosocial behaviors (Bakosh et al. 2015; Flook et al. 2010; Flook et al. 2015; Schonert-Reichl et al. 2015; Semple 2010). These findings have generated enthusiasm among researchers, clinicians, teachers, and the general public and support the growing dissemination of MBIs across clinical, educational, and community settings.

There is growing discussion, however, around methodological issues in mindfulness research, including the assessment of mindfulness and measuring changes in mindfulness (see Bergomi et al. 2013; Davidson and Kaszniak 2015; Grossman 2011; Sauer et al. 2013). Testing the assumption that MBIs have specific effects on mindfulness—or that other outcomes are mediated through such improvements—depends on the reliability and validity of measures used to assess the complex and multifaceted construct of mindfulness.

A substantial portion of youth MBI studies rely on indirect measures of mindfulness such as attention, executive functioning, or emotion regulation (Zenner et al. 2014; Zoogman et al. 2014). While such constructs are close proxies for mindfulness, it

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is important to develop measures that sufficiently differentiate mindfulness from other related outcomes; without this, there exists a critical gap in concluding that youth MBIs effect change through the mechanisms they are hypothesized to operate through. Youth MBI studies that directly assess mindfulness are beginning to grow as child and adolescent mindfulness measures become more available, those of which are reviewed in this article. Still, the direct measurement of mindfulness in youth is faced with a number of conceptual, methodological, developmental, and cultural challenges.

The first challenge in measuring mindfulness may be defining what it is. Scholars have noted the difficulties of translating the Buddhist concept of *sati* (in the Pali language) into western psychology (Bodhi 2011; Dreyfus 2011; Grossman and Van Dam 2011). One challenge is that western psychology attempts to operationalize a concept that derives from a phenomenological understanding of direct experience, embedded within a non-western cultural and philosophical framework (Grossman 2011). Mindfulness is often defined as present-moment awareness—either focused attention or open monitoring—combined with an attitude of nonjudgment, curiosity, and kindness (Bishop et al. 2004; Kabat-Zinn 1994; Lutz et al. 2008). Associated characteristics include metacognitive awareness, emotional equanimity, skillful decision-making, and acting with compassion (Nanamoli and Bodhi 2001; Teasdale et al. 2002; Walsh 1996).

These aspects of mindfulness are theoretically interrelated and difficult to isolate. Measures that exclusively examine present-focused attention, for example, do not assess the entirety of this multifaceted construct (see discussion by Grossman 2011). Moreover, since different mindfulness-based practices (e.g., meditation vs yoga) may develop different components of mindfulness (e.g., concentration vs body awareness), narrowly defined measures are likely to be differentially sensitive to different mindfulness practices. Assessing mindfulness as a global construct, although easier to do, makes it difficult to ascertain the particular mechanisms of change associated with mindfulness practices. Single-factor measurements of mindfulness make it difficult to understand what mindfulness practices actually do and how they do it (Holzel et al. 2011).

Unraveling the nuanced mechanisms of change is especially relevant in research with youth, where definitions and applications of mindfulness have largely been borrowed from the adult literature without a complete understanding of how mindfulness emerges within a developmental neurocognitive framework. For example, abstract reasoning, which may precede the ability to focus attention and “observe” thoughts and emotions with metacognitive awareness, relies on prefrontal and fronto-limbic networks that are not fully developed until early adulthood (Gogtay et al. 2004). Thus, it may be beneficial to use multifactorial assessment approaches to help clarify how different aspects of mindfulness are cultivated across different developmental stages.

The distinction between state and trait mindfulness offers another challenge to the measurement of mindfulness. Trait mindfulness refers to a stable, dispositional quality, while state mindfulness refers to the capacity to cultivate a particular state of mind during meditative practice. The operationalized definition of mindfulness and existing youth assessments favor the assessment of trait mindfulness. Thompson and Waltz (2007) suggested that there may be little relationship between state and trait mindfulness. While dispositional or trait mindfulness is seemingly easier to measure (i.e., through self- or observer-reported behaviors), it may be less informative about an individual’s ability to cultivate a state of mindful awareness—the skill explicitly targeted in most MBIs. Furthermore, dispositional mindfulness is likely to be less affected by short-term MBIs.

Many have discussed problems associated with measuring mindfulness by self-report (see Bergomi et al. 2013; Grossman and Van Dam 2011; Grossman 2011; Sauer et al. 2013). Biases in self-perception limit the reliability of all self-report measures used in behavioral research (Baumeister et al. 2007). Self-report bias may be especially problematic in mindfulness research because those with less mindfulness training may have less insight into the nature of their own minds and be less likely to report accurately. Alternatively, experienced practitioners may see their thoughts and behaviors more clearly and subsequently self-report less mindfulness (see Grossman 2011). As an individual cultivates mindfulness, he or she will be more likely to notice that their “mind has wandered” or that they are “judging.” Consequently, changes in mindfulness change not only the reliability of self-report over time, but may actually reverse expected outcomes. This phenomenon might also be due to differential item understanding, inadequate content validity, or whether the item is worded positively or negatively. Van Dam et al. (2009) found that meditators and nonmeditators with similar overall levels of “mindfulness” endorsed items differently depending on whether they were negatively or positively worded. This finding also suggests that interpretation of items is influenced by meditative experience. Self-report is also subject to the effects of social desirability and demand characteristics. By the end of a mindfulness training program, participants are well aware of how they “should” be acting and may well respond to questions so as to be a “good participant” (Nichols and Maner 2008). Similarly, those who have made significant efforts to “be mindful” may respond with the desired outcome, rather than the actual outcome. Finally, the wording used in mindfulness questionnaires is consistent with that used in mindfulness programs (e.g., “nonjudgment,” “paying attention”), which provides clues to the expected responses.

Culture, environment, and developmental level can further influence the interpretation of questionnaire items. For example, Christopher et al. (2009) found that while Thai Theravāda Buddhist monks scored higher than American

college students on certain subscales of the Kentucky Inventory of Mindfulness (KIMS; Baer et al. 2004) and Mindful Attention Awareness Scale (MAAS; Brown and Ryan 2003)—both measures of trait mindfulness—American college students scored higher than Buddhist monks on other subscales. Leigh et al. (2005) found a positive association between trait mindfulness and binge drinking, which the authors suggested may be due to increased awareness of body sensations in this population. It is possible that youth with other physically focused anxieties or trauma might respond similarly to trait measures of mindfulness. Youth of different ages or cognitive abilities may also interpret and endorse items differently.

Finally, the assessment of mindfulness needs to take into account broader cultural and contextual factors. The meanings of mindfulness, meditative practices, reasons for practicing, and expected outcomes have continuously changed across countries, cultures, and time. Many current practices and assessments of mindfulness, however, are not conceptualized within a biopsychosocial model or framed within a religious, spiritual, or cultural context (Lavelle 2016). With increasing appreciation for the complexity of what mindfulness is, we observe that even within the USA, for example, mindfulness is learned and may look markedly different in individuals of different ages, genders, ethnicities, or socio-economic strata. Mindfulness may look different within microsystems (e.g., a family, school, or religious community), across mesosystems (e.g., different teachers within a school), exosystems (e.g., educational systems), and macrosystems (e.g., broad cultural values). The assessment of mindfulness needs to progress alongside our evolving understanding of mindfulness as it fits into contemporary cultures.

This review examines existing measures of mindfulness for children and adolescents. Conceptual foundations, psychometric properties, and the intended use of each measure are described. Strengths and limitations are discussed for each measure. Studies providing validation and support for each measure are systematically included; however, intervention studies that utilized the reviewed measures are not systematically included and are rather cited as relevant. Finally, we consider ways to potentially improve self-report instruments and offer suggestions to strengthen future mindfulness studies by including a more comprehensive assessment of outcomes for youth.

Method

Search Strategy

Electronic databases (PsycINFO, PUBMED, and GoogleScholar) were searched up through June 2016 using combinations of the following terms: mindfulness, meditation, measure, assessment,

youth, child/children, and adolescent/adolescence. Reference lists in relevant articles were manually reviewed. Information from colleagues and data from professional meetings were also sourced.

Selection Criteria

Self-report instruments were selected if their primary purpose was the assessment of mindfulness in youth (up to 18 years old). Assessments that did not specifically measure mindfulness were excluded (e.g., those that evaluated aspects of attention, executive function, emotional awareness, emotion self-regulation, compassion, prosocial behaviors, or broad indices of stress or resilience).

Results

Seven self-report measures were identified. Table 1 lists the age range, number of items, time to complete, and reliability of each measure, along with a summary of positively and negatively correlated constructs. Four measures were located through electronic database searches (MAAS-A; Brown et al. 2011; CAMM; Greco et al. 2011; CHIME-A; Johnson et al. 2017; MAAS-C; Lawlor et al. 2014). Three instruments were identified through manual review of reference lists of relevant articles (MTASA: West et al. 2005), personal communication with a colleague (MICA; Briere 2011), and data presented at a professional conference (MSPTA; Droutman 2015).

Child and Adolescent Mindfulness Measure The CAMM is a 10-item, self-report measure of “present-moment awareness, and nonjudgmental, nonavoidant responses to thoughts and feelings” in children and adolescents age 10 to 17 (CAMM; Greco et al. 2011, p. 610). Respondents rate how often each item is true for them using a 5-point scale (0 = *never true*; 4 = *always true*). All 10 items are negatively worded and reversed-scored, so that higher scores indicate greater mindfulness. Items on the CAMM were adapted from the Kentucky Inventory of Mindfulness Skills (KIMS; Baer et al. 2004), an adult self-report measure that is based on conceptualizations of mindfulness from contemporary interventions such as Mindfulness-Based Stress Reduction (MBSR; Kabat-Zinn 1982), Dialectical Behavior Therapy (DBT; Linehan 1993), and Mindfulness-Based Cognitive Therapy (Segal et al. 2002) and is compatible with conceptualizations of Buddhist teachers (Goldstein and Kornfield 1976; Rosenberg 1998). Items were developed based on three of the four facets of mindfulness found on the KIMS: *observing*, *acting with awareness*, and *accepting without judgment*. The fourth item of the KIMS (*describing*) was not adapted for the CAMM due to the premature and highly variable cognitive and verbal capabilities of children (Greco et al. 2011).

Table 1 Self-report measures of child and adolescent mindfulness

Measure	Age range	Number of items	Time to complete	Cronbach's alpha (subscales)	Validated	Correlates positively	Correlates negatively	Citations
CAMM	10–17	10	Less than 5 min	.71–.84	Yes	Mindfulness (MAAS-A); wellbeing; effortful control; self-esteem; academic competence; quality of life; social skills; happiness; self-regulation	Externalizing problems; internalizing symptoms; stress; somatic complaints; rumination; self-blame; catastrophizing; worry; negative affect	de Bruin et al. (2011); Greco et al. (2011); de Bruin et al. (2014); Viñas et al. (2015); Kuby et al. (2015)
MAAS-A	14–18	14	Less than 5 min	.82–.86	Yes	Mindfulness (CAMM) life satisfaction; positive affect; happiness; quality of life; wellness; self-regulation; agreeableness; conscientiousness; openness to experience	Neuroticism; negative affect; stress; substance abuse to cope with stress; rumination; catastrophizing	de Bruin et al. (2011); Brown et al. (2011)
MAAS-C	9–13	15	Less than 5 min	.84	Yes	School self-concept; optimism; perceived autonomy in classroom; positive affect; academic efficacy; academic achievement goals	Negative affect; depression; rumination; anxiety	Benn (Modified Mindful Attention Awareness Scale, unpublished data); Lawlor et al. (2014)
CHIME-A	12–14	25	Less than 10 min	.80 (.65–.77)	Yes	Mindfulness (CAMM); well-being	Emotional dysregulation; perfectionism; negative affect; depression; anxiety; weight/shape concerns	Johnson et al. (2017)
MTASA	13–17	32	Less than 15 min	.85 (.47–.84)	Yes ^a	Mindfulness (MAAS; KIMS; FFMQ); positive affect; life satisfaction	Negative affect	West et al. (2005); West (2008)
MSPTA	9–19	19	Less than 10 min	.84 (.71–.77)	Yes ^b	Self-compassion; emotion regulation	—	Droutman (2015)
MICA	8–18	25	Less than 10 min	—	No	—	—	Briere (2011)

CAMM Child and Adolescent Mindfulness Measure, MAAS-A Mindful Attention Awareness Scale for Adolescents, MAAS-C Mindful Attention Awareness Scale for Children, CHIME-A Comprehensive Inventory of Mindfulness Experiences-Adolescents, MTASA Mindful Thinking & Action Scale for Adolescents, MSPTA Mindfulness Scale for Pre-Teens, Teens, and Adults, MICA Mindfulness Inventory for Children and Adolescents, MAAS Mindful Attention Awareness Scale, KIMS Kentucky Inventory of Mindfulness Skills, FFMQ Five Facet Mindfulness Questionnaire

^a Validation study was a doctoral dissertation

^c Validation study is under peer review

Initial validation of the CAMM was conducted with children and adolescents in fifth through tenth grade (10–17 years old; $n = 319$) enrolled in public schools. Exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) revealed a single factor structure was the best fit (Greco et al. 2011). The CAMM showed good internal reliability ($\alpha = .81$). CAMM scores were positively correlated with academic competence, social skills, and quality of life and negatively correlated with externalizing problems, internalizing symptoms, and somatic complaints (Greco et al. 2011).

de Bruin et al. (2014) conducted a validation study of a Dutch version of the CAMM with children (10–12 years old, $n = 275$) and adolescents (13–16 years old, $n = 560$) from the Netherlands. Principal component analysis (PCA) showed that a single-factor solution was a good fit. However, de Bruin et al. also found a distinct two-factor solution for both the child and adolescent samples. Children and adolescents both indicated a main factor: *present-moment non-judgmental awareness*. The second factor in the child sample was identified as *suppressing or avoiding thoughts and feelings*, while the second factor in the adolescent sample was identified as *distractibility or difficulty paying attention*. Although a single-factor solution was recommended, the authors noted, “it is... clinically interesting that mindfulness might be developing from childhood to adolescence with a focus on slightly different aspects... developmental changes in adolescence, related to hormonal changes, social, and emotional development, and brain development, may be related to the different second factors found in adolescents compared to children” (de Bruin et al. 2014, p. 427). Acceptable internal consistency ($\alpha = .71$ for children, $\alpha = .80$ for adolescents) was reported. The CAMM correlated positively ($r = .32$ in children; $r = .43$ in adolescents) with a measure of Healthy Self-Regulation (HSR; West 2008), a subscale of the Mindfulness Thinking and Action Scale for Adolescents (MTASA; West et al. 2005). Positive correlations were also found between measures of happiness and quality of life, and negative correlations were found between measures of stress, rumination, self-blame, and catastrophizing. Interestingly, children with prior meditation/yoga experience (13%, $n = 35$) did not score differently than children without meditation/yoga experience; however, adolescents with prior meditation/yoga experience (10%, $n = 54$) scored significantly lower than those without such experience. As part of a validation study of another measure, de Bruin et al. (2011) administered the CAMM and reported a similar result: adolescents with prior meditation/yoga experience scored lower than those without such experience.

The CAMM has been validated with 696 Catalan-speaking Spanish adolescents, 11–16 years old (Viñas et al. 2015). Similar to Greco et al. (2011), Viñas et al. (2015) reported good internal reliability ($\alpha = .80$) and a single-factor solution. Positive correlations with well-being, effortful control, and self-esteem were reported.

Kuby et al. (2015) validated the CAMM with a group of non-clinical adolescents (12–15 years old, $N = 562$). Findings were consistent with previous studies. This study found good internal reliability ($\alpha = .84$), a single-factor structure using CFA, and negative correlations between CAMM scores and worry, negative affect, and emotional and behavioral difficulties (Kuby et al. 2015). A small correlation was found between mindfulness and positive affect in females, but not males.

Strengths and Limitations The CAMM has been validated across a variety of populations, including English-speaking children and adolescents in the USA, Dutch-speaking children and adolescents in The Netherlands, and Catalan-speaking adolescents in Spain. However, each of these samples involved a non-clinical population, and thus, the utility of the CAMM in clinical samples of children and adolescents is still unknown. One study showed a positive correlation between the CAMM and the HSR subscale of another mindfulness measure, the MTASA, helping support its construct validity (de Bruin et al. 2014). A single-factor solution appears to be favored; this is not a strength or weakness, in itself, but may present as a limitation to researchers wishing to better understand the “active ingredients” or specific components of mindfulness influenced by a MBI. Finally, it is noteworthy that some studies showed that the CAMM may not be sensitive to meditation/yoga practice in children, or may even show contrary outcomes in adolescents with prior practice meditation/yoga experience (e.g., de Bruin et al. 2011; de Bruin et al. 2014).

Mindful Attention Awareness Scale for Adolescents The MAAS-A is a 14-item, self-report measure of trait mindfulness for adolescents 14–18 years old (MAAS-A; Brown et al. 2011). All items are negatively worded. Responses are based on a 6-point scale (1 = *almost always*; 6 = *almost never*), where higher scores reflect greater trait mindfulness. The MAAS-A was adapted from the Mindful Attention Awareness Scale (MAAS) for adults, derived from both historical and contemporary Buddhist ideology, as well as Kabat-Zinn’s (1990) clinical research on mindfulness. The MAAS-A contains the same items as the MAAS with the omission of one inappropriate item for adolescents (“I drive places on ‘automatic pilot’ and then wonder why I went there”). Mindfulness is defined in the MAAS-A as “a receptive state of attention that, informed by an awareness of present experience, simply observes what is taking place” (Brown et al. 2011, p. 1024). This measure emphasizes “presence” as a key component of mindfulness. The MAAS-A showed good internal reliability ($\alpha = .82$ – $.84$) in a normative sample of adolescents (ages 14–18, $n = 595$) and good internal reliability ($\alpha = .86$) in a sample of primarily anxiety- and mood-disordered adolescents (ages 14–18, $n = 102$) (Brown et al. 2011).

The MAAS-A adopts an “indirect assessment approach,” which means that it evaluates the absence, rather than presence, of mindful attention in a variety of situations (Brown et al. 2011). Brown and Ryan (2003) argued that this indirect approach would be more accessible for individuals with little or no mindfulness training. They found that this method showed higher criterion validity than a direct assessment approach. EFA and CFA showed a single-factor solution for the MAAS-A (Brown et al. 2011). MAAS-A scores were shown to be negatively correlated with the “big five” (Lounsbury et al. 2003) personality trait of neuroticism and positively correlated with agreeableness, conscientiousness, and to a lesser degree, openness to experience. Positive correlations were reported between the MAAS-A and greater life satisfaction, positive affect, happiness, and wellness, and negative correlations with negative affect and substance use as a means of coping with stress. Brown et al. (2011) found a moderate correlation ($r = .39$) between the MAAS-A and the HSR subscale of the MTASA.

de Bruin et al. (2011) evaluated the MAAS-A in a sample of high school adolescents (11–17 years old, $n = 717$) in the Netherlands. They reported high internal consistency ($\alpha = .85-.86$) and EFA and CFA suggested a one-factor solution. A moderate correlation between scores on the MAAS-A and the CAMM ($r = .54$) was found. Positive correlations were also found with the HSR subscale of the MTASA, happiness, and quality of life, while negative correlations were found for stress, rumination, and cognitive catastrophizing. Similar to results reported by de Bruin et al. (2014) on the CAMM, the current study showed that adolescents with prior meditation/yoga experience scored *lower* on the MAAS-A than those without. In adolescents who practiced meditation/yoga, frequency of practice did not affect scores (de Bruin et al. 2011).

The MAAS (not the MAAS-A) was psychometrically evaluated in a large sample of Chinese high school adolescents (14–20 years old, $n = 5287$). The MAAS showed high internal reliability ($\alpha = .89-.93$), a one-factor solution, and the potential for a 6-item short scale in this population (Black et al. 2012).

Strengths and Limitations The MAAS-A is the only child mindfulness measure included in this review to be validated in a clinical sample. It has been evaluated cross-culturally in the USA, The Netherlands, and China (the latter study utilized the MAAS versus the MAAS-A). MAAS-A scores have correlated positively with the CAMM (de Bruin et al. 2011) and the HSR subscale of the MTASA (Brown et al. 2011; de Bruin et al. 2011), lending support to its construct validity. On the other hand, the content and construct validity of the MAAS-A have been greatly disputed given its assessment approach (i.e., the self-attribution of *not* being mindful—or the frequency of being inattentive—in often novice meditators, e.g., “I find

myself doing things without paying attention”) and conceptualization of mindfulness (i.e., it being too narrow). Readers are referred to Grossman (2011) for a full discussion on this topic. The single-factor solution for the MAAS-A represents a limitation for researchers wishing to examine specific effects of MBIs. The MAAS-A might be best for researchers wishing to measure “present awareness” versus any other subconstruct of mindfulness. Similar to the CAMM, one study showed that prior meditation/yoga experience was associated with lower scores on the MAAS-A (de Bruin et al. 2011). This may reflect the notion that as one gains greater access to their minds, they become more aware of lapses in attention, mind wandering, judgment, etc. (Grossman 2011). Thus, researchers might be cautious in administering the MAAS-A, and similar mindfulness self-report scales, in samples where some, but not other, children have prior meditation or yoga experience. Moreover, researchers might remain cognizant of the possibility that *worse* scores on the MAAS-A, and similar scales, following MBIs might reflect greater awareness and insight—or more mindfulness.

Mindful Attention Awareness Scale for Children The MAAS-C is a 15-item, self-report measure of trait mindfulness developed for children 9–13 years old (MAAS-C; Benn unpublished data). Respondents rate how often each item is true on a 6-point scale (1 = *almost never*; 6 = *almost always*). All 15 items are negatively worded and reversed-scored, so that higher scores reflect greater trait mindfulness. Like the MAAS-A, the MAAS-C is derived from the MAAS and uses the same theoretical foundation and indirect assessment approach. The MAAS-C contains the same 14 questions as the MAAS-A using more child-friendly language, with the addition of one extra item (“I walk into a room, and then wonder why I went there”).

The MAAS-C was validated with a sample of 286 school children (4th to 7th grades) and showed good internal reliability ($\alpha = .84$). EFA suggested a single-factor solution. Self-concept in school, optimism, perceived autonomy in the classroom, positive affect, academic efficacy, and academic achievement goals were positively correlated with mindfulness, while negative affect, depression, rumination, and anxiety were negatively correlated with mindfulness (Lawlor et al. 2014).

Strengths and Limitations The MAAS-C has been validated with the youngest population (4th grade or 8–9 years old) compared to other mindfulness measures reviewed here. This is an advantage given that many MBI studies utilize elementary school-aged populations, including 4th and 5th graders. Schonert-Reichl et al. (2015) found improvements on the MAAS-C with 4th and 5th graders (9–11 years old) compared to an active control (“social responsibility”) group after a 12-week MBI using the MindUp curriculum (Hawn

Foundation 2008). Similar to the MAAS-A, the MAAS-C contains a single-factor and thus presents limitations to researches wishing to detect nuanced effects of MBIs. The MAAS-C is also inherent with the same content and construct validity concerns as the MAAS-A, described above, and outlined by Grossman (2011). Finally, the MAAS-C has only been validated in a group of non-clinical school children. Thus, its utility for clinical populations is unknown at this time.

Comprehensive Inventory of Mindfulness Experiences-Adolescents The CHIME-A is a 25-item measure of trait mindfulness for adolescents (Johnson et al. 2017) that was adapted from the 37-item adult version (CHIME; Bergomi et al. 2014). Items on the CHIME-A are both positively and negatively worded. Respondents rate how often each item is true using a 5-point scale (0 = *never true*; 4 = *always true*). EFA and CFA in adolescents samples (majority 12–14 years old) supported an eight-factor model with the following factors: *awareness of internal experiences, awareness of external experiences, acting with awareness, accepting and nonjudgmental orientation, decentering and nonreactivity, openness to experience, relativity of thoughts, and insightful understanding* (Johnson et al. 2017). The CHIME-A has sound internal consistency across all eight subscales ($\alpha = .65-.77$); however, because of poor overall internal consistency found across three hierarchical models of testing, the overall score is not recommended (Johnson et al. 2017). CHIME-A total scores positively correlated with the CAMM ($r = .35$) and negatively correlated with measures of emotional dysregulation ($r = -.61$) and perfectionism ($r = -.45$), as measured by the Difficulties in Emotional Regulation Scale (DERS; Gratz and Roemer 2004) and 11 items related to self-criticism from the Dysfunctional Attitudes Scale (DAS; Cane et al. 1986). Subscale scores positively correlated with well-being and negatively correlated with negative affect, depression, anxiety, weight, and body shape concerns.

Strengths and Limitations One strength of the CHIME-A is that its eight-factor model is helpful in clarifying which particular aspects of mindfulness are cultivated following a MBI, especially in the context of our nascent understanding of mindfulness and the developing brain. The CHIME-A has been correlated with the CAMM, bolstering its construct validity (Johnson et al. 2017). One limitation is that the CHIME-A has only been validated in adolescents primarily 12–14 years old, and thus may not be appropriate for younger children. Its utility in a clinical population is also unknown. To date, the CHIME-A has not been used in any MBI studies with youth. Finally, the authors recommend only using subscale scores, versus the total score, at this time (Johnson et al. 2017).

Mindful Thinking and Action Scale for Adolescents The MTASA is a 32-item self-report measure of trait mindfulness for adolescents 13–17 years old (West et al. 2005). Respondents rate how often each item is true on a 5-point Likert scale (1 = *never*; 5 = *almost always*). Items are both positively and negatively worded. EFA revealed four subscales on the MTASA: *healthy self-regulation (HSR), active attention, awareness and observation, and accepting experience* (West 2008). The HSR subscale has been used in validation studies of other youth mindfulness measures, showing positive correlations with the CAMM and MAAS-A (Brown et al. 2011; de Bruin et al. 2011; de Bruin et al. 2014). The MTASA has shown good overall internal consistency ($\alpha = .85$), with subscale alphas ranging from .47 to .84, in a sample of approximately 600 high school students ages 14 to 19 (West 2008). West also found moderate correlations between the MTASA and several adult measures of mindfulness, including the MAAS ($r = .42$), four subscales of the KIMS ($r = .10-.40$), and all five subscales of the Five Facet Mindfulness Questionnaire (FFMQ; Baer et al. 2006) ($r = .15-.56$). The MTASA also showed positive and negative correlations with positive and negative affect, respectively (Positive and Negative Affect Scale; Watson et al. 1988), and a positive correlation with life satisfaction (Brief Multidimensional Students' Life Satisfaction Scale; Seligson et al. 2003).

Strengths and Limitations The existence of four subscales in the MTASA benefits researchers wishing to evaluate multifaceted outcomes and adds to our understanding the nuanced effects of MBIs in youth. The HSR subscale has been correlated with both the CAMM and MAAS-A (Brown et al. 2011; de Bruin et al. 2011; de Bruin et al. 2014). In one study of incarcerated adolescents receiving a 10-week MBI, the HSR subscale showed significant pre-post improvements, while the MAAS (not the MAAS-A) did not (Himmelstein et al. 2012). The MTASA has only been validated in a non-clinical sample of adolescents; thus, its utility for clinical samples and younger children is currently unknown.

Mindfulness Scale for Pre-Teens, Teens, and Adults The MSPTA is a 19-item self-report measure of trait mindfulness for children and adolescents ages 9 to 19 and can also be used with young adults ages 17 to 25 (Droutman 2015). Items are both positively and negatively worded. Respondents rate how often each item is true on a 5-point scale (1 = *never true*; 5 = *always true*). A preliminary study with 413 children and adolescents ages 9 to 19 years old revealed a four-factor model using EFA and CFA that included the following: *attention and awareness, being non-reactive, being non-judgmental, and being non-self-critical*. The MSPTA showed good convergent validity with measures of self-compassion (Self Compassion Scale-Short Form; Raes et al. 2011) and emotion regulation

(Difficulties in Emotion Regulation Scale; Gratz and Roemer 2004). The MSPTA showed good overall internal reliability ($\alpha = .84$) and acceptable internal reliability across subscales ($\alpha = .71-.77$).

Strengths and Limitations The MSPTA has been validated in children as young as 9 years old, which might benefit those working with younger populations. It contains four subscales, a benefit for research purposes with youth. The MSPTA has not been validated in a clinical sample. It has yet to be used in any MBI studies with youth.

Mindfulness Inventory for Children and Adolescents The MICA is a 25-item self-report questionnaire measuring trait mindfulness (MICA; Briere 2011). The language is developmentally appropriate for ages 8 to 18. This measure was developed with five theoretically informed subscales: *self-acceptance*, *present-centered awareness*, *equanimity*, *metacognitive awareness*, and *acceptance of internal experience*. The MICA items and subscales were created by a subject-matter expert who integrated Buddhist concepts of mindfulness and a psychological understanding of child cognitive development (Briere 2011). Items are both positively and negatively worded. Respondents are asked to rate how much they agree with each statement on a 5-point scale (1 = *disagree a lot*; 5 = *agree a lot*).

The MICA is an experimental measure that has not yet been psychometrically evaluated or validated. In a recent pilot study of a mindfulness-based program for elementary school students (7–12 years old), the MICA measured significant pre-post improvements ($p < .01$) (R. J. Semple, personal communication), while pre-post improvements on the CAMM approached significance ($p = .054$). Effect sizes for the CAMM were somewhat smaller than the MICA ($\eta^2 = .14$ and $\eta^2 = .24$, respectively).

Strengths and Limitations The MICA is designed to be developmentally appropriate for children as young as 8 years old, providing an advantage to those working with elementary school-aged children. It has five separate subscales, again presenting an advantage for research purposes. A major drawback is that the MICA has not yet been validated and is currently unpublished. However, as indicated above, the MICA was more sensitive to changes in mindfulness, compared to the CAMM, in a study of elementary school students receiving an after-school mindfulness program (R. J. Semple, personal communication).

Discussion

Seven self-report measures of trait mindfulness for youth were reviewed. Six have been validated (CAMM, MAAS-A,

MAAS-C, CHIME-A, MTASA, and MSPTA), four of which were published validation studies (CAMM, MAAS-A, MAAS-C, CHIME-A) and the other two being a doctoral dissertation (MTASA) and conference presentation (MSPTA). The CAMM, MAAS-A, and MAAS-C have no subscales. The MTASA and MSPTA have four subscales, the MICA has five, and the CHIME-A has eight. All seven measures are rated by means of descriptively anchored Likert-type scales. Items are negatively worded on the CAMM, MAAS-A, and MAAS-C, while items are both positively and negatively worded on the CHIME-A, MTASA, MSPTA, and MICA. Assessments appropriate for children include the CAMM (10–17 years old), MAAS-C (9–13 years old), and MICA (8–18 years old). Assessments appropriate for adolescents include the CAMM (10–17 years old), MAAS-A (14–18 years old), CHIME-A (12–14 years old), MTASA (13–17 years old), MSPTA (9–19 years old), and MICA (8–18 years old). Good internal reliability was reported on the six validated measures. The CAMM, MAAS-A, MAAS-C, CHIME-A, MTASA, and MSPTA showed good convergent validity with related constructs such as psychological inflexibility, rumination, anxiety, self-compassion, and emotion regulation.

Correlations were reported between the MAAS-A and the CAMM ($r = .54$) (de Bruin et al. 2011); the CHIME-A and the CAMM ($r = .35$) (Johnson et al. 2017); the HSR subscale of the MTASA and the CAMM ($r = .32$ in children; $r = .43$ in adolescents) (de Bruin et al. 2014); and the HSR subscale of the MTASA and the MAAS-A ($r = .39$) (Brown et al. 2011; de Bruin et al. 2011). However, given that all of these measures purport to measure mindfulness, these are not overly strong correlations. The construct of mindfulness may be operationalized in idiosyncratic ways, items may be interpreted differently, or different facets of mindfulness may be assessed by each measure.

One noteworthy finding is that in two studies, adolescents with prior meditation/yoga experience scored significantly lower on the CAMM than those without such experiences (de Bruin et al. 2014; de Bruin et al. 2011). The negative wording of questions on the CAMM may influence this outcome. In one study using the FFMQ, adult meditators were less likely to endorse negatively worded items and more likely to endorse positively worded items than nonmeditators who had similar FFMQ total scores (Van Dam et al. 2009). Van Dam et al. suggested that this finding might be due to increased meta-awareness and recognition of attention lapses in meditators. Items may have different salience to nonmeditators and meditators (e.g., “at school, I walk from class to class without noticing what I am doing”). Nonmeditators may interpret the word “mindful” for example as being synonymous with “careful” (e.g., “she was mindful of her finances”). Attending mindfulness programs also increases familiarity and comprehension of the language used

on the questionnaires, which seems likely to influence response choices.

Overall, researchers should remain mindful of the possibility that assessment scores following a MBI might actually decline, yet paradoxically reflect greater awareness, or more “mindfulness” of one’s cognition, emotions, and behavior. This might be especially true in children, whose metacognitive skills are still taking shape. This certainly presents a paradox for administering and interpreting mindfulness measures in children, and results, at this point, could be viewed as ambiguous. One potential way to counteract this is to employ measures that account for “response-shift bias.” Howard (1980) has pointed out that subjects’ awareness and understanding of an intervention are likely to change from pre to post; if the intervention is doing its job, it will alter subjects’ perspectives in evaluating themselves on that variable. Echoing concerns about pre-post self-attributions of mindfulness, Howard called attention to the fact that pre-post measures can by nature show reversed outcomes. Howard (1980) suggests administering “then/post” questionnaires that allow subjects to retrospectively assess their level of functioning at pre-test and, now that they better understand the construct, how they have changed on this dimension, as well as “informed pretests” that provide subjects with a more accurate understanding of the construct being assessed. This could certainly be incorporated into pre-post mindfulness assessments for youth.

Finally, it would be helpful to integrate self-report measures with third-person (objective), second-person (observer), and first-person (qualitative) assessments. Levinson et al. (2014) developed an objective breath counting task as a measure of state mindfulness, which has yet to be tested in children. One could also employ ecological momentary assessment (EMA) to assess children’s mindful state throughout the day (e.g., using a mobile device; see Killingsworth and Gilbert 2010). Recent studies using EMA to assess mindfulness suggest that this is a feasible, and potentially more sensitive, assessment approach than paper-and-pencil questionnaires in adult subjects (Moore et al. 2016; Ruscio et al. 2016), and while EMA has been used to assess related constructs, such as mood, in children (Axelson et al. 2003), no studies have used EMA to assess mindfulness in youth. Mindfulness-related health outcomes, such as respiration or heart rate variability, could be monitored in children’s natural environments (e.g., in school or at home) using ambulatory tracking devices (e.g., Spire[®], Lief[®]). Second-person reports of behavior might be integrated from multiple observers (e.g., teachers, parents, or blind raters). Lastly, considering the many challenges of objectively measuring and quantifying mindfulness, there have been calls to increase the number of first-person, subjective narratives in MBI research.

Limitations

One limitation of this review relates to the scope of search for mindfulness measures that was conducted. Two unpublished measures were discovered through personal contact with colleagues. It is likely that other unpublished measures exist that were not ascertained. Furthermore, by excluding measures that focused on mindfulness-related constructs, such as compassion, psychological flexibility, or acceptance, we may have excluded instruments that are potentially more valid measures of mindfulness than the focused “mindfulness” measures selected for this review. Finally, it is important to note that we did not perform a systematic review of intervention studies that incorporated the measures discussed in the results, but rather cited such studies as relevant.

Future Directions

Reliable and valid measures of mindfulness are needed to support rigorous youth mindfulness research. We offer six suggestions that may enhance these efforts. (1) Clearly describe the theoretical framework and operational definition of mindfulness on which individual questionnaire items are based. (2) Define precisely what aspect(s) of mindfulness the measure aims to assess. For example, identify if the measure assesses focused or sustained attention, nonjudgmental awareness, a desired outcome such as emotional self-regulation, or an associated ecological trait such as compassion. (3) Be clear about the type of mindfulness practice that the measure is intended to evaluate. A measure that is sensitive to concentrative breath meditation, for example, may be less sensitive to loving-kindness or insight-oriented practices. (4) Report convergent validity with other mindfulness measures. Support for the relationships between measures is still limited. Evaluating multiple measures of mindfulness within the same samples would be useful in deepening our understanding of this construct. (5) Test for differential item understanding. Youth at different ages and those with and without experience of mindfulness are likely to interpret items differently. Analysis of semantically related response choices (e.g., “accept” vs “allow”) would strengthen the reliability of all measures (see Collins et al. 2009). Along these same lines, test developers might consider evaluating and reporting differential outcomes based on contextual factors of test administration (e.g., items read aloud versus completed autonomously; administered by a researcher, clinician, or teacher; or whether items are “explained” or clarified by the administrator). (6) Finally, self-report measures may consider adding “then/post” and “informed-pretest” components as discussed earlier and outlined by Howard (1980).

Suggestions for conducting studies that may support assessment research include the following: (a) control for social desirability and demand characteristics by reminding participants that

there are no “correct” answers and that responses are confidential; (b) when possible, include an active control group that uses similar language as that used in the MBI; (c) integrate subjective self-report and observer-reports with objective measures; and (d) assess for possible adverse effects of MBIs, such as increases in perceived stress (White 2012).

Conclusions

Existing self-report measures of mindfulness for youth have been helpful in evaluating the effectiveness of mindfulness interventions; however, more reliable and valid assessments and a broader range of assessments are needed. Using a variety of assessment techniques would reduce some of the methodological weaknesses seen in many outcome studies and improve our understandings of the effects of mindfulness practice on the mind, body, and behaviors.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

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

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