Mindfulness-based Intervention in Elementary School Students With Anxiety and Depression: A Series of n-of-1 Trials on Effects and Feasibility

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Abstract
Mindfulness-based interventions constitute a promising option to address anxiety and depression in elementary school students. This study evaluated the effect of a mindfulness-based intervention on anxiety and depression in elementary school students with a diagnosis of anxiety or depression disorder. A single-subject experimental A-B-A design was used. Participants were three elementary school students from grades three and four, along with their teacher. Anxiety and depression were measured on 10 occasions at baseline, during the intervention, and at follow-up. Primary hypotheses were tested using a univariate single case multilevel modeling strategy and visual analysis. Following intervention, 2 participants reported improvements on anxiety and depression, while their teachers reported deteriorating scores on these variables. Results from this n-of-1 trial design is consistent with other work suggesting caution with regard to the overall impact and efficacy of mindfulness-based interventions as a universal treatment option for youth. Future research is warranted.

Keywords
mindfulness-based meditation, cognitive-behavioral therapy, abnormal child psychology, clinical psychology, anxiety, depression

In Canada, approximately 10% to 20% of youth are diagnosed with a mental disorder and report significant psychosocial adjustment difficulties at home, in school, and with friends as a result of their mental illness.[1] Only 1 in 5 children in need of mental health services actually access such resources.[1] Poor mental health has been linked to elevated difficulties in school performance and social relations, and represent significant costs for society.[2] The economic costs of mental health has been set at 50 billion dollars in Canada in 2011, representing approximately 2.8% of the gross domestic product.[3] Empirically based psychosocial interventions have been recommended to address mental health issues in youth, especially in school settings, to prevent and reduce economic costs of psychological distress of students.[4] Faced with such an important proportion of students with mental health issues, it appears crucial to develop skill-based interventions adapted to children in regular classroom settings. Mindfulness-based interventions (MBIs), initially developed to improve quality of life in patients suffering from chronic illnesses,[5] are increasingly developing in school settings and constitute a promising option to address mental health issues in elementary school students. The goal of this single case design study was to evaluate the impact of an MBI on anxiety and depression on 3 elementary school students with a diagnosed generalized anxiety disorder,

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an anxiety disorder not otherwise specified with moderate speech pathology, and a major depressive disorder with severe speech pathology.

Background for This Study and Mindfulness-based Intervention

Mindfulness can be defined as the process by which we "[. . . pay] attention in a particular way: on purpose, in the present moment, and nonjudgmentally."[6] MBIs aim to help people bring focus to the present moment and awareness to the different manifestations of stress.[7,8] Overall, in adults, research suggests that MBIs are effective in decreasing anxiety and depressive symptoms, but with moderate effects.[9] Furthermore, MBIs have been proven effective to reduce relapse of major depression in participants with three or more depressive episodes.[10,11]

MBI research in youth suggests promising results in alleviating psychological symptoms related to both anxiety and depression.[12] Moreover, it has been suggested that MBIs may be especially beneficial for children from clinical populations, presenting mental health disorders and higher levels of psychological distress.[13] Results of randomized controlled trials with youth have suggested that MBIs can be useful in decreasing ruminative and intrusive thoughts, depressive and anxious symptoms, stress and aggressiveness, and can increase empathy and optimism while fostering enhanced emotion regulation skills.[14-16] Quasi-experimental studies have shown similar effects of MBIs, namely on conduct problems and opposition in teenagers.[17] In school settings, MBIs have shown a positive impact on cognitive performance and resilience to stress.[18] A recent literature review by Felver and colleagues[19] suggested that MBIs are both feasible and acceptable in school settings, presenting very few implementation barriers and good generalizability of the practices both inside and outside the classroom.

However, despite being arguably the most in need for a psychosocial intervention, few studies have investigated the effect of MBIs for youth with an identified disability, such as mental health and/or learning disability diagnoses. MBIs could be useful for these children, namely by helping them disengage from unpleasant emotions, modifying their behavior due to inadequate processing of emotions and decreasing avoidance through exposure to unpleasant emotions.[20,21] Skills that are taught in MBIs might also benefit many other children in preventing the onset of mental health and stress related symptoms by teaching important emotional regulation skills to all students, ultimately leading to better global functioning, happiness, and well-being.[22-24]

Transdiagnostic Treatments and n-of-1 Trials

In an effort to maximize the effectiveness of different forms of a therapeutic intervention across different psychological conditions, researchers have recently worked on developing transdiagnostic treatments.[25] These treatments combine multiple evidence-based therapeutic components and strategies that have been proven efficacious for different targeted mental health populations (eg, children with depression, anxiety, or attention deficit and hyperactivity disorders) to offer a unified and refined treatment option that can be applied and useful with individuals suffering from differing psychological conditions.[26]

To offer such transdiagnostic treatments, intraindividual processes of change and their relation to different therapeutic strategies must be identified.[25] N-of-1 trials, which allow for the study of intraindividual change over time in one or more individuals, can be useful in guiding researchers to build efficacious transdiagnostic treatments.[27,28] They are especially useful in the early stages of treatment development and research, such as with MBIs for youth in school-based settings.[29] As such, n-of-1 trials—also called single case designs, person-specific, or idiographic approaches—allow a detailed, repeated measures, study of change of specific key variables over time, which offer an insight on temporal causal patterns and functional relationships between variables.[30] "[. . .] This is the primary goal of intensive single-case analysis, which is in itself less concerned with generalizability; rather, single-case studies are primarily concerned with establishing functional relationships that can then be subject to systematic replication."[25] However, results from multiple and similar n-of-1 trials can be aggregated to provide an estimated global effect of a given treatment option for a specific subset of a given population.[29]

In recent years, the use of n-of-1 trials has gained in popularity, namely in medicine, psychology, and educational sciences, in order to provide more precise and personalized treatment options to patients.[29] For example, in the United States, a large multimillion initiative, called the Precision Medicine Initiative, was launched in 2015 in order to produce exhaustive and comprehensive data on adult and pediatric cancer progression and treatments and to favor the use of single case designs.[31] The Patient-Centered Outcomes Research Institute, launched in 2010, also places a strong emphasis on research targeting individual differences and treatment options.[32] As such, n-of-1 trials allow both physicians and psychologists to gain better insight into individual response patterns to a proposed therapy. Furthermore, unlike the usual parallel-group randomized controlled trials (RCTs), n-of-1 trials can be tailored to the condition and treatment in question, as well as the outcomes most relevant to the patient. As a result, it has been suggested that the n-of-1 trial design has the potential to provide the strongest evidence for individual treatment decisions and should therefore occupy the pinnacle of the evidence pyramid.[33]

Thus, contrary to RCTs, the individualized approach of n-of-1 trials can counteract heterogeneity of treatment effects that can be seen in large scale studies.[34]

Present Study

The goal of the present study was to evaluate the transdiagnostic potential of an MBI for children with various diagnoses such as generalized anxiety disorder, anxiety disorder not otherwise specified and major depressive disorder by using a single case design

with 3 elementary school children to document the effectiveness of the intervention over a 3-month follow-up period. Ten assessment time points were used in this project (3 preintervention, 4 during the intervention, and 3 postintervention). Both student and teacher report forms were collected in this project.

Primary Hypotheses

We hypothesized that our MBI would have a significant effect on decreasing anxiety and depression symptoms in these children. Specifically, we hypothesized that anxiety and depression symptoms would be lower at the end of the intervention phase when compared with the baseline phase. Improvements would be maintained at follow-up.

Methods

An experimental A-B-A n-of-1 trial series design was used. This design was chosen as a methodologically sound, experimental alternative to studies with larger sample sizes, in order to help measure the amplitude of change for each participant by means of regularly scheduled assessments throughout the intervention.[35] Furthermore, this n-of-1 trial was particularly appropriate since a small pool of children with a diagnosis of anxiety and depression disorders within a regular school context were available,[36-38] and since a control condition was unavailable at the time of conducting this project.[39] N-of-1 trials designs provide a rigorous means to evaluate the impact of a psychological treatment, while narrowing the gap between research and clinical practice.[38] Additionally, n-of-1 trials can be especially useful in evaluating the impact of complementary and alternative therapies, such as MBIs in youth.[38] This study design and report was developed in accordance with the CONSORT (Consolidated Standards of Reporting Trials) guidelines for n-of-1 trials.[38] This study was conducted in collaboration with a school board and an elementary school from Montreal, Canada. Ethics approval was obtained from all institutions involved. Informed consent was obtained from all individual participants and their parents.

Participants

Three elementary school students aged 9 to 10 years from grades 3 and 4 attending regular classrooms participated in this study, along with their 3 teachers. Participants from this study attended an elementary school in the underprivileged neighborhood of Montreal-North, in Montreal, Canada. All participants fulfilled the following criteria: They had previously received a psychological diagnosis for a mental health disorder based on diagnostic criteria from the *Diagnostic and Statistical Manual of Mental Disorders*, Fifth Edition (*DSM-5*),[40] were experiencing persistent psychosocial adjustment difficulties in school, and were assessed by a psychologist to confirm the presence of a psychological diagnosis. None of the participants were taking any form of medication to treat psychological symptoms at the time of this study. For the purposes of this study, participants had to be willing to participate in an 8-week MBI and be available to answer questionnaires during all phases of the study. It was also necessary that all teachers were available to fill out questionnaires at the same time as their student for all assessment periods. Teachers were not involved in the group meetings. As this project was conducted in French, participants were required to speak and understand the language. No attrition was experienced in this study; all students and their respective teacher

Table 1. Participant Characteristics.

| Characteristic | Student | | |
	Anna	Bob	Mike
Age, years	10	9	9
Grade	4	3	3
Ethnicity	Caucasian	Haitian	Hispanic
Primary language	French	French, Creole	Spanish
Diagnosis	Generalized anxiety disorder	Anxiety disorder not otherwise specified	Major depressive disorder
Comorbidities	—	Moderate speech pathology[a]	Severe speech pathology[a]
Attendance (during mindfulness-based intervention)	No absences	No absences	1 absence

[a]Diagnosed by a certified speech therapist.

filled out pre- and postintervention questionnaires. Participants were referred by the school psychology service to take part in this study. Participant characteristics can be found in Table 1. Participant names were changed to protect their confidentiality.

Anna (Generalized Anxiety Disorder)

Anna was a fourth-grade, 10-year old elementary school student. She was of Canadian descent and her mother tongue was French. She was born in Canada and had always been educated in French. Anna had received a psychological diagnosis of generalized anxiety disorder, and was experiencing persistent psychosocial adjustment difficulties in school. Specifically, absenteeism was a major problem for Anna. At preintervention, on average, she would attend school 2 days per week, out of 5. As a consequence of her absences, she was missing crucial notions that were taught by her teacher and actively avoiding examinations. Additionally, Anna also had frequent verbalizations of anxiety pertaining to the fear of her mother becoming ill or injured. She also feared becoming ill herself. She was in frequent conflicts with her classmates and had only a few friends.

Bob (Anxiety Disorder Not Otherwise Specified and Moderate Speech Pathology)

Bob was a third-grade, 9-year old elementary school student. He was of Haitian descent and his mother tongues were Creole and French. He was born in Canada and had always been educated in French. Bob had received a psychological diagnosis of anxiety disorder not otherwise specified and was experiencing persistent psychosocial adjustment difficulties in school. Specifically, Bob displayed multiple signs of rigid behavior in school. For instance, he refused to eat at school with his classmates. Bob had recently undergone multiple medical examinations, in order to eliminate any gastrointestinal reasons explaining his fear of eating. As a result of these examinations, Bob's rigidity had increased and he had recently developed a fear of becoming ill, of the doctor, and of the dentist. When one of his classmates was sick, Bob insisted to go back home or to move his desk away from this person. Bob also had a diagnosis of moderate speech pathology, which had been diagnosed by a certified speech language pathologist.

Mike (Major Depressive Disorder and Severe Speech Pathology)

Mike was a third-grade, 9-year old elementary school student. He was of Hispanic descent and his mother tongue was Spanish, although he was fluent in French. He was an immigrant and had arrived in Canada with his mother when he was a toddler. He has always been educated in French. Mike had received a psychological diagnosis of major depressive disorder, and was experiencing persistent psychosocial adjustment difficulties in school. He also had a diagnosis of severe speech pathology, which had been diagnosed by a certified speech therapist. Specifically, his teacher reported that he cried frequently in class and withdrew from his classmates. He was often sad and tired during the day. He would get easily discouraged when he had to complete a difficult task and would often fail to complete the given assignments. This was a cause for alarm from the school personnel, as Mike had always been known as a very resilient and perseverant student, in spite of his severe speech pathology. At the time of referral, Mike was in danger of repeating his school year because of his overall grades.

Mindfulness-based Intervention for This Study

This intervention was adapted from previous work done by the first author with children and adolescents.[41,42] Specifically, this intervention was inspired by Mindfulness-based cognitive therapy protocols developed by a team at the Centre de consultation psychologique specialisé of the Université Catholique de Louvain (Center for specialized psychological consultation, Catholic University of Leuven, Belgium).[43] The intervention manual was reviewed and approved by clinical psychology faculty members with expertise of mindfulness. The first author of this article, a trained therapist in MBI with previous experience with groups in pediatric oncology and school psychology, led the intervention. The MBI lasted 8 weeks. The group met once a week for 60 minutes. The duration of each session was adapted to (1) fit one daily classroom period, hence facilitating the implantation of this project and (2) offer a developmentally appropriate intervention specifically targeted to match elementary school students' shorter attention span. Weekly sessions included introduction to mindful eating, body scan, and breathing meditations, along with the observation of thoughts, physical sensations, and emotions. Homework was assigned every week, and home practice was required at least once a week. Guided meditations were recorded and a copy was given to participants for home practice. Group discussions regarding homework and home practice completion were held at the beginning of each session to monitor treatment adherence. The intervention did not include a silent retreat. Students were not close friends and did not interact outside sessions. A detailed session-by-session summary of the MBI intervention can be found in Table 2.

Measures

For the purposes of this study, a validated French version of each scale was selected. Given the repeated-measures component of this study, specific items of the following scales were chosen, in order to ensure that questionnaires could be filled out in a reasonable amount of time (approximately 5-10 minutes) by both students and teachers. A total of 8 items were administered to students and 10 items were administered to teachers.

Table 2. Mindfulness-based Intervention Session Content.

Session	Content
1	Overview of class rules and participant presentations. Expectations with regard to the intervention. Introduction to mindful eating.
2	Body scan meditation. Introduction to components of emotions (thoughts, physical sensations, behavior) and stress
3	Breathing meditation. Introduction to sitting meditation. Mindful movements through yoga-like poses.
4	Breathing meditation. Introduction to concepts of acceptance of emotions.
5	Mindful check-in exercises. Mindfulness through the senses.
6	Breathing meditation with a special focus on thoughts and judgments. Group discussion on thoughts and judgments.
7	Walking meditation. Group discussion on self-care and acceptance.
8	Short sitting meditation. Feedback regarding intervention. Distribution of a pebble stone as a reminder of the experience.

Symptom Measures

Behavior Assessment System for Children, Second Edition (BASC-II). This measure was used to evaluate internalizing symptoms in students. Items from the Teacher Report Form and the Self-Report form were used for this project. This measure presents good interrater agreement ($r = 0.53$-0.74) and test-retest reliability ($r = 0.7$-0.8), along with high internal consistency ($\alpha = 0.8$-0.9) and clinical validity.[44] Construct validity for the Teacher Report Form is also good ($\alpha = 0.7$-0.8) when the BASC-II is compared with similar behavioral assessment scales such as the Child Behavior Check List[45] and the Conners Scale–Revised.[46] The anxiety (self-report; 3 items, eg, "I worry about little things"; and teacher report; 3 items, eg, "Worries about things that cannot be changed"), and depression (self-report; 5 items, eg, "Nothing ever goes right for me"; and teacher report; 5 items, eg, "Seems lonely") subscales of the BASC-II were used in this project.

Change Measure

Five-Facet Mindfulness Questionnaire. This measure was used to evaluate perceived mindfulness in students.[47] It was used to assess the extent to which students become more mindful as they are exposed to the intervention. The measure presents good internal consistency ($\alpha = 0.72$-0.92). A total of 6 items from this scale were used in this project, taken from the following 3 subscales (2 items per subscale): Observe (eg, "When I take a shower or bath, I stay alert to the sensations of water on my body "), Act with Awareness (eg, "I do jobs or tasks automatically without being aware of what I'm doing") and Nonreact (eg, "I perceive my feelings and emotions without having to react to them"). Items from these subscales were selected because they were closest to critical mindfulness concepts that were taught in this MBI.

Assessment Time Points

A total of 10 assessment time points were included in this project. Three baseline assessments were completed during phase A (1 assessment per week), 4 assessments were completed during the active treatment phase B (1 assessment every 2 weeks in order to allow participants to acquire

Table 3. Results of Empirical Estimations of the Case-Specific Effects Using the Basic 3-Level Model for Anxiety.

	Time Point	Parameter	Parameter Estimate	Standard Error	P^a
Case 1					
Self-report	Baseline	β_0	4.33	1.61	.22
	Treatment	β_1	2.31	1.62	.21
	Follow-up	β_2	0.98	2.03	.66
Teacher report	Baseline	β_0	3.76	0.84	.20
	Treatment	β_1	1.15	1.07	.44
	Follow-up	β_2	0.87	1.19	.61
Case 2					
Self-report	Baseline	β_0	1.74	1.16	.73
	Treatment	β_1	−0.91	0.69	.23
	Follow-up	β_2	−0.88	0.94	.39
Teacher report	Baseline	β_0	5.24	1.91	80
	Treatment	β_1	−0.98	0.65	.17
	Follow-up	β_2	−2.94	0.90	**.01**
Case 3					
Self-report	Baseline	β_0	5.60	1.15	.09
	Treatment	β_1	−1.06	1.40	.51
	Follow-up	β_2	1.05	1.60	.59
Teacher report	Baseline	β_0	1.73	0.18	**.00**
	Treatment	β_1	1.51	0.27	**.02**
	Follow-up	β_2	3.24	0.26	**.00**

^{a}Values in boldface indicate statistical significance ($P < .05$).

Table 4. Results of Empirical Estimations of the Case-Specific Effects Using the Basic 3-Level Model for Depression.

	Time Point	Parameter	Parameter Estimate	Standard Error	P^a
Case 1					
Self-report	Baseline	β_0	−0.99	117.8	.99
	Treatment	β_1	4.99	1.19	.16
	Follow-up	β_2	4.99	1.68	.22
Teacher report	Baseline	β_0	3.98	0.19	**.00**
	Treatment	β_1	1.27	0.26	**.02**
	Follow-up	β_2	0.38	0.28	.28
Case 2					
Self-report	Baseline	β_0	2.71	0.46	**.01**
	Treatment	β_1	−1.15	0.62	.17
	Follow-up	β_2	−1.79	0.75	.10
Teacher report	Baseline	β_0	2.00	0.13	**.00**
	Treatment	β_1	−0.06	0.18	.73
	Follow-up	β_2	−0.13	0.19	.50
Case 3					
Self-report	Baseline	β_0	3.25	1.74	.37
	Treatment	β_1	0.04	1.74	.98
	Follow-up	β_2	0.76	2.19	.75
Teacher report	Baseline	β_0	5.49	77.8	.99
	Treatment	β_1	1.99	2.61	.65
	Follow-up	β_2	3.99	3.69	.56

^{a}Values in boldface indicate statistical significance ($P < .05$).

Table 5. Results of Empirical Estimations of the Case-Specific Effects Using the Basic 3-Level Model for Mindfulness.

	Time Point	Parameter	Parameter Estimate	Standard Error	P^a
Case 1					
Self-report	Baseline	β_0	11.61	0.29	**.00**
	Treatment	β_1	0.31	0.39	.49
	Follow-up	β_2	0.90	0.41	.13
Case 2					
Self-report	Baseline	β_0	15.25	0.65	**.00**
	Treatment	β_1	−1.94	0.87	.10
	Follow-up	β_2	−6.76	1.08	**.01**
Case 3					
Self-report	Baseline	β_0	7.75	5.19	.79
	Treatment	β_1	3.83	2.22	.13
	Follow-up	β_2	0.73	3.07	.82

^{a}Values in boldface indicate statistical significance ($P < .05$).

and practice new skills), and 3 assessments were taken during the follow-up phase A (1 assessment per month). Students and teachers filled out all measures at all assessment time points.

Data Analysis

Methods of assessment in n-of-1 trials have been the subject of ongoing debates in the past years.[48] However, although debates regarding the appropriateness and accuracy of different methods persist, recent developments in this field of research have suggested that the use of statistical analyses, when combined with visual analysis, can be useful in analyzing results of n-of-1 trials.[49,50] Multilevel modeling strategies, when used in single case design research, can provide evidence of treatment effects, namely by providing information related to observed changes at the beginning of a new phase and to differences in slopes of symptom ratings from one phase to another.[51-53] Furthermore, multilevel modeling approaches have been validated with small sample sizes (eg, N = 4-8).[54,55]

In this study, primary hypotheses were tested using a single case multilevel modeling strategy enabling the testing of comparisons between A-B-A phases, and their statistical significance. These analyses are based on a modeling strategy suggested by Moeyaert and colleagues.[56] In our model, b_0, b_1, and b_2 represent the estimated baseline level, the treatment effect and follow-up effect for each subject. Autocorrelation was considered through AR1. Fixed effect coefficients and their P values are presented in Tables 3, 4, and 5. P values were considered according to the $P = .05$ threshold.

In their article, Moeyaert and colleagues[56] present a modeling strategy for analyzing n-of-1 trial data, with the same sample size

as in this study (N = 3).[56] In this article, the authors report having sufficient statistical power to detect pre-to-post intervention effects in their sample, and conclude that a sample of 3 is sufficient to ensure adequate statistical power. Further work by the same group of authors has also stipulated that adequate statistical power is reached in small sample sizes that are characteristic of n-of-1 trials, specifically when their modeling strategy is employed to analyze the data.[57]
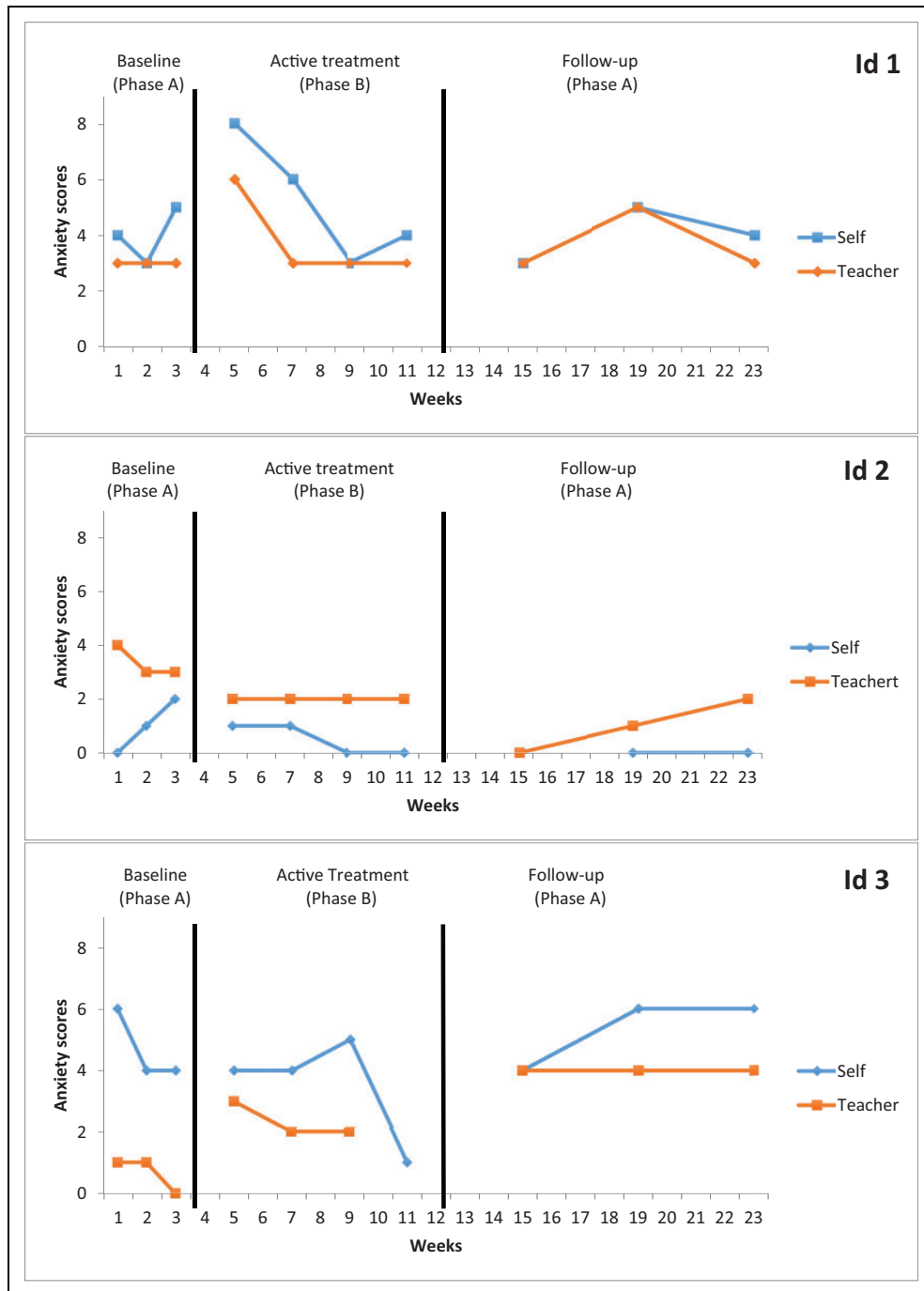
Figure 1. Graphical display of baseline level and changes in level between consecutive phases in anxiety.

Visual Analysis of the Data

Visual analysis of our data for all participants was also completed. One of the strengths of visual analysis is that it is very conservative in the evaluation of change across phases.[58] Stable or deteriorating levels of the problematic target behavior needs to be established before the onset of an intervention phase. In addition, only robust changes in the direction of treatment at or near the point of treatment can be interpreted as a basic effect. Finally, an experimental effect is based on the observation of 3 basic effects at 3 different phases within 1 single case experimental design for each dependent variable.[58]

Results

Anxiety Symptoms

Graphic presentation of the anxiety symptoms results for all participants can be found in Figure 1.

Participant 1: Anna (Generalized Anxiety Disorder). Visual analysis of the data for Anna indicates low levels of anxiety symptoms from self-reported questionnaires and moderate levels of

anxiety symptoms from teacher-reported questionnaires. Visual analysis of self-reported data suggests that the beginning of treatment caused a small increase in anxiety for Anna. However, once the treatment started, levels of anxiety returned to low levels and remained stable during follow-up. Visual analysis of teacher-reported data suggests that treatment was somewhat helpful in decreasing anxiety symptoms in Anna—which remained stable during the treatment phase. However, at follow-up, an increasing trend can be observed, suggesting the short-term impact of treatment.

The results of the weekly assessments showed no significant phase differences in scores or rates of change between the baseline, the active treatment phase and the follow-up phase for anxiety symptoms in both self-report and teacher report questionnaires (please refer to Table 3).

Participant 2: Bob (Anxiety Disorder Not Otherwise Specified). Visual analysis of the data for Bob indicates moderate to high levels of anxiety symptoms from self-reported and teacher-reported questionnaires. Visual analysis of self-reported data suggests that the beginning of treatment caused a clinically significant increase in anxiety for Bob. However, a trend can be observed during the treatment phase, where Bob's anxiety scores slowly return to baseline levels, and remain stable during follow-up. Visual analysis of teacher-reported data suggests a similar pattern than is observed in self-reported data for Bob.

Statistical analyses show significant phase differences in scores between the treatment and follow-up phases for anxiety in teacher report questionnaires, $\beta_2 = -2.94$, $t(6.47) = -3.24$, $P = .01$, indicating higher anxiety scores at the end of the follow-up period, when compared with the treatment phase (see Table 3).

Participant 3: Mike (Major Depressive Disorder). Visual analysis of the data for Mike indicates moderate to high levels of anxiety symptoms from self-reported questionnaires at baseline. Visual analysis of self-reported data suggests an important drop in anxiety symptoms during treatment. However, at follow-up, a return to baseline levels can be observed, suggesting the short-term impact of treatment. Visual analysis of the data for teacher-reported questionnaires does not concur with self-reported data for Mike. At baseline, visual analysis of the data suggests that the teacher did not observe anxiety symptoms in Mike, and that the anxiety mean level increased steadily during the treatment and follow-up phases.

The results of the weekly assessments showed significant phase differences in scores between the baseline, treatment, $\beta_1 = 1.51$, $t(2.39) = 5.56$, $P = .02$, and follow-up, $\beta_2 = -2.94$, $t(2.26) = 12.2$, $P = .001$, phases for anxiety in teacher report measures, indicating higher anxiety scores at the end of the follow-up when compared with the treatment phase and higher scores at the end of the treatment phase when compared to the baseline phase (see Table 3).

Depression Symptoms

Graphic presentation of the depression symptoms results for all participants can be found in Figure 2.

Participant 1: Anna (Generalized Anxiety Disorder). Visual analysis of the data for Anna indicates low levels of depression symptoms from self-reported and teacher-reported questionnaires. Visual analysis of self-reported data suggests that the beginning of treatment caused a small increase in depressive symptoms—just as it did for her anxiety levels—for Anna. However, once the treatment started, levels of depressive symptoms returned to low levels and remained stable at follow-up. Visual analysis of teacher-reported data indicates a somewhat stable condition throughout all phases.

Statistical analyses concur with the visual analysis for Anna. The results of the weekly assessments showed no significant phase differences in scores or rates of change between the baseline, the active treatment phase and the follow-up phase for depression symptoms in both self-report and teacher report questionnaires (please refer to Table 4). Additionally, results show significant mean differences in depression scores from baseline to treatment in teacher report questionnaires, $\beta_1 = 1.27$, $t(2.66) = 4.76$, $P = .02$, with an increase in depressive symptoms during the treatment phase.

Participant 2: Bob (Anxiety Disorder Not Otherwise Specified). Visual analyses of the data for Bob indicates low levels of depression symptoms from self-reported and teacher-reported questionnaires, and indicates a somewhat stable condition throughout all phases. However, high variability during baseline makes it difficult to confirm what appears to be a robust effect during active treatment and follow-up phases.

The results of the weekly assessments showed no significant phase differences in scores or rates of change between the baseline, the active treatment phase, and the follow-up phase for depression symptoms in both self-report and teacher report questionnaires (see Table 4).

Participant 3: Mike (Major Depressive Disorder). Visual analyses of the data for Mike indicates low levels of depression symptoms from self-reported questionnaires. Visual analysis of self-reported data suggests a drop in depression symptoms during treatment. However, the impact of the treatment seems to be short term, as depression scores exceeded baseline levels at follow-up. Visual analysis of the data for teacher-reported questionnaires does not concur with self-reported data for Mike. At baseline, visual analysis of the data suggests high levels of depressive symptoms, with a clinically significant and stable decrease during treatment. At follow-up, depression scores for Mike remained stable, which suggests a somewhat lasting effect of the intervention.

Statistical analyses show no significant phase differences in scores or rates of change between the baseline, the active treatment phase and the follow-up phase for depression symptoms in both self-report and teacher report questionnaires (see Table 4).
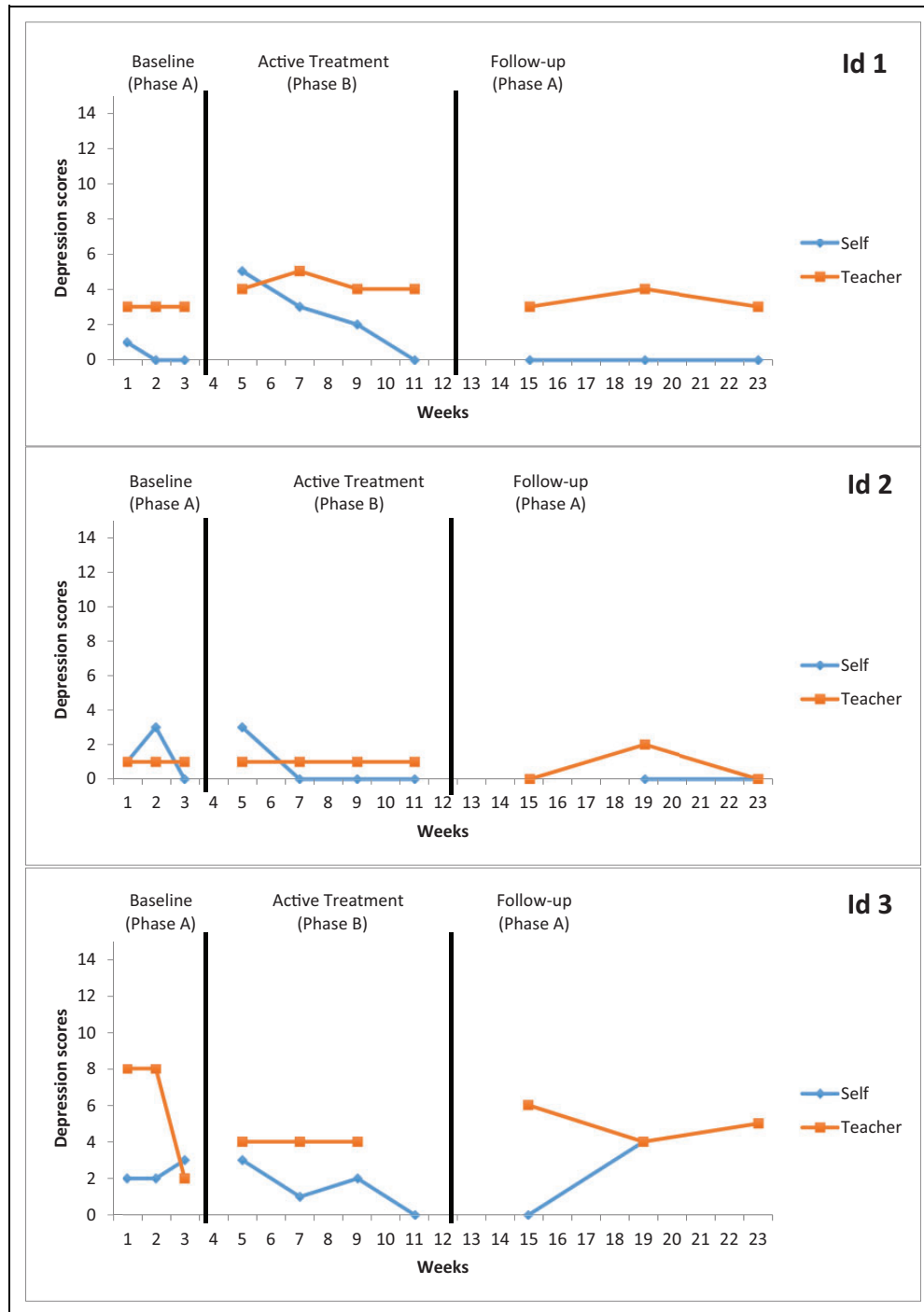
Figure 2. Graphical display of baseline level and changes in level between consecutive phases in depression.

Mindfulness Scores

Graphic presentation of the mindfulness scores results for all participants can be found in Figure 3.

Participant 1: Anna (Generalized Anxiety Disorder). Visual analysis of the data for Anna indicates high and somewhat stable levels of mindfulness scores from the self-reported questionnaire. Visual analysis of self-reported data suggests that the

beginning of treatment caused a small increase in mindfulness for Anna. Levels of mindfulness scores were stable once the treatment started and remained this way during follow-up.

Statistical analyses concur with the visual analysis for Anna. The results of the weekly assessments showed no significant phase differences in scores or rates of change between the baseline, the active treatment phase, and the follow-up phase for mindfulness scores in the self-reported questionnaire (please refer to Table 5).
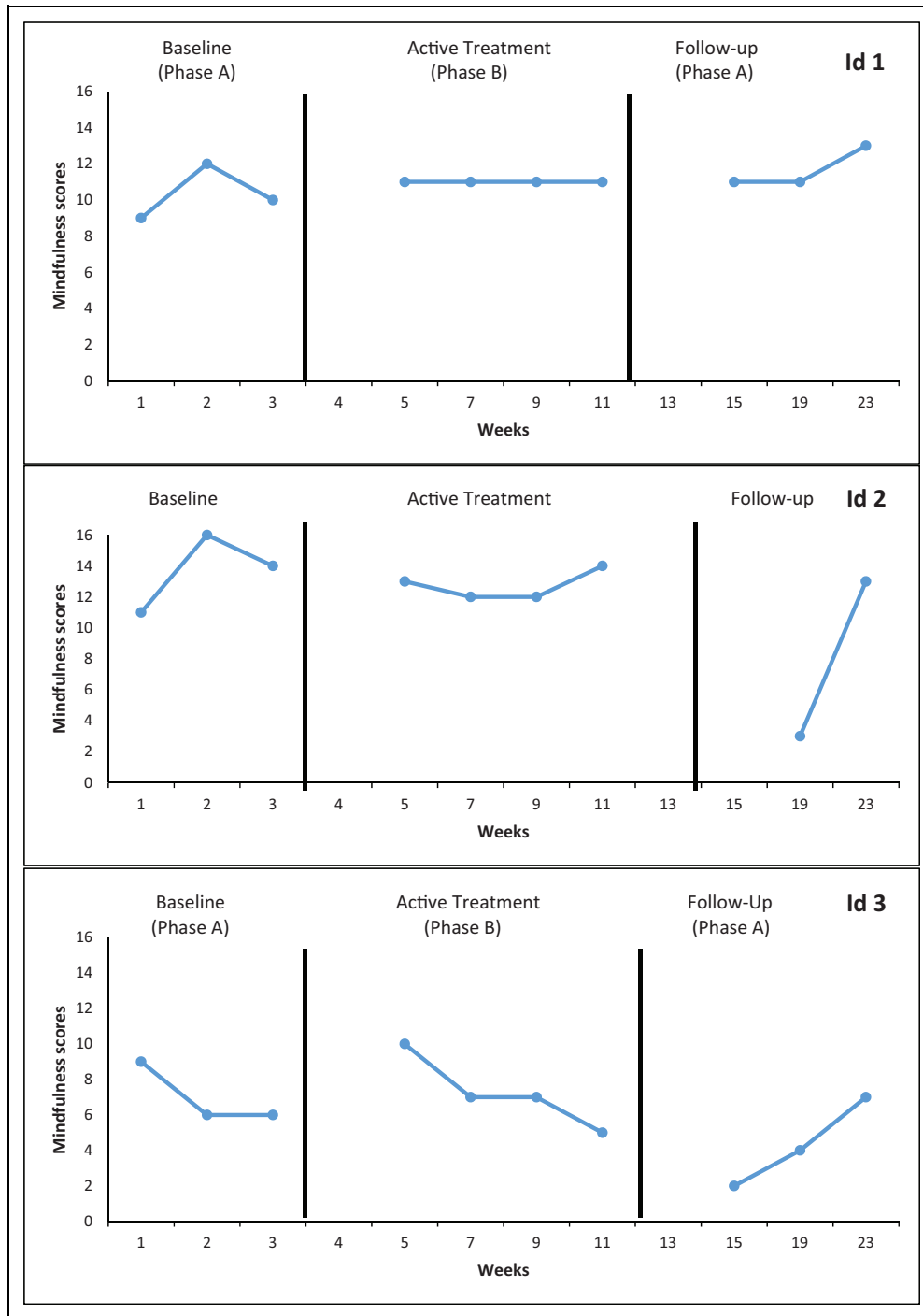
Figure 3. Graphical display of baseline level and changes in level between consecutive phases in mindfulness.

Participant 2: Bob (Anxiety Disorder Not Otherwise Specified). Visual analysis of the data for Bob indicates moderately high levels of mindfulness during baseline and active treatment, but a precipitous drop during follow-up, which then rises by the last data point to the same level as the previous active treatment phase.

Statistical analyses show significant phase differences in scores between the treatment and follow-up phases

mindfulness scores, $\beta_2 = -6.76$, $t(3.46) = -6.28$, $P = .01$, indicating lower mindfulness scores at the end of the follow-up period, when compared with the treatment phase (see Table 5).

Participant 3: Mike (Major Depressive Disorder). Visual analysis of the data for Mike indicates moderate levels of mindfulness from the self-reported questionnaire at baseline. Visual analysis of self-reported data suggests a similar pattern in the data

during the active treatment phase, with a drop in mindfulness scores. However, at follow-up, scores rise by the last data point to return to baseline levels.

The results of the weekly assessments showed no significant phase differences in scores between the baseline, active treatment, and follow-up phases for mindfulness scores (see Table 5).

Sensitivity Analyses

Item analysis was conducted on mindfulness scores. Although these were largely not significantly different pre-to-post treatment at the scale level, item analysis for the Five-Facet Mindfulness Questionnaire indicated that the most sensitive items to the intervention were those linked to observing (eg, "I pay attention to how my emotions affect my thoughts and behaviors"; "When I take a shower or bath, I stay alert to the sensations of water on my body") and acting with awareness (eg, "I do jobs or tasks automatically without being aware of what I'm doing"), which indicates that mindfulness could possibly explain, at least partially, the improvements observed in our participants.

Discussion

This article presents results from an MBI study for third and fourth grade elementary school students with diagnoses of generalized anxiety disorder, anxiety disorder not otherwise specified with a moderate speech pathology, and major depressive disorder with severe speech pathology in the context of regular classroom settings. Contrary to our initial hypothesis, our results do not clearly indicate that the MBI had a clinically significant impact on anxiety and depression symptoms in these children. Results from visual analyses of the anxiety and depression data, which require robust changes across phases to argue for an effect, along with results from statistical analyses, yield a conservative interpretation of results. For example, for Mike, although a change was observed from baseline to active treatment for anxiety and depression, regression back to baseline levels occurred for anxiety and regression above baseline levels occurred for depression. This does not suggest that a meaningful, durable basic effect was achieved. Thus, these results indicate that MBIs may have a short-term impact on elementary school students with internalized disorders such as anxiety and major depressive disorders, although caution is warranted in drawing conclusions for children with generalized anxiety disorder.

No statistically significant differences on any variables were found in self and teacher reports for Anna, which may indicate that the MBI was not useful in alleviating anxiety symptoms of the amplitude that can be found in generalized anxiety disorders. Furthermore, it is possible that pervasive anxiety disorders in youth, such as generalized anxiety disorder, may require a longer, more intensive psychological treatment to see significant improvements in patient functioning. The potential combination of anxiolytic medication with psychological treatment may also be required in these cases. However, in spite of the absence of significant results in self- and teacher-reported data, it should be noted that, over the course of the MBI sessions, Anna developed notable introspection skills, allowing her to identify more easily how she felt her anxiety (eg, in her body, what thoughts and emotions would typically accompany these feelings) and which situations tended to make her more anxious. This highlights namely the importance of including a psychoeducation component in school-based programs for children who deal with anxiety.[59] However, in spite of these improvements, Anna's anxiety levels remained high at postintervention.

Based on teacher report measures, significant differences were found in anxiety symptoms for Bob, in which his teacher reported significant deterioration at follow-up. Thus, effects on anxiety that were noted in the visual analysis of self-reported data seemed to be short term, as an increase in symptoms was found at follow-up in teacher report questionnaires. As such, short-term improvements noted in anxiety for Bob might suggest that small daily mindfulness exercises would need to be used for a longer period on a consistent basis in order to preserve this effect. The value and long-term impact of adding maintenance therapy to future research projects of this sort would be interesting to evaluate. However, caution is warranted in interpreting these results given the discrepancy between self-report and teacher report scores.

Bob's progression throughout the MBI intervention was somewhat slower than that of his colleagues, as he was most resistant to sharing his experiences and to completing weekly assignments. During the first sessions, he would become agitated when he was asked to talk openly about his fear of eating in front of others or his fear of becoming ill. However, a sudden change was noted after the fourth week of the intervention, when Bob completed assignments and became very interested in applying mindfulness to reduce his stress and overall anxiety. From that moment on, he stopped insisting to get out of the classroom when a classmate was sick and his overall avoidance of anxious situations decreased. However, his fear of eating remained until the end of the follow-up period.

Based on teacher report measures, significant differences were found for anxiety for Mike, although these differences indicated a worsening of scores throughout the intervention and at follow-up. Visual analysis showed marked improvements in depressive symptoms for Mike pre- to postintervention. This could be explained by a certain insensitivity of statistical analyses in n-of-1 trials, which mathematically take into account the slope of changes in rate without consideration of the direction of change. While a visual analysis reveals a clear change in the direction of treatment from baseline to intervention, our statistical analyses were unable to detect this due to the limitations of the mathematical functions used to assess differences in levels and trends across phases. Thus, although caution is warranted in concluding on the effect of this MBI on depression, it is possible that it somewhat helped Mike better manage his depressive symptoms. However, our MBI seemed to have the opposite effect on anxiety symptoms for Mike.

At the beginning of the intervention, an absence of pleasure was evident in Mike. He would seldom smile and have an

apathetic expression on his face. Enumerating pleasant activities was especially difficult for him. However, he could easily identify and describe moments when he felt sad and depressed, along with their corresponding emotions, physical sensations, and thoughts. Mike's involvement in the MBI was significant from the beginning of the sessions, as he showed a marked desire to improve his condition. He would systematically practice meditations between sessions and complete given assignments. In class, his teacher quickly reported improvements in terms of his mood. Mike also began to confide to his teacher when he had challenging days. His withdrawal from his peers also decreased significantly.

From a transdiagnostic standpoint, based on results from this single case design, we cannot conclude on the usefulness of MBIs for children with internalized disorders of varying intensity. Although some improvements were noted in anxiety (Bob) and depression (Mike) from the student's point of view, their teachers tended to report iatrogenic effects of the intervention for anxiety symptoms (Mike) and depression symptoms (Anna). It is possible that students themselves noted improvements on internalized symptoms that did not impact overall school functioning and were hence not observed by their teachers. It may also be possible that teachers are less able to discern internalized symptoms in their students, since these are usually less observable and tend not to disrupt classroom dynamics as much as externalized symptoms.[42] Another possibility is that the mindfulness training made children more sensitive to cues relating to their emotions, and allowed them to be more aware of the moments where they were not mindful, which may explain why certain participants reported an increase in mindfulness, followed by a decrease back to baseline levels. Children themselves might be the best judges of their anxiety and depression symptoms. It may also be that MBIs need to be adapted specifically to each disorder—and to the individual themselves—in order to address specificities of severe anxiety disorders and major depressive disorders along with individual differences separately.

Finally, the presence of varying degrees of speech pathologies in Bob and Mike, which are linked to learning disabilities in elementary school children, sheds light on the possible impact of MBIs on children with comorbid internalized disorders and learning disabilities. Children with learning disabilities often present with demoralization, and approximately 10% to 25% of these children present comorbid diagnoses such as anxious or major depressive disorder.[60] Results from this study suggest that MBIs may be especially useful for elementary school children with comorbid internalized disorders and learning disabilities. Previous MBI research with children with learning disabilities and special education needs and with teenagers with learning disabilities has shown similar results.[42,61]

Strengths

This study includes notable strengths. The multiple single case design that was chosen for this study enabled detailed investigation of intraindividual change of children with different diagnoses, thus providing insight into the transdiagnostic treatment literature of MBIs for children. The use of this approach has enabled us to document the process of change in our participants, which in turn provides valuable information to researchers interested in developing and testing MBIs for elementary school students with anxiety and depression disorders. No attrition was experienced in this study, solidifying our results.

Limitations

The A-B-A design used in this study presents some minor risks with regard to internal validity.[58] Threats to internal validity are time-related factors such as history and testing effects. As the intervention was conducted during the winter, spring break vacation might have caused variations in mood in our participants. The follow-up period took place during the months of April, May, and June, near the end of the school year, which may also have affected our results. Report cards were handed near the end of the treatment phase, which could have caused a spike in anxiety in some participants. Furthermore, it is possible that both self and teacher report forms may somewhat overstate the change taking place pre-to-post intervention and at follow-up, as students and teachers were potentially hoping for positive changes postintervention. Having a control group and blinded reporters to the intervention could improve the research design. Finally, although participants from this study were not close friends and did not have much contact outside of the MBI sessions, we cannot be sure that there was no contamination between participants, although it is highly unlikely. In future studies, a multiple baseline approach could solve some of these minor issues.

Suggestions for Further Research

Variables such as absenteeism and grades could be incorporated in future projects of this sort. For Anna, although absenteeism from school was not included as a measure in this study, it should be noted that despite the absence of statistical significant pre-to-post differences in targeted variables, her absenteeism from school dramatically dropped once the MBI got underway and remained stable throughout the follow-up period, which seems indicative of a certain improvement in stress and anxiety managing skills, and in her overall school functioning. For Mike, although school performance was not included as a measure of this study, it should be noted that his overall grades improved significantly pre-to-post treatment, to a point where he was in danger of repeating his school year pretreatment and had average grades at posttreatment and follow-up.

Future n-of-1 trials would also benefit from the inclusion of observational measures, in order to evaluate functionality (eg, at school or at home) instead or on top of symptomatology measures such as those included in this study. Given the fact that internalized disorders can manifest both in school and at home, it is important to acknowledge caregivers as a possible

source of behavior change. Including caregiver reports may help account for some self-report and teacher bias, and should be included in future studies of this sort. Parent reports would also help in providing a more complete assessment of participants' mental health and change pre-to-post intervention. Parental implication in terms of favoring daily practice and homework completion would also be important to consider in future projects. The use of web- or mobile-based mindfulness applications, which could be helpful in sending daily reminders of practice to youth, also represents an interesting avenue for future research. Finally, including other measures, such as physiological measures or salivary cortisol, behavioral observation measures or attention tests, would also improve the description of potential causal mechanisms.

Additional assessment time points in each phase would strengthen the overall design and allow more robust conclusions to be drawn. Although a minimum of 3 assessment time points are necessary to conduct n-of-1 trials, a targeted number of 5 per phase has been previously recommended.[48] If larger pools of potential participants are available, the use of randomized controlled trials with a single case approach is recommended in future studies, in order to draw more robust conclusions regarding the effectiveness of MBIs for children with internalized disorders.[25] With larger samples, sensitivity analyses could be performed (eg, analyses on different cutoffs or definitions, noncompliance to treatment or protocol violations).[62] A larger scale study would also enable one to determine whether there are specific components of anxiety and depression disorders that might be more or less affected by the MBI and whether this treatment might work better for some profiles or comorbidities.

Finally, results from this n-of-1 trial design is consistent with other work suggesting caution with regard to the overall impact and efficacy of MBIs as a universal treatment option for youth. Past studies have shown that MBIs are not universally efficacious for children and teenagers, and that caution is warranted before applying this treatment option for all, regardless of their psychological health and/or the presence of a mental health disorder. As an example, a meta-analysis by Zoogman and colleagues[12] suggests that, although MBIs have a greater impact in youth who have a mental health disorder and affect psychological variables more than physical ones, they may have a limited impact when compared with alternative treatment options, such as cognitive-behavioral therapy. Other studies have found no significant impact of MBIs on psychological symptoms and mental health in elementary and high school students.[63,64] However, some of these studies were underpowered, which can greatly affect their results. Thus, future studies would do well to pursue the documentation of the impact of MBIs in different contexts (eg, as a universal prevention intervention in regular classrooms of children varying in ages and grades, a transdiagnostic clinical intervention for children with mental health disorders, a clinical intervention for children with a specific mental health disorder, such as an anxiety disorder, attention deficit/hyperactivity disorder, or major depressive disorder), to specifically pinpoint when they can be most useful as a stress and emotional regulation tool for youth. Finally, adopting robust research designs, such as multiple baseline n-of-1 trials embedded within a randomized controlled trial, could also contribute to clarifying the optimal conditions for MBI implementation in youth.

Conclusion

Results from this study do not allow us to conclude whether MBIs can be helpful in decreasing psychosocial adjustment difficulties in elementary school students with anxiety and depression disorders. Further research evaluating the impact of maintenance therapy and parental implication via caregiver reports and more objective measures is warranted to establish the effect of MBIs for these children in a more robust manner.

Author Contributions

CM-H conceptualized and coordinated the study, taught and adapted the mindfulness-based intervention, performed data analysis, and drafted the manuscript. EL contributed to the design of the study, revised the protocol, participated in data analysis, and reviewed extensively the manuscript. CH contributed to data interpretation and revision of the manuscript. GT contributed to data interpretation and revision of the manuscript. LBA contributed to data interpretation and revision of the manuscript.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical Approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study.

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