



Stress and Well-Being: A Systematic Case Study of Adolescents' Experiences in a Mindfulness-Based Program

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Abstract

Research on mindfulness-based programs (MBPs) for adolescents suggests improvements in stress, emotion regulation, and ability to perform some cognitive tasks. However, there is little research examining the contextual factors impacting why specific students experience particular changes and the process by which these changes occur. Responding to the NIH call for “n-of-1 studies” that examine how individuals respond to interventions, we conducted a systematic case study, following an intervention trial (Learning to BREATHE), to investigate how individual students experienced an MBP. Specifically, we examined how students' participation impacted their perceived stress and well-being and why students chose to implement practices in their daily lives. Students in health classes at two diverse high schools completed quantitative self-report measures (pre-, post-, follow-up), qualitative interviews, and open-ended survey questions. We analyzed self-report data to examine whether and to what extent student performance on measures of psychological functioning, stress, attention, and well-being changed before and after participation in an MBP. We analyzed qualitative data to investigate contextual information about why those changes may have occurred and why individuals chose to adopt or disregard mindfulness practices outside the classroom. Results suggest that, particularly for high-risk adolescents and those who integrated program practices into their daily lives, the intervention impacted internalizing symptoms, stress management, mindfulness, and emotion regulation. Mindful breathing was found to be a feasible practice easily incorporated into school routines. Contextual factors impacted practice uptake and program outcomes. Implications for practitioners aiming to help high school students manage stress are discussed.

Keywords Emotion regulation · Stress · Mindfulness · Adolescents · Systematic case study

Highlights

- Systematic case study provides nuanced data about how individuals respond to a mindfulness-based program (MBP).
- High-risk adolescents received the most benefit from MBP participation.
- Students who practiced were more likely to experience change across outcomes.
- The MBP most impacted the way students responded to stress.
- Mindful breathing may be the most accessible practice for students.

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The physical, cognitive, emotional, and social changes adolescents experience during puberty can invoke considerable stress (Coleman and Hendry 1999; Siegel 2013) as neurobiological systems are more vulnerable during this period (Tottenham and Galvan 2016). Importantly, the coping mechanisms which emerge during adolescence have long-term consequences in that they may shape the coping mechanisms of adulthood (Wolke et al. 2013). Failing to develop effective coping mechanisms renders individuals vulnerable to maladjustment, increasing their likelihood to

internalize and/or externalize problems (Gini and Pozzoli 2009; Schwartz et al. 2011). One way to increase resilience is to introduce socially valid interventions that target the specific developmental needs of adolescents.

Mindfulness-based programs (MBPs) have emerged as a means for reducing stress and improving psychological well-being (Keng et al. 2011; Murphy et al. 2012), for both clinical and non-clinical adult populations (Eberth and Sedlmeier 2012; Grossman et al. 2004). Well-being can include lack of internalizing symptoms, like depression, anxiety, and rumination, as well as use of emotion regulation and compassion. Specifically, researchers have found improvement in emotion regulation (Lykins and Baer 2009), and to a lesser extent, greater compassion towards others (Benn et al. 2012). Additionally, impacts of MBPs on increased well-being or mindfulness are greater for adults who practice more frequently or for longer lengths of time each week (Bergomi et al. 2015; Parsons et al. 2017).

Despite these promising results with adults, there are far fewer studies exploring the impacts of MBPs with adolescents. Some studies with youth show similar positive effects as studies with adult populations, including increases in mindfulness, self-compassion, and resilience (Bluth and Eisenlohr-Moul 2017; Galla 2016); decreases in stress (Bluth and Eisenlohr-Moul 2017; Dariotis et al. 2016; Kerrigan et al. 2011; Sibinga et al. 2011); and improvements in relationships, emotion regulation, or negative emotions (Dariotis et al. 2016; Sibinga et al. 2011). Evidence also suggests relationships between outcomes. Ciarrochi et al. (2011) and Kerrigan et al. (2011) found that increases in adolescents' awareness corresponded to increases in their well-being. In one qualitative study, Dariotis et al. (2016) concluded that improved emotion regulation skills helped participants de-escalate their negative emotions and reduce their stress. However, other studies with adolescents have shown no main effects of MBPs (e.g., Johnson et al. 2017).

The sample in these studies is important to consider. In a meta-analysis of MBPs for youth, Zoogman et al. (2015) found MBPs have more pronounced effects in clinical populations than general populations, with larger effect sizes observed for psychological outcomes compared to social interactions or measures of attention. This is likely because clinical populations have more room for improvement especially on internalizing symptoms like anxiety and depression. Indeed, Biegel et al. (2009) found significant improvements in anxiety and depression among adolescents in psychiatric care, while the baseline scores for the non-clinical sample in the Bluth and Eisenlohr-Moul (2017) study, had little room for improvement. In a study of HIV positive and other at-risk youth, Sibinga et al. (2011) found decreases in hostility and emotional discomfort. In contrast, a systematic review of MBPs implemented in school

settings showed effects were greatest in the domain of cognitive performance, small for outcomes related to resilience and stress, and not significant for measures of emotional problems (Zenner et al. 2014). However, a systematic review of qualitative research suggested students received benefits to their mental health following participation in an MBP; unfortunately, these studies generally lacked transparency in the selection of study participants (Sapthiang et al. 2019). Characteristics of participants clearly impact the magnitude of outcomes. Universal settings like schools provide less opportunity for significant movement on particular outcomes, like anxiety and depression, than for youth in clinical settings. Since schools are increasingly adopting MBPs, research must assess how non-clinical adolescents respond to these programs.

Learning to BREATHE (L2B) is a school-based MBP developed for adolescents that has been implemented in a variety of contexts (Broderick 2013). Based on Mindfulness-Based Stress Reduction (Kabat-Zinn 1990), L2B aims to facilitate the development of emotion regulation and attention skills of secondary students. Comprised of a 6-theme module delivered in 6, 12, or 18 lessons, module themes stem from the BREATHE acronym: B—Body awareness, R—Reflections, E—Emotions, A—Attention, T—Take it as it is, H—Healthy Habits of mind, E—Empowerment. Program goals include helping adolescents (1) become aware of their thoughts, feelings and physical experience, (2) use mindful, compassionate awareness when managing distressing emotions, and (3) practice these skills in a group setting. Some L2B studies have examined students with greater clinical needs and have found improvements or protective stabilization in measures of stress, well-being, attention, or psychological symptoms. For example, an uncontrolled study in an alternative school showed adolescents experienced improvements in stress and self-esteem (Eva and Thayer 2017), while Bluth et al. (2016) found reductions in depressive symptoms for at-risk students who received L2B compared to controls. Felver et al. (2018) found no changes in the psychosocial resilience of the at-risk youth in the L2B group, but deteriorations of resilience in the control group. Quantitative evidence indicated no impacts on students' academic achievement or attendance (Felver et al. 2018), although qualitative data suggested L2B improved students' metacognitive awareness (Eva and Thayer 2017).

Results exploring L2B impacts in more universal settings have been mixed. A quasi-experimental study in a public high school showed students experienced improvements in perceived stress, negative affect, and emotion regulation (Metz et al. 2013), while Fung et al. (2016) found improvements in depressive symptoms with ethnic minorities. In contrast, a pre-post intervention study of 255 urban high school students, from which the sample for the current

study is drawn, found no main effects on self-reported measures of well-being (e.g., social connectedness and self-compassion), stress, or internalizing symptoms (e.g., depression, rumination, and anxiety). Additional tests of moderation showed small to moderate effects on some measures of attention for students who adopted mindfulness practices outside of class (Frank et al. [under review](#)).

The nascent literature base examining MBPs with adolescents has some methodological limitations. Since most studies rely solely on either qualitative or quantitative methods, they can miss the complexities of how the intervention impacts individual participants, including understanding developmental processes (Greenberg and Harris [2012](#); Yoshikawa et al. [2008](#)) and reasons for uptake of intervention practices by specific individuals (Van Ness et al. [2017](#)). Many studies also lack contextual and process information necessary for understanding the underlying mechanisms of an MBP (Meiklejohn et al. [2012](#); Tan [2016](#)). Although qualitative data can provide contextual information about students' experiences in an MBP and their decision to adopt specific practices, they do not provide the stability of consistent measures gathered at distinct times, like data collected through quasi-experimental or randomized-controlled trials (RCTs). Investigating contexts as well as changes in outcomes are both necessary to understand how MBPs impact individual adolescents. A systematic case study approach, often used to better understand the processes of therapeutic and health interventions (see Elliott [2002](#)), can help elucidate the underlying mechanisms of an MBP for adolescents. Systematic case study concurrently examines quantitative and qualitative data for individuals drawn from an RCT and thereby illuminates the “factors that affect [the intervention’s] delivery in specific cases and contexts” (Dattilio et al. [2010](#), p. 433). Furthermore, beyond an RCT, systematic case study can give in-depth information about “how a treatment works, and the processes set in motion when treatment is implemented” (p. 432).

In this study, we applied a systematic case study approach to a subsample of adolescents who participated in a larger intervention study of the L2B program. Our goal was to refine the current understanding of program delivery and impacts by exploring how individual adolescents experienced the L2B program, how their participation impacted their perceived stress and well-being, and whether they chose to adopt practices in their daily lives. Focusing on individual students, the quantitative data examined whether and to what extent students' self-reported scores changed before and after L2B on constructs including internalizing symptoms, stress, attention/self-regulation, and well-being, while the qualitative data provided contextual information about why those changes may have occurred and why individuals chose to adopt or disregard

mindfulness practices outside the classroom. This approach is consistent with recent reports from National Institute of Health and the Department of Health and Human Services calling for mixed methods “n-of-1 studies” that complement RCTs by providing information about how treatments affect individuals (Van Ness et al. [2017](#)). This method does not seek to make generalizable claims; rather, it seeks a nuanced assessment of individual students' experiences to better understand what influences those experiences, especially within a universal, school population.

Method

We conducted a systematic case study (Dattilio et al. [2010](#)) using a convergent parallel design (Creswell [2015](#)) whereby qualitative and quantitative data from specific cases (aka, “target students”) were collected and analyzed separately and then integrated for further analysis. This data integration allowed for a richer understanding of how individual students experienced the program and how they experienced stress in their lives than what the quantitative or qualitative data alone provided. Quantitative self-report data provided indications of where changes occurred across predetermined measures grouped under the following constructs: internalizing symptoms (anxiety, rumination, depression), stress (school, peer), attention/self-regulation (mindfulness, emotion regulation), and well-being (social-connectedness, self-compassion). It also provided information about how often students used specific practices outside of class. Qualitative interviews probed students' experiences in the program and offered contextual information that may have impacted their participation. We were also particularly interested in using the qualitative data to better understand the processes by which any changes may have occurred, especially related to adolescents' stress and well-being. Both the quantitative and qualitative data included questions about target students' practice.

Participants

The intervention study included adolescents (Cohort 1 $n = 134$; Cohort 2 $n = 255$) enrolled in mandatory 11th grade health class in two public high schools in an urban/suburban district of a Northeastern state in the United States. Cohort 1 was a pilot trial with no comparison group. Cohort 2 was a pre-post design with students randomly assigned to either the L2B classrooms or business-as-usual health classrooms. School A had 1778 total students with 14% students on free-reduced lunch. School B had 1338 students, 47% on free-reduced lunch. The racial/ethnic backgrounds of students at School A were Asian 4%, Black 10%, Hispanic 5%, White 77%, Other 4%, and at School B

were Asian 10%, Black 33%, Hispanic 13%, White 38%, Other 6%.

Participants were recruited through an information letter sent home to parents obtaining passive consent. There were 9 parent opt-outs across cohorts. Students gave active consent before completing measures. The participation rate was 98% for self-report measures. The participation rate for interviews was lower, which is not surprising given interviews took place outside of regular class time. Of the 48 students who agreed to an interview, 19 (40%) completed consents and participated in at least one interview.

From those 19 students, we selected nine target students, six students from School A and three from School B, from whom we had a complete corpus of data (all quantitative measures and qualitative interviews) and who represented some diversity, of demographics and across outcomes (See Table 1). Five students were from Cohort 1 and four were from Cohort 2. Table 2 shows the sociodemographic characteristics of the full sample versus the nine target students. We purposefully sought variation across the individuals, although our purpose was not to make generalizations. The nine target students were fairly well representative of the full sample in terms of race/ethnicity, family structure, maternal education, and hours of extracurricular activities, and hours of working in a job. However, the target students included fewer academically low-achieving students than the full sample and did not include any Hispanic students. The study was approved through institutional IRB. Pseudonyms are used throughout.

Intervention

L2B was integrated into the high school health curriculum. Teachers in this study implemented 12 lessons, 45 min each, over 8 weeks. Each lesson included the lesson theme, activities, and in-class mindfulness practice (Broderick 2013). Students received a workbook and audio files of mindfulness practices and were encouraged to practice skills between sessions. Support for the teachers included four sessions of personal mindfulness training, three days of L2B training, and weekly coaching from two study team members.

Procedure

The study consisted of two phases. For Cohort 1 self-report quantitative measures were collected within one week before and after the 8-week intervention period (henceforth labeled pre- and post-, respectively), and an individual interview was conducted within one month after the intervention program ended. For Cohort 2, pre- and post- self-report measures were collected and follow-up self-report measures were additionally collected three months after the

Table 1 Target student demographics

Student	School	Race/ethnicity	Family structure	Maternal education	Grades	Extra-curricular hours	Work hours	# AP courses
Cohort 1								
Damon	A	White	Two birth parents	2-year college degree	Mostly B's	0	21	0
Colin	A	White	Single parent	High School degree/GED	Mostly B's	4	0	1
Tejas	A	Black	Single parent	Some College or technical school	About half A's and half B's	21	7	1
Ian	B	White	Two birth parents	High School degree/GED	Mostly A's	20	10	1
Chandra	B	Asian/Filipino	Two birth parents	Some High School	Mostly A's	21	0	2
Cohort 2								
Briana	B	Black	Two birth parents	Graduate or advanced degree	Mostly A's	11–15	0	1
Hannah	A	Mixed	Two birth parents	Graduate or advanced degree	Mostly A's	16–20	0	1
Scott	A	Asian/Filipino	One birth parent and a step-parent	4-year college degree	Mostly A's	6–10	0	1
Javier	A	White	Two birth parents	4-year college degree	About half A's and half B's	6–10	16–20	1

Table 2 Sociodemographic characteristics of the full sample and target sample

	Cohort1 Full (N = 134)	Cohort2 Full (N = 255)	Cohort1 Target (n = 5)	Cohort2 Target (n = 4)
	% of students		# of students	
Race/ethnicity				
Non-Hispanic White	63.4%	52.5%	3	1
Non-Hispanic Black	8.2%	17.2%	1	1
Hispanic	8.2%	9.7%	0	0
Asian	5.2%	5.9%	1	1
Other	15.0%	14.7%	0	1
Family structure				
Two birth parents	64.9%	55.4%	3	3
Single parent	17.2%	19.5%	2	0
Step parent	12.7%	19.1%	0	1
Other	5.2%	6.0%	0	0
Mother education				
Less than HS diploma	12.3%	15.6%	1	0
HS/GED	20.5%	27.0%	2	0
Some or 2-year College	29.6%	20.7%	2	0
4-year College	22.1%	24.5%	0	2
Graduate/Advanced degrees	15.6%	12.2%	0	2
Grades				
Mostly A's	27.7%	21.1%	2	3
Half A's and Half B's	38.5%	29.5%	1	1
Mostly B's	10.0%	15.9%	2	0
Half B's and C's	15.4%	22.5%	0	0
Mostly C's or below	8.5%	11.0%	0	0
Weekly hours of extracurricular activities				
0 h per week	18.6%	12.0%	1	0
1–10 h	55.0%	55.0%	1	2
11–20 h	24.0%	21.9%	1	2
More than 20 h	2.3%	11.2%	2	0
Weekly hours of working in a job outside of school				
0 h per week	53.1%	58.5%	2	3
1–10 h	14.8%	18.0%	2	0
11–20 h	22.7%	17.5%	0	1
More than 21 h	9.4%	6.0%	1	0
Number of AP courses				
0	51.5%	49.1%	1	0
1	36.6%	34.5%	3	4
2	8.2%	13.4%	1	0
3 or more	3.7%	3.1%	0	0

completion of the intervention. Interviews were conducted before the intervention (pre-interview) and approximately one month after the intervention ended (post-interview).

Self-Report Measures

Internalizing symptoms

Depression was measured with the 8-item version of the Patient Health Questionnaire (PHQ-8; Kroenke et al. 2009). Rated on a 4-point scale (0 = “not at all” to 3 = “nearly every day”), items (e.g., *little interest or*

pleasure in doing things) were summed to produce a scale score ranging 0 to 24, with higher scores indicating greater depression ($\alpha = 0.83$). *Anxiety* was measured with the 7-item version of the Generalized Anxiety Disorder measure (GAD-7; Spitzer et al. 2006). Items (e.g., *trouble relaxing*), rated on a 4-point scale (0 = “not at all” to 3 = “nearly every day”), were summed for a total score, with higher scores indicating greater anxiety ($\alpha = 0.89$). *Rumination* was measured by averaging across nine 5-point scale items (1 = “strongly disagree” to 5 = “strongly agree”; e.g., *thinking back over embarrassing moments*) derived from the Rumination and Reflection Questionnaire (RRQ; Trapnell and Campbell 1999). Higher scores reflect greater rumination ($\alpha = 0.85$).

Attention and self-regulation

Emotion regulation was measured by 27 items from the Difficulties in Emotion Regulation Scale (DERS; Gratz and Roemer 2004), which assessed five subscales: lack of emotional awareness (e.g., *I pay attention to how I feel*), lack of emotional clarity (e.g., *I have no idea how I am feeling*), impulse control difficulties (e.g., *When I'm upset, I have difficulty controlling my behavior*), limited access to emotion regulation strategies (e.g., *When I'm upset, I know that I can find a way to eventually feel better*), and difficulties engaging in goal-directed behaviors (e.g., *When I'm upset, I have difficulty focusing on other things*). The total score is the average of 27 items on a 5-point scale (1 = “almost never” to 5 = “almost always”), higher scores representing greater difficulties in emotion regulation ($\alpha = 0.86$). *Mindfulness* was measured using the Child and Adolescent Mindfulness Measure (CAMM; Greco et al. 2011), which consists of 10 items on a 5-point scale (0 = “never true” to 4 = “always true”). The items were reverse coded and summed to yield scale scores ranging 0 to 40, with higher scores indicating greater mindfulness ($\alpha = 0.89$). Example items include: *It's hard for me to pay attention to only one thing at a time*; and *at school, I walk from class to class without noticing what I'm doing*.

Stress

Stress was measured using two subscales from the Adolescent Stress Questionnaire (ASQ; Byrne et al. 2007). 6 and 5 items on a 5-point scale (1 = “not at all stressful” to 5 = “very stressful”) were summed, respectively, to create two subscales, *stress of school performance* (ranging 6 to 30; e.g., *having to study things you do not understand*) and *stress of peer pressure* (ranging 5 to 25; e.g., *being judged by your friends*). Higher scores represent higher levels of stress ($\alpha \geq 0.90$ for both).

Well-being

Self-compassion was measured with the Short Form of Self-Compassion Scale (SCS-SF; Raes et al. 2011), which consists of 12 items on a 5-point scale (1 = “almost never” to 5 = “almost always”; e.g., *When I’m going through a very hard time, I give myself the caring and tenderness I need*). The total score was obtained by averaging the item ratings (with 6 items reverse scored; $\alpha = 0.77$), with the range of 12–60. Higher scores indicate greater self-compassion. *Social connectedness* was measured by 12 items from the Social Connectedness Scale-Revised (SCC-R; Lee et al. 2001), each on a 6-point scale (1 = “strongly disagree” to 6 = “strongly agree”; e.g., *feeling distant from people, seeing self as a loner*). A scale score is the average of the item ratings (negatively worded items reverse coded; $\alpha = 0.90$), with higher scores indicating greater social connectedness.

Program practice

We asked students how often they engaged in mindfulness practices *outside of class*. There was one general question for Cohort 1 and 7 questions for Cohort 2, one for body scan, mindful breaths, mindful eating, mindfulness of thoughts, mindfulness of emotions, mindful movement, and loving-kindness practice. We rated responses on an 8-point scale (0 = “never”; 1 = “less than a month”; 2 = “once a month”; 3 = “2–3 times a month”; 4 = “1 time per week”; 5 = “2–6 times a week”; 6 = “daily”; and 7 = “multiple times a day”). For Cohort 2, we averaged scores on the seven items to yield a practice scale score. The entire sample mean (standard deviation) of the program practices was 3.44 (1.88) for Cohort 1, and 3.12 (2.13) and 1.77 (1.83) for Cohort 2 post- and follow-up. Students also answered open-ended questions about when and how they used practices into their daily lives.

Interviews

One co-investigator and two graduate students trained in qualitative research conducted interviews. The semi-structured protocol included open-ended questions about participants’ background (e.g., “Tell me about your experience in this school,” “What kinds of things cause you to feel stressed?”), and questions to explore the impact of L2B on students’ perceived stress, well-being, mindfulness, belongingness, classroom attention, etc. (e.g., “Thinking back to the stressful incident you described previously, how would you handle the same incident if it happened today?” “Do you continue to use anything you learned in L2B?”). Interviews were conducted either in person, during lunch or study hall, or over the phone outside of school hours.

Analytic Plan

Our analytic plan followed two main phases. First, qualitative and quantitative data were collected and analyzed separately and concurrently. Second, we integrated the two datasets to examine how and why the qualitative and quantitative data aligned and diverged.

Quantitative data analysis

Quantitative data included student surveys administered at pre-, post-, and 3-month follow-up (follow-up for Cohort 2 only). Pre-, post-, and follow-up scores on each measure were examined for each target student. We first evaluated pre-test status using both raw scores and *z*-scores. By converting raw scores for each target student to *z*-scores using the pre-test mean and standard deviation (SD) of the entire sample, we examined how each target student scored relative to the average student. We interpreted *z*-scores of 1 or greater as at high risk. In addition, we used pre-defined cut-off raw scores to identify students who were experiencing depression and anxiety in the clinical range. We classified those with depression scores of 10 or higher as high in depressive symptomology (Kroenke et al. 2009) and anxiety scores of 10–14 as moderate anxiety and 15 or above as severe anxiety (Spitzer et al. 2006).

The primary purpose of quantitative data analysis was to examine changes in individual scores before and after the L2B intervention. To interpret the size of observed differences between pre- and post-test (or follow-up) results, we expressed score changes in a standard deviation unit of each measure, i.e., subtracting each student’s post-test score or follow-up score from the pre-test score, divided by the pre-test SD of the full sample. Given the similarity of the standardized change scores to Cohen’s effect size measure, *d*, we adopted the guidelines to interpret Cohen’s effect sizes and considered changes of 0.80 or above as large, 0.50–0.79 as medium, 0.20–0.49 as small, and 0.01–0.19 as little change (Cohen 1988).

Qualitative data analysis

Consistent with thematic analysis (Braun and Clarke 2006) and selective coding (Strauss and Corbin 1990), three coders analyzed the qualitative interviews using NVivo 11 software. One “master coder” read all interviews and two coders each read half the interviews for reliability purposes. Through an iterative process, the coders developed a codebook which included codes derived empirically from the data (e.g., “Changes as a result of L2B”) or derived from prior MBP studies and theories of change (e.g., “mindfulness,” “efficacy,” “emotional well-being”) (see Schussler et al. 2016; Ciarrochi et al. 2011; Meiklejohn et al. 2012).

Table 3 Qualitative changes as result of participation in L2B

Comparable Quant Code ^a	Manage stress	Efficacy	Mindfulness	Belongingness	Inter-personal interactions	Academics	Emotional Well-being
	Stress	Well-being	Attention/Self-Regulation	Well-being	Well-being	Attention (+) Stress (–)	Well-being (+) Int Sympt (–)
Cohort 1							
Damon	36.58%	0%	26.29%	0%	12.80%	0%	24.34%
Colin	27.09%	0%	19.33%	0%	5.18%	0%	48.40%
Tejas	40.66%	0%	23.14%	0%	0%	14.09%	22.11%
Ian	16.41%	21.59%	35.61%	0%	0%	11.74%	14.65%
Chandra	11.64%	0%	49.32%	0%	0%	14.04%	25%
Cohort 2							
Briana	34.67%	18.64%	21.84%	0%	6.21%	18.64%	0%
Hannah	34.80%	0%	0%	0%	0%	30.40%	34.80%
Scott	0%	0%	31.33%	0%	0%	68.67%	0%
Javier	15.21%	0%	16.35%	0%	18.63%	49.81%	0%

Bold values represent the outcomes most discussed for each target student and italic values represent those second most discussed

^aComparable quantitative codes are related to qualitative codes, but not equivalent

“Belongingness” is not typically measured in studies of MBPs, but we included it, hypothesizing that adolescents’ improved interpersonal interactions at school would also impact their belongingness (Osterman 2000). We used theoretical definitions for many qualitative codes. For example, “belongingness” was defined as feeling personally accepted, respected, included, and supported in the school social environment (Goodenow 1993).

Coders based their coding on the actual text, minimizing subjective interpretations. Coders clarified definitions of codes and reached consensus where any coding discrepancies occurred. Based on the prevalence of some codes (i.e., mindfulness, emotional well-being, interpersonal interactions, management of stress), the coders further analyzed all text coded within each of these categories using themes that emerged from the data. For example, the themes for “mindfulness” included “nonreactivity to emotional stimuli,” “present-centered orientation,” “observation of phenomena,” “self-awareness/reflection,” “body awareness.”

Major outcome codes from the interview data were similar, though not equivalent, to the quantitative self-report constructs. Outcome codes from the interviews with comparable self-report constructs included: managing stress (stress), efficacy (well-being), mindfulness (attention/self-regulation), belongingness (well-being), interpersonal interactions (well-being), academics (attention/self-regulation if positive, stress if negative), emotional well-being (well-being if positive, internalizing symptoms if negative). To assess how participants described the changes that occurred as a result of L2B, we ran a matrix analysis (an NVivo analytic tool) for each participant cross-referencing all major outcomes with the code “change from L2B” (see

Table 3). The matrix was converted to a row percentage to capture how outcomes were distributed across each participant. The matrix allowed us to compare, within and across participants, prevalence of outcomes that students described as having changed and areas to probe more deeply. Lastly, we integrated the qualitative and quantitative data to examine areas of convergence and divergence.

Results

Quantitative Analysis Results

We report these results in two ways: (1) by outcomes (aka, mindfulness, anxiety, etc.) grouped within the four main constructs (i.e., internalizing symptoms, stress, attention/self-regulation, well-being) across the students and (2) by individual students across constructs. Table 4 presents the full sample mean and SD of pre-test scores and the individual z-scores for the target students. Target students in Cohort 2 generally functioned better than the average of the full sample across most measures. None of the Cohort 2 target students fell in the clinical ranges for any of the scales although Hannah and Javier showed slightly higher rumination and school stress scores, respectively, relative to the average students. In contrast, all target students in Cohort 1, except Colin, functioned worse than the average within multiple constructs, especially internalizing symptoms and stress. In particular, Tejas fell in the clinical ranges in measures within all constructs, including internalizing symptoms (depression and anxiety), stress (school stress), attention/self-regulation (mindfulness, and close to the

Table 4 Full sample mean and standard deviation of pre-test measurements and individual standard scores

	Cohort 1						Cohort 2						
	Full Sample (<i>N</i> = 140)		Standardized Scores for Each Target Student					Full Sample (<i>N</i> = 251)		Standardized Scores for Each Target Student			
	Mean	(SD)	Damon	Colin	Tejas	Ian	Chandra	Mean	(SD)	Briana	Hannah	Scott	Javier
Internalizing symptoms													
Rumination	3.49	(0.69)	−0.12	−0.12	0.60	1.18	0.31	3.31	(0.75)	−0.01	<i>0.92</i>	−0.14	0.52
Depression	7.04	(5.62)	1.06	−0.90	0.88	<i>0.35</i>	−0.54	5.61	(4.92)	−0.53	−0.94	−0.94	−0.33
Anxiety	6.36	(5.83)	−0.06	−1.09	1.31	1.31	0.28	4.86	(5.42)	−0.53	−0.90	−0.53	−0.53
Stress													
Stress-school performance	20.38	(7.09)	1.36	−1.75	1.36	1.22	0.09	18.32	(6.44)	0.26	−0.36	−0.05	0.88
Stress-peer pressure	10.12	(5.95)	−0.86	−0.19	−0.86	1.49	−0.86	9.21	(5.15)	−0.62	−0.43	−0.82	−0.82
Attention and Self-regulation													
Emotion Regulation	2.41	(0.67)	0.29	−0.91	<i>0.89</i>	1.04	−0.46	2.71	(0.62)	−0.35	−0.51	−1.48	0.14
Mindfulness	33.81	(8.21)	−1.80	0.39	−2.29	−1.93	−1.44	25.33	(8.85)	0.19	0.30	0.75	−0.26
Well-being													
Social-connectedness	4.08	(1.08)	1.51	−0.26	−2.21	0.95	−2.12	4.35	(1.09)	1.34	−0.41	1.52	0.42
Self-compassion	36.49	(6.96)	−0.36	0.65	−0.79	0.36	−0.79	37.52	(7.28)	1.58	−0.35	1.44	0.89

Standardized *z*-scores are presented for each target student

Bold values indicate high-risk status or clinical ranges of symptoms (i.e., *z*-scores of 1 or greater for all scales, plus raw scores of 10 or higher for depression and raw scores of 10 or above for anxiety). Italic values indicate being close to high-risk or clinical ranges of symptoms (e.g., depression raw scores of 9; *z*-scores of 0.80 or above)

clinical cut-off for emotional regulation), and well-being (social-connectedness). Ian scored in the clinical ranges for three constructs: internalizing symptoms (rumination, anxiety, and borderline for depression), stress, and attention/self-regulation.

Table 5 presents the size of the change scores from pre- to post- and 3-months follow-up. A positive sign indicates improvement and negative sign notes deterioration or worsening. Large and medium improvement (i.e., changes of 0.80 or above and 0.50–0.79, respectively, in standard deviation units) are presented in bold print, representing clinically important improvement. Looking across students, attention/self-regulation showed significant improvements for both cohorts. Based on differences between pre- and post-, most students evidenced significant improvements (5 large and 1 moderate) in mindfulness and significant improvements (3 large and 2 moderate) in emotion regulation. There was also a pattern of positive results for internalizing symptoms, but mostly for students in Cohort 1 who had lower pre-test scores, and thus more room for improvement. Specifically, for rumination, 60% of Cohort 1 students reported significant decreases in symptoms, while only one Cohort 2 student did. Similarly, around half of Cohort 1 students reported significant declines in anxiety and depression, 60 and 40% respectively, but all of the Cohort 2 students showed little or small change. Results were inconsistent for well-being and stress.

Regarding individuals, two of the five target students in Cohort 1, Tejas and Ian, evidenced significant improvement (i.e., medium or large benefits) on the majority of quantitative measures after the L2B intervention. Ian showed marked improvements in all areas, except well-being; his self-compassion and social-connectedness measures increased only slightly. Tejas showed large or moderate improvements in internalizing symptoms, well-being, and some aspects of attention/self-regulation (e.g., mindfulness). Both students were either in the clinical or borderline clinical ranges on two of three internalizing symptoms measures at pre-test. After the intervention, Ian moved well outside the clinical range for both depression and anxiety. Tejas moved outside the clinical range of depression, but still within range of moderate anxiety. Damon and Chandra experienced significant improvements in several areas including mindfulness, but Damon remained in the clinical range of depression. Colin did not improve in any of the areas, but his pre-test scores on a number of measures (e.g., mindfulness, emotion regulation, anxiety, depression, school stress) were significantly better than his peers suggesting a ceiling effect.

Compared to Cohort 1, improvements between pre- and post- were less pronounced among Cohort 2 students. Briana evidenced large improvements in rumination and emotion regulation and moderate improvements in school-related stress, but the other Cohort 2 students showed

Table 5 Change from Pre- to Post- (Cohort 1 and 2) and Pre- to Follow-up (Cohort 2)

Quantitative variables	Cohort 1						Cohort 2					
	Damon	Colin	Tejas	Ian	Chandra	Briana	Hannah	Scott	Javier			
						Post	FU	Post	FU	Post	FU	
Internalizing symptoms												
Rumination	Sm (+)	Lg (-)	Lg (+)	Lg (+)	Lg (+)	Lg (+)	Lg (-)	Med (-)	Lg (+)	Sm (+)	Sm (+)	
Depression	Lt (+)	Sm (-)	Med (+)	Med (+)	Sm (-)	Sm (+)	Sm (-)	No	Sm (-)	Sm (+)	Sm (+)	
Anxiety	Med (+)	No	Med (+)	Lg (+)	Sm (-)	Lt (+)	Med (-)	No	Sm (+)	Lt (+)	Sm (+)	
Stress												
School stress	Sm (+)	Med (-)	No	Lg (+)	Sm (+)	Med (+)	Med (-)	Med (+)	Lg (+)	Lt (+)	Lt (+)	
Peer stress	Sm (-)	Lt (-)	No	Lg (+)	No	No	Sm (-)	No	No	Sm (-)	No	
Attention and Self-regulation												
Emotion Regulation	Med (+)	Sm (-)	Sm (+)	Lg (+)	Med (-)	Lg (+)	Med (+)	No	No	Lg (+)	Lg (+)	
Mindfulness	Lg (+)	Med (-)	Med (+)	Lg (+)	Lg (+)	Sm (+)	Lt (-)	Med (-)	Lg (+)	Lg (+)	Lg (+)	
Well-being												
Social-connection	Lg (-)	Med (-)	Lg (+)	Sm (+)	Sm (-)	Med (-)	Sm (+)	No	No	Sm (+)	Med (+)	
Self-compassion	Sm (+)	Lt (-)	Lg (+)	Sm (+)	Lt (+)	Lt (-)	Sm (+)	Lg (-)	Med (-)	Med (-)	Lg (+)	
Mindfulness practice outside of school	4.0	5.0	7.0	4.0	2.9	1.0	3.8	2.4	0.3	5.7	0.0	

A positive sign (+) indicates improvement and negative sign (-) notes deterioration or worsening. Large (Lg) and medium (Med) improvement (i.e., changes of 0.80 or above and 0.50–0.79, respectively, in standard deviation units) are presented in bold print, representing clinically important improvement. Sm, Lt, and No indicates Small, Little, and No changes, respectively. FU indicates follow-up. Bolded letters indicate large or medium improvements. For program practice, 0 = “never”; 1 = “less than a month”; 2 = “once a month”; 3 = “2–3 times a month”; 4 = “1 time per week”; 5 = “2–6 times a week”; 6 = “daily”; and to 7 = “multiple times a day”.

significant improvements only in one or two areas. In particular, Scott's scores remained unchanged in four domains and worsened significantly in three domains; he also reported never engaging in L2B practices outside of class. Hannah showed significant deteriorations in rumination, anxiety, self-compassion, and school stress, a result that may be explained with qualitative data. The results for the 3-month follow-up did not considerably differ from post-test. Two notable exceptions were Scott's large improvements in rumination, school stress, and mindfulness and Javier's improvements in both well-being measures (e.g., social connectedness and self-compassion).

Results suggest that across different target students, attention/self-regulation (measured by mindfulness and emotion regulation) is an area that might be improved by the short-term implementation of the L2B intervention. Results also show that those classified as high-risk prior to intervention (e.g., Tejas and Ian) tended to benefit most as a result of the L2B intervention, especially in their internalizing symptoms and attention/self-regulation. In addition, our quantitative data show that the intervention tended to yield no or little change for a student who did not practice mindfulness, indicating that practice may relate to outcomes.

Qualitative Analysis Results

Management of stress

This emerged as the most prevalent code throughout the qualitative data. Students affirmed their need for stress management strategies and cited this as a main benefit of L2B. For example, Chandra noted,

Lots of people at my school cry and get really frustrated and pick their nails and bite their nails because of stress.... Most people don't know how to manage stress. And I think this [L2B program] really teaches everyone how to manage it.

Seven of the nine target students described specific strategies they used to manage stress as a result of the L2B program. Mindful breathing was the most commonly cited and was applied across contexts. Tejas, a competitive swimmer and high achieving student said, "When I get overwhelmed, normally I used to just let whatever happens happen. But now I'm just starting to calm down a little bit, and just breathe." Damon noted he applied skills to everyday events:

I do it when I brush my teeth. I don't think it's helped me brush my teeth any better. It's calmed me down. It

makes me think about things more rationally, and I really do think it took away some stress in my life."

Table 3 shows more students mentioned "management of stress" than other outcomes when they described changes they experienced as a result of L2B participation. Five students mentioned it most or second most, indicating its salience in the data. Some aspect of stress management was triangulated in open-ended questions from the post-survey where students cited the most important thing they learned from L2B. Responses included controlling anxiety and responding better to stress.

Mindfulness

An in-depth analysis into all instances coded as "mindfulness" from student interviews provided insight into *how* L2B fostered adolescent mindfulness. Predominant themes included aspects of self-awareness, including observations, body awareness, or awareness of one's own thoughts. For example, a number of participants mentioned mindful eating: "I did not know how well raisins could taste" (Colin). In describing slowly eating a piece of chocolate, Javier said being mindful was like "paying attention, like watching everything in close detail, like observing everything that may be overlooked." Or as Ian said he was now,

Paying attention to little things, just savoring the moment a little....Before [L2B] I would try, I don't know if I would say that I would try too hard, but I would try to look at things too in-depth, whereas afterwards I could take it as it was.

Students who played sports (Damon, Tejas, Briana) were more likely to describe becoming more aware of their bodies and more purposeful about how they use their bodies. Damon recounted that before basketball games he was "breathing through the nose, out through the mouth, just concentrating on where that air was in my throat and in my stomach." Tejas noted that before he would "just get through practice" but after L2B he said, "Now I'll slow it down, think about what I'm doing, how my strokes are, like the specifics of it." Embedded in these comments on awareness are other outcomes like gratitude and observing without judgment.

For some, L2B helped them develop awareness of their own thoughts or thought process. Javier noted he pays "more close attention to the details, like more in depth," and Scott said he noticed he is "thinking more about it [his approach to life]" and how he "should respond." Similarly, Hannah said, "When you're mindful, it's easier to think things through. It's like a thought process that helps you

with the ordinary things in life.” All but one target student described mindfulness as a cognitive process, using words like “thinking,” “thought process”, and “rational” when they defined mindfulness and described how they managed stressors. These statements provide clues into *how* they were becoming more mindful.

Statements coded as mindfulness were primarily oriented toward the self. Students described their own awareness and changes that occurred within them. Briana defined mindfulness as, “controlling your emotions and learning more things about yourself and just concentrating more on yourself.” However, there were some descriptions that indicated outwardly-directed mindfulness, including acting with intention or non-reactivity, that impacted one’s relationships with others. Briana said it most directly, “I think more before I act now...whatever I’m doing with the situation like whether a relationship or just anything.” When asked whether anything is different after going through L2B, Hannah said “I just try to be aware of my position in society..., just try and be aware of the consequences my actions have.”

Interpersonal interactions

The qualitative data did not yield many examples of changes to students’ relationships as a result of L2B. There were only a few instances where students attributed L2B as helping them interact more productively with others, like Damon:

It’s helped me out like in arguments. I had one argument that I can think of, I went to my room and I breathed.... I just thought about it, like, I was maybe nicer to my mom. Like, I got in a fight with her and...I guess you could say it helped my relationship with her.

Other examples illustrate using mindfulness as a means of emotion regulation that may help improve interpersonal interactions. For example, Chandra said, “Now it makes more sense, because my health teacher is like, ‘analyze and be in the issue, don’t use your emotion and sort of get caught up in it,’ so that helped.”

Practice

The interviews and the open-ended survey questions revealed that the type of mindfulness practice (e.g., body scan, yoga, mindful eating) was less important than how the students used the practice. The one exception was mindful breathing which all students noted they used. Students used breathing as a way to relax, calm themselves down, focus, and reduce stress. It was easy to integrate in their daily lives

across different situations (e.g., before participating in a sporting event, brushing teeth, etc.). Even Scott, who reported no practice on the quantitative survey said in his interview, “Whenever there’s a stressful situation I need to close my eyes and just take a deep breath a couple of times and that helps me get my bearings.”

Discussion

In this systematic case study we investigated how individual adolescents’ participation in L2B impacted their perceived stress and well-being and their integration of mindfulness practices in their daily lives. The combined quantitative and qualitative data provide a more nuanced view of how L2B impacted the target students and why some of these changes may have occurred. Major findings include a seeming disconnect in the qualitative and quantitative data about perceived sources of stress and students’ management of stress. There was evidence across the data that students were becoming more mindful, namely through increased awareness. For students with a greater degree of internalizing symptoms (e.g., anxiety, rumination, depression) and difficulties with emotion regulation, L2B seemed to help improve those outcomes, especially through the transferable practice of tuning into the moment with mindful breath awareness. However, there was not much qualitative or quantitative data supporting the program’s impact on students’ academic engagement or their well-being in terms of their interpersonal interactions, self-compassion, and sense of belongingness. Regarding practice, the type of practice students engaged in was less important than that they engaged in some type of practice. These findings are described in more detail.

Although management of stress was the most prevalent theme in the qualitative data, most students did not show much improvement on quantitative stress measures. Only Ian and Scott showed significant improvement on either school-related or peer stress, a finding consistent with the larger sample (Frank et al. [under review](#)). For some students in this study, stress increased. These results diverge from findings of other researchers studying impacts of MBPs on adolescent stress. For example, Bluth and Eisenlohr-Moul (2017) found adolescents’ perceived stress decreased following an MBP. In a qualitative review of MBPs in schools, Saphiang et al. (2019) identified four main themes, two of which involved stress reduction and calming. We suggest that L2B’s impact on adolescent stress is best understood after integrating the qualitative and quantitative analyses, attending to contextual factors, students’ reported practice, and the relationship between stress and mindfulness.

Regarding context, time of year and student circumstances are important to consider. For example, since the

post-test occurred later in the semester, when normative stressors like academic workload and balancing school/leisure/work activities intensify (Byrne et al. 2007), target students likely perceived more stress at post- than pre-test, as the quantitative data indicate. Most were academically successful and involved in extra-curriculars or work and likely more susceptible to these stressors. All but Damon were enrolled in an Advanced Placement course, and all but Colin and Scott reported extra-curricular and/or work responsibilities of at least 15 h a week. Although students perceived more stress, as evident in the quantitative self-report data, participation in L2B helped equip them with simple practices to manage their stress. In qualitative interviews, all students noted practices they learned in L2B that helped them cope with stress, mindful breathing being the most cited. In addition to practices for managing stress, L2B may have increased students' awareness of their stress, a common phenomenon after mindfulness training when novice meditators "notice how chaotic their minds actually are" (Davidson and Kaszniak 2015, p. 585). Indeed, students in the present study showed improvements in mindfulness with "self-awareness" and "body awareness" emerging as predominant themes in the qualitative data. They were likely more attuned to their thoughts about stress and how their bodies carried stress (Kabat-Zinn 1990). These findings underscore the utility of triangulating quantitative with qualitative data for a more comprehensive and nuanced understanding of program outcomes (Davidson and Kaszniak 2015; Zenner et al. 2014).

Both quantitative and qualitative measures also begin to illuminate processes of how mindfulness practices affect students' mental states (Dariotis et al. 2016), such as how individuals were developing mindfulness, something with which researchers continue to grapple. In two reviews of mindfulness with adolescents, researchers speculate that improved attention may be the "generic mechanism" underpinning the effects of mindfulness interventions (Zenner et al. 2014; Zoogman et al. 2015). Attention is of particular interest in schools given the expectation for students to stay focused on increasingly challenging cognitive tasks. Results from our data suggest that a similar meta-construct—"awareness"—characterized students' nascent development of mindfulness. Quantitative data show that for seven of nine target students, mindfulness improved from pre- to post- or follow-up. The qualitative data provide more nuance as to what mindfulness entailed. Analysis of interviews indicate mindfulness meant students were engaging in what Shapiro et al. (2006) term "reperceiving," a theoretical construct explaining that individuals' intention, attention, and attitude comprise the mechanisms of mindfulness that lead to "second-order process variables" (Klingbeil et al. 2017), like aspects of physical and psychological well-being and cognitive functioning. Klingbeil

et al. (2017) note, "It seems reasonable to expect that MBIs [mindfulness-based interventions] would produce larger effects for the first-order mindfulness process, with smaller effects noted for the second-order process variables" (p. 96). In the current study, mindfulness presented as a more salient outcome in both quantitative and qualitative data than others. Students were becoming more present-oriented and aware of their emotions, developing heightened consciousness about their thought processes and reactions to stress, and exercising non-reactivity, processes that mirror the development of top-down neurocognitive processes involved in "hot" (emotionally-charged) and "cool" (affectively neutral) executive functioning during adolescence (Zelazo and Carlson 2012). From a developmental perspective, more research is definitely needed to better understand how, for adolescents, mindfulness impacts other "second-order" outcomes, including emotion regulation and aspects of executive function.

The relationship between mindfulness and academic achievement/engagement are less frequently studied in adolescents (Felder et al. 2016; Klingbeil et al. 2017). In the Zenner et al. (2014) review, only two studies examined academic achievement through grades and one was non-significant; the other studies assessed cognitive functioning using attention measures (6 studies) or a creativity test (1 study). Unfortunately, the current study also provides little conclusive data about how mindfulness impacted students' academic functioning. Qualitative data suggests students' increased awareness related to academic engagement to a very limited degree (see Table 3). In fact, students' awareness in the present study was primarily inwardly-focused, encompassing their emotions, thoughts, and responses, a finding similar to Sapthiang et al. (2019) who found MBPs improved attentional processes to regulate emotions and cognitions. This is not surprising as a focus on self is common at this developmental stage (Sebastian et al. 2008). The findings from this study are inconclusive because target students did not explicitly describe increased awareness to cognitive tasks or academic work, despite their generally high achievement or commitment to school. Also, self-report of their grades, in addition to lacking in reliability, was collected at one time point.

Our findings are consistent with the findings of Ciarrochi et al. (2011), Kerrigan et al. (2011) as well as a number of reviews (Sapthiang et al. 2019; Zoogman et al. 2015) regarding increases in adolescents' awareness corresponding to increases in their well-being, especially for those in the clinical range of internalizing symptoms. In the current study, five of the nine target students experienced positive changes in their self-reported mindfulness, emotion-regulation, and rumination. As others have noted, adolescents who experienced the most growth were in the clinical range of internalizing symptoms at baseline (Biegel et al. 2009;

Zoogman et al. 2015), like Tejas and Ian in this study. Though positively impacting some higher risk students, it may be that an 8-week MBP offered twice a week may lack the potency to significantly impact these outcomes in low-risk adolescents. Furthermore, we agree with Klingbeil et al. (2017), that it is important to investigate not just the broad constructs (i.e., internalizing symptoms), but to drill down to sub-outcomes—like rumination, anxiety, and depression—and the reactions of individuals, in order to illuminate the underlying mechanisms of how mindfulness programs impact adolescents.

Contrary to our assumption, quantitative data on social connectedness was mixed, and qualitative data on interpersonal interactions and belongingness was minimal. However, we did see some evidence in the qualitative data of students' becoming aware of their experience and employing mindfulness practices, like breathing, to regulate their emotions, potentially resulting in better interpersonal interactions. Given the limitations of the data, we can only hypothesize that better emotion regulation and well-being may facilitate improved interactions. In their study of pre-adolescent students in disadvantaged urban communities, Dariotis et al. (2016) concluded that improved emotion regulation skills gained through mindfulness practice helped participants de-escalate their negative emotions and reduce stress. Based on other studies with adolescents, improved self-awareness, even if only a small increase, may facilitate self-regulation (Tang et al. 2007; Zenner et al. 2014), which in turn may lead to improvements in well-being (Lykins and Baer 2009; Sibinga et al. 2011) and thus improved social interactions. Since our findings on improved relationships were muted, we speculate that for adolescents, the emphasis on awareness of *self* may establish a foundation for indirectly improving relational and belongingness outcomes, but this requires more empirical investigation. At this developmental stage, it may be necessary to couple mindfulness more intentionally with compassion training to maximize interpersonal outcomes (Hildebrandt et al. 2017).

Probably most significantly, the cases presented here suggest home practice may impact outcomes, similar to the findings of Huppert and Johnson (2010). In the quantitative data, seven of the nine target students showed medium or large changes in mindfulness at either post- or follow-up. In the qualitative data, students described greater awareness of themselves, their thoughts, and their ability to observe, which we coded qualitatively as “mindfulness.” The students with the largest changes also reported the most practice suggesting that mindfulness scores may at least partially be explained by home practice. We also found some evidence that the amount of practice related to improvements in internalizing symptoms, like with Tejas, Javier, Chandra, and Damon. However, Colin and Hannah showed a change in the opposite direction despite reporting

practice. Again, the combination of qualitative and quantitative data helps contextualize this finding. Colin's lack of positive change was likely the result of a ceiling effect in pre-test scores of quantitative measures, and information obtained in the interviews likely explains Hannah's results. Despite frequent use of mindfulness practices and large improvements in mindfulness, Hannah's stress and her internalizing symptoms, especially rumination, deteriorated from pre- to post-. Information from the post-interview revealed that during the study, Hannah experienced the death of a close family member. In her interview, she explained that though she was struggling in some ways with this loss, use of mindfulness practices helped her manage her grief. Contextual data, such as this type of challenging life event, are difficult to take into account in quantitative or qualitative research alone underscoring the need for mixed methods and the usefulness of n-of-1 studies to understand intervention effects (Dattilio et al. 2010; Davidson and Kaszniak 2015; Van Ness et al. 2017).

Unfortunately, we did not collect details on what each student's practice entailed or how long practice lasted, information necessary to fully understand how practice contributes to mindfulness and well-being (Tan 2016). Some students were employing practices, like body scan and yoga, but this varied across participants in terms of type and intensity of practice, as self-reported. However, all students indicated in interviews they were integrating breathing purposefully into their daily routines or using breathing as a response to stress.

Implications

Adolescence is a stressful time, so identifying effective coping strategies that adolescents may use is important for practitioners in school settings. Findings from this systematic case study suggest that for these target students, participation in L2B helped them manage stress by improving their awareness. Students' stress did not decrease; in fact, for a number of students, it increased. But as students honed their awareness, they felt better prepared to handle their stressors. As in other studies, greater use of mindfulness practices was related to more significant improvement in outcomes, like mindfulness and rumination (Parsons et al. 2017; Waters et al. 2015), though the type of practice the individual used was less important (Schussler et al. 2019). This leaves a lot of flexibility for school personnel seeking to implement mindfulness practices or MBPs in their schools.

Students' preference for mindful breathing also has implications for how schools consider ways to reduce students' stress. That all target students described integration of mindful breathing into their daily lives suggests that, at least to an extent, mindfulness can be incorporated into an

adolescent's regular activities in a developmentally appropriate manner (Tan 2016). Sustainability of practices after an intervention is especially important to support positive outcomes (Bergomi et al. 2015). If mindful breathing universally cultivates present-centered awareness—of body, emotions, thoughts—in a way that adolescents can both individualize the practice and integrate it throughout their day, then it can be adopted as a simple coping mechanism to buffer against internalizing problems precipitated by stress (Gini and Pozzoli 2009; Schwartz et al. 2011). Furthermore, mindful breathing is a feasible practice that easily can be incorporated into school routines (Zenner et al. 2014), even those not part of an MBP. It may also provide an accessible starting point for school personnel new to implementing MBPs.

Limitations and Future Research

Limitations of this research include restricted sample. Given the n-of-1 design is intended to provide rich information about individuals, the results are not intended to be generalizable. Although the students in the larger intervention study are representative of each school, as the intervention was universally administered in participating teachers' health classes, students who volunteered for interviews may not represent a general population due to self-selection. Specifically, more high-achieving than lower-achieving students, most of whom adopted some practice, volunteered. Future case studies with more diverse samples are needed. Although the present study included multiple types of data—quantitative self-report, qualitative interviews, open-ended survey questions—another limitation is that data was all student self-report. Future research should use multiple methods, including first-, second-, and third-person data (Davidson and Kaszniak 2015) like observations and biobehavioral data, to investigate the process by which adolescents in an MBP develop self-awareness and self-regulation and how these capacities relate to well-being, including management of stress. More research should also address whether and how MBPs affect individuals' interpersonal interactions, including if compassion training coupled with an MBP is more likely to impact well-being. Specifically, more mixed methods research, including systematic case studies, would be especially helpful in exploring whether MBPs can effectively impact adolescents' relationships and sense of belongingness. Finally, more research is needed on the nature of home practice, including types, amount, and quality (Ribeiro et al. 2018; Waters et al. 2015) and its impact on outcomes, like attention and emotion regulation.

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while J.L.M., E.B., and K.K. led the quantitative data collection. The first draft of the manuscript was written by D.L.S. and Y.O., and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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Compliance with Ethical Standards

Conflict of Interest In accordance with ethical obligations, P.C.B., developer of Learning to Breathe, is reporting a financial interest that may be affected by the research reported in the enclosed paper.

Ethics Approval This study was approved by the Human Research Ethics committee of Pennsylvania State University (Study 00000492; initial approval 2/24/2015).

Informed Consent (1) Consent to Participate—Informed consent was obtained from all individual participants included in the study. Parents of minors provided passive consent to participate. (2) Consent to Publish—Participants provided informed consent for publication of their de-identified data.

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