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A Randomized Trial Evaluating School-Based Mindfulness Intervention for Ethnic Minority Youth: Exploring Mediators and Moderators of Intervention Effects

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Abstract
The study examined the efficacy of a school-based mindfulness intervention on mental health and emotion regulation outcomes among adolescents in a wait-list controlled trial. The study also explored mediators and moderators of intervention effects. A total of 145 predominantly ethnic minority (Asian and Latino) 9th grade students with elevated mood symptoms were randomized to receive a 12-week mindfulness intervention at the start of the academic year, or in the second semester of the year. Students completed measures of emotion regulation and mental health symptoms at baseline, post-intervention, and 3-month follow-up. Intent-to-treat analyses revealed significant treatment effects of the mindfulness intervention for internalizing symptoms and perceived stress at post-treatment. Pooled pre-to-post treatment analyses of the entire sample revealed a small effect size for attention problems, medium for internalizing and externalizing problems, and large for perceived stress. We also found a small effect size for cognitive reappraisal, medium for expressive suppression, emotional processing, emotional expression, and rumination and large for avoidance fusion. Mediation analyses showed that treatment effects on internalizing symptoms and perceived stress were mediated by reductions in expressive suppression and rumination. Moderation analyses revealed that treatment effects were larger among youth with more severe problems at baseline for internalizing problems, externalizing problems, and perceived stress. However, for attention problems, students with lower severity at baseline appeared to have larger treatment gains. The study provided evidence that mindfulness intervention was beneficial for low-income ethnic minority youth in reducing perceived stress and internalizing problems, and improving emotion regulation outcomes. Furthermore, mindfulness training was associated with reduced mental health symptoms via improvements in emotion regulation.

Keywords School-based intervention · Mindfulness · Ethnic minority youth · Depression · Emotion regulation

Introduction

The lifetime prevalence for any mood disorder among adolescents in the U.S. is approximately 14%, with an almost two-fold increase from early to late adolescence (Merikangas et al. 2010). These prevalence rates highlight the need for early detection and intervention. Despite similar levels of internalizing mental health need, ethnic minority youth from immigrant families are less likely to receive intervention, compared to their Non-Hispanic Whites peers (Gudiño et al. 2008, 2009). This remains the case in school mental health settings where barriers to access are reduced (Guo et al. 2014). This is

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a pressing concern for Asian American and Latino youth who show higher levels of internalizing symptoms than other groups (Lau et al. 2016; Martinez et al. 2012). Student problems related to depressed or anxious mood tend not be recognized by educators as they are less disruptive in school contexts (Guo et al. 2014). Within immigrant and ethnic minority families, low mental health literacy and stigma concerns among caregivers may also contribute to the underutilization of mental health services among children of color (Gudiño et al. 2008; Pescosolido et al. 2008; Yeh et al. 2005).

Early universal screening for mental health problems and school-based mental health services have been touted as key strategies to reduce disparities in care for youth (Stephan et al. 2007). School-based interventions, compared to clinic-based interventions, are found to be associated with lower stigma and yielded greater utilization rate especially among ethnic minority youth (Angold et al. 2002; Jaycox et al. 2010). In school settings, mindfulness interventions have emerged as cost-effective and beneficial to address a range of student emotional and behavioral problems (e.g., Semple et al. 2010; Broderick and Metz 2009). Mindfulness is a form of attention training using meditation techniques, in which one learns to pay attention, in the present moment and without judgment (Kabat-Zinn 1994). It is the deliberate act of regulating attention through observing one's thoughts, emotions, and body states (Black et al. 2009). Mindfulness training is touted as promoting skill acquisition that assists learning (Lutz et al. 2008), which is especially helpful during adolescence as executive functions continue to mature. Risk of psychopathology increases dramatically during adolescence (Silk et al. 2003), yet the plasticity of the adolescent brain provides an opportune window for early intervention to build resilience and to prevent onset or halt progression of symptoms (Ahmed et al. 2015).

Schools worldwide have incorporated mindfulness and meditation training in recent years (see Waters et al. 2015 for a review). Overall, studies have found mindfulness interventions to improve attention difficulties (Semple et al. 2010), cognitive control (e.g., Schonert-Reichl et al. 2015), anxiety/depressive symptoms (e.g., Biegel et al. 2009), academic grades (Beauchemin et al. 2008), and reduce conduct problems (Singh et al. 2007) in youth. A recent meta-analysis revealed overall large effects on student cognitive performance, medium effects on resilience to stress, and small effects on mental health symptoms (Zenner et al. 2014). Our research group was among the first to demonstrate the effectiveness of mindfulness interventions with ethnic minority adolescents in schools serving low-income families (Fung et al. 2016). Among students selected on the basis of elevated depression symptoms, intervention effects were observed for internalizing and externalizing symptoms.

However, to date little is known about processes that mediate change in mindfulness interventions with adolescents (Izard 2002). Waters et al. (2015) proposed emotion regulation as one of the ways in which school-based meditation programs may be linked to psychological well-being and social competence. Emotion regulation refers to the process by which individuals influence what emotions they have, when they have them, and how they experience and express them, with the goal of responding to the corresponding environmental demands appropriately (Gross 1998b). In the face of distress or unpleasant emotions, people may choose different ways to regulate or cope with them. Indeed, research with adults suggests that improved emotion regulation subserves the positive effects of mindfulness training (Chambers et al. 2009). Although some studies have documented adaptive emotion regulation as a positive outcome following mindfulness interventions (e.g., Broderick and Metz 2009), studies have not examined the extent to which various emotional regulation processes may mediate the effects of mindfulness interventions on adolescent wellbeing. In the current study, we examine several emotion regulation processes as potential targets of mindfulness training.

First, expressive suppression is the active reduction of emotionally expressive behavior when emotionally aroused (Butler et al. 2003; Gross 1998b). It often leads to incongruence between inner and outer experience and individuals who suppress their emotional expression report more depressive symptoms, lower life satisfaction and self-esteem (Gross and John 2003), and more psychological problems (Gross 1998a; Wegner 1994). These findings have been replicated in both children (Zeman et al. 2002) and adolescents (Betts et al. 2009). Through mindfulness training, which emphasizes non-judgmental awareness and healthy engagement with emotions (Hayes and Feldman 2004), individuals learn to genuinely experience and express their emotions rather than suppress them (Bridges et al. 2004), thus leading to better emotional outcomes.

Relatedly, mindfulness intervention strategies aim to reduce experiential avoidance, which is an attempt to disengage or draw attention away from a particular state or an internal experience (Greco et al. 2008). Adolescents who avoid negative experience report more depressive symptoms (Silk et al. 2003). While avoidance may temporarily provide relief by reducing difficult emotions, it may result in long-term maladjustment (Hayes 2004) and increased depression over time (Aldao et al. 2010). Experiential avoidance is often associated with cognitive fusion, wherein one gets too attached or entangled with the content of their own thoughts and feelings, and perceives them as reality rather than as transient internal phenomena (Luoma and Hayes 2003). Mindfulness training emphasizes the importance of accepting rather than avoiding one's emotional experiences (Brown and Ryan 2004), which is beneficial, regardless of valence of the emotions (Whelton

2004). Mindfulness practices teach individuals to notice and label these internal experiences as emotions and thoughts as a key strategy to promoting detachment from them.

Another common emotion regulation process is cognitive reappraisal, which refers to reinterpreting or thinking about a stressful situation differently as to effectively change its associated distressing emotions (Gross and John 2003; Gross 1998b, 2002). Reappraisal is associated with positive mental health outcomes, including better social support, lower depressive symptoms, greater life satisfaction and better interpersonal functioning (Gross and Thompson 2007). While reappraisal is generally supported as a more adaptive emotion regulation strategy, it may actually be linked to experiential avoidance (i.e. when motivated by an unwillingness to experience an emotion) or rumination (when an individual gets entangled in a web of thoughts). Currently, there is little evidence on the effects of mindfulness training on cognitive reappraisal. In contrast to cognitive behavioral interventions, mindfulness based interventions does not include instruction on restructuring negative thoughts but rather promote acceptance of these thoughts as transient and tolerable. Thus, mindfulness changes how one relates to thoughts and perceptions, which may be reflected in reappraisal. However, rather than changing the content of thoughts, mindfulness may act to changes one's relationship to thoughts.

Rumination involves passive and repetitive focusing of attention on the causes and consequences of one's distress (Nolen-Hoeksema 1991). It is generally considered a maladaptive emotion regulation strategy and is associated with depression (Verstraeten et al. 2009) and anxiety (Michl et al. 2013) in adolescents. Papadakis et al. (2006) argue that rumination amplifies negative emotions associated with everyday stressors by increasing the amount of time focused on personal distress. Other research suggests that rumination is closely linked to cognitive avoidance (Dickson et al. 2012), and ruminative worry may enable emotional avoidance by prolonging favored, predictable, albeit negative emotional states (Newman and Llera 2011). Just as mindfulness practices may reduce experiential avoidance, it may also help adolescents disengage from rumination. The non-judgmental component associated with present-moment observation within mindfulness training may be particularly relevant in reducing rumination (Bishop et al. 2004), as one learns to observe and allow their thoughts to come and go without over-identifying or over-engaging with them. Indeed, studies have found mindfulness to be associated with reduced rumination among adults (Keune et al. 2011; Evans and Segerstrom 2011).

Overall, mindfulness training may promote emotional approach, namely coping through acknowledging, understanding, and expression emotions (Stanton et al. 2002). Stanton et al. (2000) identified two specific types of emotional approach coping strategies: emotional processing (active attempts to acknowledge and understand own feeling) and emotional expression (expressing and overtly letting out emotions). Although early research contends that emotion-focused coping may be less adaptive compared to problem-focused coping, more recent research has found coping through active attempts to acknowledge, understand, and express emotions to be linked with greater hope, self-esteem, psychological well-being, and general functioning in a university sample (Stanton et al. 2000; Smyth 1998). Low use of both emotional processing and expression, on the other hand, predicted increased depressive symptoms and decreased life satisfaction. It is plausible that through mindfulness training, one learns to express and acknowledge their emotions more.

In the context of delivering school-based interventions with culturally diverse youth, it is important to also consider potential diversity in the relations between these facets of emotion regulation and psychological health among adolescents. The studies reported above have included predominantly European American samples and have generally concluded that cognitive reappraisal, emotional approach, and emotional expression are associated with better health outcomes and academic performance (John and Gross 2004), whereas expressive suppression, avoidance fusion, and rumination are associated with poorer mental health (Mennin and Farach 2007). However, other studies have identified the importance of cultural context in understanding the link between emotion regulation practices and wellbeing (Butler et al. 2007; Soto et al. 2011).

For example, expressive suppression may be a more encouraged form of emotion regulation in cultures that are more interdependent (e.g., Asian or Latino contexts) given cultural norms surrounding the value of down-regulating the display of strong emotion to promote group harmony (Butler et al. 2007; Gross and John 2003). Moreover, the negative effects of emotion suppression on depression, anxiety and distress appear diminished among Asian-origin cultural groups and among individuals endorsing interdependent cultural values (Butler et al. 2007; Soto et al. 2011; Tsai et al. 2017). The effects of suppression may also be moderated by acculturation such that it may represent effective coping among youth who are enculturated to their interdependent cultural heritage, but not for those who are more acculturated to Western culture (Huang et al. 1994). Similarly, individuals of Asian descent were found to engage in rumination at a higher rate than European Americans (Chang et al. 2010; Kwon et al. 2013) and the negative effects of rumination appear to be more attenuated among Asian Americans (Chang et al. 2010). Furthermore, two ethnic groups that are both considered interdependent may still vary in cultural norms and practices regarding cultural norms and emotion regulation (Su et al. 2015). As such, it is important to understand the extent to which there may be cultural/ethnic differences in the outcomes associated with emotion regulation processes and how such differences may be relevant to understanding outcomes of mindfulness training. Finally, research on adult psychotherapy has suggested that the initial level of symptoms or

functioning can affect treatment outcomes (e.g., Dimidjian et al. 2006; Elkin et al. 1995). It will be important to examine if these effects will be replicated among adolescents.

This study has three aims. The first aim was to evaluate the efficacy of a school-based mindfulness-based program in reducing mental health symptoms (internalizing, externalizing, and attention problems, and perceived stress) in a sample of ethnic minority youth in a wait-list controlled trial. The second aim was to examine different emotion regulation strategies as potential mediators of outcomes. We hypothesized that mindfulness training will enhance the use of cognitive reappraisal, emotional processing, and emotional expression and reduce expressive suppression, avoidance fusion, and rumination, which in turn improves symptoms of perceived stress, attention and internalizing and externalizing problems. The final aim was to explore potential moderators of outcomes including baseline measures of mental health, youth acculturation, and ethnicity.

Method

Participants

The study represents a close collaboration between two universities and Alhambra Unified School District (AUSD), a local school district in the greater Los Angeles area. AUSD is an urban public school district that serves a high proportion of ethnic minority (41.6% Latino, 51.7% Asian) and low-income families, with 70–81% of students on campuses receiving free or reduced cost lunch. The Gateway to Success Program within AUSD was established in 2005 to partner with universities and community health centers to deliver school-based mental health services to students regardless of whether they are insured, underinsured or non-insured. Data shows that the Gateway program has been effective in linking youth with mental health needs to care (Finer et al., 2014). In this study, participants were recruited from three AUSD high schools. The study sample included two cohorts of ninth-grade students who participated in the mindfulness intervention during the 2013–2014 and 2014–2015 school years. Overall, the sample included a total of 145 students (32.4% male) between the ages of 13 and 15 ($M = 13.99$, $SD = 0.36$). In the sample, 62 students self-identified as Asian American (42.8%) and 62 as Latino (42.8%). 119 students (82.1%) were born in the U.S., while the remaining foreign-born students have lived in the U.S. between 1 to 14 years.

Procedures

Depression Screening and Recruitment

Figure 1 shows the participant flow from recruitment to 3-month post-intervention for the combined two cohorts.

Reflecting an ongoing collaboration with AUSD, the recruitment protocol was slightly altered from the first and to the second cohort to better meet the needs of the school district and students. For the first cohort, all 9th grade students in the district's three high schools participated in a screening survey as part of a routine wellness screening. Given evidence suggesting that disparity in mental health services among ethnic minorities may be due to internalizing over externalizing problem types, a screening measure specific for depressive symptoms in adolescents was chosen to identity youth with indicated needs (Short Mood and Feelings Questionnaire Child version, SMFQ; Angold et al. 1995). All 9th grade students participated in the screening, unless their parents actively opted out of it. In this manner, 1282 out of the total population of 1902 9th grader students (67.4%) were screened. Cut-off scores were determined to identify students who scored in the top 20% of the SMFQ within each school; cut-off scores were set at seven, seven and nine, respectively. The 222 students who met the cutoff on the SMFQ were then administered the Patient Health Questionnaire (PHQ-9; Kroenke and Spitzer 2002) to screen for severe depression and suicidality. Students who endorsed active suicidal ideation and/or received a probable diagnosis of Major Depressive Disorder were excluded from the study and referred for individual therapy through the school district (22 students; 9.9%). The remaining 200 eligible students were then informed about the mindfulness groups at the school and invited to participate. Parent consents and child assents were then obtained. Among the 200 students who were invited to groups, 64 students (32.0%) ultimately enrolled in the program. Of the remaining 136 eligible students who did not participate, 58 students/ parents declined (42.6%) and 78 parents could not be reached for consent (57.4%).

Based on the feedback we received from the school after the first cohort and that a large percent of students (68%) who were screened and eligible did not enroll in the mindfulness program based on the passive consent process, the recruitment process was slightly altered for the second cohort. For the second cohort, school counselors visited all freshman classrooms at the same three high schools in the beginning of the school year and presented the students with the opportunity to participate in the mindfulness program. The program was emphasized as optional for students and described as a chance for them to learn skills to manage stress associated with the stressful transition to high school. Active consent was sought where students indicated anonymously whether they were interested or not interested in participating in the mindfulness program on a slip. Among the 253 students who expressed interest in participating, 182 students (71.9%) received parent consent to first complete the screening survey (SMFQ), and if eligible, participate in the mindfulness groups. For the remaining 71 students (28.1%), 32 (12.6%) students/parents declined and 37 (14.6%) parents could not be reached for consent. Given

Fig. 1 Participant flow chart
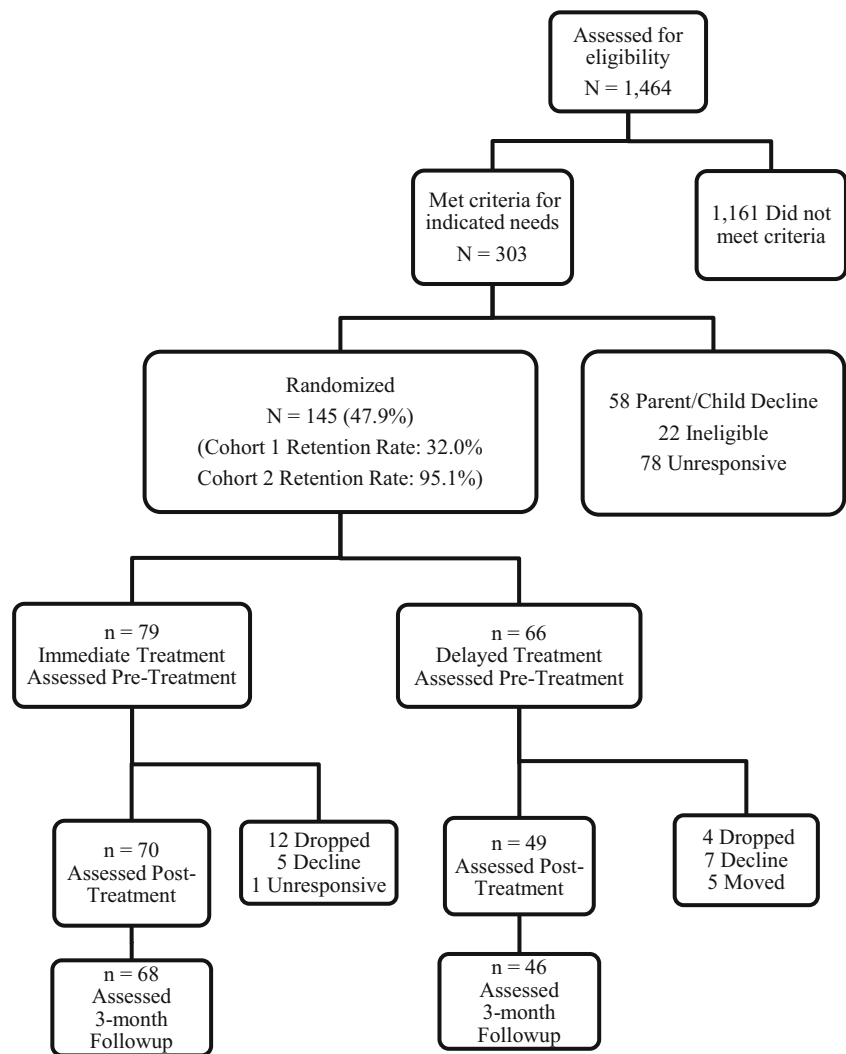
the much smaller number of students who were screened, instead of using the top 20th percentile as the cut-off like with the first cohort, the SMFQ cut-off score was set at eight at all three schools for the second cohort based on past studies suggesting it as an indicator for mild to moderate depression (Stoep et al. 2005). In the second cohort, a total of 81 students (44.5%) met the cut-off criteria and were invited to participate in mindfulness groups. Among those who were invited, 77 students (95.1%) enrolled in the groups and only four students (4.9%) did not enroll (three declined and one was deemed inappropriate for groups by the school counselor due to significant behavioral problems). Two students showed significant distress based on the PHQ9 assessment and were subsequently referred for individual counseling through the school district but were not excluded from groups.

For both cohorts, after parental consent and student assent were obtained, students were randomized into the treatment group or the delayed treatment group by sealed envelope. Treatment groups were held in the fall semester whereas delayed treatment groups were held in the spring semester. In the

first cohort, 64 students were randomized into treatment ($n = 37$) or delayed treatment ($n = 27$) groups. In the second cohort, 81 students were randomized into treatment ($n = 42$) or delayed treatment ($n = 39$) groups. The combined cohorts had a total number of 145 students randomized into treatment (fall, $n = 79$) or delayed treatment (spring, $n = 66$) groups. A total of four mindfulness groups was conducted at each high school (two treatment groups and two delayed treatment control groups). Each group comprised of no more than ten students and was conducted on campus during school hours. Each group was led by two advanced doctoral psychology students who had one to four years of clinical experience. Although group leaders were not required to have prior training or practice of mindfulness, they all learned about mindfulness-based intervention, received a 2-day training on the Learning to BREATHE (L2B) curriculum, watched training videos by the curriculum developer, and received weekly supervision from the first and last authors. Treatment groups were conducted from October to May of each school year (2013–2014 and 2014–2015). All study procedures were approved by and

in accordance with the ethical standards of the Institutional Review Boards at Fuller Theological Seminary and University of California, Los Angeles.

Intervention

The students received a mindfulness-based stress reduction (MBSR) program based on a curriculum called Learning to BREATHE (L2B) (Broderick 2013). The L2B program was designed for middle and high school students to facilitate their development of emotion regulation and aims to increase their understanding of their thoughts and feelings while providing guided group practice. There are six core themes in the L2B program: body awareness (Body), understanding and working with thoughts (Reflection), understanding and working with feelings (Emotion), integrating awareness of thoughts, feelings and bodily sensations (Attention), reducing harmful self-judgments (Tenderness), and integrating mindful awareness into daily life (Habit). Group leaders spend two sessions on each of the core themes, for a total of 12 sessions for the current study's intervention. Each session lasts approximately 50 min and involves an opening mindful breathing practice (5 min), homework review (10 min), a short didactic presentation of the theme of that week (5 min), group discussions and activities to illustrate the theme (10 min), an in-session group mindfulness meditation practice (15 min), and homework assignment (5 min). Core practices include the body scan, mindfulness of thoughts, mindfulness of emotions, and loving kindness. Each week, students were assigned mindfulness meditation practices as homework and were provided audio recordings of mindfulness practices to support their home-based practice.

Intervention Adherence

Session Selection Four sessions were randomly selected from each of the two cohorts at each of the three schools across the two study years in order to ensure even distribution of coding. A total of 48 sessions (16.67% of sessions delivered) were coded for adherence.

Coder Training Coders received introductory training on mindfulness, attended an orientation to the Learning to Breathe program, and read relevant sections of the manual. Coders attended didactics on adherence coding and each coded one gold standard session. The coder was deemed reliable once he/she scored within one point difference between his/her score and the trainer-established adherence score for the same session. To ensure security and confidentiality all session recordings were stored on an encrypted and password protected server at the home institutions and all coding was completed within the research lab.

Adherence Scores Study sessions were coded for adherence to the Learning to Breathe adherence coding rubric supplied by the developer (Broderick and Metz 2009). In the adherence coding rubric, sessions were given a score of 1 for each activity listed in the rubric that was observed within the recording. Maximum scores for each session ranged from 7 to 20 points, with an average of 12.42 possible points per session. Across all coded sessions, the average adherence score was 89.6% (range 70.6%–100%), indicating good adherence to the Learning to Breathe curriculum.

Assessment

Assessments were conducted during three time points within the immediate treatment condition: pre-treatment, post-treatment and 3-month follow-up. Students in the delayed treatment condition completed a second baseline assessment at the conclusion of the immediate treatment group, resulting in four assessment time points. All student assessments were conducted on school-campus. Internal consistency is reported at Time 1.

For the immediate treatment condition of the combined cohorts, four students were randomized but declined during baseline assessment and did they return for following assessments. One student was randomized and participated in baseline assessment, but did not return for groups or follow-up assessments. Twelve students dropped out of treatment, but continued to be assessed for all time-points. For the delayed treatment condition, five students moved out of the district and did not complete all three time-points. Eight students participated in the initial baseline assessment, but declined prior to participating in groups and did not return for following assessments. Four students dropped out of treatment and did not return for following assessments. This yielded an overall retention rate of (78.6%). Using intent-to-treat conventions, the main analyses for the current study included all students for whom baseline data was obtained ($n = 145$).

Data Analytic Plan

To determine the effects of the intervention, ANCOVA analyses were conducted to examine the effect of condition on post-treatment measures of primary treatment outcomes and potential mediators, controlling for baseline measures. To explore changes over time in the full sample, data from the treatment and delayed treatment group were pooled and repeated measures ANOVA were conducted to examine effects of time from baseline to post-treatment to three-month follow-up. Intention-to-treat (ITT) analyses were conducted and all missing data were handled using the last-observation-carried-forward method, which is considered a conservative approach. Moderation and mediation analyses via bootstrapping were conducted using the pooled sample. Finally, data on treatment

acceptability (enrollment rate, retention rate, and levels of satisfaction) were reported.

Measures

Youth Behavior Problems The 112-item Youth Self Report (YSR; Achenbach 1991) was used to assess participants' emotional and behavioral problems. Participants reported on their experience of *internalizing problems* (e.g., "I feel dizzy of lightheaded"; "I feel worthless or inferior"), *externalizing problems* (e.g., "I destroy my own things"; "I break rules at home, school, or elsewhere"), and *attention problems* (e.g., "I daydream a lot"; "I have trouble concentrating or paying attention") over the last six months on a 3-point Likert-type scale (0 = *Not true* to 2 = *Very true or often true*). T-scores for internalizing, externalizing, and attention problems, which take into account the participant age and gender, were calculated using the ADM scoring software. The YSR has well established reliability and validity among different racial/ethnic youth groups (e.g., Gudiño et al. 2009; Polo and López 2009; Achenbach 1991).

Perceived Stress Participants' experience of stressful experiences over the past month was assessed via the 9-item Perceived Stress Scale (PSS; Cohen et al. 1994). The PSS has consistently shown strong reliability (e.g., α range = 0.73–0.93) with both Latino American and Asian American samples (e.g., Nguyen-Rodriguez et al. 2008; Hwang and Ting 2008; Taylor-Piliae et al. 2006). Participants rated how often they perceived stressful situations to occur in the last month (e.g., "In the last month, how often have you felt nervous and 'stressed'?") on a 5-point Likert-type scale (0 = *Never* to 4 = *Very often*). The mean score was used in analyses with higher scores representing higher perceived stress in the last month. Participants completed the measure at pre-treatment, post-treatment, and follow-up. The measure showed acceptable reliability at baseline (α = 0.73).

Emotion Regulation The 10-item Emotion Regulation Questionnaire for Children and Adolescents (Gullone and Taffe 2012) was used to assess participants' emotion regulation patterns. Of the full measure, 6 items tap in *cognitive reappraisal* (e.g., "When I want to feel happier, I think about something different") and 4 items tap into *expressive suppression* (e.g., "I keep my feelings to myself"). Each item is rated on a 5-point Likert-type scale (0 = *Strongly disagree* to 4 = *Strongly agree*). Both cognitive reappraisal (α = 0.82) and expressive suppression (α = 0.68) subscale show acceptable reliability. Reliability and validity of the ERQ was established with multiple samples with strong ethnic minority representation (Gross and John 2003 with α ranging from 0.75–0.82 for cognitive reappraisal and from 0.68–0.76, for expressive suppression.

Emotional Approach Coping Participants' reported on their coping through emotional approaches by using the 8-item Emotional Approach Coping Scale (Stanton et al. 2000). The measure has been shown to reliable with a sample of ethnically diverse youth (e.g., α = 0.88; Tull et al. 2006). Participants were asked to indicate how often they engage in *emotional expression* (4 items; e.g., "I allow myself to express my emotions," α = 0.84) and *emotional processing* (4 items; e.g., "I take time to figure out what I'm really feeling," α = 0.74) in order to cope with their feelings on a 5-point Likert-type scale (0 = *I don't do this at all* to 4 = *I do this all the time*). Higher mean scores indicate greater frequency in engaging in emotional expression and emotional processing, respectively.

Avoidance Fusion The 8-item short form of the Avoidance and Fusion Questionnaire for Youth (AFQ-Y8; Greco et al. 2008) was used to capture participants' psychological inflexibility in via cognitive fusion (e.g., "If I feel sad or afraid, something must be wrong with me") and experiential avoidance (e.g., "I push away thoughts and feelings that I don't like"). Participants rated their agreement with each item on a 5-point Likert-type scale (0 = *Not at all true* to 4 = *Very true*). While the original AFQ measure was originally developed and validated with a predominantly non-Hispanic White sample, the measure has since demonstrated strong reliability when administered to ethnically diverse youth (e.g., α = 0.81–0.87; Howe-Martin et al. 2012). The measure illustrated good reliability at baseline (α = 0.79).

Rumination Patterns of self-focused rumination was assessed using the 13-item rumination subscale of the Children's Response Styles Questionnaire (Abela et al. 2004). Participants were asked to report on what they do (and not what they think they should do) when feeling sad (e.g., "Think about how alone you feel") on a 5-point Likert-type scale (0 = *Almost never* to 4 = *Almost always*). Higher scores on the rumination scale indicate a greater tendency to ruminate when feeling sad or low mood. The reliability and validity of the rumination subscale of the CRSQ has been well established with multiple adolescent samples, including a majority ethnic minority community-based sample of adolescents (α range = 0.86–0.88; Hilt et al. 2010; McLaughlin and Hatzenbuehler 2009). The scale illustrated strong reliability for our sample of adolescents at baseline (α = 0.91).

Heritage Language Enculturation The heritage language enculturation scale was developed by adapting a pre-existing measure 3-item of heritage language fluency (Kim and Chao 2009) and incorporating measurement of individuals' heritage language use frequency. The resulting scale consists of 3 items assessing individuals' language ability (e.g., "How well do you speak and understand this other language?") and 2 items assessing the frequency of heritage language use (e.g., "How

often do you listen to music/radio or watch television/movies in this other language?"). Participants rated their ability and frequency of their heritage language use on a 5-point Likert-type scale (0 = *Not at all* to 4 = *Almost perfectly/always*). Participant responses were average to create an enculturation index score. Only participants who reported heritage language use reported on their heritage language enculturation, while participants who denied heritage language use were given an index score of 0. In addition to being the standard method of assessing language ability, self-reported language ability has been shown to be reliable and have concurrent validity with third-party ratings of language ability (Portes & Hao, 2002). The current enculturation scale also showed high reliability with our sample (Cronbach's $\alpha = 0.87$).

Post-Intervention Evaluation The post-intervention satisfaction questionnaire evaluates youth's overall experience in the program. Youth rated how helpful they found various components of the mindfulness program on a 10-point Likert-type scale (1 = *Not useful*, 10 = *Very useful*). They also rated how often they practiced mindfulness and used the audio files to support their practice. Finally, youth responded to open-ended questions about what they have learned and whether they would recommend the program to their friends.

Results

Preliminary Analyses

Table 1 displays means and standard deviations of demographic variables, and child behavior problems at baseline for immediate and delayed treatment groups. Independent samples *t*-tests were conducted to examine immediate and delayed treatment group differences on demographic and main study variables (Table 1). Based on the results, there were no significant differences on all study variables with the exception of externalizing problems and cognitive reappraisal. Students in the delayed treatment group reported higher levels of externalizing problems and lower levels cognitive reappraisal compared to students in the immediate treatment group at baseline. There was an 84.43% overall retention rate in the intervention study (16 students dropped out of treatment). Youth on average attended 9.05 out of 12 sessions.

Table 2 displays bivariate correlations between main study variables at baseline. Cognitive reappraisal was associated with decreased stress and internalizing problems. Emotional processing was not associated with any mental health outcomes, whereas emotional expression was negatively associated with perceived stress. Expressive suppression, on the other hand, was positively associated with internalizing problems and perceived stress. Finally, avoidance fusion and

rumination were both significantly correlated with increased internalizing, externalizing, and attention problems, and perceived stress.

Pre- to Post-Treatment Efficacy

Due to our research design, students were nested within cohorts within schools. As such, we ran a series of four null models predicting post-intervention internalizing symptoms, externalizing symptoms, attention problems, and perceived stress to assess the amount of variance account for at the cohort level and the school level. Intra-class correlation coefficients were low at both the school level (ICC < 0.01) and the cohort within school level (ICC < 0.05), indicating minimal clustering. Multilevel modeling was thereby determined unnecessary for the following analyses (Hayes 2006).

To determine the effects of the intervention, ANCOVA analyses were conducted to examine the effect of condition on post-treatment measures of primary treatment outcomes and potential mediators, controlling for baseline measures. Table 3 displays the results indicating that immediate treatment was significantly associated with reduction in internalizing problems ($F(1, 137) = 6.08$, $p = 0.015$), perceived stress ($F(1, 140) = 11.86$, $p < 0.001$), and rumination ($F(1, 133) = 11.96$, $p < 0.001$). Immediate treatment was also marginally associated with reduction in avoidance and fusion ($F(1, 139) = 3.52$, $p = 0.063$). In addition, immediate treatment was associated with increase in cognitive reappraisal ($F(1, 140) = 7.56$, $p = 0.007$), emotional processing ($F(1, 140) = 10.23$, $p = 0.002$), and emotional expression ($F(1, 140) = 6.41$, $p = 0.012$). Immediate treatment was not associated with changes in externalizing problems, attention problems, and expressive suppression.

To explore changes over time, secondary analyses were conducted in which data were pooled for all participants to simulate an open trial design. Time 1 (baseline) data from the immediate treatment condition was combined with Time 2 (second baseline) pretreatment data from the delayed treatment condition to create a pooled pretest group. Time 2 (post-treatment) data from the immediate treatment condition was combined with Time 3 (post-treatment) data from the delayed treatment condition to create a pooled posttest group. Time 3 (follow-up) data from the immediate treatment condition was combined with Time 4 (follow-up) data from the delayed treatment condition to create a pooled follow-up group. A repeated measures ANOVA was conducted to examine effects of time. As displayed in Table 4, there were significant effects of time in the pooled sample on all primary outcomes and potential mediators. Youth across treatment conditions showed reduction in internalizing, externalizing, and attention problems, stress, expressive suppression, avoidance and fusion, and rumination. In addition, youth demonstrated improvement in emotional processing, and emotional

Table 1   Baseline characteristics of treatment and delayed treatment groups

	Immediate ($n = 79$)		Delayed ($n = 66$)		
Socio-Demographics					
Gender	27 Male, 52 Female		20 Male, 46 Female		
Ethnicity	39 Hispanic, 34 Asian, 3 Caucasian, 1 African American, 2 Mixed		25 Hispanic, 31 Asian, 2 Caucasian, 2 African American, 6 Mixed		
% US Born	85%		79%		
	M	*SD*	*M*	*SD*	$t(138)$
Age	14.0	0.34	14.0	0.37	−0.04
Primary outcomes					
Internalizing Problems	66.96	9.07	67.58	10.45	0.37
Externalizing Problems	55.22	9.33	59.67	14.37	2.20*
Attention Problems	68.49	12.53	69.53	13.17	0.48
Perceived Stress	2.39	0.55	2.29	0.55	−1.11
Potential mediators					
Cognitive Reappraisal	2.35	0.79	2.04	0.72	−2.47*
Expressive Suppression	2.34	0.79	2.24	0.80	−0.74
Emotional Processing	1.72	0.95	1.80	0.83	0.54
Emotional Expression	1.35	0.99	1.44	0.89	0.55
Avoidance Fusion	1.89	0.95	1.94	0.74	0.33
Rumination	26.35	11.55	28.98	11.47	1.33

*$p < 0.05$

expression as a function of time. All these effects were maintained at the 3-month follow-up.

Moderation Analyses

To determine whether there was potential variability in treatment effects, we examined three potential moderators: baseline symptom severity, race/ethnicity, and heritage enculturation as potential moderators of intervention effects on four primary outcome measures: internalizing problems, externalizing problems, attention problems, and stress. Mauchly's Test of Sphericity indicated that the assumption of sphericity had been violated in tests of internalizing problems ($\chi^2(2) = 34.14$, $p < 0.001$) and attention problems ($\chi^2(2) = 31.22$, $p < 0.001$); therefore, a Greenhouse-Geisser correction was used in those instances. We found significant interactions between time and symptoms at baseline for internalizing problems ($F(1.64, 229.92) = 16.40$, $p < .001$), externalizing problems ($F(2, 280) = 24.24$, $p < 0.001$), attention problems ($F(1.67, 235.02) = 7.85$, $p < 0.01$), and perceived stress ($F(2, 284) = 34.78$, $p < 0.001$). Post hoc two-level mixed regression analyses with each time-point nested within the participant were conducted. As illustrated in Fig. 2, there were significant interactions between time and baseline symptoms such that

Table 2   Bivariate correlations of main study variables at baseline

Variables	1	2	3	4	5	6	7	8	9	10
1. Cognitive reappraisal	–									
2. Expressive suppression	0.08	–								
3. Emotional processing	0.33***	−0.06	–							
4. Emotional expression	0.38***	−0.16†	0.69***	–						
5. Avoidance fusion	0.08	0.41***	0.09	0.04	–					
6. Rumination	−0.08	0.24**	0.18*	0.05	0.59***	–				
7. Internalizing problems	−0.06	0.42***	−0.02	−0.12	0.56***	0.48***	–			
8. Externalizing problems	−0.23**	−0.03	0.05	0.06	0.26**	0.29***	0.22***	–		
9. Attention problems	−0.04	0.14	−0.05	0.03	0.28***	0.28***	0.49***	0.21***	–	
10. Perceived stress	−0.20*	0.25**	−0.11	**−0.20***	0.47***	0.41***	0.38***	0.25***	0.23***	–

†$p < 0.10$. * $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$

Table 3 Summary of primary treatment outcomes

| | Time 1 | | | | Time 2 | | | | ANCOVA | | |
| | Immediate treatment | | Delayed treatment | | Immediate treatment | | Delayed treatment | | F (1, 133) | η_p^2 | Cohen's d |
	M	SD	M	SD	M	SD	M	SD			
Primary outcomes											
Internalizing problems	66.96	9.07	67.58	10.45	62.60	17.31	68.00	15.12	6.08*	0.04	0.42
Externalizing problems	55.22	9.33	59.67	14.37	52.53	10.04	57.34	13.33	0.58	0.00	0.10
Attention problems	68.49	12.53	69.53	13.17	62.92	11.52	66.09	13.23	2.32	0.02	0.26
Perceived stress	2.39	0.55	2.29	0.55	1.94	0.56	2.18	0.64	11.86***	0.08	0.58
Potential mediators											
Cognitive reappraisal	2.35	0.79	2.04	0.72	2.53	0.61	2.12	0.70	7.56**	0.05	0.46
Expressive suppression	2.34	0.79	2.44	0.80	2.07	0.76	2.17	0.76	1.86	0.01	0.23
Emotional processing	1.72	0.95	1.80	0.83	2.01	0.91	1.69	0.82	10.32**	0.07	0.54
Emotional expression	1.35	0.99	1.44	0.89	1.78	1.03	1.53	1.00	6.41*	0.04	0.43
Avoidance fusion	1.89	0.95	1.94	0.74	1.31	0.92	1.48	0.77	3.52†	0.02	0.32
Rumination	26.35	11.55	28.98	11.47	21.11	10.65	27.68	10.70	11.96***	0.08	0.60

Age and gender as covariate

† $p < 0.10$. * $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$

Table 4 Pre-treatment, post-treatment, and follow-up outcomes in the full ITT sample

	Pre-treatment M (SD)	Post-treatment M (SD)	Follow-up M (SD)	F(2, 284) Time	η_p^2	Cohen's d
Primary outcomes						
Internalizing problems	67.41 (12.24)[a]	64.55 (16.48)[a]	62.28 (16.85)[b]	8.88[***]	0.06	0.51
Externalizing problems	56.21 (11.40)[a]	54.54 (10.55)[b]	53.33 (10.37)[b]	10.76[***]	0.07	0.56
Attention problems	67.37 (12.91)[a]	64.71 (11.68)[b]	64.71 (12.91)[b]	5.26[**]	0.04	0.39
Stress	2.30 (.59)[a]	1.98 (.61)[b]	1.96 (.64)[b]	27.60[***]	0.16	0.88
Potential mediators						
Cognitive reappraisal	2.24 (0.76)	2.39 (.69)	2.30 (.68)	3.50[*]	0.02	0.31
Expressive suppression	2.25 (0.78)[a]	2.03 (0.84)[b]	1.91 (0.75)[b]	16.56[***]	0.10	0.68
Emotional processing	1.70 (0.88)[a]	1.97 (.92)[b]	2.04 (.98)[b]	12.17[***]	0.08	0.58
Emotional expression	1.42 (.98)[a]	1.66 (1.04)[b]	1.84 (1.02)[c]	13.39[***]	0.09	0.61
Avoidance fusion	1.72 (0.88)[a]	1.30 (0.85)[b]	1.24 (0.82)[b]	28.86[***]	0.17	0.90
Rumination	27.06 (11.29)[a]	23.67 (10.97)[b]	23.23 (11.19)[b]	13.41[***]	0.09	0.61

Means with different superscripts denote significantly different means

[*] $p < 0.05$. [**] $p < 0.01$. [***] $p < 0.001$

students with increased internalizing symptoms ($B_{post\text{-}treatment}$ $= -0.41$, $p < 0.001$; $B_{follow\text{-}up} = -0.50$, $p < 0.001$) externalizing symptoms ($B_{post\text{-}treatment} = -0.32$, $p < 0.001$; $B_{follow\text{-}up} = -0.38$, $p < 0.001$), and perceived stress ($B_{post\text{-}treatment} = -0.05$, $p < 0.001$; $B_{follow\text{-}up} = -0.07$, $p < 0.001$) at baseline demonstrated greater improvements from the mindfulness intervention at both post-treatment and follow-up. For attention problems, analyses revealed the opposite patterns of results with students higher on attention problems at baseline exhibiting attenuated improvements in attention problems compared with students with lower scores on attention problems at baseline ($B_{post\text{-}treatment} = 0.45$, $p < 0.001$; $B_{follow\text{-}up} = 0.46$, $p < 0.001$).

Second, we explored child race/ethnicity as a potential moderator of intervention effects, comparing Asian and Latino students. Mauchly's Test of Sphericity indicated that the assumption of sphericity had been violated, $\chi^2(2) = 11.37$, $p < 0.01$, and therefore, a Greenhouse-Geisser correction was used. There was a significant interaction between time and ethnicity for child-reported attention problems ($F(0.83, 221.94) = 5.64$, $p = 0.005$) only. Post hoc subgroup regression analyses revealed that there was a significant main effect of time on attention problems for youth who are of Asian descent ($F(2, 116) = 17.13$, $p < 0.001$), but this relationship was not significant for youth who are of Hispanic descent. No other interactions were found between ethnicity and time on the remaining mental health outcomes.

Finally, we explored child enculturation to their heritage language as a potential moderator of intervention effects. There was a no significant interaction between time and enculturation to heritage language on child-reported internalizing problems ($F(1.57, 220.31) = 0.37$, $p = 0.69$), externalizing problems ($F(1.82, 254.27) = 0.04$, $p = 0.96$), attention problems ($F(1.64, 231.42) = 2.31$, $p = 0.11$), or perceived stress ($F(1.81, 256.28) = 0.30$, $p = 0.96$). A Greenhouse-Geisser

correction was used to correct for violation for assumption of sphericity in the above analyses.

Mediation Analysis

A series of hierarchical regression analyses were employed to examine three adaptive emotion regulation strategies (cognitive reappraisal, emotional processing, and emotional expression) and three maladaptive emotion regulation strategies (expressive suppression, avoidance fusion, and rumination) as potential mediators that may explain treatment effects on the primary outcomes. Mediation analyses were conducted on the two primary outcomes that improved as function of treatment group in the efficacy analyses described above (internalizing problems and perceived stress). Indirect effects were tested using the PROCESS macro version 2.16 within SPSS (Hayes 2013) with 10,000 bootstrap samples for bias-corrected bootstrap 95% confidence intervals. Analyses were not conducted on the remaining two mental health outcomes that did not improve as a function of treatment group (externalizing problems and attention problems). Change scores for each of the potential mediators were calculated from pre- to post- treatment to determine whether these changes mediated treatment effects on internalizing problems and stress.

Primary Outcome 1: Internalizing Problems In the first step, treatment condition predicted post-treatment internalizing problems ($\beta = -0.17$, $p < 0.05$), controlling for age, gender, and baseline level. In the second step, treatment condition was significantly associated with changes in expressive suppression ($\beta = -0.21$, $p < 0.05$), avoidance fusion ($\beta = -0.17$, $p < 0.05$), and rumination ($\beta = -0.23$, $p < 0.01$). In the third step, changes in expressive suppression ($\beta = 0.20$, $p < 0.001$), avoidance fusion ($\beta = 0.36$, $p < 0.001$), and rumination ($\beta =$
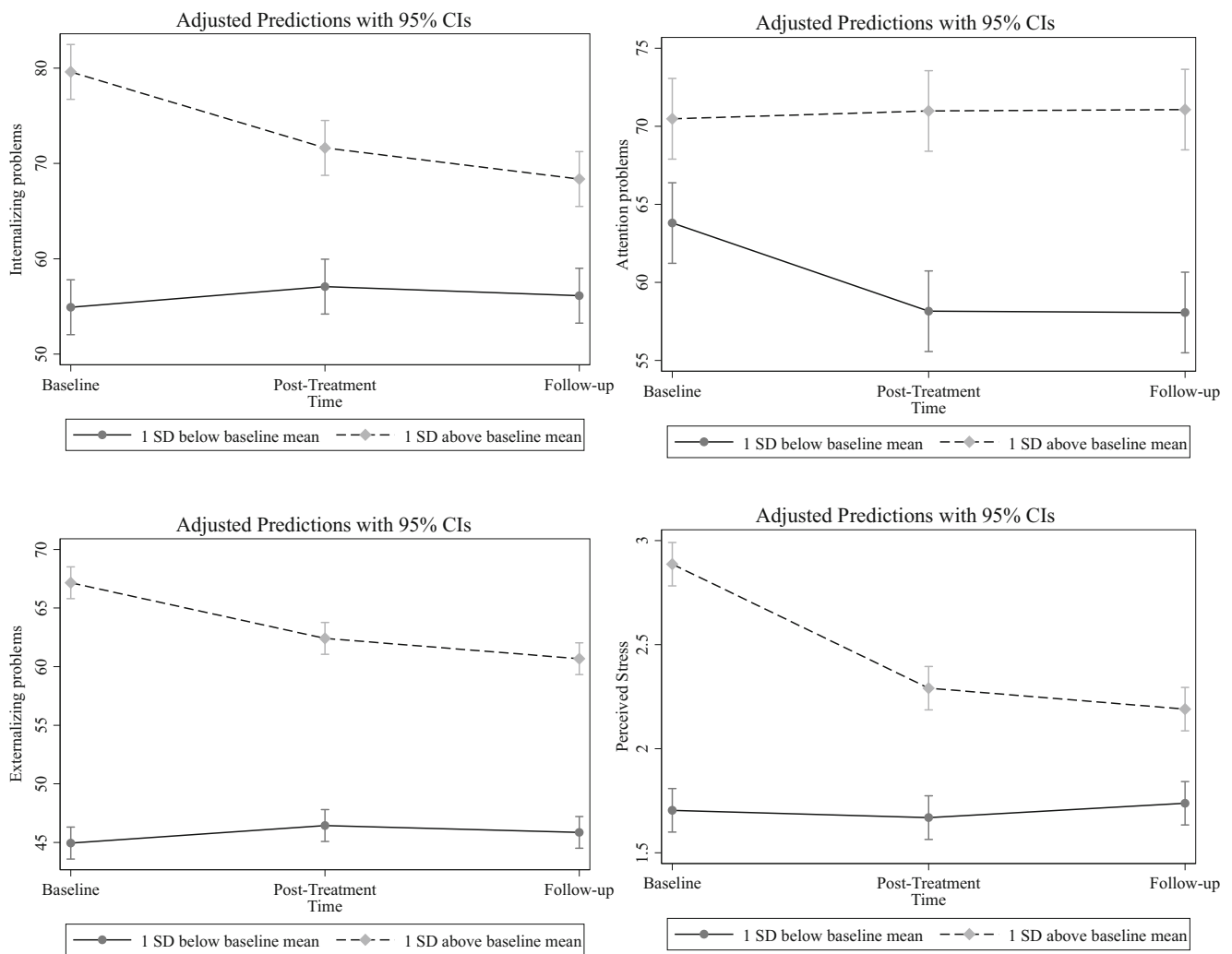
Fig. 2 Moderation by baseline symptoms

0.37, $p < 0.001$) were associated with post-treatment internalizing problems. In the final step, as displayed in Table 5, when the change score for each of the three mediators was added to the equation, it independently predicted variance in post-treatment internalizing problems after controlling for age, gender, and baseline levels, and treatment condition status no longer predicted internalizing problems, suggesting full mediation. A test of the indirect effect using the PROCESS macro with 10,000 bootstrap samples for bias corrected bootstrap confidence intervals indicated that the effect of the intervention on internalizing behavior problems was significantly mediated by changes in expressive suppression ($b = -1.06$, $SE = 0.72$, 95% CI $= -3.02$, -0.06) and rumination ($b = -1.59$, $SE = 1.03$, 95% CI $= -4.22$, -0.16). Changes in avoidance fusion, cognitive reappraisal, emotional processing, and emotional expression did not mediate the effect of the intervention on internalizing problems.

Primary Outcome 2: Perceived Stress First, treatment condition predicted post-treatment perceived stress ($\beta = -0.24$,

$p < 0.01$), controlling for age, gender, and baseline level. Second, as described above, treatment condition was significantly associated with changes in expressive suppression, avoidance fusion, and rumination. Third, changes in expressive suppression ($\beta = 0.21$, $p < 0.01$), avoidance fusion ($\beta = 0.26$, $p < 0.001$), and rumination ($\beta = 0.25$, $p < 0.01$) were associated with post-treatment perceived stress. Finally, as displayed in Table 6, when the change score for each of the three mediators was added to the equation, it was associated with post-treatment perceived stress after controlling for age, gender, and baseline levels, and the effect of treatment condition was no longer significant, suggesting full mediation. Furthermore, the tests of indirect effects using 10,000 bootstrap samples indicated that the effect of the intervention on perceived stress was significantly mediated by changes in expressive suppression ($b = -0.03$, $SE = 0.02$, 95% CI $= -0.10$, -0.003) and rumination ($b = -0.04$, $SE = 0.02$, 95% CI $= -0.10$, -0.01). Changes in avoidance fusion, cognitive reappraisal, emotional processing, and emotional expression did not mediate the effect of the intervention on perceived stress.

Table 5 Regression analyses of expressive suppression and rumination as mediators of intervention effects on internalizing behavior problems

	B	SE	β	Indirect effect
Step 1				
Age	−0.15	2.41	0.00	
Gender	3.02	1.86	0.11	
Time1 internalizing problems	0.71	0.07	0.65**	
Treatment condition	−4.55	1.68	−0.17**	
Step 2				
Mediator 1: Expressive suppression				
Time1 internalizing problems	0.73	0.07	0.67**	−1.06*
Treatment condition	−3.51	1.63	−0.13*	
Expressive suppression change scores	3.09	1.11	0.18**	
Mediator 2: Rumination				
Time1 internalizing problems	0.81	0.07	0.74**	−1.59*
Treatment condition	−2.45	1.54	−0.09	
Rumination change scores	0.45	0.08	0.35**	

$^†p < 0.10$, $^* p < 0.05$, $^{**} p < 0.01$

Acceptability of Treatment

At Week 12, youth reported moderate levels of satisfaction. They gave an overall mean rating of 7.35 ($SD = 2.03$) on a scale of 1 to 10 across different components of the mindfulness program. In terms of engagement, 45.5% of youth reported practicing mindfulness at least two to three times a week and 32.2% reported using the audio files at least once a week. Finally, 93.3% of youth indicated that they would recommend the mindfulness program to a friend. When asked what was the most important thing they learned from the mindfulness intervention, many students indicated stress management. They said they learned "how to handle stressful moments," "that you don't have to feel stressed all the time you can do things to prevent it or for it to go away," or "that no matter how stressful life can be, you can always control it by doing certain things." They also shared about learning how to relate to their emotions better, that they learned "how to understand and comprehend my feeling so I would know how to deal with them," "how to notice my feelings before doing anything," and "that it's okay to feel the way you are feeling."

Discussion

Findings from the current study demonstrate that a school-based mindfulness intervention was efficacious in reducing behavior problems and improving emotion regulation

Table 6 Regression analyses of expressive suppression and rumination as mediators of intervention effects on perceived stress

	B	SE	β	Indirect effect
Step 1				
Age	0.08	0.14	0.05	
Gender	0.14	0.10	0.11	
Time1 perceived stress	0.51	0.08	0.49**	
Treatment condition	−0.29	0.10	−0.24**	
Step 2				
Mediator 1: Expressive suppression				
Time1 perceived stress	0.55	0.08	0.51**	
Treatment condition	−0.28	0.09	−0.23*	
Expressive suppression change scores	0.11	0.06	0.13†	−0.03*
Mediator 2: Rumination				
Time1 perceived stress	0.53	0.08	0.50**	
Treatment condition	−2.47	0.10	−0.20	
Rumination change scores	0.01	0.01	0.17*	−0.04*

$^†p < 0.10$, $^* p < 0.05$, $^{**} p < 0.01$

outcomes among ethnic minority youth with elevated depressive symptoms in a wait-list controlled trial. In terms of the primary mental health outcomes, relative to youth in the delayed treatment condition, youth who were in the immediate treatment condition demonstrated lower levels of internalizing problems and perceived stress. Effects sizes were in the medium range, which were comparable to that found in previous studies (e.g., So and Orme-Johnson 2001) but higher than others (e.g., Joyce et al. 2010). But overall, these effect sizes are within the range of that reported in a meta-analysis of mindfulness-based interventions for child and youth behavior problems (Burke 2010). Our pooled pre-to-post treatment analyses of the entire sample revealed small size effect for attention problems, medium for internalizing and externalizing problems, and large for perceived stress. These observed improvements were all maintained at the three-month follow-up. The observed large effect of mindfulness training on perceived stress may be due to the fact that our screening measure identifies youth with elevated stress symptoms. Furthermore, perceived stress was a targeted symptom within the mindfulness intervention, which may account for the observed greatest improvements in perceived stress.

In terms of the different emotion regulation outcomes, our end-point analyses suggested mindfulness intervention was effective in reducing rumination while increasing cognitive reappraisal, emotional processing and emotional expression. Effect sizes were small for cognitive reappraisal, expressive suppression, emotional expression and avoidance fusion and medium for emotional processing and rumination. The pooled pre-to-post treatment analyses of the entire sample revealed that these observed improvements were maintained at three months following the intervention. Consistent with previous work that found mindfulness to increase emotional awareness and acceptance of emotional responses among adolescents (Metz et al. 2013), larger effect sizes were observed with more emotion-focused strategies (reduction in rumination and improvement in emotional processing). The largest effect size observed for rumination suggests that present-moment focus within mindfulness training may be particularly effective in helping youth to not get entangled in their thoughts but to simply observe them as they come and go.

Results of mediation analyses revealed that improvements in youth internalizing problems and stress could be accounted for by the reduction of expressive suppression and rumination. Treatment related changes in avoidance fusion, cognitive reappraisal, emotional coping, and emotional processing did not mediate youth mental health outcomes. Emotion regulation difficulties can take different forms. One way to manage difficult emotions is to avoid or suppress them, for example by denying or pushing away unpleasant feelings (expressive suppression). Another way is to be preoccupied or consumed by the emotions and experiences (rumination). Mindfulness emphasizes open and non-judgmental awareness of one's

thoughts, feelings and bodily sensations, regardless of valence. Thus, it represents a different, healthier way of engaging with one's emotions and experience. In mindfulness practice, one's attention is constantly redirected back to the present moment to avoid "secondary elaborating processing" of thoughts, feelings, and sensations (Bishop et al. 2004). The practice of reorienting one's attention to the present-moment experience with intentionality, openness, and without judgment can be an antidote to rumination or suppression. This is consistent with previous literature that finds mindfulness training to reduce expressive suppression (e.g., Jazaieri et al. 2014), rumination (e.g., Borders et al. 2010), and increase cognitive flexibility (e.g., Davis and Nolen-Hoeksema 2000) in adults. Our study found these results to be generalizable to adolescents. More importantly, our study found that to the extent that youth reported improvements in emotion regulation outcomes (i.e., using less expressive suppression and rumination), we see improvements in their mental health wellbeing. To our best knowledge, this is one of the first empirical studies that identified specific factors through which mindfulness training impacts emotional wellbeing among adolescents.

Ethnic minorities, including individuals of Asian and Latino descent, tend to use more expressive suppression (Gross 1998a) and rumination (Chang et al. 2010) compared with European Americans. Expressive suppression and rumination are often associated with adverse psychological functioning (e.g., depression, lower life satisfaction) among European American samples (Gross and John 2003; Aldao et al. 2010). Scholars have highlighted cultural differences in the use of emotion regulation strategies and their effects on wellbeing (Larsen and Prizmic 2004), arguing that heritage cultural orientations held by Latino and Asian Americans may shape an interdependent construal of the self that has implications for certain emotion regulation practices. For example, studies have found that the deleterious effects of suppression and rumination were mitigated among individuals who hold more interdependent cultural values (Kwon et al. 2013; Chang et al. 2010). However, in our study we found expressive suppression to be associated with increased internalizing symptoms and perceived stress. Rumination was also associated with greater internalizing, externalizing, and attention problems as well as perceived stress. These findings parallel those found in most European American samples, highlighting the detrimental effects of suppressing or being over-engaged with emotions among adolescents. Our study did not include a measure of cultural values or self-construal so we are unable to ascertain how cultural values may moderate the relationship. However, a majority of the youth in our sample were born in the U.S. and are likely to be more acculturated to the U.S. mainstream culture. Past studies have found that expressive suppression was associated with lower levels of depression only among children who retain their interdependent cultural heritage, but not for those who are more acculturated to Western culture (Huang

et al. 1994), suggesting the moderating effect of child acculturation. Given that ethnic minorities may be more likely to engage in rumination or emotional suppression and that preliminary evidence suggests that they may be detrimental to wellbeing among adolescents, mindfulness training may be particularly relevant for them as they practice being more aware and accepting of their own emotions.

Intervention efficacy varied by initial status although the directionality appeared to differ based on the outcome variable. Consistent with the adult literature, youth with elevated internalizing problems, externalizing problems, and perceived stress benefited the most from the intervention (Dimidjian et al. 2006). However, youth with lower initial severity on attention problems benefitted more from the intervention. Attention problems were rated high for all participants at baseline. It is possible that similar to other mental health problems, youths who reported their attention problems to be around the subclinical range benefitted more from mindfulness training. Overall, the study included high school freshmen with elevated mood symptoms and we did not include any diagnostic criteria for entry into the study. As such, this trial can be viewed within an indicated prevention approach and we found differential treatment response depending on baseline severity of youth behavior problems. Studies have found increased prevalence of mood disorders in older adolescents and that the symptoms tend to persist through adulthood (e.g., Merikangas et al. 2009). Similarly, the use of rumination was found to increase from late childhood through adolescence and may be a greater risk factor for depression among adolescents compared to adults (Papadakis et al. 2006). This highlights the importance of prevention intervention during early and mid-adolescence that targets mechanisms of change to help address mood symptoms before they reach clinical levels (Ahmed et al. 2015). Overall, our study found no evidence of moderation of treatment effects by culture or acculturation, but Asian students, compared to Latino students, reported greater reduction in attention problems. However, this may be due to the fact that Asian students reported higher levels of attention problems at baseline compared to Hispanic students. Ethnicity did not moderate any other treatment effects. This may be due to the fact that both Latino and Asian youth are from more interdependent cultural groups, thus limiting the ability to detect variability in terms of the impact of cultural self-construal. Our study may also have lacked sufficient power to detect the moderation effect of ethnicity given our relatively small sample size.

Our enrollment rate differed significantly between the two cohorts due to different recruitment and screening process, which has administrative implications. For the first year, consistent with the standard school district protocol, we adopted a passive consent procedure through the use of universal screening. The study enrollment rate of 32% was comparable to some studies (e.g., Rosselló et al. 2008), but lower than most other school-based intervention trials for adolescents with enrollment rates in the range of 50–60% (e.g., McCarty et al. 2013; Horowitz et al. 2007). Although the universal screening was successful in identifying youth with indicated needs, it posed significant strain on the school counselors given the large number of screenings. It also created administrative challenges when the school district does not have sufficient resources to triage students in a time-sensitive manner without compromising other routine procedures, deeming the procedure unsustainable to continue. As a result, for the second year, active student consents were obtained in which only students who expressed a potential interest in participating in the mindfulness program completed the depression screening. Based on this process, 95% of eligible students accepted the invitation to be enrolled in the mindfulness intervention. Interestingly, despite the very two different recruitment and screening procedure, the group sizes were comparable between the two years suggesting that active consent may be a more viable and effective method of recruitment. Overall, we observed high retention and engagement rates in our study. Data on post-treatment evaluation also suggests that youth find the mindfulness program helpful and are willing to recommend it to a friend.

Several limitations of the current study should also be noted. Outcomes were assessed solely by youth self-report and could be subject to social desirability. Future trials should include multiple-informant, multi-method assessments of outcome. Parent and teacher report or other more objective measures would be important to take into account. Furthermore, our study sample is relatively homogeneous in that it included primarily Asian and Latino students, who both ascribe to a more interdependent cultural orientation. It would be important for future studies to include student from more independent cultural backgrounds to examine the effects of cultural value or orientation. In addition, out study had a relatively small sample size that may have lacked sufficient power to detect effects, particularly for potential mediation via changes in avoidance fusion, cognitive reappraisal, emotional processing, and emotional expression on students' internalizing problems and perceived stress. Finally, our study did not require prior mindfulness training from study group leaders. Although group leaders were encouraged to engage in regular mindfulness practices in their daily lives, we did not systematically record or measure how often they engage in mindfulness practices or how it impacts treatment efficacy. Kabat-Zinn (2003) has argued that mindfulness "cannot be effectively be taught to others in an authentic way without the instructor's practicing it in his or her own life." Further studies should examine the extent to which group leaders' own practice of mindfulness may moderate treatment effects.

Notwithstanding these limitations, results from this randomized clinical trial provide evidence that a mindfulness-based program may be beneficial for ethnic minority youth

in reducing perceived stress and internalizing problems, and improving emotion regulation outcomes. The observed treatment effect sizes were mostly in the medium range and the observed improvements were all maintained at the three-month follow-up. Importantly, our study provided robust empirical evidence that mindfulness training was associated with improved mental health wellbeing via improvements in emotion regulation (i.e., reductions in expressive suppression, avoidance, and rumination) even with ethnic minority youth from more interdependent cultural backgrounds. Although challenges arose, our findings suggest that the mindfulness intervention was feasible to implement in public schools and appealing to students.

Compliance with Ethical Standards

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

Ethical Approval The authors attest that they have complied with ethical standards, including, but not limited to, oversight by the Institutional Review Board of the Fuller Theological Seminary and University of California, Los Angeles.

Informed Consent Informed assent was obtained by all study participants and informed consent was obtained by participant parents/guardians.

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