

School-Based Mindfulness Instruction: An RCT

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abstract

BACKGROUND AND OBJECTIVE: Many urban youth experience significant and unremitting negative stressors, including those associated with community violence, multigenerational poverty, failing educational systems, substance use, limited avenues for success, health risks, and trauma. Mindfulness instruction improves psychological functioning in a variety of adult populations; research on mindfulness for youth is promising, but has been conducted in limited populations. Informed by implementation science, we evaluated an adapted mindfulness-based stress reduction (MBSR) program to ameliorate the negative effects of stress and trauma among low-income, minority, middle school public school students.

METHODS: Participants were students at two Baltimore City Public Schools who were randomly assigned by grade to receive adapted MBSR or health education (Healthy Topics [HT]) programs. Self-report survey data were collected at baseline and postprogram. Deidentified data were analyzed in the aggregate, comparing MBSR and HT classes, by using regression modeling.

RESULTS: Three hundred fifth- to eighth-grade students (mean 12.0 years) were in MBSR and HT classes and provided survey data. Participants were 50.7% female, 99.7% African American, and 99% eligible for free lunch. The groups were comparable at baseline. Postprogram, MBSR students had significantly lower levels of somatization, depression, negative affect, negative coping, rumination, self-hostility, and posttraumatic symptom severity (all P s < .05) than HT.

CONCLUSIONS: These findings support the hypothesis that mindfulness instruction improves psychological functioning and may ameliorate the negative effects of stress and reduce trauma-associated symptoms among vulnerable urban middle school students. Additional research is needed to explore psychological, social, and behavioral outcomes, and mechanisms of mindfulness instruction.

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WHAT'S KNOWN ON THIS SUBJECT: Many urban youth experience significant negative stressors. Mindfulness instruction reduces stress and improves psychological functioning in adults. Research in youth is promising but has been conducted in limited populations. Little is known about mindfulness instruction for low-income minority students.

WHAT THIS STUDY ADDS: In this randomized active-controlled trial, school-based mindfulness instruction led to improved psychological functioning and lower levels of posttraumatic stress symptoms. High-quality mindfulness instruction merits consideration as primary prevention for mental and behavioral health problems in low-income, minority urban students.

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Recent violence in Baltimore City has drawn attention to the acute and chronic problems experienced by many of the city's poor and minority residents. Due to effects of multigenerational poverty, limited educational and economic opportunities, high levels of drug use and trade, and pervasive community violence, urban youth in Baltimore and many US cities are at increased risk for exposure to a variety of stresses, including early life stress, recurrent and chronic stress, and exposure to significant and/or recurrent traumas. As an example, it is estimated that 50% to 96% of urban youth directly witness violence within their community.¹ The significant, recurrent, and chronic nature of these stressors may overwhelm the capacity to cope acutely and chronically,² which is required for healthy development and positive trajectories. Any or all of these forms of stress may contribute to the state of toxic stress in which an individual's ability to manage or cope with stress is overwhelmed on an ongoing basis. Pediatricians have been called to action to understand the complex and intertwined systems that are disrupted by stress,³ as well as to recognize that effective health approaches to mitigate the negative effects of toxic stress and trauma may be interventions that occur in the community, not only in medical settings.⁴

In response to the pervasive exposure to stress and trauma, we have developed and previously tested a program of mindfulness instruction intended to reduce the negative impacts of stress and toxic stress among urban youth. Based on Jon Kabat-Zinn's well-studied mindfulness-based stress reduction (MBSR) program for adults,^{5,6} we had previously adapted and evaluated the MBSR program for use with urban youth in clinic⁷⁻⁹ and school settings.¹⁰ In particular, we conducted a randomized controlled

trial (RCT) of our school-based 12-week MBSR program compared with a 12-week active control (health education) program at a small middle school for city-dwelling boys. Compared with the active control program, MBSR participants had significantly less anxiety, improved coping, and borderline attenuation of the salivary cortisol increase associated with the academic term.¹⁰ We were interested in expanding the program to urban public schools with significant need. Through collaboration with Elev8 Baltimore, a nonprofit organization aimed at optimizing linkage and utilization of school-based activities for the benefit of students and their families, we found the complementary elements for implementation. Elev8 Baltimore had experience with and presence in the schools and understood firsthand the high level of students' exposure to trauma and toxic stress.

Implementation science has elucidated a number of essential considerations for program expansion. The consolidated framework for implementation research articulates the importance of the following elements: evidence-based intervention, the outer setting, the inner setting, the individuals involved, and the process.^{11,12} Attending to these elements of implementation and in collaboration with Elev8 Baltimore, we used the evidence-based MBSR program with two Elev8 Baltimore schools in which we could ensure high potential for student benefit, site-specific awareness of school culture, school administration buy-in, high-quality program instruction, high-quality program implementation staff, community partnership, infrastructure to support ongoing collaboration with school and Elev8 Baltimore, and structure and process for evaluation of implementation and program effect.

METHODS

Participants and Study Design

Students were eligible to participate in the study if they attended fifth through eighth grades, including special education, in either of two Elev8 Baltimore schools selected for this trial, during the 2012–2013 academic year. Conceptualized and presented as two complementary programs focused on overall student wellness, Healthy Topics (HT) and MBSR were incorporated into the school curriculum and delivered to all students during the "resource" class time for a portion of the school year, instead of classes such as advisory, art, or music. Students were randomly assigned by school and grade into either the intervention program or the active control program; thus, each school had both programs. Blinding to group assignment occurred at the data management, analysis, and interpretation levels. The study was approved by the Johns Hopkins School of Medicine Institutional Review Board.

Intervention Program

Our 12-week program is adapted from MBSR, a structured 8-week program of instruction in the cultivation of mindfulness, a practice of purposeful nonjudgmental attention to the happenings of the present moment.⁵ MBSR programs consist of 3 components: (1) didactic material related to mindfulness, meditation, yoga, and the mind-body connection; (2) experiential practice of various mindfulness meditations, mindful yoga, and body awareness during group meetings and encouragement of home practice; and (3) group discussion focused on the application of mindfulness to everyday situations and problem-solving related to barriers to effective practice.^{5,13,14} The MBSR program includes a number of formal and informal techniques, all of which share the goal of

enhancing nonjudgmental present-focused awareness, aimed to reduce dysregulated focus on the past (ie, rumination) and worries about the future (ie, anxiety).

Our previously-adapted 12-week, school-based MBSR curriculum¹⁰ was taught by 2 experienced MBSR instructors, both with long-standing personal meditation practices, >10 years' experience teaching mindfulness, and MBSR instructor training through the University of Massachusetts Center for Mindfulness. The MBSR instructors met regularly to optimize program implementation. The adapted MBSR program remains consistent with typical MBSR programs for adults and with MBSR core content.¹³ In addition, the content, course structure, sequence of content presentation, and core mindfulness practices are maintained. Students attended an average of ~80% (74%–85%) of the program sessions and anecdotally reported especially enjoying the mind jar and worry box activities.

Active Control Program

HT is an age-appropriate general health program structured to match MBSR, including number and length of classes, location, didactic and experiential instruction, and group size. The HT program covers age-appropriate topics such as nutrition, exercise, body systems, adolescence, and puberty. HT was adapted from the Glencoe Health Curriculum (McGraw Hill, 2005) and is designed to control for the effects of a positive adult instructor, peer group experience, attention, and time. It was taught by 3 trained, experienced health instructors. Students attended an average of ~80% (76%–88%) of the program sessions.

Implementation

Our community partner, Elev8 Baltimore, had 3 years of experience with school administration and

staff at both schools. In discussion with Elev8, school administrators agreed to incorporate MBSR and HT programs into the school curriculum and work with the program staff to facilitate scheduling and implementation. Program staff worked closely with Elev8 staff and program instructors to enhance program implementation, school support, and the community partnership. Both schools offered other programs to middle school students focused on mentorship, homework assistance, and after-school activities, but no other programs directly targeted stress.

Measures

Data were collected by program staff (not instructors) during class time over 2 sequential days at baseline and after completion of the 12-week programs. Makeup data collection for absent students was conducted on a case-by-case basis over the following few days. Valid, reliable, age-appropriate self-report surveys were used to measure outcomes of interest, including mindfulness, psychological functioning, and trauma symptoms.

Mindfulness was measured with the 10-item Children's Acceptance and Mindfulness Measure,^{15–17} which had good reliability in our sample ($\alpha = 0.74$ and 0.73). The widely used Perceived Stress Scale¹⁸ showed low reliability within our sample ($\alpha = 0.41$ and 0.29); by using exploratory factor analysis (EFA) methods, we extracted 2 factors: positive/coping (4 items) and stress (6 items), which had improved reliability ($\alpha = 0.64$ – 0.75).

Psychological symptoms measured were depressive symptoms (Children's Depression Inventory—Short Form [CDI-S]¹⁹); paranoid ideation, hostility, somatization, by using the Symptom Checklist-90-R (SCL-90-R)²⁰; and anxiety (Multidimensional Anxiety Scale for Children [MASC]).²¹ The CDI-S had

good reliability within our sample ($\alpha = 0.84$). The SCL-90-R showed acceptable to excellent reliability in our sample (hostility $\alpha = 0.86$ and 0.85 ; somatization $\alpha = 0.87$ and 0.90 ; paranoid ideation $\alpha = 0.67$ and 0.71). The MASC is a measure of anxiety, with excellent reliability in our sample ($\alpha = 0.89$).

We assessed mood and emotion regulation with the following measures: Positive and Negative Affect Schedule (PANAS),²² the Differential Emotions Scale (DES),²³ the Aggression scale,²⁴ and the State-Trait Anger Expression Inventory (STAXI-2).²⁵ The PANAS yields 2 factors: positive affect and negative affect, with good reliability in our sample (positive affect $\alpha = 0.81$ and 0.89 ; negative affect $\alpha = 0.84$ and 0.87). The DES yields several factors found to have acceptable reliability and validity in youth²⁶ and adequate reliability in our sample ($\alpha = 0.61$ – 0.81). The Aggression Scale has sufficient reliability and validity in similar populations²⁷ and excellent reliability in our sample ($\alpha = 0.92$). The STAXI is a measure of anger expressivity, from which we used 2 subscales: temperamental expressivity and reactive expressivity. The measure has been found to have adequate reliability and validity in African American youth²⁸ and was reliable with our sample ($\alpha = 0.78$ – 0.80).

Coping was measured by using the Children's Response Style Questionnaire (CRSQ),²⁹ the Brief COPE,³⁰ and the Coping Self-Efficacy Scale (CSE).³¹ The CRSQ measures 3 types of reactions: rumination, problem solving, and distraction with adequate reliability (rumination $\alpha = 0.86$ and 0.87 ; problem solving $\alpha = 0.68$ and 0.73 ; distraction $\alpha = 0.67$ and 0.70). The Brief COPE measures 14 coping approaches with 2 items each. Given the many subdomains, confirmatory factor analysis (CFA) method was used to identify typically positive coping approaches (16

items: use of instrumental support, active coping, distraction, venting, positive humor, use of emotional support, positive reframing, planning, and religion) and typically negative coping approaches (9 items: behavioral disengagement, denial, substance abuse, negative humor, and self-blame). The factors demonstrated adequate reliability ($\alpha = 0.73\text{--}0.88$). Finally, the CSE creates an overall variable of coping self-efficacy with excellent reliability in this sample ($\alpha = 0.96$).

We measured posttraumatic symptoms by using the Children's Post-Traumatic Symptom Severity Checklist (CPSS).³² Unfortunately, an administrative error led to the inadvertent omission of the CPSS from the baseline survey; we have CPSS data from postprogram only. Because all other measures were comparable between groups at baseline, we infer that CPSS was as well. The measure has adequate reliability and validity in socioeconomically disadvantaged youth³³ and excellent reliability in our sample ($\alpha = 0.94$). Furthermore, 2 factors were generated from the CPSS: depressive symptoms (10 items) and reexperiencing symptoms (6 items). Both factors were found to have good reliability (depressive $\alpha = 0.92$, reexperiencing $\alpha = 0.85$).

Sample Size

A priori power calculations demonstrated power $>80\%$ with a sample of at least $N = 90$ based on previous work with small to moderate effects (β ranging from 0.38 to 0.51; ΔR^2 ranging from 0.04 to 0.54) for associations between MBSR participation and outcomes of coping and psychological symptoms. Thus, ample power was present for this study.

Data Analysis

Preliminary data analysis included EFA and CFA to determine the most appropriate factor structure for each

measure. EFA employed principal components analysis methods with varimax rotation. CFA methods used maximum likelihood extraction methods with varimax rotation and were used for all measures to examine the factor structure. EFA methods were used when CFA results suggested potential deviation from expected factor structures among established scales. Where applicable, EFA and CFA results were presented in the Measures section above. Preliminary analyses examined descriptive statistics (eg, means, median, proportions) for all study variables of interest. Given that data collection at both time points was held over 2 class periods, missing data due to attrition/absence occurred. Although we provided classes to 400 students at 2 schools, baseline data were collected from 300 students, with subsequent data collection sessions ranging from 292 to 300 students (72.8%–74.8%). Missing data analyses demonstrated that missingness was due largely to attrition/absence and did not present in an obvious pattern. Given that data were collected at the aggregate level (not linked by individual student over time), it was not possible to examine participant characteristics in relation to missing data over the course of the study. Initial analyses examined potential differences in participant characteristics and demographics across intervention groups at baseline by using independent samples t tests for continuous variables and χ^2 analyses for categorical variables. To test the overall potential intervention effect, multivariate linear regression models were examined. A binary grouping variable (intervention versus control) was the main predictor with outcome variables of interest at follow-up. All models included gender, age, and school as covariates. Each outcome variable of interest was examined in a separate model due to collinearity. Given the data structure of students within grades and within schools,

mixed effects models were examined with random effects for grade. The random effect for grade was not significant in any models and was thus removed from further analyses. We hypothesized that MBSR would improve participants' psychological functioning.

RESULTS

Three hundred students in the fifth through eighth grades participated and provided survey data from 2 urban elementary/middle schools. Study participants were 50.7% female and 99.7% African American (Table 1). Approximately 99% of participants were eligible for free or reduced meals. When comparing HT and MBSR groups at baseline, χ^2 tests revealed no significant differences in gender ($P = .99$), ethnicity ($P = .32$), age ($P = .45$), nor any study variables of interest ($P = .10\text{--}.99$). The lack of significant differences at baseline suggests that randomization resulted in balanced study arms.

On the basis of our randomization scheme, we conducted 14 separate classes of 21 to 37 students each at 2 schools. Multivariate models demonstrated significant differences between MBSR and HT program participants after implementation of the 12-week programs; compared with HT, students who had participated in the MBSR program showed better psychological functioning and coping. As shown in Table 2, MBSR participants reported lower levels of depressive symptoms ($\beta = -0.16, P = .02$), self-hostility ($\beta = -0.14, P = .02$), somatization ($\beta = -0.13, P = .03$), negative affect ($\beta = -0.19, P = .003$), negative coping ($\beta = -0.13, P = .04$), and rumination ($\beta = -0.13, P = .03$). Importantly, MBSR students also showed significantly lower levels of posttraumatic stress symptoms ($\beta = -0.15, P = .02$), including in both subdomains of depressive ($\beta = -0.13, P = .03$) and reexperiencing ($\beta = -0.17, P = .008$)

symptoms. No significant adverse events were reported.

DISCUSSION

In our school-based RCT of an adapted MBSR program compared with an active control (HT) for vulnerable urban youth, MBSR participants showed significant improvements in psychological symptoms, coping, and a reduction in posttraumatic symptoms. In particular, they had lower levels of depressive symptoms, self-hostility, somatization, negative mood, negative coping approaches, and posttraumatic symptoms. This rigorous school-based RCT, informed by implementation science, supports the hypothesis that the MBSR program is effective primary prevention for the negative effects of toxic stress and trauma, and ultimately beneficial for urban youth.

Research on mindfulness for children and youth is beginning to emerge,³⁴ but few randomized active-controlled trials of school-based mindfulness instruction exist in the literature and populations are limited. Britton conducted a RCT in a private independent school comparing a mindfulness meditation class with an active control ($n = 101$), finding that mindfulness was associated with reductions in thoughts of self-harm.³⁵ A recent trial of a mindfulness program compared with a social responsibility control in a mostly middle-class population showed that mindfulness led to positive outcomes in psychological symptoms, cognitive control, interpersonal outcomes, and stress physiology.³⁶ Although these findings are promising, little information is available on mindfulness instruction for low-income, urban, minority populations.

Important aspects of implementation were addressed in this trial: an evidence-based program; Elev8

TABLE 1 Baseline Characteristics, n (%)

	HT $n = 141$ (47.0%)	MBSR $n = 159$ (53.0%)	Total $n = 300$
Gender ($n = 298$)			
Female	71 (50.7)	80 (50.6)	151 (50.7)
Male	69 (49.3)	78 (49.4)	147 (49.3)
Ethnicity ($n = 258$)			
African American	129 (99.2)	128 (100)	257 (99.7)
White	1 (0.8)	0 (0.0)	1 (0.4)
Grade			
Fifth	28 (19.9)	45 (28.3)	73 (24.3)
Sixth	48 (34.0)	34 (21.4)	82 (27.3)
Seventh	15 (10.6)	45 (28.3)	60 (20.0)
Eighth	50 (35.5)	35 (22.0)	85 (28.3)
Site			
School A	98 (69.5)	90 (56.6)	188 (62.7)
School B	43 (30.5)	69 (43.4)	112 (37.3)

Baltimore's school-based staff and experience with each school's students, staff, and administration; dedicated staff to coordinate program implementation and data collection and link with teachers and school staff; dedicated program instructors; and reasonably accepting administration. Furthermore, our RCT used specific strategies to ensure the delivery of high-quality program content and process in both study arms: instructors were trained, experienced, and dedicated mindfulness and health education instructors who brought expertise regarding program content and delivery; the mindfulness curriculum was previously tested and had been adapted from the evidence-based MBSR program^{8,10}; communication between program and Elev8 staff was supported by weekly meetings; and the community partnership functioned effectively to navigate challenges that arose related to logistics, school administration, and implementation.

There are a number of limitations of this study. These include variability of student session engagement and attendance, no information regarding outside student mindfulness exposure and/or practice, missing data, variability in school administration support for programs,

and variability in classroom teacher support for programs.

However, the trial also has a number of notable strengths. The RCT study design with an active comparison group (controlling for positive adult instructor and group activity) and comparable groups at baseline provides a high level of confidence that the improvements seen in the MBSR arm are due specifically to the mindfulness aspects of the intervention, as opposed to baseline differences and/or other nonspecific intervention effects. Furthermore, because this is a group-based prevention program, program costs may well be offset by decreased need for behavioral and mental health interventions.

Given the unmanageable toxic stress and trauma experienced by many urban youth, these findings are important and timely. Efforts to improve the circumstances in which urban youth live are essential and impactful. This study provides additional support for efforts to include high-quality mindfulness instruction to enhance students' capacity to manage the inevitable stress and trauma they will face, as well as in trauma-informed approaches. Depressive and posttraumatic stress symptoms have been linked with impaired academic performance and attendance.^{37,38} By

TABLE 2 Multivariate Postprogram Comparisons

Variables	HT	MBSR	Model
	<i>n</i> = 141 (46.8%)	<i>n</i> = 159 (53.2%)	
	Mean (SD)	Mean (SD)	β (<i>P</i>)
Mindfulness	15.99 (5.29)	18.86 (5.75)	.09 (.14)
Stress, PSS	12.16 (4.88)	10.93 (5.30)	−.05 (.36)
Positive/coping	8.65 (3.14)	8.03 (4.19)	−.03 (.63)
Response style/coping, CRSQ			
Rumination	28.93 (7.87)	26.91 (8.90)	−.13 (.03)*
Distraction	15.32 (4.23)	14.78 (4.33)	−.04 (.55)
Problem solving	11.02 (3.27)	10.27 (3.76)	−.13 (.06)
Psychological symptoms, SCL-90R			
Hostility	56.04 (12.29)	52.91 (12.21)	−.09 (.12)
Somatization	57.40 (14.04)	52.92 (13.92)	−.13 (.03)*
Paranoid ideation	60.69 (9.63)	59.45 (10.79)	−.07 (.24)
Affect, PANAS			
Positive affect	31.85 (9.90)	32.35 (10.14)	.03 (.62)
Negative affect	24.61 (8.41)	21.39 (8.80)	−.19 (.003)**
Coping, Brief COPE			
Positive coping	38.33 (9.00)	35.62 (11.02)	−.07 (.29)
Negative coping	19.66 (5.11)	17.93 (5.34)	−.13 (.04)*
Depression, CDI-S	57.59 (13.74)	53.53 (12.36)	−.16 (.02)*
Anger expressivity, STAXI			
Temperamental expressivity	9.12 (5.18)	8.30 (3.33)	−.10 (.10)
Reactive expressivity	15.40 (5.27)	14.46 (4.86)	−.10 (.08)
Differential emotions, DES			
Interest	8.58 (3.05)	8.09 (3.25)	−.10 (.10)
Enjoyment	9.26 (3.08)	9.22 (3.39)	−.03 (.60)
Sadness	7.44 (2.94)	6.89 (2.78)	−.08 (.16)
Anger	8.06 (3.11)	7.84 (3.44)	−.03 (.56)
Guilt	7.87 (3.48)	6.92 (3.04)	−.08 (.19)
Contempt	8.10 (3.70)	7.08 (2.88)	−.10 (.09)
Fear	6.93 (3.32)	6.04 (2.80)	−.11 (.06)
Self-hostility	6.60 (3.47)	5.48 (2.92)	−.14 (.02)*
Shame	7.24 (3.22)	7.15 (3.08)	.00 (.92)
Shyness	7.23 (3.40)	6.58 (3.18)	−.08 (.15)
Coping self-efficacy, CSE	156.05 (57.89)	149.00 (57.74)	−.09 (.14)
Anxiety, MASC	11.09 (8.00)	10.53 (7.60)	−.04 (.55)
Aggression	22.20 (16.86)	19.81 (16.98)	−.06 (.35)
Posttraumatic symptoms, CPSS	21.55 (13.04)	17.16 (12.36)	−.15 (.02)*
Depression	12.64 (8.37)	10.16 (7.49)	−.13 (.03)*
Reexperiencing	7.39 (4.70)	5.96 (4.69)	−.17 (.008)**

All models included gender, age, and school as covariates. Each outcome variable of interest was examined in a separate model. PSS, Perceived Stress Scale. * $P < 0.5$; ** $P < 0.01$

providing high-quality mindfulness instruction during childhood, improvements in psychological symptoms, coping, and posttraumatic symptoms have the potential to shift life trajectories in meaningful ways, including academic performance, mental and physical health, and quality of life.

CONCLUSIONS

As we continue to learn that many adult diseases have their roots in childhood exposure to stress and trauma, it is essential to intervene with primary prevention strategies to reduce their negative effects among children and youth. This trial provides convincing evidence that

high-quality school-based MBSR instruction for youth in urban public schools is feasible, acceptable, and leads to improvements in psychological symptoms, coping, and posttraumatic stress symptoms. Improvements in these domains may ultimately reduce the negative impact of stress and trauma experienced in childhood and adolescence and lead to significant positive shifts, when imagined over the life course.

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ABBREVIATIONS

CDI-S: Children's Depression Inventory—short form
 CFA: confirmatory factor analysis
 CPSS: Children's Post-Traumatic Symptom Severity Checklist
 CRSQ: Children's Response Style Questionnaire
 CSE: Coping Self-Efficacy Scale
 EFA: exploratory factor analysis
 HT: Healthy Topics
 MASC: Multidimensional Anxiety Scale for Children
 MBSR: mindfulness-based stress reduction
 PANAS: Positive and Negative Affect Schedule
 RCT: randomized controlled trial
 SCL-90-R: Symptom Checklist-90-R
 STAXI: State-Trait Anger Expression Inventory

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