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Inclusion of Yoga, Breath Control, and Mindful Self-Regulation with Physical Exercise in 9- to 12-Year-Olds: Effects on Mood through Self-Efficacy

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Abstract

When basic yoga poses and mindful self-regulation methods are interspersed in youth physical activity programming, mood might improve beyond that induced by exercise alone. Based on self-efficacy theory, mechanisms of mood improvements might include feelings of mastery over the exercise environment (i.e. exercise-related self-efficacy). A 45 minute/day physical activity component of elementary after-school care was administered either with basic yoga poses and methods of breath control and mindful self-regulation (treatment group, n=59), or in a traditional manner (comparison group, n=55) over a school year to boys and girls ages 9-12 years (mean age=9.9 years). Analyses of variance (ANOVAs) indicated that both overall negative mood and exercise self-efficacy improved significantly more over both the first half of the school year and full school year in the treatment group. Effect sizes increased over time. In mediation analyses computed separately over both temporal intervals, score changes in exercise self-efficacy significantly mediated the significant bivariate relationships between group and changes in negative mood. In further regression analyses, it was found that relationships between changes in mood and self-efficacy were reciprocal, and thus mutually reinforcing. Findings suggested a benefit of incorporating yoga and mindful self-regulatory skills into the physical activity components of children's after-school care. They also supported self-efficacy theory, in that mood change was suggested to have occurred largely through treatment-associated changes in self-efficacy. Additional positive effects (e.g. on academic performance) of the inclusion of yoga and mindfulness strategies in youth physical activity programming should be evaluated in extensions of this research.

Keywords: Yoga; Breath control; Self-regulation; Mood; Self-efficacy; Exercise; Physical activity; After-school; Youth; Children

Introduction

Yoga and mindful self-regulation strategies such as breath control, muscular relaxation strategies, cognitive restructuring, and reframing goal striving have proven to be effective at improving mood states in adults [1]. Although positive effects are generally suggested [2,3], there is less evidence of this in children. Physical activities of various types and intensities have been associated with improved mood [4]. It has been proposed that these mood improvements are linked to exercise-induced biochemical changes in the brain such as in serotonin, endorphin, and nor epinephrine levels [4,5]. Recently, however, researchers have questions such biochemical explanations because there has been an absence of a physical activity dose-mood change relationship in some research; seemingly a requisite for such relationships [6]. Alternate explanations include assumptions that mood improvements are associated with feelings of accomplishment and mastery (i.e. self-efficacy) around completing regular physical activities, which hold an element of challenge for many individuals [4,5]. It was assumed that increased self-efficacy yields a positive psychological climate that is associated with positive mood states.

The premise that exercise-induced mood change occurs largely through associated changes in exercise-related self-efficacy is consistent with the well-established social cognitive and self-efficacy theories advanced by Bandura [7,8]. It also might be inferred through those theories that mood and self-efficacy changes have symbiotic, mutually reinforcing, relationships. Yoga and breath/muscular control strategies might be especially disposed to increasing self-efficacy (and vicariously, mood improvements) because they are challenging initially, but are also readily improved upon.

The aim of the present research was to evaluate the inclusion of basic yoga poses and various mindful self-regulation

strategies in the daily physical activity/exercise components of elementary after-school care. It was expected that such inclusions would be associated with mood and self-efficacy improvements significantly greater than typically administered exercise components. It was also hypothesized that treatment-induced increases in exercise self-efficacy would significantly mediate relationships between program type and reductions in negative mood. Thus, it was posited that the treatment would induce mood improvements largely through improved self-efficacy. It was hoped that findings could inform future physical activity programming in youth.

Materials and Methods

Participants

Participants of after-school care sites in the southeastern United States, who were of ages 9-12 years, were randomly assigned to either the experimental physical activity/behavioral skills treatment (treatment group, n=59) or a standard physical activity after-school care component (comparison group, n=55). At baseline, there was no significant group difference in age (overall mean [M]=9.9 years, standard deviation [SD]=0.8), gender (overall 44% girls), body mass index (BMI) (overall M=18.4 kg/m^2, SD=3.1), racial make-up (overall 38% White, 59% Black, and 3% other), or socioeconomic status based on after-school care sites' location (a middle median yearly family income of ~US$75,000). University institutional review board (IRB) approval, written informed consent from each participant's parent/legal guardian, and verbal assent from each participant was received.

Measures

Overall negative mood was measured by 6 items targeting the respondent's feelings of tension, anger, depression, fatigue, confusion, and vigor occurring over the past 2 weeks. Sample items are "angry," "nervous," and "sad". The survey was based on an earlier scale validated with teens [9,10]. Item responses ranged from 0 (not at all) to 5 (extremely). Their strong loadings (i.e. 0.60–0.71) on only the appropriate construct supported the measure's construct validity. In a separate sample of a similar age range, test-retest reliability over 1 week was 0.72.

The Exercise Barriers Self-Efficacy Scale for Children incorporated 5 items that assessed the respondent's confidence that he/she would exercise "most days of the week even if," (e.g. "I did not like the activity," "exercise was not fun") [11]. The survey was based on an earlier scale validated with adults [12]. Responses ranged from 1 (not true) to 5 (definitely true). In a sample of 7-12-year-olds, internal consistency was Cronbach's α=0.79 [11], and α=0.78 for the present sample. Test-retest reliability over 1 week was 0.77 [11].

Procedure

Along with IRB approval, requirements of the World Medical Association's Declaration of Helsinki of 1964 and its subsequent amendments were followed throughout. After-school care staff were trained in the treatment condition, where applicable. Both the treatment and comparison condition's instructors were trained in the administration of basic, safe physical activity processes for the 45 minutes/day, 5 days/week program where such structured activity was mandated by governing counsels. The participant-to-counselor ratio was limited to 18:1.

Specifically, the treatment condition consisted of daily components of a) basic yoga poses (e.g. tree pose [vrksasana], downward-facing dog [adho mukha shvanasana]) and other stretching and breathing exercises, b) moderate-to-vigorous physical activities via an assortment of mobility tasks, c) mindful self-regulatory skills (e.g. thought stopping, productive self-talk, reframing challenging tasks through process goal setting, abbreviated progressive muscle relaxation) paired with breath control, and d) other balance and body weight resistance activities. Based on social cognitive and self-efficacy theories [7,8], self-regulatory skills were intended to foster participants' exercise-related self-efficacy through overcoming personal barriers. Deep breathing and abbreviated progressive relaxation aimed to improve tension and overall mood. All physical activity/exercise tasks were structured to be inclusive of deconditioned and less-coordinated participants. The comparison condition's activities were largely left to the discretion of the after-school care counselors. They typically included running and ball games, often with some type of stretching warm-up included.

Surveys were administered privately at baseline, at the end of the first half of the school year (~3.5 months after baseline), and at school-year end (~7 months of activities after baseline). Study staff conducted structured fidelity checks during approximately 10% of sessions, with the few minor protocol deviations easily corrected.

Statistical Analysis

After first establishing that the 12% of missing data were missing-at-random within the study's intention-to-treat design [13], the expectation-maximization algorithm [14] was used to facilitate imputation. For the planned regression analyses with 2 predictors, to detect a small–moderate effect (f^2=0.10) at the statistical power of 0.80 (α≤0.05), a total sample size of 99 was required [15]. Based on recent suggestions, gain (change) scores were unadjusted for baseline scores [16]. Statistical significance was set at α≤0.05 (2-tailed), throughout. Analyses were conducted using SPSS Statistics version 22.0 (IBM, Armonk, NY).

GLM mixed-model repeated measures analyses of variance (ANOVAs) first determined if there were significant time × group interactions between scores changes on overall negative mood and exercise self-efficacy occurring over the first half of the school year, and over the full year. Planned one-way ANOVA follow-ups assessed between-group differences in score changes over the same temporal intervals. Effect sizes were expressed as partial eta-squared ($\eta^2_p=SS_{effect}/[SS_{effect}+SS_{error}]$), where 0.01, 0.06,

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and 0.14 are considered, by convention, to be small, moderate, and large effects, respectively.

Accounting for changes over the first half of the school year and over the full year in separate equations, mediation of the prediction of change in negative mood by group (treatment group coded "1", comparison group coded "0") by change in exercise self-efficacy was calculated using a bootstrapping method that incorporated 20,000 resamples of the data [17]. Significance of mediation is detected when 0 is not found in the score range between the lower and upper limits of a 95% confidence interval (95% CI) around the path a (predictor→mediator) × path b (mediator→outcome) interaction term (i.e. the indirect effect). Path c (predictor→outcome) and path c′ (predictor→outcome, controlling for the mediator) were also calculated.

A reciprocal effect was also tested for in the above equations by reversing the position of the mediator and outcome variables in parallel equations. If mediation is significant in both of the paired models, then a reciprocal, or mutually reinforcing, relationship between the mediator and outcome has been detected [18]. In each mediation equation, significance of the overall model is also reported as R^2.

Results

There was no significant baseline difference in overall negative mood or exercise self-efficacy between the treatment and comparison group. Descriptive statistics for changes over the first half of the school year (baseline–time 2) and over the full school year (baseline–time 3) are given in Table 1. There were significant time × group interactions found on both negative mood and exercise self-efficacy changes, over both time frames. Follow-up analyses indicated significantly more favorable changes in the treatment on both psychosocial variables.

Table 1: Changes in study measures from baseline–Time 2 (half school year) and baseline-Time 3 (full school year).

	Baseline		Time 2		Time 3		Time × Group Interaction	Change from Baseline-Time 2			Change from Baseline-Time 3		
	Mean	SD	Mean	SD	Mean	SD		Mean	SD		Mean	SD	
							$F_{1, 112}$ (η^2_p)			$F_{1, 112}$ (η^2_p)			$F_{1, 112}$ (η^2_p)
Overall negative mood													
Treatment group	6.95	3.59	5.42	3.60	3.39	4.06		-1.59	3.72		-3.61	4.11	
Comparison group	5.65	3.34	6.25	3.25	4.64	3.74		0.60	3.19		-0.98	3.43	
							12.87***(0.10)			11.33**(0.09)			13.60***(0.11)
Exercise self-efficacy													
Treatment group	16.10	5.70	17.37	4.97	18.00	4.82		1.27	5.19		1.90	4.56	
Comparison group	16.62	4.87	15.75	5.40	15.56	5.44		-0.87	6.00		-1.05	5.44	
							9.92** (0.08)			4.18*(0.04)			9.92**(0.08)

Treatment group n=59; Comparison group n=55.Time 2=mid-school year; Time 3=end of school year. SD=standard deviation. Significance of time × group interactions were derived from GLM repeated-measures mixed-model analyses of variance (ANOVAs).Significance of differences in change scores were derived from one-way ANOVAs. η^2_p=partial eta-squared ($SS_{effect}/SS_{effect}+SS_{error}$), where 0.01, 0.06, and 0.14 are, by convention, considered small, moderate, and large effects, respectively.

*p≤0.050; **p≤0.010; ***p≤0.001.

Score changes in exercise self-efficacy over both the first half of the school year (Figure 1, top) and over the full school year (Figure 2, top) significantly mediated the bivariate relationships between group and changes in negative mood, β=-0.25 (SE=0.19), 95% CI=-0.73, 0.00, and β=-0.46 (SE=0.29), 95% CI=-1.29, -0.05, respectively. The overall mediation models were significant in each case, R^2-values=0.12 and 0.15, respectively, p-values<0.001.

Tests for reciprocal relationships over both the first half of the school year (Figure 1, bottom) and over the full school year (Figure 2, bottom) were also significant, R^2-values=0.07 (p=0.019) and 0.12 (p<0.001), respectively. Changes in negative mood significantly mediated the bivariate relationships between group and changes in self-efficacy, β=0.65 (SE=0.39), 95% CI=0.08, 1.67, and β=0.71 (SE=0.43), 95% CI=0.08, 1.87, respectively.

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Figure 1: Mediation of the relationship of group assignment and change in negative mood by change in exercise self-efficacy over the first half of a school year.

Treatment group was coded "1". Comparison group was coded "0".

*p≤0.050; **p≤0.010; ***p≤0.001.

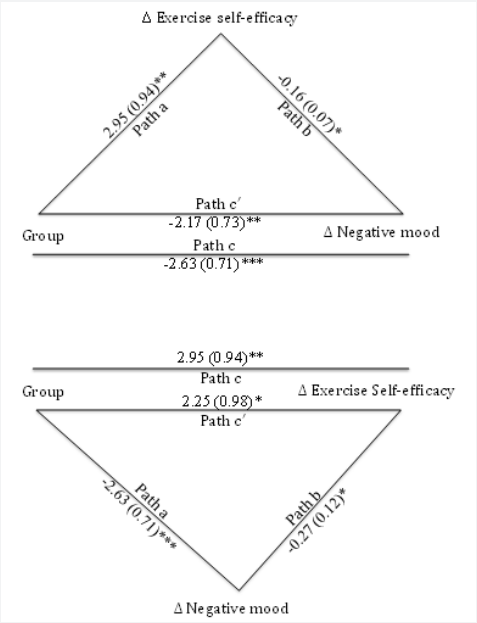

Figure 2: Mediation of the relationship of group assignment and change in negative mood by change in exercise self-efficacy over the full school year.

Treatment group was coded "1". Comparison group was coded "0".

*p≤0.050; **p≤0.010; ***p≤0.001.

Discussion

The findings supported the need for further research into various forms of yoga and mindful self-regulation methods within common physical activity/exercise settings in youth. Because physical activity-related self-efficacy improvement was demonstrated to be a facilitator of mood improvement (and vice versa), previously suggested methods to further increase self-efficacy (e.g. setting specific incremental goals to increase perceptions of mastery; incorporating students as demonstrators to increase confidence in possessing needed skills) [8] should be considered for inclusion. The results also supported self-efficacy theory-based explanations of the physical activity-mood change relationship. Although it has been generally accepted that yoga and other strategies requiring both mental and physical self-control will improve mood, analyses of mechanisms of such changes have been minimal. Thus, the present findings also contributed to corresponding theory development.

Limitations of this research, such as expectation effects from participants noticeably involved in a program that is atypical of United States after-school care, should be acknowledged. That could have biased survey scores. Also, replications across narrower age ranges, and with older and younger children should more carefully match the standard exercise portions of contrasting programs to better assess effects of specifically the yoga/mindfulness training elements. Also, relative effects of health outcomes (e.g. body mass index; effects on overweight and obesity) are important, and should also be contrasted with typical exercise curricula, and curricula focused on maximizing moderate-to-vigorous physical activity [19]. This contrast might be especially useful within physical education settings because of its wide dissemination. Effects on other variables (e.g. academic outcomes) might also be investigated within replications. Taken together, however, the present program alterations/additions appeared to be positive, productive, and well-accepted by both participants and instructors.

Conclusion

The benefits of including yoga and mindful self-regulation strategies within elementary after-school care was suggested within this research. It will be incumbent upon further research to replicate findings in different age groups and contexts to maximize both psychological and physiological effects, and promote holistic health in the many youths in need.

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Conflict of Interest

The author declares no conflict of interest, financial or otherwise.

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