

Effects of Hatha Yoga and African Dance on Perceived Stress, Affect, and Salivary Cortisol

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ABSTRACT

Background: Dance and yoga have been shown to produce improvements in psychological well-being. **Purpose:** The aim of this study was to examine some of the psychological and neuroendocrine responses to these activities. **Methods:** Sixty-nine healthy college students participated in one of three 90-min classes: African dance ($n = 21$), Hatha yoga ($n = 18$), or a biology lecture as a control session ($n = 30$). Before and after each condition participants completed the Perceived Stress Scale (PSS), completed the Positive Affect and Negative Affect Schedule, and provided a saliva sample for cortisol. **Results:** There were significant reductions in PSS and negative affect ($ps < .0001$) and Time $\times$ Treatment interactions ($ps < .0001$) such that African dance and Hatha yoga showed significant declines, whereas there was no significant change in biology lecture. There was no significant main effect for positive affect ($p = .53$), however there was a significant interaction effect ($p < .001$) such that positive affect increased in African dance, decreased in biology lecture, and did not change significantly in Hatha yoga. There was a significant main effect for salivary cortisol ($p < .05$) and a significant interaction effect ($p < .0001$) such that cortisol increased in African dance, decreased in Hatha yoga, and did not change in biology. Changes in cortisol were not significantly related to changes in psychological variables across treatments. There was 1 significant interaction effect ($p = .04$) such that change in positive affect and change in cortisol were negatively correlated in Hatha yoga but positively correlated in African dance and biology. **Conclusions:** Both African dance and Hatha yoga reduced perceived stress and negative affect. Cortisol increased in African dance and decreased in Hatha yoga. Therefore, even when these interventions produce similar positive psychological effects, the effects may be very different on physiological stress processes. One factor that may have par-

ticular salience is the amount of physiological arousal produced by the intervention.

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INTRODUCTION

As western medicine and public health are increasingly successful at preventing and curing diseases that for centuries resulted in mortality and disability, humans are encountering chronic diseases at greater rates (1). Many of these diseases are aggravated by stress (2–4). Stress-related difficulties in chronic disease tend to not respond to traditional primary, secondary, or tertiary medical or public health approaches. The growth in the use of *complementary* and *alternative* forms of medicine has been linked to the perceived need for care that develops from the stress of modern life (5). This study examined the effects of two activities that are increasingly popular as complementary and alternative interventions.

Yoga has received considerable attention for its therapeutic benefits over the past 50 years. Yoga has been associated with increased positive mood (6). It has also been shown to have benefits for a number of stress-related disorders, including carpal tunnel syndrome and depression (7,8). The effect of yoga on cortisol is unclear, with studies showing both no effect (9) and reduced cortisol (10). Yoga, especially the more relaxing practices such as Hatha, may result in similar physiological and psychological responses as some forms of stress reduction or relaxation therapies. Guided imagery and music therapy, massage, progressive muscle relaxation, and cognitive behavioral stress management (CBSM) have been shown to improve mood and decrease perceived stress and cortisol levels (11–13).

Dance, as a complementary form of medicine, has received little attention compared to yoga. The existing literature suggests that dance can reduce depression, increase positive mood, improve coping in cancer patients, and relieve arthritis (14–17). Both yoga and dance appear to have beneficial psychological and physiological effects and may also prove to be useful adjuvant treatments for a variety of diseases. Both use a focusing of attention on the body as a method of reducing stress and

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improving well-being. However, the two differ on the level of physical activity required: Yoga employs slow, measured movement to enhance relaxation; dance entails vigorous, rhythmic physical activity. Psychologically, yoga is also more of an introspective and meditative activity; dance is more of a performance encouraging self-expression.

Hormonal responses to exercise are significantly dependent on the relative intensity of the activity (18). Therefore, if we specifically focus on the exercise-induced physiological arousal generated by these two behaviors, we would expect that African dance and Hatha yoga may increase and decrease cortisol levels, respectively. One difficulty with this hypothesis is that we would then be ignoring the psychological responses to these treatments, which will likely be decreased perceived stress and improvement in affect. In a recent meta-analysis, it has been shown that acute psychological stressors may produce an enhanced cortisol response, yet this cortisol response is not correlated with the intensity of perceived stress and distress experienced (19). Cortisol levels may be correlated with changes in negative emotions (19). Research on hormonal responses to acute decreases of perceived stress and acute affective improvement have been limited. The relaxation studies mentioned earlier suggest that acute decreases in perceived stress and acute affective improvement are correlated with decreases in cortisol levels (11–13).

One important empirical question to be asked in this study is whether changes in physiological variables (arousal and demand) or psychological variables (perceived stress and affect) will influence acute hormonal responses to two common forms of behavioral therapies. Although both dance and yoga therapies have been incorporated in the treatment of a variety of different illnesses and likely improve perceived stress and affect, the most apparent difference between the two practices is the level of physiological arousal. We suspect that both activities will induce significant improvements in perceived stress and affect; however, because of the factor of exercise-induced physiological arousal, cortisol is considered an exploratory outcome.

The major aim of this study was to investigate the effects of Hatha yoga and African dance on two psychological and biological markers of stress. An instructional biology class of the same duration was included in the study as a control. It was specifically hypothesized that African dance and Hatha yoga would significantly decrease perceived stress and negative affect while enhancing positive affect. We also included salivary cortisol collection and assays as secondary, exploratory outcomes.

METHODS

Participants

Participants were healthy undergraduate students enrolled in classes of African dance, Hatha yoga, and introductory biology; they were recruited for participation in this study by offering a chance to win money in a small lottery. Instructors and students were informed that the experiment would take approximately 5 min before and 5 min after class. Eighty students expressed interest. Eleven failed to appear on time, resulting in 69 participants. These participants included 21 from Afri-

can dance, 18 from Hatha yoga, and 30 from the biology lecture. Forty-seven (65%) of the participants were women, and 22 (35%) were men. Mean age of the participants was 19, with a range of 17 to 24.

Overview of Study Procedures

There were three experimental conditions in this study. In an attempt to control for circadian rhythms of salivary cortisol, all classes took place within the 2-hr period of 4:00 p.m. to 6:00 p.m. Data collection took place within a 3-day window between Tuesday and Thursday in early spring, 3 weeks into the semester, to control for possible seasonal and schoolwork-related differences between, for instance, finals week and the beginning of the semester. Participants were instructed to arrive 15 min before the class began. Participants were also asked to eat lunch at least 3 hr before class and not to take any drugs (prescription or recreational), unless medically necessary on the day of the experiment.

On arriving to class, each participant was consented. To control for order effects, the questionnaires were reversed for one half of the participants in each class. Participants were asked to expectorate four times at 1-min intervals while filling out the prequestionnaire. Samples were immediately frozen while participants completed the pre-questionnaire; then the students participated in class as usual. Immediately after class was finished, the same collection procedure was repeated. Participants again expectorated four times in 1-min intervals while completing the post-questionnaire, and samples were frozen.

Biological Methods

Salivary cortisol was measured by utilizing a one-site chemiluminescence immunometric assay involving competitive inhibition. The luminometer and salivary cortisol kit were provided by Nichols Institute Diagnostics (San Juan Capistrano, CA).

Psychological Measures

Perceived stress was measured using the 14-item Perceived Stress Scale (PSS) (20). Participants were instructed to answer the PSS by placing a mark on the horizontal axis of a 115 mm Visual Analog Scale. Affect was measured using the 20-item Positive Affect and Negative Affect Schedule (PANAS; visual analog version) (21).

RESULTS

Preliminary Analyses

Pearson correlation coefficients were calculated for pre- and post-PSS; PANAS; and salivary cortisol variables and demographic and lifestyle variables such as age, gender, dietary and exercise habits, cigarette smoking, and recreational and prescription drug use. Chi-square tests were used to measure the differences in gender ratios across all three classes. The gender ratio of the biology class was marginally significantly different in comparison to African dance and Hatha yoga, $\chi^2(2, N = 70) = 5.98, p = .05$; and there was no significant difference in the gen-

TABLE 1
Means Table for Perceived Stress, Positive and Negative Affect, and Cortisol

Measure	Classes	No.	Pre M	Pre SD	Post M	Post SD	p
PSS	All classes	69					< .0001 ^a
	Biology	30	66.3	10.6	65.9	9.0	.781
	Yoga	18	70.2	10.4	57.7	10.4	< .0001
	Dance	21	68.7	9.9	58.5	11.1	< .001
Negative affect	All classes	68					< .0001 ^a
	Biology	29	31.1	12.9	33.4	12.6	.261
	Yoga	18	31.5	10.7	25.7	8.9	< .05
	Dance	21	30.8	16.9	25.2	11.4	< .05
Positive affect	All classes	68					< .0001 ^a
	Biology	29	62.2	16.0	53.2	18.1	< .001
	Yoga	18	67.4	12.6	70.5	11.8	.219
	Dance	21	68.8	12.8	78.0	17.6	< .05
Cortisol	All classes	62					< .0001 ^a
	Biology	27	0.31	0.1	0.31	0.1	.792
	Yoga	15	0.46	0.1	0.38	0.2	< .05
	Dance	20	0.35	0.1	0.58	0.07	< .0001

Note. PSS = Perceived Stress Scale.

^aTime × Class interaction effect.

der ratio between African dance and Hatha yoga, $\chi^2(1, N = 40) = 0.302, p = .50$. There were no significant correlations found between any of the demographic and lifestyle variables and the pre- and post-dependent measures ($ps > .06$). Therefore, no demographic and lifestyle variables were used as covariates in any further analyses.

Psychological Outcomes

Table 1 displays the means and standard deviations for all outcomes. Results of the PSS and PANAS scales were analyzed using repeated measures analyses of variance (ANOVAs). A main effect was found for PSS, $F(1, 66) = 44.45, p < .0001, \eta^2 = .40$; as well as a significant Time × Class interaction, $F(2, 66) = 11.77, p < .0001, \eta^2 = .26$. Both African dance and Hatha yoga showed significant reductions in PSS ($ps < .001$), which were significantly larger than for biology ($p = .001$) and which did not change significantly ($p = .78$). There was no significant difference between African dance and Hatha yoga ($p = .88$; see Figure 1).

There was a main effect for PANAS negative affect, $F(1, 65) = 5.44, p < .05, \eta^2 = .07$; and a significant Time × Class interaction effect, $F(2, 65) = 4.68, p < .0001, \eta^2 = .13$. Both African dance and Hatha yoga showed significant reductions in negative affect ($ps < .05$), which were significantly larger than for biology ($p < .05$) in which negative affect did not change significantly ($p = .26$). There was no significant difference in negative affect between African dance and Hatha yoga ($p = .94$).

There was no significant main effect for positive affect $F(1, 65) = .403, p = .53, \eta^2 = .006$, but there was a significant Time × Class interaction, $F(2, 65) = 10.85, p < .0001, \eta^2 = .25$. There was a significant decline in positive affect in the biology class ($p < .001$), a significant increase in positive affect in dance ($p < .05$), and no significant change in Hatha yoga ($p = .22$). Post hoc analyses revealed that for positive affect, African dance and biology were significantly different ($p < .0001$),

Hatha yoga and biology were significantly different ($p < .005$), and there was no significant difference between African dance and Hatha yoga ($p = .17$).

Salivary Assays

Sixty-two participants were included in the salivary cortisol analysis. Salivary assays for 5 participants were lost because insufficient saliva was collected for reliable conduct of assays. The repeated measures ANOVA for cortisol revealed a main effect for time, $F(1, 59) = 4.19, p < .05$. There was a significant

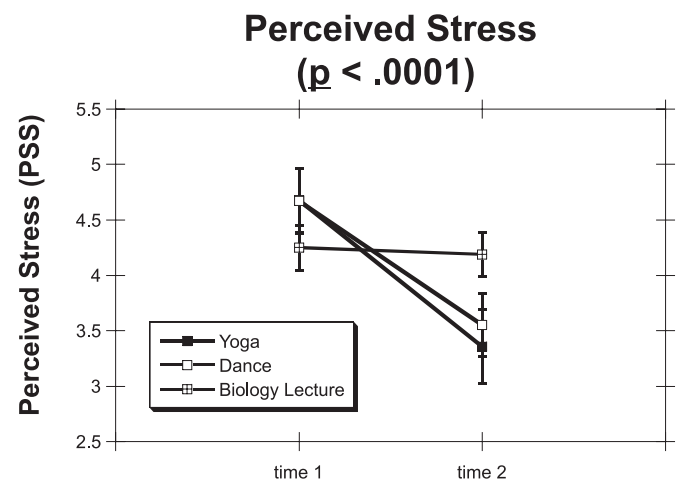


FIGURE 1 The effect of yoga, dance, and biology on perceived stress. There was a significant Time × Class interaction ($p < .0001$) such that both African dance and Hatha yoga showed significant reductions in the Perceived Stress Scale ($ps < .001$). These reductions were significantly larger than for biology ($p = .001$), which did not change significantly ($p = .78$). There was no significant difference between African dance and Hatha yoga ($p = .88$).

Time $\times$ Class interaction effect, $F(2, 59) = 17.28, p < .0001$; therefore, salivary cortisol increased significantly for African dance ($p < .0001$), decreased significantly for Hatha yoga ($p = .01$), and remained unchanged for biology ($p = .79$). Post hoc analysis revealed that African dance resulted in significantly greater increases in cortisol than both Hatha yoga ($p < .001$) and biology ($p < .0005$), whereas Hatha yoga and biology were not significantly different ($p = .86$; see Figure 2).

Predictors of Change in Cortisol Within Classes

To examine if psychological changes had differential effects on cortisol across treatments, a series of repeated measure analyses of covariance were conducted. Pre- and post-class cortisol values were entered as the repeated measures, class was the fixed factor, and pre- and post-class psychological variables were entered sequentially as covariates. There was no significant effect of cortisol on change in any psychological variables ($ps > .55$). There was a significant Class $\times$ Residualized Post-Class Positive Affect effect, $F(2, 52) = 3.52, p = .04, \eta^2 = .12$; therefore, the partial correlations between cortisol and residualized positive affect were $r = .25$ for biology, $r = .35$ for African dance, and $r = -.46$ for Hatha yoga. There were no similar interaction effects for negative affect or perceived stress ($ps > .24$). There were no other Class $\times$ Psychological Measure interactions.

DISCUSSION

As hypothesized, African dance and Hatha yoga significantly decreased perceived stress and negative affect, compared to the biology class. Positive affect was significantly increased

in African dance, significantly decreased in biology class, and did not change reliably in Hatha yoga. These findings are consistent with the literature showing a reduction in perceived stress and improved affect in response to dance and yoga (6,9,14–17).

We also found that cortisol increased in African dance, decreased in Hatha yoga, and did not change in the biology class. Our findings are not in agreement with a large literature that has suggested that salivary cortisol is a reliable biological marker of changes in perceived stress and affect (11–13,19,22). Acute manipulations of perceived stress and affect have reliably demonstrated to be positively correlated with cortisol levels (11–13,19,22). Although perceived stress and negative affect decreased in both African dance and Hatha yoga, cortisol levels significantly increased and decreased, respectively. We believe that differences in physiological arousal are most likely to account for the different effects on cortisol.

Although Hatha yoga and African dance produced significant reductions in perceived stress and negative affect compared with a control condition, there was no significant relation between change in these psychological variables and cortisol. In part, this may be because the Hatha yoga condition reduced cortisol levels, whereas the African dance condition produced an increase in cortisol. There was a relation between positive affect and cortisol within the different classes; however, this relation varied depending on the condition, with a positive relation between change in cortisol and positive affect in African dance and negative relation in Hatha yoga.

The influence of perceived stress and affective changes and cortisol recently has been given some attention (11–13, 19,22,23). Most of the literature, however, suggests that cortisol responds to acute changes in negative affect. One study found that positive and negative mood induction had no effect on salivary cortisol levels (23). Although African dance and Hatha yoga both decreased perceived stress and improved affect, cortisol levels significantly changed in opposite directions. We have accounted for the change in cortisol in dance with physiological arousal, but what may account for the significant decrease in cortisol for Hatha yoga? Change in positive affect in Hatha yoga was negatively correlated with cortisol; therefore, our results support the premise that affective changes may affect cortisol levels. Although, it is also possible that the slow, concentrated breathing and behavioral postures of Hatha yoga decrease cortisol levels regardless of changes in mood or perceived stress.

Given that cortisol is a catabolic steroid that facilitates regulation of physical arousal through glucose metabolism and regulation of heart rate and blood pressure (4,18), it is not surprising that African dance would produce significant increases in cortisol. These findings underscore that, although cortisol can be influenced by perceived stress and distress under some circumstances, these subtle changes are easily overwhelmed by cortisol's role in regulating arousal. Psychological manipulations of perceived stress and mood do have an effect on hormonal responses to physical training. One study involving rowers during a period of heavy training found that CBSM reduced depressed mood, negative affect, fatigue, and cortisol levels

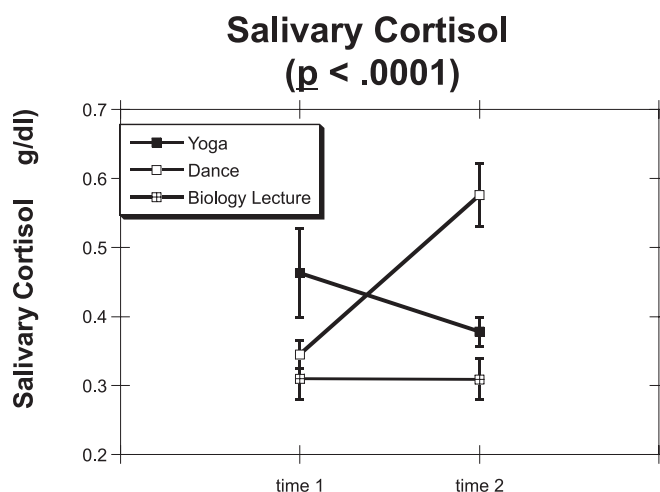


FIGURE 2 The effect of yoga, dance, and biology on salivary cortisol. There was a significant Time $\times$ Class interaction effect ($p < .0001$), such that salivary cortisol increased significantly for African dance ($p < .0001$), decreased significantly for Hatha yoga ($p = .01$), and remained unchanged for biology ($p = .79$). African dance resulted in significantly greater increases in cortisol than both Hatha yoga ($p < .001$) and biology ($p < .0005$), whereas Hatha yoga and biology were not significantly different ($p = .86$).

(24). It is important to note that these were not acute effects but measures taken over a 4-week period.

There are several limitations to this study, as well as caveats in the interpretation of the data that should be mentioned. Due to the following limitations, these results should be considered preliminary. First, the participants were not randomly assigned. Therefore, the influence of personality characteristics resulting in a preference for African dance versus Hatha yoga class on outcome variables cannot be ruled out. Further, this study examined the acute effects of Hatha yoga and African dance, and these findings do not reflect the effects of repeated practice over time for these measures. Finally, participants were a homogeneous group of healthy young college students, suggesting caution in generalizing these results to a broader population.

Behavioral factors influence hypothalamic–pituitary–adrenal functioning. Our findings suggest the effects of behavior may be very difficult to sort out, particularly if these behaviors involve physiological arousal. These findings also suggest that these interventions aimed at reducing perceived stress may be effective in reducing stress and distress. However, even when these interventions produce similar positive psychological effects, the effects may be very different on acute physiological stress processes. One factor that may have a particular salience is the amount of physiological arousal produced by the intervention. However, it may well be that repeated practice of both Hatha yoga and African dance lead to reductions of basal cortisol secretion over time, which could contribute to their beneficial effects on health.

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