Original Article

Improvements in well-being and vagal tone following a yogic breathing-based life skills workshop in young adults: Two open-trial pilot studies

Michael R Goldstein, Gregory F Lewis[1], Ronnie Newman[2,3], Janice M Brown[4], Georgiy Bobashev[4], Lisa Kilpatrick[5], Emma M Seppälä[6], Diana H Fishbein[7], Sreelatha Meleth[5]

Department of Psychology, University of Arizona, Tucson, AZ, [1]Department of Psychiatry, University of North Carolina at Chapel Hill, Chapel Hill, NC, [2]International Association for Human Values, Washington, DC, [3]Nova Southeastern University Lifelong Learning Institute, Davie, FL, [4]RTI International, Research Triangle Park, NC, [6]Center for Compassion and Altruism Research and Education, School of Medicine, Stanford University, Stanford, CA, [7]Department of Human Development and Family Studies, Penn State University, State College, PA, USA, [5]RTI International, Atlanta, GA

Address for correspondence: Dr. Sreelatha Meleth, BioStatistics and Epidemiology Unit, Environmental Health Sciences Division, RTI International 2951 Flowers Road South, Atlanta, GA 30341, USA.
E-mail: smeleth@rti.org

ABSTRACT

Background: While efficacy of Sudarshan Kriya Yoga (SKY) has been demonstrated in a number of prior studies, little is known about the effects of SKY taught as part of the Your Enlightened Side (YES+) workshop designed for college students and other young adults.

Aims: This study aimed to assess the effects of YES+, a yogic breathing-based life skills workshop, on multiple measures of well-being and physiological stress response.

Materials and Methods: Two nonrandomized open-trial pilot studies were conducted with a total of 74 young adults (age 25.4 ± 6.6 years; 55% female). Study 1 collected a variety of self-report questionnaires at baseline, postworkshop, and 1-month follow-up. Study 2 collected self-report questionnaires in addition to electrocardiography with a stationary cycling challenge at baseline and 1-month follow-up.

Results: Study 1: Improvements in self-reported depression (P's ≤ 0.010), perceived stress (P's ≤ 0.002), life satisfaction (P's ≤ 0.002), social connectedness (P's ≤ 0.004), and gratitude (P's ≤ 0.090) were observed at postworkshop and 1-month after workshop relative to baseline. Study 2: Improvements in self-reported emotion regulation were observed at 1-month follow-up relative to baseline (P = 0.019). Positive and Negative Affect Schedule-Expanded Form positive affect increased (P = 0.021), while fatigue and sadness decreased (P's ≤ 0.005). During the stationary cycling challenge, rate to recovery of electrocardiography inter-beat interval also increased from baseline to 1-month follow-up (P = 0.077).

Conclusions: These findings suggest that a life skills workshop integrating yogic breathing techniques may provide self-empowering tools for enhancing well-being in young adults. Future research is indicated to further explore these effects, particularly in regards to vagal tone and other aspects of stress physiology.

Key words: Emotion regulation; meditation; stress management; vagal tone; well-being; yoga breathing techniques.

INTRODUCTION

The transition from adolescence to adulthood, particularly for college students, is accompanied by several major life changes and challenges. For many individuals, this is a period when one moves away from home, begins

Access this article online	
Website: www.ijoy.org.in	Quick Response Code
DOI: 10.4103/0973-6131.171718	

How to cite this article: Goldstein MR, Lewis GF, Newman R, Brown JM, Bobashev G, Kilpatrick L, *et al*. Improvements in well-being and vagal tone following a yogic breathing-based life skills workshop in young adults: Two open-trial pilot studies. Int J Yoga 2016;9:20-6.

interacting with different peer groups, and has greater financial and academic responsibilities. The emotional stress associated with these changes is correlated with less time devoted to sleep,[1] increased alcohol intake,[2] reduced academic performance,[2,3] and increased rates of anxiety disorders and/or depression.[4]

Your Enlightened Side (plus more) (YES+) is a life skills workshop with a strong emphasis on breathing practices for reducing stress and increasing well-being. Additional stress management tools including meditation, yoga, and interpersonal exercises that impart social and emotional learning skills and stress reduction strategies complement the breathing techniques.

The central practice taught in YES+ is a unique rhythmical breathing technique called Sudarshan Kriya.[5] It is taught along with two preparatory breathing practices: An advanced form of *Ujjayi* breathing (breathing against airway resistance) and *bhastrika* (forceful nasal breathing). Collectively, these three breathing practices are referred to as Sudarshan Kriya Yoga (SKY).

Prior literature has demonstrated significant improvements in psychological and physiological outcomes of SKY in adults, including decreases in subjective stress,[6] clinical and subclinical depression and anxiety,[6-8] posttraumatic stress symptoms,[9-11] impulsivity,[12] and tobacco use,[13] as well as increases in calm, mental focus,[14] emotion regulation,[15,16] and overall well-being.[6,17]

However, little is known about the effects of SKY specifically taught in the YES+ workshop format designed for college students. One randomized controlled trial has demonstrated and attenuated levels of subjective stress and several hematological markers, including lymphocytes and platelet count, during exam periods following SKY training.[18] These findings have not yet been replicated, and the extent to which the effects of YES+ generalize to other health-related changes such as cardiovascular function remain unclear.

To address this gap in the literature and provide further preliminary data on the specific effects of YES+ on well-being, two separate nonrandomized open-trial studies were conducted. Study 1 implemented a collection of measures targeted at a variety of domains of subjective well-being. Study 2 sought to further explore changes in self-reported affect and emotion regulation scales, as well as changes in autonomic function, with a physical exercise task.

STUDY 1 MATERIALS AND METHODS

Procedure and participants

Fifty undergraduate and graduate students at the University of Wisconsin–Madison were recruited [Table 1]. Participants provided written informed consent and underwent a brief screening interview. Participants with a reported history of panic or bipolar disorder were excluded due to the potential adverse effects of the SKY technique for these individuals. Ethics approval was obtained from the IRB at the University of Wisconsin–Madison.

Data collection for the first wave of enrollment included 2 times points: Within 1 week prior to the workshop (T1) and within 1 week following the 5-day YES+ workshop (T2). For the second enrollment wave, a 3rd time point was added 1-month postworkshop (T3) to assess longer-term outcomes. For each time point, participants were sent a link to access the questionnaires via secure online database.

Your Enlightened Side+ workshop

The workshop totaled 20 h across 5 consecutive days and was taught by certified instructors with at least 250 h of prior training. From day three onward, participants were instructed to begin practicing a daily 20–25 min home SKY practice and were encouraged to attend once-weekly 90-min postworkshop sessions for a longer version of SKY in a group format.

Self-report measures

Outcome measures included the 10-item Center for Epidemiologic Studies Depression Scale (CESD-10),[19] a version of the Perceived Stress Scale (PSS)[20] that asked about the last week instead of the last month, the Social Connectedness Scale,[21] SWLS,[22] and 6-item Gratitude Questionnaire.[23]

Table 1: Demographic information

	Study 1	Study 2
Total, *n*	50	29
Age, mean (SD)	22.3 (3.9)	32.5 (5.1)
Gender, *n* (%)		
Male	21 (42)	17 (59)
Female	29 (58)	12 (41)
Ethnicity, *n* (%)		
Caucasian	31 (62)	4 (14)
African American	4 (8)	6 (21)
Asian American	16 (32)	19 (66)
American Indian	2 (4)	0 (0)
Hispanic	2 (4)	0 (0)

SD = Standard deviation

Statistical analysis

Internal reliability for each scale was assessed via Cronbach alpha. For the first wave of participants with 2 times points, paired two-tailed *t*-test was conducted to evaluate mean change from T1 to T2. For the second subgroup with 3 times points, repeated measures ANOVA was utilized to test the effect of time for each measure, with *post-hoc* tests (Bonferroni-corrected) assessing specific changes relative to baseline for any measure with a significant omnibus effect ($\alpha = 0.05$). Finally, differential change between the two subgroups for the overlapping T1 and T2 data was evaluated via two-way mixed model ANOVA. Analyses were conducted in SPSS (IBM Corp., Armonk, NY).

STUDY 1 RESULTS

For the first recruitment wave, data at 2 times points were available for all 12 participants [Figure 1]. For the second wave ($n = 38$), which contained 3 times points, 5 participants were lost to follow-up postworkshop (T2). Sixteen participants were unable to complete questionnaires at the 1-month follow-up (T3), primarily due to summer vacation scheduling conflicts. Thus, the data from all 3 times points were analyzed for 17 participants, with an additional 28 participants for T1 and T2 only.

Results from the self-report measures are displayed in Table 2. All scales demonstrated moderate to high internal reliability ($\alpha = 0.76$–0.95). For the subgroup with only T1 and T2 data, a significant improvement was observed for the measurements of depression (CESD-10), PSS, social connectedness, and SWLS. The Gratitude Questionnaire exhibited a trend-level difference ($P = 0.053$). For participants with all 3 times points, a significant effect of time was observed for all measures. Significant improvements were observed on all measures from baseline to T2 and were sustained through 1-month postworkshop (T3) with the exception of the Gratitude Questionnaire ($P = 0.090$ following Bonferroni correction).

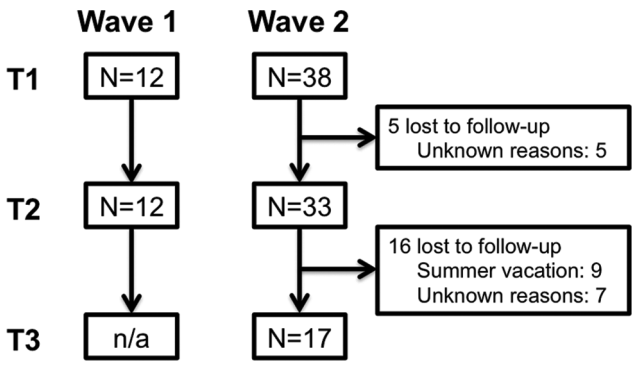

Figure 1: Study 1 enrollment and data collection flow

A subgroup ("T1-T2 only" subgroup and "T1-T3" subgroup) x time (T1 and T2) mixed model ANOVA indicated no significant interaction effects across the self-report measures ($P = 0.140$–0.840), suggesting that those only completing the first 2 times points reported the similar changes from T1 to T2 as those completing all 3 times points.

STUDY 2 MATERIALS AND METHODS

Procedure and participants

Twenty-nine young adults were recruited from the greater Atlanta area [Table 1]. Ethics approval was obtained from the IRB at Research Triangle Institute, and all participants provided written informed consent. Inclusion and exclusion criteria were the same as for Study 1.

Similar to Study 1, the data were collected in two waves. The first workshop was held after recruiting 14 participants. The second workshop was held 1 month later for an additional 15 participants. The same YES+ workshop design, timeline, and daily home practice instructions as Study 1 were used. Experimental visits for Study 2 occurred at baseline and at a 4-week follow-up.

Self-report measures

Participants completed the emotion dysregulation measure (EDM),[24] a 13-item Likert scale containing two subscales ("Emotional Sensitivity/Emotional Response" and "Return to Emotional Baseline"), and the Positive and Negative Affect Schedule-Expanded Form (PANAS-X).[25]

Cycling challenge and heart rate variability measures

As part of this pilot study, a physical exercise task was also implemented for a subset of participants with electrocardiogram (ECG) recordings at each time point. Participants were positioned on a stationary bicycle, allowed approximately 5 min rest, then engaged in a self-paced cycling challenge lasting approximately 5 min, followed by a 5–10 min recovery period. ECG signals were collected using previously published standard procedures.[26] Due to technical issues during recordings; baseline and 4-week follow-up data were only available for 11 participants.

To assess cardiac vagal tone, the rate to recovery from the cycling challenge was the primary construct of interest. As illustrated in Figure 2, for each recording, a polynomial function was fitted to the inter-beat interval (IBI) data derived via EZ-IBI software (UFI, Morro Bay, CA). Then, the local peak preceding the recovery slope and the peak immediately following this transition were identified,

Table 2: Study 1 self-report measures

	Pre and post only (n=28)			*t*	*P*
	Alpha	Pre	Post		
CESD-10	0.820	9.50 (5.1)	4.89 (3.6)	−3.98	<0.001
PSS	0.882	16.29 (7.0)	11.21 (5.6)	−3.55	0.001
Connectedness	0.947	86.39 (17.9)	102.43 (13.7)	5.19	<0.001
SWLS§	0.901	23.70 (7.3)	27.29 (5.8)	3.63	0.001
GQ-6§	0.879	37.30 (5.8)	38.71 (4.5)	2.02	0.053

	Follow-up subgroup (n=17)				ANOVA			*Post-hoc* (*P*)	
	Alpha	Pre	Post	4-week Follow-up	df	*F*	*P*	Pre vs. Post	Pre vs. 4-week Follow-up
CESD-10	0.806	7.82 (4.4)	2.88 (2.3)	4.65 (4.2)	2.32	13.86	<0.001	<0.001	0.010
PSS	0.876	16.35 (7.5)	8.24 (4.8)	10.71 (5.0)	2.32	17.62	<0.001	<0.001	0.002
Connectedness	0.942	87.88 (18.1)	109.41 (8.2)	101.94 (11.5)	2.32	21.63	<0.001	<0.001	0.004
SWLS	0.862	24.94 (5.6)	30.24 (4.4)	28.94 (5.7)	2.32	16.46	<0.001	<0.001	0.002
GQ-6‡	0.755	35.76 (4.9)	39.35 (3.4)	38.00 (3.6)	2.30	9.02	0.001	0.002	0.090

Values are displayed as mean (SD). Where applicable, *post-hoc* *t*-test was conducted with Bonferroni correction for the two specified comparisons of interest. §n = 27 for pre; ‡n = 16 for 4-week follow-up. CESD-10 = Center for Epidemiologic Studies Depression Scale (10-item version); PSS = Perceived Stress Scale; Connectedness = Social Connectedness Scale; SWLS = Satisfaction With Life Scale; GQ-6 = Gratitude Questionnaire (6-item version); α = Cronbach alpha estimate of internal reliability; SD = Standard deviation

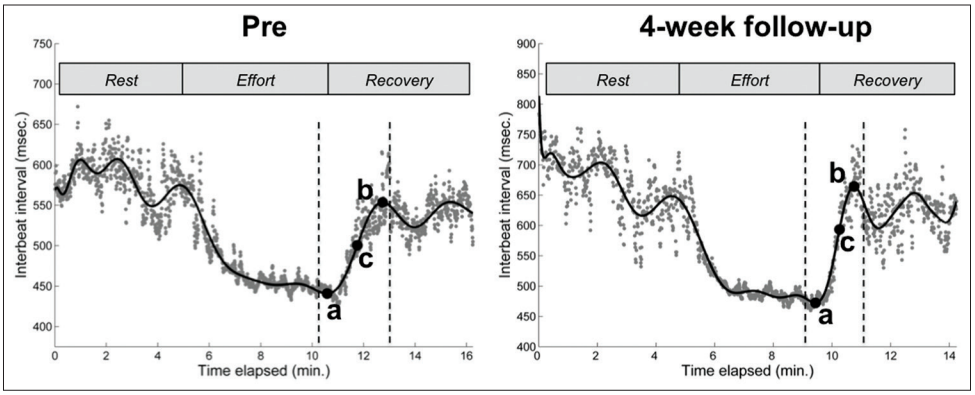

Figure 2: Inter-beat interval across rest, stationary bicycle effort, and recovery periods for a representative participant from Study 2 at preworkshop and 4-week follow-up time points. A least-squares polynomial of best fit was calculated for each recording. Within each effort to recovery transition window (dotted lines), the local minimum (a) and maximum (b) were determined, between which the inflexion point (c) was used to derive maximal linear point-slope of the curve as a measure of recovery rate. Across participants with available data at both time points (n = 11), mean point-slope increased from preworkshop to 4-week follow-up (P = 0.077)

along with the inflexion point between these peaks. To capture the recovery rate not confounded by individual differences in the prominence of the second peak caused by asymptotes of some fitted lines (resulting in the peak occurring in the middle of the recovery period rather than the beginning), the linear point-slope was calculated at the inflexion point. Additional, commonly used metrics of heart rate (HR) variability were computed based on the IBI series data using CMetX.[27]

Statistical analysis

As with Study 1, internal reliability for each self-report scale was assessed using Cronbach alpha, and differences in self-report and IBI measures between the 2 times points (baseline and 4-week follow-up) were evaluated using paired *t*-test. Relationships among these measures were assessed with linear regression. Analyzes were conducted in SAS (SAS Institute Inc., Cary, NC) and MATLAB (MathWorks, Natick, MA).

STUDY 2 RESULTS

Three participants dropped out due to job-related relocations, one due to difficulties with childcare and one withdrew after baseline measurements before the intervention began.

Both self-report composite scales and subscales demonstrated moderate to high internal reliability (α = 0.78–0.96). From baseline to 4-week follow-up, the EDM instrument measuring the overall changes in emotional dysregulation decreased (P = 0.019), driven by changes in both the Emotional Sensitivity/Emotional Response subscale (P = 0.016) and the Return to Emotional Baseline subscale (P = 0.045). For the PANAS-X, composite positive affect increased (P = 0.021) [Table 3], along with seven associated sub-scales including joviality (P = 0.031), self-assurance (P = 0.008), attentiveness (P = 0.011), and serenity (P = 0.001). A significant difference was not observed for composite negative affect, although

subscales for sadness ($P = 0.005$) and fatigue ($P < 0.001$) decreased significantly, and hostility ($P = 0.057$) evidenced a trend-level change.

Commonly used measures of cardiac chronotropy including HR, mean IBI, root mean square of successive differences, and logarithm of respiratory sinus arrhythmia corresponding to rest, effort, and recovery periods of the cycling challenge are presented in Table 4. Using a difference metric as done in prior research[28] to assess the change in average values from effort to recovery periods of the cycling challenge, no significant changes on these four metrics were observed between baseline and week 4 ($0.143 < P < 0.481$).

However, the linear point-slope of the IBI recovery curve, a measure that more precisely reflects the rate to recovery process, demonstrated a trend-level effect indicating an increase in the recovery rate from baseline (mean change in IBI/s = 3.03 ± 1.15) to 4-week follow-up (4.06 ± 1.74), $T(10) = 1.97$, $P = 0.077$ [Figure 2]. This change corresponded to a 48% mean increase in the IBI recovery rate. No difference was observed for the goodness-of-fit of the polynomial functions fitted to the IBI data (R^2 = 0.80 ± 0.12 vs. 0.82 ± 0.12), $P = 0.540$. The self-report composite scales and sub-scales did not significantly correlate with IBI point-slope at either time point or proportionally to the amount of change.

Table 3: PANAS-X scale scores at baseline and 4 weeks following workshop in study 2 (n=29)

Sub-scale	Baseline	4-week Follow-up	*t*	*P*
Negative affect	21.0 (7.2)	16 (6.2)	−1.76	0.106
Positive affect	23.9 (9.3)	26.9 (5.4)	2.51	0.021
Fear	11.9 (3.8)	9.3 (4.3)	−1.30	0.219
Hostility	12.2 (4.7)	10.1 (3.6)	−2.02	0.057
Guilt	11.1 (5.1)	8.3 (3.8)	−1.46	0.172
Sadness	11.3 (5.7)	8.3 (4.6)	−3.17	0.005
Joviality	23.1 (6.9)	26.8 (6.5)	2.33	0.031
Self-assurance	15.8 (5.3)	18.9 (4.5)	2.94	0.008
Attentiveness	12.1 (3.5)	14 (2.5)	2.78	0.011
Shyness	7.2 (2.5)	6.6 (3.1)	−1.55	0.153
Fatigue	12.2 (3.9)	7.7 (2.9)	−4.79	<0.001
Serenity	8.4 (2.3)	11.5 (1.9)	4.18	0.001
Surprise	6.2 (3.5)	6.9 (2.3)	0.90	0.386

PANAS-X = Positive and Negative Affect Schedule-Expanded Form

Table 4: Measures of cardiac chronotropy during cycling challenge in study 2 (n=11)

	Baseline	4-week Follow-up
HR		
Rest	72.9 (13.2)	75.1 (13.1)
Effort	101.1 (15.8)	104.8 (14.0)
Recovery	76.7 (14.0)	78.1 (13.7)
IBI		
Rest	849.4 (142.9)	824.4 (141.5)
Effort	608.0 (97.0)	585.3 (85.6)
Recovery	807.5 (130.7)	794.5 (143.9)
RMSSD		
Rest	33.8 (11.1)	31.6 (10.4)
Effort	14.8 (7.8)	9.7 (5.0)
Recovery	38.1 (10.7)	37.4 (12.1)
RSA		
Rest	5.9 (0.8)	5.9 (0.6)
Effort	3.7 (1.7)	3.0 (1.0)
Recovery	5.9 (0.7)	6.0 (0.5)

Values are displayed as mean (SD) for the rest, stationary bicycle effort, and recovery periods. HR = Heart rate; IBI = Inter-beat interval; RMSSD = Root means square of successive differences; RSA = Logarithm of respiratory sinus arrhythmia; SD = Standard deviation

DISCUSSION

The results of these two open-trial pilot studies suggest that the YES+ workshop is associated with improvements in both subjective well-being and autonomic system functioning. These changes including reductions in depression, perceived stress, sadness, and fatigue, and improvements in social connectedness, satisfaction with life, gratitude, emotion regulation, and positive affect including joviality, serenity, self-assurance, and attentiveness from baseline to 1-month following completion of the workshop.

Strength of Study 2 was the inclusion of a physical exercise task to evaluate the changes in autonomic regulation reflected in the rate to recovery of HR. The increase in IBI slope of recovery from the cycling challenge may reflect enhanced parasympathetic activity and vagal tone afforded by SKY and other components of the YES+ workshop.[5] Mean values and variability in IBI across rest and effort periods observed here corroborate prior literature.[28-30] It is notable that the recovery slope of the cycling challenge increased from baseline to several weeks following YES+, as the workshop does not explicitly target physical fitness. This observation would benefit from replication and additional data to explore the extent of changes in vagal tone. While this analysis focused on IBI as a simple, intuitive measure with high reliability relative to other HR variability measures,[31] it is important for future studies to explore additional metrics controlling for respiratory rate in the context of both physical and psychological stress tasks.[32]

Limitations

Because of the uncontrolled nature of both study designs, placebo effects are not accounted for and may have influenced results. The self-report measures and voluntary completion of the questionnaires in Study 1 created the potential for self-attribution and self-selection biases. However, the follow-up analyses indicated that differential change across participants was unlikely, and the physiological measures of Study 2 corroborate the self-report data of changes hypothesized to reflect

improvements in well-being. Randomized controlled trials combining self-report psychological and objective physiological measures with larger sample sizes would allow for enhanced evaluation of the relationships between these outcomes and the YES+ interventions.

CONCLUSIONS

These two nonrandomized trials of YES+ suggest that this workshop holds potential as a self-empowering, nonpharmacological method for enhancing stress management and wellness in college students. Given the long-term impact of stress on physical and emotional health, providing such a workshop to young adults might help to prevent several consequences correlated with poor stress management, ranging from substance use and risky sexual behaviors to eating disorders, and cardiovascular disease. The known association between positive affect and healthy life choices further increase the potential benefits of YES+.

Acknowledgments

The authors are grateful for the voluntary commitment from participants in both studies; Spencer Dawson, Ezra Smith, Samantha Reznik, and other colleagues for the insightful discussions; Dr. John Allen for direct and indirect support with discussions and resources for data analysis; Diedre Jackson, Josette Agarwal, Annelies Richmond, and Daniel Moss of the Art of Living Foundation for providing the workshop instruction; and the Art of Living Center in Atlanta for providing the space for workshops and other resources in kind support.

Financial support and sponsorship

This research was funded in part by RTI International's Independent Research and Development funds (to SM) and National Science Foundation Graduate Research Fellowship (to MRG).

Conflicts of interest

M.R. Goldstein, G.F. Lewis, J.M. Brown, G. Bobashev, L. Kilpatrick, D.H. Fishbein, and S. Meleth declare no conflicts of interest. E.M. Seppälä was the workshop instructor for Study 1. R. Newman supervised YES+ instructors in Study 2 and is Director of Research and Health Promotion for the Art of Living Foundation, North America.

REFERENCES

1. Ari LL, Shulman S. Pathways of sleep, affect, and stress constellations during the first year of college: Transition difficulties of emerging adults. J Youth Stud 2012;15:273-92.
2. Park CL, Levenson MR. Drinking to cope among college students: Prevalence, problems and coping processes. J Stud Alcohol 2002;63:486-97.
3. Murff SH. The impact of stress on academic success in college students. ABNF J 2005;16:102-4.
4. Rawson HE, Bloomer K, Kendall A. Stress, anxiety, depression, and physical illness in college students. J Genet Psychol 1994;155:321-30.
5. Brown RP, Gerbarg PL. Sudarshan Kriya yogic breathing in the treatment of stress, anxiety, and depression: Part I-neurophysiologic model. J Altern Complement Med 2005;11:189-201.
6. Kjellgren A, Bood SA, Axelsson K, Norlander T, Saatcioglu F. Wellness through a comprehensive yogic breathing program – A controlled pilot trial. BMC Complement Altern Med 2007;7:43.
7. Katzman MA, Vermani M, Gerbarg PL, Brown RP, Iorio C, Davis M, *et al.* A multicomponent yoga-based, breath intervention program as an adjunctive treatment in patients suffering from generalized anxiety disorder with or without comorbidities. Int J Yoga 2012;5:57-65.
8. Vedamurthachar A, Janakiramaiah N, Hegde JM, Shetty TK, Subbakrishna DK, Sureshbabu SV, *et al.* Antidepressant efficacy and hormonal effects of Sudarshana Kriya Yoga (SKY) in alcohol dependent individuals. J Affect Disord 2006;94:249-53.
9. Descilo T, Vedamurtachar A, Gerbarg PL, Nagaraja D, Gangadhar BN, Damodaran B, *et al.* Effects of a yoga breath intervention alone and in combination with an exposure therapy for post-traumatic stress disorder and depression in survivors of the 2004 South-East Asia tsunami. Acta Psychiatr Scand 2010;121:289-300.
10. Carter JJ, Gerbarg PL, Brown RP, Ware RS, D'Ambrosio C, Anand L, *et al.* Multi-component yoga breath program for vietnam veteran post traumatic stress disorder: Randomized controlled trial. Trauma Stress Disord Treat 2013;2:1-10.
11. Seppälä EM, Nitschke JB, Tudorascu DL, Hayes A, Goldstein MR, Nguyen DT, *et al.* Breathing-based meditation decreases posttraumatic stress disorder symptoms in U.S. military veterans: A randomized controlled longitudinal study. J Trauma Stress 2014;27:397-405.
12. Ghahremani DG, Oh EY, Dean AC, Mouzakis K, Wilson KD, London ED. Effects of the Youth Empowerment Seminar on impulsive behavior in adolescents. J Adolesc Health 2013;53:139-41.
13. Kochupillai V, Kumar P, Singh D, Aggarwal D, Bhardwaj N, Bhutani M, *et al.* Effect of rhythmic breathing (Sudarshan Kriya and Pranayam) on immune functions and tobacco addiction. Ann N Y Acad Sci 2005;1056:242-52.
14. Murthy PJ, Gangadhar BN, Janakiramaiah N, Subbakrishna DK. Normalization of P300 amplitude following treatment in dysthymia. Biol Psychiatry 1997;42:740-3.
15. Gootjes L, Franken IH, Van Strien JW. Cognitive emotion regulation in yogic meditative practitioners. J Psychophysiol 2011;25:87-94.
16. Warner A, Wall K, Birk H, Koopman C. Psychological and spiritual well-being of women with breast cancer participating in the art of living program. In: Hicks NL, Warren RE, editors. Psychology of Cancer. Hauppauge, NY: Nova Science Publishers, Inc; 2012. p. 63-108.
17. Bhatia M, Kumar A, Kumar N, Pandey RM, Kochupillai V; EEG study, *et al.* Electrophysiologic evaluation of Sudarshan Kriya: An EEG, BAER, P300 study. Indian J Physiol Pharmacol 2003;47:157-63.
18. Subramanian S, Elango T, Malligarjunan H, Kochupillai V, Dayalan H. Role of sudarshan kriya and pranayam on lipid profile and blood cell parameters during exam stress: A randomized controlled trial. Int J Yoga 2012;5:21-7.
19. Radloff LS. The CES-D Scale: A self-report depression scale for research in the general population. Appl Psychol Meas 1977;1:385-401.
20. Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. J Health Soc Behav 1983;24:385-96.
21. Lee RM, Draper M, Lee S. Social connectedness, dysfunctional interpersonal behaviors, and psychological distress: Testing a mediator model. J Couns Psychol 2001;48:310-8.
22. Diener E, Emmons RA, Larsen RJ, Griffin S. The satisfaction with life scale. J Pers Assess 1985;49:71-5.
23. Mccullough ME, Emmons RA, Tsang JA. The grateful disposition:

A conceptual and empirical topography. J Pers Soc Psychol 2002;82:112-27.
24. Newhill CE, Bell MM, Eack SM, Mulvey EP. Confirmatory factor analysis of the emotion dysregulation measure. J Soc Social Work Res 2010;1:159-68.
25. Watson D, Clark LA. The PANAS-X: Manual for the Positive and Negative Affect Schedule – Expanded Form. Iowa City, IA: Department of Psychology, The University of Iowa; 1999.
26. Dale LP, Carroll LE, Galen G, Hayes JA, Webb KW, Porges SW. Abuse history is related to autonomic regulation to mild exercise and psychological wellbeing. Appl Psychophysiol Biofeedback 2009;34:299-308.
27. Allen JJ, Chambers AS, Towers DN. The many metrics of cardiac chronotropy: A pragmatic primer and a brief comparison of metrics. Biol Psychol 2007;74:243-62.
28. Porges SW, Heilman KJ, Bazhenova OV, Bal E, Doussard-Roosevelt JA, Koledin M. Does motor activity during psychophysiological paradigms confound the quantification and interpretation of heart rate and heart rate variability measures in young children? Dev Psychobiol 2007;49:485-94.
29. Spalding TW, Jeffers LS, Porges SW, Hatfield BD. Vagal and cardiac reactivity to psychological stressors in trained and untrained men. Med Sci Sports Exerc 2000;32:581-91.
30. Wallot S, Fusaroli R, Tylén K, Jegindø EM. Using complexity metrics with R-R intervals and BPM heart rate measures. Front Physiol 2013;4:211.
31. Sookan T, McKune AJ. Heart rate variability in physically active individuals: Reliability and gender characteristics. Cardiovasc J Afr 2012;23:67-72.
32. Lewis GF, Furman SA, McCool MF, Porges SW. Statistical strategies to quantify respiratory sinus arrhythmia: Are commonly used metrics equivalent? Biol Psychol 2012;89:349-64.