Cognitive Behaviour Therapy Vol 35, No 1, pp. 3–10, 2006

Routledge
Taylor & Francis Group

Stress Management: A Randomized Study of Cognitive Behavioural Therapy and Yoga

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Abstract. In this study, a stress management program based on cognitive behavioural therapy principles was compared with a Kundaliniyoga program. A study sample of 26 women and 7 men from a large Swedish company were divided randomly into 2 groups for each of the different forms of intervention; a total of 4 groups. The groups were instructed by trained group leaders and 10 sessions were held with each of groups, over a period of 4 months. Psychological (self-rated stress and stress behaviour, anger, exhaustion, quality of life) and physiological (blood pressure, heart rate, urinary catecholamines, salivary cortisol) measurements obtained before and after treatment showed significant improvements on most of the variables in both groups as well as medium-to-high effect sizes. However, no significant difference was found between the 2 programs. The results indicate that both cognitive behaviour therapy and yoga are promising stress management techniques. *Key words: stress management; intervention; cognitive behavioural therapy; yoga; catecholamines; cortisol*

Received January 30, 2003; Accepted October 10, 2005

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Stress-related health problems, such as chronic fatigue, muscular pain and burnout, have increased dramatically in modern societies in recent years (European Commission, 2000). A variety of stress-management techniques is used to address this problem. In a meta-analysis of occupational stress-reducing interventions, van der Klink and colleagues (2001) distinguished 4 intervention types: cognitive-behavioural interventions, relaxation techniques, multimodal programs, and organization-focused interventions. They concluded that all of the intervention types were effective, but cognitive-behavioural interventions were more effective than the other types. In a review of work-site stress management interventions, including muscle relaxation, meditation, biofeedback, cognitive-behavioural skills and combinations of these techniques, Murphy (1996) concluded that the effectiveness of the interventions varied according to the health-outcome measure used. Cognitive-behavioural skills were more effective for psychological outcomes, whereas muscle relaxation techniques were more effective for physiological outcomes. Using a combination of techniques (e.g. muscle relaxation plus cognitive-behavioural skills) seemed to be more effective across outcome measures than using a single technique. A similar recommendation is given by Jones and Johnston (2000), who concludes that a stress management intervention should include psycho-education and analyses of individual reaction in combination with management techniques, such as relaxation, assertiveness training, time management and cognitive restructuring.

Yoga is an ancient Indian practice focusing on breathing and physical exercises, thereby combining muscle relaxation, meditation and physical workout. There is a plethora of yoga schools, of which one of the most common is Kundaliniyoga. Kundaliniyoga is characterized

 ISSN 1650-6073
DOI 10.1080/16506070500401292

by exercises (*kriyas*) that stimulate the blood flow and energy supply to the brain, the nervous system and the glands in the endocrine nervous system (Singh-Khalsa, 1998). Although there is a lack of controlled studies, yoga is regarded as a promising method for the treatment of stress-related problems (Fersling, 1997). Several studies have shown yoga to be promising for both physiological (Murugesan, Govindarajulu, & Bera, 2000) and psychological outcome measures (Malathi, Damodaran, Shah, Patil, & Maratha, 2000).

In many randomized controlled studies a comparison is made between an active treatment and a wait list control group, which enables control for history, spontaneous recovery and other confounders (Sackett, Haynes, Tugwell, & Guyatt, 1991). Although this a common approach with many advantages, it has also been criticized. From medicine, a common criticism is that it is unethical to withhold a treatment from a patient who needs it (Feldman, Wang, Willan, & Szalai, 2003). Others emphasize that the possibility of being in a control group might be regarded as unacceptable to potential participants, hence increasing the risk of non-compliance and drop-out (Schafer, 1982). This is particularly true for interventions in the workplace, where organizations rarely agree to participate in true experiments and randomized controlled trails with non-treatment or wait list control groups.

In the present randomized study, 2 active methods for stress management, cognitive behaviour therapy and Kundaliniyoga, are compared. It is hypothesized that both methods have positive effects on perceived stress, stress behaviour, vital exhaustion, anger, quality of life, blood pressure, heart rate, catecholamine and cortisol levels, but that cognitive behaviour therapy and yoga have different impacts on various outcome measures.

Method

Design

Following recruitment and informed consent and before assessment, the participants were assigned randomly to 1 of 2 conditions: yoga and cognitive behaviour therapy, in either an all-female group or a mixed group (making 4 groups in total). Data were collected pre- and post-treatment. The study was approved by the local ethics committee.

Participants

Participants were recruited from a large Swedish company in the financial sector. All personnel received information about the design of the project and the 2 methods, and were invited to participate through the company's personnel department. Participation in the study was free of charge, but the company provided financial means for analyses of the physiological data. It was emphasized that there was no opportunity to choose between the 2 methods, and the participants were requested not to share information about the specific content of the methods with each other during treatment. Twenty-seven women and 10 men with self-reported stress-related problems agreed to participate in the study. Four individuals dropped out. In all, 33 participants completed the treatments: 17 on the cognitive behaviour therapy program, and 16 on the yoga program. Two participants missed the physiological measurements after treatment. Accordingly, physiological data are available for only 31 of the 33 individuals, despite all participants having completed the questionnaire. The main characteristics of the participants are presented in Table 1.

Table 1. *Characteristics of study participants.*

	Cognitive behaviour therapy	Yoga
	$n=19$	$n=18$
Gender		
Male	5 (26%)	5 (28%)
Female	14 (74%)	13 (72%)
Level of education		
Swedish high school	6 (44%)	7 (35%)
University	11 (56%)	9 (65%)
Marital status		
Married/cohabiting	11 (65%)	14 (88%)
Single	3 (18%)	1 (6%)
Divorced/widowed	3 (18%)	1 (6%)
Number of children		
0	9	8
1	2	5
$\geqslant 2$	6	3

Procedure

The 10 sessions in each program ranged over a 4-month period during the winter and spring of 2000. There was a difference in preferences with regard to the scheduling of the sessions. Yoga was held weekly (with 1 week's interruption between sessions 6 and 7 due to the school vacation), whereas cognitive behaviour therapy was initially held weekly (first 4 weeks), followed by 3 sessions held once every other week, and finally by 3 sessions once every 3 weeks. In order to end the 2 training programs at approximately the same time, the yoga groups started a few weeks later than the cognitive behaviour therapy groups. The all-female cognitive behaviour therapy group had 2 female instructors (SI, UvT), whereas the mixed group had just 1 male instructor (JG). A trained yoga instructor led both yoga groups. The cognitive behaviour therapy sessions were performed at the company premises and the yoga sessions at locations nearby.

Measurements for all participants were taken 2 weeks prior to the first cognitive behaviour therapy group session and 2 weeks after the final group sessions. Measurements took place in a room at the company's premises. Upon arrival for the measurements, the participants returned a questionnaire that they had completed at home. Following a short explanation of procedures, they were instructed to sit down and relax for 5 minutes before measurements of blood pressure and heart rate were taken. The measurements were repeated after 5 and 10 minutes. Finally, urine samples for catecholamines and saliva samples for cortisol determinations were obtained. During the measurements, relaxing classical music (*The Four Seasons* by Vivaldi and *Cello Suites* by Bach) was played on a compact disk player. The conditions were the same for pre- and post-measurements.

Following post-measurements, all participants were offered individual feedback on the outcomes of their tests.

Intervention programs

The cognitive behaviour therapy program consists of a modified version of a treatment used for coronary heart disease (Burell, 1996). Each session in the cognitive behaviour therapy program was divided into 5 sections: relaxation, discussion on home assignments, psycho-education, management techniques, and introduction of new home assignments. For relaxation, the principles of ''applied relaxation'' (Öst, 1987) were used. The homework assignments followed the same basic structure, including 4 parts: registration tasks (e.g. stress behaviour, anger and irritation, problems, etc.), daily drills (training new management techniques, such as listening without interrupting, eating slowly, etc.), case studies, and relaxation training. The psycho-education section consisted in the presentation of stress-related topics, such as the psychophysiology of stress, theoretical stress models, time urgency, irritation and anger. The management methods employed concerned problem-solving, assertiveness training, goal setting, time management, cognitive and behavioural restructuring and relapse prevention. To ensure a high degree of control over the content of the sessions, they followed a pre-set manual (including a written manuscript). Each session was followed by a meeting in which group leaders evaluated the content of the session.

The main focus of the yoga program was on physical exercise. Sessions 1–3 had their origin in a yoga program designed for back treatment. In sessions 4–6 a program involving basic movements, normally used as an introduction to Kundaliniyoga, was implemented. Sessions 7–9 were aimed at balancing body, energy and mind. The final session involved exercises that can be used daily to alleviate tension in the shoulders, neck and head, or when some extra energy is needed. At each session, participants were given a compendium that contained a theoretical account of a specific theme, and advice, suggestions and yoga exercises relevant to that theme. Each session included a 15-minute discussion of different topics, such as life behaviours, restoration, reflection, self-respect, physical exercise and food/eating habits. The yoga participants also received home assignments, which involved physical exercises and reading through the compendium in question. Various themes were presented, including personal goals, breathing, body postures, meditation and mantra knowledge and intuition.

To ensure that the 2 treatments differed, both were manual-based. Group leaders were informed of the necessity of closely following the manuals.

Questionnaires

Five scales covering different aspects of stress were used for the outcome measures. The first dependent measure, for general stress level, consisted in a Swedish translation of the "Perceived Stress Scale" (PSS) (Cohen, Kamarck, & Mermelstein, 1983; Eskin & Parr, 1996). The PSS is a 14-item scale designed to measure the degree to which life situations are appraised as stressful. The internal consistency reliability for the Swedish version is 0.82 (Cronbach's alpha). The second dependent measure, concerning the extent of Type-A behaviour, was the 20-item scale "Daily Stressors" (Burell, 1996). The third dependent measure was a Swedish version of the "Maastricht Questionnaire" (Appels, Höppener, & Mulder, 1987), which measures exhaustion. The scale, consisting of 19 items, was designed to measure the degree of vital exhaustion. As a fourth dependent measure, a Swedish version of the MMPI-2 Anger Sub-scale was used (Graham, 1990). Since 1 question was misinterpreted by a large number of participants, the original 15-item scale was transformed into a 14-item scale, with 1 item removed for statistical analysis. The fifth dependent measure was quality of life, which was measured using the Quality of Life Inventory (QOLI) (Frisch, Cornell, Villanueva, & Retzlaff, 1992). The QOLI consists of questions of importance and satisfaction regarding 16 areas in life (in total 32 items). Unfortunately, no data on reliability are available for the present versions of "Daily stressors", "exhaustion", "MMPI-2 Anger sub-scale" and QOLI. In order to make the scales more homogeneous, all items except those on the "Quality of Life Inventory" were presented with 5 response categories, regardless of the original number.

Physiological measures

Urinary catecholamine. Subjects were instructed not to smoke, use snuff or drink coffee or alcohol, and to avoid any activities that might expose them to stress during the 3 hours preceding the time of measurement.

They were instructed to empty their bladders, and note the exact time of voiding, about 2 hours before the time of measurement. Urine was voided again at the time of measurement, and the exact period in time from previous voiding was calculated. Following measurement of sample volume, the pH of the sample was adjusted to 3.0 with 6 M HCl. A 20 ml volume was frozen (−18℃) prior to analysis for adrenaline and noradrenaline by high-pressure liquid chromatography (HPLC) (Riggin & Kissinger, 1977). After determining the concentration of catecholamines in the sample, values were multiplied by volume and divided by time (pmol/min).

Cortisol in saliva. Cortisol in saliva was measured through use of a standard centrifugation tube (Salivette; Sarstedt Inc., Rommelsdorf, Germany), which contains a small cotton roll that is "chewed" upon for a couple of minutes to obtain a sufficient amount of saliva. Tubes with saliva samples were frozen (−18℃) until centrifuged and analysed for cortisol by radioimmunoassay (RIA).

Blood pressure and heart rate. Systolic and diastolic blood pressure and heart rate were measured by an automatic digital blood pressure device (DS-140, A&D Company, Japan). The median of 3 measurements was used for the statistical analyses.

Statistical analysis

SPSS, version 9.0, was used for the statistical analysis. Mean scores on the outcome measures at pre- and post-treatment for both groups were analysed by means of a 2-way repeated measures ANOVA. Group differences at pre- and post-treatment were tested using an independent-samples *t*-test. Two-tailed tests were used. Effect sizes were calculated according to Cohen's (1988) *d* statistic. For each scale the magnitude of change from pre- to post-treatment was defined as $(M_{pre}-M_{post})/SD_{pooled}$, where, $SD_{pooled}=\sqrt{[(SD_{pre2}+SD_{post2})/2]}$. Positive effect sizes represent improvements in stress and other symptoms (e.g. reductions in problems)) with the exception of QOLI, where negative effect sizes represent improvements.

Results

Questionnaire data

The changes in scores on the various variables following the intervention programs are summarized in Table 2.

Table 2. *Means and standard deviations of questionnaire data for the cognitive behaviour therapy and yoga treatment at pre- and post-treatment and effect sizes (Cohen's d) from pre- to post-treatment.*

	Cognitive behaviour therapy					Yoga				
	Pre $n=17$		Post $n=17$			Pre $n=16$		Post $n=16$		
	M	SD	M	SD	*d*	M	SD	M	SD	*d*
PSS	2.19	0.40	1.54	0.51	1.42	2.06	0.48	1.67	0.47	0.82
Stress behaviour	2.25	0.49	1.72	0.41	1.17	2.26	0.52	1.92	0.45	0.70
Exhaustion	1.85	0.62	1.28	0.68	0.88	1.82	0.74	1.25	0.56	0.87
Anger	1.15	0.46	0.81	0.45	0.75	1.23	0.51	0.96	0.44	0.57
QOLI	1.95	0.92	2.46	1.34	−0.44	2.21	1.32	2.46	1.37	−0.19

PSS=Perceived Stress Scale; QOLI=Quality of Life Inventory.

Perceived stress (PSS) decreased significantly among participants on both programs (cognitive behaviour therapy: $t(16)=6.14$, $p<0.001$; yoga: $t(15)=2.89$, $p<0.01$). Ratings on the stress behaviour scale (cognitive behaviour therapy: $t(16)=4.80$, $p<0.001$; yoga: $t(15)=2.66$, $p<0.05$) and of exhaustion (cognitive behaviour therapy: $t(16)=3.69$, $p<0.01$; yoga: $t(15)=2.91$, $p<0.01$) also decreased significantly for both programs. Ratings of anger decreased significantly for cognitive behaviour therapy but not for yoga (cognitive behaviour therapy: $t(16)=3.61$, $p=0.0002$; yoga: $t(15)=1.97$, $p=0.07$). The increase in QOLI was non-significant in both cognitive behaviour therapy and yoga (cognitive behaviour therapy: $t(16)=-1.80$, $p=0.09$; yoga $t(15)=-1.25$, $p=0.23$).

Effect sizes varied from d=−0.44 (QOLI) to d=1.42 (PSS) for cognitive behaviour therapy and from d=−0.19 (QOLI) to d=0.87 (Exhaustion) for yoga.

Physiological measures

The results from the measures of catecholamines in urine (adrenaline and noradrenaline), salivary cortisol, systolic blood pressure, diastolic blood pressure and heart rate are presented in Table 3.

In the yoga group, the noradrenaline levels decreased significantly between pre- and post-measurements, $t(14)=3.15$, $p=0.007$, but not in the cognitive behaviour therapy group ($t(15)=1.12$, $p=0.20$). The decrease in adrenaline was not significant for any of the 2 treatments but approach significance in the cognitive behaviour therapy group (cognitive behaviour therapy: $t(15)=2.07$, $p=0.06$; yoga $t(14)=0.44$, $p=0.66$). The difference for noradrenaline between the groups approached significance ($F(1,29)=3.18$, $p=0.085$), but this was not the case for adrenaline ($F(1,29)=0.48$, $p=0.495$). For cortisol there was no significant change in either group (cognitive behaviour therapy: $t(15)=1.27$, $p=0.22$; yoga: $t(14)=1.59$, $p=0.13$).

Table 3. *Means and standard deviations of physiological data for the cognitive behaviour therapy and yoga treatment at pre- and post-treatment and effect sizes (Cohen's d) from pre- to post-treatment.*

	Cognitive behaviour therapy					Yoga				
	Pre $n=16$		Post $n=16$			Pre $n=15$		Post $n=15$		
	M	SD	M	SD	*d*	M	SD	M	SD	*d*
HR	64.4	11.89	60.9	8.30	0.34	66.2	9.57	61.4	7.47	0.56
SBP	117.6	13.71	112.9	8.78	0.41	115.5	11.88	113.7	12.23	0.15
DBP	79.4	9.22	76.6	7.74	0.33	76.6	8.28	78.4	9.94	−0.20
Adrenaline	40.9	22.0	31.2	13.7	0.53	48.2	18.6	44.7	25.0	0.16
Noradrenaline	238.3	81.57	216.8	66.3	0.29	273.6	87.4	197.4	46.6	1.09
Cortisol	8.77	5.41	10.76	7.23	0.31	8.73	3.89	12.8	9.48	0.56

HR=heart rate, SBP=systolic blood pressure; DBP=diastolic blood pressure.

Heart rate was not significantly lower after either of the 2 programs, but approaching significance in the yoga group (yoga $t(14)=1.99$, $p=0.07$; cognitive behaviour therapy $t(15)=1.51$, $p=0.15$). The reverse was true for the decrease in systolic blood pressure (SBP) (cognitive behaviour therapy $t(15)=1.99$, $p=0.07$; yoga $t(14)=0.69$, $p=0.50$). Mean diastolic blood pressure (DBP) after cognitive behaviour therapy had decreased from 79.4 to 76.6 mmHg, but this change was not significant ($t(15)=1.48$, $p=0.16$). Mean diastolic blood pressure after yoga had increased from 76.6 mmHg to 78.4, but again the change was not significant ($t(14)=-0.88$, $p=0.39$). The difference between the 2 programs did not reach significance ($F(1,29)=2.72$, $p=0.11$).

Effect sizes varied from $d=0.29$ (noradrenaline) to $d=0.53$ (adrenaline) for cognitive behaviour therapy and from $d=0.15$ (SBP) to $d=1.09$ (noradrenaline) for yoga. Cortisol had a negative effect size, implicating an increased value, of $d=-0.31$ for cognitive behaviour therapy and $d=-0.56$ for yoga.

Discussion

In this study, both cognitive behaviour therapy and yoga programs resulted in a statistically significant reduction in scores on almost all stress-related subjective and physiological variables. Overall, the effect size for the questionnaire data was generally medium to large (Cohen, 1992), whereas the effect size for the physiological measures was lower, ranging from small to medium (with the exception of yoga and noradrenaline, where the effect size was large). Thus, the hypothesis was confirmed. No statistically significant difference between the 2 intervention programs was found for any of the variables, but they differed in effect size: cognitive behaviour therapy had larger effect size on all questionnaire data whereas there was a more complex picture regarding the physiological data. The failure of showing a statistical significant difference between the 2 treatments could be due to the differences in effect size, which can be caused by the small group sizes, and thereby low statistical power.

Unlike the other variables, cortisol levels increased, although non-significantly. Cortisol levels are known to vary considerably between individuals and over time (Cummins & Gevirtz, 1993), and due to seasonal fluctuations (Maes et al. 1997). It has also been shown that individuals exposed to chronic stress (Yehuda, Teicher, Trestman, Levengood, & Siever, 1996) or report a stressful work situation (Kurina, Schneider, & Waite, 2004) may have markedly reduced cortisol levels, thereby suggesting that an increase in cortisol levels could be considered an improvement. The contradictory findings make it difficult to interpret the results. Further studies are needed.

Given the difference in approaches to stress management in the 2 interventions – one mainly physical, the other mainly mental and behavioural – and drawing on the conclusions of Murphy (1996), the 2 treatments might have different effects on different outcome measures. Although our results do not provide enough evidence for any firm conclusions to be drawn, the larger effect of cognitive behaviour therapy on adrenaline and that of yoga on noradrenaline along, suggests that the specific contribution of cognitive behaviour therapy is mental relaxation, whereas the specific contribution of yoga is physical relaxation (Lundberg, 2000).

Even though arguments can be presented for the benefits of comparing 2 active treatments – most importantly the added value of comparing a new treatment with an existing treatment rather than with no treatment at all – the choice of design does have disadvantages. The most important lies in the lack of untreated controls. The outcome improvements found might be due to changes caused by factors other than the intervention programs, such as seasonal changes, general changes in workload and stress, or there may simply be a regression towards the mean (since the participants who volunteered for the study had high levels of perceived stress). However, a general decrease in workload and stress does not seem likely in the present case. During the period of the intervention programs, time pressure and workload in Sweden increased considerably, as did work absenteeism due to stress-related disorders (Wennberg, 2001). In addition, during the study a reorganization was performed at the company, details of which were announced only a few weeks before the post-treatment measurements were taken. This reorganization

involved changes in work tasks, colleagues, leaders and work environment for the study participants, factors that are known to contribute to stress (European Agency for Safety and Health at Work, 2000).

Another disadvantage of considering 2 active treatments in general, and the treatments in this study in particular, lies in the risk of inter-treatment contamination. Although efforts were made to avoid contamination, one explanation for the lack of difference in outcome between the treatments is that they did not differ sufficiently in content. In line with the Jones and Johnston recommendation (2000) for most effective treatment, the cognitive behaviour therapy groups included a reference to physical intervention, e.g. "applied relaxation", whereas the yoga groups, although having a main focus on physical exercise, also talked about stress-related issues.

One risk of assigning participants at random to 2 different treatment groups is always that some might be disappointed with their assigned group. Although no participant refused to participate in their group, and all participants completed their treatment, a few stated on their post-treatment evaluation form that they would have preferred the other treatment. These objections were divided equally between the 2 groups That is, there were both yoga participants who would rather been trained in cognitive behaviour therapy and cognitive behaviour therapy participants who would have preferred training in yoga. Despite their comments, there was still a significant reduction in stress-related problems among them, which may provide evidence that the treatments would be even more effective if participants were able to choose between them.

The largest shortcoming of the current study is probably the lack of follow-up data to assess long-term change. With only 1 post-treatment assessment, no conclusions could be drawn about the process of change.

Despite the methodological shortcomings of the study, the consistent pattern in the outcome variables and the medium-to-large effect sizes indicates that both cognitive behaviour therapy and yoga are promising stress management techniques. Future studies are needed to replicate the results, and methodological issues need to be resolved. Since both methods are multimodal, and in light of the recent development in cognitive behaviour therapy, there is a need to generate further data on the effects of the different models.

Acknowledgements

The authors are indebted to Maj-Lis Bäckström and Laura Ikäheimo Lundberg at SEB for providing facilities and encouraging employees to participate in the study, to Marie Öfvergård for running the yoga training program, to Dr Gunilla Burell for instructions regarding the cognitive behavioural therapy program, and to Ann-Christine Sjöbeck for performing the hormone assays. Financial support was obtained from the Bank of Sweden Tercentenary Foundation (UL). All authors share equal responsibility for this manuscript. JG, SI and UvT also served as instructors for the cognitive behaviour therapy intervention program.

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