Effect of 3-Month Yoga on Oxidative Stress in Type 2 Diabetes With or Without Complications

A controlled clinical trial

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OBJECTIVE—To assess the effect of yoga on anthropometry, blood pressure, glycemic control, and oxidative stress in type 2 diabetic patients on standard care in comparison with standard care alone.

RESULTS—In comparison with standard care alone, yoga resulted in significant reduction in BMI, glycemic control, and malondialdehyde and increase in glutathione and vitamin C. There were no differences in waist circumference, waist-to-hip ratio, blood pressure, vitamin E, or superoxide dismutase in the yoga group at follow-up.

CONCLUSIONS—Yoga can be used as an effective therapy in reducing oxidative stress in type 2 diabetes. Yoga in addition to standard care helps reduce BMI and improve glycemic control in type 2 diabetic patients.

Oxidative stress has been implicated as the root cause underlying the development of insulin resistance, β-cell dysfunction, diabetes, and its associated clinical conditions like atherosclerosis, microvascular complications, and neuropathy (1,2). Yoga has been found to be beneficial in reducing oxidative stress in type 2 diabetes (3,4), but there is a lack of controlled trials to demonstrate the same. This report describes the effect of yoga on oxidative stress, glycemic control, blood pressure control, and anthropometry in type 2 diabetic patients with or without complications compared with control subjects on standard care.

RESEARCH DESIGN AND METHODS—This study was conducted at the diabetes clinic of Kasturba Medical College hospital and at four community diabetes clinics offering primary care to diabetic patients in Mangalore, India. A total of 123 type 2 diabetic patients aged between 40 and 75 years, none of whom were alcoholics or smokers, were included. Patients with acute macrovascular complications, cancer, pulmonary tuberculosis, and rheumatoid arthritis and those who were unable to perform yoga were excluded. Patients were grouped as 60 for yoga and 63 for control. Stratified sampling was used at the time of allocation to maintain an equal number of patients with uncomplicated diabetes and with microvascular, macrovascular, and peripheral neuropathy in these groups.

Three months’ yoga included tadasana, padahastasana, vrikshasana, trikonasana, parshvothanasana, vajrasana, vakrasana, gomukasana, paschimotanasan, uttanapadasana, pawanamuktasana, bhujangasana, shalabhasana, dhanurasana, viparitakarani, sitkari and bhramari pranayama, anuloma viloma, and shavasana poses. The control group at their baseline visit was given general oral and written information about diet and exercise. Compliance with the intervention was defined as attendance for at least 3 days/week at the yoga center for 3 months. Drug dosages with regard to diabetes and blood pressure were kept constant throughout the study period.

Malondialdehyde (5), glutathione (6), superoxide dismutase (7), vitamin C (8), and vitamin E (9) were measured to assess the oxidative stress and antioxidant status. BMI, waist circumference, waist-to-hip ratio, blood pressure, fasting plasma glucose (FPG), postprandial plasma glucose (PPPG), and HbA1c were analyzed.

Data were analyzed using SPSS version 11.0. Paired t test was used to compare the continuous variables from baseline to follow-up. Wilcoxon signed rank test, a nonparametric test, was used to compare the differences in various parameters before and after intervention between the two groups.

RESULTS—Three participants withdrew from yoga intervention during the first month of the study and were not included in the final analysis. Among these, two moved their residence and one reported illness unrelated to the study. Mean ± SD age was 59.8 ± 9.9 years for the yoga group and 57.5 ± 8.9 years in the control group. There were no significant differences in sex, duration of diabetes, or hypertension between the groups at baseline. Average attendance at the yoga classes was 82–88%.

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Received 25 December 2010 and accepted 1 July 2011.

DOI: 10.2337/dc11-0967

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care.diabetesjournals.org

Diabetes Care Publish Ahead of Print, published online August 11, 2011
CONCLUSIONS—Yoga practitioners achieved a 20% reduction in oxidative stress which is similar to the findings of Gordon et al. (10) 6 months of yoga in type 2 diabetes. In our knowledge, to date there are no results of the effect of yoga on glutathione and vitamin status in type 2 diabetes. In this study, yoga improved antioxidant levels, thereby reducing the oxidative stress. Other lifestyle interventions such as aerobic exercise and resistance training are known to improve stress parameters (11,12). Antioxidants like glutathione and vitamin C were seen in control groups. Greatest improvements in BMI, FPG, PPPG, and HbA1c were achieved by yoga intervention. This was overcome in the control group, whereas it increased by 1.4% in the yoga group, whereas it increased by 6.25% in the control group (Table 1). No significant changes in waist circumference, waist-to-hip ratio, blood pressure, vitamin E, or superoxide dismutase were observed in the yoga group compared with the control group.

Table 1—Parameters at baseline and after 3 months

<table>
<thead>
<tr>
<th></th>
<th>Yoga group (n = 60)</th>
<th>Control group (n = 63)</th>
<th>Change at 3 months</th>
<th>P</th>
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<tbody>
<tr>
<td></td>
<td>Baseline</td>
<td>After 3 months</td>
<td>Change at 3 months</td>
<td></td>
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<tr>
<td>FPG (mmol/L)</td>
<td>8.1 ± 2.6</td>
<td>7.3 ± 2.3</td>
<td>−0.8 ± 0.3</td>
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<tr>
<td>PPPG (mmol/L)</td>
<td>12.0 ± 4.0</td>
<td>10.9 ± 3.6</td>
<td>−1.1 ± 0.4</td>
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<tr>
<td>HbA1c (%)</td>
<td>8.4 ± 1.3</td>
<td>8.3 ± 1.5</td>
<td>−0.1 ± 0.2</td>
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<tr>
<td>BMI (kg/m²)</td>
<td>25.9 ± 3.5</td>
<td>25.4 ± 3.4</td>
<td>−0.5 ± 0.1</td>
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<tr>
<td>Waist circumference (cm)</td>
<td>92.9 ± 9.5</td>
<td>92.7 ± 9.4</td>
<td>−0.2 ± 0.1</td>
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<tr>
<td>Waist-to-hip ratio</td>
<td>0.93 ± 0.08</td>
<td>0.91 ± 0.07</td>
<td>−0.02 ± 0.01</td>
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<tr>
<td>Systolic blood pressure (mmHg)</td>
<td>137.8 ± 17.9</td>
<td>133.3 ± 13.8</td>
<td>−4.5 ± 4.1</td>
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<tr>
<td>Diastolic blood pressure (mmHg)</td>
<td>82.8 ± 9.3</td>
<td>79.8 ± 7.4</td>
<td>−3.0 ± 1.9</td>
<td></td>
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<tr>
<td>Malondialdehyde (μmol/L)</td>
<td>53.0 ± 11.3</td>
<td>42.2 ± 9.9</td>
<td>−10.8 ± 1.4</td>
<td></td>
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<tr>
<td>Glutathione (μmol/gHb)</td>
<td>7.5 ± 2.6</td>
<td>8.3 ± 2.5</td>
<td>0.8 ± 0.1</td>
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<tr>
<td>Vitamin C (μmol/L)</td>
<td>29.0 ± 27.8</td>
<td>37.0 ± 21.0</td>
<td>8.0 ± 6.8</td>
<td></td>
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<tr>
<td>Vitamin E (μmol/L)</td>
<td>58.0 ± 18.6</td>
<td>59.7 ± 23.9</td>
<td>1.7 ± 5.3</td>
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<tr>
<td>Superoxide dismutase (units/gHb)</td>
<td>5.669.9 ± 1.410.7</td>
<td>5.249.0 ± 1.247.2</td>
<td>−420.9 ± 163.5</td>
<td></td>
</tr>
</tbody>
</table>

Data are means ± SD. P values are significance values in yoga group compared with the control group.
which made it easy for the patients to attend the classes; in addition, culturally, Indian patients would accept yoga better than the Western population.

Our study is limited by the fact that the allocation to the groups was not randomized. Random allocation in community settings is difficult. In this study, social and environmental factors during these training sessions may have a beneficial influence on oxidative stress. The strength of our study was the stratification of sample according to complications. Participants with various complications may have increased oxidative stress; stratification made the two groups identical.

In conclusion, yoga can be used as an effective therapy in reducing oxidative stress in type 2 diabetes. Yoga is also beneficial in improving glycemic parameters and BMI and can be administered as an add-on therapy to standard lifestyle interventions. Yoga was not beneficial in reducing the blood pressure or waist circumference in this short-term study. Further studies are needed to confirm that yoga is beneficial in preventing the progression of diabetes and its complications.

Acknowledgments—This study was funded by a grant from Manipal University (431/013/2007).

No potential conflicts of interest relevant to this article were reported.

S.V.H. designed the study, acquired and interpreted data, and wrote the manuscript. P.A. developed the protocol, designed the study, interpreted data, and reviewed and edited the manuscript. S.K. analyzed data. V.J.P. acquired data and contributed to discussion. S.D. and V.D. reviewed and edited the manuscript.

The authors thank Laura Prakash, School of Public Health, University of Minnesota, Minneapolis, MN, for her contribution to the study. The authors express appreciation to the participants whose cooperation and dedication made this study possible. The authors also acknowledge an ITREOH training grant from Fogarty foundation, which was responsible for their training in medical writing.

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