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Original Research Article

To Study the Impact of Stress Management Programme on Lipid Profile in Young Female School Teachers: A Longitudinal Interventional Study

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ABSTRACT

Background: Teaching is a stressful job and level of stress varies across different population. Female teachers perceive more stress as compared to males.
Aims: To study the impact of stress management programme on lipid profile in young female school teachers.
Materials and methods: The present pilot study was conducted in the department of Physiology of Burdwan Medical College after taking institutional ethical clearance and informed consent of the subjects. Two hundred healthy female school teachers were selected from the local population. Stress level in the subjects was assessed according to the Presumptive stressful life event scale (PSLES). The Perceived Stress Scale (PSS) of Sheldon Cohen was used to measure perceived stress scores. Anthropometric measurements, resting pulse rate and blood pressure were recorded, followed by analysis of lipid profile. The subjects were given a training of progressive muscle relaxation for three months and PSS, lipid profile were reassessed. SPSS version 16 was used to analyse the data.
Results: Two hundred female school teachers with PSLES scores more than 200 were included in the present study. All were non vegetarian. They belonged to middle socioeconomic class. All were married. 86% of the teachers traveled more than two hours to reach their school and were more stressed in comparison to 14% of the teachers who traveled less than two hours. Workplace distance from home and non-participation of partners in household work were significant contributors in increasing perceived stress levels. Mean values of different parameters were as follows: Age 30.84±2.56; BMI 26.48±2.76; Waist/ Hip ratio 0.998±0.079; PSLES 315.33±29.04; PSS 28.036±3.093 before practice of PMR vs.24.59± 3.67 after practice of PMR; P value< 0.001**. Total cholesterol, triglyceride, LDL, VLDL were significantly decreased following PMR training while HDL significantly increased after training. PSS was positively correlated with total cholesterol, triglyceride, LDL, VLDL and negatively correlated with HDL.
Conclusions: Female school teachers are highly stressed. Distance of work place, non-participation of partners in household work is important factors for increase in stress levels. Increased stress levels were associated with dyslipidemia in the present study and practice of progressive muscle relaxation may help in reducing stress levels and improve lipid profile in this group of subjects.
Keywords: Female school teachers, Progressive muscle relaxation, lipid profile.

INTRODUCTION

School teachers are exposed to high level of stress. Socio-demographic variables, salary, working environment, work pressure play a significant role in causing stress across teachers of different cultures. [1] Stress has long been recognized as a major risk factor for development of atherosclerosis. Stress-induced atherogenic lipid profile potentiates the effects of dietary and genetic factors responsible for atherogenesis. [2-6]

The atherogenic effects of stress induce changes in nitric oxide (NO) levels; cytokine production; vascular smooth muscle mitogenesis; development of insulin resistance; increased neuropeptide Y (NPY) actions and modulation of the renin-angiotensin system activity. These effects may be directly and indirectly related to development of stress-induced dyslipidemia. [7-10]

A high amount of NO is usually produced by endothelial nitric oxide synthase (eNOS). It is a vasodilator substance. It has got antithrombogenic properties. It is an inhibitor of smooth muscle cell proliferation. It also prevents leukocyte- and monocyte-adhesion. Decrease in NO bioavailability is a key feature for development of endothelial dysfunction. This results in lower responses to vasodilator agents, and represents an early stage of atherosclerosis. Endothelial dysfunction may significantly contribute to the development and progression of atherosclerosis in the following way: favoring coagulation; inflammatory cell adhesion; imbalance between vasoconstrictor and vasodilator responses; increasing transendothelial transport of atherogenic particles. [9-11]

Stress-induced rise of glucocorticoid levels usually reduces the expression of guanosine triphosphate cyclohydrolase messenger ribonucleic acid (mRNA). Guanosine triphosphate cyclohydrolase messenger ribonucleic acid is necessary for tetrahydrobiopterin cofactor (BH4) synthesis. Tetrahydrobiopterin cofactor stabilizes eNOS. If BH4 levels decrease, endothelial eNOS becomes uncoupled. As a result, transfers electrons to molecular oxygen generating superoxide anions. Superoxide anions react avidly with NO to form peroxynitrites, resulting in diminished NO bioavailability. This mechanism favors the traffic of oxidized lipids across the endothelium. High LDL levels induced by stress also decrease eNOS mRNA expression. [12-15]

Chronic elevations of cholesterol in the bloodstream are usually associated with impaired endothelium-dependent NO production. This is due to increased interaction between caveolin and eNOS. Caveolin proteins are expressed in majority of cell types which play a role in development of atherogenesis. These include endothelial cells, macrophages, and smooth muscle cells. High levels of LDL cholesterol also increase the caveolin concentration in endothelial cells; strengthen the caveolin-eNOS complex; reduce the interaction between Ca^{2+} - calmodulin and eNOS. All these effects decrease eNOS translocation from caveolin to the cytoplasm and subsequently diminish NO production. Lipid peroxidation induced by stress impairs nitric oxide production (NO); stimulates inflammatory response; increases the traffic of inflammatory molecules and oxidized LDL to sub-endothelial space. All the above factor leads to vascular endothelial dysfunction. [16,17]

Stress at workplace is an important risk factor for the development of metabolic syndrome. [18] The modern world is facing a pandemic of lifestyle disorders that require changes to be made consciously by individuals themselves, and stress management strategies are the best lifestyle ever designed, that have potential in the prevention, management, and rehabilitation of prevalent lifestyle disorders. [19]

Teaching is a stressful job and level of stress varies across different population. School teachers are exposed to high level of stress. Socio-demographic variables, salary, working environment, work pressure play a

significant role in causing stress across teachers of different culture. A study was conducted by Dawn S et al in west Bengal in 2016. 338 school teachers were interviewed across schools from rural, urban and semi urban area of West Bengal. Related data were collected on socio-demographic sheet and stress score was collected on Work Stress Scale (WTS). Data were analyzed by standard statistical methods. Female sex, age - 50-60 years, urban, private School, headmaster & assistant headmaster, higher paid teachers were found to suffer from high level of stress. [18]

Stress coping methods are the cognitive, behavioral and psychological efforts to deal with stress. [19] Considering the above background, the present study was conducted to study the impact of stress management programme on lipid profile in young female school teachers. Working females from middle income group were selected as they have to manage both household works as well as their jobs and these factors add extra stress to their lives.

MATERIALS AND METHODS

This pilot study was conducted in the department of Physiology of Burdwan Medical College in a time span of six months after taking institutional ethical clearance and informed consent of the subjects.

Inclusion criteria: Two hundred healthy female school teachers were selected from the local population.

Exclusion criteria: Subjects known to have any cardio respiratory disease or systemic illness, sports personnel, persons on antipsychotics, subjects practicing any other forms of yoga, people taking any medications that may alter lipid metabolism, subjects with history of major illness in the recent past, pregnant, puerperal, lactating mothers were excluded.

On first appointment, particulars of the subject, personal history, food habit, family history, history of past illness and treatment history of the subjects were carefully recorded. Subjects were asked to tally a list of 51 life events based on a relative score. Stress level in the subjects was assessed according to the Presumptive stressful life event scale (PSLES). [19] Accordingly, they were categorized into no stress, less/moderate stress and severe stress. Score Stress up to 40: No stress; 41-200 Less/moderate stress; More than 200 severe stresses. Finally, 200 subjects with scores above 200 were chosen for the study group, as they had higher risk of developing illness. [19]

The Perceived Stress Scale (PSS)of Sheldon Cohen, [19] the most widely used psychological instrument for measuring the perception of stress, was used to measure perceived stress scores. It is a measure of the degree to which situations in one's life are appraised to be stressful. Items were designed to find how unpredictable, uncontrollable, and overloaded respondents find their lives. The scale also includes a number of direct queries about current levels of experienced stress. The questions in the PSS ask about feelings and thoughts during the last month. It comprises of 10 items, four of which are reverse-scored, measured on a 5-point scale from 0 to 4. PSS scores are obtained by reversing responses (e.g., 0 = 4, 1 = 3, 2 = 2, 3 = 1 and 4 = 0) to the four positively stated items (items 4, 5, 7, and 8) and then summing across all scale items. Total score ranges from 0 to 40. [19]

General physical examinations were done and written consent was taken. Life event stress and perceived stress scores of the subjects were measured by using PSLES and PSS respectively.

Weight and height were measured; BMI and waist/hip were calculated.

Resting Pulse and blood pressure were measured.

Fasting blood samples were drawn from subjects by sterile needle and syringes and sent to biochemical laboratory in sterile vials for analysis of Lipid profile.

Sample processing and analysis

After plasma separation by centrifuge, quantitative estimation of Cholesterol, HDL and triglyceride was conducted by standardized enzymatic colorimetric method. The blood triglycerides by glycerol phosphate oxidase / Peroxidase (GPO-PAP) method and HDL-Cholesterol by phosphotungstic acid method, Total Cholesterol estimated by CHOD - PAP method. All analysis was done using automated clinical chemistry analyzer (TRANSASIA ERBA XL- 600) and calculation at the Biochemistry Laboratory of Burdwan Medical College. For all biochemical analysis, coefficient of variation was < 10.

All our subjects were on non-vegetarian diet and there was no change in dietary habit in the study period. The subjects were given a training of progressive muscle relaxation for three months (each daily session lasted for 20 minutes) and lipid profile and perceived stress scores were reassessed after three months.

Statistical analysis: The computer software "Statistical Package for the Social Sciences (SPSS) version 16 (SPSS Inc. Released 2007. SPSS for Windows, Version 16.0. Chicago, SPSS Inc.) was used to analyse the data. The difference between the groups was considered significant and highly significant if the analysed probability values (*P* value) were $P < 0.05$* and $P < 0.01$**, respectively.

RESULTS

Two hundred female school teachers with PSLES scores more than 200 were included in the present study. All were non vegetarian. They belonged to middle socioeconomic class. All were married. 86% of the teachers traveled for more than two hours to reach their school and were more stressed in comparison to 14% of the teachers who traveled less than two hours. Workplace distance from home and non-participation of partners in household work were significant contributors in increasing perceived stress levels. Mean values of different parameters were as follows: Age 30.84±2.56; BMI 26.48±2.76; Waist/ Hip ratio 0.998±0.079; PSLES 315.33±29.04; PSS28.036±3.093 before practice of PMR vs.24.59±3.67after practice of PMR; P value< 0.001**. Total cholesterol, triglyceride, LDL, VLDL were significantly decreased following PMR training while HDL significantly increased after training (Table 1; Figure1). PSS was positively correlated with total cholesterol, triglyceride, LDL, VLDL and negatively correlated with HDL (Table 2, Figure 2-6).

TABLE 1: LIPID PROFILE BEFORE AND AFTER PRACTICE OF PMR.

PARAMETER (mg/dl)	BEFOREPMR MEAN ± SD	AFTER PMR MEAN ± SD	P VALUE
TOTAL CHOLESTEROL	163.77±12.68	160.005±15.29	0.0088**
TRIGLYCERIDE	136.47±24.28	119.423±26.399	<0.001**
LDL	93.178±18.59	90.856±10.21	<0.001**
HDL	40.685±5.59	45.418±4.83	<0.001**
VLDL	31.76±1.65	24.25±6.23	<0.001**

TABLE 2: CORRELATION OF PSS WITH LIPID PROFILE

PARAMETER	R VALUE (CORRELATION WITH PSS)
TOTAL CHOLESTEROL	0.24
TRIGLYCERIDE	0.15
LDL	0.08
HDL	-0.137
VLDL	0.114

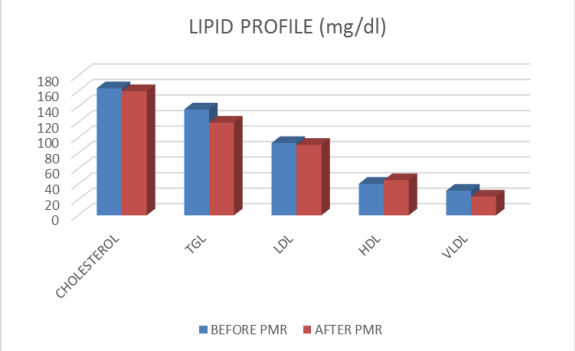

FIGURE 1: LIPID PROFILE BEFORE AND AFTER PRACTICE OF PMR.

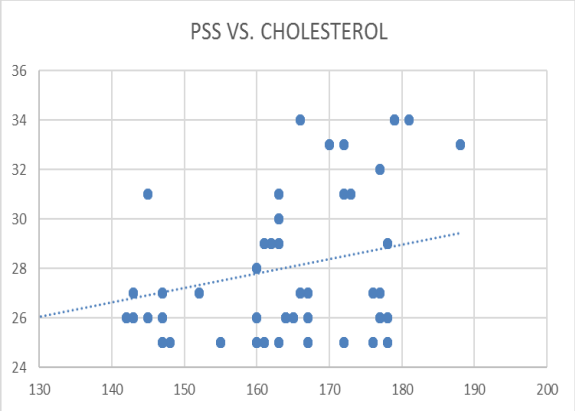

FIGURE 2: CORRELATION OF PSS WITH TOTAL CHOLESTEROL

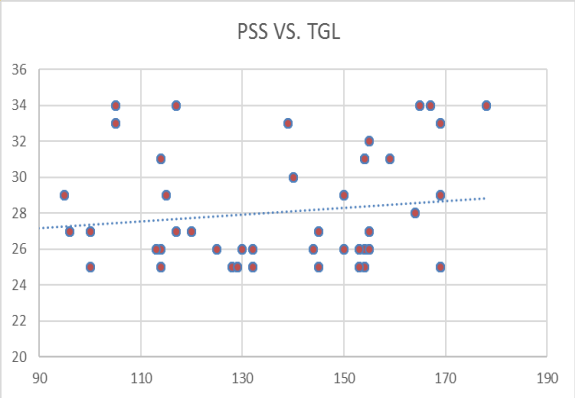

FIGURE 3: CORRELATION OF PSS WITH TRIGLYCERIDE

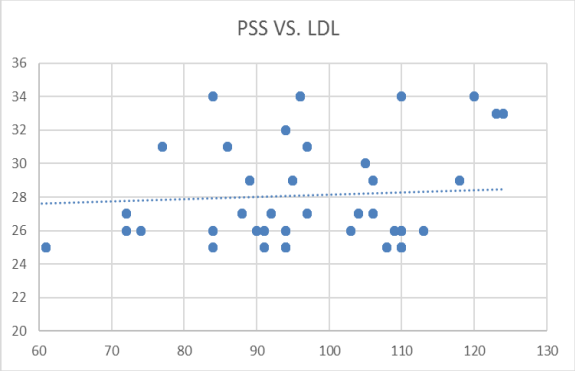

FIGURE 4: CORRELATION OF PSS WITH LDL CHOLESTEROL

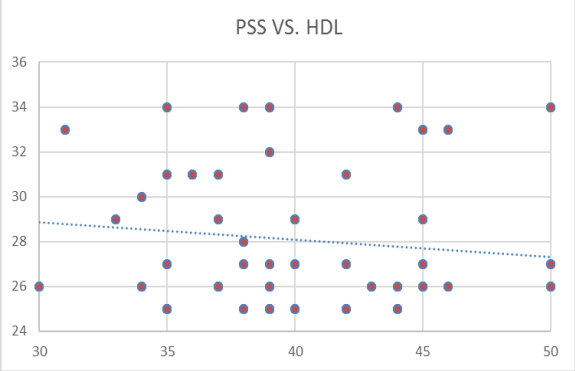

FIGURE 5: CORRELATION OF PSS WITH HDL CHOLESTEROL

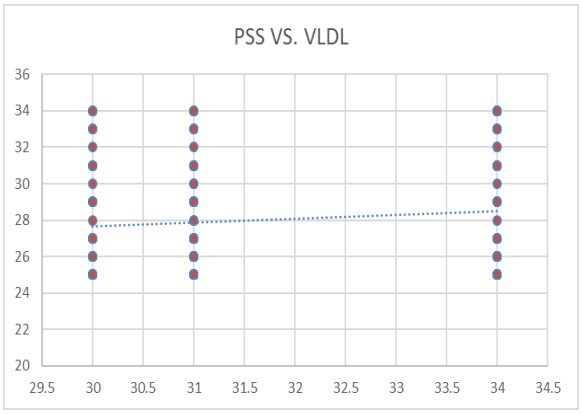

FIGURE 6: CORRELATION OF PSS WITH VLDL CHOLESTEROL

DISCUSSION

Teaching is a stressful occupation. Female teachers are found to be more stressed as compared to their male counterparts. Increased remuneration and decreased time to commute to schools can decrease stress levels. A regular increment in remuneration and relocation according to place of residence can decrease the stress level. [1,18] For female teachers, helping hand from their spouses in household chores may lead to a big difference. In the present study it was found female teachers perceived high levels of stress and three months' practice of PMR helped in reducing stress levels and caused improvement in lipid profile.

Morphological changes in blood vessels are usually associated with atherosclerosis. The increase in intima media thickness (IMT) in the carotid artery has long been used as a marker of target organ damage in human hypertension. [20] In experimental studies in animals, the IMT of the aorta observed in stressed rats [21] has been found to be related to the atherogenic effects of stress. It has been observed in different studies that rats submitted to chronic mild unpredictable stress presented higher IMT and lower relaxation response to acetylcholine in the thoracic aorta, in comparison with non-stressed animals. These effects were observed 15 days after the end of the stress protocol in a study and were associated with insulin resistance, dyslipidemia. [21]

The high level of catecholamines induced by stress usually stimulates endothelial permeability to the traffic of

oxidized LDL. Once these are trapped in the endothelium of an artery, LDL can undergo progressive oxidation. It may cross the endothelial barrier, and be internalized by macrophages expressing scavenger receptors. This leads to lipid peroxide formation and accumulation of cholesterol esters and culminating in foam cells formation. [22-23] Oxidized LDL particles upregulate the expression of adhesion molecules and secretion of chemokines. These contribute to the recruitment of circulating monocytes and leukocytes. [24- 25] One of the major initial steps in the formation of atherosclerosis is the adhesion of monocytes to the vascular endothelium. Their entry into sub-endothelial space is followed by their differentiation into macrophages. [25] These cells are also responsible for uptake of LDL and other particles, and thereby starting the atherogenesis process. [25] The macrophages in the endothelial space also have VLDL receptors. These bind the apolipoprotein (apo) E-containing lipoproteins, which include VLDL, intermediate density lipoprotein, β-migrating VLDL. The LDL-receptor-related proteins in macrophages are also capable of binding apo E-containing lipoproteins, lipoprotein lipase, and lipoprotein lipase-triglyceride-rich lipoprotein complex. [26-27] All these factors lead to the sequence in the development of atherosclerosis.

Activation of the renin-angiotensin system (RAS) by stress also plays an important role in the pathogenesis of endothelial dysfunction, hypertension and atherosclerosis. Lipid accumulation in blood vessels enhances the expression of RAS components. These in turn stimulates accumulation of oxidized LDL in blood vessels. [23]

LDL-cholesterol can accumulate in vascular smooth muscle cells. [28] This effect is mediated via AT1R. Angiotensin II increases LDL uptake by arterial wall macrophages. [29] Angiotensin II binds LDL. The angiotensin II-modified LDL is taken up by macrophages via scavenger receptors. These lead to cellular cholesterol accumulation. [30]

Dyslipidemia induced by stress is an important part of the body's response to cope with stressors. The increase in blood lipids induced by stress is adaptive and usually returns to normal levels when the stressor ends. But, when the stressor is maintained over a prolonged period, the dyslipidemia induced by stress persists. This may have deleterious effects and contribute to the development of insulin resistance, obesity, hypertension and atherosclerosis. [31]

Impaired endothelium-dependent vascular relaxation has been reported in patients with high cholesterol (HC). The systemic effects of elevated cholesterol on blood pressure (BP) and BP reactivity to stress were studied by Sung BH et al. [31] They examined the BP response to a standard mental arithmetic test (MAT) in 37 healthy, normotensive HC subjects and 33 normal cholesterol controls (NC). Both groups were age, body mass index, and gender matched. HC had slightly higher systolic BP at baseline (122 v 118 mm Hg, $P < .05$) than NC and systolic BP response during MAT was significantly higher in HC compared to NC (18 ± 8 v 10 ± 5 mm Hg, $P < .05$). Maximal changes in systolic BP were positively significantly correlated with cholesterol ($r = 0.41$, $P < .001$), whereas heart rate and diastolic BP changes showed no significant correlation with serum cholesterol. To confirm that BP reactivity was dependent on cholesterol, MAT was repeated after treatment with 20 mg/day of lovastatin, a hepatic hydroxymethyl glutaryl coenzyme A (HMG-CoA) reductase inhibitor, for 6 weeks using a cross-over design in 26 HC subjects. Lovastatin significantly altered lipid profiles (−26% total cholesterol, +8% HDL, −34% LDL). A small decrease in systolic BP at baseline (−3 mm Hg, P = NS) and significantly lower systolic BP (−8 mm Hg, $P < .05$) during MAT was observed after the treatment with lovastatin. Patients with high cholesterol had an exaggerated systolic BP response to

MAT. Decreased BP reactivity during HMG-CoA reductase inhibitor therapy suggests that lowering cholesterol may have a role in the overall control of BP. In the present study serum cholesterol levels were also had significant positive correlation with PSS.

Previous studies have suggested that mental status may influence serum lipid levels. A study Shahnam M et al. [32] was conducted on the adult population living in rural and urban areas in Central Iran to assess the correlation between stress level and lipid profile disorders. The study population consisted of 9752 adults aged ≥19 years living in respectively three districts namely Isfahan, Arak and Najaf Abad. Demographic data, age, and sex were the variables recorded. Blood samples were drawn to determine the lipid profile i.e. total cholesterol (TC), LDL cholesterol (LDL-C), low levels of high-density lipoprotein cholesterol (HDL-C) and triglycerides (TGs). Stress levels were assessed using the General Health Questionnaire. Logistic regression and Chi-square tests were used for analysis of data. The odds ratios of high stressed individuals had high levels of TC, LDL-C were higher as compared to normal individuals and low levels of HDL-C compared to normal individuals after adjustment for age and sex. Similar results were also observed in the present study. No significant correlation was found between stress levels and TG in the study. But in the present study we observed a significant positive correlation between PSS and TGL. We used PSS scores while the above study used General Health Questionnaire which may be the cause of variance in the result.

In 2010, Shahnam M et al. [32] demonstrated higher levels of total cholesterol and LDL-C and lower levels of HDL-C among stressed individuals. LDL cholesterol is known to decrease baroreceptor sensitivity and total cholesterol decreases HRV and reduction of LDL cholesterol and total cholesterol following relaxation exercises may contribute to increases in HRV.[462]Thus, stress produces significant cardiovascular hazards by altering biochemical parameters. Practicing PMR may alter the lipid profile and help in prevention of cardiovascular diseases.

Matousek RH et al [33] observed that PMR not only improves the clinical parameters but also decreases cortisol levels and results in decrease of total cholesterol, triglyceride, and LDL-C levels. In the present series also, we found significant decrease in total cholesterol, triglyceride, LDL, VLDL levels and increase in HDL levels in subjects after practicing PMR.

Blood lipids disorders are prevalent in the world. Some of their risk factors are modifiable such as mental and physical stress which exists in some places such as work environment. Objective of a study by Assadi SN in 2017 [34] was to determine the effects of psychological and physical stress on the lipid profiles. This was a historical cohort study. The people who were employed as general worker were recruited for the survey. The study was conducted with flexible interview for getting history, lipid profile examination, and a checklist including occupational and non-occupational risk factors and using the health issues. According to the type of stress exposures, the study population was divided into 5 groups and lipid profiles were analyzed in all groups. These groups were exposed to psychological stress, physical stress or both of them; mild psychological stress (group 1), mild physical work without psychological stress (group 2), mild psychological stress and mild physical work (group 3), moderate physical work without psychological stress (group 4), and heavy physical work without psychological stress (group 5). The relative risks for triglycerides more than 200 mg/dL was 1.57 (1.02–2.42) and low density lipoprotein (LDL) more than 130 mg/dL was 14.54 (3.54–59.65) in group 1. The relative risks for high density lipoprotein (HDL) less than 45 mg/dL was 14.61 (8.31–25.68) in group 1 and 16.00 (8.30–30.83) in group 3. After multinomial logistic regression they had significant differences. Psychological stress was

predicted as a risk factor for lipid disorders, and suitable physical activity was protective in this situation. In the present study subjects with higher stress scores also had significantly higher blood cholesterol, triglyceride, LDL, VLDL levels.

CONCLUSIONS

Female school teachers are highly stressed. Distance of work place, non-participation of partners in household work is important factors for increase in stress levels. Increased stress levels were associated with dyslipidemia in the present study and practice of progressive muscle relaxation may help in reducing stress levels and improve lipid profile in this group of subjects.

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