International Journal of Research and Review
www.ijrrjournal.com E-ISSN: 2349-9788; P-ISSN: 2454-2237

Original Research Article

A Study to Observe Correlation of Fasting Sugar, Postprandial Blood Sugar and HbA_1c with Perceived Stress and Lipid Profile in Newly Diagnosed Diabetic Subjects on Regular Walk and Progressive Muscle Relaxation Regimen in a Population of Eastern India

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ABSTRACT

Background: Stressful experiences might affect diabetes, in terms of both its onset and its exacerbation and perceived stress is a strong risk factor for type 2 diabetes. Aims: To study correlation of fasting sugar, postprandial blood sugar and HbA1C with perceived stress and lipid profile in newly diagnosed diabetic subjects on regular walk and Progressive muscle relaxation regimen in a population of eastern India.
Materials and methods: This pilot study was conducted in Burdwan medical college in a time span of one year after taking institutional ethical clearance and informed consent of the subjects. Two hundred newly diagnosed diabetes patient attending diabetic clinic of Burdwan Medical College were included. On first appointment, particulars of the subjects, personal history, demographic profile, dietary habit, family history, history of past illness, treatment history of the subjects were recorded. General physical examinations were done and initial laboratory values (Fasting and PP sugar, HbA_1C, lipid profile) and anthropometric measurements (height, weight, BMI, Waist/Hip ratio) were recorded. Perceived stress scores were measured using Cohen's scale. Walking regimen were given according to the recommendation of American Diabetic Association that is150 min/week (distributed over at least 3 days) of moderate to brisk walking with no gaps longer than 2 days. All subjects were given a training of Progressive muscle relaxation (PMR). Training involved tensing the specific muscle groups for 7–10 sec, followed by releasing them (relaxing) for 15–20 sec as per Jacobson's protocol. They were asked to practice this technique at home for 20 min every day for 3 months and come for follow-up. All the parameters were reassessed 3 months after practicing the walking regimen and PMR. Paired t test was used and correlation coefficient calculated to analyze the data. Results: No significant change was seen in BMI, W/H ratio and HDL levels. There was significant improvement in all other parameters after three months. All parameters excepting HDL were positively correlated with FBS, PPBS, HbA_{1c} before and after following the regimen.
Conclusions: Perceived stress is a strong risk factor for type 2 diabetes and stress management programmes like relaxation therapies along with exercise may be made a part and parcel of treatment for better glycaemic control and lipid metabolism.

Keywords: Diabetes, perceived stress, relaxation therapy.

INTRODUCTION

Stressful experiences might affect diabetes, in terms of both its onset and its exacerbation. According to surveillance carried out globally in 2008, ten percent of adults, above the age of 25 years were found to be diabetic. Stress is a potential contributor to chronic hyperglycaemia. Lifestyle modification with exercise, like brisk walking and stress management programmes may be useful approach in treatment of diabetic individuals to improve glycaemia control and lipid metabolism. [1-5]

In a large population-based survey of glucose intolerance, Mooy et al. [6] demonstrated an association between stressful experiences and the diagnosis of type 2 diabetes. The researchers investigated stress levels in subjects with previously undetected diabetes. Some researchers have demonstrated the possibilities of stressful experiences influencing diabetes control. [7]

Research also supports the behavioral link with diabetes. [6-7] Peyrot et al. [8] found that stress and coping affected glycemic control by interfering with self-care practices. Coping behavior was also shown to affect glycemic control in a study of type 1 and type 2 diabetes that used sophisticated statistical techniques to demonstrate a "network" of interlinked variables in relation to the achievement of treatment goals. Active coping behavior was associated with higher self-efficacy and greater satisfaction with doctor-patient relationships. The researchers suggested that their findings have clinical implications for diabetes care because coping behavior (a key factor in their analysis) was linked to self-care but could also be influenced by the health care professionals involved in that care. However, little work has been carried out to try to implement the findings of coping research into clinical practice till date. Changes in clinical practice have usually involved behavioural interventions (task-oriented) rather than cognitive ones or have only included coping implicitly rather than explicitly. [9-10]

Something that affects people's responses to stress is coping style. Coping style is how a person deals with stress. Any stressful event might be judged by people in different ways, based on factors such as previous experience, psychological factors, and social influences. An event that is seen by one individual as particularly threatening might be seen as totally harmless by another individual. However, when a situation is regarded as threatening, that is, seen as having the potential to cause harm to the individual, a specific pattern of physiological responses is elicited, known as the stress response or "fight/flight" response. The actions initiated by the central nervous system in response to a threat affect the entire body and are associated with three different bodily systems: the autonomic nervous system, the neuroendocrine system, and the immune system. [11]

With regard to the effects of stress on the neuroendocrine system, the HPA axis is of considerable importance.39 Upon encountering a threat or a stressor, the hypothalamus secretes corticotropin-releasing factor, which causes the release of adrenocorticotropin. This in turn travels to the adrenal cortex, where it leads to the secretion of glucocorticoid hormones, in particular cortisol. [11]

Cortisol exerts considerable influence over bodily functions, both when the body is at rest and during stress. In normal circumstances, it is secreted according to a circadian (daily) rhythm, with cortisol levels highest in the morning and lowest in the evening. However, exposures to stress stimulate the HPA axis to release additional amounts of cortisol to maintain homeostasis and reduce the effects of stress. Cortisol influences a wide range of processes, including the breakdown of carbohydrates, lipids, and proteins to provide the body with energy. It also has an effect on bone and cell growth and may modulate salt and water balance. Cortisol has an immunosuppressive effect and therefore plays a role in the regulation of immune and inflammatory processes. [11]

That the central nervous system communicates with and exerts an influence on the immune system is now well established; brain lesions can alter a variety of immune measures, and both the autonomic and the neuroendocrine system have been shown to influence the state of the immune system.41 Because both the neuroendocrine and the autonomic system are influenced by psychosocial factors, it follows that the immune system is also affected by such factors, although the precise nature of these complex interactions remains to be determined. [11]

Diabetes causes more deaths a year than breast cancer and AIDS combined. For some people with diabetes, controlling stress with relaxation therapy seems to help, though it is more likely to help people with type 2 diabetes than people with type 1 diabetes. Stress blocks the body from releasing insulin in people with type 2 diabetes, so cutting stress may be more helpful for these people. People with type 1 diabetes don't make insulin, so stress reduction doesn't have this effect. Some people with type 2 diabetes may also be more sensitive to some of the stress hormones. Relaxing can help by blunting this sensitivity. [12]

Current policy and research around type 2 diabetes (T2D) interventions largely invoke a behavioral model. Activation of the physiologic stress response (PSR) from chronic exposure to stressors, low socioeconomic status (SES), severe mental health problems, or aggressive behavior increases the risk of T2D. An increased risk for T2D in people exposed to stressful working conditions or traumatic events; with depression; with personality traits or mental health problems that put them in conflict with others; of low SES, either currently or in childhood; and in racial/ethnic minority populations, independent of current SES. [12]

There are many ways of relaxation: Breathing exercises, Progressive relaxation therapy, Exercise. Whatever method we choose to relax; we have to practice. Just as it takes weeks or months of practice to learn a new sport, it takes practice to learn relaxation. Beneficial effect of walking on metabolic control and stress management of diabetic patients is widely known. So the present study was conducted to observe correlation of Diabetic profile and perceived stress and lipid metabolism in newly diagnosed diabetic subjects on regular walk and Progressive muscle relaxation regimen in a population of eastern India.

MATERIALS AND METHODS

This pilot study was conducted in Burdwan medical college in a time span of one year after taking institutional ethical clearance and informed consent of the subjects. Two hundred newly diagnosed diabetes patient attending diabetic clinic of Burdwan Medical College were included.

Inclusion criteria: Newly diagnosed diabetic patients aged above 25 years attending diabetic clinic of Burdwan Medical College and hospital were included in the study.

Exclusion criteria: Diabetics with renal diseases, liver diseases and other endocrine abnormalities, smokers, alcoholics and drug addicts were excluded. Diabetics practicing any exercise other than walking or on stress relieving medication or practicing stress management programme other than walking or having ischemic heart disease, hypertension, congenital diseases and subjects on medication that may alter lipid metabolism and autonomic reflexes and pregnant woman were not included.

Methods: On first appointment, particulars of the subjects, personal history, demographic profile, dietary habit, family history, history of past illness, treatment history of the subjects were recorded. General physical examinations were done and written consent was taken after proper counselling. Initial laboratory values (Fasting and PP sugar, HbA_1C, lipid profile) and anthropometric measurements (height, weight, BMI, Waist/Hip ratio) were

recorded. The Perceived Stress Scale (PSS) of Sheldon Cohen, the most widely used psychological instrument for measuring the perception of stress, was used to assess stress levels. 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. [13-15]

Walking regimen were given according to the recommendation of American Diabetic Association that is150 min/week (distributed over at least 3 days) of moderate to brisk walking with no gaps longer than 2 days. [16] All subjects were also given a training of Progressive muscle relaxation (PMR). Training involved tensing the specific muscle groups for 7–10 sec, followed by releasing them (relaxing) for 15–20 sec as per Jacobson's protocol. [13-15] They were asked to practice this technique at home for 20 min every day for 3 months and come for follow-up.

All the parameters were reassessed 3 months after practicing the walking regimen and PMR. During the study period they were followed up as routine checkup at OPD and over telephonic conversation.

Statistical analysis: Data were analyzed using software SPSS version16; probability values (P Value) <0.05 were considered as statistically significant and P Values <0.01 were considered as statistically highly significant. Paired t test was used and correlation coefficient calculated.

RESULTS

The present study was conducted on two hundred newly diagnosed diabetic subjects. On the first occasion anthropometric measurements were done, FBS, PPBS, HbA_{1c}, Lipid Profile were analysed. 127 subjects were male and 73 were female. Perceived stress scores were calculated. They walked in the morning for 3 months and practiced PMR. After 3 months all parameters were reassessed. No significant change was seen in BMI, W/H ratio and HDL levels. There was significant improvement in all other parameters after three months (Table 1, Figure 1-4). All parameters excepting HDL were positively correlated with FBS, PPBS, HbA_{1c} before and after following the regimen (Table 2, 3,4,).

Table 1: Shows comparison of different parameters of diabetic individuals before and after intervention regimen

Parameters	Mean ± SD		P value
	Diabetic Group before walking and PMR	Diabetic Group after Walking and PMR	
BMI (Kg/M^2)	27.53±4.43	27.11±4.36	0.500
W/H ratio	0.99±0.136	0.97±0.102	0.116
FBS(mg/dl)	168.29±40.16	116.46±23.98	<0.001**
PPBS(mg/dl)	284±68.88	168.09±41.82	<0.001**
HbA_{1c}(%)	8.26±1.09	7.704±0.765	<0.001**
Cholesterol(mg/dl)	215.51±42.06	196.85±21.81	<0.001**
Triglyceride(mg/dl)	200.97±67.13	169.46±22.94	<0.001**
LDL(mg/dl)	125.25±17.41	116.45±10.97	<0.001**
HDL(mg/dl)	36.69±4.14	37.41±3.45	0.155
VLDL(mg/dl)	21.45±5.69	19.65±3.58	0.008**
Perceived stress score	27.06±5.20	16.79±5.98	<0.001**

Results show highly significant difference in Fasting and Post prandial blood sugar, HbA_{1c}, serum cholesterol, triglyceride, LDL and VLDL level, PSS scores, but no significant difference in HDL level, BMI, Waist-hip ratio.

P-value <0.05* (significant)
P-value <0.01** (highly significant)

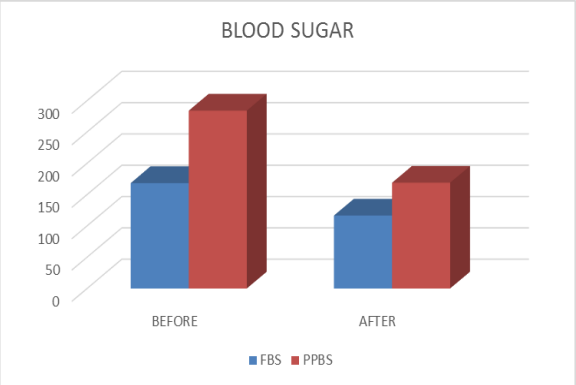

Figure 1: Comparison of Blood Sugar levels before and after intervention

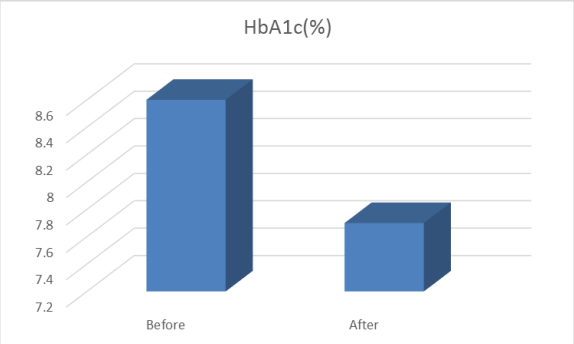

Figure 2: Comparison of HbA_{1c} levels before and after intervention

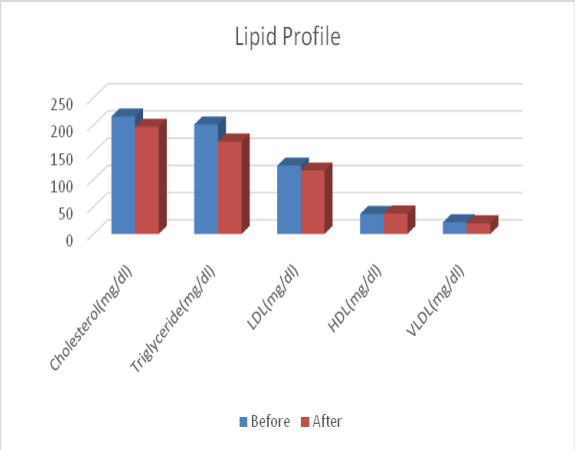

Figure 3: Comparison of Lipid Profile levels before and after intervention

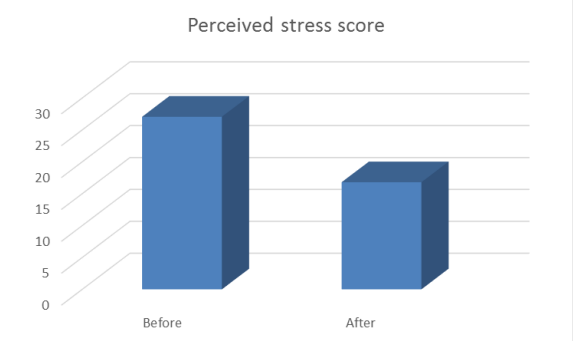

Figure 4: Comparison of PSS levels before and after intervention

Table 2: CORRELATION BETWEEN FBS AND OTHER PARAMETERS

Parameter	R value (correlation with FBS before walking and PMR)	R value (correlation with FBS after walking and PMR)
BMI (Kg/M^2)	+0.859	+0.756
W/H ratio	+0.978	+0.962
PPBS(mg/dl)	+0.979	+0.892
HbA_{1c}(%)	+0.997	+0.989
Cholesterol(mg/dl)	+0.961	+0.952
Triglyceride(mg/dl)	+0.923	+0.925
LDL(mg/dl)	+0.938	+0.933
HDL(mg/dl)	--0.925	--0.913
VLDL(mg/dl)	+0.971	+0.976
COHEN Perceived stress score	+0.982	+0.983

All parameters were positively correlated with FBS while HDL showed a negative correlation.

R-correlation coefficient

W/H-waist hip ratio FBS- Fasting blood sugar
BMI- Body Mass Index PPBS-Post prandial blood sugar
LDL- Low Density Lipoprotein. HbA_{1c}-Glycosylated haemoglobin
VLDL-Very Low Density Lipoprotein
HDL-High Density Lipoprotein

TABLE-3: CORRELATION BETWEEN PPBS AND OTHER PARAMETERS

Parameters	R- Values	
	Morning Walker Group before walking and PMR	Morning Walker Group after walking and PMR
BMI (Kg/M^2)	+0.853	+0.800
W/H ratio	+0.977	+0.976
FBS(mg/dl)	+0.979	+0.892
HbA_{1c}(%)	+0.999	+0.999
Cholesterol(mg/dl)	+0.567	+0.534
Triglyceride(mg/dl)	+0.988	+0.839
LDL(mg/dl)	+0.642	+0.587
HDL(mg/dl)	--0.538	--0.513
VLDL(mg/dl)	+0.923	+0.863
Perceived stress score	+0.873	+0.895

All parameters were positively correlated with PPBS while HDL showed a negative correlation.

R-correlation coefficient

W/H-waist hip ratio FBS- Fasting blood sugar

BMI- Body Mass Index PPBS-Post prandial blood sugar

LDL- Low Density Lipoprotein. HbA_{1c}-Glycosylated haemoglobin

VLDL-Very Low Density Lipoprotein HDL-High Density Lipoprotein

TABLE-4: CORRELATION BETWEEN HbA_{1c} AND OTHER PARAMETERS.

Parameters	R-Values	
	Morning Walker Group before walking	Morning Walker Group after walking
BMI (Kg/M^2)	+0.902	+0.802
W/H ratio	+0.972	+0.970
FBS(mg/dl)	+0.997	+0.989
PPBS(mg/dl)	+0.999	+0.999
Cholesterol(mg/dl)	+0.236	+0.212
Triglyceride(mg/dl)	+0.029	+0.027
LDL(mg/dl)	+0.359	+0.316
HDL(mg/dl)	--0.698	--0.648
VLDL(mg/dl)	+0.196	+0.201
Perceived stress score	+0.901	+0.887

All parameters were positively correlated with HbA_{1c} while HDL showed a negative correlation.

R-correlation coefficient

W/H-waist hip ratio FBS- Fasting blood sugar

BMI- Body Mass Index PPBS-Post prandial blood sugar

LDL- Low Density Lipoprotein. HbA_{1c}-Glycosylated haemoglobin

VLDL-Very Low Density Lipoprotein HDL-High Density Lipoprotein

DISCUSSION

Perceived stress is a strong risk factor for type 2 diabetes. The present study was conducted to observe the effects of PMR and walking in newly diagnosed diabetic subjects.

The aim of a study by Harris ML et al was to examine the relationship between perceived stress and type 2 diabetes onset, and partition the estimates into direct and indirect effects. Women born in 1946–1951 (n = 12,844) completed surveys for the Australian Longitudinal Study on Women's Health in 1998, 2001, 2004, 2007 and 2010. The total causal effect was estimated using logistic regression and marginal structural modelling. Controlled direct effects were estimated through conditioning in the regression model. A graded association was found between perceived stress and all mediators in the multivariate time lag analyses. A significant association was found between hypertension, as well as physical activity and body mass index, and diabetes. Moderate/high stress levels were associated with a 2.3-fold increase in the odds of diabetes three years later, for the total estimated effect. The findings of our study are similar to this study. But we observed no change in BMI as our follow time was only 3months.

Weaver LJ et al explored the relationship between mental health and type 2 diabetes among women in New Delhi, India. They recruited a convenience sample of 184 diabetic women from 10 public and private clinics. Patients completed a finger-stick blood test and a questionnaire assessing demographic characteristics, depression and anxiety symptoms, and diabetes-related disabilities restricting their performance of daily tasks. A subsample of 30 women participated in follow-up qualitative interviews at their homes. More than one quarter of our sample of diabetic women reported high levels of anxiety symptoms, whereas 18% reported high levels of depression symptoms. Anxiety symptoms were patterned according to recency of diabetes diagnosis, with 40% of women diagnosed less than 2 years before their interview reporting high anxiety symptom levels, as opposed to 23% of women diagnosed more than 2 years in the past. Depression and anxiety scores differed with respect to their relationship to recency of diagnosis, number of children, blood glucose level, and functional disabilities restricting performance of daily tasks. In the present study we also found decrease in perceived stress scores and improvement in

diabetic profile following exercise and relaxation therapy

Psychological stress is common in many physical illnesses and is increasingly recognized as a risk factor for disease onset and progression. An emerging body of literature suggests that stress has a role in the aetiology of type 2 diabetes mellitus (T2DM) both as a predictor of new onset T2DM and as a prognostic factor in people with existing T2DM. Our study also suggests similar findings.

Diabetes Mellitus (DM) is a serious chronic illness. The proportion of incident type 2 diabetes is 95% of the population of DM in the world. The prevalence of DM in Indonesia showed an increase of 1.1% in 2007 to 2.1% of the population of DM in 2013, and the most cases were Type 2 Diabetes Mellitus. Management of blood sugar levels can be done by pharmacologic and nonpharmacologic methods. One of nonpharmacologic therapy is a complementary therapy. Progressive muscle relaxation is part of a complementary therapy which is a mind- body therapy. A study by Avianti, N et al in 2016 [17-20] was aimed to measure the effectiveness of progressive muscle relaxation on the blood sugar levels of patients with type 2 diabetes. This was a Quasi experiment study with pre- and posttest randomized control group design, consisting of 48 samples with 24 patients in the treatment group and 24 the control group. Subjects in the treatment group received guided progressive muscle relaxation exercises 2 times a day for 3 consecutive days with a duration of 25 - 30 minutes in one workout. Subjects of the control group were allotted breathing exercises. There were significant differences between the average blood sugar levels between the treatment group and the control group, with p value = 0.000 ($p < 0.05$). Progressive muscle relaxation was found to be effective in reduction of blood sugar levels of patients with type 2 diabetes at Dr. Salamun Hospital and Advent Hospital in Ban- dung where this study was conducted. Similar results were also observed in the present study.

Perceived stress was found to be a strong risk factor for type 2 diabetes our findings also support and extend previous research examining the relationship between stress and diabetes.

We had conducted a study [16] to compare effects of regular evening versus morning walk on biochemical and stress profile in newly diagnosed diabetic subjects in a population of eastern India. Two hundred newly diagnosed diabetes patients were included. 100 Subjects were advised to walk in the morning. 100 Subjects were advised to walk in the evening. Initial laboratory values (Fasting and PP sugar, HbA1c, lipid profile) and anthropometric measurements (height, weight, BMI, Waist/Hip ratio) were recorded. Life event stress and perceived stress of the subjects were measured by using Presumptive life event stress scale and perceived stress scale respectively. All the parameters were reassessed 3 months after practicing the walking regimen. Results: There were significant changes in both groups before and after the walking regimen, in FBS, PPBS, HbA1c, serum cholesterol, Triglyceride, LDL, VLDL level and Perceived stress scores. No significant change in both groups were observed before and after the walking regimen, in BMI, Waist/Hip ratio, serum HDL, and Presumptive stress score. There was no significant difference in mean values of different parameters, between the two groups before and after the walking regimen. In the present study we studied the effects of PMR and walking on diabetic individuals. PSS in the previous study was (Morning walker and Evening walker) 17.28±6.2 vs. 17.27±6.24 before walking regimen and 12.79±4.98 vs. 12.8±3.97 after walking regimen; while the PSS in the present study in subjects were much more compared to the previous study 27.06±5.20 and so they were advised to practice progressive muscle relaxation along with walking. The subjects in the present study

were more stressed as compared to the previous study on initial examination. The PSS in these subjects were decreased after following this advice 16.79±5.98. The correlation of FBS, PPBS, HbA_1C was also analyzed in the present study. This is the difference between the two studies. We did not observe any change in BMI and W/H ratio in both the studies. We had conducted 3 other studies to observe the effects of PMR [13-15] and observed changes in BMI and W/H ratio. We had not included diabetic individuals in those studies, while in the studies mentioned above we included type 2 diabetic individuals and insulin resistance may be the cause of this variation. We also did not measure PSLES scores in the present study, while in the previous study [16] we had measured the PSLES scores and divided the subjects into two groups accordingly.

Yoga, meditation, hypnosis may help to reduce stress levels, but these techniques need professional supervision and training, but progressive muscle relaxation (a technique developed by Edmund Jacobson) though a recognized method for reduction of stress and anxiety is easy to learn and requires no constant guidance. [13-15] Once the individual learns the correct way of doing PMR he/she can continue doing it to relieve the tension in the muscles. Muscle tension accompanies anxiety; one can reduce anxiety by learning how to relax the muscular tension. PMR has gained popularity as an effective tool in various health conditions, ranging from hypertension to epilepsy. [13-15] PMR needs to be popularized as a stress management programme among population for better management of health and disease.

CONCLUSIONS

Perceived stress is a strong risk factor for type 2 diabetes and stress management programmes like relaxation therapies along with exercise may be made a part and parcel of treatment for better glycaemic control and lipid metabolism.

Limitations: The follow up time in this study was only 3 months and we did not use a control group which adds to the limitations of the present study.

Conflict of interest: Declared none.

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How to cite this article: Chaudhuri A, Ray B, Nandi K. A study to observe correlation of fasting sugar, postprandial blood sugar and HbA_1c with perceived stress and lipid profile in newly diagnosed diabetic subjects on regular walk and progressive muscle relaxation regimen in a population of eastern india. International Journal of Research and Review. 2018; 5(12):166-174.

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