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Original Research Article

A Study of Effect of Progressive Muscle Relaxation on Perceived Stress and Markers of Obesity in Young Adult Urban Females

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ABSTRACT

Background: Asian Indians are considered as "high-risk population" for both metabolic syndrome and cardiovascular disease.
Aims: To study of effect of progressive muscle relaxation on perceived stress and markers of obesity in young adult urban females.
Materials and methods: The present study was conducted in Burdwan Medical college after taking institutional ethical clearance and informed consent of the subjects. Two hundred healthy females in the reproductive age group were divided into two Groups according to PSLES score: Group A having PSLES scores more than 200 and Group B having PSLES scores between 41-200. 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. Body mass index and waist/ hip ratio of the subjects were measured. They were given a training of progressive muscle relaxation for 3 months and the parameters were re-evaluated.
Results: There was no difference in age and dietary habits between the two groups. Group A Age: 22.54±3.2; Group B Age: 22.22±3.23; P value: 0.489. There was significant difference in PSLES scores between the two groups. Group A PSLES: 314.25 ±28.29; Group B PSLES: 114.94±4.83; P value: <0.0001. There was significant difference in PSS, BMI and W/H ratio between the two groups before PMR training with Group A having significantly higher values of all parameters. Significant difference in PSS, BMI and W/H ratio between the two groups was also observed following PMR training with Group A having significantly higher values of all parameters. There was significant difference in PSS, BMI and W/H ratio in group A before and after practice of PMR. There was significant difference in PSS, BMI in Group B groups before and after PMR training but no significant difference in W/H ratio was observed. PSS and BMI significantly decreased in both groups following PMR training, while W/H ratio only decreased in group A i. e. subjects with higher stress following PMR training.
Conclusions: Perceived stress may cause an increase in body mass index and waist/ hip ratio and stress management programmes like PMR may help in improving the markers of obesity by decreasing perceived stress levels.

Keywords: Perceived stress, BMI, W/H ratio.

INTRODUCTION

One of the greatest public health challenges in the first half of 21st century is preventing the epidemic of obesity. In India obesity is most prevalent in urban populations (male = 5.5%, female = 12.6%), followed by the urban slums (male = 1.9%, female = 7.2%). Obesity rates are the lowest in rural populations (male = 1.6%, female = 3.8%). From the presented data it is obvious that females of urban population have higher chances of development of obesity and its consequences as compared to their male counterparts and rural females. Obesity has reached epidemic proportions in India, with morbid obesity affecting 5% of the country's population. Socioeconomic class has an effect on the rate of obesity. As populations become more westernized, concerns about an obesity epidemic are on rise. [1-2]

The distribution of body fat in different position of our body has significant effect in various health issues; especially central obesity. Abdominal subcutaneous fat is strongly responsible for morbidity than subcutaneous fat in any other site. [3] The roles of stress and behavioural stress response in the development of disease are in heightened focus in the present society. Stress may be the direct cause in the production or exacerbation of disease. It may also indirectly contribute to the development of behaviours like smoking, overeating or drug abuse that increase the risk of disease. [4-6]

Torres SJ et al in 2007 [7] in their study implied that, stress is thought to influence and change human eating behavior. Stress appears to alter overall food intake in two ways:

1.Undereating

2.Overeating.

Chronic stressful life seems to be associated with a greater preference for energy and nutrient dense foods. [7] Evidence from longitudinal studies suggests that chronic life stress may be linked to weight gain. Stress-induced over-eating may be one reason contributing to the development of obesity and obesity especially abdominal obesity increases the risk of CVD. [8]

Jääskeläinen A et al in 2014 [8] showed that, compared with non-stress-driven eaters, stress-driven eaters had a higher prevalence of overweight, obesity and abdominal obesity.

Progressive Muscle Relaxation technique may be of help in reducing stress induced obesity. Night eating syndrome (NES) is characterized by a lack of appetite in the morning, consumption of 50% or more of daily food intake after 6:00 p.m., and difficulty in falling and/or staying asleep. It is associated with stress and with poor results at attempts to lose weight. A study was conducted in 2003 to observe whether relaxation intervention (Progressive Muscle Relaxation Therapy) may be beneficial to NES population. 20 adults with NES were randomly assigned to two groups: either relaxation training or a Control (quietly sitting for the same amount of time) group. All subjects attended two laboratory sessions 1 week apart. Pre- and post-session indices of stress, anxiety, relaxation, and salivary cortisol were obtained. The results indicated that 20 min of a muscle relaxation exercise significantly reduced stress, anxiety, and salivary cortisol. After practicing these exercises daily for one week, subjects exhibited lower stress levels, anxiety, fatigue, anger and features of NES were also improved. [9]

Glucocorticoids, the hormonal end-product of the HPA axis, primarily exert catabolic effects to utilize available energy resource against the challenge posed by intrinsic or extrinsic stressors. Glucocorticoids increase hepatic gluconeogenesis and plasma glucose concentration, induce lipolysis (but they favor abdominal and dorsocervical fat accumulation) and cause protein degradation at multiple tissues to provide amino acids that may be used as an additional substrate for oxidative pathways. Glucocorticoids also antagonize the beneficial anabolic actions of GH, insulin and sex steroids on their target tissues. [9-12]

Chronic activation of HPA axis, can be damaging. It may increase visceral adiposity, decrease lean body (muscle and bone) mass, suppress osteoblastic activity and cause insulin resistance. The integrity of metabolic homeostasis is also centrally affected by the neuroendocrine integration of the HPA axis and the central stress pathways to the CNS centers that control appetite/satiety and energy expenditure. [13]

In a study by Lawson et al. [14] the high cortisol and neuropeptide Y levels were found to be associated with disordered eating psychopathology independent of body mass index. Recent data also support that insulin and leptin play important roles in the regulation of central pathways related to food reward.

Chronic stress acts as a risk factor that triggers, exacerbates, or causes weight gain, dyslipidemia, or coronary artery disease. [15-16] Repeated activation of stress centers may be involved in the pathogenesis of abdominal obesity and its comorbidities. One consequence of hormonal imbalance may be "stress eating,". Researchers have extensively studied the association between adiposity and the magnitude of cardiovascular reactions to acute psychological stress.

Young females of urban population are more stressed as compared to females and percentages of obese urban females are twice that of males. Obesity and stress are two significant risk factors for the development of cardiovascular diseases. Young urban females in the modern period suffer more from cardiovascular diseases as compared to their male counter parts. Previously the scenario was opposite. Premenopausal females were protected from cardiovascular diseases due to the effects of estrogen and progesterone. But the modernized competitive stressful society has brought about different changes in the present day life. [17,18] The present study was conducted to study effect of progressive muscle relaxation on perceived stress and markers of obesity in young adult urban females so that early lifestyle modification may help to improve the quality of life in these individuals.

MATERIALS AND METHODS

The present 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 females in the reproductive age group were selected from the local population.

Inclusion criteria: Two hundred healthy females in the reproductive age group 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 autonomic reflexes, 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 two Groups with hundred subjects in each group:

A: More than 200 severe stresses; B: 41-200 Less/moderate stress.

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 followed by anthropometric measurements.

(a) Body Weight: A digital weighing machine was used to measure body weight with an accuracy of ± 100 gm. Subjects were weighed without their shoes.

(b) Height: Stadiometer was used for measuring height. Standing body height was measured without shoes to the nearest 0.5 cm with the use of height stand with shoulders in relaxed position and arms hanging freely.

(c) Body Mass Index (BMI)

BMI and Waist-Hip Ratio were measured to correlate stress with obesity in the present study [404]. BMI was calculated as body weight in kilograms divided by square of body height in meters [404].

(d) Waist - Hip Ratio (WHR)

WHR of the subjects were measured. Waist circumference was measured at the level of umbilicus and hip circumference at the fullest point around buttocks. Waist circumference was divided by hip circumference in order to calculate the WHR.

Subjects were given PMR training for three months and each training session lasted for 20 mins. [20]

Instructions for progressive muscle relaxation training: (Repeat all steps given below twice)

a. Settle into a comfortable position preferably lying down
b. Take in slow deep breath through your nose, hold and release. Feel the sense of relaxation while breathing out. Notice the feeling of relaxation that develops every time during breath out.
c. Bring attention to forehead. Tense your forehead raise your eye brows as high as you can, hold, feel the tension.
   Relax your forehead. Let all the tension drain from your forehead. Feel the sensation of relaxation.
d. Close your eyes very tightly and wrinkle your nose, hold, feel the tension.
   Relax and let the discomfort fade away. Feel the sensation of relaxation.
e. Put your mouth into a forced smile, clench your teeth very tightly, lips jaws and cheek should very tense, hold, feel the tension.
   Relax your face and feel the sensation of relaxation.
f. Breath in deeply, hold the breath and breath out, relax and let go. Feel the sensation of relaxation.
g. Tense your neck, shrug your shoulders, try to touch your ears with your shoulder, feel the tension in neck and shoulder.
   Let go, Relax, feel the sensation of relaxation.
h. Squeeze your hands into fists as much as possible, hold, feel the tension in hands and forearm.
   Relax, feel the sensation of relaxation.
i. Face your palms against the floor. Push your hand towards the floor, hold, feel the tension.
   Relax your hands, arms, shoulders and feel the sensation of relaxation.
j. Take in deep slow breath, hold it for count of 4, breath out, feel sense of relief in your chest as your breath out. Relax the chest.
k. Arch your back, have a pillow under the middle and lower part of your back, try to put your shoulder blades together, hold this position, notice the feeling of tension.
   Relax and feel the sensation of relaxation.
l. Squeeze your abdomen hold this position, feel the tension.
   Relax. Feel the sensation of relaxation.
m. Push down the heels against the floor, tighten your back, calves, squeeze your legs, back, hold. Feel the tension.
   Release, feel the sensation of relaxation.
n. Crow the toes and tighten muscles of feet, hold, feel the tension.
   Relax and feel the sensation of relaxation.
   Rest for few moments longer to feel the relaxed sensation that has spread all over the body.

PSS and anthropometric parameters were reevaluated after 3 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

There was no difference in age and dietary habits between the two groups. Group A Age: 22.54±3.2; Group B Age: 22.22±3.23; P value: 0.489. There was significant difference in PSLES scores between the two groups. Group A PSLES: 314.25 ±28.29; Group B PSLES: 114.94±4.83; P value: <0.0001. There was significant difference in PSS, BMI and W/H ratio between the two groups before PMR training with Group A having significantly higher values of all parameters (Table1). Significant difference in PSS, BMI and W/H ratio between the two groups was also observed following PMR training with Group A having significantly higher values of all parameters (Table2). There was significant difference in PSS, BMI and W/H ratio in group A before and after practice of PMR (Table3). There was significant difference in PSS, BMI in Group B groups before and after PMR training but no significant difference in W/H ratio was observed (Table 4). PSS and BMI significantly decreased in both groups following PMR training, while W/H ratio only decreased in group A i. e. subjects with higher stress following PMR training.

Table 1: Shows comparison of PSS, BMI and W/H ratio of the two groups before practice of PMR

Parameter	Group A N=100 Mean ± SD	Group B N=100 Mean ± SD	P Value
PSS	27.95±3.09	18.99±3.88	**<0.0001****
BMI	26.63±0.46	24.34±2.54	**<0.0001****
W/H ratio	0.97±0.02	0.87±0.05	**<0.0001****

There was significant difference in PSS, BMI and W/H ratio between the two groups.

Table 2: Shows comparison of PSS, BMI and W/H ratio of the two groups after practice of PMR

Parameter	Group A N=100 Mean ± SD	Group B N=100 Mean ± SD	P Value
PSS	24.53±3.39	14.5±2.065	**<0.0001****
BMI	25.002±2.78	23.195±2.69	**<0.0001****
W/H ratio	0.87±0.065	0.85±0.066	**<0.0001****

There was significant difference in PSS, BMI and W/H ratio between the two groups after PMR training.

Table 3: Shows comparison of PSS, BMI and W/H ratio of the Group A before and after practice of PMR

Parameter	Group A (Before) N=100 Mean ± SD	Group A (After) N=100 Mean ± SD	P Value
PSS	27.95±3.09	24.53±3.39	**<0.0001****
BMI	26.63±0.46	25.002±2.78	**<0.0001****
W/H ratio	0.97±0.02	0.87±0.065	**<0.0001****

There was significant difference in PSS, BMI and W/H ratio in group A before and after practice of PMR.

Table 4: Shows comparison of PSS, BMI and W/H ratio Group B before and after practice of PMR

Parameter	Group B (Before) N=100 Mean ± SD	Group B (After) N=100 Mean ± SD	P Value
PSS	18.99±3.88	14.5±2.065	**<0.0001****
BMI	24.34±2.54	23.195±2.69	**0.002****
W/H ratio	0.87±0.05	0.858±0.066	0.127

There was significant difference in PSS, BMI in Group B groups before and after PMR training but no significant difference in W/H ratio was observed.

DISCUSSION

In the present study 200 Subjects were divided two groups according to PSLES scores; one group having PSLES greater than 200 (A) and other group having PSLES score less than or equal to 200 (B). PSS and BMI significantly decreased in both groups following PMR training, while W/H ratio only decreased in group A i. e. subjects with higher stress following PMR training.

PMR training have shown to decrease PSS in studies by Hassanpour-Dehkordi A et al. [21] Stress management programs such as meditation, yoga, hypnosis, guided imagery, muscle relaxation, etc., have shown to improve positive coping skills and has been used in the treatment of various disease as adjuvant therapy. [20]

Physical adaptation occurs due to stress, mainly to promote an adaptive redirection of energy. Oxygen and nutrients are shunted to the central nervous system (CNS) and the stressed body site(s), where they are needed the most. Increases in cardiovascular tone, respiratory rate, and intermediate metabolism (gluconeogenesis, lipolysis) all work in concert to promote availability of vital substrates, while energy consuming functions, like digestion, reproduction, growth, and immunity are temporarily suspended. [21,22]

Restraining forces are also activated during stress to prevent a potential excessive response of the components of the stress system. [9,22] The ability of the individual to develop the restraining forces that prevent such an over-response accurately and in time is equally essential for a successful general adaptive response. If the counteracting forces of the body fail to control the elements of the stress response in a precise manner, the prolongation of the initial adaptive responses may turn maladaptive responses and contribute to the development of disease. Relaxation exercises may help in improvement of the adaptive responses. [20]

Stress in a known factor responsible for the development of dyslipidemia, and dyslipidemia is known to alter autonomic functions by decreasing heart rate variability and baroreceptor sensitivity. [9,20-22] This effect of stress is also evident in the present study. Stress also alters distribution of body fat and significant positive correlation of PSS with BMI and WAIST/ HIP was also found in the present study.

A study in 2013, explored the concept that whether viewing pictures of nature prior to a stressor altered the autonomic function during recovery from the stressor. Natural scenes are thought to produce relaxation effects on the mind. [22] Parasympathetic activities were significantly higher in the study during recovery following the stressor when viewing scenes of nature compared to viewing scenes depicting built environments. It was concluded that viewing nature scenes prior to a stressor alters the autonomic activity in the recovery period.

Exercise and physical activity are effective stress management techniques that are often disregarded in treating patients. Any type of exercise helps to relieve stress by producing endorphins, neurotransmitters that boost mood. Exercise can also help lower blood pressure and reduce cholesterol. [19,20,23] The goal of stress management techniques is to combine physical and mental disciplines in an effort to achieve peacefulness and balance. In addition to releasing stress, they can also help with weight management and may help to combat insomnia, fatigue, depression, anxiety, reduce blood pressure, lower heart rate, improve mood. Subjects who practice these regimes regularly may experience improved mental balance, greater flexibility and increased strength of mind. [19,20]

Chronic environmental stress is known to be associated with generation of excess reactive oxygen species (ROS) and also contribute in pathogenesis of depression. The purpose of a study by Herbet M et al in 2017 [24] was to evaluate biochemical and molecular changes associated with ROS generation in the brains of rats submitted to chronic variable stress. Male Wistar rats (50–55 days old, weighing 200–250 g) were divided in two groups: a) control, b) stressed.

Rats in the stressed group were exposed to stressful conditions for about 40 days. Then the animals were decapitated and brain samples were collected. In prefrontal cortex biochemical parameters measured were as follows:

1.lipid peroxidation and concentration of glutathione-GSH,

2.GSSG,

3.GSH/GSSG ratio,

4.Glutathione peroxidase,

5.Glutathione reductase activities.

In the hippocampus parameters measured were:
1.Marker of DNA,
2.Oxidative damage and expression of DNA-repairing genes (Ogg1, MsrA)
3.Gene-encoding antioxidative transcriptional factor (Nrf2).
The results demonstrated indirect evidence of ROS overproduction and presence of oxidative stress and further revealed disruption of oxidative defense systems (decreased GR activity, diminished GSH/GSSG ratio, and decreased Nrf2 expression) and activation of the oxidative DNA repair system (increased Ogg1 and MsrA expression). It was concluded in the study that there is independent activation of oxidative stress response genes in chronic variable stressful conditions.

Depression is currently one of the most common affective disorder. 120 million people worldwide suffer from depression and the number of cases is increasing steadily day by day. It has been predicted that by 2020, depression will rank second in lifestyle diseases that reduce the capacity to work. Known causes of depression till date do not provide sufficient explanation of pathophysiology, in spite of extensive research conducted in this area. It has been observed that the process is multifactorial with many subtypes and etiology. Studies have shown that chronic stress is a factor that contributes directly in the pathogenesis of depression. Stressful events may induce multiple behavioral, neurochemical, biological alterations, as an adaptive response to meet environmental demands. It has been described that a prolonged and sustained stimulation, caused by stress exceeding the body's capacity to maintain homeostasis, may result in psychopathological diseases. [20,9]

Insomnia, anxiety, and fatigue are more common in hemodialysis patients as compared to healthy subjects and affect patients' quality of life. In a study in 2016 [25] the effects of progressive muscle relaxation (PMR) and aerobic exercise was compared. The parameters studied were anxiety, sleep quality, and fatigues in patients with chronic renal failure undergoing hemodialysis were evaluated. Hemodialysis patients were randomly assigned to three groups:
1.PMR Group
2.Aerobic exercise Group
3.Control Group.

PMR group patients performed relaxation exercises and exercise group patient practiced aerobic exercise daily for 60 days. Questionnaires of anxiety, sleep quality, and fatigue were completed by participants before and after the interventions. PMR program was found to significantly decrease general anxiety, trait anxiety, state anxiety, and Beck anxiety while aerobic exercise significantly reduced beck anxiety. PMR program and aerobic exercise both significantly improved sleep quality in hemodialysis patients. PMR program significantly reduced Rhoten fatigue but had no effect on Piper fatigue. Aerobic exercise was found to have no effect on Rhoten and Piper fatigue. Results in the study demonstrated significantly better results of PMR as compared to aerobic exercise in improving the symptoms of anxiety, sleep disorders, and fatigue.

Fatigue and poor sleep quality cause severe anxiety and somehow undermine quality of life in hemodialysis patients. Non-pharmacological treatments such as aerobic exercise and particularly PMR may be recommended as a highly economical but efficient and efficacious strategy to manage different problems of these patients.

In the present study we also observed that PMR decreased PSS scores in all subjects and was a significant contributor in improvement in the quality of life of these subjects.

Hassanpour-Dehkordi A et al in 2016 [26] conducted a study to investigate the effect of progressive muscle relaxation on elderly's quality of life in a population of Iran. Participants were randomly divided into two groups: intervention group and control groups. The intervention group practiced muscular progressive relaxation three days per week for three months (total 36 sessions). The instrument of data gathering consisted of questionnaires on individual's demographic data and quality of life SF-36. After intervention, quality of life increased significantly in the subjects practicing muscular progressive relaxation and fatigue severity decreased significantly in the intervention group. There was a significant difference in mean score of physical performance, restricted activity after physical problem, energy, socially function, physical pain, overall hygiene, and quality of life between intervention and control groups. These results are similar to the present study. PSS were significantly decreased following PMR sessions in both groups in the present study.

Healthcare teams needs to incorporate these safe programs of stress management in care designs as these programmes are well studied, effective and economical.

Torres et al. [7] also found that Perceived stress was positively correlated with BMI and Waist hip ratio.

The peripheral hormone ghrelin has an essential role in stress, emotions, and eating process. Ghrelin and leptin concentrations have been associated with interpersonal stress factors associated with weight gain and obesity. [27] Peripheral neuropeptide Y (NPY) plays a major mechanistic role in development of obesity. [27]

When an organism encounters a stressful event, a number of steps occur to divert resources and to assist coping mechanisms. In terms of acute appetite regulation, corticotrophin-releasing hormone (CRH) is released from the medial parvocellular paraventricular nucleus of the hypothalamus (PVN) in response to stressor. This further stimulates adrenocorticotropic hormone (ACTH) release from the pituitary and cascade of events leading to glucocorticoid release. CRH is also released into the arcuate nucleus of the hypothalamus (ARC) to inhibit neuropeptide Y (NPY)/agouti-related peptide (AGRP) neurons there. These cells are normally responsible for stimulating feeding behavior and suppressing energy expenditure. In the above mentioned pathway CRH released after acute stress inhibits appetite. [27-30]

One third of Indian population is said to be suffering from chronic energy deficiency (CED), with increased risk of developing chronic diseases. A new anthropometric measure called A Body Shape Index (ABSI) is said to be a better index in predicting risks for premature mortality. ABSI is also in part said to be a surrogate of visceral fat. A study by Sharma S et al in 2014 was aimed to explore the association between indices of HRV (heart rate variability), BMI, WC, and ABSI in healthy Indian males with low BMI (BMI < 18.5 kg/m2) and to compare with normal BMI group (BMI 18.5 to 24.9 kg/m2). ABSI and BMI were derived from anthropometric parameters, namely, height, weight, and waist circumference in 178 males aged between 18 to 78 years. Subjects were categorized into two groups based on their BMI. Power spectral analysis of HRV demonstrated a significant negative correlation between Log HF (high frequency) and ABSI in both low BMI and normal BMI group. The results demonstrated that even with slight increase in BMI among low BMI individuals, there could be a greater risk of cardiovascular morbidity and mortality. Other studies have also shown that body fat distribution is a major factor, particularly visceral fat carrying the greatest risk for cardiovascular morbidity and mortality. [31-33]

Jääskeläinen A [8] et al. studied the prevalence of stress-related eating and its association with overweight, obesity, abdominal obesity, dietary, and other health behaviors at the age of 16. They also examined whether stress-related eating is predicted by early-life factors including the birth size and maternal gestational health. It was noted that Stress-related eating was highly prevalent among 16-year-old girls and was associated with obesity, as well as adverse dietary and other health behaviors among both genders.

Habhab et al. in 2009 showed the relationship among stress, restraint, and eating. Highly stressed women preferred sweet, high-fat food more than did low-stressed women, whereas low-stressed women took more low-fat than high-fat food. [34]

Epidemiologic evidence provides a strong link between psychosocial stress with obesity. The aim of a study by Endrighi R et al in 2015 [35] was to investigate whether changes in adiposity following minimal weight loss affect heightened stress responses in women. They examined the role of the adipokine leptin in driving inflammatory responses.

Twenty-three overweight or obese, healthy, women (Mean age = 30.41 ± 8.0 years; BMI = 31.9 ± 4.1 kg/m2) recruited in the study completed standardized acute mental stress before and after a 9-week calorie restriction program designed to modify adiposity levels. Cardiovascular (blood pressure and heart rate were the parameters studied) and inflammatory cytokines (leptin and interleukin-6; IL-6 were the parameters assessed) responses to mental stress were assessed several times in between baseline and a 45-min post-stress recovery period. There were modest changes in adiposity measures but the adipokine leptin was markedly reduced (−27%) after the intervention. Blood pressure reactivity was attenuated (−3.38 ± 1.39 mmHg) and heart rate recovery was improved (2.07 ± 0.96 Bpm) following weight loss. Blood pressure responses were inversely associated with changes in waist/hip ratio following intervention. Decreased levels of circulating leptin after weight loss was found to be inversely associated with the IL-6 inflammatory response to stress (r = −0.47). The study offered preliminary evidence suggesting that modest changes in adiposity following a brief caloric restriction program may yield beneficial effect on cardiovascular stress responses. It was also observed that reductions in basal leptin activity might be important in blunting pro-inflammatory responses.

Kubera B et al in 2017 [36] conducted a study to observe the combined effects of ‘stress exposure’ and ‘autonomic variability’ on long-term changes in body form. Data of 1369 men and 612 women from the Whitehall II cohort were analyzed. Body-mass-index, hip-to-height-ratio and waist-to-height-ratio were measured at three time points over a ten-year period. HRV and ‘psychological distress’ (General-Health-Questionnaire) were assessed. Men with high psychological distress were found to be at risk of developing an increased waist-to-height-ratio (F=3.4, P=0.038). Men with high psychological distress and low HRV were prone to develop an increased body mass and hip-to-height-ratio (psychological distress: F=4.3, P=0.016; HRV: F=5.0, P=0.008). They found statistical trends that women displayed similar patterns of stress-related changes in body form (P=0.061; P=0.063). Assessing ‘psychological distress’ and ‘autonomic variability’ can thus predict changes in body form. Psychological distress was found to be associated with an increased risk of developing the ‘wide-waisted phenotype’, while psychological distress combined with low autonomic variability was associated with an increased risk of developing the ‘corpulent phenotype’.

Medical students usually have to face tremendous academic and non-academic stresses owing to the vast curriculum and inadequate time. The impact of stress on mental and physical health was assessed by Priya SAK et al in 2017 [37] using stress questionnaires and anthropometric parameters in medical students. The objective of this study was to find the inter relationship between waist hip ratio (WHR) and various stressors the students are exposed to. Ninety-seven first MBBS students participated in this cross-sectional study and were administered the medical student stress questionnaire (MSSQ), (a validated tool), and the anthropometric measurements (waist and hip circumference, waist hip ratio, body mass index) were carried. The study showed a negative correlation of WHR with all the stress parameters of which inter personal relationship stress (IRS) and teaching learning related stress (TLRS) were significant. Similar results have also been observed in the present study.

We had conducted a longitudinal interventional double blinded randomized control trial on females of reproductive age group in a time span of 5 years. [38] Parameters recorded were Waist/ hip ratio, Body mass index (BMI), Pulse rate, Blood pressure (BP), Electrocardiogram (ECG), fasting blood sugar (FBS), Lipid profile, Pulmonary Function test (PFT), Perceived Stress levels, Presumptive Stressful Life Event Scale (PSLES) score. The present study was a pilot project before conduction of the above study and we only included 200 subjects in the present study, while in the previous study we had included 2012 subjects. Same subjects were not included in the studies. Only markers of obesity were assessed in the present study. PSS, BMI was significantly decreased following PMR training but no change in waist /hip ratio was observed in the group with mild to moderate stress. But in the previous study we had observed significant decrease in all markers of obesity following relaxation exercises.

From the above discussions it is evident that mental stress increases BMI and Waist/Hip ratio and these results are similar to the present study.

CONCLUSIONS

Perceived stress may cause an increase in body mass index and waist/ hip ratio and stress management programmes like PMR may help in improving the markers of obesity by decreasing perceived stress levels.

Conflict of interest: Declared None.

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