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Correlation of Perceived Mental Stress and Pulmonary Function Among Hypertensive Adults in the Age Group of 30-50 years - An Observational Study

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ABSTRACT

Introduction: Hypertension is increasing in India and is one of the most important risk factors for cardiovascular morbidity and mortality. It has been linked to many diseases. Several studies showed that hypertension and lung function are associated causing reduction in lung function. Also stress has been listed as a potential and important cause of hypertension. But there was paucity of information about the stress having an effect on lung function in hypertensive adults, thus there was a need to conduct this study.
Materials and Method: The study comprised of 72 controlled hypertensive adults. Stress was assessed using Perceived stress scale and the lung function was assessed using a Spirometer (Spirobank II). Data was collected and recorded in the Excel 2016 spreadsheet and analyzed using GraphPad Prism 9. Shapiro-Wilk test was used to analyze the normality of the data. Since the data has not passed the normality test, Spearman's correlation test was used for calculating the correlation.
Results: There was a very weak correlation between Perceived stress scale (PSS) score and FEV 1 which was statistically not significant ($p>0.05$). A weak correlation was found between PSS score and FVC which was statistically significant ($p<0.05$). PSS was negatively correlated with both the parameters of PFT (FEV1 and FVC) and there was no correlation between PSS and FEV1/FVC.
Conclusion: Increased perceived stress levels may affect the lung function in hypertensive adults.

Keywords: Hypertension, Controlled hypertension, Pulmonary function, Stress, depression, lung function

INTRODUCTION

Hypertension is defined clinically as Systolic BP 140 mmHg or greater and Diastolic BP 90 mmHg or greater averaged over two or more readings on two or more visits following an initial screening.[1] It is commonly known as a "silent killer". [1] Controlled hypertension is defined clinically as an average systolic blood pressure of <140 mm Hg and an average diastolic blood pressure of <90 mm Hg over two readings in people with hypertension as a result of treatment by lifestyle modification or pharmacotherapy. [1] HTN affects about 1 billion people worldwide.[2] High blood pressure is increasing in India due to rapid urbanization and globalization leading to adoption.[3] In India, the overall prevalence of hypertension was 30.7% in 2019.[4] Adult hypertension prevalence has risen dramatically over the past three decades from 5 per cent to between 20-40 per cent in

urban areas and 12-17 per cent in rural areas.[3]

The number of hypertensive individuals is anticipated to nearly double to 213 million by 2025.[3] In Mumbai, the prevalence of hypertension was 34.5% according to the survey done in the year 2018.[5] It is an increasingly important public health challenge. HTN is considered as one of the most important risk factors for cardiovascular morbidity and mortality.[6] There are several factors predisposing to hypertension. Singh et al in the year 2017 listed some of the risk factors which includes-eldest age group, married subjects, subjects of upper socioeconomic status, illiterate subjects, and retired subjects. Tobacco and alcohol consumption, overweight, obesity, and abdominal obesity were also associated with hypertension.[7] Pre-hypertension is defined as a grey area falling between 120–139 mmHg systolic BP and 80–89 mmHg diastolic BP.[7] Although pre-hypertension is not a medical condition in itself, pre-hypertensive subjects are at more risk of developing HTN.[7]

Hypertension has been linked to multiple diseases including cardiac, cerebrovascular, renal and eye diseases as it imposes on many organs and systems of the body.[4]

Several studies showed that hypertension and lung function are associated, moreover some studies found an association between reduced pulmonary function and hypertension[2],[4],[5],[10],[12]

Anuradha Yadav et al in the year 2015 found an inverse relation between HTN and pulmonary functions predominantly restrictive pattern. The cause for this reduction in lung function may be that the left ventricular failure causes pulmonary vascular engorgement and interstitial oedema which may reduce the compliance of the lungs ultimately resulting in mild restrictive disease manifested by lower values of FVC.[8] Sparrow et al[9] and Selby et al[10] reported a significant association between FVC and the incidence of hypertension. Swati Shah et al in the year 2014 conducted a study on 30 hypertensives and 30 non-hypertensives to compare the pulmonary function test. The study found out that the mean values of all PFT parameters were significantly lesser in hypertensives and along with it those on beta-blockers were found to have deleterious effects on PFT and are more prone to develop obstructive lung disease.[2]

Nowadays, modern life is full of hassles, deadlines, frustrations, stress and demands.

Stress has been defined as a process in which environmental demands exceed the adaptive capacity of organism.[11] Mental stress is a form of stress that occurs because of how events in one's external or internal environment are perceived, resulting in the psychological experience of distress and anxiety. It is often accompanied by physiological responses.[12]

Stress has been listed as a potential and important cause of hypertension.[13] Stress causes increase in blood pressure with one of two hemodynamic mechanisms.[14] The myocardial mechanism increases blood pressure through enhanced cardiac output; that is, increase in heart rate and stroke volume (i.e., the amount of blood pumped with each heart beat). The vascular mechanism constricts the vasculature, thereby increasing blood pressure. Both epidemiological and controlled studies have demonstrated relationships between psychosocial stressors and disease.[14] An occupational gradient in coronary heart disease (CHD) risk has been documented in which men with relatively low socioeconomic status have the poorest health outcomes.[14] Much of the risk gradient in CHD can be eliminated, however, by taking into account lack of perceived job control, which is a potent stressor. Other factors include risky behaviors such as smoking, alcohol use, and sedentary lifestyle, which may be facilitated by stress. Among men and women, work stress has been reported to be a predictor of incident CHD and hypertension. [14]

American Psychological Association states that, Chronic stress, or a constant stress experienced over a prolonged period of

time, can contribute to long-term problems for heart and blood vessels. The consistent and ongoing increase in heart rate, and the elevated levels of stress hormones and of blood pressure, can take a toll on the body. This long-term ongoing stress can increase the risk for hypertension, heart attack, or stroke.[15] Sandip Bhelkar et al in the year 2018 conducted a study to find the association between stress and hypertension among adults and he found that higher stress was significantly associated with hypertension.[13] Since blood pressure and serum cholesterol increases during stress, the relationship between stress and hypertension has long been suspected. Cases with high stress had 2.52 times higher chance of hypertension.[11] This stress can result in psychological and biological changes that may place person at risk of disease and production of stress hormones (cortisol) may be triggered by normal physiological activities in humans. However, prolonged activation of stress hormones can be harmful to the individuals.[11] The mechanism underlying association between stress and hypertension can be divided into 2 mechanisms-The first is behavioral mechanism and the second is pathophysiological mechanism.[11]

The former contributes to adverse health behaviors such as physical inactivity, poor diet and

smoking while the later involves neuro-endocrine activation by Hypothalamus Pituitary Adrenal system (HPA).[11] Factors affecting blood pressure through stress include white coat hypertension, job strain, race, social environment, and emotional distress.

Furthermore, when one risk factor is coupled with other stress producing factors, the effect on blood pressure is multiplied.[11]

Psychological stress is associated with a long-lasting allostatic load, contributing to sustained

blood pressure elevation. Most hypertensive patients have psychological problems, and have been shown to have symptoms of depression.[16]

But the awareness about stress being the major cause of hypertension is less thus Karthikeson.PS conducted a study regarding awareness of stress related hypertension in Chennai in the year 2016 and the study concluded that it created awareness via surveys among the Indian population that stress can cause hypertension thus prevention needs to be taken.[19] An epidemiological cross-sectional study was conducted to assess the level of stress and its association with hypertension in young adult population of age group 20 to 40 years in an urban slum of Mumbai in the year 2017 and the study found that severe stress is associated with development of hypertension. Special attention should be given to increase the awareness about stress, its related complications and prevention and control measures.[11]

Recently the impact of lockdown during Covid-19 pandemic resulted in stress among the Indian population. This was supported by a study conducted in the year 2021 which showed that lockdown during Covid-19 had an impact on the people's mental health causing stress.[20]A survey was conducted by Indian clinicians to find the risk factors causing hypertension during the Covid-19 pandemic and the study showed that tobacco use, obesity and co-morbidities are top three modifiable risk factors for HTN followed by emotional stress, during Covid-19 pandemic.[21]

Gordon et al in the year 2021 conducted a large scale study of stress, emotions, and blood pressure in daily life using a digital platform and it concluded that stress is often associated with pathophysiological responses, like BP reactivity, which when experienced repeatedly may be one pathway through which stress leads to poor physical health.[22]

In a survey conducted by Kenexa Research Institute, 56% of the women surveyed said that their stress level was reasonable while 26% felt that they were under unreasonable stress.[23]

Also while doing the frontline jobs, women experienced 10% more stress than males,

whereas in service and production jobs, women felt 8% additional stress than males.[23]

Anurima Chaudhuri et al in the year 2019, found that women reported higher level of stress as compared to men and the increased perceived stress level among the working women was negatively correlated with the PFT.[23] The reason for this may be of specific autonomic, ventilatory and immunological pathways for emotion induced lung function changes. Thus it concluded that increased stress level may adversely affect the lung function even in healthy young individuals.[23]

Hypertension is one of the commonest non-communicable diseases in India. It is a chronic, persistent, largely asymptomatic disease.[29] Many studies have shown that hypertension is a chronic disease affecting many organs in the body.[2]

Also stress has been listed as a potential and important cause of hypertension.[13]

Amrita Sarkar et al in the year 2021 found out that the prevalence of stress in hypertensive patients was 84.3% and there was highly significant association between stress and hypertension.[32] Several studies have proved that stress results in sustained elevation of blood pressure.[11],[13],[17],[33],[34]

Stress may contribute to shallow breathing which may compromise the body posture when shoulders are rounded, forward and tensed causes the ribcage to become small and tight, reducing the chest expansion which causes reduction in the body's capacity to take in more air leading to reduced lung volume and capacity. But there was paucity of information about the stress having an effect on lung function in hypertensive adults, thus there was a need to conduct this study.

The current study aimed to find the correlation of Perceived mental stress and Pulmonary function among hypertensive adults.

Objectives: 1) To assess the perceived mental stress in hypertensive adults using Perceived Stress Scale.

2) To assess the lung function in hypertensive adults using Pulmonary Function Test (Parameters to be assessed- FEV1, FVC, FEV1/FVC)

3) To correlate perceived mental stress and pulmonary function among hypertensive adults.

LITERATURE REVIEW

1. Tadvi A, Janardhan R. Bandi. An epidemiological cross-sectional study to assess the level of stress and its association with hypertension in young adult population of age group 20 to 40 years in an urban slum of Mumbai, Maharashtra, India. International Journal of Community medicine and Public Health.2017 Jan;4(2):348.
   A cross sectional community based study of 450 participants in the age group of 20 to 40 years using a questionnaire-cum-examination form that was devised relevant to the study. Blood pressure was assessed using sphygmomanometer and stress was assessed using stress questionnaire score. Amongst 450 participants 9.1% participants had minimal stress,36.4% had mild stress,31.6% had moderate stress and 22.9% had severe stress. Association between severe stress and hypertension was found to be statistical significant.[11]

2. Pederson et al. Influence of psychological stress on upper respiratory infection--a meta-analysis of prospective studies. 2017Oct;72(8):823-32.
   A Systematic review and meta-analysis was conducted to find an association between psychological stress and upper respiratory infection.27 prospective studies were examined. The results revealed a significant overall main effect of psychological stress on the risk of developing URI.[49]

3. Afreen et al. Association of Reduced Lung Function With Major Depressive Disorder. Bangladesh Crit Care J September 2017;5(2): 126-128.
   A study was conducted to find an association between reduced lung function and Major Depressive Disorder. For this, 30 newly diagnosed female MDD patients aged 20 to 50 years were enrolled from the Department of Psychiatry. Lung function was assessed using spirometer and the result of this study suggested that ventilatory function of lung were significantly reduced in MDD patients and the apparent effect of depression on poor lung function in MDD patients may be explained by the reduced psychomotor activity along with poor respiratory muscle strength in depressive illness. [54]

4. Bhelkar S, Deshpande S, Mankar S, Hiwarkar P. Association between Stress and Hypertension among Adults More Than 30 Years: A Case-Control Study. Natl J Community Med 2018;9(6):430-433.
   A study was conducted on newly diagnosed hypertensive patients aged 30 and above with age and gender matched controls. Stress was assessed using Perceived Stress Scale. The study concluded that high stress is significantly associated with hypertension and is an independent risk factor for hypertension.[13]

5. Chaudhuri A, Maulik SG. A study of correlation of perceived stress and pulmonary function tests among working women in an urban population of West Bengal. International Journal of Research and Review. 2019; 6(7):324-332.
   A study was conducted on 600 working women. Subjects were divided into two groups according to perceived stress scores with 300 subjects in each group. Subjects with PSS SCORES 20 and above (Group A) and Subjects with PSS SCORES less than 20 (Group B). Pulmonary function tests were carried in all subjects. The study found that there was no significant difference in FEV1/FVC% between the two groups. PSS was negatively correlated with all parameters of PFT in both groups. The study concluded that most working females perceive high levels of stress which may have adverse outcome in their pulmonary function test results. Increased perceived stress levels may adversely affect lung function even in healthy young individuals.[23]

6. Park et al. Relationship between depression and lung function in the general population in Korea: a retrospective cross-sectional study. International Journal of COPD.2018;13: 2207–2213.
   This study evaluated the relationship between lung function and depression in the general population in Korea. Data from the Ansung–Ansan cohort, a community-based cohort in Korea, were used to analyze the relationships between depression and lung function parameters. A total of 3,321 men and women aged 40–69 years were enrolled. Spirometry data included the forced expiratory volume in 1 second (FEV1), forced vital capacity (FVC), and the FEV1/FVC ratio. A propensity score analysis was conducted with the aim of reducing the bias of the retrospective study. The overall prevalence of depression in the study population was 13.1%. Depression was significantly more

prevalent in women than in men and in never smokers than in ever smokers The group with depression was older and had a lower average body mass index than the group without depression. The FEV1,FVC and FEV1/FVC ratio were significantly lower in the group with depression than in the group without depression. The study concluded that depression is associated with decreased lung function in the general population, especially in adults older than 50 years.[47]

7. A D Rengganis, A B Rakhimullah and H Garna. The Correlation between Work Stress and Hypertension among Industrial Workers: A Cross-sectional Study IOP Conf. Series: Earth and Environmental Science.2020;1:441.
A cross-sectional study was conducted on 100 male workers in the production department of an Industry situated in Indonesia. Their stress was assessed using Work stress Questionnaire. The study found a significant correlation between work stress and hypertension among these industrial workers.[42]

MATERIALS & METHODS

MATERIALS:

Chair with support, BP Apparatus, Stethoscope, Pulse oximeter, Pulmonary Function Test Apparatus (Spirometer), nose-clip and mouthpieces, Perceived Stress Scale, Weighing machine, Pen

OUTCOME MEASURES:

1. **Perceived Stress Scale (PSS)-**

It is a classic stress assessment instrument developed by Sheldon Cohen in 1983. It is a 10-item scale widely used to assess the perception of stress. It is a measure of degree to which situations in one's life are appraised as stressful. The questions are of a general nature and hence are relatively free of content specific to any population group. The questions in this scale ask about the feelings and thoughts during the last month.

There are two subscales in the PSS-10:

a. Perceived helplessness (items 1, 2, 3, 6, 9, 10) – measuring an individual's feelings of a lack of control over their circumstances or their own emotions or reactions.
b. Lack of self-efficacy (items 4, 5, 7, 8) – measuring an individual's perceived inability to handleproblems.

This scale has been shown to be reliable, valid and a responsive functional outcome measure for assessing the perception of mental stress The 10- item self-report instrument has established reliability and validity (r=0.85) (Cohen. S, Kamarck T and Mermelstein R, 1983).[24]

Scoring: Sum up all the scores. Individual scores on PSS can range from 0-40

Higher score indicates a higher level of perceived stress.[24]

Score	Interpretation
0-13	Low stress
14-26	Moderate stress
27-40	High stress

Higher levels of psychological stress as measured by the PSS-10 have been associated with elevated markers of biological aging, higher cortisol levels, as well as suppressed immune function, greater infection-induced release of pro-inflammatory cytokines, greater susceptibility to infectiousdisease, slower wound healing, and higher prostate-specific antigen levels (Cohen & Janicki-Deverts, 2012). Persons who score higher on the PSS also report poorer health practices, such as sleeping fewer hours, skipping breakfast, and consuming greater quantities of alcohol (Cohen &Williamson, 1988)

2. **Pulmonary Function Test (Spirometer)-**

PFT is an evaluation of the respiratory system. A spirometer is an apparatus used

for measuringthe volume of air inspired and expired by the lungs. The primary purpose of pulmonary function testing is to identify the severity of pulmonary impairment. Pulmonary function testing has diagnostic and therapeutic roles and helps clinicians answer some general questions about patients with lung disease.[25]

Spirometry testing is performed with the patient seated or standing. The patient should wear comfortable, non-restrictive clothing and avoid vigorous exercise or ingestion of a large meal just prior to the test. Age, height, weight, gender, and race/ethnicity should be recorded to allow for calculation of reference values.[25]

The FVC maneuver has three phases: inhalation, the initial "blast" phase of exhalation, and completion of exhalation The patient is instructed to inhale maximally and then to exhale immediately by "blasting" the breath out. The patient is coached to continue exhalation until airflow is no longer recorded and a minimum of six seconds has elapsed since initiation of the test. Application of a nose clip or manual occlusion of the nostrils is recommended.[25] ATS/ERS guidelines have determined specific criteria for the start and end of the test. ATS/ERS have outlined criteria for test acceptability.[25]

Acceptability criteria (adapted from Miller et al.)

Within maneuver criteria:

To be acceptable, each individual spirogram must meet the following criteria:

no artifacts such as:

- cough in first second
- glottis closure influencing measurement
- early termination or cut-off
- sub-maximal effort at any point
- leak
- obstructed mouthpiece
- good start
- extrapolated volume (EV) < 5% of FVC or 0.15L, whichever is greater
- satisfactory exhalation
- duration ≥ 6s in adults, or plateau in volume-time curve or if subject cannot continue to exhale

Between maneuver criteria:

Once three acceptable spirograms are obtained apply the following:

Two largest values for FVC must be within 0.150L of each other

Two largest values for FEV1 must be within 0.150L of each other

If both of above are met, testing session may be terminated

If not, continue testing until:

- Both criteria are met with additional maneuvers performed
- OR
- Total of 8 tests have been performed
- OR
- The patient no longer is able to or no longer wishes to continue

Figure 1: Criteria for PFT test acceptability[25]

METHODOLOGY:

- Institutional Ethics Committee approval was taken.
- All the necessary precautions were taken considering COVID -19 pandemic.
- Participants were screened according to the inclusion and exclusion criteria.
- Selection of the participants was done using Convenience sampling method from a Physiotherapy and Medicine Outpatient Department of Tertiary care centre.
- Subjects were asked to sit comfortably on a chair. They were explained about the need of the study and the procedure in the language they understand.
- A prior written informed consent was taken from all the subjects participating

in the study in their own preferable languages.

- On the day of the test, no nicotine or coffee (caffeine) was permitted.[44]
- Demographic data of the subjects were taken using Data Record Sheet.
- Stress was assessed using Perceived Stress Scale in their preferred language using interview based method and the scores of the subjects were measured.
- After taking normal breaths for a minute, the lung function was assessed using a Spirometer (Spirobank II) in which participants were asked to inspire as deeply and fully as possible to fill the lungs. Then keeping the nostrils closed by nose clip, the mouth piece of the transducer was held firmly between the lips. Then they were asked to expel forcefully with maximum effort through the mouth piece of the transducer.
- The computer graphically displayed the results.
- The procedure was done 3 times for each patient and the best one was taken as the result.

Figure 2: PFT testing

STATISTICAL ANALYSIS

Data of 72 samples were collected and recorded in the Excel 2016 spreadsheet and was analyzed using GraphPad Prism 9. Qualitative variables were expressed as absolute number and percentage. Quantitative variables were expressed as mean and standard deviation. Shapiro-Wilk test was used to analyze the normality of the data. Since the data has not passed the normality test, Spearman's correlation test was used for calculating the correlation.

DESCRIPTIVE STATISTICS

Table 1: Descriptive statistics for age distribution

Age (years)	Study Group
Minimum	30
Maximum	50
Median	44.5
Mean	43
Standard Deviation	±6.59

Graph 1: Pie chart representing frequency distribution of gender

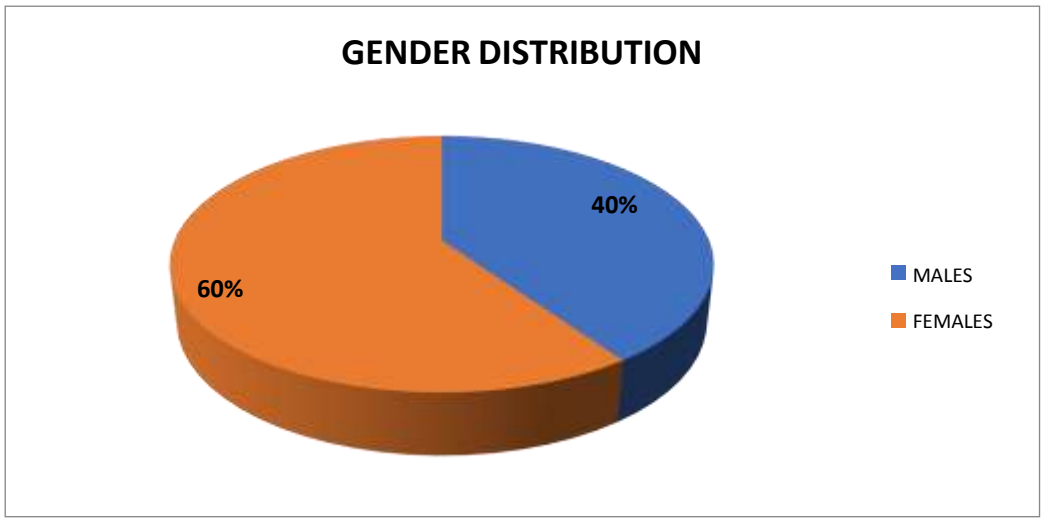


Table 3: Descriptive statistics

	Mean	Median	Standard Deviation
Height(cm)	162.2	163	±7.7
Weight(kg)	63	60	±10.7
BMI(kg/m2)	23.7	23	±3.4
Systolic BP	126	128	±6.6
Diastolic BP	76.6	80	±6.3

Table 4: Descriptive data of the parameters

Parameters	Mean	Median	StandardDeviation	Minimum	Maximum
PSS	20	21	±3.7	10	27
FEV1	77	78	±15.5	40	100
FVC	76	77.5	±15.8	40	100
FEV1/FVC	97	100	±3.7	50	100

INFERENTIAL STATISTICS

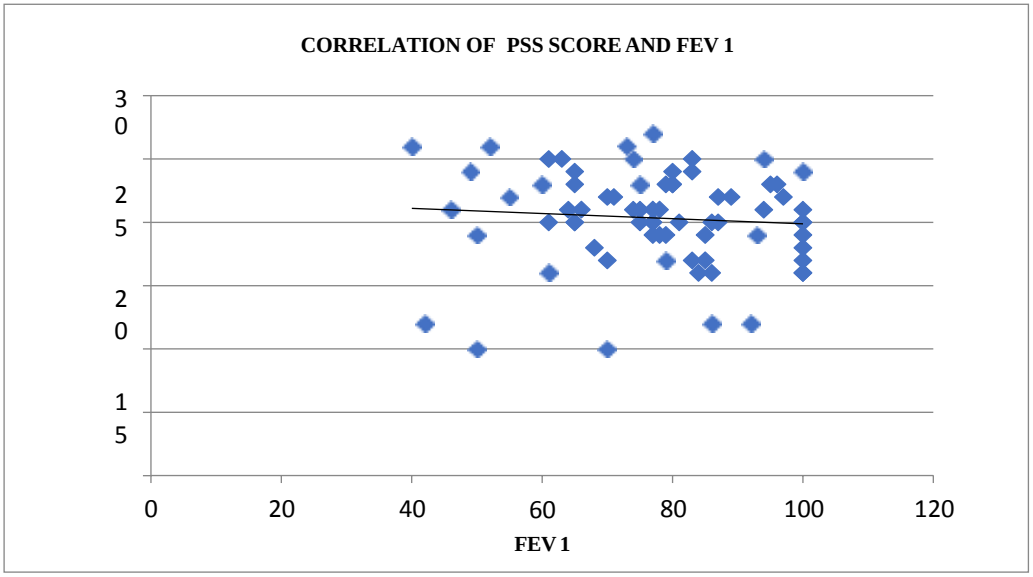
Table 5: Correlation of Perceived Stress Scale with Pulmonary Function Test

PARAMETERS (%)	CORRELATIONCOEFFICIENT (r)	p value	SIGNIFICANCE
FEV 1	-0.1868	0.1160	Not Significant
FVC	-0.2938	0.0122	Significant
FEV 1/FVC	-0.0024	0.9851	Not Significant

p <0.05= Statistically Significant, p>0.05=Not Significant

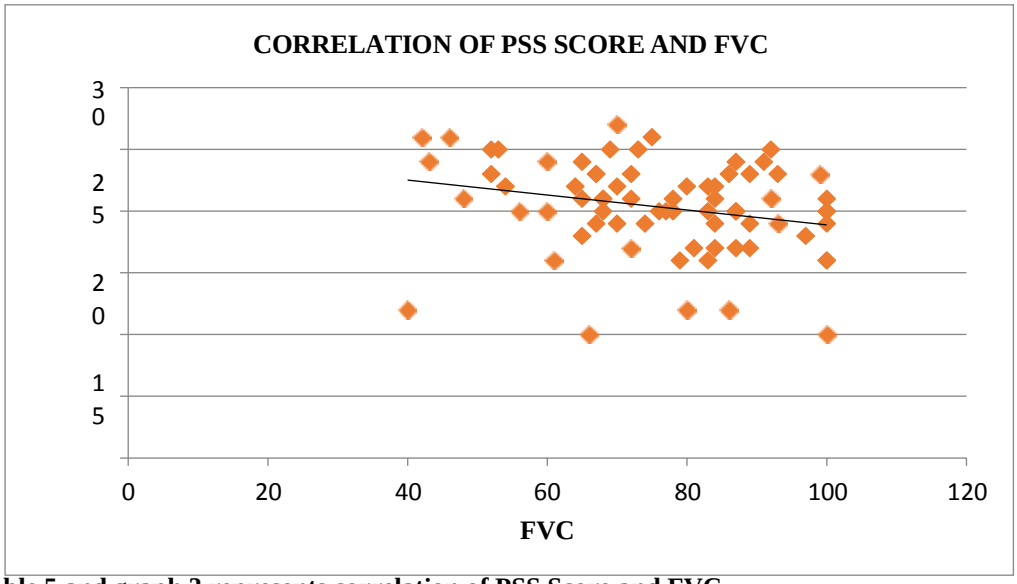
RESULTS

Graph 2: Correlation of PSS Score and FEV 1



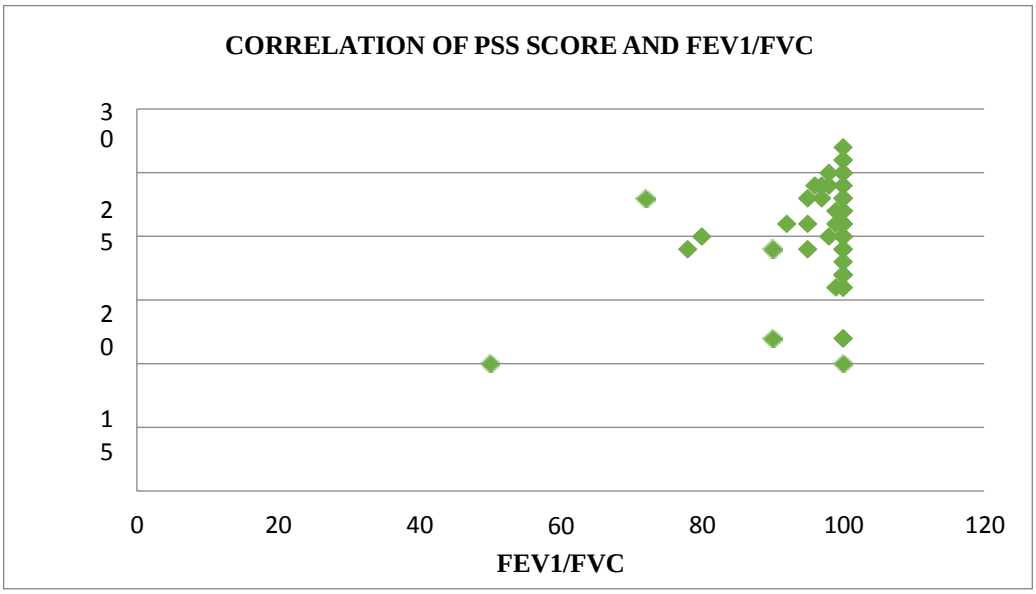
Inference: The above table 5 and graph 2 represents correlation of PSS Score and FEV 1. The graph shows a very weak negative correlation between PSS Score and FEV

Graph 3: Correlation of PSS Score and FVC



Inference: Table 5 and graph 3 represents correlation of PSS Score and FVC.
It shows a weak negative correlation between PSS Score and FVC

Graph 4: Correlation of PSS Score and FEV1/FVC



Inference: Table 5 and graph 4 represents correlation of PSS Score and FEV1/FVC.
It shows no correlation between PSS Score and FEV1/FVC

DISCUSSION

72 participants were screened and selected for the study according to the inclusion and exclusion criteria from Physiotherapy and Medicine Outpatient Department of Tertiary health care centre within the age group of 30-50.70% participants had normal BMI and 30% participants were overweight.

Inference from results:

1. There was a very weak negative correlation between Perceived Stress Scale and FEV1 which was statistically not significant.
2. There was a weak negative correlation between Perceived Stress Scale and FVC which wasstatistically significant.
3. There was no correlation between Perceived Stress Scale and FEV1/FVC which was statistically not significant.

This study included a group of hypertensive adults having controlled hypertension.

The inverse correlation between PSS and Pulmonary function might be because of the stress which contributes to shallow breathing which may compromise the body posture when shoulders are rounded, forward and tensed causing the ribcage to become small and tight, reducing the chest expansion which causes reduction in the body's capacity to take in more air leading to reduced lung volume and capacity. This study showed similar results to a study done on working women by Chaudhuri et al in 2019. The correlation was negative which means that higher the stress levels cause reduction in the lung function. The reason for this correlation indicated the importance of specific autonomic, ventilatory and immunological pathways for emotion-induced lung function changes. Thus, the study concluded that most working females perceive high levels of stress which may have adverse outcome in their pulmonary function test results. Increased perceived stress levels may adversely affect lung function in even healthy young individuals.[23] Another study was conducted by Goodwin et al to determine the association between lung function and mental health problems among adults in the United States. Data were drawn from the First National Health and Nutrition Examination Survey (1971−1975), with available information on a representative sample of US adults aged between 25–74 years. Lung function was assessed using spirometry, and provisional diagnoses of restrictive and obstructive airway disease were made based on the percentage of expected FEV1. Mental health problems were assessed with the General Well-Being scales. Restrictive lung function and obstructive lung function, compared with normal lung function, were each associated with a significantly increased likelihood of mental health problems. After adjustment for differences in demographic characteristics, obstructive lung function was found to be associated with significantly lower overall well-being and restrictive lung function was associated with significantly lower overall well-being, general health, vitality and self-control and with higher depression subscale scores compared with no lung function problems. Consistent with previous findings from clinical and community-based studies, these results extended available data by providing evidence of a link between objectively measured lung function and self-reported mental health problems.[52]

This was supported by Ritz T et al who reviewed studies from 15 years that have used experimental emotions and stress induction techniques or longitudinal diary observations to explore these influences of stress on lung function tests. Findings from the study suggested that unpleasant emotional states were associated with a decline in lung function in health and asthma. Changes were usually small on average, but usually reached clinical significance in a subset of patients.[53] Pleasant emotional states were also sometimes associated with a lung function decline, suggesting a susceptibility of the airways to arousal in general.[53]

Leiseth et al examined the independent and combined association of lung function and anxiety symptoms with the prevalence of dyspnoea in different situations. The study included 5627 women and 5066 men. Dyspnoea was calculated using FEV1 and anxiety was assessed using Hospital, Anxiety and Depression scale. The results showed that there was an inverse linear association between FEV1 and dyspnoea and a positive association between anxiety and dyspnoea which was statistically significant. The study concluded that impaired lung function and anxiety symptoms were independently associated with reporting dyspnoea.[60]

A study was conducted by P Lehrer to find the link between chronic anger and age related deterioration in pulmonary function. It states that the psychophysiology of anger overlaps with that of stress. Stress related factors are known to depress immune

function and increase susceptibility to or exacerbate a host of diseases and disorders including asthma, hypertension, upper respiratory infection, various skin diseases, chronic fatigue syndrome, irritable bowel syndrome, vasovagal syncope and more obviously, various psychiatric disorders. One connection between lung disease and anger may be through the physiological effects of chronic anger.[50]

Increased chronic anger may have particularly deleterious effects on the body because it prevents homeostatic release and may change the set points for modulatory reactions. It often reflects chronic personality maladjustment or, in some cases, chronic exposure to job or marital dissatisfaction which perpetuate anger and its physiological accompaniments.

Thus, although temporary changes in emotion or stress which occur normally in all of us may temporarily affect our adaptability and susceptibility to various diseases, chronic anger as assessed in the paper by Kubzansky et al in this issue of Thorax might be expected to produce more long lasting effects. [50] Although a healthy ability to express a wide range of emotion is generally considered to be a sign of health and good adaptation, chronic anger may lead to chronic dysregulation.[50] The paper by Kubzansky et al establishes a link between chronic anger and age related deterioration in pulmonary function.[50]

Reported psycho-physiological accompaniments of chronic anger include sympathetic arousal, an increased nor-epinephrine: epinephrine ratio and vasoconstriction, increased serum lipids and low density lipoproteins, decreased expression of the anti-inflammatory cytokine interleukin-10 in response to exposure to influenza virus and an increased expression of the pro-inflammatory tumor necrosis factor-α following lipo-polysaccharide stimulation. Thus the study concluded that interpersonal stress, anger, dysregulation and sadness produces wear and tear on the lungs thus decreasing the pulmonary function.[50]

A Systematic review and meta-analysis was conducted to find an association between psychological stress and upper respiratory infection and the study confirmed the hypothesis that psychological stress is associated with increased susceptibility to URI, lending support to an emerging appreciation of the potential importance of psychological factors in infectious disease.[49] Moreover, a previous study found a relationship between depression and lung function.[47] The mechanisms underlying the association between depression and lung function remain unclear; however, there are several possible mechanisms to consider. For example, decreased lung function may be related to symptoms such as dyspnoea, which can lead to feelings of hopelessness, reduced physical activity, social isolation, and a sedentary lifestyle. All of these factors can be associated with an increased level of depressive symptoms.[47]

This was supported by a study conducted to find the association between depressive symptoms and pulmonary function among healthy adults. It identified an inverse association of depressive symptoms and pulmonary function in healthy adults especially in men and individuals with a history of smoking.[48] Islam and his colleagues investigated lung function by spirometry in depressive disorder patients and found lung function parameters were significantly lower in depressive disorder patients in comparison to healthy subjects.[54],[55]

Recently Guo et al in the year 2020 conducted a cross-sectional study to examine the relationship between depression and lung function. The study stated that although the exact mechanism underlying the debilitating effect of depression on lung function remains unclear, it may be explained by the role played by the immune system. It is widely known that the overproduction of pro-inflammatory cytokines in the body may

cause deterioration of multiple subsequent immunological functions by elevating the levels of plasma adreno-corticotropic hormone, which is followed by an increase in cortisol levels, resulting in depression.[56] Additionally, it is known that depression could enhance the production of pro-inflammatory cytokines. Interestingly, the overproduction of pro-inflammatory cytokines also induces abnormal endothelial function, leading to impaired lung alveolar function and consequent persistent lung function decline.[56]
Thus, the results of the current study were in synchrony with the above literature.

CONCLUSION

- There was a very weak negative correlation between PSS score and FEV
- A weak negative correlation was seen between PSS score and FVC
- No correlation between PSS score and FEV1/FVC was observed
- Thus, the study concluded that increased perceived stress levels may affect the lung function in hypertensive adults.

CLINICAL IMPLICATIONS:

- Stress management techniques like:
  - Relaxation (Progressive Muscle Relaxation) can be used as it improves pulmonaryfunction by decreasing the perceived stress in hypertensive patients.[63]
  - Breathing exercises
  - Yoga and Physical activity for 30mins with moderate intensity exercises like brisk walking and cycling can be done to reduce stress[66],[67]
  - A well balanced diet, listening to music and a good sleep helps reduce stress.[68]

- As the study concluded that stress has an effect on pulmonary function in hypertensive adults, all the above mentioned stress management techniques along with breathing exercises should become a mandatory part of treatment in hypertensive patients as these exercises will help in lowering blood pressure, heart rate, improving lung function which reduces the levels of stress hormones in the blood thus increasing the feeling of calm andwellbeing.[64],[65]

SUGGESTIONS:

- Further studies can be conducted in India on healthy individuals and on hypertensivepatients.
- Hypertensive patients can be classified depending upon their grades of severity.
- Further studies with design of RCT can be done in order for higher level of evidence.
- Similar studies can be done on exercising and non-exercising hypertensive patient.

Declaration by Authors

Ethical Approval: Approved
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