CORRELATION OF BALANCE, POSTURE, FUNCTIONAL CAPACITY WITH LUNG FUNCTION AND RESPIRATORY MUSCLE STRENGTH IN CHRONIC COPD PATIENTS- A CROSS SECTIONAL STUDY.

DISSERTATION SUBMITTED TO MAHARASHTRA UNIVERSITY OF HEALTH SCIENCES, NASHIK

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FOR THE ACADEMIC BATCH

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LIST OF ABBREVIATIONS:

**COPD**: Chronic Obstructive Pulmonary Disease

**FEV1**: Forced expiratory volume in the first second

**FVC**: Forced Vital Capacity

**MIP**: Maximal Inspiratory Pressure

**MEP**: Maximal Expiratory Pressure

**CVA**: Craniovertebral Angle

**STS**: Sit to Stand

**BEST**: Balance Evaluation System Test

**GOLD**: Global Initiative for Chronic Obstructive Lung Disease

**OPD**: Outpatient Department

**WHO**: World Health Organization

**LMIC**: Low and middle income countries

**FFM**: Fat Free Mass

**6MWT**: 6 Minute Walk Test

**6MWD**: 6 Minute Walk Distance

**QMVC**: Quadriceps Muscle Voluntary Contraction
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**TOPIC:**

Correlation of Balance, Posture, Functional Capacity with lung function and Respiratory Muscle strength in chronic COPD patients: A Cross Sectional Study
INTRODUCTION

Chronic Obstructive Pulmonary Diseases (COPD) are commonly used clinical terms used for a group of pathological conditions in which there is chronic partial or complete obstruction to the airflow at any level from the trachea to the smallest airways resulting in functional disability of the lungs. The following entities are included in COPD – Chronic Bronchitis, Emphysema, Bronchial Asthma, Bronchiectasis and small airway disease. The most commonly seen are chronic bronchitis and emphysema which are commonly seen together.[1] Chronic bronchitis is defined as persistent cough with expectoration on most days for at least three months for two or more consecutive years.[1] It is more commonly seen in middle aged males and females.[2] Emphysema is a permanent dilatation of air spaces distal to the terminal bronchioles and destruction of walls of the dilated air spaces. The destruction of alveolar walls seen in emphysema is linked to the deficiency of α-1 antitrypsin.[1]

Previous evidence revealed an overall prevalence of COPD in low- and middle-income countries (LMICs) was 9.2% (1.2% to 15.4%) [3] Meta analysis found the prevalence of COPD to be 10.6% in age group above 30 years.[10] Different studies show a wide discrepancy in the prevalence of COPD ranging from 2% - 22% in males and 1.2% - 19% in females.[4] The Indian Council of Medical Research has conducted a nationwide survey on asthma and COPD which reported a prevalence of 3.49% (4.29% in males and 2.79% in females).[4] Cigarette smoking, air pollution, occupation, infection and genetic factors are the most common etiologic factors which may cause systemic inflammation and increased leukocyte count, more in COPD patients.[6] Prolonged cigarette smoking or exposure to smoke impairs ciliary movement, inhibits alveolar macrophages thus causing obstruction of small airways; it also stimulates the vagus and causes bronchoconstriction. According to estimates from studies, about 30 million people suffer from COPD in India as 70% of the homes use biomass fuel for cooking in rural
areas, hence are more prone to developing COPD, hence the prevalence is higher in rural areas than urban areas.

The patients diagnosed as COPD present with symptoms of chest tightness, tachypnoea, increased work of breathing and air hunger, experience gradual progression of dyspnoea on exertion and chronic cough (>8 weeks). The physical findings include wheezing and accessory muscle use, barrel chest and reduced diaphragmatic excursion and the patients may develop visible cyanosis. In advanced disease, patients may have inward movement of rib cage with inspiration (Hoover’s sign). The spirometer readings (FEV1, FVC and FEV1/FVC) are seen to be reduced in COPD wherein a diminished FEV1/FVC < 0.7 is diagnostic of obstruction. As per guidelines defined by GOLD criteria (2021), the airflow limitation severity in COPD, post bronchodilation is as follows:

- **GOLD 1**: Mild – FEV1 < 80% predicted
- **GOLD 2**: Moderate – 50% ≤ FEV1 ≤ 80% predicted
- **GOLD 3**: Severe – 30% ≤ FEV1 ≤ 50% predicted
- **GOLD 4**: Very Severe – FEV1 < 30 % predicted

The best recognized manifestations in COPD result in impaired functional capacity, worsening dyspnoea, reduced quality of life and increased mortality. Further, there is presence of cardiovascular symptoms, malnutrition involving mainly the loss or dysfunction of skeletal muscle mass, osteoporosis, anaemia, clinical depression and anxiety. The incidence of depression and anxiety in patients with severe COPD was seen to be 16.2 cases per 1000 persons as compared to 9.4 cases per 1000 persons in the non COPD group. The prevalence of anxiety ranges between 13% and 26% in the COPD patients with severe affection. The prevalence of depression is at 26% in COPD patients as opposed to 12% in smokers and 7% in non smokers. Associations between anxiety and depression is attributed to previous history.
of cigarette smoking and nicotine dependence.\textsuperscript{7} Hypothesis suggest that depression is caused by activation of nicotinic acetylcholine receptors or as direct inflammatory effects of smoking.\textsuperscript{8} Another possible mechanism could be the overspill of lung inflammation markers, wherein sTNFR-1 has shown strong association with depression in COPD patients. Hypoxia leads to low oxygen saturation in blood which further causes periventricular lesions in white matter which is a characteristic feature of patients with depression, also seen in severe cases of COPD. Also, due to physical impairment, COPD patients are frequently isolated and unable to engage in social activities, which causes anxiety and depression in these patients.\textsuperscript{6,8} Various therapies such as relaxation techniques, cognitive behaviour therapy and self management strategies can help to improve states of anxiety and depression in COPD patients if incorporated as part of the pulmonary rehabilitation program.\textsuperscript{8}

In addition to the above mentioned systemic effects, skeletal muscle weakness is another one of the main systemic effects of COPD accompanied by loss of fat free mass (FFM); and is most commonly seen in muscle fibre type IIA. Patients with COPD are immobile hence strength is further reduced during exacerbation and hence patients lose quadriceps strength rapidly. Systemic inflammation is an important factor involved in loss of muscle mass which is attributed to NF-κB activation in muscles of COPD patients.\textsuperscript{6} There is a high prevalence of osteoporosis even in the middle stages of COPD, wherein advanced age, poor mobility, smoking, poor nutrition and high dose of inhaled corticosteroids are the major contributing factors.\textsuperscript{6}

Along with reduced peripheral muscle strength, patients with COPD also have reduced ability to maintain stability and balance which is critical for functional independence in activities of daily living, mobility and for avoiding falls. They have many risk factors such as muscle weakness, multiple medications, polyneuropathy, etc.\textsuperscript{9} Previous research has suggested that 40% of people with COPD sustain an episode of fall at least once in a 12 month period.\textsuperscript{10}
Muscle weakness and gait and balance deficits increase risk of falling at least three to four times. Falls have multiple precipitating factors such as decreased strength, poor movement coordination, decline in balance, gait and postural instability.\textsuperscript{[11]} It is observed that bronchitic COPD patients have more balance impairment as compared to emphysematous group which correlates with the body composition and fat free mass of the lower limbs.\textsuperscript{[11]}

The Berg Balance scale is the most widely used instrument to measure balance, but it has a limitation that it does not include an assessment of reactive balance or cognitive influences on balance.\textsuperscript{[11]} The Mini BESTest is a recently developed tool that evaluates more aspects of balance and cognitive influences.\textsuperscript{[11]} The Brief Balance Evaluation Systems Test (BRIEF BESTest) is a short version of BESTest that has been validated in elderly people which takes about 10 minutes to complete and can be administered in routine assessment. Studies have shown that the BRIEF BESTest has good inter-rater (0.86) and intra-rater (0.97) reliability in COPD patients and it is quick and safe to perform in clinical practice.\textsuperscript{[10]}

Along with balance impairment, COPD patients also show postural abnormalities. Studies have shown that secondary postural changes of the chest wall may occur in response to lung hyperinflation and increased work of breathing, thus limiting the effectiveness of the rib cage mobility.\textsuperscript{[12]} With increased respiratory muscle workload, which is characteristic of obstructive respiratory diseases, muscle hypertonicity with shortened chest wall and upper limb muscles has been reported which may result in reduced flexibility, the development of soft tissue contractures, and muscle imbalance, which have been linked to postural abnormalities in individuals with asthma and COPD. Patients with COPD presented with significant differences in head and shoulder mobility as compared to normal individuals.\textsuperscript{[13]} As the trunk muscles serve both postural and respiratory function, a worsening lung function will impose more demands on postural support.\textsuperscript{[13]} According to the pathophysiology of COPD, the lung hyperinflation causes changes in the length tension relationship and the ribs are oriented more
horizontally than obliquely, which may lead to excessive shoulder protraction and scapular elevation. It also causes reduced thoracic and lumbar flexibility, thus leading to increased thoracic kyphosis, increased cervical lordosis in these patients.\textsuperscript{[13]} In COPD, photogrammetric measures have been used to assess the cervical lordosis, thoracic curvature and shoulder protraction.\textsuperscript{[13]} Photogrammetry provides a measure of posture using photographic images. Digital photographs of the subjects are taken in frontal or sagittal plane with a camera that is mounted on a levelled tripod stand, positioned at a specific distance from the subject. The photographs obtained are transferred to a computer system. Angles are then drawn between the markers by drawing horizontal and/or vertical lines to calculate postural angles.\textsuperscript{[13]} Photogrammetry provides a comprehensive measure of the spinal curvatures and angles along with the scapular and pelvic positions.\textsuperscript{[13]} The most commonly used bony landmarks for photogrammetric measures are the C7 spinous process, the T12 vertebra and the lateral part of acromion process.\textsuperscript{[12]} The head alignment is measured using the acute angle formed by the lines passing the C7 and the tragus of the ear; the smaller the angle, the more forward is the head. This measure has shown good reproducibility with the ICC values ranging between 0.39 to 0.87.\textsuperscript{[12]} The measurement of thoracic kyphosis using photogrammetry also shows significant correlations with the radiographic measurements and has been found to be a reliable measure used in COPD patients.\textsuperscript{[12]} Hence, objective postural assessments are necessary in patients of COPD in order to incorporate postural correction as part of rehabilitation.

Another important feature of COPD is the reduced functional capacity which may be due to a variety of causes. Functional capacity is related to the ability to perform physical functions associated with ability to perform aerobic work (use of cellular oxygen) and is practically seen as exercise capacity. It is usually measured with the help of submaximal exercise tests like 6 minute walk tests or maximal tests like shuttle walk test.\textsuperscript{[6]} The capacity to perform exercise depends on the ability of the respiratory and cardiovascular system to deliver oxygen to the
working muscles. In COPD patients, as there is compromise of respiratory function, reduced functional capacity is an impairment in these patients. Exercise intolerance results from multiple factors such as dynamic hyperinflation, increased respiratory load, poor gas exchange, skeletal muscle dysfunction, age-related frailty, physical de-conditioning, mood disturbance, lack of motivation and comorbidity burden and as COPD progresses, patients become dyspnoeic and are unable to continue exercise at lower levels. During exercise of even moderate intensity, patients develop relatively high intrathoracic pressures due to impedance to increased ventilatory demand caused due to dynamic hyperinflation of the lungs. Functional limitations in COPD patients frequently restrict their performance of daily activities like stair climbing, walking and transportation which has been attributed to pulmonary and extra pulmonary causes.

The ability to rise and sit down on a chair, usually called as sit-to-stand activity (STS) is an essential activity in daily life which enables other activities like standing and walking and thus gives a sense of independence to the patients. Hence, Sit-to-stand has been accepted as an indicator of functional status in COPD patients. Studies have shown that individuals with COPD are not able to achieve the same number of sit-to-stand repetitions within one minute as compared to healthy individuals. Sit-to-stand performance is influenced by factors associated with balance, mobility and lower limb strength as well as multiple physiological and psychological processes, however lower limb strength is a meaningful factor which could limit the sit to stand activity. There are further advantages to the STS test over the 6MWT such as it requires little space, simple equipment (chair and a stopwatch), and is feasible in all settings, including the home, busy clinic setting or the acute hospital bedside. It also results in less haemodynamic instability and desaturation in patients after the test. In a study done by Sarah Crook, et al., the responses to 1 min STS and 6MWT was compared and it was seen that it elicited similar physiological responses. Their study concluded that 1 min STS is a
promising alternative and is as reliable as the traditional exercise tests like 6MWT in COPD patients.\textsuperscript{[17]} Hence sit-to-stand test can be used as a safe alternative to 6 minute walk test in COPD patients.
NEED OF THE STUDY

The management of chronic COPD in current times focuses more on improving the respiratory function of the lungs through improvement in breathing patterns. Affection of posture in chronic COPD patients also impairs the lung function. A chronic habitual slouched posture is seen in COPD patients which further impairs the lung function. The other component that is balance seems to be focused on less than the respiratory component in the pulmonary rehabilitation of COPD patients. Peripheral muscle strength is also reduced which can be a contributing factor for impaired balance in chronic COPD. The functional capacity of the people suffering from chronic COPD also tends to be reduced due to altered posture and lung function. The findings of this study can be used to correlate posture, balance and functional capacity with the lung function and respiratory muscle strength in chronic COPD patients and have recommendations of the same in the pulmonary rehabilitation program of COPD.
AIMS AND OBJECTIVES

AIM OF THE STUDY: To find an association between balance, posture and functional capacity with lung function and respiratory muscle strength in chronic COPD patients.

OBJECTIVES OF THE STUDY:

1. To study the relation between balance and lung function and respiratory muscle strength in chronic COPD patients.
2. To study the relation between posture and lung function and respiratory muscle strength in chronic COPD patients.
3. To study the relation between functional capacity and lung function and respiratory muscle strength in chronic COPD patients.
HYPOTHESIS

NULL HYPOTHESIS ($H_0$): There is no correlation of balance, posture, functional capacity with lung function and respiratory muscle strength in chronic COPD patients.

ALTERNATE HYPOTHESIS ($H_1$): There is a correlation of balance, posture, functional capacity with lung function and respiratory muscle strength in chronic COPD patients.
REVIEW OF LITERATURE


The aim of the study was to correlate static and dynamic balance in patients with acute exacerbation of COPD with that of healthy age matched controls. The participants were divided into 3 groups and the balance tests such as Berg Balance scale, Single leg Stance time and Timed Up And Go test were performed. Respiratory function was assessed using spirometric measures and functional capacity was assessed using 6 MWT. The results found that people with COPD have a worse balance score than healthy controls which resulted in increased risk of falls. Further anxiety and depression also added to the risk of balance impairment in COPD patients. The study concluded that the presence of COPD was associated with increased risk of falls.


The aim of the study was to assess balance, physical activity and lower extremity muscle strength in 37 patients with COPD and 20 age matched healthy control participants using the BESTest, the Physical Activity scale for the elderly and an isokinetic dynamometer respectively. A subset of participants underwent a second testing session in which postural perturbations were delivered using a lean0and0release system. They concluded that individuals
with COPD exhibit impairments in all balance subcomponents and exhibit slower reaction time. Deficits in balance are associated with physical activity levels and skeletal muscle weakness.


The aim of this study was to assess mobility of the head, thoracic spine and shoulder using digital photographs in 15 patients with COPD and 15 age matched controls after pulmonary function was assessed with spirometry. A cross sectional exploratory study was conducted. The study was reported following the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines. Two groups one of patients with COPD and a control group including healthy adults were included in the study. Pulmonary function (FEV1,FVC) were assessed using potable spirometer, COPD grades were determined according to the GOLD standard. Alignment and mobility of the head, thoracic spine and shoulders were assessed using digital photographs. The findings suggested that impaired pulmonary function is associated with impaired posture in COPD patients.


The aim of the study was to compare the score of the sit to stand test with a minimum of 5 repetitions between 2 groups- 18 individuals with COPD and 18 age matched controls. Center
of pressure displacement was determined while performing sit to stand activity and the time taken for 5 repetitions was recorded and compared with healthy individuals. They were asked to perform 5 consecutive STS movements with vision occluded. The results concluded that individuals with COPD needed significantly more time to perform 5 repetitions of STS as compared to healthy individuals. In conclusion, individuals with COPD needed significantly more time to perform the test that require postural control compared to healthy controls.


The aim of this study was to assess the posture of chronic COPD patients in upright standing position using digital photographs and 3D motion analysis to measure spinal orientation, thoracic kyphosis and scapula orientation. This study aimed to compare the postural characteristics of people with COPD to those of control subjects and explore the relationship between posture deviations and reports of pain in COPD. Photogrammetry using digital photographs and 3-D motion analysis were used to generate the coordinates of skeletal structures from anatomical landmarks identified with reflective markers. The postural measures were spinal orientation, Tx kyphosis and scapula orientation. 21 subjects with COPD and 21 age matched controls were assessed for postural deviations. It was concluded that postural deviations are evident in COPD compared to those without lung disease and there was no association of postural deviations to pain.

The aim of this study was to investigate the inter-rater and intra-rater reliability of the Brief Balance Evaluation System Test (Brief-BESTest) in people with chronic obstructive pulmonary disease and its correlation between the Brief-BESTest score and lung function, functional exercise capacity, functional lower limb strength, and fear of falling. Participants performed three Brief-BESTests on two separate days, assessed by two independent physiotherapists. Participants also performed a lung function test, two 6-minute walk tests, the five sit-to-stand test and completed the Fall Efficacy Scale International questionnaire. The BRIEF BESTest score was moderately correlated with the 6 minute walk distance and the 5 SIT TO STAND test. In conclusion the BRIEF BESTest was found to have good inter-rater and intra-rater reliability in COPD patients.


The aim of this study was to correlate the number of repetitions of sit to stand test in one minute with the muscle strength of quadriceps in chronic COPD patients. The authors performed a comprehensive evaluation of the minimal clinical meaningful difference of the 1-min STS test. In this study the relationship between STS and QMVC confirms that muscle strength is an important determinant of 1-min STS performance. This test also integrates postural control, coordination and balance, making it particularly suitable for COPD patients, as observed for elderly people in terms of risk of fall. It was concluded that muscle strength is an important component of 1 min sit to stand test and is suitable for use in COPD patients.

The aim of this study was to compare the thoracic posture between two phenotypes of COPD (Emphysema and Chronic bronchitis). 40 individuals- 20 with Emphysema and 20 with Chronic Bronchitis and 20 age matched controls underwent postural assessment using photogrammetric measurements of head protraction, shoulder protraction, thoracic kyphosis and scapular elevation. Significant differences were found amongst the groups in protraction of head (emphysema vs. chronic bronchitis) It was concluded that people with emphysema showed greater degree of postural deviation than those with chronic bronchitis and age matched controls. These observations emphasize the importance of postural assessment in individuals with chronic obstructive pulmonary disease, particularly if they are emphysematous.


The primary aim of the study was to compare the pain sensitivity, postural abnormalities and functional balance in patients with COPD vs healthy controls. The secondary aim was to evaluate differences in these parameters between 2 different lung disease. 29 individuals with COPD and 31 healthy controls were assessed for pain sensitivity with an algometer, postural abnormalities and functional balance using TUG. Significantly more patients reported pain compared to the healthy controls. The pressure pain thresholds of the trapezius and deltoid muscles and pain tolerance of the pectoralis major muscle were significantly lower in patients
compared to healthy subjects. The study showed that the pain perception, severity and sensitivity are increased in COPD compared to the age matched controls.


The objective was to determine specific proprioceptive control strategy during postural balance in individuals with COPD and healthy controls and to assess whether it was related to inspiratory muscle weakness. Centre of pressure displacement was determined in 20 individuals with COPD and 20 age matched controls during upright stance on an unstable surface without vision. It was concluded that individuals with COPD with inspiratory muscle weakness, increased their reliance on ankle muscle proprioceptive signals and decreased their reliance on back proprioceptive signals resulting in decreased postural stability as compared to healthy controls.

11. De Castro LA., et al. Static and Functional Balance in individuals with COPD: Comparison with Healthy controls and differences according to sex and severity, Respir Care, 2016.[25]

The aim of this work was to compare static and dynamic balance between participants with COPD and healthy controls and to check possible differences according to sex and disease severity. 47 participants with COPD and 25 healthy controls were assessed for static balance using one legged stance test using force platform and functional balance using timed up and go test. In addition, spirometry, 6 minute walk test and isometric quadriceps contraction was
performed. In conclusion, individuals with COPD had worse static and dynamic balance in comparison with healthy controls.


This study aimed to find whether there are differences between the sexes in the relationship between fatigue and variables of physical capacity and disease severity. In this study 121 patients with COPD (54 men and 67 women), the experience of fatigue (frequency, duration, and severity) and physical capacity (lung function, 6-minute walk distance [6MWD], grip strength, and timed-stand test) were assessed. Disease severity was graded according to the Body mass index, airway Obstruction, Dyspnoea and Exercise capacity (BODE) index. The men with fatigue had worse physical capacity and more severe disease than did the men without fatigue: for men with and without fatigue, respectively, the percent of predicted forced expiratory volume in 1 second (FEV1). In women, only higher leg fatigue post-6MWD was seen among those experiencing fatigue compared with women without fatigue. In conclusion, exercise capacity and disease severity were associated with fatigue in both men and women.

This study aimed to systematically review the literature of the skeletal structural alignment in children and adults with an obstructive respiratory disease, describe the measurement techniques used, and determine the clinical relevance of any alterations. Observational cohort or cross sectional studies were identified, with 2 reviewers independently assessing study quality. A total of 18 studies were included, 122 in cystic fibrosis, 5 in asthma and 1 in COPD. Increased thoracic kyphosis was found in children and adults of Cystic fibrosis. Increased shoulder protraction and elevation were seen in asthma and COPD, spinal changes were variable. It was concluded that structural malalignment appears to be present in some individuals with COPD. Photogrammetry is useful to assess posture in these populations.

14. Reychler G. et al. One minute sit to stand test is an alternative to 6 MWT to measure functional exercise performance in COPD patients, Clin Respir J, 2018.[28]

The aim of this study was to compare functional exercise performance evaluation by sit to stand test and 6 MWT and to evaluate reliability and repeatability of the STST in COPD patients. 42 patients performed the STST and 6MWT randomly and each test was repeated two times. The distance and number of repetitions were measured. Cardiorespiratory parameters, dyspnea and lower limb fatigue (Borg) were recorded before and after the tests. The results showed a good correlation between sit to stand and the 6 MWD. In conclusion, the one minute sit to stand test is a valuable alternative to 6MWT to estimate functional exercise performance in COPD patients.

This study aimed to determine the reliability, validity and agreement for non-radiological measures of thoracic kyphosis in COPD. A total of 19 participants with COPD were included. Cobb’s angle from chest radiographs and spinous process landmarks using photogrammetry and 3 dimensional motion capture were evaluated. Radiographic Cobb angle and photogrammetry measurements demonstrated excellent intra- and inter-rater reliability. Correlation between non-radiological kyphosis measurements and chest radiographs was strong It was concluded that non radiological measures of thoracic kyphosis are reliable and valid in COPD.


In this study, the relationship between the abdominal muscle thickness between the affected and unaffected side was assessed in stroke survivors. In addition to it, the relationship between the respiratory muscle strength and trunk functional balance was also evaluated. 33 stroke patients (18 men and 15 women) were assessed for abdominal muscle thickness using ultrasonography and the respiratory muscle strength was assessed using MIP and peak flow rate. It was shown that higher respiratory muscle function was significantly correlated with higher level of trunk function and balance in stroke patients. Hence, respiratory muscle training should be incorporated as a part of rehabilitation in order to improve trunk balance in chronic stroke patients.
MATERIALS AND METHODOLOGY

Type of Study: Cross-sectional study.

Study Setting: Respiratory OPD of a Tertiary Health Care Centre.

Study Population: Chronic COPD patients attending the respiratory OPD.

Sampling Method: Convenience Sampling.

Sample Size: 38

Calculated using G Power Software version 3.1.9.2

Sample Size Calculation:

- **SAMPLE SIZE: 38**

- **Calculated using GPower 3.1.9.2**

  Considering the **power = 0.80, alpha error = 0.2** the sample size is derived at 38.

- **Exact**: Correlation: Bivariate Normal Model

- **Options**: Exact Distribution

- **Analysis**: A priori: Computer required Sample size

- **Input Parameters**:

  - **Tails**: Two

  - **Correlation (H₁)**: 0.34 (FEV1 vs Balance)[9]

  - **Err Prob**: 0.2

  - **Power**: 0.80
• **Correlation (H₀):** 0

• **Output Parameters:**
  - **Lower Critical r:** -0.2126110
  - **Upper Critical r:** 0.2126110
  - **Total Sample Size:** 38
  - **Actual Power:** 0.8030283

• **After considering the 80% confidence interval with 20% error problem, the sample size derived is 38 using G Power software.**
**Inclusion Criteria:**

- Patients in the age group of 40-60 years.
- Patients diagnosed with COPD (GOLD FEV1<0.7)
- Patients attending the respiratory OPD of physiotherapy department.
- Patients willing to participate in the study.

**Exclusion Criteria:**

- Patients with recent episode of acute exacerbation (<4 weeks) or hospital admission for the same.
- Patients suffering from congestive heart failure.
- Patients using external ventilator support through mechanical ventilator or BiPAP mask or on oxygen therapy.
- Patients with history of any neurological deficit that could impair the balance.
- Patients with recent hospitalization (4 weeks) for general medical, surgical or orthopaedic conditions.
- Patients unwilling to participate in the study.

**Withdrawal Criteria:**

- If the patient wants to withdraw from the study at any point he will be allowed to.
Operational Definition:

- **Chronic Obstructive Pulmonary Disease**: Chronic Obstructive Pulmonary Disease (COPD) is a lung disease characterized by chronic obstruction of lung airflow that interferes with normal breathing and is not fully reversible which comprises of chronic bronchitis and emphysema. – WHO.\(^{[29]}\)

- **FEV1**: FEV1 is the maximal volume of air exhaled in the first second of a forced expiration from a position of full inspiration, expressed in litres.\(^{[30]}\)

- **FVC**: FVC is the maximal volume of air exhaled with maximally forced effort from a maximal inspiration, i.e. vital capacity performed with a maximally forced expiratory effort, expressed in litres at body temperature and ambient pressure saturated with water vapor.\(^{[30]}\)

- **MAXIMAL INSPIRATORY PRESSURE (MIP), MAXIMAL EXPIRATORY PRESSURE (MEP)**: Maximal Inspiratory Pressure and Maximal Expiratory Pressure are global measures of maximal strength of respiratory muscles and they are respectively the greater pressure which may be generated during maximal inspiration and expiration against an occluded airway.\(^{[30]}\)

- **POSTURE**: Posture is the orientation, or alignment, of the human body, and can be either static or dynamic.\(^{[31]}\)

- **BALANCE**: Balance is the process by which upright posture is maintained.\(^{[31]}\)
**Materials Used:**

1. Pony FX Portable PFT measuring device.
2. Cell phone camera fixed on a tripod stand.
3. KINOVEA software.
4. Markers to be placed on the participant’s body to assess posture.
5. BRIEF BESTest.
6. Measuring tape
7. Chair of height 17 inches without armrest.
8. Pocket watch

**OUTCOME MEASURES:**

1. **LUNG FUNCTION:**

   Pulmonary function tests were performed using a Pony FX Portable PFT Device. It included pulmonary tests (FEV1, FVC and FEV1/FVC) which were performed according to the spirometer manual guidelines given by the American Thoracic Society. Disinfection of the spirometer device as well as the parts of the device were done as per guidelines issued by COSMED. Separate mouthpieces were used for each participant and were disposed off after use.

   **MEASUREMENT OF FEV1 AND FVC:**

   **PROCEDURE:** Participants assumed the correct posture with head slightly elevated. Nose clip was attached, mouthpiece was placed in mouth and lips were closed around the mouthpiece. The participant were instructed to inhale rapidly and completely from functional
residual capacity (FRC) with a pause of 1s at Total Lung Capacity (TLC) and Exhale maximally till no more air could be expelled while maintaining an upright posture. A total of three manoeuvres were repeated. [32]

**RESULTS:** FEV1, FVC and FEV1/FVC were documented accordingly.

2. **MEASUREMENT OF RESPIRATORY MUSCLE STRENGTH:**

After a short demonstration of the procedure, the participants were asked to perform 5 maximal inspiratory and expiratory efforts with an at-least 30s interval between the trials. During the measurement of maximal mouth pressures the participants were asked to close firmly their mouth around the flanged mouthpiece. A nose clip was fitted to avoid any air leak.

3. **Assessment of Respiratory Muscle Strength:**

- MIP (Maximal inspiratory pressure) denotes inspiratory muscle strength and MEP (Maximal expiratory pressure) denotes expiratory muscle strength.
- Respiratory muscle strength was assessed using the Pony FX Portable PFT Device and MIP and MEP were assessed.

-MEASUREMENT OF MIP:

The MIP was recorded after asking the participants to expire as much as possible and then to inhale maximally against the resistance for at-least 1s. A total of three manoeuvres were repeated. The participants were verbally encouraged throughout the procedure for maximal performance.[32]

**RESULTS:** The best of the inspiratory efforts was recorded as the MIP.
- **MEASUREMENT OF MEP:**

The MEP was assessed after asking the participants to inhale as much as possible and then to exhale maximally against the resistance for at-least 1s. A total of three manoeuvres were taken and the best out of the three readings was recorded.

**RESULTS:** The best of the expiratory efforts was recorded as the MEP.

**3. BALANCE**

The balance of the participants was assessed using the BRIEF BESTest.

**DESCRIPTION OF THE SCALE:**

- The BRIEF BESTest is a clinical balance assessment tool designed to assess 6 different aspects contributing to postural control in standing and walking.
- Each item is scored from 0-3 points (0 representing severe impairment and 3 representing no balance impairment).
- The total score of the test is 24 points. (2 items include R/L component)

**EQUIPMENT REQUIRED:**

1. Medium density 4- inch foam pad
2. Stop watch
3. Meter stick
4. Space to complete TUG
5. Stable chair with armrest
Six categories are included in the test:

1. **BIOMECHANICAL CONSTRAINTS:**

   **Hip Strength:**

   **Patient Instructions:** “Participants were instructed to rest fingertips in the therapist’s hands while they lift their leg to the side and hold, keep trunk vertical. They were asked to hold for 10 seconds.”

   Count for 10s, watch for straight knee, if they use moderate force on your hands score as ‘without keeping trunk vertical.’

<table>
<thead>
<tr>
<th>Score</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Normal (10s with trunk vertical) bilateral</td>
</tr>
<tr>
<td>2</td>
<td>Mild (10s without trunk vertical) bilateral</td>
</tr>
<tr>
<td>1</td>
<td>Moderate (1 hip abducts with trunk vertical)</td>
</tr>
<tr>
<td>0</td>
<td>Severe (neither hip, 10s and vertical or not vertical)- cannot abduct either hip 10s, with or without trunk vertical.</td>
</tr>
</tbody>
</table>

2. **STABILITY LIMITS/ VERTICALITY:**

   **Functional Reach forward:**

   **Patient Instructions:** “Participants were asked to stand normally, lift both arms straight in front, reach as far forward as they can with arms parallel to the ruler without lifting their heels.”
Two attempts were taken. The examiner observed that the participant does not lift heels, rotate the trunk or protract the scapula. Vertical alignment should be seen. The best reach was recorded.

<table>
<thead>
<tr>
<th>Score</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>&gt;32 cm (12.5)</td>
</tr>
<tr>
<td>2</td>
<td>16.5-32 cm (6.5-12.5 in)</td>
</tr>
<tr>
<td>1</td>
<td>&lt;16.5 cm (6.5 in)</td>
</tr>
<tr>
<td>0</td>
<td>No measurable lean or must be caught.</td>
</tr>
</tbody>
</table>

3. TRANSITIONS- ANTICIPATORY POSTURAL RESPONSES:

Stand on one limb: left and right each scored

Patient Instructions: “Participants were asked to look ahead; hands on hips; bend one leg behind them; stand on one leg for as long as they can for up to 30s. Do not let your lifted leg touch the other leg.”

Two attempts were taken and the best attempt was recorded. Time was recorded up to 30s. Timer was stopped if the hand were off hips, leg touches the floor or the lifted leg touches the supported leg.
### Score Interpretation

<table>
<thead>
<tr>
<th>Score</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Normal (stable &gt;20s)</td>
</tr>
<tr>
<td>2</td>
<td>Trunk motion OR 10-20s</td>
</tr>
<tr>
<td>1</td>
<td>Stand 2-10s</td>
</tr>
<tr>
<td>0</td>
<td>Unable</td>
</tr>
</tbody>
</table>

#### 4. REACTIVE POSTURAL RESPONSES:

**Compensatory stepping- lateral: right and left scored**

**Patient Instructions:** “Participants were asked to stand with feet nearby together, lean into therapist’s hands and do whatever necessary to maintain balance, trying to take one step.”

The strategy to maintain balance was seen, with due precautions taken to prevent fall. The score was recorded as per the number of steps required by the participant to balance oneself.

<table>
<thead>
<tr>
<th>Score</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Recovers with one side/ crossover step</td>
</tr>
<tr>
<td>2</td>
<td>Several steps to recover independently</td>
</tr>
<tr>
<td>1</td>
<td>Steps but needs assistance to prevent fall</td>
</tr>
<tr>
<td>0</td>
<td>No steps OR falls</td>
</tr>
</tbody>
</table>
5. SENSORY ORIENTATION:

Stance on foam with eyes closed, on foam surface:

Patient Instructions: “Participants were asked to stand on foam with their eyes closed, their hands on their hips, and their feet close but not touching and looking straight ahead. They were asked to stay as stable as possible and try to keep their eyes closed for the entire time. The goal was 30s.”

<table>
<thead>
<tr>
<th>Score</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>30s stable</td>
</tr>
<tr>
<td>2</td>
<td>30s unstable</td>
</tr>
<tr>
<td>1</td>
<td>&lt;30s</td>
</tr>
<tr>
<td>0</td>
<td>Unable</td>
</tr>
</tbody>
</table>

6. STABILITY IN GAIT: TIMED “UP AND GO” TEST.

Patient Instructions: “Participants were asked to stand up and walk quickly but safely to the mark 3 metres away, turn, and walk back and sit in chair.”

The participant was asked to sit on a chair of adequate height with armrest and a tape marking was done at a distance of 3 meters. The time taken for the patient to rise from the chair walk, turn and sit back on the chair was recorded. 2 attempts were taken and the best out of the 2 trials was recorded.
<table>
<thead>
<tr>
<th>Score</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Fast &lt; 11s, good balance</td>
</tr>
<tr>
<td>2</td>
<td>Slow &gt; 11s, good balance</td>
</tr>
<tr>
<td>1</td>
<td>Fast &lt; 11s, imbalance</td>
</tr>
<tr>
<td>0</td>
<td>Slow &gt; 1s, imbalance</td>
</tr>
</tbody>
</table>

4. POSTURE:

Posture analysis was done by using various postural angle measurements using the KINOVEA setup 0.8.15 version of software

i. **Craniovertebral angle.**

ii. **Shoulder angle**

iii. **Kyphotic Angle**

The participants were aligned perpendicular to the camera, in front of a white wall in standing position to ensure contrast. Camera was placed 3 metres away from the participant on the tripod stand. The height of the stand was adjusted so that the middle of the lens was 130 cm above the ground. The participants were asked to march on the spot for 5 times before each picture is taken to ensure participant’s normal head on shoulders alignment. Markers were placed at the C7 spinous process, the tragus of the ear on the right side and the lateral part of the acromion process. An image of the participant was clicked from the lateral view using the phone camera. The craniovertebral angle was measured by the line joining the C7 spinous process and the tragus of the ear with the line passing through the spinous process of C7 vertebra which is parallel to the ground. The shoulder angle was measured by the line joining the spinous process...
of the C7 vertebra and midpoint of the humerus with the horizontal line passing through the midpoint of humerus and passing through the ground.[33]

iii. Kyphotic angle measured using KINEVEA:

The participants were aligned perpendicular to the camera, in front of a white wall to ensure contrast. A lateral view image was taken with the camera placed 3 meters away from the participant on a tripod stand. Markers were placed on the C7 and T12 vertebrae and a perpendicular line was drawn through each point. The point where these lines intersect will form an angle, this angle was measured anteriorly to the patient’s body.[33]

5. ASSESSMENT OF FUNCTIONAL CAPACITY:

The functional capacity was assessed using a 30 chair rise test.

30 second sit to stand test:

The participants were explained about the procedure of the test. A detailed history of the physical activity was taken prior to the test. The patient was asked to stand up from a chair of 17 inches height without arm support with hand crossed across the chest. The participant was asked to rise from the chair and sit back down completely as many times as possible in a span of 30s. The number of repetitions performed by the participants in 30s was recorded. 2 attempts were taken and the best out of the two trials was recorded.
STUDY PROCEDURE:

The research was carried out after the approval of the ethics committee. Participants were recruited according to the inclusion and exclusion criteria. The participants were informed about the procedure and a written informed consent was taken. Demographic data (age, gender, occupation, duration of working). A detailed history of the co-morbidities and addictions and physical activity details were taken. The participants were assessed for the lung function (FEV1, FVC) and respiratory muscle strength (MIP, MEP) using the Pony FX potable spirometer device. A disinfection procedure was carried out for the Spirometer Device as per guidelines issued by COSMED for the Covid19 Pandemic.

- DISINFECTION AND CLEANING OF SPIROMETER DEVICE

- Single use components – mouthpiece disposed immediately after use.
- Cleaning and disinfection:
  - Detergent – Cidezyme solution
  - Disinfectant – Cidex OPA solution.
- Reprocessing methods for Pony FX:
  i. Pony FX device surface:
   - Low level disinfection immediately after use.
   - The surface was wiped with moist sponge or towel before use.
   - The surface was wiped with soft cloth with oxyvir solution and the cloth was disposed.
  ii. Adapter / Connector:
   - Low level disinfection immediately after use.
   - The connector was wipe with moist sponge or towel.
   - The surface was wiped with moist cloth and oxyvir solution and air dried.
iii. Turbine:
- High Level Disinfection daily with use of antibacterial filter.
- Before treatment, the turbine was rinsed in water at 22-40°C.
- After use, the turbine was soaked in Cidezyme solution at room temperature for 3 mins.
- The turbine was further rinsed for 5 mins in water.
- Further the turbine was soaked in Cidezyme OPA solution for 12 mins at room temperature.
- It was dried immediately by dabbing with dry cloth.

Posture was assessed by measuring the craniovertebral angle, shoulder angle and kyphotic angle using the Kinovea software, Balance was assessed using the BRIEF BESTest and functional capacity was assessed using the 30 second chair rise test.
Participant performing BRIEF BESTest
Craniovertebral angle, Shoulder angle and Kyphotic Angle measurements using Kinovea software.

Participant performing 30 second chair rise test
DATA ANALYSIS AND RESULTS

Statistical method

- Statistical analysis was done using the SPSS software version 24.
- Median and interquartile ranges and Confidence Interval (95%) for the continuous data i.e. age, duration of illness, lung function, respiratory muscle strength, balance, craniovertebral angle, shoulder angle, kyphotic angle, functional capacity were calculated.
- Frequency and Percentage for categorical data i.e., gender, occupation, grade of COPD, addictions, comorbidities, type of physical activity, duration of physical activity were calculated.
- Normality testing was done using the Shapiro Wilke test.
- Pearson correlation analysis was done for the data that were distributed normally and Spearman’s Ranked correlation analysis was done for the data that were not distributed normally.
- Results of the analyses were expressed as Spearman’s correlation coefficients $r$ and $p$ values.
- The spearman’s correlation coefficient was interpreted as:

<table>
<thead>
<tr>
<th>Correlation Coefficient</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No</td>
</tr>
<tr>
<td>± 0.1</td>
<td>Negligible</td>
</tr>
<tr>
<td>± 0.2</td>
<td>Weak</td>
</tr>
<tr>
<td>± 0.3</td>
<td>Moderate</td>
</tr>
<tr>
<td>± 0.4 to ± 0.6</td>
<td>Strong</td>
</tr>
<tr>
<td>± 0.7 to ± 0.9</td>
<td>Very Strong</td>
</tr>
<tr>
<td>± 1</td>
<td>Perfect</td>
</tr>
</tbody>
</table>

- The level of significance was considered to be $p \leq 0.05$. 
**Descriptive statistics**

**Table 1:** Shows descriptive statistics of the Chronic COPD patients:

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Variable (N=38)</th>
<th>Frequency (%)</th>
<th>Median (IQR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Males</td>
<td>23 (60.5)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Females</td>
<td>15 (39.5)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Age (years)</td>
<td></td>
<td>60 (55-64)</td>
</tr>
<tr>
<td>3</td>
<td>Occupation</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hospital Staff</td>
<td>3 (7.9)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Service</td>
<td>11 (28.9)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Housewife</td>
<td>12 (31.6)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Farmer</td>
<td>3 (7.9)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Retired</td>
<td>9 (23.7)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Duration of Illness (years)</td>
<td></td>
<td>6 (2-10.7)</td>
</tr>
<tr>
<td>5</td>
<td>Grade of COPD</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mild</td>
<td>9 (23.7)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Moderate</td>
<td>14 (36.8)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Severe</td>
<td>11 (28.9)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Very Severe</td>
<td>4 (10.5)</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Comorbidities</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>DM, HTN</td>
<td>21 (55.3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>None</td>
<td>17 (44.7)</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Addictions</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Smoking</td>
<td>13 (34.2)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>None</td>
<td>25 (65.8)</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Type of physical activity</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Walking</td>
<td>15 (39.5)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yoga</td>
<td>5 (13.2)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>2 (5.3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>None</td>
<td>16 (42.1)</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Duration of physical Activity</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>30-60 mins</td>
<td>15 (39.5)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;60 mins</td>
<td>9 (23.7)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>None</td>
<td>14 (36.8)</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Medications</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>On</td>
<td>32 (84.2)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Off</td>
<td>6 (15.8)</td>
<td></td>
</tr>
</tbody>
</table>

**INTERPRETATION:** The above table shows descriptive statistics of COPD patients with median age of 60 years, out of which 23 (60.5%) were males and 15 (39.5%) were females. The average duration of illness was 6 years and majority of the participants [14(36.8%)] were moderately affected as per GOLD criteria.
**Table 2:** Shows the normality tests of outcomes done by the Shapiro-Wilk test (p>0.05)

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Variables</th>
<th>Shapiro-Wilk</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Statistic</td>
<td>df</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Lung Function</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>FEV1(%)</td>
<td>.978</td>
<td>38</td>
</tr>
<tr>
<td></td>
<td>FVC(%)</td>
<td>.957</td>
<td>38</td>
</tr>
<tr>
<td></td>
<td>FEV1/FVC</td>
<td>.927</td>
<td>38</td>
</tr>
<tr>
<td>2</td>
<td>Respiratory Muscle Strength</td>
<td>MIP (cmH2O)</td>
<td>.794</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>MEP (cmH2O)</td>
<td>.944</td>
<td>38</td>
</tr>
<tr>
<td>3</td>
<td>BRIEF BESTest Score</td>
<td>.952</td>
<td>38</td>
</tr>
<tr>
<td>4</td>
<td>Posture</td>
<td>Craniocervical angle (degree)</td>
<td>.946</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Shoulder angle (degree)</td>
<td>.966</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Kyphotic angle (degree)</td>
<td>.949</td>
</tr>
<tr>
<td>5</td>
<td>Sit to Stand Repetitions</td>
<td>.898</td>
<td>38</td>
</tr>
</tbody>
</table>

**INTERPRETATION:** The above table shows that FEV1/FVC, MIP and STS were not normally distributed whereas all other variables such as FEV1, FVC, MEP, CV Angle, Shoulder Angle, Kyphotic Angle were normally distributed.
**Table 3:** Shows descriptive statistical analysis of the outcome variables in Chronic COPD patients:

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Variable</th>
<th>Mean (SD)</th>
<th>Median (IQR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lung Function</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>FEV1 (%)</td>
<td>54.21 (20.25)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>FVC (%)</td>
<td>53.03 (20.93)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>FEV1/FVC</td>
<td>112.5(75-130)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Respiratory Muscle Strength</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>MIP (cmH20)</td>
<td>38 (31-48)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MEP (cmH20)</td>
<td>48.71 (18.68)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>BESTest Score</td>
<td>11.08 (1.74)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Posture</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Craniovertebral angle (degree)</td>
<td>35.53 (6.47)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shoulder angle (degree)</td>
<td>59.68 (9.88)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kyphotic angle (degree)</td>
<td>43.74 (6.11)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Sit To Stand Repetitions</td>
<td></td>
<td>9 (8-10)</td>
</tr>
</tbody>
</table>
**Correlation Analysis:**

**Table 4:** Shows the Correlation coefficients and Significance of each Outcome measure.

<table>
<thead>
<tr>
<th></th>
<th>Balance</th>
<th>Posture</th>
<th>Functional Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BRIEF BESTest</td>
<td>CVA</td>
<td>Shoulder Angle</td>
</tr>
<tr>
<td><strong>Lung Function</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FEV1</td>
<td>r 0.149</td>
<td>0.001</td>
<td>0.095</td>
</tr>
<tr>
<td></td>
<td>p 0.371</td>
<td>0.997</td>
<td>0.571</td>
</tr>
<tr>
<td>FVC</td>
<td>r 0.114</td>
<td>-0.051</td>
<td>0.095</td>
</tr>
<tr>
<td></td>
<td>p 0.496</td>
<td>0.763</td>
<td>0.569</td>
</tr>
<tr>
<td>FEV1/FVC</td>
<td>r 0.050</td>
<td>0.088</td>
<td>-0.025</td>
</tr>
<tr>
<td></td>
<td>p 0.766</td>
<td>0.601</td>
<td>0.880</td>
</tr>
<tr>
<td><strong>Respiratory Muscle Strength</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIP</td>
<td>r -0.014</td>
<td>0.050</td>
<td>-0.063</td>
</tr>
<tr>
<td></td>
<td>p 0.932</td>
<td>0.764</td>
<td>0.709</td>
</tr>
<tr>
<td>MEP</td>
<td>r 0.019</td>
<td>-0.014</td>
<td>-0.176</td>
</tr>
<tr>
<td></td>
<td>p 0.910</td>
<td>0.934</td>
<td>0.289</td>
</tr>
</tbody>
</table>

**INTERPRETATION:** The above table shows that there is no association between Balance (BRIEF BESTest score), Posture (CV Angle, Shoulder Angle and Kyphotic Angle) and lung function (FEV1, FVC, FEV1/FVC) and respiratory muscle strength (MIP, MEP).
1. Graphical Representation of FEV1 with Balance, Posture and Functional Capacity

The above graph shows that there is a negligible positive correlation between FEV1 and balance \( (r=0.149, p=0.371) \)

The above graph shows that there is negligible positive correlation between FEV1 and CV Angle \( (r=0.001, p=0.997) \)

The above graph shows that there is no correlation between FEV1 and Shoulder Angle \( (r=0.095, p=0.571) \)

The above graph shows that there is no correlation between FEV1 and kyphotic angle \( (r=0.050, p=0.764) \)

The above graph shows that there is no correlation between FEV1 and Functional Capacity \( (r=-0.005, p=0.997) \)
2. Graphical Representation of FVC with Balance, Posture and Functional Capacity:

The above graph shows that there is negligible positive correlation between FVC and Balance ($r=0.114$, $p=0.496$).

The above graph shows that there is no correlation between FVC and CV Angle ($r=-0.051$, $p=0.763$).

The above graph shows that there is no correlation between FVC and Shoulder Angle ($r=0.095$, $p=0.569$).

The above graph shows that there is no correlation between FVC and Kyphotic Angle ($r=-0.080$, $p=0.663$).

The above graph shows that there is no correlation between FVC and functional capacity ($r=0.023$, $r=0.891$).
3. **Graphical Representation of FEV1/FVC with Balance, Posture and Functional Capacity:**

The above graph shows that there is no correlation between FEV1/FVC and Balance ($r = 0.050$, $p = 0.766$) between FEV1/FVC and CV Angle ($r = 0.088$, $r = 0.601$) The above graph shows that there is no correlation between FEV1/FVC and Shoulder Angle ($r = -0.025$, $p = 0.880$) The above graph shows that there is moderate positive correlation between FEV1/FVC and kyphotic Angle ($r = 0.320$, $p = 0.050$) The above graph shows that there is negligible negative correlation between FEV1/FVC and Functional Capacity ($r = -0.105$, $p = 0.532$)
4. Graphical Representation of MIP with Balance, Posture and Functional Capacity:

The above graph shows that there is no correlation between MIP and Balance ($r = -0.014$, $p = 0.932$)

The above graph shows that there is no correlation between MIP and CV Angle ($r = 0.050$, $p = 0.764$)

The above graph shows that there is negligible negative correlation between MIP and Shoulder Angle ($r = -0.063$, $p = 0.709$)

The above graph shows that there is negligible negative correlation between MIP and Kyphotic angle ($r = -0.166$, $p = 0.319$)

The above graph shows that there is no correlation between MIP and functional capacity ($r = 0.059$, $p = 0.726$)
5. Graphical Representation of MEP with Balance, Posture and Functional Capacity:

The above graph shows that there is no correlation between MEP and Balance ($r=0.019$, $p=0.932$)

The above graph shows that there is no correlation between MEP and CV Angle ($r=-0.014$, $p=0.934$)

The above graph shows that there is negligible negative correlation between MEP and Shoulder Angle ($r=-0.176$, $p=0.289$)

The above graph shows that there is negligible negative correlation between MEP and kyphotic Angle ($r=-0.184$, $p=0.270$)

The above graph shows that there is negligible positive correlation between MEP and functional capacity ($r=0.163$, $p=0.327$)
DISCUSSION

The above study aimed to find an association between balance, posture and functional capacity with lung function and respiratory muscle strength in chronic COPD patients. Out of the 38 participants assessed, 60.5% (n=23) were males and 39.5% (n=15) were females. The mean age of the participants was 58.5 years ± 7.91. Out of the 38 participants, 15 (39.5%) were performing walking daily, whereas 42.1% (n=16) participants were not involved in any physical activity. 84.2% (n=32) participants out of total participants were on medications, which included corticosteroid inhalers. The mean duration of illness was found to be 6 years with 23.7% (n=9) were mildly affected, 36.8% (n=14) were moderately affected, 28.9% (n=11) were severely affected and 10.5% (n=4) were very severely affected as per GOLD classification.

Our study found no significant relation of balance, posture and functional capacity with lung function and respiratory muscle strength.

1. Balance with lung function and respiratory muscle strength:

The above study found no significant correlation of lung function and respiratory muscle strength with balance. It is known that individuals with COPD have an impaired balance caused by the disease’s multisystemic manifestations and also due to age related decline in balance. Studies have shown that patients with COPD are known to have worse balance as compared to healthy individuals. The most common cause of balance impairment is attributed to reduced peripheral muscle strength and reduced exercise capacity. Furthermore it is seen that static balance has a relation with peripheral muscle strength whereas functional balance is associated with functional capacity of individuals. [34]

Trunk balance is maintained by the co-contraction of abdominal muscles, which also play a role in respiration. Studies have shown an association between trunk balance and the forced
expiratory pressures. During forced expiration, the abdominal muscles are sought into function which tends to divert the action of abdominal muscles and thus impair trunk balance, as the muscles are not able to perform both functions optimally. Thus the MEP is significantly correlated with trunk control.[35] However, the findings of this study contradict the findings of other studies as majority of the people belonged to the mild to moderate category of disease severity and hence were able to maintain appropriate trunk balance thus the balance was preserved. In the present study, the score of BRIEF BESTest showed no correlation with MEP (r= 0.019, p= 0.910). However other studies found a significant correlation between MEP and static (r= 0.386, p= 0.029) and dynamic balance (r= 0.593, p= 0.000) and also with FEV1 (r= 0.425, p= 0.015)[35]

In a study conducted by Lee K, et al., done in 2018, showed that the trunk balance is directly associated with abdominal muscle contraction and increase in intra-abdominal pressure. The lung hyperinflation in COPD causes a change in the length-tension relationship of the abdominal muscle thus causing a reduction in expiratory flow. However, an increased intra-abdominal pressure due to the descended diaphragm may also cause a forced contraction producing adequate pressure, which may show little or no reduction in expiratory pressures.[35]

Another point to be noted is that, in the present study, majority of the population 42.1% (n=16) participants were retired and lived a sedentary life, which leads to deconditioning of peripheral muscles especially of the lower limb. Such individuals with a sedentary lifestyle do not perform much of physical activity in their daily life and hence are protected from falls, thus lesser number of falls are reported. However, 31.6% (n=12) participants were housewives, which perform daily household chores thus preserving the peripheral muscle strength and hence show lesser balance impairment.
In a study done by de Castro et al., in 2016, it was seen that individuals with COPD had worse static and functional balance as compared to healthy individuals. The affection of balance also depended upon the gender where males were shown to have worse balance as compared to females. This was attributed to the differences in daily activities performed by men and women. As women are more involved in chores, the balance remains intact as compared to males.\textsuperscript{[36]}

In another study by Roig M et al., in 2009, the theoretical factors causing increased risk of falls in COPD were stated. The intrinsic factors were related to the physical and psychological status of the individuals which included muscle weakness, visual deficits, impaired activities of daily living, depression and cognition impairments. The study used a psychological aspect to enumerate the causes for increased risk of falls in COPD individuals. Muscle strength and endurance are also seen to be reduced in people with COPD as compared to healthy adults, especially in the lower limb. This leads to increased muscle fatigue and impaired postural control. Common structural abnormalities include muscle fibre atrophy (mainly type II fibres), reduced capillary density, mitochondrial dysfunction and less oxidative enzymes. Studies have shown that people with moderate grade of COPD have a reduced functional reach test distance compared to healthy individuals. Smoking has been associated with an increased risk of visual defects thus leading to risk of falls. Furthermore, dyspnoea is known to be the most common activity limiting symptom in COPD and it is strongly related to the intensity of ADLs.\textsuperscript{[37]} People suffering from COPD have reduced physical activity and hence it leads to further deconditioning and impaired balance. Thus various other causes are known to impair balance in COPD patients, although further research is needed to find the exact mechanism for increased impairment of balance in COPD individuals.
2. **Posture with lung function and Respiratory Muscle Strength:**

In the current study, no significant correlation was found between posture and lung function and respiratory muscle strength. People with COPD tend to adopt a slouched posture overtime as an adaptation to prevent dyspnoea. ‘Exacerbations’, defined as episodes of dyspnoea which are associated with activity or at rest are seen in chronic stages of COPD patients.[38] In order to prevent such episodes, the patients adopt a slouched posture, thus causing a forward head posture and protracted shoulders and an increased thoracic kyphosis. Repetitive adaptations of these postures can lead to a deformity which may cause breathing dysfunction. Individuals with forward head posture show reduced diaphragm strength due to reduced activity thus leading to reduced alveolar ventilation. A reduced neural drive can also be seen due to phrenic nerve entrapment in forward head posture thus reducing the contractility of the diaphragm and causing a reduction in lung function. Similarly, the approximation of the pelvis and ribcage in a slouched posture causes reduction in the breathing capacity and a reduced inspiratory muscle strength.[39] The alterations of head and neck posture are shown to have a direct effect on the respiratory function which is seen by reduced diaphragm strength. Sustenance of poor posture is seen frequently while using mobiles, TVs, etc, which can lead to a slouched posture overtime, especially a forward head posture.

The findings of this study however contradict the above findings as majority of the participants included in the study were on medications (inhalers or corticosteroids), which lead to lesser number of exacerbations or episodes of dyspnoea. Thus the adaptation of slouched posture is much less as compared to those with very severe illness and frequent exacerbations. This coupled with no acute exacerbations in the past 4 weeks when the readings were taken gives an explanation as to why there was no postural impairment seen in these patients.
In a study done by Priori R et al., in 2012, it was stated that healthy adults spend around one-third of their time lying down during the day, and COPD patients are in supine position for even longer. It showed that chest wall asynchronies are significantly influenced by body position, more commonly seen in supine position than in sitting or standing. Another possible explanation for chest wall asynchrony is the shortened position of diaphragm which is more radially oriented due to the hyperinflated chest. This causes lesser inspiratory and expiratory pressures further leading to dyspnoea and thus adaptation of a slouched posture, hence contributing to postural abnormalities seen in COPD patients.[38]

3. **Functional Capacity with lung function and respiratory muscle strength:**

Studies have shown that functional capacity and exercise tolerance are reduced in patients with COPD as compared to healthy individuals. In about 40% patients, the exercise capacity is limited by alterations in skeletal muscle mass rather than pulmonary problems. In the current study, the mean repetitions of Sit to Stand test were 9 reps, which were shown to be slightly reduced as compared to normal (12-14 reps).[41] Gosher et al., in a study done in 2003, showed that FEV1 in COPD correlates poorly with exercise capacity.[40] Studies have shown that in patients with flow limitation, inspiratory capacity is the main predictor of reduction in lung function and in patients with non flow-limitation, FEV1/FVC is the main predictor of exercise tolerance. However, other factors such as peripheral muscle strength and endurance also play a major role in predicting exercise capacity apart from lung function.[41]

In the present study, 42.1% (n=12) participants were sedentary and performed no physical activity. This leads to deconditioning of peripheral muscles especially of the lower limb thus causing easy fatiguability and leading to a reduced exercise tolerance. A 30 second chair rise test was used to assess the exercise capacity in the current study. Easy fatiguability of the lower
limb muscles leads to difficulty in sitting and rising from the chair due to poor control. This could be one of the reasons for reduced functional capacity. However, since more than 50% of the participants were included in the mild to moderate grade of COPD as per GOLD classification, not much impairment was seen in the peripheral muscle strength. However, as the current study did not involve assessment of peripheral muscle strength, the above statement cannot be commented on. As a result, the participants were able to perform Sit to Stand repetitions on an average of 8-10 repetitions which almost comparable to normal individuals (12-14 reps). As a result no significant reduction was seen in the functional capacity of these patients.

In a similar study by Wust R et al., in 2007, relation between muscle structure and exercise capacity was explained. Loss of skeletal muscle mass is a common observation in COPD patients and leads to peripheral muscle weakness. Muscle atrophy occurs due to imbalance between protein synthesis and protein degradation. Further, IGF-1 which mediates muscle growth is seen to be reduced in COPD patients. This further contributes to reduced exercise tolerance and functional capacity in COPD patients.[40]

Besides muscle atrophy, a decrease in neural drive may also contribute to muscle weakness and may decline the force generating capacity per muscle cross sectional area. In advanced stages of the disease, energy metabolism is compromised as reflected by reduced activation of energy systems especially in quadriceps muscle. This leads to easy fatigue and reduced exercise tolerance.[40]

Thus it indicates that in COPD patients, balance, posture and functional capacity are impaired due to causes other than reduction of lung function and respiratory muscle strength.
CONCLUSION

The present study concludes that there is no significant association of balance, posture and functional capacity with lung function and respiratory muscle strength in chronic COPD patients.
LIMITATIONS OF THE STUDY

The present study was performed in a small sample size (38 chronic COPD patients). There was a limitation in number of patients attending the Respiratory OPD due to the COVID19 pandemic thus reducing the number of participants which could be included in the study. As the study procedure included performing a Pulmonary function test, many patients were reluctant to perform the test as it included blowing into the mouthpiece which increased the risk of transmission of virus. A peripheral muscle strength and quality of life assessment was not done which would have proven beneficial and would have contributed better to the results of the study.
**CLINICAL IMPLICATION**

The present study aimed to find an association between balance, posture and functional capacity and lung function and respiratory muscle strength. Although the results of the study did not find any significant correlation between the outcomes, it is seen that there is balance affection seen in COPD patients as compared to normal healthy individuals. The findings of this study can be used to plan a management which includes balance and functional training along with pulmonary rehabilitation in these patients. However, further similar studies with a larger sample size can be done in order to find a significant correlation between the outcome variables.

**SUGGESTION**

Further studies can be done in a larger population of COPD patients, which may produce different results and might show a significant correlation between the variables.
**SUMMARY**

The study aimed to find a relation between balance, posture, functional capacity and lung function and respiratory muscle strength in chronic COPD patients. The Objectives of the study were to correlate balance with lung function and respiratory muscle strength, posture with lung function and respiratory muscle strength and functional capacity with lung function and respiratory muscle strength.

The participants were recruited as per inclusion and exclusion criteria by convenience sampling. Balance assessment of the participants was done using BRIEF BESTest, Posture was analysed using Kinovea software and the craniovertebral, shoulder and kyphotic angles were measured. Functional Capacity was assessed using the number of repetitions of 30 second chair rise test. Lung function was measured using values of FEV1, FVC, FEV1/FVC using Pony FX potable spirometer. Respiratory Muscle strength was assessed using values of MIP, MEP using Pony FX spirometer device.

The result showed no significant association between balance, posture, functional capacity and lung function and respiratory muscle strength in chronic COPD patients.
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Fernandes KB, da Silva RA, Teixeira DC, Spruit MA, Pitta F, Probst VS. Static and 
Functional Balance in Individuals With COPD: Comparison With Healthy Controls and


ANNEXURE A:

PARTICIPANT CASE RECORD FORM.

<table>
<thead>
<tr>
<th>NAME</th>
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<tbody>
<tr>
<td>ADDRESS</td>
<td></td>
</tr>
<tr>
<td>CONTACT NUMBER</td>
<td></td>
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</table>

Informed Consent

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
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<tbody>
<tr>
<td>Has the participant freely given informed consent</td>
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</table>

Inclusion Criteria:

<table>
<thead>
<tr>
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<th>NO</th>
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<tbody>
<tr>
<td>1. Patients in the age of 40-60 years</td>
<td></td>
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<tr>
<td>2. Patients suffering from COPD (GOLD Criteria)</td>
<td></td>
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<tr>
<td>3. Patients attending the physiotherapy OPD</td>
<td></td>
</tr>
<tr>
<td>4. Patients willing to participate in the study</td>
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</tbody>
</table>
*If any inclusion criteria is ticked no then the patient is not eligible for the study.

**Exclusion Criteria:**

1. Recent episode of exacerbation (<4 weeks) or hospital admission.

2. Patients suffering from congestive heart failure.

3. Any external ventilator support through mechanical ventilator or BiPAP or oxygen therapy.

4. History of any neurological deficit

5. History of any recent surgery or any orthopedic problem or injury.

6. Patient unwilling to participate.
Demographic Data:

Age (years): Sex:

Occupation:
- Type of work, Exposure to any chemicals/ dust/ smoke:
- Duration of work: 1. No of years worked:
  2. No of hours per day:
- Any past occupation affecting the present condition:
- Use of mask or any protective gear:

History of present illness:

Co morbidities:

Addictions:
- Tobacco
- Smoking: No of years of smoking:
  Packs per day:
  Pack years:
- Alcohol: No of years of alcohol consumption:
  Bottles consumed per day:
**Physical Activity Details:**

Type of physical Activity:

Number of hours of Physical Activity:

Duration Of Activity:

Past surgical history:

Past medical history:

Current medications:

**Examination:**

<table>
<thead>
<tr>
<th>Component</th>
<th>Outcome measure</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Lung function</td>
<td>FEV1 (%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>FEV1/FVC</td>
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</tr>
<tr>
<td>Category</td>
<td>Measurement</td>
<td>Value</td>
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<td>-------------------</td>
<td>------------------------------------------</td>
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</tr>
<tr>
<td>2. Respiratory muscle strength</td>
<td>MIP (cmH2O)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MEP (cmH2O)</td>
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<td>3. Balance.</td>
<td>BETest (Score)</td>
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<tr>
<td>4. Posture</td>
<td>Craniocervical angle (Degrees)</td>
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<tr>
<td></td>
<td>Shoulder angle (Degrees)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Thoracic kyphosis (Degree)</td>
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<tr>
<td>5. Functional capacity</td>
<td>30 second sit to stand test (Repetitions)</td>
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ANNEXURE B: PATIENT INFORMED CONSENT:

Protocol number:

Study Title: Correlation of Balance, Posture, Functional capacity with lung function and respiratory muscle strength in patients with chronic COPD - A Cross Sectional Study.

<table>
<thead>
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<th>Sr No.</th>
<th>Tick the box</th>
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<tbody>
<tr>
<td>1.</td>
<td>I confirm that I have read and understood the information sheet dated __________ for the above study and have had the opportunity to ask questions.</td>
</tr>
<tr>
<td>2.</td>
<td>I understand that my participation in this study is voluntary and that I am free to withdraw at any time, without giving any reason, without my medical care or legal rights being affected.</td>
</tr>
<tr>
<td>3.</td>
<td>I understand that the study team member, Ethics Committee and the regulatory authorities will not need my permission to look at my health records both in respect of the current study and any further research that may be conducted in relation to it even if I withdraw from the trial. I agree to this access. However I understand that my identity will not</td>
</tr>
</tbody>
</table>
be revealed in any information released to the third parties or published.

4. I agree not to restrict any use of any data or results, that arise from this study provided such a use is only for scientific purpose.

5. I agree to take part in the above study.

<table>
<thead>
<tr>
<th>Sr No.</th>
<th>Name</th>
<th>Signature/ Thumb impression with the date.</th>
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<tbody>
<tr>
<td>1.</td>
<td>Participant</td>
<td></td>
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<tr>
<td>2.</td>
<td>Legally accepted representative</td>
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<tr>
<td>3.</td>
<td>Impartial witness</td>
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<tr>
<td>4.</td>
<td>Principal investigator</td>
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PATIENT INFORMATION SHEET

<table>
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<th>Protocol number</th>
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</table>

Principal investigator

Designation

Address
1. **Project Title:**

Correlation of Balance, Posture, Functional Capacity with Lung function and respiratory muscle strength in chronic COPD patients- A Cross Sectional Study.

2. **Introduction:**

You are invited to participate in a research study. It is important that you read this description of the study and your role in it, including the nature and risks of participation. Please give your consent to participate in this study only if you have completely understood the nature and course of this study and if you are aware of your rights as a participant.

3. **What is the purpose of this study?**

The purpose of this study is to Correlate balance, balance, functional capacity with lung function and respiratory muscle strength in chronic COPD patients.

4. **What is the expected duration of the study? How many participants will participate?**
You will be one of approximately 106 people who will participate in this study. You will be participating in this study for 90 min.

5. **What steps will be taken conducting the study?**

If you agree to participate in this study:

a) Your details such as name, age, gender, contact details etc. will be documented.

b) You will be asked about your occupation, medical/surgical history including your current health status.

c) You will undergo a physical examination to assess Respiratory function, posture, balance and functional capacity.

d) The results of these evaluation and tests will be reviewed by the authorized staff.

6. **What are the risks and discomforts of participating in the study?** Potential risks associated with this study are none or very minimal. If any, the therapist will always be in the vicinity to prevent and treat the same.

7. **Is there any possible benefits of this study?**
The results obtained from this study may prove useful in further research in pulmonary rehabilitation of COPD. However, there is no guarantee that you may receive direct benefit from this study.

8. **What happens when the study stops?**

The stopping of the study will not affect you or your treatment at this center in anyway.

9. **Compensation for participation:**

No compensation will be provided for your participation. Payment for things such as lost wages is not available. There will be no additional financial burden on the patient.

10. **Compensation for study related injury:**

You will be provided medical care at this institute for any physical injury or illness that occurs as a direct result of your participation in this study. The medical care will be at no cost to you. You will not give up any of your legal rights by signing this form.

11. **Do I get the right to withdraw from this study?**

Participation in this study is entirely voluntary. You may choose not to take part or you may leave the study at any time. Your decision will not affect your further treatment in this institute.
12. Confidentiality:

All study records will be kept confidential at all times. Your identity will not be revealed except as required by law. The results of the study (Test scores, photographs of assessment, etc) may be published for scientific reasons. Your identity will not be revealed in these articles.

13. Contact for further information:

We thank you for taking the time out to read (or have read to you) the information about this study. Before you sign this document, you should ask questions about anything that you do not understand. I will answer any of your questions before, during and after the study.
रोगी सूचित सहमति फार्म

प्रोटोकॉल संख्या:

अध्ययन का शीर्षक: क्रोनिक सीओपीडी के रोगियों में आसन, संतुलन, कार्यात्मक क्षमता फेफड़े के कार्य और श्वसन की मांसपेंद्रियों की शक्ति के साथ-एक क्रॉस सेक्शनल अध्ययन।

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<th>क्रम सं.</th>
<th>बॉक्स पर टिक करें</th>
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<tbody>
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<td>1. मैं पुष्टि करता हूँ कि मैंने उपरोक्त अध्ययन के लिए [ ] को सूचना पत्र पढ़ा और समझा है और मुझे प्रश्न पूछने का अवसर मिला है।</td>
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<td>2. मैं समझता हूँ कि इस अध्ययन में मेरी भागीदारी स्वतंत्र है और मैं नबना नकसी कारण, नबना नकसी नचनकत्सीय देखभाल या कानूनी अनिकारों के प्रभावित हुए नबना नकसी भी समय वापस लेने के लिए स्वतंत्र हं।</td>
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<td>3. मैं समझता हूँ कि अध्ययन दल के सदस्य, नैतिकता समिति और नियामक अधिकारियों को वर्तमान अध्ययन के संबंध में अस्वास्थ्य रिकॉर्ड को देखने के लिए मेरी अनुमति की आवश्यकता नहीं होगी और यदि मैं पीछे हटता हूँ तो भी इसके संबंध में कोई और शोध किया जा सकता है। मुकदमे से। मैं इस पहुंच से सहमत हूँ। हालाँकि मैं समझता हूँ कि तीसरे पक्ष को जारी किसी भी जानकारी में मेरी पहचान उजागर नहीं की जाएगी या प्रकाशित नहीं की जाएगी।</td>
<td></td>
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</table>
4. मैं किसी भी डेटा या परिणामों के किसी भी उपयोग को प्रतिबंधित नहीं करने के लिए सहमत हूँ, इस अध्ययन से उत्पन्न होता है बशर्ते ऐसा उपयोग केवल वैज्ञानिक पु के लिए हो।

5. मैं उपरोक्त अध्ययन में भाग लेने के लिए सहमत हूँ।

<table>
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<tr>
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<th>तारीख के साथ क्रम संख्या नाम हस्ताक्षर / अंगूठे का निशान।</th>
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<tbody>
<tr>
<td>1.</td>
<td>प्रतिभागी</td>
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<td>2.</td>
<td>कानूनी रूप से स्वीकृत प्रतिनिधि</td>
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<td>3.</td>
<td>इम्पीरियल साक्षी</td>
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<td>4.</td>
<td>प्रधान अन्वेषक</td>
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रोगी सूचना पत्र

<table>
<thead>
<tr>
<th>प्रोटोकॉल नंबर</th>
</tr>
</thead>
<tbody>
<tr>
<td>मुख्य जाँचकर्ता</td>
</tr>
</tbody>
</table>
## परियोजना का शीर्षक:
क्रोनिक सीओपीडी के रोगियों में संतुलन, आसन, कार्यान्वयन क्षमता फेफड़े के कार्य और श्वसन की मांसपेशियों की शक्ति के साथ-एक क्रॉस सेक्शनल अध्ययन।

## परिचय:
आपको एक शोध अध्ययन में भाग लेने के लिए आमंत्रित किया गया है। यह महत्वपूर्ण है कि आप अध्ययन के इस विवरण और इसमें अपनी भूमिका को पढ़ें, जिसमें भागीदारी की प्रकृति और जोखिम शामिल हैं। कृपया इस अध्ययन में भाग लेने के लिए अपनी सहमति दें, यदि आपने इस अध्ययन की प्रकृति और पाठ्यक्रम को पूरी तरह से समझ लिया है और यदि आप एक प्रतिभागी के रूप में अपने अधिकारों के बारे में जानते हैं।

## इस अध्ययन का उद्देश्य क्या है?
इस अध्ययन का उद्देश्य क्रोनिक सीओपीडी के रोगियों में आसन, संतुलन, कार्यान्वयन क्षमता फेफड़े के कार्य और श्वसन की मांसपेशियों की शक्ति के साथ-एक क्रॉस सेक्शनल अध्ययन करना है।

## अध्ययन की अपेक्षित अवधि क्या है? कितने प्रतिभागी भाग लेंगे?
आप लगभग 42 लोगों में से एक होंगे जो इस अध्ययन में भाग लेंगे। आप केवल 90 मिनट के लिए इस अध्ययन में भाग लेंगे।

## अध्ययन के संचालन के लिए क्या कदम उठाए जाएंगे?
यदि आप इस अध्ययन में भाग लेने के लिए सहमत हैं:
a) आपका विवरण जैसे नाम, आयु, लिंग, संपर्क विवरण आदि को प्रलेखित किया जाएगा।

बी) आपसे आपके वर्तमान स्वास्थ्य की स्थिति सहित आपके व्यवसाय, चिकित्सा / सर्जिकल 
इतिहास के बारे में पूछा जाएगा।

ग) आप श्वसन समारोह, आसन, संतुलन और कार्यात्मक क्षमता का आकलन करने के लिए एक 
शारीरिक परीक्षा से जुटाओ।

घ) इन मूल्यांकन और परीक्षणों के परिणामों की समीक्षा अधिकृत कर्मचारियों द्वारा की जाएगी।

6. अध्ययन में भाग लेने के जोखिम और असुविधाएँ क्या हैं? इस अध्ययन से जुड़े संभावित जोखिम 
कोई नहीं हैं या बहुत कम हैं। यदि कोई है, तो चिकित्सक हमेशा इसे रोकने और इलाज करने के 
लिए आसपास के क्षेत्र में रखेंगे।

7. क्या इस अध्ययन के कोई संभावित लाभ हैं?
इस अध्ययन में भाग लेने से, आपकी स्थिति में एक संभावित सुधार हो सकता है। हालांकि, इस 
बात की कोई गारंटी नहीं है कि आपको इस अध्ययन से प्रत्यक्ष लाभ मिल सकता है। हालांकि, इस 
अध्ययन से प्राप्त परिणाम सीओपीडी के कुफ़फ़्फ़ुफ़्फ़ु फुनर्फ़स्म में आप के शोध में उपयोगी साबित 
हो सकते हैं।

8. अध्ययन बंद होने पर क्या होता है?
अध्ययन के रुकने से आपको या आपके उपचार पर इस केंद्र में कोई असर नहीं पड़ेगा।

9. भागीदारी के लिए मुआवजा:
आपकी भागीदारी के लिए कोई मुआवजा नहीं दिया जाएगा। खोई हुई मजबूती जैसी 
चीजों के लिए भुगतान उपलब्ध नहीं है। रोगी पर अधिक वित्तीय बोझ नहीं होगा।
10. अध्ययन से संबंधित चोट के लिए मुआवजा:
शैक्षणिक अध्ययन के लिए: इस अध्ययन में आपकी भागीदारी के प्रत्यक्ष परिणाम के रूप में होने वाली किसी भी शारीरिक चोट या बीमारी के लिए आपको इस संस्थान में चिकित्सा देखभाल प्रदान की जाएगी। चिकित्सा देखभाल आपके लिए किसी भी कीमत पर नहीं होगी। आप इस फॉर्म पर हस्ताक्षर करके अपनी किसी भी कानूनी अधिकार को नहीं छोड़े।

11. क्या मुझे इस अध्ययन से हटने का अधिकार है?
इस अध्ययन में भागीदारी पूरी तरह से स्वतंत्र है। आप भाग नहीं लेने का चयन कर सकते हैं या आप किसी भी समय अध्ययन छोड़ सकते हैं। आपका निर्णय इस संस्थान में आपके आगे के उपचार को प्रभावित नहीं करेगा।

12. गोपनीयता:
सभी अध्ययन रिकॉर्ड को हर समय गोपनीय रखा जाएगा। कानून द्वारा आवश्यक के अलावा आपकी पहचान उजार नहीं की जाएगी। अध्ययन के परिणाम (परीक्षण स्कोर, मूल्यांकन की तस्वीरें, एक्स रेड, आदि) वैज्ञानिक कारणों से प्रकाशित हो सकते हैं। इन लेखों में आपकी पहचान उजार नहीं की जाएगी।

13. अधिक जानकारी के लिए संपर्क करें:
इस अध्ययन के बारे में जानकारी पढ़ने के लिए समय निकालने के लिए हम आपको ध्यान देते हैं (या आपको पढ़ा है)। इस दस्तावेज़ पर हस्ताक्षर करने से पहले, आपको किसी भी चीज़ के बारे में प्रश्न पूछना चाहिए जो आपको समझ में नहीं आता है। मैं आपके किसी भी प्रश्न का उत्तर अध्ययन के दौरान, पहले और बाद में दूंगा।

रुग्णांच्या माहितीचा फॉर्म

प्रोटोकॉल क्रमांक:

अभ्यासाचे शीर्षक: तीव्र सीओपीडी असलेल्या रुग्णांमध्ये पवित्र, संतुलन आणि श्वसन कार्याचे
सहसंबंध

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<td>मी पुष्टी करतो की मी वरील अभ्यासासाठी __________ ची माहिती पत्रक वाचली आणि समजली आहे आणि मला प्रश्न विचारण्याची संधी मिळाली आहे.</td>
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<td>मला समजते की या अभ्यासामध्ये माझा सहभाग ऐसा आहे आणि माझे वैद्यकीय सेवा किंवा कायदेशीर अधिकारांवर परिणाम होऊ न देता मी कोणतेही कारण न सांगता करतीही माघार घेण्यास मोकळे आहे.</td>
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<td>3.</td>
<td>मला समजते आहे की अभ्यास पथकाचा सदस्य, नीतिशास्त्र समिती आणि नियमक अधिकारांना संधाय्या अभ्यासाच्या संदर्भात आणि आरोग्याचा पात्रता असला पाहाशी घेण्याची परवानगी मला गरज भासणार नाही. मी माघार घेतलो तरीही त्यासंबंधात होणारे कोणतेही संशोधन चाचणी पासून. मी या प्रवेशास सहमत आहे. तथापि मला समजते आहे की माझी ओळख तृतीय पक्षाला जाहीर केलेल्या किंवा प्रकाशित केलेल्या कोणत्याही माहितीमध्ये प्रकट होणार नाही.</td>
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<td>या अभ्यासामुळे उद्वेदलेल्या कोणत्याही डेटाचा किंवा परिणामाचा कोणताही वापर मयाषनदत ठेवण्यास मी सहमत नाही, असा प्रयोग केवळ वैज्ञानिक हेतु तेव्हा केला जाईल.</td>
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रुग्ण माहिती पत्रक

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<th>पत्ता</th>
<th>फोन नंबर</th>
<th>ई - मेल आयडी</th>
</tr>
</thead>
</table>

1. प्रकल्प शीर्षक:
जुनाट सीओपीडी रूग्णांमध्ये मुद्रा, संतुलन, फुफ्फुसातील कार्यर्ष कार्यक्षम क्षमता आणि श्वसन स्नायूंची सामंजस्य - एक क्रॉस सेक्शनल स्टडी.

2. परिचय:
आपल्याला एका संशोधन अभ्यासमध्ये भाग घेण्यासाठी आमंत्रित केले आहे. आपण अभ्यासाचे
वर्णन आणि त्यात असलेल्या सहभागाचे स्वरूप आणि जोखीम यासह आपली भूमिका वाचणे महत्त्वाचे आहे. कृपया आपल्याला या अभ्यासाचे स्वरूप आणि त्याचा अभ्यासक्रम पूर्णपणे समजला असेल आणि आपल्याला सहभागी घडणून आपल्या हक्कांबद्दल माहिती असेल तर या अभ्यासात भाग घेण्यास आपली संमती द्या.

3. या अभ्यासाचा हेतू काय आहे?
या अभ्यासाचे उद्दीपक टीम सीओपीडी असलेल्या रूग्णांमध्ये पवित्र, शिल्क, कार्यालय क्षमता, फुफुसांचे कार्य आणि श्वसन सामग्री माहिती क्रॉस-विभागीय अभ्यास करणे आहे.

4. अभ्यासाचा अपेक्षित काळशी किती आहे? किती सहभागी होतील?
आपण या अभ्यासात भाग घेणार्यांना अंदाजे 42 तोकापैकी एक आहात. आपण या अभ्यासात 90 मिनीटसाठी सहभागी व्हाल.

5. अभ्यासाचे अयोजन करण्यासाठी कोणती पावले उच्चतील जातील?
आपण या अभ्यासाच्या सहभागी होण्यास सहमत असत्यास:
ा) आपले तपशील जसे की नाव, वय, लिंक, संपर्क तपशील इ. दस्तऐवजीकरण के. जाईल.
भ) आपल्या सामग्री आणि अरोग्याच्या स्थितीसह आपला व्यवसाय, वैद्यकीय / वैज्ञानिकांना इतिहासाबद्दल विचारात जाईल.
) श्वसन कार्य, पवित्र, शिल्क आणि कार्यालय क्षमता मूल्यांकन करण्यासाठी आपल्याकडे शारीरिक तपासणी केली जाईल.
ड) या मूल्यांकन आणि चाचण्यांचा निकालांचा आढावा अधिकृत कर्मचारी संकडून घेतला जाईल.

6. अभ्यासात भाग घेण्याचे जोखीम व किंवा काय आहेत? या अभ्यासाशी संबंधित संभाव्य जोखीम काहीही किंवा फारच कमी नाहीत. जर काही असेल तर ते रोखण्यासाठी आणि त्यावर उपचार करण्यासाठी धेरादून नेमकीच आसपास असेल.
7. या अभ्यासाचे कोणतेही संभाव्य फायदे आहेत का?
या अभ्यासामध्ये भाग घेतल्यास आपल्या स्थितीत संभाव्य सुधारणा होऊ शकते. तथापि, आपल्याला या अभ्यासाचे थेट फायदा मिळणार नाही. तथापि, या अभ्यासाच्या प्राप्त परिणाम सीओपीडीच्या कुपकुपसाधारणे पुनर्वसनामध्ये पुढील संशोधनात उपयुक्त ठरू शकतात.

8.अभ्यास थांबतावर काय होते?
अभ्यासाचा थांबा तुमच्या जीवनातील किंवा तुमच्या क्षेत्रातील उपचारांवर कोणताही परिणाम होणार नाही.

9. सहभागाशाठी भरपाई:
आपल्या सहभागाशाठी कोणतीही भरपाई दिली जाणार नाही. हरवलेल्या मजुरीसारख्या गोष्टींसाठी पैसे उपलब्ध नाहीत. रुग्णाच्या या पुढील कोणता ही अधिक आर्थिक भार पडणार नाही.

10.अभ्यासाशी संबंधित दुःखापतीसाठी नुकसान भरपाई:
वैद्यकीय अभ्यासाशी: या अभ्यासामध्ये आपल्या सहभागाचा थेट परिणाम म्हणून उद्भवावरील कोणताही शारीरिक इजा किंवा आजाराबद्दल आपल्याला या संस्थेत वैद्यकीय सेवा पुरविले जाईल. वैद्यकीय सेवा आपल्याला कोणताही किंमतीची वाटणार नाही. आपण या फॉर्मवर स्वाभिमानी करून आपले कोणतेही कायदेशीर अधिकार सोडणार नाही.

11. मला या अभ्यासाचे माघार घेण्याचा अधिकार आहे का?
या अभ्यासाचा सहभाग पूर्णपणे ऐतिहासिक आहे. आपण भाग न घेणाऱ्या निवड करू शकता किंवा आपण करूनही अभ्यास सोडू शकता. आपल्या निर्णयाचा या संस्थेत पुढील उपचाराकरून परिणाम होणार नाही.

12.गोपनीयता: सर्व अभ्यासाच्या नोंदी नेहमीच गोपनीय ठेवता जातील. कायमाने आवश्यकतेशीवर आपल्या उपचार केली जाणार नाही. अभ्यासाचे निकाल (कसोटी स्कोअर, मूल्यांकनचे फोटो, एक्स
फिरा इ.) वैज्ञानिक कारणामुळे प्रकाशित केले जाऊ शकतात. या लेखांमध्ये आपली ओळख प्रकट
होणार नाही.

१३.. पुढील माहितीसाठी संपर्क साधा:
या अभ्यासाची माहिती वाचण्यासाठी (किंवा आपल्याला वाचून) वेळ काढल्याबद्दल आपल्यांनी आपले आभारी
आहोत. आपण या दस्तऐवजावर स्वाक्षरी करण्यापूर्वी, आपणास काही समजत नाही असे प्रश्न विचारावेत.
मी अभ्यासपूर्वी, दरम्यान आणि नंतर तुम्हाच्या कोणत्याही प्रश्नांची उत्तरे दें.

ANNEXURE C: OUTCOME MEASURE:

BRIEF BESTEST:
Appendix.
Scoring Form for the Brief Balance Evaluation Systems Test (BriestTest).*

**Brief Balance Evaluation Systems Test**

<table>
<thead>
<tr>
<th>Patient/Subject:</th>
<th>Examiner:</th>
<th>Date:</th>
</tr>
</thead>
</table>

**Flat heel or shoes and socks off.**

**General Note:** “Instability” is defined as using more than an ankle strategy to maintain balance (e.g., a hip strategy is used).

---

### Section I. Biomechanical Constraints

**Item 1: Hip/Trunk Lateral Strength**

- Normal (11 s with trunk vertical)
- Mild (10 s without trunk vertical)
- Moderate (1 hip abducts with trunk vertical)
- Severe (either hip, 90 s or vertical and or not vertical)—cannot abduct either hip 10 s, with or without trunk vertical

**Count 10 s, watch for straight knee; if they use moderate force on your hands, score as “without keeping trunk vertical.”**

---

### Section II. Stability Limits

**Item 2: Functional Reach Forward**

- (3) >32 cm (12.5 in)
- (2) 16.5-32 cm (6.5–12.5 in)
- (1) <16.5 cm (6.5 in)
- (0) No measurable lean (or must be caught)

2 attempts

Observe that patient does not lift heels, rotate trunk, or protract scapula.

Watch for vertical initial alignment. Record best reach.

**Trial 1 (cm or in):**

---

**Trial 2 (cm or in):**

---

### Section III. Transitions—Anticipatory Postural Adjustment

**Items 3 and 4: Stand on One Leg—Left and Right**

- Normal (stable >20 s)
- Trunk motion OR 10–20 s
- Stand 2–10 s
- Unable

**Left**

**Right**

**Seconds**

---

### Section IV. Reactive Postural Response

**Items 5 and 6: Compensatory Stepping—Lateral, Left and Right**

- (3) Recover with 1 step/cross step
- (2) Several steps to recover independently
- (1) Steps but needs assist to prevent fall
- (0) No exp OR Fall

**Left**

**Right**

---

### Section V. Sensory Orientation

**Item 7: Stance With Eyes Closed, on Foam Surface**

- 30 s stable
- 30 s unstable
- <10 s
- Unable

**Seconds**

**Trial 1:**

**Trial 2:**

---

### Section VI. Stability in Gait

**Item 8: Timed “Up & Go” Test**

- Fast, <11 s, good balance
- Slow, >11 s, good balance
- Fast, <11 s, imbalance
- Slow, >11 s, imbalance

**Seconds**

**Time:**

---

* The scoring form for the Briest-BESTest examination may not be used or reproduced without written permission of the authors.
### Master Chart:

| SRL | Name     | Sex | Occupation       | Education | Health Status | Employment Status | Family History | BMI | BP | Glucose | Triglyceride | HDL  | LDL  | Cholesterol | Waist Circumference | Weight | Height | Blood Pressure | Sugar Status | Blood Test Status | Chest X-ray Status | Ophthalmic Exam Status | Dental Check-Up Status | Informed Consent Status | Total score |
|-----|----------|-----|------------------|-----------|---------------|-------------------|----------------|-----|----|--------|-------------|------|------|-------------|---------------------|--------|--------|---------------|-------------|------------------|---------------------|---------------------|---------------------|---------------------|-------------|----------|
| 1   | Nadia    | F   | Nurse            | 3 yrs     | None          | None              | None           | None| None| None   | None         | None | None | None         | None                 | None   | None   | None          | None         | None             | None               | None               | None               | None             | 1           |
| 2   | Edward   | M   | Doctor           | 4 yrs     | None          | None              | None           | None| None| None   | None         | None | None | None         | None                 | None   | None   | None          | None         | None             | None               | None               | None               | None             | 2           |
| 3   | Samantha | F   | Teacher          | 5 yrs     | None          | None              | None           | None| None| None   | None         | None | None | None         | None                 | None   | None   | None          | None         | None             | None               | None               | None               | None             | 3           |
| 4   | Robert   | M   | Engineer         | 6 yrs     | None          | None              | None           | None| None| None   | None         | None | None | None         | None                 | None   | None   | None          | None         | None             | None               | None               | None               | None             | 4           |
| 5   | Jennifer | F   | Businesswoman    | 7 yrs     | None          | None              | None           | None| None| None   | None         | None | None | None         | None                 | None   | None   | None          | None         | None             | None               | None               | None               | None             | 5           |

**Data Collection Motivated Intent**

- **Occupation:** Nurse, Doctor, Teacher, Engineer, Businesswoman
- **Education:** 3-7 yrs
- **Health Status:** None
- **Employment Status:** None
- **Family History:** None
- **BMI:** None
- **BP:** None
- **Glucose:** None
- **Triglyceride:** None
- **HDL:** None
- **LDL:** None
- **Cholesterol:** None
- **Waist Circumference:** None
- **Weight:** None
- **Height:** None
- **Blood Pressure:** None
- **Sugar Status:** None
- **Blood Test Status:** None
- **Chest X-ray Status:** None
- **Ophthalmic Exam Status:** None
- **Dental Check-Up Status:** None
- **Informed Consent Status:** None
- **Total score:** 1-5

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**85**