# Vestibular Assessment in Chronic Obstructive Pulmonary Disease Patients

*Thesis*
*Submitted for Partial Fulfillment of Master Degree in Audiology*

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**Walid Askar**

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# List of Abbreviations

| Abb. | Full term |
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**ABC** ..... Activity-specific Balance Confidence
**ABR**..... Auditory Brainstem Response
**AECOPD** ..... Acute Exacerbation of Chronic Obstructive Pulmonary Disease
**AEPs** ..... Auditory Evoked Potentials
**BBS** ..... Berg Balance Scale
**BMI**.....Body Mass Index
**CDP**..... Computerized Dynamic Posturography
**COPD**..... Chronic Obstructive Pulmonary Disease
**DHI**..... Dizziness Handicap Inventory
**DPOAE** ..... Distortion Product Oto-Acoustic Emission
**FEF** ..... Forced Expiratory Flow
**FEV1** ..... Forced Expiratory Volume
**FLP** .....Foam Laser dynamic Posturography
**FVC** ..... Forced Vital Capacity
**GERD**..... Gastro-Esophageal Reflux Disease
**GOLD**..... Global initiative for chronic Obstructive Lung Disease
**HL**..... Hearing Level
**HRQL**..... Health-Related Quality of Life
**ICS**..... Inhalation Corticosteroids
**ICU** ..... Intensive Care Unit
**LABAs**..... Long-Acting β-Agonists
**LAMAs** ..... Long-Acting Muscarinic receptors Antagonists
**LVN** ..... Lateral Vestibular Nucleus
**mCTSIB**..... Modified Clinical test of Sensory Interaction of Balance
**MRC** ..... Medical Research Council
**OAE**..... Oto-Acoustic Emission

# List of Abbreviations Cont...

| Abb. | Full term |
|---|---|

**OHCs**..... Outer Hair Cells
**OLS** ..... One Leg Stance
**OR** ..... Odds Ratio
**OSAS**..... Obstructive Sleep Apnea Syndrome
**PR**..... Pulmonary Rehabilitation
**PSG** ..... Polysomnography
**PTA** ..... Pure Tone Audiometry
**ROS** ..... Reactive Oxygen Species
**SD**..... Speech Discrimination
**TNF** ..... Tumor Necrosis Factor
**TUG**..... Timed Up and Go test
**VNG**..... Video-nystagmography
**VOR**..... Vestibulo-Ocular Reflex
**VSR** ..... Vestibulo-Spinal Reflex

# INTRODUCTION AND RATIONALE

Chronic Obstructive Pulmonary Disorder (COPD) is a common preventable and treatable disease which is characterized by persistent airflow limitation that is usually progressive and associated with an enhanced chronic inflammatory response in the airways and the lung to noxious particles or gases. It affects more than 5 percent of the population and is associated with high morbidity and mortality (the fourth leading cause of death in the world) ***(Buist et al., 2007)***.

Balance disorder is a common manifestation in people with COPD which may contribute to overall functional decline. COPD causes balance impairment through hypoxia of inner ear, vestibular nuclei (more sensitive to hypoxia than other cerebral nuclei) and generalized cerebral hypoxia. In addition to musclo-skeletal weakness, visual deficits and poly-neuritis due to accumulation of toxins. All of these factors affect position sense in the feet and legs, increasing the balance dysfunction in those patients ***(Rennard et al., 2013; Beauchamp et al., 2016).***

Screening tools such as questionnaires and office testing were developed to identify individuals at risk of falling and are frequently used as a part of falls prevention programs in hospitals ***(Jacobson and Shepard, 2014).***

The diagnostic process of imbalance is more or less a complicated task especially in older adults. This diagnostic

process must distinguish between otologic, central, medical, and psychogenic etiologies ***(Agrawal et al., 2012).*** Video-Nystagmography (VNG), especially the caloric test, has been the most important test of the vestibular function. The caloric test, despite its limitations, is a sensitive test for detecting common vestibular abnormalities ***(Shepard, 2002).***

However, caloric test alone does not reflect the functional ability of the patient to maintain balance in daily life conditions and to predict risk for falls. Moreover quantitative measurement of balance function by an objective test as computerized dynamic posturography test (CDP) is an integral part of the assessment of the functional ability and risk for falls in dizzy patients in general.

The use of this high technology vestibular laboratory testing provides adequate data about localization and quantification of vestibular abnormalities. However it is sometimes not feasible in COPD patients due to their health condition.

Many studies were done to assess the effect of Chronic Obstructive Pulmonary Disorder on the vestibular function, however only a few investigations had evaluated the relationship between hypoxia related to COPD and the functional decline in vestibular system, accordingly, the present study was planned to apply a test battery approach to evaluate balance and functional status of those patients.

# AIM OF THE WORK

***The aim of the work is to:***

1. Apply office test battery to evaluate COPD patients.
2. To evaluate vestibular and functional status in COPD patients.
3. Correlate findings of office tests with vestibular and functional laboratory tests.

Chapter 1

# CHRONIC OBSTRUCTIVE PULMONARY DISEASE (COPD)

## Definition:

Chronic Obstructive Pulmonary Disease (COPD) is a common preventable and treatable disease; which is characterized by persistent airflow limitation that is usually progressive and associated with an enhanced chronic inflammatory response in the airways and the lung to noxious particles or gases. Exacerbations and co-morbidities contribute to the overall severity in individual patients. The chronic airflow limitation characteristic of COPD is caused by a mixture of small airways disease "obstructive bronchiolitis" and parenchymal destruction "emphysema", the relative contributions of which vary from person to person ***(GOLD, 2016).***

COPD is the fourth leading cause of death in the world, represents an important public health challenge that is both preventable and treatable. COPD is a major cause of chronic morbidity and mortality throughout the world; many people suffer from this disease for years and die prematurely from it or due to its complications. Globally; the COPD burden is projected to increase in the coming decades because of continuous exposure to COPD risk factors and aging of the population ***(GOLD, 2016).***

## Prevalence:

The reported prevalence of COPD is ranged from 0.2% in Japan to 37% in the USA, but this varies widely across countries and populations, by diagnosis methods, and by age group analysis. Studies show that only 32%-50% of symptom defined AECOPD (Acute Exacerbations of COPD) are reported by patients to health care professionals ***(Rycroft et al., 2012)***.

### Epidemiology

The prevalence of COPD varies greatly per country and also within countries ***(Buist et al., 2008)***.

This heterogenecity can be contributed to not only differences in diagnostic methods and classification but also to smoking habits, population age, indoor and outdoor air pollution, occupational exposure, prevalence of pulmonary tuberculosis, chronic asthma and socioeconomic status ***(Salvi and Barnes, 2009)***.

### Epidemiology in Egypt

In 5 years-study (1972-1976) 13.6 % of patients admitted to Ain Shams Chest section were COPD sufferers ***(El Waraki et al., 1992)***.

It was found that the prevalence of chronic obstructive lung disease was 23.1% in an elderly population living in a rural area in Minya Governorate ***(Shaabaan et al., 1997)***.

In a review of > 1000 critically ill patients admitted to Alexandria University Hospitals ICU along 12 years, acute respiratory failure on top of COPD was the most common cause of admission ***(Gad El Hak, 1980)***.

## Morbidity and Mortality:

The risk of hospital admission increases with decreasing lung function and when chronic respiratory symptoms are presented ***(Feenstra, 2001).***

COPD death rates are very low under the age of 45 years, and increase steeply with age. It is considered the fourth leading cause of death in the USA and Europe; mortality in females has been doubled over the last 20 years ***(Murray et al., 1997).***

## Risk factors:

### *1. Exposure to:*

- **Tobacco smoke:** Cigarette smoking is the most important risk factor for COPD, either active or passive exposure to smoke as well as fetal affection in pregnant females ***(Holt, 1987).***
- **Infections:** Illnesses diagnosed as whooping cough, bronchiolitis or pneumonia in the first year of life were associated with a significant reduction in forced expiratory volume measured in the first decade ***(Tager et al., 1988).***