# Assessment of Diaphragmatic Mobility by Chest Ultrasound in Relation to the Body Mass Index and Spirometric Parameters

Thesis

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By


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بسم الله الرحمن الرحيم

قالوا

سبحانك لا علم لنا

إلا ما علمتنا إنك أنت

العليم الحكيم

صدق الله العظيم

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# List of Abbreviations

| Abb. | Full term |
|---|---|
| *ATS* | *American Thoracic Society* |
| *ATS/ERS* | *American thoracic society/European thoracic society, 2005* |
| *BMI* | *Body mass index* |
| *C* | *Cervical vertebra* |
| *COPD* | *Chronic obstructive pulmonary disease* |
| *DM* | *Diabetes mellitus* |
| *DTF* | *Diaphragmatic thickness fraction* |
| *ERV* | *Expiratory reserve volume* |
| *ERV* | *Expiratory reserve volume* |
| *FEF25%–75% or MMEF* | *The flow measured between 25% and 75% of the forced expiratory manoeuvre (expressed in l$^{st}$ second)* |
| *FEV1* | *Forced expiratory volume in the first second* |
| *FEV1%* | *Percent of $FEV_1$ of the predicted* |
| *FRC* | *Functional residual capacity* |
| *FVC* | *Forced vital capacity* |
| *FVC%* | *Percent of FVC of the predicted* |
| *HS* | *Highly significant* |
| *HTN* | *Hypertension* |
| *IC* | *Inspiratory capacity* |
| *ICU* | *Intensive care unit* |
| *ILD* | *Interstial lung disease* |
| *IQR* | *Interquartile range* |
| *Kgs* | *Kilograms* |
| *L* | *Liters* |
| *L* | *Lumbar vertebra* |

# List of Abbreviations

| Abb. | Full term |
|---|---|
| *Lbs* | *Bounds* |
| *LLN* | *Lower limit of the confidence interval* |
| *Lt.* | *Left* |
| *$M^2$* | *Meter square* |
| *MHz* | *Mega hertz* |
| *MVV* | *Maximum voluntary ventilation* |
| *n* | *Number* |
| *No.* | *Number* |
| *NS* | *Non significant* |
| *PEF* | *Peak expiratory flow* |
| *PFTs* | *Pulmonary function tests* |
| *p-value* | *Probability value* |
| *R* | *Pearson correlation* |
| *Rt.* | *Right* |
| *RV* | *Reserve volume* |
| *S* | *Significant* |
| *SD* | *Standard deviation* |
| *Sec* | *Second* |
| *sig.* | *Significance* |
| *TLC* | *Total lung capacity* |
| *TV or VT* | *Tidal volume* |
| *U/S* | *Ultrasound* |
| *UAO* | *Upper airway obstruction* |
| *USA* | *United states of America.* |
| *VC* | *Vital capacity* |
| *VIDD* | *Ventilator induced diaphragmatic dysfunction* |
| *WHO* | *world Health Organization* |

# INTRODUCTION

Diaphragm is the major respiratory muscle used for quiet breathing. Different structural and functional techniques are available for evaluating the diaphragm. Each technique has its strengths and weaknesses ***(Gerscovich et al., 2001).***

Traditionally, this evaluation is accomplished through history, physical exam., fluoroscopic sniff test, nerve conduction studies, and electromyography (EMG). Nerve conduction studies and EMG in this setting are challenging, uncomfortable, and can cause serious complications such as pneumothorax ***(Aarti et al., 2013).***

Ultrasound of the diaphragm is an evolving diagnostic modality with several techniques and measurements that can be employed for structural and functional assessment of the diaphragm. It is now being more commonly used for the evaluation of diaphragm structure and function ***(Epelman et al., 2005).***

Ultrasound focuses mainly on the posterior and lateral parts of the diaphragm, which are the muscular crural components innervated by the phrenic nerve, rather than the anterior central tendon seen in fluoroscopy, which moves 40% less with respiration. The diaphragm is usually higher in children, young adults, and obese individuals, and its position and motion depend on the position of the subject ***(Houston et al., 1992).***

Muscle fibers shorten with contraction and cause muscle thickening. Increase in diaphragmatic thickness during inspiration has been used as an indirect measurement of muscle fiber contraction ***(Gottesman et al., 1997).***

Age-related changes in body composition and fat distribution may be associated with the pulmonary impairment observed in elderly persons, and some studies found a direct relationship between BMI and the lung function determined by spirometric examination ***(Lerolle et al., 2009).***

Some studies found that healthy subjects with smaller BMI ((<18.5)showed a decreased amount of diaphragmatic motion, and as the BMI and WC increased, the diaphragmatic motion increased. This increase in motion, however, is not linear, and as the BMI and WC increase, the diaphragmatic motion does not show a parallel increase ***(Arora and Rochester, 1982).***

Weight may have effects on pulmonary function tests including impairment on pulmonary function testing, small airway dysfunction and expiratory flow limitation, alterations in respiratory mechanics, decreased chest wall and lung compliance, decreased respiratory muscle strength and endurance, decreased pulmonary gas exchange, lower control of breathing, and limitations in exercise capacity **(*Faintuch et al., 2014).***

# Aim of the Work

The aim of this work was to asses the diaphragmatic mobility by chest US in relation to BMI, spirometric parameters trying to find correlation between diaphragmtic mobility (excursion), BMI and spirometric parameters.