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ABSTRACT OF DOCTORAL THESIS

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TITLE:

"The effect of mobility techniques on the mobility of the diaphragm in people with asthma"

Introduction: The respiratory muscles work uninterruptedly throughout our lives[1]. The diaphragm, which is the most important muscle of respiration due to its anatomical uniqueness and contribution to minute ventilation (60%-80%), generates a craniocaudal movement of its dome during contraction[2,3]. The physiological diaphragmatic function prevents medical problems related to venous drainage, lymphatic flow, poor posture, neck and pelvic function[1,2]. In contrast, abnormal diaphragm function is associated with respiratory symptoms such as shortness of breath, intolerance to exercise, sleep disturbances and hypersomnia. In even more severe cases, it can have a negative impact on survival[4].

According to the literature, patients with Chronic Obstructive Pulmonary Disease (COPD) or Asthma often show diaphragmatic dysfunction[2, 5]. This dysfunction is related to the mechanical linkage between its various parts, thereby placing it at a mechanical disadvantage to the muscle fibers. This pathological change affects the diaphragm's ability to raise and expand the lower rib cage (apposition zone-area in which the lower rib cage and the diaphragm are in direct contact). These changes cause an increase in the work of breathing and diaphragmatic weakness[6].

In COPD, due to the obstruction of the airways, the air is gradually trapped in the pulmonary parenchyma during the exhalation phase, resulting in pulmonary hypertension during exercise and at rest[7]. This clinical condition disrupts the architecture of the thoracic cage, significantly reduces the physiological advantage of the diaphragm resulting in the movement of the upper thorax to contribute more during respiration[7]. The mobility of the diaphragm in inhalation is reduced due to its reduced length, its lower position in the thoracic cage, and the reduced application zone, thus significantly increasing the work of respiration[8]. Similarly, in patients with moderate or severe asthma, restricted expiratory flow (early airway closure), activation of the inspiratory muscles at the end of expiration, and decreased lung flexibility may lead to

pulmonary overstretching, causing functional abnormalities[9]. Patients with COPD whose normal function of the respiratory muscles has been affected show an abnormal respiratory pattern, shortness of breath, and reduced ability to exercise and perform daily activities. Hyperventilation syndrome in asthma and pulmonary hyperinflation in COPD, although triggered by different mechanisms, provoke common pathological changes[10,11,12] and affect the diaphragm's ability to raise and expand the lower rib cage. This may lead to a decrease in the transverse diameter of the lower ribcage during inspiration[13,14].

In the last decades, the main research and clinical question is by which physiotherapy techniques we can improve the effectiveness of respiratory muscles during respiration. For this reason,several physiotherapy techniques can be used. Breathing retraining is a worldwide acceptable and effective therapy for improving its operation[15,16,17].

It is an easy and safe technique, without cost and widespread use in the clinical environment. Respiratory model teaching techniques have high documentation of effectiveness and are applied as a primary physiotherapy intervention in pulmonary rehabilitation[18, 19, 20]. In addition, the use of specific diaphragm mobilization techniques, although they do not yet have strong research documentation, according to recently published studies, their positive effect is reported in patients with COPD[21]. These effects concern the increase of the mobility of the chest wall, the increase of the mobility of the diaphragm, the increase of the inspiratory force, the capacity for exercise, and the function of the lungs[22, 23].

The effectiveness of specific diaphragm mobilization techniques has been studied in COPD[21, 26], but pediatric asthma[27] has not been studied in adult asthma. In addition, their effect in combination with standard respiratory pattern retraining techniques has not been investigated. The present study hypothesizes that the combination of the mentioned physiotherapy techniques will contribute positively to the length-tension relationship and mobility of the diaphragm, the chest mobility and ultimately functionality, in the feeling of shortness of breath and the psychology of patients with asthma. Therefore, new studies are needed to combine these new rehabilitation applications to promote valid, reliable, and objective results. The amplification of the above in patients with asthma using respiratory standards and the application of special diaphragm mobilization techniques will contribute to their better rehabilitation management.

Purpose: This study aims to examine the effect of the combination of diaphragm mobilization techniques and respiratory pattern retraining exercises in conjunction with the individual respiratory pattern retraining in people with moderate to severe asthma.

Participants: Patients will participate in the study after being informed and writing their consent for voluntary participation.

Main Outcomes: Diaphragm Excursion measured by ultrasonography[28], Chest Expansion measured by inch tape[29], Maximum Respiratory PressuresPimax- Pemax (MICRO RPM)[30,31]Dyspnoea scale measured by the Medical Research Council (MRC) modified[32,33], the functional capacity (6MWT, SF12, ACT)[34,35,36,37,38]and psychology (HADS)[39,40].

Intervention: The study will be performed in people with moderate to severe asthma who will be community-based. The participants will be divided into two experimental intervention groups(A and B). Intervention group A will receive diaphragm mobilization techniques and breathing retraining exercises, while intervention group B will only receive breathing retraining exercises.Patients will have two sessions per week for one month. The participants will also be asked to attend two follow-up sessions after the end of the experiment. These will occur one and two months after the end of the experiment, respectively.

Statistical Analysis: The statistical analysis program 'Statistical Package for the Social Sciences (SPSS) will be used for all analyses. The level of significance αwill be set to 0.05.

Expected research results: The ultimate goal of this work is to inform the clinical practice for the best and most complete treatment of diaphragmatic dysfunction that occurs in obstructive diseases such as asthma. The expected research results are the improvement of the mobility and the length-tension relationship amic relationship of the diaphragm, the chest development, and consequently the dyspnea and the functionality of the patients. The effect of the rehabilitation techniques selected in the study will be tested with various measurements and at a relative depth of 2 months after the end of the therapeutic interventions.

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