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INFLUENCE OF BREATHING EXERCISES AND RESPIRATORY REHABILITATION ON POSTURAL DISORDERS IN CHILDHOOD AND ADULTHOOD

Vanya Pavlova[1], Ruska Paskaleva[1], Violeta Ivanova[1]*

[1]Trakia University, Faculty of Medicine - Stara Zagora, Bulgaria,
e-mail: vanya.pavlova@trakia-uni.bg, ruska.paskaleva@trakia-uni.bg, violeta.ivanova@trakia-uni.bg

Abstract: Postural abnormalities in childhood and adulthood are a relevant medical and social problem associated with significant alterations of the spine and several internal organs and systems. Impaired posture, spine and chest deformities impair the respiratory and cardiovascular functions. Breathing exercises, respectively respiratory rehabilitation, are an key means exerting a beneficial influence on the impaired functions of these organs and systems, and are also successfully applied in musculoskeletal pathologies. The aim of the study was to overview the scientific reports on the influence and application of breathing exercises and respiratory rehabilitation in various postural disorders in childhood and adulthood. For the purposes of the study, a search in electronic databases such as Pubmed, Web of Sciences, Academic search complete on EBSCO, Scopus, Google Scholar, etc. was carried out. According to the studied sources, breathing exercises are an essential part of traditional and innovative methods for conservative and surgical treatment of postural abnormalities. Studies demonstrate better results with protocols that include breathing exercises as element of the rehabilitation programme compared to those without breathing exercises. Respiratory rehabilitation plays an important role in the treatment of postural disorders in childhood and adulthood, both in their conservative and postoperative treatment. It not only improves the respiratory function, but has also a positive effect on the general posture, muscle balance and quality of life of the individual.

Keywords: respiratory rehabilitation, postural disorders, breathing exercises.
Field. Medical sciences

1. INTRODUCTION

Postural abnormalities in childhood and adulthood are a relevant medical and social problem associated with significant alterations of the spine, the chest and several internal organs and systems. Normal human posture is determined by the correct mutual arrangement of the spinal and motor segments, with normal curves in the sagittal plane and a vertical shape in the frontal plane. Postural abnormalities occur when the balance between the forces generated by muscle action, the passive stabilisation by the ligamentous apparatus and the forces of gravity is disturbed (Popov, 2009). The posture is age- and gender-related (Latalski et al., 2013), as well as depends on factors such as lifestyle, environmental conditions, reduced or absent physical activity, which are prerequisites for the emergence of postural disorders (Lizak et al., 2014). Modern lifestyle and reduced motor activity lead to changes in the spine and the chest even at preschool age. The deviations from normal posture are a common phenomenon during the growth and development period (Paskaleva, 2021). Postural defects are typical for the teenage period because of reduced physical activity consequently to increased screen time in front of the TV, video games, etc. (Latalski et al., 2013; Shah and Patil, 2019), as well as a result of poor postural habits, e.g. carrying a backpack on one shoulder, sitting on a low desk, and a number of psychological factors (Latalski et al., 2013). All these may lead to disharmonic development of growing organism's organs and affection of respiratory system functions (Shah and Patil, 2019). An essential factor in the etiology of postural abnormalities is the incorrect motor posture, more common in people who spend long periods of time in static positions (standing, sitting, etc.). The etiology of the problem includes factors such as rapid growth during childhood, muscle imbalance and muscle contractures, pain from nerve root compression leading to antalgic scoliosis; respiratory diseases (emphysema), general weakness, overweight, impaired proprioception or muscle spasticity (in cerebral palsy). Posture may also be impaired from structural deformities resulting from developmental abnormalities, trauma, disease, etc. (Popov, 2009).

Postural disorders affect not only the vertebral column and chest, but also impair the functions of cardiovascular and respiratory organs and systems - they affect blood circulation, hinder lung function, disrupt breathing due to low oxygen consumption (Mitova et al., 2014). The functions of some internal organs (stomach, liver, etc.) are disturbed (Lizak et al., 2014). Numerous studies have shown that pos-

*Corresponding author: vanya.pavlova@trakia-uni.bg

tural disorders in childhood and adulthood have a negative impact on respiratory system functions. According to Kunal K and Arora S (2022), breathing or posture disorders are positively correlated and lead to a vicious circle of symptoms such as anxiety, tight chest and/or chest pain, difficult shallow breathing, hyperventilation etc. In adolescent idiopathic scoliosis, Rezaeian Z et al. (2023) found decreased muscle strength, reduced endurance, changes in chest volume, and impaired breathing along with the noticeable body deformation. According to Basbug G et al. (2023), the work of the inspiratory and expiratory muscles in adolescents with scoliosis is affected in addition to disorders of respiratory dynamics. A study found that every 10 degrees of thoracic scoliosis are accompanied with approximately 4% decrease in vital capacity (Ishikawa and Bach, 2010). Barois A (1999) found a significant reduction in lung volumes and capacities in idiopathic scoliosis. The vital capacity associated with Cobb angle, vertebral rotation and thoracic lordosis was significantly reduced. Maximum pulmonary ventilation and forced expiratory volume per 1 second were reduced without changes in residual volume. A significantly more pronounced functional lung disorder on the concave side of the scoliotic curve is a characteristic feature. The ventilatory pattern is characterised by low tidal volume and high respiratory rate with increased ventilation work. It has been established that scoliosis occurring before the age of 5 years has a worse respiratory prognosis with involvement of the lungs and the chest (Barois, 1999). According to Redding et al. (2017), respiratory muscle weakness is common and persistent in children with early onset of scoliosis and correlates with reduced vital capacity. A study of 60 patients with idiopathic scoliosis (43 women) with a Cobb angle between 20° and 66° demonstrated that the increased Cobb angle and body rotation angle affected negatively the respiratory function. It was also found that increased body rotation angle was associated with reduced inspiratory and expiratory muscle strength (Çetinkaya et al., 2024). According to researchers, kyphoscoliosis is outlined with a restrictive ventilatory syndrome (Barois, 1999). In idiopathic kyphoscoliosis, the vital lung capacity and the respiratory reserve are reduced regardless of the accompanying muscle weakness (Barois, 2004).

Postural disorders during the adulthood begin in childhood or result of ageing, accompanied by musculoskeletal changes and an increased tendency towards spine curving (Eftekhari et al., 2024). The musculoskeletal changes resulting from anatomical, physiological and biomechanical alterations, change the posture of elderly people, which is characterised by extreme neck, waist and upper back lordosis (Ciccarelli et al., 2014). Increased thoracic kyphosis in adulthood leads to disorders not only in the posture, but also in diaphragmatic mobility, respiratory function and the quality of life (Rashed et al., 2024).

2. THE AIM OF THE STUDY

The aim of the study was to overview the scientific reports on the influence and application of breathing exercises and respiratory rehabilitation in various postural disorders in childhood and adulthood

3. MATERIAL AND METHODS

For the purposes of the study, a search in electronic databases such as Pubmed, Web of Sciences, Academic search complete on EBSCO, Scopus, Google Scholar, etc. was carried out.

4. RESULTS AND DISCUSSION

Conservative approaches occupy a significant place in the treatment of postural disorders. Some of the most popular physiotherapeutic methods in Europe for correction and stabilisation of the deformity, especially during the childhood, are Schroth, SEAS, BSPTS, FED, FITS, Lyon, Side Shift and DoboMed. Their focus is the application of corrective exercises in three planes, development of stability and balance, breathing exercises and sense of posture (Seleviciene et al., 2022). A number of studies have shown that the application of these methods, as well as of other exercises for spinal curvatures correction, have a beneficial effect not only on postural disorders, but also on the respiratory functions. According to Kisner C and Colby LA, (2013) exercises for posture correction contribute to increasing lung capacity and breathing depth. A six-month study demonstrated that posture correction exercises and moderate intensity exercises improved respiratory function in teenagers from Karad. Adolescents with postural disorders 12-18 years of age were studied. The applied methodology included moderate intensity exercises (running, jumps in place and side-to-side hops) for 30 minutes daily, 5 times a week as well as posture correction exercises (chin tuck - 3 sets of 10 repetitions; scapular retraction - 3 sets of 10 repetitions; cat and camel - 3 sets of 10 repetitions). As a result of the study, the authors reported an improvement in posture and a significant effect of moderate intensity exercises on respiratory function in the subjects

studied (Shah and Patil, 2020). A study reported that core stabilisation exercises in addition to traditional scoliosis exercises improved respiratory muscle strength in patients with adolescent idiopathic scoliosis. Thirty patients, randomly assigned to two groups were studied: experimental (n = 15, age = 13.8 ± 2.8 years, Cobb angle = 19.3 ± 6 degrees, Risser sign: n (1) = 1; n (2–4) = 14) and control group (n = 15, age = 15.8 ± 3.4 years, Cobb angle = 20.8 ± 7.9 degrees, Risser sign: n (1) = 1; n (2–4) = 14). Both groups received traditional scoliosis exercises for a period of 8 weeks and basic core stabilization exercises were added to the programme of the experimental group only. The results showed statistically significant improvement ($P < 0.05$) in maximum inspiratory pressure, maximum expiratory pressure (mean changes = 17.4 ± 5.2 cmH2O; 10.6 ± 4.3 cmH2O, respectively), significantly more pronounced compared to the control group (Yildirim et al., 2022).

The effects of breathing exercises, respectively respiratory rehabilitation on postural disorders and their role abnormal posture correction were investigated by different researchers. According to some studies, poor posture could be corrected with breathing exercises. Exercises for respiratory system training improve breathing coordination and muscle strength, as well as the chest and diaphragmatic mobility (Kunal and Arora, 2022). According to the reviewed sources, breathing exercises, respectively respiratory rehabilitation occupy a substantial place in both traditional and innovative methods for conservative and surgical treatment of postural deformities.

Pulmonary rehabilitation is an evidence-based, multidisciplinary complex discipline. It is integrated into the general approach to the treatment of patients and is specifically aimed at reduction of the respiratory complaints' severity, optimisation of the functional state, and prevention of complications from other organs and systems (Dimitrova, 2013). In addition to respiratory diseases, the respiratory rehabilitation is applied in cardiovascular illnesses, musculoskeletal injuries, immobilisation etc. (Gavrailov et al., 2015). It has a tonic action on the nervous system and improves metabolism (Gavrailov et al., 2015; Tenforde et al., 2020; Mollova et al., 2022). It is defined as the most effective curing strategy for reducing shortness of breath, increasing physical endurance and life quality (Dimitrova, 2013). Respiratory gymnastics improves chest excursions, increases the respiratory muscles' strength, diaphragmatic mobility, and excites the upper respiratory tract receptors, leading to bronchial dilation and breathing deepening. This in turn improves pulmonary ventilation, circulation in the pulmonary circuit and promotes expectoration (Tenforde et al., 2020; Mollova et al. 2022). Respiratory gymnastics improves lung vital capacity, chest and diaphragmatic mobility, lung tissue elasticity, optimises the respiratory act, improves the oxygen supply of necessary for the body's physical efforts (Gavrailov et al., 2015). There is moderate evidence about improvement in the quality of life after diaphragmatic breathing in both the short and long term (Prem et al., 2013).

Several studies have proven the effects of pulmonary rehabilitation in postural disorders. Basbug G, et al. (2023) found that inspiratory muscle training improves significantly respiratory function, respiratory muscle strength and functional capacity in patients with adolescent idiopathic scoliosis. Thirty-six adolescents divided into control and experimental groups, were studied. Both groups received an 8-week conventional exercise programme (diaphragmatic breathing exercises, resistive local exercises, spinal stabilisation exercises, interscapular muscle strengthening and stretching). The experimental group was additionally trained with a Threshold IMT device (15 minutes, 2 times a day). The results showed improved lung volumes and capacities in both groups (forced expiratory volume in the 1st second, peak expiratory flow; improved respiratory muscle strength by maximum inspiratory pressure and maximum expiratory pressure; functional capacity by 6-minute walk test), significantly more pronounced in the experimental group. Another pulmonary rehabilitation study (Dogar et al, 2021) also found improved respiratory functions in 30 patients with adolescent idiopathic scoliosis, 1 and 6 months after surgical intervention. The examined subjects were divided into 2 groups, and after the scoliosis surgery group 1 (n = 15) received diaphragmatic breathing exercises and pursed lip breathing, while group 2 (n = 15) was treated only surgically. Post-surgery, the authors reported significant improvements in forced vital capacity and forced expiratory volume in the 1st second (l/s) in both groups after surgery ($P = .001$, $P = .014$, $P = .001$, $P = .005$, respectively) as well as significantly increased partial pressure of oxygen (pO2) values 6 months post-surgery compared with pre-surgery values in group 2 ($P = .022$) (Dogar et al., 2021).

In adulthood, cardiorespiratory failure is a common cause of death in patients with severe kyphoscoliosis (Hornstein et al., 1987). A study (Rashed et al., 2024) of 40 postmenopausal women with increased thoracic kyphosis found that the addition of diaphragmatic breathing exercises increased diaphragmatic excursion to a greater extent than corrective exercises alone. Significant improvements in kyphosis angle, chest pain and life quality were observed after a 12-week programme of corrective exercises alone or combined with diaphragmatic breathing exercises.

Respiratory rehabilitation with the complex of methods and tools is aimed at respiratory functions

improvement, with a direct effect on the posture and stance in children and adults. It is an effective method contributing to posture correction through major muscle groups strengthening and muscle imbalance correction. The ability to combine respiratory rehabilitation with other therapeutic methods increases its effectiveness and is a prerequisite for achieving long-term results. It is an important component of the therapy of children with spinal deformities such as scoliosis, kyphosis, lordosis etc. These abnormalities often affect the respiratory function, because the displacement of the spine and ribs limits the normal chest mobility. The respiratory rehabilitation has a significant impact on the treatment and management of postural disorders in adulthood, which are often associated with incorrect posture, muscle imbalance and limited spine mobility, all of which can lead to compromised respiratory function. The possible role of respiratory rehabilitation for improvement of postural control and correction of deformities accompanying postural disorders is an important aspect that necessitates further in-depth investigation.

5. CONCLUSION

Respiratory rehabilitation plays an important role in the treatment of postural disorders in childhood and adulthood, both in their conservative and postoperative treatment. The effect of pulmonary rehabilitation for postural disorders is manifested with improved chest mobility, unblocked and improved mobility of the diaphragm, greater lung volumes and capacities, improved breathing mechanics and oxygen supply of tissues. It not only improves the respiratory function, but has also a positive effect on the general posture, muscle balance and quality of life of the individual. Studies demonstrate better results with protocols that include breathing exercises as element of the rehabilitation programme compared to those without breathing exercises. Regular interventions could prevent the progression of respiratory disorders associated with spinal deformities and also, assist in body's long-term adaptation.

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