THE EFFECTS OF EXERCISE PROGRAMS ON THE CORRECTION OF KYPHOSIS: A SYSTEMATIC REVIEW

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Abstract: *The term kyphosis is used to describe a spinal curvature that results in an abnormal curvature of the back. Kyphosis can develop due to trauma, developmental abnormalities, degenerative disc disease, as well as inflammatory and infectious diseases. Kyphosis adversely affects both children and the elderly and makes it impossible for them to carry out the normal duties of daily living. In this regard, this systematic review aims to find and determine, based on previous research, the application and effects of various forms of exercise programs on kyphosis correction. All peer-reviewed and analyzed scientific papers were collected and selected using the Internet database of electronic editions of scientific journals: Google Scholar, NCBI, PubMed, PLOS, SCIndeks. The works were searched in the time period from 2000 to 2024. The keywords used to search the database are kyphosis, hyperkyphosis, effects of an exercise program, and Scheuermann's disease (kyphosis). When selecting papers in this study, the criteria by which papers were considered and selected were as follows: examining the effects of various exercise programs on kyphosis, then on strengthening and stretching the muscles of the chest, back, shoulders and neck and reducing the angle of kyphosis. Based on these criteria, 15 papers were included in the final analysis. The best effects on kyphosis corrections, the final analysis found, were having workouts that included stretching and strength exercise programs, lasting a minimum of 4 weeks, with a weekly frequency of 3 workouts of 60 minutes.*
Key words: *kyphosis, hyper-kyphosis, effects, exercise programs*

INTRODUCTION

Spinal deformities are defined as deviations from the normal spinal curvature observed in either the frontal or sagittal plane. Poor muscle development, combined with insufficient physical activity and non-physiological forces acting on the musculoskeletal system, often lead to improper posture (Biševac, Mahmutović, Mekić & Dolićanin, 2021). Spinal deformities can result in symptoms such as pain, weakness, numbness, tingling, loss of function, as well as pulmonary and cardiac complications (Frost, Camarero-Espinosa & Foster, 2019). One of the most common deformities is hyperkyphosis, which Sheehan and Grayhack (2017) define as an exaggerated rounding deformity of the thoracic or thoracolumbar spine, measuring more than 40 degrees using the Cobb angle technique. Similarly, Yaman and Dalbayrak (2014) describe hyperkyphosis as a spinal curvature that results in an abnormal rounding of the back. Kyphosis may develop due to trauma, developmental anomalies, degenerative disc disease, as well as inflammatory and infectious conditions. Hyperkyphosis can be characterized as an excessive thoracic curvature (>40°–45°), and it is among the most prevalent disorders of the spine, as well as a significant etiological factor in upper back pathologies, ranging from shoulder pain to vertebral compression fractures. The prevalence of hyperkyphosis has been reported to be 15.3% in 11-year-old children, 38% in adults aged 20 to 50, and 35% in adults aged 20 to 64. Hyperkyphosis may also develop as a result of muscular and neuromuscular diseases. Conditions such as cerebral palsy, muscular dystrophy, spinal muscular atrophy, spina bifida, neurofibromatosis, connective tissue disorders, Paget's disease, tumors, and spinal surgeries are also known to cause kyphosis (Yaman & Dalbayrak, 2014). From an age-related perspective, it has been established that the kyphotic angle tends to increase with age, leading to age-associated hyperkyphosis. Although increased kyphosis is a typical consequence of osteoporosis, studies have shown that up to 70% of patients with age-related hyperkyphosis do not suffer from reduced bone mineral density (Perriman, Scarvell, Hughes, Lueck, Dear, Smith, 2012). The exact proportion of patients with non-osteoporotic hyperkyphosis remains unknown; however, estimates suggest that 10% to 45% of individuals over the age of 50 are diagnosed with non-osteoporotic hyperkyphosis. In terms of gender, the prevalence of thoracic hyperkyphosis increases to 50% in men and 65% in women over the age of 65 (Bartynski, Heller, Grahovac, Rothfus & Kurs-Lasky, 2005). Various

methods are used to correct hyperkyphosis, including corrective exercises, manual therapy, postural strengthening exercises, taping, and orthotic devices (Seidia, Rajabi, Ebrahimi, Alizadeh & Minoonejad, 2014). Based on this, the aim of the present study is to determine, through a systematic review of existing research, the effects of implementing exercise programs in the treatment and correction of kyphosis.

METHODS

To collect data on the effects of exercise programs on the correction of kyphosis, scientific articles were gathered and analyzed by searching online databases of peer-reviewed journals, including Google Scholar, NCBI, PubMed, PLOS, and SCIndeks. The reviewed studies were published between 2000 and 2023. The keywords used for database searches included: *kyphosis*, *hyperkyphosis*, *hyper-kyphosis*, *effects of exercise on kyphosis/hyperkyphosis*, and *Scheuermann's kyphosis*. The inclusion criteria for selecting research studies were as follows: investigation of the effects of exercise on the reduction of pain and the degree of kyphosis, as well as improvement in spinal function and mobility (flexibility).

RESULTS

Figure 1 illustrates the process of data collection, analysis, and exclusion of identified studies. A large number of studies were initially found through database searches. The majority of studies were excluded based on their abstracts, titles, and publication dates, with only studies published between 2000 and 2024 considered for inclusion. Based on the fulfillment of the established criteria, the number of studies was narrowed down to 15, which were included in the final analysis.

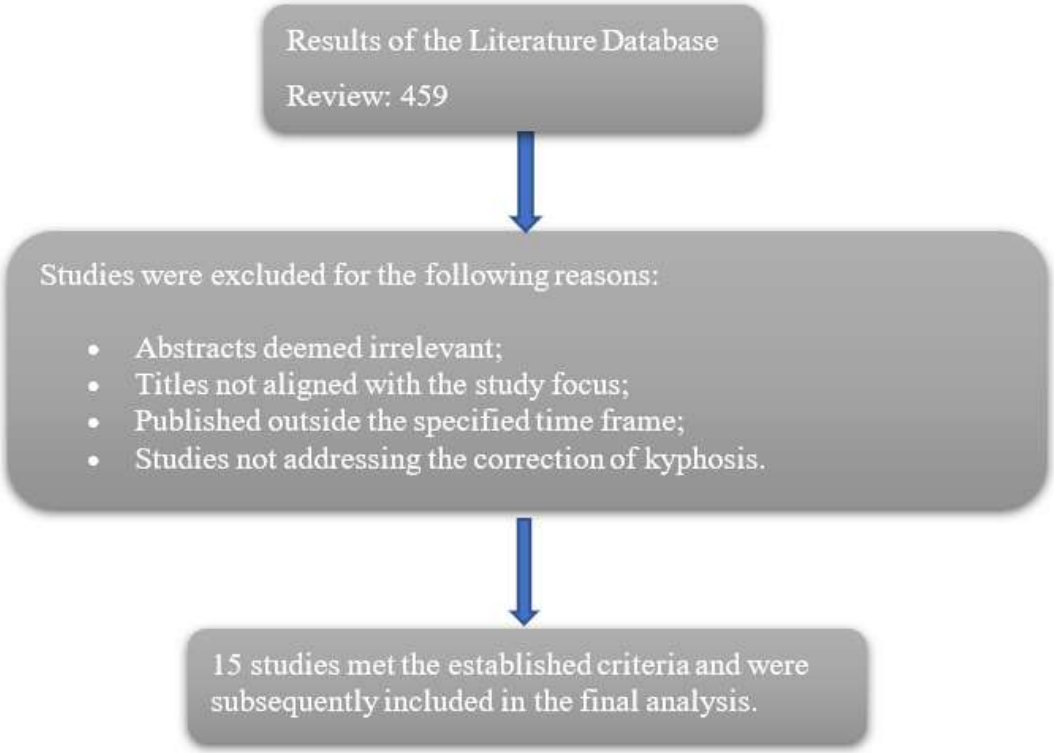

Figure 1 Process of Data Collection, Analysis, and Exclusion of Identified Studies

From the data presented in the table 1, it can be observed that the sample was mixed-gender in five studies, including both male and female participants. In another five studies, the samples consisted solely of female participants, while the remaining five studies included only male participants.

Table 1 Analysis of articles

References	Study Sample N	Groups EG/CG	Experimental Program		Measurement Instruments and Results
			Frequency and Duration	Exercise Program	
Bišević et al. (2021)	n=110 M: 63 F: 47 MA: 6.6±2.4	EGk1 (n=6) EGs2 (n=11) EGl3 (n=1)	TD: 6 months WF: 4 times SD: 90 min	Corrective exercises consisted of strengthening weakened muscles and stretching shortened muscles.	The study results demonstrate that corrective exercises produce sig.↑ in spinal deformities when comparing the (IA) to the (FA).
Ahmadnezhad et al. (2015)	n=30 F: 30 MA: 12.16±3	EG(n=15) CG(n=15)	TD: 8 weeks WF: 3 times	Exercise program consisted of 9 corrective exercise games aimed at strengthening weakened and stretching shortened muscles.	EG showed sig.↑ better results compared to CG; these exercise games may contribute to kyphosis correction.
Yazici et al. (2017)	n=40 M: 40 MA: 17.24 ±2.84	EG(n=20) CG(n=20)	TD: 8 weeks WF: 3 times SD: 60 min	Combined program of PNF stretching and strengthening of abdominal and erector spinae muscles.	An eight-week corrective exercise program demonstrated effective reduction of the kyphosis angle in the experimental group (EG).
Obayashi et al. (2012)	n=26 EG:8m и 5f CG:8m и 5f MA: 16.85±1.2	EG(n=13) CG(n=13)	TD: 4 weeks WF: 3 times SD: 10 min	The experimental group (EG) performed respiratory-muscular exercises using the SpiroTiger device.	The experimental group (EG) achieved sig.↑ between pre- and post-testing.
Rahimi et al. (2020)	n=52 M: 52 MA: 20.65±1.29	EG(n=26) CG(n=26)	TD: 6 weeks WF: 6 times	The experimental group (EG) performed Dynamic Neuromuscular Stabilization (DNS) breathing exercises in varying postures each week, aiming to strengthen spinal stabilizer muscles, improve posture, and reduce the kyphotic angle.	A sig.↑ and reduction of the lumbar angle was observed in the EG after testing and compared to the CG. Results indicate that home-based exercises can also contribute to better posture and a reduced kyphotic angle.
Hamidiyeh et al. (2021)	n=24 M: 24 MA: 60±4	EG(n=12) CG(n=12)	TD: 8 weeks WF: 3 times SD: 60 min	The experimental group (EG) utilized the TRX (Total Resistance Exercises) training method, targeting the strengthening of the erector spinae muscles.	The results indicated that properly structured total resistance training **sig.↑** strengthens stabilizing muscles and contributes to a reduction in the kyphotic angle in middle-aged individuals.
Azizi (2011)	n=10 F: 10 MA: 19-23	EG(n=10)	TD: 6 weeks WF: 3 times SD: 30 min	The hydrotherapy program consisted of warm-up, range of motion and flexibility exercises, strengthening and stabilization, endurance training, as well as coordination and balance exercises.	Results showed a significant difference between pre-test and post-test measurements.

Gaber (2014)	n=30 F: 30 MA: 13.2±3.79	EG1(on land) EG2(in water)	TD: 6 weeks WF: 3 times SD: 30 min	EG1 performed static and dynamic strengthening exercises along with stretching aimed at elongating and restoring the pectoral muscles to their natural position. EG2 followed the same exercises, adapted for aquatic training.	Both EG1 and EG2 significantly reduced the kyphosis angle and strengthened the trunk and back muscles, with negligible differences between the two groups.
Ahmadi et al. (2019)	n=30 M: 30 MA: 18-22	EG(n=14) CG(n=16)	TD: 8 weeks WF: 3 times SD: 60 min	The exercise program for the experimental group (EG) consisted of three phases, including aquatic training with myofascial release of tight muscles and breathing exercises.	Results showed that corrective aquatic exercises significantly reduce postural deformities and neck and shoulder pain in students.
Naderi et al. (2019)	n=24 M: 24 MA: 68.75±2.67	EG(n=12) CG(n=12)	TD: 12 weeks WF: 3 times	Exercises included spinal mobility, stretching of the suboccipital muscles, pectoralis muscle stretching, strengthening of the cervical flexor muscles, and strengthening of the scapular retractor muscles.	The EG achieved **sig.↑** compared to the CG, indicating enhanced posture and a reduction in kyphosis among older adults.
Seidi et al. (2014)	n=60 M: 30 F: 30 MA: 20.84±1.69	EG1 (n=20) EG2 (n=20) CG (n=20)	TD: 12 weeks WF: 3 times	In this study, EG1 utilized the Local Corrective Exercise Program (LCEP), while EG2 followed the Comprehensive Corrective Exercise Program (CCEP).	Based on the results after 12 weeks, both LCEP and CCEP groups demonstrated a significant reduction in thoracic kyphosis angle. However, considering the effect sizes (CCEP = 5.08; LCEP = 1.42), it can be concluded that CCEP is a more effective program than LCEP.
Vaughn et al. (2007)	n=71 M: 23 F: 48 MA: 39.8±13.2	EG(n=32) CG(n=39)	TD: 13 weeks	The seven prescribed exercises in this study combined strengthening, stretching, and self-mobilization activities performed at home. These exercises targeted the erector spinae muscles. Each exercise included a defined progression in repetitions and resistance, utilizing Theraband™ elastic bands.	The EG demonstrated **sig.↑** ($p < 0.05$) between pre- and post-assessments, indicating that home-based exercises can yield positive outcomes.

Ball et al. (2009)	n=35 F: 35 MA: 50-59	EG(n=35)	TD: 1 year WF: 3 times	Nine extensor muscle strengthening exercises were used. Participants were instructed to keep a WHOQOL-BREF exercise diary and were subsequently assessed on their adherence during follow-up evaluations.	In addition to reducing the kyphosis angle and restoring the spine to its natural alignment, a significant increase in height was also observed among the participants.
Sawdon-Bea (2010)	n=44 F: 44	EG(n=23) CG(n=21)	TD: 10 weeks WF: 3 times	The EG followed a 10-week exercise program consisting of stretching, postural strengthening exercises, breathing exercises, upper and mid-back training, as well as weight training for the upper extremities.	This study demonstrated that a home-based exercise program is feasible, safe, and effective for a significant reduction in thoracic kyphosis and significant strengthening of the back extensor muscles in women.
Katzman et al. (2017)	n=99 M: 28 F: 71 MA: 70.6±0.6	EG(n=50) CG(n=49)	TD: 6 months WF: 3 times SD: 1 hour	The experimental group's exercise program consisted of spine muscle strengthening and postural training under therapist supervision.	The EG demonstrated a significant decrease in kyphosis angle at pre- and post assessment, as well as improved postural alignment.

Legend: GS – TD - Training Duration; WF - Weekly Frequency; SD - Session Duration; M – Male participants; F – Female participants; MA – Mean age; sig.↑ – Statistically significant improvement in results; n – Number of participants; EG1 – Experimental Group 1; EG2 – Experimental Group 2; EG3 – Experimental Group 3; CG – Control Group; TD – Total duration of the intervention/program; WF – Weekly frequency of sessions; ST – Duration of each training session; I – Intensity; WHOQOL-BREF – Quality of life assessment instrument developed by the World Health Organization

The largest sample size was reported by Biševac et al. (2021), comprising 110 participants. The smallest sample size was found in the study by Azizi (2011), which included only 10 participants. The youngest sample was represented in the study by Biševac et al., 2021 where the mean age of participants was 6.6 ± 2.4 years. In contrast, the oldest participants were included in the study by Katzman et al. (2017), with a mean age of 70.6 ± 0.6 years, while the study by Vaughn et al. (2007) exhibited the greatest range in mean age (39.8 ± 13.2 years). The study by Sawdon-Bea, J. (2010) did not provide clear data regarding the average age of participants.

The majority of studies (10 in total) included one experimental group and one control group (Ahmadnezhad et al., 2015; Yazici et al., 2017; Obayashi et al., 2012; Rahimi et al., 2020; Hamidiyeh et al., 2021; Ahmadi et al., 2019; Naderi et al., 2019; Vaughn et al., 2007; Sawdon-Bea, 2010; Katzman et al., 2017), while only the study by Seidi et al. (2014) featured two experimental groups and one control group. There were also studies that included only experimental groups: Ball et al. (2009) with one experimental group; Azizi (2011) with one experimental group; Gaber (2014) with two experimental groups; and Biševac et al. (2021) with three experimental groups.

The duration of the studies ranged from 4 weeks (Obayashi et al., 2012), which was the shortest, to one year (Ball et al., 2009), which was the longest study. The most common total duration of the exercise programs was 8 weeks, reported in four studies (Ahmadi et al., 2019; Hamidiyeh et al., 2021; Yazici et al., 2017; Ahmadnezhad et al., 2015). The most frequent weekly training/treatment frequency was three sessions per week, reported in 12 studies, whereas the study by Vaughn et al. 2007 did not provide this information.

The longest treatment/corrective exercise sessions were conducted with the experimental groups in the study by Biševac et al. (2021), lasting 90 minutes. In addition to having the longest treatment duration, this study also had the largest sample size (110 participants) and the youngest average age of participants (6.6 ± 2.4 years). The authors aimed to determine whether regular performance of

corrective exercises—designed to stretch shortened muscles and strengthen weakened muscles—could improve posture in preschool and school-aged children.

Exercises for kyphosis were primarily performed in the prone position, while exercises for lordosis were conducted in the supine position. Exercises targeting scoliosis required special attention, as physiotherapists needed to carefully consider the direction of spinal deviation during training to specifically strengthen weakened muscles and stretch shortened muscles.

DISCUSSION

This systematic review included five studies with exclusively male participants, five with exclusively female participants, and five with an equal representation of both genders. Other studies also demonstrate that the prevalence of kyphosis is nearly equal in men and women, although there is a slight increase in kyphosis incidence among women over 60 years of age.

Research indicates that kyphosis affects both younger and older populations, which can be associated with a sedentary lifestyle, decreased physical activity, and increased use of modern technology.
According to the results of Seidi et al. (2014), after 12 weeks, both the Local Corrective Exercise Program (LCEP) and the Comprehensive Corrective Exercise Program (CCEP) groups showed a statistically significant reduction in the thoracic kyphosis angle. However, considering the effect size (LCEP = 5.08; CCEP = 1.42) and the mean reduction in kyphosis angle (CCEP = −12.25°; LCEP = −5.04°), the CCEP was more effective than the LCEP. Theoretically, there is a close relationship among various deviations such as hyperkyphotic deformity and abnormalities of the head and shoulders in the upper body. From this, it is concluded that correcting each deformity separately, as performed in the LCEP, lacks sufficient scientific justification and is believed to be less effective than the CCEP in reducing the thoracic curvature in patients with hyperkyphosis. In contrast, the CCEP exercises are designed so that most muscles and joints of the head, neck, trunk, and upper extremities are actively and simultaneously engaged in every movement. This approach not only positively influences the postural alignment of the upper body but also distributes the exercise load, avoids focusing on isolated muscles, and delays fatigue.

Since the Cobb angle gradually progresses with age, at a rate of less than 1° per year on average, even a small reduction in kyphosis may be clinically significant, particularly if treatment effects are maintained over time, as highlighted by Katzman et al. (2017). Changes in kyphosis measured by the kyphometer align with previous studies reporting improvements in clinical kyphosis measures following targeted spinal strengthening. An improvement of 0.43 points (95% CI 0.24, 0.61) in the self-image domain of the SRS-30 is comparable to changes observed after scoliosis surgery. Moreover, the authors note that self-image is a component of self-efficacy, which can have long-term benefits and contribute to higher levels of physical functioning, performance, and adherence to exercise in patients with arthritis and other chronic conditions. The authors conclude that such exercise programs also benefit significantly older patients.

In the study by Sawdon-Bea (2010), twenty-three participants in the experimental group performed a strengthening exercise program consisting of eight exercises, conducted three times per week over a 10-week period. Twenty-one participants served as the control group. Using MANOVA, the authors compared the kyphosis index, peak expiratory flow, forced vital capacity, maximal inspiratory pressure, 6-minute walk test, and back extensor strength measured before and after the exercise intervention. Univariate ANOVA tests revealed a significant group-by-time interaction for both the kyphosis index and back extensor strength. Subsequent post-hoc tests identified significant improvements in the kyphosis index and back extensor strength in the exercise group, with no improvements observed in the control group. This study demonstrated that a home-based exercise program is feasible, safe, and effective in significantly reducing thoracic kyphosis and substantially strengthening back extensor muscles in postmenopausal women with osteoporosis.

The study by Ball et al. (2009) lasted a full year. In their cross-sectional study, they observed a steady increase in cervical depth and thoracic curvature among women aged 40 to 70 years, without compression fractures. The greatest change in thoracic curvature was noted between participants aged 50 and 70 years. Cervical depth (kyphosis) increased linearly from 50 to 59 years of age. Based on these observations, the authors investigated the effect of spinal extension exercises on the progression of

kyphotic changes over one year. The greatest improvements reported in this study were achieved through stretching exercises targeting the thoracic curvature.

In the study by Rahimi et al. (2020), the weekly training frequency was six sessions, with three sessions conducted at home and three sessions in designated indoor facilities under professional supervision. The duration of individual training sessions ranged from 10 to 90 minutes. The experimental group performed Dynamic Neuromuscular Stabilization (DNS) breathing exercises with different postures each week, aimed at strengthening spinal stabilizer muscles to improve posture and reduce the kyphosis angle.

In the study by Obayashi et al. (2012), the experimental group performed respiratory muscle exercises lasting 10 minutes, three times per week, over a total program duration of four weeks. As explained by Obayashi and colleagues, respiratory muscle training is not only used in the rehabilitation of patients with respiratory diseases but also in endurance training for athletes. During respiration, the back and abdominal muscles are engaged, which contribute to the maintenance of proper spinal posture.

In the study by Ahmadnezhad et al. (2015), the kyphosis angle was measured using a flexible ruler, a reliable and non-invasive method. Participants were in a relaxed position during measurements. The flexible ruler was placed over the spinous processes from T2 to T12 to obtain the spinal curvature angle. In the study by Yazici et al. (2017), a spinal mouse was used to assess the kyphosis and lordosis angles. The exercise program consisted of PNF (Proprioceptive Neuromuscular Facilitation) stretching (targeting the chest, groin, hamstrings, and gluteus muscles), strengthening of the abdominal muscles (variations of crunches and plank holds), hip flexor and extensor exercises, and Williams exercises aimed at strengthening the spinal muscles.

Azizi (2011) employed a hydrotherapy exercise program to reduce the kyphosis angle. Before testing, kyphosis angle, back muscle strength, spinal muscle flexibility, and shoulder range of motion were measured. The experimental group showed significant improvements at post-testing in back muscle strength (sig. $\uparrow \leq 0.05$), shoulder abduction (sig. $\uparrow \leq 0.05$), spinal flexibility, and thoracic expansion (sig. $\uparrow \leq 0.05$), leading to the conclusion that strengthening these muscles improves posture and consequently reduces the kyphosis angle.

In the study by Ahmadi et al. (2019), the exercise program consisted of three phases: 1) normalization of peripheral structures; 2) restoration of muscular balance; and 3) enhancement of sensory systems and motor skills through training. Exercises were conducted in an aquatic environment. In the first phase, muscle trigger points were released by water massage, and myofascial release of stiff muscles was induced by foam rolling. The second phase involved static stretching exercises combined with corrective breathing pattern exercises. Finally, strengthening exercises and aquatic games were performed with an emphasis on maintaining correct posture.

CONCLUSION

Based on the results of the conducted systematic review, various exercise programs aimed at stretching and strengthening the muscles of the chest, back, shoulders, and neck can be effectively applied in the management of kyphosis. Most of the studies included in this review utilized different forms of stretching and strengthening exercise programs. The chest muscles (pectoralis major and minor) are typically shortened and tight, thus targeted with stretching exercises, while the back, shoulder, and neck muscles (trapezius, latissimus dorsi, and rhomboids) tend to be weakened and elongated, requiring strengthening exercises. Research has shown that exercise programs performed both in aquatic environments and home settings are equally effective and beneficial alongside conventional methods for correcting kyphosis. Among the commonly used exercise aids are elastic bands, foam rollers, and weights. Analyzing the studies reviewed in this work, it is concluded that priority should be given to exercise programs focused on strengthening and stretching weakened and overstrained musculature, conducted for a minimum duration of four weeks, with a frequency of three training sessions per week.

REFERENCES

1. Ahmadi, H., Yalfani, A., & Gandomi, F. (2019). The Effect of Eight-Week Water-Based Corrective Exercises on Forward Head, Rounded Shoulder, Thoracic Hyperkyphosis Posture, and Neck Pain: A Randomized Controlled Trial. *Research Square,* https://doi.org/10.21203/rs.2.18600/v1
2. Ahmadnezhad, L., Ebrahimi Atri, A., Khoshraftar Yazdi, N., & Sokhangoei, Y. (2015). The effect of eight-weeks corrective games on kyphosis angle and postural control in mentally retarded children having kyphosis. *Journal of Research and Health,* 5(2), 178-183.
3. Azizi, M. (2011). The effect of hydrotherapy on some of the selected parameters related to Kyphosis in Kyphotic girls. *Procedia-Social and Behavioral Sciences,* 15, 1595-1599.
4. Ball, J. M., Cagle, P., Johnson, B. E., Lucasey, C., & Lukert, B. P. (2009). Spinal extension exercises prevent natural progression of kyphosis. *Osteoporosis International,* 20, 481-489.,
5. Biševac, E., Mahmutović, E., Mekić, R., & Dolićanin, Z. (2021). Efekat korektivnih vežbi na funkcionalne deformitete kičmenog stuba kod dece predškolskog i školskog uzrasta. *Specijalna edukacija i rehabilitacija, 20*(1), 51-63.
6. Frost, B. A., Camarero-Espinosa, S., & Foster, E. J. (2019). Materials for the spine: anatomy, problems, and solutions. *Materials, 12*(2), 253.
7. Gaber Mohamed, W. (2014). The Effect of a Specific Short-Term Training Program on Correcting the Curvature Angle of Kyphosis in Female Young Gymnasts. *Journal of Applied Sports Science,* 4(2), 32-38.
8. Hamidiyeh, M., Naserpour, H., & Chogan, M. (2021). Change in Erector Spinae Muscle Strength and Kyphosis Angle Following an Eight Weeks TRX Training in middle-age Men. *International Journal of Aging Health and Movement,* 3(1), 13-20.
9. Katzman, W. B., Vittinghoff, E., Lin, F., Schafer, A., Long, R. K., Wong, S., ... & Lane, N. E. (2017). Targeted spine strengthening exercise and posture training program to reduce hyperkyphosis in older adults: results from the study of hyperkyphosis, exercise, and function (SHEAF) randomized controlled trial. *Osteoporosis International,* 28, 2831-2841.
10. Katzman, W. B., Wanek, L., Shepherd, J. A., & Sellmeyer, D. E. (2010). Age-related hyperkyphosis: its causes, consequences, and management. *Journal of Orthopaedic & Sports Physical Therapy*, 40(6), 352-360.
11. Rahimi, N.M., Mahdavinejad, R., Attarzadeh Hosseini, S. R., & Negahban, H. (2020). Efficacy of dynamic neuromuscular stabilization breathing exercises on chest mobility, trunk muscles, and thoracic kyphosis: a randomized controlled 6-Week trial. Iranian Rehabilitation Journal, 18(3), 329-336.
12. Naderi, A., Rezvani, M. H., Shaabani, F., & Bagheri, S. (2019). Effect of kyphosis exercises on physical function, postural control and quality of life in elderly men with hyperkyphosis. *Iranian Journal of Ageing,* 13(4), 464-479.
13. Obayashi, H., Urabe, Y., Yamanaka, Y., & Okuma, R. (2012). Effects of respiratory-muscle exercise on spinal curvature. *Journal of sport rehabilitation,* 21(1), 63-68.
14. Perriman, D. M., Scarvell, J. M., Hughes, A. R., Lueck, C. J., Dear, K. B., & Smith, P. N. (2012). Thoracic hyperkyphosis: a survey of Australian physiotherapists. *Physiotherapy Research International,* 17(3), 167-178.
15. Sawdon-Bea, J. (2010). *Effects of a 10-week exercise intervention on thoracic kyphosis, pulmonary function, endurance, back extensor strength, and quality of life in women with osteoporosis.* Doctoral dissertation, Texas Woman's University.
16. Seidi, F., Rajabi, R., Ebrahimi, I., Alizadeh, M. H., & Minoonejad, H. (2014). The efficiency of corrective exercise interventions on thoracic hyper-kyphosis angle. *Journal of back and musculoskeletal rehabilitation,* 27(1), 7-16.
17. Sheehan, D. D., & Grayhack, J. (2017). Pediatric scoliosis and kyphosis: an overview of diagnosis, management, and surgical treatment. *Pediatric annals,* 46(12), e472-e480.
18. Vaughn, D. W., & Brown, E. W. (2007). The influence of an in-home based therapeutic exercise program on thoracic kyphosis angles. *Journal of Back and Musculoskeletal Rehabilitation,* 20(4), 155-165.
19. Yaman, O., & Dalbayrak, S. (2014). Idiopathic scoliosis. *Turkish neurosurgery*, 24(5). 646-657.
20. Yazici, A. G., & Mohammadi, M. (2017). The effect of corrective exercises on the thoracic kyphosis and lumbar lordosis of boy students. *Turkish Journal of Sport and Exercise,* 19(2), 177-181.

EFEKTI PROGRAMA VEŽBANJA NA KOREKCIJU KIFOZE: SISTEMATSKO PREGLEDNO ISTRAŽIVANJE

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***Sažetak**: Termin kifoza se koristi za opisivanje kičmene krivine koja dovodi do abnormalne zaobljenosti leđa. Kifoza se može razviti zbog traume, razvojnih anomalija, degenerativnih bolesti diska, kao i inflamatornih i zaraznih bolesti. Kifoza utiče nepovoljno kako na decu tako i na starije i onemogućava normalano obavljanje svakodnevnih životnih obaveza. S tim u vezi ovo sistematsko pregledno istraživanje ima za cilj pronaći i utvrditi na osnovu dosadašnjih istraživanja, primenu i efekte raznih oblika programa vežbanja na korekciju kifoze. Svi pregledani i analizirani naučni radovi su prikupljeni i selektovani korišćenjem internet baza podataka elektronskih izdanja naučnih časopisa: Google Scholar, NCBI, PubMed, PLOS, SCIndeks. Radovi su pretraživani u vremenskom periodu od 2000. do 2023. godine. Ključne reči koje su korišćene za pretraživanje baze podataka su kifoza, hiperkifoza, efekti programa vežbanja i Šojermanova bolest (kifoza). Pri odabiru radova u ovom istraživanju, kriterijumi na osnovu kojih su radovi bili razmatrani i odabirani su sledeći: ispitivanje uticaja različitih programa vežbanja na kifozu, zatim na jačanje i rastezanje mišića grudi, leđa, ramena i vrata i smanjenje ugla kifoze. Na osnovu pomenutih kriterijuma u konačnu analizu je ušlo 15 radova. Najbolje efekte na korekcije kifoze, konačnom analizom je utvrđeno, da imanju radovi koji su sadržali programe vežbi rastezanja i snage, u trajanju od minimum 4 nedelje, sa nedeljnom učestalošću od 3 treninga po 60 minuta.*

***Ključne reči**: kifoza, hiperkifoza, efekti, programi vežbanja*