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The effect of additional breathing exercises in postural training on decreasing the hyperkyphosis curve in the elderly

Ilmanisa[1*], Muthiah Munawwarah[1], Kesit Ivanali[1], Trisia Lusiana Amir[1]

ABSTRACT

Background: Elderly is someone who is classified as old and is experiencing the aging process. The risk of falling and decreased function are two of the many geriatric syndromes, which are affected by various things, such as muscle weakness, imbalance, and poor posture.

Objective: This study aimed to determine the difference in the effect of adding deep breathing exercises on postural training and only postural training on reducing the hyperkyphosis curve.

Methods: This study is quasi-experimental with a pre-test and post-test group design, in which the thoracic kyphosis curve is measured with a flexible ruler. The total sample in this study was 22 people divided into two groups. Group 1 consisted of 11 people with the intervention given, namely postural training, and group 2 consisted of 11 people with the intervention given, namely postural training and deep breathing exercise.

Results: Hypothesis testing I and II using the Paired sample t-test showed a value of p=0.000, with an average value before and after in group 1 of 54.17 ± 2.39 and 50.90 ± 2.43, while in group 2, it was 54.61 ± 2.07 and 50, 11±1.93. Furthermore, Hypothesis testing III used the Mann Whitney-u tried and obtained a value of p=0.000 with a difference in group 1 of 3.26 ± 0.57 and group 2 of 4.50 ± 0.41.

Conclusion: There is a significant difference in effectiveness with the addition of breathing exercises in postural training and postural training alone in reducing the hyperkyphosis curve.

Keywords: Breathing Exercise, Hyperkyphosis, Postural Training.
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[1]College of Physical Therapy, Universitas Esa Unggul, Jakarta, Indonesia;

*Corresponding to:
Ilmanisa;
College of Physical Therapy, Universitas Esa Unggul, Jakarta, Indonesia;
ilmanisaku@gmail.com

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BACKGROUND

The Elderly is someone who has been classified as elderly and is experiencing an aging process. A person is generally categorized as elderly if they are over 60, but this definition varies highly depending on socio-cultural, physiological, and chronological aspects.[1] Based on statistical data, Indonesia has 9.6% of older adults or around 25 million people.[2] The distribution of the elderly population in Bali dominates, ranked 4th (10.3%) in Indonesia based on the Ministry of the Health of the Republic of Indonesia 2015. Since 2004-2015 Indonesia has shown an increase in age life expectancy from 60.8 years to 70.8 years, and the projection for 2030-2035 is 72.2 years.[3]

It is known that with age, humans will experience changes that occur in them, from physiology and physical form to psychology. The problems commonly faced by the elderly are knowns a geriatric syndrome. The risk of falling and functional decline are two of the many geriatric syndromes, which are affected by various things, such as muscle weakness, imbalance, and poor posture. Posture is the alignment of body parts in an upright, sitting, or lying position. Posture involves complex interactions between bones, joints, connective tissue, and muscles.[4]

Kyphosis is a curvature of the thoracic spine, formed by the shape of the spine and intervertebral discs and – in a standing position – paraspinal muscle strength. Hyperkyphosis is present when the kyphosis angle exceeds the normal range. Apart from the consequences of normal aging, such as decreased muscle strength and degenerative changes of the spine, other factors contribute to an increase in the kyphosis angle.[5]

Spinal fractures are present in no less than 40% of people with hyperkyphosis, and with any kyphotic angle, vertebral fracture increased by 3.8^{o}. Increasing evidence shows a link between hyperkyphosis and negative health effects, such as reduced physical performance and doubling the risk of falling.[6] Hyperkyphosis is the most common posture problem in older adults, and it affects as many as 40% of older adults over 65.[7] Hyperkyphosis is a spine deformity in the sagittal plane.[8] Hyperkyphosis is when the thoracic curve exceeds its normal value. An angle of thoracic kyphosis over 40^{o} is said to be hyperkyphosis.[9]

Past age 40, the kyphosis angle increases more rapidly in women than men. Women aged 55-60 have an average grade of 43º; at 76-80, it expands to 52º.[10] The prevalence of hyperkyphosis in older adults is greater in women than in men because the strength of the male extensor muscles is better than that of women.[6] Perriman et al. (2011) said that at the age of more than 65 years, hyperkyphosis reaches 50% of older adults and 65% of older adults.[11]

Increased thoracic kyphosis may cause mechanical restriction of pulmonary function. Older adults with hyperkyphosis often have dyspnoea, decreased vital capacity, and forced expiratory volume.[12] Accent thoracic kyphosis deformed the thoracic cage, increasing the anteroposterior thoracic diameter and reducing the distance between the xiphisternum and pubis, which changes the position of the thoracic cage.[13] The spinal and thoracic cage deformities cause a decrease in rib mobility and impair the mechanics of the respiratory system. These respiratory impairments occur due to musculoskeletal alterations, placing the respiratory muscles at a mechanical disadvantage and decreasing respiratory muscle efficiency related to dyspnoea.[14]

Postural training is a set of exercises utilizing auditory, visual, and tactile in teaching, developing, and maintaining neutral spinal alignment. The principle of postural training is based on Kendall's theory which explains that to fix posture problems, we have to stretch what is short and strengthen the weak. Postural training aims to re-educate postural muscles, correct alignment, correct muscle imbalances, increase endurance, reduce the thoracic kyphosis curve, and increase thoracic mobility muscles.[15]

Postural training in hyperkyphosis conditions can improve muscle balance by stretching the anterior muscles and strengthening the posterior muscles. These muscles will be trained to maintain an upright posture and increase mobility, thereby correcting malalignment and reducing the thoracic kyphosis curve.[7]

A breathing exercise aims to train the breathing muscles or the muscles that work during respiration. Deep breathing is an exercise that can regulate breathing patterns and improve posture. The deep breathing that is done repeatedly can overcome stiffness in the thoracic cage and straighten the curve of thoracic kyphosis. This process makes it possible to reduce thoracic hyperkyphosis.[16]

Based on the problems, the presentation of the results of preliminary studies, and the lack of research on decreasing the hyperkyphosis curve in older adults in Indonesia, this study was conducted to determine The effect of additional breathing exercises in postural training on reducing the hyperkyphosis curve in older adults.

METHODS

This research method is quasi-experimental in which the researcher with a pre-test and post-test group design. The sample was divided into two groups, with 11 representatives in each group, the first treatment group was given a postural training intervention, and the second treatment group was assigned a postural training intervention with a deep breathing exercise.

The study was conducted for five weeks, from 4 October 2020 to 7 November 2020, among older adults with hyperkyphosis at RT 06/RW 03, Saga Village, Balaraja District. The kyphosis curve value will be measured using the flexicurve ruler with the measurement formula in Figures 1 and 2.

Sampling is done using a purposive sampling technique from affordable populations with an examination based on inclusion criteria, namely: female, aged 55-65 years, has a kyphosis curve value of more than 40° by flexicurve ruler measurement, negative red flag examination, and is willing to cooperate and participate in the research as a whole. Exclusion criteria included elderly with pulmonary disease; neurological disorders; medical conditions preventing them from exercising; elderly with severe kyphosis.

RESULTS

The research was conducted for five weeks from 4 October 2020 to 7 November 2020 among older adults with hyperkyphosis at RT 06/RW 03, Saga Village, Balaraja District. Sampling in this study was carried out using purposive sampling, namely selecting samples that met predetermined inclusion criteria. Overall the selection obtained 22 people were divided. There were two groups, namely 11 people in treatment group I, who were given a postural training intervention, and ten others in treatment group II, who were given a postural training intervention with a deep breathing exercise.

Based on Table 1, it can be seen that the samples in Group 1 and Group 2 consisted of 11 older women. In group 1, the mean age was 59.45 ± 3.20, the mean height was 153 ± 5.31, the mean weight was 49.36 ± 3.01, and the mean body mass index was 21.12 ± 1.52. Whereas in group 2, the mean age was 60.27 ± 3.35, the mean height was 152 ± 5.65, the mean body weight was 49.91 ± 4.39, and the mean body mass index was 21.57 ± 1. 08.

Table 2 shows treatment group I, with a total sample of 11 people. The mean value of the thoracic kyphosis curve before the intervention was 54.17 ± 2.39, and after the intervention was 50.90 ± 2.43. In Table 2, treatment group II, with a total sample of 11 people, the mean value of the thoracic kyphosis curve before the intervention was 54.61 ± 2.07, and after the intervention was 50.11 ± 1.93. The comparison of mean kyphosis curves is shown in Graph 1.

The data before and after in treatment group I and before and after the difference in treatment group II are normally distributed in Table 2, where the results are $p>\alpha$ (0.05). Meanwhile, the difference in the treatment group I was not normally distributed because the *p*-value was 0.009. The results of Levene's test showed that the two groups had a homogeneous variance, where the effect of $p> \alpha$ was 0.661. Based on the Paired sample t-test in Table 2, it was found that the *p*-value was 0.000, where the *p*-value $<\alpha$ (0.05). This shows that Ho is rejected and Ha is accepted, which means that providing postural training interventions effectively reduces the hyperkyphosis curve.

Based on the Paired sample *t-test* in Table 2, the *p*-value was 0.000, where the *p*-value $<\alpha$ (0.05). This shows that Ho is rejected and Ha is accepted, which means that postural training and deep breathing exercise effectively reduce the hyperkyphosis curve. The mean difference in Group 1 is 3.26 ± 0.57, and the difference in Group 2 is 4.50 ± 0.41. After testing the Mann Whitney-u test, the *p*-value was 0.000, so Ho was rejected, and Ha was accepted, which means that there is a difference in the effect of adding deep breathing exercises on postural training and postural training on reducing the hyperkyphosis curve.

Table 1. Characteristics of participants.

Characteristic	Group I (*N* = 11) mean ± SD	Group II (*N* = 11) mean ± SD
Age (years)	59.5 ± 3.2	60.3 ± 3.4
Height (cm)	153.0 ± 5.3	152.0 ± 5.7
Weight (kg)	49.4 ± 3.0	49.9 ± 4.4
BMI (kg/m²)	21.1 ± 1.5	21.6 ± 1.1

Abbreviations: BMI, body mass index; *N*, number of subjects; SD, standard deviation.

DISCUSSION

The results of this study showed that the provision of postural training interventions effectively reduces the hyperkyphosis curve. Thoracic hyperkyphosis can lead to a variety of musculoskeletal problems related to aging.[17] In patients with hyperkyphosis, there will usually be a shortening of the anterior muscles and weakness of the posterior muscles. Referring to Kendall's theory which says that in improving posture based on stretching shortened muscles and strengthening weakened muscles, postural training was carried out in this study to extend the anterior muscles and support the posterior muscles.[15]

Postural training involves auditory, visual, and tactile samples to teach them to develop and maintain neutral spinal alignment. In their research, Katzman et al. (2017) concluded that spine-strengthening and postural training reduce thoracic hyperkyphosis in older men and women.[7]

On average, Cobb angles develop slowly with age less than 1° a year, reducing even minor kyphosis. The amount may be important, especially if the effect of the treatment is maintained over time. Kyphometer-derived changes in kyphosis are consistent with previous studies reporting an increase in the clinical size of kyphosis after targeting spinal strengthening.[18]

Providing postural training interventions and deep breathing exercises effectively reduces the hyperkyphosis curve. Hyperkyphosis causes limited mobility in the thoracic cage, directly connected to the thoracic. An increase in the thoracic kyphosis curve will cause a reduced capability of thoracic expansion in respiration, especially inhalation. For this reason, in this study, we also added deep breathing exercises to treatment group II.[19]

A deep breathing exercise is a type of exercise with the principle of maximal inspiratory position and maximal expiratory position.[20] In

Table 2. *Shapiro Wilk*, *Levene's*, paired *T*-test, and independent *T*-test of thoracal kyphosis curve scores before and after the groups' interventions.

Groups	Time	Mean±SD	*P*-value *Shapiro Wilk*	P-value *Levene's*	*P*-value paired *T*-test	*P*-value independent *T*-test
1	Pre-intervention	54.2±2.4	0.094	0.661	<0.001	<0.001
	Post-intervention	50.9±2.4	0.263			
	Changes	3.3±0.6	0.009			
2	Pre-intervention	54.6±2.1	0.632		<0.001	
	Post-intervention	50.1±1.9	0.498			
	Changes	4.5±0.4	0.067			

Abbreviations: SD, standard deviation.

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$$=180/\pi \times \left(ATAN\left(H \times X_{Total} \times \frac{\frac{-3-X_{Middle}+2-X_{Total}}{X_{Middle}}}{X_{Total^2}+X_{Middle^2}-2\times X_{Total}\times X_{Middle}} \right) - ATAN\left(\begin{array}{l} 3\times H\times \frac{\frac{X_{Total}-2\times X_{Middle}}{X_{Middle^2}}}{X_{Total^2}+X_{Middle^2}-2\times X_{Total}\times X_{Middle}} \\ \times X_{Total^2}-2\times H\times \frac{\frac{X_{Total^2}-3\times X_{Middle^2}}{X_{Middle^2}}}{X_{Total^2}+X_{Middle^2}-2\times X_{Total}\times X_{Middle}} \\ \times X_{Total}+H\times X_{Total}\times \frac{\frac{-3\times X_{Middle}+2\times X_{Total}}{X_{Middle}}}{X_{Total^2}+X_{Middle^2}-2\times X_{Total}\times X_{Middle}} \end{array} \right) \right)$$

Figure 1. The formula for measuring the kyphosis curve

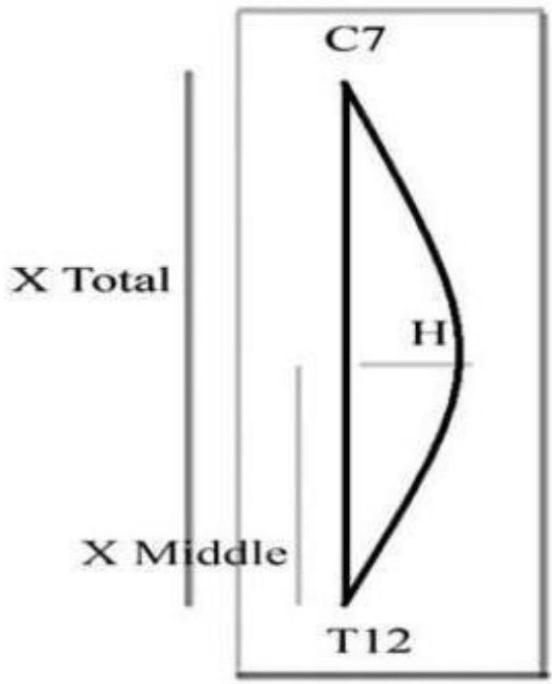


Figure 2. Thoracal kyphosis curve.

its application, deep breathing will help train and stretch the breathing muscles, which experience tightness due to an increase in the thoracic kyphosis curve. In his research, Jang et al. (2015) concluded that therapeutic exercises designed to mobilize the thorax and reduce the thoracic kyphosis curve in which deep breathing exercises are beneficial in improving spinal posture in older women.[19]

In the Mann-Whitney-u test, the value of p=0.000 was obtained. This means there is a difference in the effect of adding deep breathing exercises on postural training and postural training on reducing the hyperkyphosis curve. Based on the study results, it can be seen that both treatments can be used to reduce the thoracic kyphosis curve in older women. However, treatment two did show better results, and this was due to the accumulated effects of postural training and deep breathing exercise.

When a person experiences hyperkyphosis, many muscles in the upper body experience decreased function. This will increase the risk of rounded shoulders and forward head posture. This condition causes tightness in the pectoralis minor and scalenus muscles, as well as weakening of the middle trapezius, rhomboid, and quadratus lumborum muscles.[21] Also, hyperkyphosis conditions can cause anterior rotation of the thoracic cage, which then causes a decrease in the thoracic expansion.[22]

Adding deep breathing exercises to postural training can help mobilize the thorax to support the reduction of the thoracic kyphosis curve. Deep breathing exercises focus on the thoracic cage, the main structure that changes shape due to hyperkyphosis.[19] Inspiration and expiration in deep breathing exercises will activate the respiratory muscles around the lungs to contract. During inspiration, the diaphragm will contract and make room in the chest cavity to expand the lungs. The intercostal muscles will help lift and rotate the thoracic cage posteriorly to allow the lungs more air. Posterior rotation of the cage occurs thorax during deep breathing exercises and helps mobilize the thorax directly connected to the thoracic.[22]

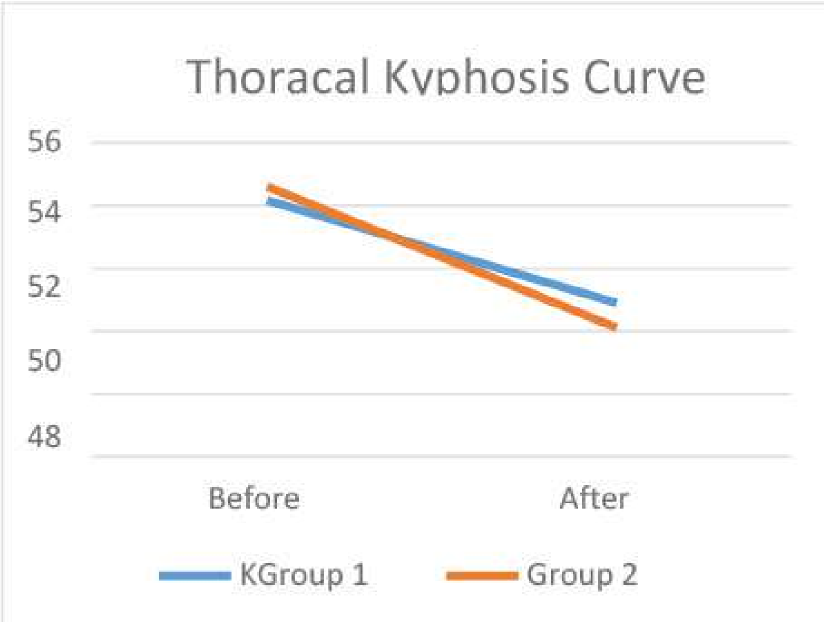
This study had several limitations. First, the results of the two groups showed a significant change in the kyphosis curve values, but both had not touched the normal kyphosis curve values themselves. This could be due to the sample's physical activity that was not well controlled during the exercise program. Second, the limited time in implementing the training program can also affect the results of changes in the kyphosis curve value, so the current research only shows short-term effects.

CONCLUSION

Based on the results of previous research and discussion, it can be concluded that Postural training intervention is effective in reducing the hyperkyphosis curve; Postural training and deep breathing exercise interventions are effective in reducing the hyperkyphosis curve; There is a significant difference in effectiveness with the addition of deep breathing exercises in postural training and postural training in reducing the hyperkyphosis curve.

CONFLICT OF INTEREST

This study does not have any conflict of interest.



Graph 1. Comparison of Mean Kyphosis Curves.

ETHICAL CONSIDERATION

The authors obtained informed consent that the sample had been approved before conducting the study.

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This study received no grant from any institution.

AUTHOR CONTRIBUTION

I conceived the study design, collected and analyzed the data, and drafted the manuscript; MM, KI, and TLA interpreted the data analysis and drafted the manuscript.

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