Medica Hospitalia
Journal of Clinical Medicine
Med Hosp 2024; vol 11 (3) : 246–251

OPEN ACCESS

Original Article

The Effect of Core Stability Exercise on Decreasing Angle of Trunk Rotation Degree in Idiophatic Scoliosis

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p-ISSN: 2301-4369 e-ISSN: 2685-7898
https://doi.org/10.36408/mhjcm.v11i3.1050

Accepted: January 09th, 2024
Approved: October 30th, 2024

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Abstract

Background : Scoliosis is a group of conditions consisting of changes in the shape and position of the spine on the lateral side that may be accompanied by rotation caused by various etiologies. Core stability exercise is a form of exercise that can be used to reduce the degree of scoliosis curve. This study aims to determine the effect of core stability exercise on junior high school student (JHS).
Methods : This study used one group pre and post test with control design involving 32 students of SMP 2 Wonosari Klaten who were divided into 2 groups, using the blind randomized control trial method. 16 subjects as intervention group given treatment of core stability exercise and a control group 16 subjects as control group without any treatment. The intervention was carried out for 5 weeks with a frequency of 3 times a week. Measuring the degree of the scoliosis curve using a scoliometer. The pre-test trunk rotation angle (ATR) value for the treatment group was found to be an average of 5.06° and a post-test ATR value of 4.75°. Meanwhile, in the control group, there was no change in the ATR value during the pre-test or post-test, which was 5.43°.
Results : Statistical test of differences in pre-post test of treatment groups using the Wilcoxon test obtained a value of $p = 0.025$ ($p < 0.05$).
Conculsion : There is an effect of core stability exercise on reducing the scoliosis curve in junior high school student.

Keywords : angle of trunk rotation, core stability exercise, idiopatic skoliosis, skoliosis

INTRODUCTION

Scoliosis is a general term for a group of conditions consisting of changes in the shape and position of the spine, chest, and trunk. Changes in the anatomical structure are characterized by curvature of the spine to the lateral side accompanied by rotation.[1] The causes of scoliosis are divided into congenital, neuromuscular and idiopathic.[2] Idiopathic scoliosis is a lateral curvature of the spine of 10 degrees or more of unknown etiology without any underlying congenital or neuromuscular abnormalities.[3]

According to the SOSORT Consesus 2016, idiopathic scoliosis based on age is classified into: infant (0 to 2 years), juvenile (3 to 9 years), adolescent (10 to 17 years) and adult (18 years and more). Idiopathic scoliosis can develop at any time during childhood or adolescence.[4]

Research conducted by Baswara *et al*., indicated that the criteria for moderate scoliosis were most often found in females in the juvenile age group 13 students and in adolescents group was 18 students, meanwhile according to the severe risk scoliosis criteria, only one case was found in the juvenile age group of male students and in the adolescent age group, the same number was found in 3 students, men and women.[5] The prevalence of idiopathic scoliosis has increased among school-age children aged 10 to 15 years.[6] In Asia, 0.4 to 7% suffer from idiopathic scoliosis.[7] Research conducted by Komang-Agung *et al*. (2017) in Surabaya revealed that the prevalence rate of idiopathic scoliosis in the age group of 9 to 16 years among males (0.51%) was lower than that of females (2.42%) with a ratio of 1:4.7.[8] From the above data, we can conclude that many adolescents suffer from idiopathic scoliosis. Various interventions have been proposed to treat cases of idiopathic scoliosis. The type of scoliosis treatment depends on the severity of the scoliosis curve and includes exercises, bracing, and surgery.[9]

Core stability exercise is a form of exercise that activates the internal core muscles synergistically. Core stability exercise is one of the exercise interventions that can be used by physical therapists to treat idiopathic scoliosis in mild and moderate degrees. An imbalance in postural muscle activity results in unilateral compensatory postural muscle movement. Core stability exercises can increase postural stability and reduce postural imbalances by involving local muscle stability training (transvesus abdominis, multifidus and diaphragm) and global muscle stability training (psoas major, quadratus lumborum and pelvic floor).[10]

Research conducted by Qi *et al*. showed that core stability exercises resulted in a statistically significant reduction in cobb angle from before to after treatment in subjects aged 13 years with a 12-week exercise dose with a frequency of 3 times a week.[11] Research by Weng & Li shows that core stability exercises can significantly reduce the cobb angle in idiopathic scoliosis and improve the poor body posture of scoliosis patients.[12] According to research by Kocaman *et al*., shows that the results in reducing the degree of scoliosis curve in the mild category are more effective using scroth exercises rather than using core stability exercises.[13] A systematic study conducted by Khaledi *et al*., shows that core stability exercises are safe, easy to perform, and effective in improving the degree of idiopathic scoliosis curve, but there is insufficient evidence to support this hypothesis, so additional research evidence quality is still necessary to draw definitive conclusions and make clinical decisions.[14]

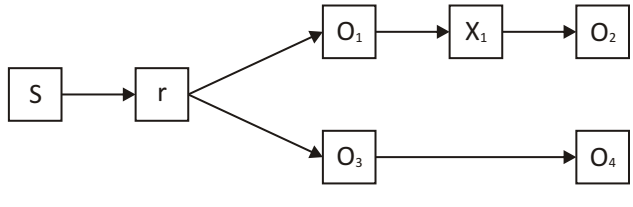
However, there are several fundamental differences between this research and research conducted by Weng & Li and conducted by Qi *et al*., namely the implementation time and the number of movement exercises.[11,12]

Based on the above data, researchers were prompted to conduct research on the effect of core stability exercises on reducing the degree of spinal curvature in idiopathic scoliosis patients with mild degrees. of scoliosis in junior high school adolescents (JHS) aged 12 to 14 years. This research will be conducted to find out whether core stability exercises can reduce the degree of scoliosis curve in JHS.

METHODS

This research uses a type of randomized controlled trial research, 2 groups namely one group of research subjects as the treatment and another group as the control group. The sampling technique used blind allocation with randomized, using simple random sampling subjects choosed in the form of random lottery numbers in the container provided. If they got an odd number, the subject became the treatment group and if they got an even number the subject became the control group. The initial examination using the APECS application and then the protocol for measuring the degree of the ATR curve using a scoliometer will be carried out separately for male and female students. The research location is at SMP 2 Wonosari Klaten in June–July 2023. Core stability training was provided to the treatment group in 15 sessions at a frequency of 3 times per week for 5 weeks. The control group only received training on how to maintain correct body posture.

The research design is described as follows :



The explanation:

S : Subject

r : Randomized

O_1 : Examination of scoliosis using the APECS application and measurement of the ATR (Angle of Trunk Rotation) value of the degree of spinal curvature using a scoliometer measuring instrument before treatment in group 1.

X_1 : Providing core stability exercise treatment

O_2 : Measurement of ATR value for scoliosis degree curve using scoliometer measuring instrument after treatment in group 1.

O_3 : Examination of scoliosis using APECS application and measurement of ATR value of degree of spinal curvature using scoliometer measuring instrument before treatment in group 2.

O_4 : Measurement of the ATR value of the scoliosis degree curve using a scoliometer measuring instrument after treatment in group 2.

The inclusion criteria for this study were (1) the subject was a junior high school adolescent aged 12 to 14 years, (2) idiopathic scoliosis detected, (3) an ATR value of 4º to 6º detected on the basis of the measurement results. with a scoliometer, (4) understood the instructions given and are able to communicate well, (5) willing to respond and complete informed consent.

The exclusion criteria for this study were as follows: (1) junior high school adolescents who have congenital scoliosis or congenital spinal defects, (2) experienced spinal fractures, surgery spinal cord, have congenital spinal disorders, (3) have limb disorders. upper or lower movements, (4) have a history of diseases related to rheumatology, neuromuscular, cardiovascular, respiratory or renal problems, (5) the respondent is currently participating in a scoliosis therapy program or participating in other research.

Inspections and measurements are carried out to collect initial data. The initial examination to determine whether or not there is scoliosis is done using the APECS (AI Posture Evaluation and Correction System) application and the instrument to measure the degree of spinal curvature in scoliosis in this study is a scoliometer. The scoliometer is a tool used to measure ATR which is applied simultaneously with the forward bend test and has a good correlation with the gold standard (cobb angle).[15]

APECS is software created to assess posture through non-invasive photogrammetry techniques, to correct and prevent postural deformities with various exercises.[16] APECS was used at the beginning of the study for screening or early detection by analyzing the anterior and posterior shoulder height level, trunk position and waist line.

The Pearson correlation coefficient between the APECS application and the gold standard (X-ray) was 0.9874 (98.74% correspondence). The agreement between plain radiographs and average APECS Pro measurements from all examiners (including right and left sides) was 94.64% (kappa = 0.8323; p = 0.001), indicating an excellent result.[17]

Data analysis used SPSS version 26.0. Data analysis included descriptive analysis and difference testing. The normality test uses the Shapiro-Wilk test and the homogeneity test uses the levene's test. The pre-test and post-test data of the treatment group and the control group were analyzed using the Wilcoxon rank-sum test. Post-test data on scoliosis curve degree in the treatment group and control group were analyzed using the Mann Whitney test. The basis for drawing conclusions is that if the *p-value* <0.05, then there is an effect after treatment with core stability exercises. But if the *p value* is ≥ 0.05, there is no effect after the intervention.

All research procedures have been approved with the issuance of ethical clearance number 1.116/VI/HREC/2023 from the Health Research Ethics Commission (KEPK) RSUD Dr. Moewardi. Research subjects received an explanation regarding the aims, objectives, benefits, and research protocol and completed a questionnaire and informed consent letter before the intervention was performed. Each subject in the treatment group received training on how to exercise and follow-up in the form of participation in training according to a predetermined schedule.

The basic stability exercises applied in this study were curls up, hundreds pattern, diafragmatic breathing, bird dog, face down, and sitting in a crossed leg position. This exercise aims to activate the posture muscles so that the degree of the scoliosis curve decreases. The training dose given for each movement is 8 repetitions for 3 sets with a rest of 30 seconds for each set. Each movement has a hold time of 5 seconds.

RESULTS

The subjects of this research were middle school students aged 13 to 14 years old. The subjects were students who met the inclusion criteria and whose their parents were willing to sign informed consent.

The research subjects consisted of 32 people, the research subjects were divided into 2 groups. Group I consisted of 16 subjects who received treatment in the form of core stability exercises and Group II consisted of 16 subjects constituting the control group. During the research process, no subjects withdrew or dropped out, so the number of subjects in this study did not change, which was 32 people.

Table 1 shows the subject characteristics. The results of subject characteristics based on gender in the treatment group and control group showed data on the frequency of 10 female subjects and 6 male subjects. Most of the subjects were girls. In this study, the age of the treatment group was obtained with a mean age of 13.93

TABLE 1
The Subject characteristics by gender and age

Variabel	Treatment Group (n=16)	Control Group (n=16)
Sex		
Men	6	6
Women	10	10
Age	13.93 (0.250)	13.81 (0.403)
Weight	45.87 (8.89)	46.5 (7.10)
Height	155.25 (8.22)	154.62 (6.97)

Values listed are in the form of mean or mean and (standard deviation)

TABLE 2
ATR scoliometer values before and after treatment

Value	Treatment Group (n=16)	Control Group (n=16)	*(p)*
Scoliometer (ATR value)			0.002
Pre Test	5.06° (0.573)	5.43° (0.512)	
Post Test	4.75° (0.577)	5.43° (0.512)	
(p)	0.025	1.00	

Values listed are in the form of mean or mean and (standard deviation)

and a standard deviation of 0.250. Meanwhile, the control group obtained age data with a mean of 13.81 and a standard deviation of 0.403. Body weight in the treatment group had a mean of 45.87 and a standard deviation of 8.89, while in the control group it had a mean of 46.5 and a standard deviation of 7.10. Body height in the treatment group has a mean of 155.25 and a standard deviation of 8.22, while in the control group it has a mean of 154.62 and a standard deviation of 6.97.

Table 2 presents the ATR scoliometer values before and after treatment. In the pre-test measurement of the ATR value for the treatment group, the result was a mean of 5.06 and a standard deviation of 0.5737, while in the control group the result was a mean of 5.43 and a standard deviation of 0.5123. In the post-test measurement of the treatment group, the results obtained were a mean ATR value of 4.75 and a standard deviation of 0.5773. Meanwhile, in the control group, the average ATR value was 5.43 and the standard deviation was 0.5123.

The effect of core stability exercise on reducing the degree of scoliosis curve is known through hypothesis testing. Hypothesis testing in the treatment group, namely the pre and post-test difference between the treatment groups using the Wilcoxon test, showed a value of p=0.025 (p<0.05) meaning that there was a significant influence between before and after being given the core stability exercise. Hypothesis testing in the control group, namely the pre- and post-test difference test for the treatment group using the Wilcoxon test with a scoliometer, showed a value of p=1.00 ($p \geq 0.05$), which means that there is no significant effect (Table 2).

The results of the post-test difference in the ATR degree of scoliosis curve in the treatment group and the control group using the Mann Whitney test obtained a value of p=0.002 (p<0.05), which means that there is a difference in influence between the two groups (Table 2).

DISCUSSION

Postural stability can be achieved through good coordination of core muscles and regulation of intra-abdominal pressure (IAP) by the central nervous system. IAP regulation and the Integrated Spinal Stabilization System (ISSS) play an important role in spinal stabilization. The cause of the increase in IAP is the work of the diaphragm muscle. Activation of the diaphragm muscle can stimulate the pelvic floor muscles, transverse abdominis muscles, multifidus and balanced activation between spinal flexor and extensor muscles in the thorax region to increase IAP and ensure postural stability.[18]

Hypothesis testing of the data was performed and the results show that core stability exercise has an effect on reducing the ATR degree of the scoliosis curve.

Hypothesis testing in the treatment group, namely the pre- and post-test difference between the treatment groups using the Wilcoxon test, showed a value of $p = 0.025$ meaning that there was a significant influence between before and after being subjected to core stability exercise treatment, as evidenced by a decrease in the mean ATR value of 0.31°. Hypothesis testing in the control group, namely the pre and post-test difference between the control group using the Wilcoxon test, showed a result of $p = 1.00$ ($p \geq 0.05$), which means there is no significant effect.

This is consistent with research by Weng & Li, showing that core stability exercises can significantly ($p<0.01$) reduce Cobb angle in idiopathic scoliosis and improve poor body posture in older people. scoliosis patients with a total of 31 subjects after receiving treatment for 12 weeks. The decrease in Cobb angle was 2.74° in the group that received core stability exercises.[12]

However, there are several fundamental differences between this research and the research conducted by Weng & Li, that is the implementation time and the number of movement exercises. The research conducted by Weng & Li required a 12-week treatment period, whereas this research was only conducted for 5 weeks. The number of movement exercises applied in Weng & Li research was 7 movements, while this study only implemented 6 types of movements of core stability exercises.[12] However, this difference is not an inhibiting factor to prove that providing core stability exercises to adolescents with idiopathic scoliosis can reduce the degree of the scoliosis curve.

Another study whose results were consistent with this research and became the basis for it was conducted by Qi *et al*., and involved 38 subjects aged 12 to 14 years old, divided into two groups. Group I received a treatment of core stability exercises and group two received no treatment. The exercise was applied for 12 weeks with an intensity of 3 times per week. In addition to having results consistent with this research, the research conducted by Qi *et al*., had the same number of basic stability exercise movements, i.e. 6 movements. The research results of Qi *et al*., showed that there was a decrease in the mean value of scoliosis degree after undergoing core stability exercise intervention with a decrease in the mean value of Cobb angle, namely 3, 76°.[11]

The above two studies had statistical analysis results of $p = 0.01$ ($p < 0.05$), which means that there was a significant influence between before and after core stability exercise treatment basic. Meanwhile, this study has a value of $p=0.025$ ($p<0.05$), which means that it also has an effect on providing core stability exercises on reducing the ATR value for the degree of scoliosis.

Thus, this does not exclude the possibility that just 5 weeks, 3 times a week and 6 types of core stability exercises can reduce the degree of idiopathic scoliosis curve in junior high school adolescents. This is proven by the results of the statistical analysis, the value of $p = 0.025$ ($p<0.05$), which means that there is an influence between before and after the treatment of core stability exercises and a decrease in the average ATR value of 0.31°.

Activating the core muscles as the stabilizing muscles of the spine will relax the surrounding muscles that were previously in spasm. The coordinated and simultaneous contraction of these muscles will provide rigidity to support the trunk. As a result, intradiscal pressure is reduced and will reduce the workload of the lumbar muscles, so lumbar muscle tension is thereby achieved.[19]

CONCLUSION

This research proves that providing core stability exercises for 5 weeks can reduce the degree of scoliosis curve in junior high school adolescents.

Based on the above research results, suggestions that can be made to future researchers should increase the number of research subjects from multiple regions in order to describe the results of the population as a whole. Future researchers can also compare types of core stability training with other types of training.

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