

# Physiotherapy Intervention in Improving The Quality of Life of Scoliosis Individuals: Case Study

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## Abstract

**Background:** Scoliosis is a spinal problem. If scoliosis is not corrected immediately, the curvature will get worse, which can cause discomfort, an asymmetrical body appearance, and obvious changes in posture. This can also cause the quality of life to decrease. One of the public health services, namely physiotherapy, can help restore body posture by reducing the curve of the spine.

**Objective:** To determine the quality of life of individuals with scoliosis before and after physiotherapy intervention.

**Method:** This research design uses a case study and analytical descriptive qualitative research type. The sampling technique used is a purposive sampling technique where the inclusion and exclusion criteria have been determined and are by the research objectives. After grouping respondents, the next step was a pre-test, physiotherapy intervention and then evaluation.

**Results:** There was an improvement in the quality of life in scoliosis patients after providing physiotherapy intervention.

**Keywords:** scoliosis, physiotherapy, quality of life

## Introduction

The greatest gift from Allah SWT that we must accept with gratitude is health. A way to express gratitude for the gift of health that has been given by Allah SWT by maintaining good health. It has been mentioned in the Word of Allah SWT in QS. Yunus: 57

يَا أَيُّهَا النَّاسُ قَدْ جَاءَكُمْ مَوْعِظَةٌ مِّن رَّبِّكُمْ ۖ وَشِفَاءٌ لِّمَا فِي الصُّدُورِ وَهُدًى وَرَحْمَةٌ لِّلْمُؤْمِنِينَ

It means, "O people, indeed a lesson has come to you from your Lord, as well as healing medicine for the diseases in your chest, and guidance and mercy for those who believe." Therefore, it is our duty as a human being to give thanks to Allah. SWT for all His blessings, including health benefits. One part of the body that often experiences health problems is the spine. Even inside the spine, there is a spinal cord which stores many important nerves and the spine can support the weight of the human body. Bone problems The back can be in the form of changes in bone shape to scoliosis, kyphosis, or lordosis (Pristianto et al., 2022). This disorder is the result of incorrect posture and posture for a long time which then causes trauma to the spine.

About 85% of scoliosis sufferers have idiopathic scoliosis, and about 60% to 80% of idiopathic scoliosis cases occur in women (Naufal et al., 2023). According to (Ramadhani & Romadhoni, 2022), data on the prevalence of idiopathic scoliosis in adolescents recorded in Surakarta City is 5% among elementary school students and 4% among junior high school students. In adolescents aged 10 to 15 years, the prevalence of scoliosis cases is 0.47% -5.2%, where the ratio of girls is greater than boys and increases with increasing age (Nabilah et al., 2022).

Scoliosis is a misalignment of the spine that exceeds 100 in the sagittal plane which can be measured using an X-Ray device.. Scoliosis is a disorder of the spinal structure where there is a sideways curvature (lateral curvature) that forms the shape of the letter 'S' or 'C'. This condition becomes apparent when the curvature gets worse and can cause discomfort(Nabilah et al., 2022). This can result in an asymmetrical body appearance and visible changes in posture.

One public health service that can help overcome the problem of scoliosis is physiotherapy or what is known as physical therapy. Physiotherapy aims to restore, maintain and develop body movement and function. Physiotherapy intervention in scoliosis can reduce pain, correct curved spine, strengthen and lengthen muscles, and prevent progression in mild to moderate scoliosis. In addition, physiotherapy can also prevent and reduce further complications and improve the quality of life for individuals with scoliosis. Therefore, physiotherapy can be the right therapeutic choice to treat scoliosis. Physiotherapy intervention in the form of pilates, therapeutic manipulation, stretching, muscle release, dry needling, and core stabilization. Pilates exercises are exercises designed to develop strength, peace, balance, and inner awareness that aim to help prevent and rehabilitate injuries, improve posture, and improve starting, circulation, and balance. Therapeutic manipulation is a physiotherapy technique performed using the hands to improve body posture and reduce pain in scoliosis patients. Research shows that core stabilization can help reduce the degree of scoliosis curve and increase muscle strength in scoliosis patients(Yagci & Yakut, 2019).

Based on the background explained above, then The author is interested in discussing cases of scoliosis with the title "Physiotherapy Interventions in Improving the Quality of Life of Individuals with Scoliosis: Case Study".

## **Method**

### **Desain**

This research design uses a case study and analytical descriptive qualitative research type. Pre-test data collection was carried out after the respondents had been obtained by the research objectives. At the end of the research, an evaluation was carried out by carrying out post-test measurements. This post-test measurement is carried out using the same method as the pre-test to obtain post-test results that can be compared validly with the pre-test.

### **Place and Time of Research**

The place where the research was carried out was at the Physiotherapy Gymnasium, Muhammadiyah University, Surakarta. This research was carried out from November to December 2023.

### **Sample**

The sampling technique used is a purposive sampling technique where the inclusion criteria have been determined and are by the research objectives. First, respondents who have a curve degree of curvature  $\leq 5$ . Furthermore, this research limits the group of respondents to only women. Finally, the inclusion criteria include respondents who are willing and agree to be used as research samples to emphasize the importance of voluntary participation and consent for research ethics by filling out an informed consent form. There are exclusion criteria that need to be considered, firstly, respondents who have experienced an injury in the last six months are excluded from this study. Furthermore, respondents who did not agree were used as research samples. By applying these inclusion and exclusion criteria, it is hoped that research can obtain relevant samples and ensure the safety of research samples. The research sample was obtained consisting of 4 respondents, each of whom had different characteristics. The following are sample characteristics:

Table1. Sample Characteristics

Name	Age	Degree of Scoliosis	Type Curve	TB	BB	Scoliosis Research Society Questionnaire 30 (Total results)	LGS Trunk		Core Endurance Test			Leg Length			FootprintsClark'e Angle Method		
							Flexion	Extension	Flexor	Extensors	Lateral	Bone length (cm)	True length (cm)	Appearance Length (cm)	Dextra	Sinistra	Δ
N	21	110	C Dextra	158 cm	49 kg	83	550	200	20 seconds	16 seconds	S (2) seconds) D (10 seconds)	D (53) S (48)	D (96) S (87)	D (93) S (93)	500 (high)	550 (high)	50
R	21	90	C Sinistra	166 cm	55 kg	75	550	200	12 seconds	19 seconds	S (8) seconds) D (8 seconds)	D (50) S (50)	D (89) S (90)	D (98) S (99)	550 (high)	500 (high)	50
A	21	80	S	161 cm	54 kg	86	850	250	17 seconds	10 seconds	S (8) seconds) D (7 seconds)	D (47) S (47)	D (85) S (86)	D (94) S (94)	450 (normal)	470 (high)	20
Y	21	89	S	154 cm	43 kg	75	500	250	8 seconds	8 seconds	S (3) seconds) D (5 seconds)	D (41) S (41)	D (80) S (81)	D (87) S (88)	300 (normal)	70 (flat)	230

**Respondent N :** Degree of scoliosis curve 110 with type C. Respondent N has a height of 158 cm and a body weight of 49 kg. The quality of life questionnaire score was 83 points. The range of motion of the joints, especially in trunk flexion, is 550 and extension is 200. The results of the core endurance test on the flexors are 12 seconds, extensors 19 seconds, left lateral 8 seconds, and right lateral 8 seconds. The results of Clarke's angle are dextra 500 and sinistra 550. The difference in length of the right and left legs using the true length method is 9 cm.

**Respondent R :** Degree of scoliosis curve 90 with type C. Respondent R has a height of 161 cm and a weight of 54 kg. The quality of life questionnaire score was 75 points. The range of motion of the joints, especially in trunk flexion, is 550 and extension is 200. The results of the core endurance test on the flexors are 20 seconds, extensors 16 seconds, left lateral 2 seconds, and right lateral 10 seconds. The results of Clarke's angle are dextra 550 and sinistra 500. The difference in leg length using the true length method is 1 cm.

**Respondent A :** Degree of scoliosis curve 80 with type S. Respondent A has a height of 166 cm and a weight of 58 kg. The quality of life questionnaire score was 86 points. The range of motion of the joints, especially in trunk flexion, is 850 and extension is 250. The results of the core endurance test on flexors are 17 seconds, extensors 10 seconds, left lateral 8 seconds, and right lateral 7 seconds. The results of Clarke's angle dextra 450 and sinistra 470. The difference in leg length using the true length method is 1 cm.

**Respondent Y :** Degree of scoliosis curve 80 with type S. Respondent Y has a height of 154 cm and a weight of 43 kg. The quality of life questionnaire score was 75 points. The range of motion of the joints, especially in trunk flexion, is 500 and extension is 250. The results of the core endurance test on the flexors are 8 seconds, extensors 8 seconds, left lateral 3 seconds, and right lateral 5 seconds. The results of Clarke's angle are dextra 300 and sinistra 70. The difference in leg length using the true length method is 1 cm.

### ***Ethical Clearance***

This research has received ethical clearance with Number 139/KEPKFIK/XII/2023 given from the Health Research Ethics Committee, Faculty of Health Sciences, Muhammadiyah University of Surakarta. This ethical clearance statement is valid from December 18, 2023, to December 18, 2024.

## **Research Instrument**

### **a. Scoliometer**

A scoliometer is a tool used to measure the degree of curvature of the spinal curve. This tool shows a good correlation with the gold standard has good intra- and inter-rater reliability and is sensitive in detecting angular curves >100 using a reference criterion of 50 (Amendt et al., 1990). A study shows that the scoliometer has a validity value of  $r=0.7$  and interrater reliability of  $r=0.92$  while interrater reliability of  $r=0.89$  which means it has a good relationship (Coelho et al., 2013).

### **b. Goniometer**

In this study, a goniometer was used to measure the decreased range of motion of joints, especially in the trunk. The goniometer measuring instrument is quite often used to measure the range of motion of joints because it has quite high validity ( $r=0.87$ ) and reliability, namely ICC 0.90 (Ferro et al., 2010).

### **c. Core Endurance Test**

A series of tests to check muscle strength and power in the core. Core muscles greatly influence spinal stability. The core endurance test consists of movements of the trunk flexor endurance test, trunk lateral endurance test, and trunk extensor endurance test which are measured using a stopwatch. The trunk flexor endurance test has ICC values of 0.95 and 0.90. Meanwhile, the trunk lateral endurance test showed excellent intra-rater reliability, with an ICC value of at least 0.97. The trunk extensor test has also been shown to have good reliability, with an ICC (1.1) value of at least 0.77 (Evans et al., 2007).

#### **d. *Mitline***

In this study, the midline was used to measure leg length differences. Differences in leg length were measured using the true length, bone length and appearance length methods. The true length was measured using the midline from the Superior Iliac Spine (SIAS) to the medial malleolus through the patella. Bone length was measured from the greater trochanter to the tibial tuberosity. Meanwhile, the appearance length starts from the umbilicus to the lateral malleolus via the patella.

#### **e. Footprint with Clarke's angle**

Clarke's angle method is used to measure the angle between two lines on the foot, namely the line connecting the medial end of the metatarsal with the medial end of the tibia. The intra-rater reliability value of Clarke's angle method is good, showing an ICC of 0.99: 95% CI from 0.997-0.998(Hegazy et al., 2021). This shows that this method can be used to measure the angle between two lines on the leg with high precision and with valid results.

#### **f. Zebris**

The Zebris tool in this research was used to measure the centre of pressure path length (COP path length) and stance force. COP is a measure used to evaluate sway and postural balance and measures the total distance travelled by the centre of pressure, such as standing or performing balance exercises. Meanwhile, force stance is the body position required to produce or respond to certain forces in an activity.

#### **g. Scoliosis Research Society Questionnaire 30**

A tool to measure the quality of life in scoliosis patients can be used by the Scoliosis Research Society 30 (SRS-30). The measure has been shown to provide a valid assessment of health-related quality of life among patients with degenerative spine disease independent of pain location. The Scoliosis Research Society 30 (SRS-30) consists of several domains including self-image/appearance, mental health, function/activity, pain, and management satisfaction. The ICC reproducibility values of total domains and SRS-30 subscores with stable symptoms were 0.905 (95% CI, 0.870–0.930) and 0.904 (95% CI, 0.871–0.929), respectively. The SRS-30 questionnaire was proven to be valid and applicable in evaluating the quality of life in individuals with scoliosis(Kyrola et al., 2017).

#### **h. Physiotherapy intervention**

The physiotherapy intervention was carried out over two months, starting from November to December 2023, with sessions held every two days per week. Physiotherapy interventions have been carried out in various

categories such as stretching, pilates, core stabilization, strengthening, myofascial release, and therapeutic manipulation. The stretching exercise consists of anterior-posterior pelvic tilt, elevation pelvic tilt, bound angle pose, and stretching the hamstring and quadriceps muscles. Core stabilization exercises consist of plank, side plank, bridge, bridge with knee extension, and dynamic neuromuscular stabilization. Strengthening exercise with towel curl exercise. Combining various types of physiotherapy interventions can increase muscle strength, flexibility and core strength.

## Results and Discussion

### Results

#### Scope of Joint Movement in the Trunk

Table2. Trunk Joint Scope of Motion

Individual	Pre-test	Post-test
<b>N</b>	S = 200 - 00 - 550	S = 200 - 00 - 850
<b>R</b>	S = 200 - 00 - 550	S = 200 - 00 - 600
<b>A</b>	S = 250 - 00 - 850	S = 250 - 00 - 850
<b>Y</b>	S = 250 - 00 - 500	S = 250 - 00 - 700

Based on the table of results for the range of motion of the trunk joints, it is known that 3 individuals experienced an increase in the range of motion of the trunk joints with flexion movements. Meanwhile, 1 individual experienced neither an increase nor a decrease in the range of motion of the joint. Individual N experienced an increase in the range of motion of the flexion joints from 550 to 850. Individual R also experienced an increase in the range of motion of the flexion joints from 550 to 600. Individual Y experienced an increase in the range of motion of the flexion joints from 500 to 700. The range of motion of the joints in the trunk extended movement in individual N and R results remain 200 while individuals A and Y are 250 before and after giving physiotherapy intervention.

#### *Footprint Test*

Table3. Footprint Test

Name	Pre-test			Post-test		
	<i>Dextra</i> <i>Footprints</i>	<i>Footprint</i> <i>Sinista</i>	$\Delta$	<i>Dextra</i> <i>Footprints</i>	<i>Footprint</i> <i>Sinista</i>	$\Delta$
<b>N</b>	450 (normal)	470 (high)	20	450 (normal)	420 (normal)	30
<b>R</b>	500 (high)	550 (high)	50	450 (normal)	500 (high)	50
<b>A</b>	550 (high)	500 (high)	50	450 (normal)	450 (normal)	00
<b>Y</b>	300 (normal)	70 (flat)	230	340 (normal)	380 (normal)	40

Based on Table 3, the left footprint results show that individual N experienced a decrease in degree from 470 high arcus to 420 normal. Individual R experienced a decrease in the right degree from 500 to 450, normal and the sinistra from 550 to 500, although it was not yet normal. Individual A experienced a decrease in the degree of the right side from 550 to 450 and the left side from 500 to 450. Individual Y on the left side experienced flat feet with a result of 70 and after physiotherapy intervention, it became normal 380.

### **Core Endurance Test**

The core endurance movements that have been measured are trunk flexor endurance, trunk extensor endurance, and trunk lateral endurance which are measured using a stopwatch.



Picture 1. a. Trunk flexor endurance, b. Trunk extensor endurance, and c. Trunk lateral endurance

The muscles that play a role in trunk flexor movements include the rectus abdominis, obliquus internus abdominis, obliquus externus abdominis, transversus abdominis, multifidus, and quadratus lumborum muscles. Lateral trunk movement is used to measure the endurance of the transversus abdominis, obliques, quadratus lumborum and erector spinal muscles. Meanwhile, the muscles that play a role in trunk extensor movements include the erector spine, multifidus, quadratus lumborum, and iliocostalis. The following are the results of the core endurance test carried out by each individual:

Table 4. Core Endurance Test

Name	Core Endurance Test					
	Pre-test			Post-test		
	Trunk flexor	Trunk extensors	Lateral trunk	Trunk flexor	Trunk extensors	Lateral trunk
N	20 seconds	16 seconds	S (2 seconds)	37 seconds	22 seconds	S (40 seconds)
			D (10 seconds)			D (41 seconds)
R	12 seconds	19 seconds	S (8 seconds)	37 seconds	18 seconds	S (50 seconds)
			D (9 seconds)			D (38 seconds)
A	17 seconds	10 seconds	S (8 seconds)	18 seconds	12 seconds	S (32 seconds)
			D (7 seconds)			D (17 seconds)

<b>Y</b>	8 seconds	8 seconds	S (3 seconds) D (5 seconds)	23 seconds	39 seconds	S (33 seconds) D (35 seconds)
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Based on the table, all individuals experienced an increase in core endurance. The average of all pre-test individuals on trunk flexor was 14.25 seconds, increasing to 28.75 seconds. The average trunk extensor increased from 13.25 seconds to 22.75 seconds. The average right lateral trunk was 7.75 seconds to 32.75 seconds. The average left lateral trunk was 5.25 seconds, increasing to 38.75 seconds.

**Dextra and Sinistra Leg Length**

Table5. Leg Length

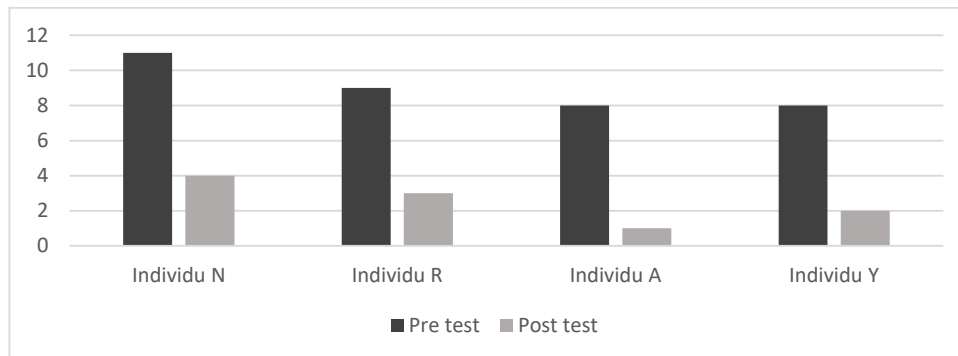
Name	Pre-test			Post-test		
	Bone Length	True Length	Appearance Length	Bone Length	True Length	Appearance Length
<b>N</b>	D (53)	D (96)	D (93)	D (52.5)	D (94)	D (93)
	S (48)	S (87)	S (93)	S (52)	S (87)	S (93)
<b>R</b>	D (50)	D (89)	D (98)	D (50)	D (90)	D (100)
	S (50)	S (90)	S (99)	S (50)	S (90)	S(100)
<b>A</b>	D (47)	D (85)	D (94)	D (47)	D (85)	D (94)
	S (47)	S (86)	S (94)	S (47)	S (86)	S (94)
<b>Y</b>	D (41)	D (80)	D (87)	D (41)	D (81)	D (89)
	S (41)	S (81)	S (88)	S (41)	S (81)	S (89)

Based on Table 5, leg length measurements were carried out using the bone length, true length and appearance length methods. Some individuals have different leg length differences. Individual N experienced a difference in leg length of 5 cm using the bone length method after being given physiotherapy intervention, which decreased to 0.5 cm. The true length experienced a difference of 10 cm before physiotherapy intervention and decreased to 7 cm. Individual R before being given physiotherapy intervention using the true length and appearance length methods had a difference of 1 cm and after being given physiotherapy intervention did not experience a difference in leg length. Individual A did not experience changes in leg length both before and after physiotherapy intervention. Individual Y before being given the intervention had a difference in leg length of 1 cm and after being given the physiotherapy intervention there was no difference in leg length.



## Degree of Curvature of Scoliosis

Graph 1. Degree of Scoliosis Curvature



Based on the results table, it can be seen that all respondents with type S and type C scoliosis have experienced a significant reduction in the degree of scoliosis curve after being given physiotherapy intervention. Respondent N's test 110 decreased to 40. Respondent R's test 90 decreased to 30. Respondent A from 80 to 10. Respondent Y from 80 to 20.

## Total Quality of Life

Table6. Total Quality of Life

Total Quality of Life		
	Pre-test	Post-test
<b>Individual N</b>	83	96
<b>Individual R</b>	75	84
<b>Individual A</b>	86	98
<b>Individual Y</b>	75	86

Based on the results of this table, there was an increase in the quality of life of individuals with scoliosis after providing physiotherapy intervention. Respondent N from 83 points rose to 96 points. Respondent R from 75 points to 84 points. Respondent A 86 points rose to 98 points. Meanwhile, respondent Y rose from 75 points to 86 points.

## Force Stance

Table7. Force Stance

			Pre-test				Post-test			
			N	R	A	Y	N	R	A	Y
<b>Forceaverage (%)</b>	<i>Left foot</i>	<i>Forefoot</i>	42	43	36	35	46	47	27	44
		<i>Back foot</i>	58	57	64	65	54	53	73	56
	<i>Total force</i>		45	58	43	53	86	57	52	51

<i>Right foot</i>	<i>Forefoot</i>	39	56	39	26	68	55	37	45
	<i>Back foot</i>	61	44	61	74	32	45	63	55
	<i>Total force</i>	55	42	57	47	14	43	48	49

Force was measured using a Zebris tool. Based on the table of force stance results measured using the zebris tool, it was found that Individuals N and A had dominant stance force pre-test on the right leg and post-test dominant on the left leg. Meanwhile, Individuals R and Y's dominant stance force is on the left foot.

### **Center of Pressure (COP)**

Table8.Center of Pressure

	Pre-test				Post-test			
	N	R	A	Y	N	R	A	Y
<b>COP Path Length (mm)</b>	36	34	95	82	183	128	314	73

COP measured using a Zebris tool. COP is the point of the total pressure of the body concentrated when standing with the location of the reaction force vector vertically on the surface in contact with the feet (Jamshidi et al., 2009). In biomechanics, (COP) or centre of pressure is used to study the body's postural and balance strategies (D'Anna et al., 2022). The results from the COP table show that the COP path length of individual N pre-test was 36 mm to 183 mm, individual R pre-test was 34 mm to 138 mm, individual A pre-test was 95 mm to 314 mm, and individual Y pre-test was 82 mm to 73 mm.

## **Discussion**

### **Range of motion of joints in the trunk**

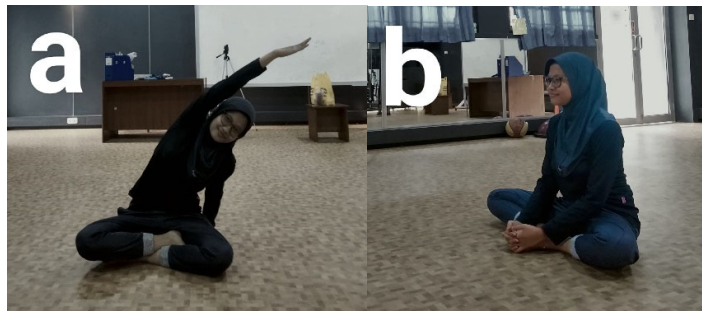
The relationship between scoliosis and the range of motion of the trunk joints shows that scoliosis is a condition where the spine curves to the side which can result in disturbances in balance, muscle function and range of joint motion.. According to the International Standard Orthopedic Measurement (ISOM) method, the range of motion of the trunk joints, especially the lumbar joints, is normally S=(300-00-850)(Sulfandi, 2021).

In this study, individuals N, R, and Y experienced an increase in joint range of motion in flexion movements after being given physiotherapy intervention. A physiotherapy exercise program to strengthen the spinal stabilizer muscles. Stronger muscles can support the spine, then the individual improves movement and reduces mobility limitations that may be caused by scoliosis. Meanwhile, individual A did not experience an increase or decrease in the range of motion of the trunk joints. Each individual has a different response to physiotherapy intervention. The range of motion of a joint can be influenced by how stiff the muscles are, the condition of the connective tissue, and daily postural habits.

Research shows that manipulation therapy interventions can improve trunk mobility and joint range of motion in individuals with compression conditions (Nugraha et al., 2022). Manipulation therapy has been carried out on the cervical, thoracic, lumbar and ankle areas. This therapy helps improve mobility and flexibility in the affected area including the trunk, thereby potentially increasing the range of motion of the joint (Prasetyo et al., 2015).

Stretching exercise including exercises that can prevent contractures and increase mobility in the trunk area (Pelealu et al.,

2014). Stretching exercises that have been done include the bound angle pose, and the mermaid pose in Pilates.



Picture2. a. the mermaid pose, b. bound angle pose

Pilates exercises have been shown to increase trunk strength, endurance, and flexibility, which contributes to an increased range of motion of the trunk joints(Ghorbani et al., 2023).

### ***Foot posture***

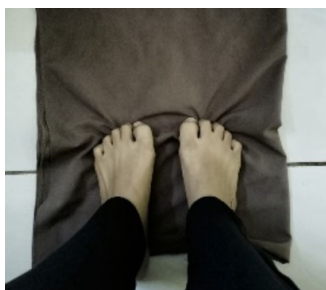
Problems with low arches (pes planus) and high arches (pes cavus) can cause an imbalance in body posture which can cause a forced stance and an unstable Center of Pressure (COP). Imbalances in the body's foundation can affect the structures above it, including the spine(Nadhir & Norlinta, 2022).

In this study, measuring the stance force of individuals with scoliosis used a Zebris measuring instrument with the individual standing. Based on the force stance results in table 7, Individuals N, R, A, and Y showed maximum force on the rearfoot and backfoot due to pes cavus. Individuals with pes cavus suffer from lateral ankle instability in the midfoot and rearfoot. Unstable parts of the foot receive more pressure, while other areas receive less pressure (Rosdiana et al., 2022). This affects the individual's stance and forces them to balance his body when standing.

Based on the results in table 8, individuals N, R, and A from pre-test to post-test COP results are getting bigger. That is, the COP moves significantly, which can indicate that the individual is struggling to maintain his balance. The degree of the individual scoliosis curve decreases but the COP is greater because when the degree of curve decreases, there is a change in overall body posture. These changes in posture can affect load distribution on the legs and alter COP patterns(Horng et al., 2021). Therefore, changes in overall body posture may impact load distribution on the legs and COP patterns, even if the degree of scoliosis decreases.

Meanwhile, individual Y from pre-test to post-test COP results are getting smaller. This indicates that there is a stable increase in body balance. Individual Y from pre-test to post-test which could be due to increased muscle strength, better body coordination, or adaptation to the intervention. An individual's improvement in balance, demonstrated by a decrease in COP from pre-test to post-test could be due to several factors, including increased muscle strength, better body coordination, and adaptation to the intervention. Increased muscle strength can help maintain body balance, while better body coordination allows for a more effective response to changes in position. In addition, adaptation to interventions that have been carried out can also contribute to positive changes in body balance.

Weakness of the muscles that play a role in foot posture by supporting the shape of the arch of the foot, such as the quadratus lumborum, sacrospinalis and other extensor muscles, can cause scoliosis to worsen because the soles of the feet can affect the position of the knees, hips and the spine above them. The towel toe cruel exercise physiotherapy intervention helps strengthen the flexor muscles of the foot and improve the arch of the foot (Haryoko, 2022).



Picture3. *Towel toe cruel exercise*

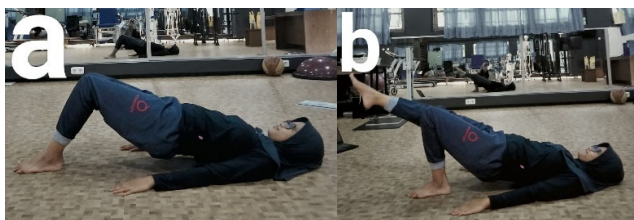
Towel toe crul exercise is done by placing a towel in front of your feet, placing the soles of your feet on the towel with your heels still on the floor, then using your toes to squeeze the towel and you will feel the muscles on the bottom of your feet working.

### ***Core endurance***

Core endurance can help overcome scoliosis by increasing muscle strength and core muscle endurance (Yagci & Yakut, 2019). Muscle strengthening and core endurance can be in the form of planks and side planks. In individuals with scoliosis who experience muscle hypotonia, muscle strengthening is done through core endurance training, and side plank movements.

In this study, several individuals had muscle hypotonia, such as individual N, on the left side, so that when doing a side plank, the left side of the body was below. Individual R also has hypotonic muscles on the right side so that when doing a side plank, the right side of the body is below. This position helps support the body and engage the core muscles, thereby contributing to increased stability and muscle strength

Core endurance has an important role in reducing the risk of scoliosis because strong core muscles can help lift the load on the spine and maintain a balanced position (Rachmawati et al., 2012). Core muscle strengthening is also done with bridge intervention, bridge extension of one knee.



Picture4. a. bridge, b. bridge extension one knee

Bridge and bridge extension one knee movements are included in core stabilization exercises. Core stabilization exercise is effective in reducing vertebral rotational deformity and pain in scoliosis (Ghorbani et al., 2023).

### **Leg length**

Scoliosis can cause muscle imbalances along the spine, hips, and legs, which in turn can cause changes in posture and differences in leg length. Scoliosis due to leg length discrepancy is caused by long-term asymmetrical loading of the lower extremities (Pinto et al., 2019).

In the research, the intervention used to overcome leg length differences due to scoliosis was core stability exercise. Core stability exercise intervention using a gymball can help reduce balance disorders caused by scoliosis which results in differences in leg length (Priatna & S, 2014).



*Picture5. Core stabilization exercise with gym ball*

Core stabilization exercise is an exercise that involves core muscle activation and body stabilization using a gym ball as an addition.

### **Degree of scoliosis curve**

The degree of scoliosis curve is by measuring how much the spine curves in someone who suffers from scoliosis. In this study, all individuals with scoliosis such as N, R, A, and Y after being given physiotherapy intervention experienced a reduction in the degree of scoliosis. This means that a decrease in the degree of scoliosis means that the curvature of the spine is improving so that the spine becomes straighter than before the physiotherapy intervention was given.

The physiotherapy intervention that was carried out in this study was dynamic neuromuscular (DNS). DNS quickly reduces the degree of scoliosis and relieves pain by increasing the stabilization of the cervical-thoracic-lumbar spine (I. Park et al., 2021). Apart from that, Pilates exercises such as mermaid side stretch on a roll, and myofascial release.



*Picture6. Mermaid side stretch on roll*

Pilates mermaid stretch is considered beneficial for scoliosis, as it helps stretch, strengthen and stabilize the muscles in the core and back, resulting in better posture and better spinal alignment (Moore, 2019).

In individuals with scoliosis, when doing mermaid stretches the muscles on the side of the body that has a higher curve tend to become weaker because they are constantly stretching and becoming tense to maintain body posture. So these muscles do not have the same strength or tone as the muscles on the side with the lower curve. When doing the mermaid stretch, the side with the higher curve will experience further stretching to help loosen tight muscles and help restore flexibility and strength to weakened muscles on that side. (Y. Park et al., 2021). In addition, myofascial release and dry needling are also used to relieve muscle tension and increase muscle flexibility (Lew et al., 2021).

## **Quality of Life**

Quality of life describes the extent to which a person feels satisfied, happy and fulfilled in his life to the maximum (Afiyanti, 2014). The quality of life of each individual is different. A tool for measuring the quality of life in scoliosis patients can use the Scoliosis Research Society 30 (SRS-30) questionnaire. The SRS-30 performed similarly in different pain groups, independent of age, gender, or deformity severity.

The Scoliosis Research Society Questionnaire 30 (SRS 30) has 5 domains including self-image/appearance, mental health, function/activity, pain, and satisfaction with physiotherapy management. The SRS-30 has 23 questions without post-operative questions and 30 with post-operative questions. The maximum total score was 115 points without questions after surgery and 150 points with questions after surgery. In this study, all individuals with scoliosis were not individuals after scoliosis surgery.

### **Self-image/appearance**

In the Scoliosis Research Society 30 (SRS 30) regarding self-image/appearance before surgery there are 30 points. Scoliosis can affect a person's self-image relating to the way individuals describe themselves and consider their current perception of themselves (Wahyuni & Fahrudin, 2020).

Individual N initially achieved 15 points from the SRS 30 questionnaire and after the intervention, his assessment increased to 19 points. Individual N was satisfied with his appearance when wearing clothes, stated that his body appearance was quite good and gave a rating of 9 on a scale of 1-10. Individual R before the intervention obtained 14 points from the SRS 30 questionnaire, which increased to 17 points after the intervention. Even though Individual R felt quite good about his appearance when wearing clothes, Individual R stated that his back appearance was less attractive and gave a rating of 6 on a scale of 1-10.

Individual A initially scored 19 points on the SRS 30 questionnaire, and after intervention, his rating increased to 22 points. Post-physiotherapy, Individual A felt very good about his appearance when wearing clothes, considered his whole body appearance to be very good, and rated him a 10 on a scale of 1-10. Individual Y before the intervention scored 17 points from the SRS 30 questionnaire, and after the intervention, his points increased to 21. After the physiotherapy intervention, Individual Y felt quite good about his appearance when wearing clothes, although Individual Y thought that the appearance of his back was less attractive, giving an assessment of 5 on a scale of 1-10.

### **Mental health**

In the Scoliosis Research Society 30 (SRS 30) points related to mental health before surgery, 25 points were recorded. Before receiving physiotherapy intervention, Individual N scored 21 points on the SRS 30 questionnaire on mental health. After the intervention, there was a change in his mental health, increasing to 23 points. Post-physiotherapy, Individual N often feels happy, although sometimes experiences a little anxiety. However, he did not experience excessive pressure. Individual R before the intervention received 14 points from the SRS 30 mental health questionnaire, and there was no change after being given physiotherapy intervention. Often, Individual R experiences anxiety, feelings of depression, and lack of happiness.

Individual A before receiving physiotherapy intervention scored 18 points and after the intervention, there was a change in his mental health to 23 points. After physiotherapy intervention, Individual A often feels happy without feeling anxious

or depressed. Meanwhile, Individual Y before being given physiotherapy intervention got 16 points and after physiotherapy intervention, his score increased to 21 points. Post-physiotherapy, Individual Y often feels happy, although sometimes experiences a little anxiety. Although I don't feel excessive pressure.

### **Function/activity**

Individual scoliosis function/activity domains before surgery total 25 points. Individual N before being given physiotherapy intervention received 17 points and after being given physiotherapy intervention there was an increase to 22 points. After physiotherapy intervention, Individual N was able to carry out activities well but had scoliosis several times limits individual N ability to carry out daily activities at home. Individual R before being given physiotherapy intervention got 19 points and after being given physiotherapy intervention 24 points.

Individual A before being given physiotherapy intervention got 23 points and after being given physiotherapy intervention there was an increase to 24 points. Individual Y before being given physiotherapy intervention got 21 points and after being given physiotherapy intervention there was an increase to 23 points. After physiotherapy intervention, all individuals can carry out their normal activities without any obstacles.

### **Painful**

In the Scoliosis Research Society 30 (SRS 30) points related to pain before surgery a total of 25 points. Individual N before being given physiotherapy intervention got 21 points and after being given physiotherapy intervention there was an increase to 23 points. After being given individual physiotherapy intervention, N did not experience the pain that he had previously felt mild pain in his back several times. Individual R before being given physiotherapy intervention got 19 points and after being given physiotherapy intervention there was an increase to 20 points. Individual A, before being given physiotherapy intervention, got 17 points. After being given physiotherapy intervention, this increased to 20 points. Individual Y before being given physiotherapy intervention got 13 after being given physiotherapy intervention there was no change in pain.

### **Satisfaction with Physiotherapy Management**

In the Scoliosis Research Society 30 (SRS 30) points related to satisfaction with physiotherapy management before surgery a total of 10 points. Individuals N, R, and A filled out the 9-point physiotherapy management satisfaction and would choose the same therapy if they had similar conditions. Meanwhile, individual Y filled in 8 points for satisfaction with physiotherapy management and would likely choose the same therapy if they had a similar condition.

Appropriate scoliosis intervention can help improve body posture and reduce the degree of scoliosis curve, thereby helping to improve the quality of life for individuals with scoliosis. A study states that a combination of manual therapy, myofascial release, core stabilization exercise, yoga, and Pilates can produce significant improvements in body posture (Aly et al., 2019). So it can improve the quality of life of individuals with scoliosis.

### **Closing**

Based on the research that has been conducted, it can be concluded that there is an improvement in the quality of life in scoliosis patients after providing physiotherapy intervention. Scoliosis recovery can contribute to improving the quality of life of individuals with scoliosis. Therefore, improvements in the quality of life of individuals with posture problems may be due to increased muscle strength, increased joint range of motion, and improved body balance.

The suggestion for this research is that when providing action, physiotherapists cannot work alone, but rather require collaboration between other members of the medical team and individuals with scoliosis to achieve success in the healing process. Apart from that, so that the planned physiotherapy program can run smoothly, individuals with scoliosis are strongly advised to exercise at home according to the guidelines provided by the physiotherapist.

A limitation of the research is that each individual responds differently to physiotherapy interventions. Factors such as the severity of the scoliosis and other individual factors may influence the outcome of the intervention. Therefore, it is difficult to extend the results of this study to all individuals with scoliosis.

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