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ORIGINAL ARTICLE

The Association of Severity of Scoliosis Curvature and Quality of Life in Adolescent Idiopathic Scoliosis Patients at Prof. Dr. Soeharso Orthopedic Hospital Surakarta: A Cross-sectional Study

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ABSTRACT

Introduction: In 2018 in Surakarta, Central Java, a team from the Orthopedic Hospital Prof. Dr. Soeharso Surakarta examined a total of 1100 junior high school students throughout Surakarta city and found that 1% of students had scoliosis. Common symptoms include pain, leg length discrepancy, posture disturbance, and psychological problems, resulting in poor health-related quality of life. Physical and Rehabilitation Medicine section of the European Union of Medical Specialists (UEMS), which recommends regular monitoring of patients with scoliosis including quality of life measurements.

Objective: To determine the association between scoliosis curve severity and quality of life in adolescent idiopathic scoliosis patients.

Methods: This study employed an observational analytic approach with a cross-sectional design and utilized purposive sampling over a one-month period. Secondary data were collected by assessing the severity of scoliosis curves based on patients' X-ray results, while primary data on the quality of life of adolescent scoliosis patients were gathered through questionnaires developed by the researcher.

Results: Spearman test was used to analyze the association of scoliosis curve severity and quality of life. Significant results were obtained with p=0.008

Conclusion: The results of this study support the theory and previous research which state that there is an association between the degree of scoliosis curve and the quality of life in patients.

Keywords: Adolescent idiopathic scoliosis, Quality of life, The SJ-27 Questionnaire

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INTRODUCTION

Scoliosis is a musculoskeletal disorder characterized by lateral spinal curvature of more than 10^0 accompanied by spinal rotation and deformation of the ribs in the direction of the convex curve.[1] The deformities in scoliosis were always in three dimensions, because it involved rotation of the axial spine, not only movement or rotation on the frontal parts. Its prevalence is approximately 10.4% globally.[2] Scoliosis was the third highest health problem for children and adolescents. The etiology of scoliosis was still debatable. In most cases the confirmed etiology is still unknown; therefore, these cases are classified as idiopathic scoliosis. Idiopathic scoliosis can be classified based on the age of disease onset: infantile (birth to 2-year-old), children (3-year-old to 9-year-old), and adolescent (≥10-year-old).[3] Adolescent idiopathic scoliosis (AIS) had the highest prevalence among idiopathic scoliosis, especially in female teenagers, with estimated prevalence of 0.47 - 5.2% and female to male ratio 2-4:1. A study in 2018 concluded that 1% of students had scoliosis.[1,4]

Patients with scoliosis experienced hypokyphosis of the thorax. Moreover, they often complain about pain, differing leg lengths, postural disorders, gait imperfection, and psychological problems. Patients with progressive scoliosis may even have pulmonary impairments. These symptoms often impacted their quality of life and regular follow up was recommended including life quality measurement.[5-7] Information on quality of life in AIS patients can help physicians in providing better health care quality which in turn may increase the effectiveness of medical intervention.[5]

Surgery and non-surgery measures are used to treat scoliosis. Untreated scoliosis resulted in higher morbidity and hospitalization. Non-surgery modalities include physical therapy, brace fitting, and regular observation. The use of braces is highly efficient to prevent disease progression. However, long-term bracing may lead to physical complaints, psychological problems, and low quality of life.[8] Surgery was indicated in patients with severe degree of spinal curvature. Approximately half of scoliosis patients were treated with surgery, such as spinal fusion surgery. However, their quality of life was reportedly lower compared to brace.[6,9,10]

Patients with spinal disorders, including AIS patients, have a high risk of a low quality of life which may be due to their psychosocial and physical condition. Assessment of the quality of life is crucial as it may reflect the effectiveness of medical intervention.[5] For this reason, a study on the quality of life in AIS patients is important. This study aimed to determine the association between scoliosis curve severity and quality of life in adolescent idiopathic scoliosis patients.

METHODS

Study Population and Research Methods

This study is an observational cross-sectional study performed on scoliosis patients presented to Medic Rehabilitation Clinic Dr. Soeharso Orthopedic Hospital between 30th September and 30th October 2024. This study had received the ethical approval from Dr. Soeharso Ethical Committee with the ethical approval number: IR.03.01/D.XXV.2.3/8746/2024. Patients were included using the non-probability purposive sampling technique where all patients fulfilling the inclusion and exclusion criteria were recruited into the study until the sample size target was achieved. Sample size was calculated using the alpha (α) of 0.05 and beta (β) of 0.1 and minimal correlation coefficient of 0.5. The minimal sample size calculated is 32 subjects.

Inclusion criteria for the study include female patients, aged between 10-year-old to 18-year-old, diagnosed as AIS by a specialist, and had Cobb angle $>10^0$ through radiologic imaging. Patients that had a history of surgery or presented with other congenital diseases were excluded.

Data was collected on the day of enrollment, including name, age, history of brace use, physical therapy, and scoliosis curvature. All participants underwent radiologic imaging to measure their Cobb angle. Quality of life assessments were performed by giving SJ-27 questionnaires to all subjects included in the study.

Case Definition

Age was categorized into nine groups: 10-year-old, 11-year-old, 12-year-old, 13-year-old, 14-year-old, 15-year-old, 16-year-old, 17-year-old, and 18-year-old.

Radiologic imaging was performed on all participants. Cobb angle was measured using the imaging. The severity of the spinal curvature was divided into three categories based on the curvature degree: mild ($<25^0$), moderate (25^0 - 45^0), and severe ($>45^0$).

Quality of life was analyzed using the SJ-27 questionnaire which was translated into Indonesian. This questionnaire consists of 27 items where each question was given points ranging from 0 point (no impairment) to 4 points (severe impairment). The total score was between 0 to 108 points where higher SJ-27 scores had poor quality of life. The SJ-27 questionnaire measured several domains including back pain, discomfort on clothing, physical activities, self-awareness of the disorder, and psychological problems occurring, such as depression.[9]

Data Analysis

Descriptive statistics were used to assess demographic and clinical characteristics of the subjects. Categorical data, such as age categorization, history of brace use, and physical therapy, was described in frequency and percentage. Mean and standard deviation were used to represent numerical data (SJ-27 scores).

An analysis of the association between scoliosis curve severity and quality of life was performed using Spearman's rho test. Significant association was concluded if $p<0.05$. Data was analyzed using software SPSS version 25.

Table 1. Research Characteristics

Characteristics	Frequency N = 47	Percentage (%)
Age (year-old)		
11	1	2.1
12	2	4.3
13	2	4.3
14	9	19.1
15	11	23.4
16	9	19.1
17	5	10.6
18	8	17.0
Spinal Curvature (degree)		
<25	13	27.7
25 - 45	20	42.6
>45	14	29.8
Brace usage		
Yes	16	34.0
No	31	66.0

RESULTS

Forty-seven respondents were included in this study. Based on age, most patients were 15-year-old (11 subjects, 23.4%), followed by 14-year-old and 16-year-old (9 subjects, 19.1% each). One respondent (2.1%) aged 11-year-old and none were aged 10-year-old. The complete age distribution on subjects included in this study is displayed in Table 1. Radiologic imaging was used to analyze the spinal curvature in all patients. The results showed that most patients had a spinal curve 25^0 - 45^0 (42.6%) as written in Table 1. Patients with mild and severe degrees of spinal curvature were almost similar with 27.7% and 29.8%, respectively.

Scoliosis can be managed through surgery and non-surgery modalities. Non-surgery therapy included physical therapy and brace-fitting. All our study participants had physical therapy. Brace was fitted in 16 participants (34.0%) and 31 participants (66.0%) did not have a history of brace fitting as displayed in Table 1. Our study uses the SJ-27 questionnaire to analyze the quality of life. The questionnaire was given to all subject resulted in median 38 (28 – 50). The minimum score was 6 while the highest score was 78 (Figure 1).

Figure 1. Dot Plot of the SJ-27 scores

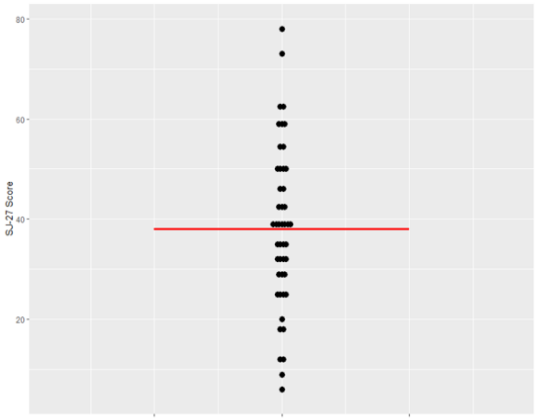

Table 2. The SJ-27 Questionnaire Results Based on The Degree of Spinal Curve

	SJ-27 Results Median (Q1 – Q3)
Spinal curvature	
$<25^0$	31 (26 – 38)
$25^0 – 45^0$	38 (24.8 – 51)
$>45^0$	42 (34.5 – 60)

Notes: Q1 : Quartile 1, Q3 : Quartile 3

In the three groups of severity degree of spinal curvature, a difference of median SJ-27 results was detected. The worst SJ-27 curvature was detected in the severe degree of spinal curvature (more than 45^0) where the median was 42 (34.5 – 60).

Patients with a moderate degree of spinal curvature presented a slightly lower SJ-27 results with a median of 38 (24.8 – 51), while the lowest score was shown in mild degree of spinal curvature with a median of 31 (26 – 38). Median results for each spinal curve severity were displayed in Table 2.

Spearman's rho test was used to analyze the association between scoliosis curve severity and quality of life in patients with AIS. The analysis showed p=0.008 and authors concluded that there is a significant relationship between scoliosis curve severity and quality of life in patients with adolescent idiopathic scoliosis.

DISCUSSION

Scoliosis is defined as a spinal disorder with an abnormal curve along the spinal axis with a Cobb angle more than 10^0. Ten percent of the worldwide population was diagnosed with scoliosis; however, its prevalence differed in each country. Turkey displayed a prevalence of 0.47%, while South Korea and Germany reported 3.3% and 5.2% of their populations had scoliosis, respectively.[2,7]

The etiology of scoliosis is still unknown. Several experts claimed that genetic factors were crucial, but some also debated contributing specific factors, such as exercise and environmental factors. Nevertheless, Zhuang et al. found changes in five proteins related to bone growth in scoliosis patients, including pyruvatinase M2, annexin A2, heat shock 27k protein, γ-actin, and β-actin.[11] Mutations of the locus gene MAPK7 and allele marker DS 1034 in chromosome 19p13.3 were also contributed to AIS. A study in China showed that changes and asymmetry in the paravertebral muscles cause a postural disorder and changes in spine movement control, causing AIS.[12]

Spine Curvature Severity

Scoliosis is detected in 2 - 3% of the population. Female patients are eight times more likely to needing further care. Due to its nature and progression, scoliosis patients routinely go to the clinic for control, need extensive treatment, and place a high burden on health care.[9,13]

Scoliosis is characterized by two curves, primary and secondary. The primary curve is located in the cervical, thoracal, or lumbar part, depending on the location of the vertebral peak at the coronal plate. When the two areas met, an intersection curve appeared. The apical vertebrae are the most cephalad and caudal vertebrae with surfaces sloping towards the concavity of the curve. Rotation heavily occurred in the apical vertebra. Direction of the concavity is expressed as the Cobb angle. Cobb angle is used to measure the severity of the curvature. This method can be used to evaluate curve, disease progression, and timing for surgery interventions. Cobbometer was previously used to calculate Cobb angle. However, recent developments found software to analyze the angle. Scoliosis curves can be classified based on the curve location where: cervical scoliosis was diagnosed if the curve occurred between C1 - C6, cervicothoracic if between C7 - T1, thoracic if between T2 - T12, thoracolumbar if between T12 - L1, lumbar if between L2 - L4, and lumbosacral scoliosis if the curve was detected between L5 - S1.[14,15] Other than Cobb angle, Adams Forward Ben test can also be used in determining scoliosis. This test is simple, non-invasive, not painful, no instrument is needed and often used by physiotherapists and orthopedists. Nowadays, traditional tests are still performed using Adams test while the Cobb angle measurement is still considered the gold standard.[3]

Mechanical changes on the backbone on Adolescent Idiopathic Scoliosis (AIS) patients were

related to an increase of back pain, psychosocial and biochemical problems, and respiratory difficulties. Patients with severe spinal curvature degree may be presented with shortness of breath or pulmonary compromise with impairment of lung function. Neurological disorders with postural control dysfunctions occurred more commonly in AIS patients with a more progressive curvature. Young age, female, history of scoliosis in the family, and bone immaturity are the risk factors of disease progression.[6]

Based on the curvature angle, AIS patients can be divided into mild, moderate, and severe. Mild AIS patients presented with Cobb angle $<25^0$ and were usually treated with physical therapy and regular observation. Braces were fitted in patients with moderate scoliosis (Cobb angle $25^0 – 45^0$). However, patients with severe scoliosis (Cobb angle $>45^0$) were recommended for surgery.[9] Patients with high degree of spinal curvature experienced more severe disfigurement of the ribs, causing more serious disease in the future. In children aged 10-year-old to 16-year-old, 0.4% reportedly had Cobb angle $\geq 40^0$. [6]

In our study, most of our subjects were categorized as moderate scoliosis where 42.6% subjects presented with Cobb angle between 25^0 - 45^0. Patients with mild and severe scoliosis were almost similar, 27.7% and 29.8%, respectively.
Patients with IS had higher concern for their appearances compared to healthy population. Savvides et al revealed that patients with thorax curvature $>40^0$ and torso rotation $>20^0$ had a negative self-image. Fortin et al found a significant correlation between low Cobb angle and low pain severity in AIS patients.[16]

The Use of Brace

Scoliosis cases can be managed through surgery and non-operative measures, depending on the degree of the major Cobb angle. Patients with mild scoliosis (Cobb angle $<25^0$) usually had physical therapy and regular observation. The brace is fitted in those with moderate scoliosis (Cobb angle 25^0 - 45^0), while surgery is recommended in patients with severe scoliosis (Cobb angle $>45^0$).[6,9] Approximately 30,000 children were brace-fitted and 38,000 underwent spinal fusion surgery. If left untreated, AIS was found to be related with an increase of physical complaints and psychological problems.[9,17]

Brace is the most common treatment modality in AIS patients with high efficiency and effectiveness. Its goal is to control the curvature degree and prevent disease progression. However, it needed to be completed before bone maturity because prolonged bracing may cause a decrease in spinal mobility which led to poor appearance and self-esteem. Prolonged bracing was also related to poor quality of life, muscle weakness, and osteoporosis.[8] This was proven by a study from Danielsson et al. that concluded a significant relationship between spinal mobility and back pain severity.[18] Brace was also said to have no significant effect in reducing pain.[16] Patients also reported higher satisfaction to surgery compared to brace even though operation was also connected with poor quality of life.[10] In our study, all patients underwent physical therapy, and most respondents were not brace-fitted.

The Association of Scoliosis Curve Severity and Quality of Life

Quality of life is measured through questionnaires given to patients. The revised Scoliosis Research Society-22 (SRS-22r) questionnaire is the gold standard. It measures quality of life through 5 domains: function, self-image, pain, mental health, and satisfaction with health care. However, this questionnaire may be impacted by the culture differences between West and Asian culture. The Japan Scoliosis-27 (SJ-27) questionnaire was developed to analyze the quality of life in Asian female patients with AIS, and its validity and reliability has been proven. This questionnaire measures quality of life in AIS patients through 5 domains: back pain, discomfort in clothing, physical activity, self-awareness of scoliosis, psychological problems such as depression. Minimum points were 0 while maximum scores reached up to 108. Poor quality of life is depicted through high SJ-27 scores.[9]

Scoliosis is a progressive disease impacting the harmony of human's back bone, torso mobility, and body symmetrical. Due to this, this disease may decrease the quality of life. Although it was often considered as a 'non-dangerous' disease; however, quality of life was severely impacted on patients with scoliosis. This may be due to several factors. First, patients often report pain in the waist and back, especially in the lumbar area, which may become more severe if untreated.[17] A study from Sarkovich et al revealed that almost half of AIS patients reported back pain.[19] Back pain can result in moderate functional disability. In severe cases, patients may even experience shortness of breath. Moreover, AIS patients experienced psychological disorders which were likely more pronounced in adolescents, for example low self-esteem due to negative body image. Anxiety was one of the most common psychological symptoms reported. A recent literature review on the impact of adolescent idiopathic scoliosis on psychological comorbidities found that body image

concerns were the most crucial cause of psychological problems.[20] Patients also complained of discomfort when wearing clothes on her upper body, especially in severe scoliosis.[9] Female with scoliosis have a high risk of eating disorders. However, it was still unclear whether this was the result of negative body image.[21] Finally, although scoliosis patients reported lower quality of life despite their curvature severity, patients with a higher curve degree was proven to be related with overall quality of life decrease.[5, 10]

In our study, there was a significant correlation between scoliosis curve severity and quality of life in female patients with AIS. Patients with a higher degree of spinal curvature had lower quality of life. This result is similar with a study from Japan which stated that SJ-27 scores were significantly related to major Cobb angle.[9]

Study Limitation

This study has several limitations. First, it is a cross-sectional study utilizing secondary data and does not include healthy subjects as a control group. The inclusion of a healthy control group would allow for a more comprehensive comparison and better assessment of the quality of life specifically attributable to AIS.

Second, although several potential confounding factors such as physical activity levels and socioeconomic are known to influence quality of life according to the previous studies, they were not analyzed in this study due to limitations in the available dataset. These variables were not collected or sufficiently detailed in the secondary data, thus preventing their inclusion in the statistical analysis. Excluding these confounders may introduce bias or limit the internal validity of the findings, as uncontrolled variables could influence the observed associations. Future studies should consider incorporating and analyzing these confounding factors to provide a more robust understanding of the determinants of quality of life in AIS patients.

CONCLUSION

This study found a significant association between scoliosis curve severity and quality of life in patients with Adolescent Idiopathic Scoliosis (AIS). While the association is evident, the absence of key variables such as lifestyle and socioeconomic factors limits the ability to fully isolate the impact of curve severity alone. Future research should incorporate a broader range of influencing factors to better understand the complexity of quality-of-life outcomes, particularly among female AIS patients.

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