

CORRELATION OF THE FLAT FOOT AND THE SEVERITY OF SCOLIOSIS IN ELDERLY PATIENTS AT PHC HOSPITAL SURABAYA

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ABSTRACT

Introduction: The main symptoms of scoliosis are postural changes such as slouching, uneven shoulders, protruding ribs, or asymmetrical waist. Several previous studies have demonstrated that the foot plays an important role in supporting body weight and establishing dynamic balance in walking function. In addition, flat feet (pes planus) may cause lower limb rotation and lower back pain, possibly due to altered postural responses and the resulting compensatory pattern between the spine and lower limbs. **Objective:** To describe the association between the occurrence of pes planus and the severity of scoliosis in elderly patients (age 60 and above) at PHC Surabaya Hospital. **Methods:** This study is an analytical study using a cross-sectional study with probability sampling with purposive sampling. The minimum number of samples required for this study was calculated using the Lemeshow formula, resulting in 69 samples. Data were collected in the form of primary data (medial longitudinal arch [MLA] Clarke angle measurement results) and secondary data (medical records) of 69 patients with a history of scoliosis (using Cobb angle criteria) from August to October 2023 at PHC Surabaya Hospital, where specialists in orthopedics and traumatology were gathered. They were then tested with the Spearman correlation test using the Statistical Package for Social Sciences (SPSS) version 29. **Results:** patients diagnosed with flat feet (pes planus) Among the 69 patients, 57 patients (82.6%) had scoliosis, but based on the results of the statistical analysis of the two variables, there was no significant correlation between them ($p = 0.932$). **Conclusion:** In PHC Surabaya Hospital, there were no significant results regarding the correlation between the occurrence of flat feet (pes planus) and the severity of scoliosis. This was due to the inclusion and exclusion criteria set by the researchers, such as age, BMI, and medical history.

Keywords: Flat foot, Scoliosis, Elderly Patient.

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INTRODUCTION

The main symptoms of scoliosis are changes in posture, such as slouching. Examples: slumped shoulders, protruding ribs, hip asymmetry, etc.^{1,2} Due to changes in spine mobility and posture, movement patterns may change from step to step.³ Unfortunately, the underlying mechanisms that cause spinal deformity in patients with scoliosis are: foot characteristics and gait performance remain unclear.

To obtain more detailed information on the underlying mechanisms, it is essential to have a deeper understanding of a series of body parameters in patients with scoliosis, including foot morphology, plantar pressure distribution, and gait performance. Plantar pressure measurement and gait analysis are widely recognized as important biomechanical parameters for quantitatively evaluating human gait, which can provide useful information on foot function and help develop more effective prevention and intervention strategies.⁴⁻⁷ In some studies, the pressure curve (COP) of patients with scoliosis is different from that of healthy controls.^{6,8-11} Several previous studies have shown that the foot plays an important role in supporting body weight and establishing dynamic balance in gait function.¹²

Foot problems Lead flatfoot (pes planus) occurs in approximately 15-25% of

adults and consists of a set of deformities related to collapse of the medial longitudinal arch, heel eversion, and forefoot abduction. Flatfoot is associated with a possible defect in the absorptive ability of the foot to walk and adapt to the environment.¹³⁻¹⁵

It is usually asymptomatic at first, but can cause pain and affect balance.¹⁶ Flatfoot may be an associated factor. Foot osteoarthritis and recurrent knee pain.¹⁷ In addition, flatfoot may cause lower limb rotation and lower back pain. This is probably due to altered postural responses and the resulting compensatory patterns between the spine and lower limbs.^{18,19}

Therefore, it remains controversial in the existing literature. The degree of scoliosis is determined using the Cobb angle as follows: Mild scoliosis, Cobb angle 40° or 45°. None of these studies were able to correlate differences in plantar pressure distribution and gait with the degree of scoliosis severity. There is a need to investigate the relationship between scoliosis severity and gait performance.²⁰⁻²²

Foot structure can have a significant effect on the dynamic function of the foot, and the relationship between foot morphology and function has been studied for a long time.^{23,24}

For example, medial translation of COP may be associated with low foot arch morphology.⁸ Previous studies have shown that foot posture can affect the gait performance of scoliosis patients.²⁵

To the best of our knowledge, most studies have not mentioned the difference in foot morphology between scoliosis and control groups, or the effect of foot posture on the walking performance of scoliosis patients. Therefore, it is unclear whether foot posture has a significant effect on the walking performance of scoliosis patients, and what differences there are between patients with different degrees of scoliosis and normal control patients.

The aim of this study was to describe the association between the occurrence of flatfoot and the severity of scoliosis in elderly patients at Surabaya PHC Hospital.

METHOD

Population

The population used in this study were scoliosis patients who had a history of flat foot/ pes planus and were treated at PHC Surabaya Hospital in July – September 2023.

The inclusion criteria in this study are:

- a. Patients ≥ 60 years old who were diagnosed with flat foot/pes planus at PHC

Surabaya Hospital in August – October 2023.

- b. Measurements the vertebral curvature with Cobb's angle criteria consisting of the severity of scoliosis (mild, moderate, and severe).

The exclusion criteria in this study are:

- a. History of secondary causes such as trauma or surgery to the vertebrae or spine, systemic disease such as rheumatoid arthritis or lupus, and neuromuscular diseases.
- b. History of drug use that anti-inflammatory corticosteroid or immunosuppressive drugs.
- c. Personal Nutrition Condition of Obesity (BMI ≥ 30).

The drop out criterion in this study was that the patient died before the measurements were taken.

Medial Longitudinal Arch Measurements

Patients were instructed to stand with both feet on a povidone-iodine-soaked felt pad and press firmly against the stamp pad. They were then asked to step forward and place their right foot on the chart sheet⁴⁴

Participants were asked to stand steadily in a relaxed bipedal standing position for 2 seconds, with equal weight

on both feet, facing forward, and then step forward to clear the chart sheet. If the footprint was not clear due to insufficient ink, the footprint was discarded and the process repeated.²⁶

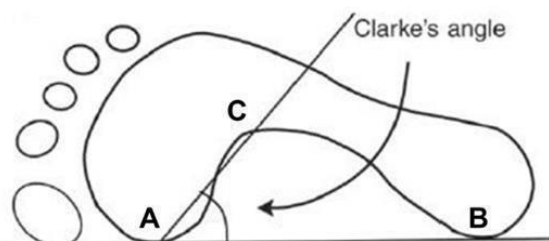


Figure 1. Clarke's angle.²⁶

CA was calculated using a marking pen, ruler, and protractor marked at 1 degree intervals. CA is determined by calculating the angle between the medial tangent (line AB in Figure 1 connecting the medial end of the first metatarsal head to the heel) and a second line (line AC in Figure 1 connecting the first metatarsal head to the heel apex of the MLA concavity) connected and determined. Below is the interpretation of CA.^{26,27}

Table 1. Interpretation of Flat Foot/ Pes Planus based on Clarke's angle.^{26,27}

Normal	42°–54°
Mild Pes planus	35°–41°
Moderate Pes planus	30°–34,9°
Severe Pes planus	<30°

Foot Posture Index

Foot posture was measured using the Foot Posture Index (FPI), in which an experienced researcher manually inspected the subjects' feet.²⁸ The FPI consists

of six items, each rated on a scale of -2, -1, 0, +1, and +2 (negative values for clear signs of supination, 0 for clear signs of neutrality, and positive values for clear signs of pronation).

The six elements were used to classify foot position as follows: (i) palpation of the talar head, (ii) observation of supramalleolar/inframalleolar curvature, (iii) calcaneal inversion/valgus, (iv) prominence of the medial talonavicular joint, (v) congruence of the medial arch, and (vi) abduction/adduction of the forefoot in the hindfoot.²⁹

Measuring the Severity of Scoliosis

Demographic information about the participants was obtained through surveys and questionnaires. Weight and height were measured using an automated weight/height measuring system.

Radiographic Cobb angle and ankle range of motion were assessed by the same experienced physiotherapist. 4,444 scoliosis patients were classified as normal (Cobb angle 45°) according to the Cobb angle of the major curve according to clinical practice (Table 2).

Table 2. Cobb Angle Criteria of Scoliosis

Angle	Criteria
<10°	Normal
10°-20°	Mild
20°-45°	Moderate
>45°	Severe

Statistical Analysis

This study is an analytical study with a cross-sectional study. The sampling technique used in this study is probability sampling with purposive sampling, because the sample is selected from members of the population based on inclusion, exclusion and drop out criteria determined by the researcher. The minimum number of samples required for this study was calculated using the Lemeshow formula, resulting in 69 samples.

Data were collected in the form of primary data (medial longitudinal arch [MLA] Clarke angle measurements) and secondary data (medical records) of 69 patients with a history of scoliosis (using Cobb angle severity criteria) at PHC Surabaya Hospital in August - October 2023 by specialists in Orthopedics and Traumatology .

RESULT

Table 3. Characteristics of Patient's Scoliosis Severity due to Flat Foot

		Severity of Scoliosis			
		Normal	Mild	Moderate	Severe
Severity of Flat	Mild	9 (13%)	4 (5%)	8 (11,6%)	7 (10,1%)
Foot/Pes Planus	Moderate	3 (4%)	3 (4%)	6 (8%)	11 (15,9%)

	Severe	0 (0%)	7 (10,1%)	9 (13%)	2 (2%)
Total		12 (17,4%)	14 (20,3%)	23 (33,3%)	20 (29%)

Based on the table above it can be seen that from the 69 patients studied, 57 patients (82,6%) had scoliosis ranging from mild to severe after measuring with the Cobb Angle Criteria. The severity of the scoliosis patients studied include: mild 24,5% (14/57), moderate 40,4% (23/57), and severe 35,1% (20/57).

From this data, it can be seen that a total of 69 patients with a diagnosis of pes planus can see the degree of severity, among others including mild 40,6% (28/69), moderate 33,3% (23/69), and severe 26,1% (18/69).

Then tested with the Spearman Correlation test using the Statistical Package for the Social Sciences (SPSS) version 29. These two research variables use an ordinal data scale which was then tested with the Spearman Correlation test using the Statistical Product and Service Solution (SPSS) version 29.

Table 4. Results of statistical analysis using the Statistical Package for the Social Sciences (SPSS) version 29.

	x	y
Spearman's rho	Correlation Coefficient	1.000 .011
	Sig. (2-tailed)	. .932
	N	69 69

y	Correlation Coefficient	.011	1.000
	Sig. (2-tailed)	.932	.
	N	69	69

From the results of the analysis with the Statistical Package for the Social Sciences (SPSS) version 29, the value of $p = 0.932$ ($p < 0.05$) was obtained, which interprets the research results as not significant.

DISCUSSION

Loss of the MLA in individuals with pes planus is generally accompanied by dysfunction of the supporting structures of the MLA (Lig. calcaneo-naviculare plantare, Lig. collaterale mediale, posterior tibial

tendon, plantaris aponeurosis, or M. flexor hallucis longus and brevis) resulting in a decrease in the function of the MLA in foot shock absorption, thereby increasing TF pressure.⁶

This condition will also limit the tibia to rotate internally and will increase rotational pressure on the TF joint.³ On the other hand, weakness of the M. abductor hallucis which is responsible for the dynamic stability of the MLA will cause decreased ability biomechanics, external

force absorption, and impaired postural stability.

This study aimed to compare the plantar pressure distribution foot morphology with mild, moderate, and severe AIS and their matched healthy peers. Idiopathic scoliosis is a deformity without a clear etiology. Research has shown that the disease is likely related to genetic factors, growth disorders, and estrogen. Severe scoliosis cases had lower weights and BMIs than other cases, suggesting that scoliosis, especially severe scoliosis, may affect the physical growth of these adolescents.^{30,31}

In severe scoliosis, height may be reduced due to the larger curvature. However, such differences were not observed, probably due to the small sample size of severe cases. Many previous studies have reported that plantar pressure and gait are affected by multiple factors, such as age, sex, BMI, and walking speed.³²⁻³⁴

Therefore, we analyzed the plantar pressure of elderly people with mild, moderate, and severe scoliosis and compared it with that of elderly people. We compared healthy people taking into account age, sex, BMI, and activity. After adjusting for these covariates, we found significant differences in foot function between the scoliosis group and the control group.

There are several limitations to this

research:

- a. This study only involved patients aged 60 years and over, so the correlation between the incidence of flat foot/ pes planus and the severity of scoliosis is unknown in the younger population.
- b. Because this study involved elderly patients aged 60 years and over, comorbid diseases in the population, such as hypertension, dyslipidemia, diabetes, and gout arthritis could not be avoided. This plays a role in confounding factors causing spinal degeneration changes.
- c. Not all patients studied were new patients, so it cannot be ascertained whether the severity of scoliosis based on Cobb Angle in patients is the result of progression of scoliosis or the first onset of scoliosis that correlates with flat foot/pes planus.
- d. This study uses BMI criteria according to WHO which classifies obesity for individuals with a BMI of 30. This is a weakness of the research because the Indonesian population uses the Asia-Pacific BMI, which classifies obesity for individuals with a BMI of ≥ 25 .
- e. Not all patients studied were patients with bilateral flat foot/ pes planus history, so the correlation between

the incidence of pes planus and the severity of scoliosis cannot be clearly known.

CONCLUSION

PHC Surabaya Hospital did not find any significant results regarding the correlation between the occurrence of flatfoot/pes planus and the severity of scoliosis.

This is related to the inclusion and exclusion criteria set by researchers, such as age and BMI. However, it can be determined that the prevalence of flat foot/pes planus and scoliosis patients at PHC Surabaya Hospital is 82.6%.

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