



The relationship between the medial longitudinal arch and lower back disability among vocational school dancer

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ABSTRACT

Background: Gianyar is one of the districts in Bali, Indonesia, that still maintain customs and traditions in ceremonies and rituals carried out as an implementation of culture. To support these activities, the performing arts commonly presented are traditional dance. The various foot movements in traditional dance will undoubtedly be a problem if there is a deformity in the foot. There is a phenomenon where abnormalities in the shape of the arch of the foot can potentially cause lower back disability. Deformities in the arch of the foot can affect the gait cycle, leg length, and the arrangement of the pelvic bones, which can trigger lower back pain.

Objective: The purpose of this study was to determine the relationship between the medial longitudinal arch and lower back disability in traditional dancer.

Methods: This study is an analytical observational study with a cross-sectional research design conducted in December-January

2023. The study subjects were 74 students from Vocational School 3 of Sukawati. Majoring in traditional dance, aged 15 to 18 years, with a non-probability sampling technique using purposive sampling.

Results: The researchers conducted anamnesis and examination according to inclusion and exclusion criteria and then observed the presence of a flat foot by measuring the Clarke angle value. The analysis used was bivariate analysis with the Spearman correlation test. The bivariate analysis results showed a significant relationship ($p=0.000$) between the medial longitudinal arch and lower back disability in traditional dancers at Vocational School 3 of Sukawati, with a muscular correlation strength and negative correlation coefficient value of -0.705 .

Conclusion: There is a significant relationship between the medial longitudinal arch and lower back disability in traditional dancers at Vocational School 3 of Sukawati.

Keywords: lower back disability, medial longitudinal arch, traditional dancer.

Cite this Article: Ayuningtiyas, N.P.D., Nugraha, M.H.S., Negara, A.A.G.A.P., Antari, N.K.A.J. 2023. The relationship between the medial longitudinal arch and lower back disability among vocational school dancer. *Physical Therapy Journal of Indonesia* 4(1): 91-94. DOI: 10.51559/ptji.v4i1.84

INTRODUCTION

Gianyar is a district that maintains customs and traditions in ceremonies and rituals to implement Balinese culture. To support these activities, performing arts are often an integral part and a way of life in the daily lives of its people.¹ The performing arts commonly presented are traditional dance. Dance is a form of art with movement as its expressive medium or substance; the revealed movements are human. The movements in dance are not realistic or everyday, but rather movements given an expressive form. The traditional dance grows and develops in a specific region and is adopted by the community from generation to generation. Traditional dance, which consists of various forms, whether a solo dance, a duet dance, or a group dance, cannot be separated from the four aspects within it. These aspects include *agem*, *tandang*, *tangkis*, and *tangkep*.²

Given the diversity of foot movements in traditional dances such as *jinjit*, *rising* (small running movements with the feet raised and knees bent), *debeg* (stomping the front part of the foot),

and others, it would be problematic if there is a deformity in the foot.³ There is a phenomenon where abnormalities in the shape of the foot arch can potentially cause lower back disability.⁴

Disability is a limitation or inability of a person to perform daily functional activities, which is considered to be a result of impairment. Abnormalities in the shape of the foot due to deformities in the medial longitudinal arch are a possible cause of disability and lower back pain, as the biomechanics of the lumbar and lower extremities have been proven to interfere with each other. The lower extremities are directly related to the biomechanics of the spine, and deformities such as anterior pelvic tilt can increase the incidence of foot deformities. With anterior pelvic tilt and obesity, the load on the forefoot increases and becomes susceptible to flattening of the arch and malalignment of the 1st ray of the foot. Conversely, improper foot mechanics lead to postural abnormalities directed toward compensation.⁵

A deformity in the arch of the foot can affect the gait cycle, leg length, and the arrangement of the pelvic bones, which can trigger lower

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Received : 2023-04-29

Accepted : 2023-05-29

Published : 2023-06-09

back pain. This condition is not good when the feet are used for physical activities such as dancing because it increases the risk of injury to the lower back.⁶ Therefore, it is essential to pay attention to this to improve dancing skills. Thus, a significant relationship was found between the medial longitudinal arch and low back disability in traditional dancers at Vocational School 3 of Sukawati.

METHODS

The research method used in this study is an analytical observational method using a cross-sectional approach. The study was conducted at Vocational School 3 of Sukawati, Gianyar, Bali, Indonesia, and was carried out from December to January 2023. The sample for this study was taken using a purposive sampling technique and met the inclusion and exclusion criteria. The inclusion criteria for this study were male and female students of Vocational School 3 of Sukawati majoring in traditional dance, aged 15-18 years old, in good health condition, with underweight and normal BMI, engaging in moderate physical activity with a value of >600-3000 MET minutes/week and vigorous physical activity with a value of >3000 MET minutes/week, cooperative and willing to participate in the study. The exclusion criteria for this study were having a history of musculoskeletal injuries in the legs, such as tendon rupture or post-trauma, and obesity assessed through interviews. The subjects obtained for this study were 74 research subjects. The independent variable in this study is the medial longitudinal arch. The dependent variable in this study is a lower back disability. The control variables in this study are BMI and physical activity level.

The sampling technique in this study was carried out using purposive sampling while still adjusting to the inclusion and exclusion criteria to be eligible as research subjects.⁷ Based on the existing inclusion criteria, individuals will fill out the IPAQ questionnaire first to determine the level of physical activity as a variable controlled in this study, where individuals with low and moderate levels of physical activity are included as study subjects.⁸

Data were collected by directly measuring the wet footprint test for students who agreed to participate in the study while still adhering to the existing health protocols, such as wearing masks, washing hands, and maintaining distance.⁹ The results of the wet footprint test measurements were divided into two categories: regular foot and flat foot. Meanwhile, the MODI questionnaire was prepared in a Google Form format that respondents could complete online. The results of

the questionnaire were divided into five categories: minimal disability (0-20%), moderate disability (21-40%), severe disability (41-60%), crippled (61-80%), and the patient is already very tormented by the pain (81-100%).¹⁰

The measurement to determine the shape of the medial longitudinal arch is performed using the wet footprint test. Footprints can be taken using ink or plain water (wet test).¹¹ In the wet footprint test, the shape of the foot arch is determined by wetting the foot and then stepping on a piece of paper so that a footprint is left on the paper.¹² Measurements of the regular foot, flat foot, and cavus foot categories are done using Clarke's angle. Clarke's angle is obtained by calculating the angle of the tangent line formed by the first line connecting the medial edge of the first metatarsal head and the heel and the second line connecting the first metatarsal head to the peak of the medial longitudinal arch. The standard foot has an angle of $31^\circ - <45^\circ$, flat foot $<31^\circ$, and cavus foot $>45^\circ$.¹³

The Oswestry Disability Index is the gold standard for assessing functional disability outcomes in back pain.¹⁰ This questionnaire consists of 10 questions about pain intensity, self-care, lifting, walking, sitting, standing, sleeping, sex life, social life, and traveling. Each item consists of 6 multiple-choice questions ranging from the lowest level with a score of 0 to the highest score of 5.¹⁴

The statistical tests used in this study were univariate analysis and bivariate analysis. Univariate analysis was conducted to provide an overview of the variables, which included medial longitudinal arch, lower back disability, age, gender, BMI, and physical activity level.¹² Bivariate analysis was conducted to determine the relationship between the medial longitudinal arch and lower back disability, and Spearman's rho test was used for the bivariate analysis.¹⁵

RESULTS

In this study, the research subjects were 15-18-year-old students at Vocational School 3 of Sukawati, selected using a purposive sampling technique with inclusion and exclusion criteria fulfilled by 74 participants. After data collection and univariate and bivariate analysis using Spearman's rho, the data were found as presented in the table below.¹⁶

Based on Table 1, it can be seen that the frequency of normal foot subjects and flat foot subjects is the same, with 37 respondents. Based on the MODI questionnaire assessment, there were 34 respondents (45.9%) who had a minimal disability and 40 respondents (54.1%) who had a moderate disability.

Table 1. Characteristics of respondents

| Characteristics | Frequency (n) | Percentage (%) |
|--|---------------|----------------|
| Medial Longitudinal Arch | | |
| Normal Foot | 37 | 50,0 |
| Flat Foot | 37 | 50,0 |
| Modified Oswestry Disability Questionnaire | | |
| Minimal Disability | 34 | 45,9 |
| Moderate Disability | 40 | 54,1 |
| Age | | |
| 15 | 14 | 18,9 |
| 16 | 11 | 14,9 |
| 17 | 32 | 43,2 |
| 18 | 17 | 23,0 |

Table 2. Results of the Spearman's Rho Correlation Test for The Relationship between Medial Longitudinal Arch and Lower Back Disability

| Variable Correlation | Correlation | P-value |
|--------------------------|-------------|---------|
| Medial Longitudinal Arch | -0,705 | 0,000 |
| Lower Back Disability | | |

According to Table 2 above, testing with the Spearman correlation test resulted in a p-value of 0.000. Based on these results, the decision-making is if the value of Asymp.Sig (2-sided) or $p < 0.05$, then H_0 is rejected, and H_a is accepted, which means a relationship exists between the medial longitudinal arch and lower back disability in traditional dancers at Vocational School 3 of Sukawati.

DISCUSSION

According to the survey, it was found that 17 years old is the age with the highest incidence of flat foot. The prevalence of flat foot is very high in 17 years old, decreasing with age as skeletal maturity advances. The number of study subjects with flat feet among students is also in line with the results of a study conducted by Balouchy (2015), which found a significant difference in the relationship between flatfoot and the occurrence of lower back disability.¹⁸ The results of this study indicate that the lower the degree of the medial longitudinal arch, the higher the level of a lower back disability.

The results of the subject testing showed that 54.1% of the respondents had a moderate disability. This can be related to the level of physical activity and BMI of the study subjects, which are factors that can cause lower back disability.

Our body consists of muscles, tendons, and interconnected tissues. When one part of our body moves, the others respond by stretching or contracting to allow that action. Walking is one of the best examples of this. When we walk, we place our entire body weight on our feet. The feet absorb

the impact, with the spine as the direct support that keeps us upright. This interconnected system is the main reason why deformities of the foot arch can cause back pain.¹⁹

The study conducted by Balouchy (2015) found a significant difference in the relationship between the shape of the foot arch and the incidence of lower back disability. The foot arch abnormalities studied, including pes cavus, pes planus, and natural foot, impact the lumbosacral region, which causes back pain.¹⁰

The foot serves as the point of contact during weight-bearing and mobilization processes. Excessive weight-bearing activity (overuse) in dancers increases the risk of lower extremity injuries, metatarsal stress fractures, cuboid syndrome, and stress on the plantar tissue structures. Injuries to the plantar structures can lead to a decrease in the curvature of the plantar arch due to increased plantar pressure in the midfoot area and an increased center of mass.²⁰

Deviations in the arch of the foot can affect the gait cycle, leg length, and the alignment of the pelvic bones, thus triggering lower back pain. Deformities in the arch of the foot significantly impact the biomechanics of the lumbosacral region. During the gait cycle phase with weight-bearing on a normal arch, the foot position will pronate, and the arch will flatten to distribute torque to absorb rotation on the leg and prepare the body to respond to reaction forces. In the stance phase, there is kinematic interaction at the joint, namely when the calcaneus everts, followed by the adduction of the talus and flexion of the plantar pedis, the talus will translate towards the anteromedial direction, which results in internal rotation of the tibia and femur, and eventually, the pelvis will shift forward due to the tight connective tissue where in the sacroiliac joint, the posterior surface of the sacrum rotates upwards. In the hip joint, the acetabulum moves anterior to the caput femur. Which is assisted by the anterior sacroiliac ligament, sacrospinous ligament, sacrotuberous ligament, erector spinal muscles, M. iliopsoas, M. sartorius, and M. Rectus femoris. If there is hyper pronation, there will be an increase in compensatory movements at the proximal joint and excessive stress on the lumbopelvic region.²¹

The strength of this study was that it explained the relationship between the medial longitudinal arch and lower back disability in traditional dancers at Vocational School 3 of Sukawati. The study used the MODI questionnaire, a gold standard for measuring lower back disability. However, the study also has some limitations, such as other factors that were not investigated by the researcher, such as differences in training intensity and types

of exercises in each dance class, footwear usage, and injury history, which may affect disability. In this study, further research is needed regarding MET variations that affect the inclusion criteria. In addition, the more subjects, the better the research is so that more subjects are used.

CONCLUSION

Based on the objectives and results of the study, it can be concluded that there was a significant correlation between the medial longitudinal arch and lower back disability among dance students at Vocational School 3 of Sukawati, with a strong negative correlation coefficient. This can be interpreted as the lower the degree of the medial longitudinal arch, the higher the level of the lower back disability. However, other factors, such as differences in training intensity and types of exercises in each dance class, footwear usage, and injury history, were not studied and could potentially affect the results.

ETHICAL CLEARANCE

The Research Ethics Commission, College of Medicine, Universitas Udayana, stated that this research is ethically feasible with number 2100/UN14.2.2.VII.14/LT/2022.

CONFLICT OF INTEREST

This study has no conflicts of interest.

FUNDING

This study received no grants from any institution.

AUTHOR CONTRIBUTIONS

NPDA is preparing study designs, collecting data, processing data, and writing manuscripts. MHSN, AAGAPN, and NKAJA are directing data collection and revising the manuscript.

ACKNOWLEDGMENT

The authors thank all parties involved in this study.

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