International Journal of Public Health Excellence (IJPHE)
Vol. 4, Issue 1, June-December 2024, pp. 59~63
Journal Homepage: https://ejournal.ipinternasional.com/index.php/ijphe
ISSN: 2809-9826, DOI: 10.55299/ijphe.v4i1.854

The Relationship Between Flat Foot and Dynamic Balance in Basketball Players

Vida Nanda Chattalia[*]
[*]Master of Sport Physiology, Medical Faculty, UdayanaUniversity, Bali, Indonesia

Article Info

Article history:

Received May 05, 2024
Revised June 13, 2024
Accepted July 07, 2024

Corresponding Author:

Vida Nanda Chattalia
Sport Physiology Department, Medical Faculty, Udayana University, Indonesia
Email: vidanandachattalia@gmail.com

ABSTRACT

Basketball players always engage in highly mobile physical activities that need to be supported by normal foot anatomy. Most important parts influencing musculoskeletal and biomechanics in the foot is the arch of the foot. Flat foot, is one of the most common conditions encountered. It refers to a medical condition where the arch of the foot becomes flat. Balance is one of the most crucial coordination skills in basketball. Good dynamic balance can be achieved if athletes have normal foot arches. If the normal arch is lost, can lead to dynamic balance disturbances. This research method uses a cross-sectional analytical observational design to examine the relationship between flat foot and dynamic balance in basketball players. In this study, 26 individuals participated as research subjects. Dynamic balance measurements using the Y Balance Test (YBT). Arch of foot measurements using the wet footprint test. Data analysis in this study using the Pearson Correlation test. This research concludes that there is a significant relationship between flat foot and dynamic balance in junior high school basketball players in Denpasar. The findings of this study indicate a statistically significant relationship, as evidenced by p-values of 0.045 and 0.003 ($p < 0.05$).

Keywords: *Flat Foot, Dynamic Balance, Basketball Players*

1. INTRODUCTION

Basketball is currently one of the most popular sports across all age groups, especially among young people. This sport is highly engaging and can be played by anyone, from children to adults, and is open to both men and women [1]. Basketball is widely popular, and almost every school, particularly Junior High Schools (JHS), offers basketball as an extracurricular option. Various competitions held regularly serve as a platform for junior high basketball players to showcase their potential and skills [2]. Basketball players always engage in highly mobile physical activities during training and competitions. These physical activities need to be supported by normal foot anatomy for optimal performance [1]. One of the most important parts influencing musculoskeletal and biomechanics in the foot is the arch of the foot [3]. The foot arch functions to support the foot during movement and weight bearing, provides strength and balance during walking, evenly distributes weight on the foot, and stores energy during running [4]. Different heights of the foot arch, either higher or lower, lead to foot supination and pronation, causing varying distribution of plantar pressure and thus affecting muscle strength of foot and ankle [5].

Flat foot, also known as fallen arches or pes planus, is one of the most common conditions encountered. It refers to a medical condition where the arch of the foot becomes flat or low. The entire sole of the foot touches or nearly touches the ground [1]. Traumatological and Orthopedic Books also explain that this foot shape abnormality is caused by weakness of the supporting structures of the medial longitudinal arch, which consists of intrinsic foot muscles, the plantar ligament, anterior and posterior tibialis tendons [6]. Biomechanical changes due to flat foot can lead to balance disturbances, gait abnormalities, and the formation of deformities [7]. Flat foot are a common chronic condition, with reported case found that 28% to 35% of children in early school experience flat foot, with 80% of them having a moderate degree [8]. Another study with total sample 54 high school basketball players in

Denpasar, found that 23 people or 42.6% had flat foot [9]. A preliminary survey conducted by the author at 7 junior high schools in Denpasar found that out of 128 basketball players, 31 people (24.2%) had bilateral flat foot, and 28 people (21.9%) had unilateral flat foot.

Balance is the ability to maintain the center of gravity relative to the base of support and is the result of the neuromuscular system's work as a response to feedback from visual, vestibular, and somatosensory components [10]. There are two types of balance: static balance and dynamic balance. Static balance is the ability to maintain balance in fixed position and posture [11]. Meanwhile, dynamic balance is the ability to sustain and maintain body position while in motion [12]. Research conducted on high school students found that out of 6,000 basketball players, there was one injury per year, and more than 25% of players experienced injuries lasting more than one week due to poor balance control [13]. Another study stated that ankle sprains are almost > 7 times more likely to occur in basketball players due to poor balance [14]. Research by Nugroho & Nurulita stated that there is a relationship between flat foot and dynamic balance ($p < 0.05$) with a value of $r = -0.599$. This value indicates that the higher the degree of flat foot, the lower the dynamic balance [8]. A study by Nakhostin-Roohi showed that 50 teenage girls aged 14-17 years with flat foot had poor static and dynamic balance [15].

Balance is one of the most crucial coordination skills in sports, especially in basketball. The sudden and intense changes in direction, coupled with physical contact among basketball players, heavily rely on dynamic balance. Dynamic balance has a significant direct effect on jump shot ability, accounting for 51.9% [16]. Good balance enables players to control their bodies, minimize errors, reduce the risk of falling when changing directions and moving quickly on the court, and effectively implement technical skills [17]. Good dynamic balance can be achieved if athletes have normal foot arches. If the normal arch has not yet appeared or is lost, walking patterns will change. Gait analysis results in flat foot individuals show differences in step length due to compensatory plantar flexor muscle activity, leading to missing walking phases [18]. Additionally, overpronation in flat foot causes the ground reaction force (GRF) to shift medially during the stance phase [19]. Hyperpronation will place the muscles in the knee and foot region work harder to maintaining the body position to stand stable. The constant pressure experienced by the muscles due to prolonged abnormal posture and repetitive movements will causing muscle imbalances [20].

2. METHOD

This research was conducted in 8 Junior High Schools located in the Denpasar area. It employed a cross-sectional analytical observational design to examine the relationship between flat foot and dynamic balance in basketball players. The inclusion criteria for the study were voluntary willingness to participate as research subjects by signing informed consent, male, and aged 13-15 years old. Exclusion criteria included postoperative lower limb surgery within the last year, acute lower limb injury, the use of foot orthoses or insoles, suffering from diseases affecting the eyes or ears, and experiencing central or peripheral nervous system disorders. In this study, 26 individuals participated as research subjects. Dynamic balance measurements were conducted using the Y Balance Test (YBT), assessed as a simple measurement tool using three directions: Anterior (A), Posteromedial (PM), and Posterolateral (PL). The Y Balance Test with interrater test-retest reliability averaging across the three directions had an intraclass correlation coefficient range of 0.85-0.93, indicating good reliability [21]. Arch of foot measurements were conducted using the wet footprint test by wetting the sole of the foot with ink and then stepping on a sheet of paper while standing. The Clarke's angle formed by the degree arch was measured. If the measurement result was < 31°, the subject was considered to have flat feet. The sensitivity value was 89.8% for assessing patients' foot arches through Clarke's Angle [22]. Data analysis in this study utilized computer data analysis applications with bivariate analysis using the Pearson Correlation test.

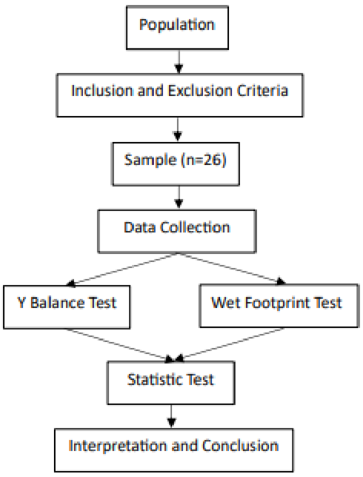

Fig 1. Research Flowchart

3. RESULTS AND DISCUSSION

Table 1. Subject Characteristic

	N	Min	Mean	Max	SD
Age	26	13	14.08	15	0.891
Body Mass Index	26	18.65	20.57	22.83	1.560
Right Clarke’s Angle	26	0	13.54	30	7.875
Left Clarke’s Angle	26	0	13.04	27	6.428
Right Composite YBT	26	70.48	102.66	132.75	15.736
Left Composite YBT	26	73.96	101.68	126.13	14.741

Based on Table 1, the research subjects consisted of 26 students, with an average age of 14 years and an average BMI of 20.57. The flat foot measured using Clarke’s angle indicated that the average Clarke’s angle on the right foot was 13.54 and on the left foot was 13.04. The dynamic balance measured with the Y Balance Test (YBT) yielded average composite scores of 102.66 for the right foot and 101.68 for the left foot.
The results of normality test and the correlation or relationship between flat foot and dynamic balance can be seen in the following table.

Table 2. Normality Test Shapiro-Wilk

	Sig. 2 Tailed
Right Clarke’s Angle	0.464
Left Clarke’s Angle	0.328
Right Composite YBT	0.702
Left Composite YBT	0.486

Based on Table 2, the results of the Shapiro-Wilk normality test on Clarke’s Angle and the Composite Y-Balance Test value showed significant values > 0.05, indicating that the data from each variable were normally distributed.

Subsequently, hypothesis testing was conducted using the Pearson Correlation test. The results of the hypothesis test can be seen in the table below.

Table 3. Pearson Correlation Test

	Sig. 2 Tailed	Pearson Correlation
Correlation of Right Clarke's Angle with Right Composite YBT	0.045	0.397
Correlation of Left Clarke's Angle with Left Composite YBT	0.003	0.567

The hypothesis test in Table 3, showed significant values of 0.045 and 0.003 (p-values < 0.05), meaning that H0 was rejected or there is a relationship between flat foot and dynamic balance in junior high school basketball players in Denpasar. Furthermore, flat foot has a weak relationship on the right foot and a moderate relationship on the left foot, with positive direction indicating that a smaller Clarke’s Angle (more severe flat foot) results in smaller dynamic balance measurements with the YBT.

The research results showed a p-value of < 0.05, indicating a relationship between flat foot and dynamic balance. This is consistent with the research by Antara et al, involving 101 samples aged 6-11 years, which obtained a research result of p 0.00, indicating a relationship between flat foot and dynamic balance in students of State Elementary School 4 Tonja Kota Denpasar [23]. Research conducted by Putri involving a population and sample size of 40 elementary school students, both male and female, aged 7-9 years, showed a relationship between arch curvature abnormalities and static and dynamic balance disorders, with a correlation test result of p 0.000 (>0.05) [24]. Research conducted by Beata, involving a total population sample of 200 children aged 10-15 years, randomly selected from elementary school children, significantly showed a relationship between morphological variables of flat foot arches and postural stability in both static and dynamic conditions [25]. Speed and balance are prerequisites for performing basic techniques in basketball. Considering that in basketball, each player must be able to attack quickly and defend (return to the defensive area) quickly as well. Good balance can help athletes adjust their walking style in difficult situations. The length and frequency of steps can directly affect a player's balance [26].

Flat foot conditions cause the intrinsic muscles to work harder, resulting in overuse to stabilize the arches due to the loss of passive support from ligaments, leading to foot fatigue and pain [27]. Weakness in intrinsic foot muscles as dynamic stabilizers of the medial longitudinal arch reduces their ability to absorb external pressure and leads to postural instability. Pressure in the plantar area is centered on the second and third metatarsals compared to normal feet during dynamic activities. Change in plantar pressure distribution, increasing the risk of injury. Non-anatomical foot alignment causes additional pressure on muscle spindles and the talocalcaneal joint, resulting in proprioceptive disturbances in the foot [28]. Biomechanical theory of musculoskeletal foot components work together to support the body during foot strike and push-off to absorb shock and prepare rigid levels. A wide flat foot without arches causes the body's lever components to be stiff during walking and running processes, leading to balance disturbances and quick fatigue. Children with normal feet are considered more stable because the pressure from body weight is evenly distributed across the entire sole of the foot [29]. Dynamic balance capabilities can control the body's overall center of gravity during exercise. In basketball, the difficulty of controlling balance when holding the ball is much greater compared to everyday technical actions such as running and jumping. Good balance can help athletes adjust their gait in difficult situations. Additionally, balance in basketball is equally important for both the offensive and defensive teams [26]. So, intervention are needed to correct the condition of flat foot and improve the dynamic balance. Strengthening exercises is usually given to correct flat foot and additional balance exercises are given to improve the dynamic balance of basketball players.

4. CONCLUSION

This research concludes that there is a significant relationship between flat foot and dynamic balance in junior high school basketball players in Denpasar. The findings of this study indicate a statistically significant relationship between flat foot and dynamic balance, as evidenced by p-values of 0.045 and 0.003 ($p < 0.05$).

ACKNOWLEDGEMENTS

Author thanks to research partner who have helped finish this article.

REFERENCES

[1] N. Darwis, "Perbandingan Agility Antara Normal Foot Dan Flat Foot Pada Atlet Unit Kegiatan Mahasiswa Basket di Kota Makassar", skripsi, 2016
[2] I. Indraharsani, I. Budisetyani, "Efektivitas Self-Talk Positif Untuk Meningkatkan Performa Atlet Basket", Jurnal Psikologi Udayana, vol. 4, no. 2, pp. 367-378, 2017, doi: 10.24843/JPU.2017.v04.i02.p12
[3] A. Ozdinc, N. Turanz, "Effect of Ballet Training of Children in Turkey on Foot Antropometric Measurements and Medial Longitudinal Arc Development", J Pak Med Assoc, vol. 66, no. 7, pp. 869-874, 2016
[4] M. Lowth, "Pes Planus : Orthopaedics and Sports Medicine", Orthopaedisc and Sports Medicine, 2016
[5] X. Zhao, T. Tsujimotor, B. Kim, K. Tanaka, "Association of Arch Height With Ankle Muscle Strength and Physical Performance In Adult Men", Biol Sport, vol. 34, no. 2, pp. 119-126, 2017, doi: https://doi.org/10.5114/biolsport.2017.64585
[6] H. Sahabuddin, "Hubungan Antara Flat Foot Dengan Keseimbangan Dinamis Pada Murid TK Sulawesi", skripsi, 2016
[7] F. Idris, "Filogeni dan Ontogeni Lengkung Kaki Manusia", Majalah Kedokteran Indonesia, vol. 60, no. 2, pp. 74-80, 2010
[8] A. Nugroho, F. Nurulita, "Hubungan Antara Pes Planus Dengan Keseimbangan Dinamis Pada Murid Mi Nurul Karim Colomadu", Jurnal Keterapian Fisik, vol. 4, no.1, pp. 1-58, 2019, doi: https://doi.org/10.37341/jkf.v4i1.120
[9] N. Sari, I. Juhanna, M. Nugraha, I. Sugiritama, "Perbedaan Tinggi Vertical Jump Pada Pemain Basket Dengan Normal Foot Dan Flat Foot di Denpasar", Majalah Ilmiah Fisioterapi Indonesia, vol. 9, no. 2, 2021, doi: https://doi.org/10.24843/MIFI.2021.v09.i02.p05
[10] G. Boccolini, "Using Balance Training to Improve the Performance of Youth Basketball Players", Sport Sci Health, vol. 9, no. 1, pp. 37-42, 2013, doi: https://doi.org/10.1007/s11332-013-0143-z
[11] C. Condon, K. Cremin, "Static balance norms in children," Physiother. Res. Int., vol. 19, no. 1, pp. 1–7, 2014, doi: 10.1002/pri.1549
[12] S. Jazi, F. Purrajabi, A. Movahedi, S. Jalali, "Effect of Selected Balance Exercises on The Dynamic Balance of Children with Visual Impairments," J. Vis. Impair. Blind., vol. 106, no. 8, pp. 466–474, 2012, doi: 10.1177/0145482x1210600803
[13] A. Rahmantha, "Pengaruh Core Stability Exercise Terhadap Keseimbangan Dinamis Pemain Basket SMPN 1 Lawang Usia 12-15 Tahun", Skripsi, 2020
[14] T. McGuine, J. Greene, T. Best, G. Leverson, "Balance as a Predictor of Ankle Injuries in High School Basketball Players", Clin J Sport Med, vol. 10, no. 4, pp. 239-244, 2000, doi: https://doi.org/10.1097/00042752-200010000-00003
[15] B. Nakhostin-Roohi, A. Hedayati, A. Aghayari, "The Effect of Fleible Flat-Footedness on Selected Physical Fitness Factors in Female Students Aged 14 to 17 Years", Journal of Human Sport and Exercise, Vol. 8, No. 3, pp. 788-796, 2013, doi: https://doi.org/10.4100/jhse.2013.83.03
[16] Gusril, R. Estigana, A. Fardi, W. Rasyid, "Beberapa Faktor yang Berkaitan Dengan Kemampuan Jump Shoot Atlet Basket", Jurnal Olahraga Pendidikan Indonesia (JOPI), vol. 1, No. 1, pp. 60-77, 2021, doi: https://doi.org/10.54284/jopi.v1i1.6

[17] T. McLeod, T. Armstrong, M. Miller, J. Sauers, “Balance Improvements in Female High”, Journal of Sport Rehabilitation, vol. 18, pp. 465- 481, 2009, doi: https://doi.org/10.1123/jsr.18.4.465
[18] Y. Morio, K. Izawa, Y. Omori, H, Katata, D. Ishiyama, S. Koyama, “The Relationship between Walking Speed and Step Length in Older Aged Patients”, Diseases, vol. 7, no 1, 2019, doi: https://doi.org/10.3390/diseases7010017
[19] K. Githa, A. Ayu, N. Komang, I. Wiwiek, “Perbedaan Gait Parameter Terhadap Tipe Arkus Pedis (Normal Foot, Flat Foot Dan Cavus Foot) Pada Anak Sekolah Dasar Usia 10-12 Tahun Di Denpasar Barat”, Maj Ilm Fisioter Indones, vol. 8, no.2, pp. 57-61, 2020, doi: https://doi.org/10.24843/MIFI.2020.v08.i02.p11
[20] V. Mosca, “Flexible Flatfoot in Children and Adolescents”, Jornal Children Orthopedic, vol. 4, no. 2, pp. 107–121, 2010, doi: https://doi.org/10.1007/s11832-010-0239-9
[21] S. Shaffer, D. Teyhen, C. Lorenson, R.Warren, C. Koreerat, C. Straseske, J. Childs, JD, “Y-Balance Test: A Reliability Study Involving Multiple Raters”, Military Medicine, Vol. 178, No. 1, pp. 1264-1270, 2013, doi: https://doi.org/10.7205/MILMED-D-13-00222
[22] S. Pita-Fernandez, C. Gonzalez-Martin, T. Seoane-Pillado, B. Lopes-Calvino, S. Pertega-Diaz, V. Gil-Guillen, V, “Validity of Footprint Analysis to Determine Flatfoot Using Clinical Diagnosis as the Gold Standard in a Random Sample Aged 40 Years and Older”, J Epidemiol, Vol. 25, No. 2, pp. 148-154, 2015, doi: https://doi.org/10.2188/jea.JE20140082
[23] K. Antara, I. Adiputra, I. Sugiritama, “Hubungan Flat Foot Dengan Keseimbangan Statis Dan Dinamis Pada Anak Sekolah Dasar Negeri 4 Tonja Kota”, Majalah Ilmiah Fisioterapi Indonesia, Vol. 5, No. 3, 2017, doi: https://doi.org/10.24843/MIFI.2017.v05.i03.p05
[24] Putri, “Relationship Between Abnormalities the Arcus Form Static and Dynamic Balance Levels in Class 1-4 Students for Primary School Muhammadiyah Ambokembang Academic 2018/2019 in Pekalongan”, International Journal of Multicultural and Multireligious Understanding, vol. 6, no. 4, pp. 552-525, 2019, doi: https://doi.org/10.18415/ijmmu.v6i4.1031
[25] S. Beata, “Feet Deformites and Their Close Assosiation with Postural Stability Deficits in Children Ages 10-15 Years,” BMC Musculoskeletal Disorders, vol. 20, no. 1, 2019, doi: https://doi.org/10.1186/s12891 -019-2923-3.
[26] G. Lin, “Balance Training and Physical Ability Of Basketball Players”, *Rev Bras Med Esporte*, vol. 29, 2023, doi: https://doi.org/10.1590/1517-8692202329012022_0543
[27] T. Dabholkar, A. Agarwal, “Quality of Life in Adult Population with Flat Feet”, International Journal of Health Sciences and Research, vol. 10, no. 2, pp. 193- 200, 2020
[28] M. Kim, “Foot Pressure Analysis of Adults with Flat and Normal Feet at Different Gait Speeds on An Ascending Slope”, J Phys Ther Sci, vol. 27, no. 12, pp. 3767-3769, 2015, doi: https://doi.org/10. 1589/jpts.27.3767
[29] R. Snell, “Anatomi Klinik”, EGC. Jakarta, 2004.

BIOGRAPHIES OF AUTHORS

Vida Nanda Chattalia is a physiotherapist working on private physiotherapy clinic especially orthopaedic and sport physiotherapy in Bali, Indonesia. Now still ongoing Master of Sport Physiology. Here the contact: vidanandachattalia@gmail.com