Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/jptcp.v31i1.3998

EFFECTS OF INSOLES WITH AND WITHOUT SHORT FOOT EXERCISES ON PAIN, DISABILITY AND FOOT POSTURE IN CHILDREN WITH PES PLANUS

Dr Eram Aslam[1]*, Dr. Maryam Nasim[2], Dr. Arooj Shabir[3], Dr. Arnab Altaf[4], Aamna Hassan[5], Dr. Mubashra Tariq[6], Kiran Aslam[7], Dr. Sidra Shafeeq[8]

[1]*MS-PPT (RIU), Senior Physiotherapist, Bashir Medical and Kidney Centre, Lahore, Riphah International University, Lahore – Pakistan. Email: doctor.eram786@gmail.com
[2]MS-OMPT (RIU, Lecturer, University of South Asia Raiwind Road, Lahore - Pakistan Email: maryamnaseem90@gmail.com
[3]Doctor of Physical Therapy, Government College University, Faisalabad - Pakistan Email: aroojshabir152@gmail.com
[4]BSPT (UHS)MPhil (RCRS), Lecturer, Riphah International University, Lahore - Pakistan Email: arnab.altaf@riphah.edu.pk
[5]DPT, MSPT (Pediatrics), Lecturer, Agile Institute of Rehabilitation Sciences, Bahawalpur – Pakistan. Email: amnah1197@gmail.com
[6]MS-PPT (RIU), Senior Physiotherapist, City Rehabilitation Centre, Lahore/ Senior Lecturer, City Institute of Management and Emerging Sciences, Lahore - Pakistan Email: mubashratariq745@gmail.com
[7]MPhil (SCH) Orthoptics, PGR, Mayo Hospital, Lahore, King Edward Medical University, Lahore – Pakistan. Email: kiranmoaz2030@gmail.com
[8]BSPT & TDPT, Senior Lecturer, Riphah International University, Lahore - Pakistan Email: sidra.shafique@riphah.edu.pk

***Corresponding Author:** Dr Eram Aslam
*MS-PPT (RIU), Senior Physiotherapist, Bashir Medical and Kidney Centre, Lahore, Riphah International University, Lahore – Pakistan. Email: doctor.eram786@gmail.com

Supervised by: Dr. Arnab Altaf
BSPT (UHS)MPhil (RCRS), Lecturer, Riphah International University, Lahore - Pakistan
Email: arnab.altaf@riphah.edu.pk

Abstract

Background: Pes Planus, commonly known as flatfoot, is a condition that can lead to significant discomfort and functional impairment. While various treatments have been proposed, the effectiveness of combining shoe insoles with Short Foot Exercise (SFE) has not been extensively studied.

Objective: To evaluate the efficacy of combined shoe insole and SFE intervention in improving symptoms of flatfoot compared to shoe insoles alone.

Methods: This randomized controlled trial recruited 26 children aged 8-16 years with symptomatic bilateral pes planus. Participants were divided into two groups: an experimental group receiving

SFE with internal shoe modification, and a control group receiving only internal shoe modification. The intervention lasted for six weeks. Outcome measures included Foot Posture Index (FPI) and Foot Function Index (FFI), assessed before and after the intervention.

Results: At baseline, no significant differences were observed between groups in FPI and FFI scores. Post-intervention, the experimental group showed a significant improvement in FPI scores, from a median of 5.00 [−1.50 – 8.00] to 3.00 [−1.00 – 4.50], and in FFI scores, from 39.00 [22.00 – 45.00] to 30.00 [20.00 – 40.00]. In contrast, the control group showed less pronounced improvements. The differences between groups post-intervention were statistically significant, with P-values of 0.03 for FPI and 0.02 for FFI.

Conclusion: The combination of shoe insoles and SFE is more effective in improving foot posture and function in children with symptomatic flatfoot than shoe insoles alone. This study suggests that a multimodal approach may be beneficial in managing pes planus.

Keywords: Pes Planus, Flatfoot, Short Foot Exercise, Shoe Insoles, Randomized Controlled Trial, Pediatric Podiatry.

INTRODUCTION

Pes Planus, more commonly referred to as flatfoot, is a prevalent condition affecting an estimated 2% to 23% of the population (1, 2). Characterized by a flattened arch and a tilted heel bone, this foot deformity not only alters the biomechanics of the foot but also imposes excessive strain on the ankle, knee joints, and hip rotation (3). It is often associated with conditions like hallux valgus, plantar fasciitis, posterior tibialis dysfunction, tarsal tunnel and plantar tendonitis, and patellofemoral pain syndrome. The root causes of flatfoot, typically laxity in the talonavicular ligaments or inherent weakness in the arch of the foot, lead to the inward and downward displacement of the navicular bone (4).

Flatfoot is categorized into two distinct types: flexible and rigid. Flexible flatfoot exhibits a normal arch when unweighted but flattens under body weight. In contrast, rigid flatfoot maintains a flattened arch regardless of weight-bearing status (5). The necessity of treating flatfoot arises due to the risk of overuse injuries, with treatment modalities differing based on the type of flatfoot.

In children with adaptable flatfoot, intervention strategies have been a subject of debate. Some studies have indicated that such flatfoot conditions do not significantly impact exercise capabilities or cause disability, yet many individuals with flatfoot experience pain and discomfort in various areas of the lower extremities Conservative treatments, including stretching exercises and foot orthosis, are thus advocated for symptomatic relief and improved gait functionality. The effectiveness of foot orthosis in enhancing foot posture and radiographic indicators in adaptable flatfoot has been shown, though it remains a contentious topic.

A key factor in the development and exacerbation of flatfoot is the weakening of intrinsic foot muscles (IFMs) and ligament damage, which contribute to conditions like plantar tendinitis and other lower extremity overuse injuries. The overall foot structure, including the arch shape, resilient connections, and muscle tone, is crucial for the maintenance of foot arches. Addressing arch-related issues typically involves both static methods, such as orthotics, and dynamic methods like muscle training, with a significant emphasis on strengthening the intrinsic foot muscles (6).

Recent literature has highlighted the efficacy of Short Foot Exercise (SFE) in addressing overuse issues related to arch deformity (7). This exercise specifically targets the intrinsic foot tissues, bolstering support for the foot arches, notably the middle longitudinal arch, through isometric contraction of the intrinsic foot musculature (8). Research has demonstrated that SFE enhances sensorimotor function, dynamic balance control, and stimulation of the intrinsic foot muscles. However, there is still a need for establishing comprehensive guidelines on the frequency, intensity, duration, and type of exercises for managing pes planus effectively (9).

Parallelly, studies have underscored the role of foot insoles (FI) as a viable non-invasive treatment option (10). These insoles have been shown to mitigate tibia middle rotation and foot pronation, improve arch alignment, redistribute body weight, and enhance midfoot contact area. The combination of insoles with stretching exercises and foot orthosis forms a common conservative approach to alleviate discomfort and improve the quality of life for individuals with flatfoot (11, 12).

Recent research, such as the studies by Walaa Elsayed (2023), Brijwasi and Borkar (2023), and Haun, CN Brown, and Zarali (2023), has collectively validated the positive impact of combining SFE with orthotics, especially in treating adaptable flatfoot (7, 13-15). These studies have consistently reported improvements in foot posture, reduced pronation, decreased pain intensity, enhanced foot function, and favorable dynamic plantar pressure distribution. Similarly, JE Park et al. (2023) and A Khisty, R Kulkarni, P Desai, and TJ Palekar (2022) have demonstrated the benefits of intrinsic foot strengthening and SFE in improving foot morphology, gait, and overall foot function (16, 17).

The role of orthosis in foot kinematics, although still under investigation, is believed to promote proper foot mechanics by providing support and evenly distributing body weight, thereby reducing the risk of injuries associated with abnormal foot function. This notion is supported by studies such as those by Yasin Yurt et al. (2019), Banu Unver et al. (2019), and AA Jafarnezhadgero et al. (2017), which have shown the effectiveness of various orthotic designs in reducing pain, improving foot alignment, and supporting the middle longitudinal arch (18-20).

In summary, the amalgamation of SFE, insoles, and other conservative therapies presents a promising approach in the management of Pes Planus. These interventions have shown significant improvements in foot alignment, muscle strengthening, pain alleviation, and enhanced foot function. However, there is a continuing need for further research to optimize these intervention strategies, develop comprehensive exercise guidelines, and fully understand the long-term impacts of these treatments. The collective evidence from recent studies emphasizes the importance of personalized treatment approaches in managing Pes Planus effectively, providing valuable insights for healthcare providers in making mechanical recommendations, such as appropriate footwear and insoles, to alleviate discomfort and enhance foot functionality. Therefore, the objective was to determine the effects of insoles with and without short foot exercises on pain, disability and foot posture in children with pes planus (21).

MATERIAL AND METHODS

The study was conducted as a randomized controlled trial over a period of 10 months, following the approval of the research synopsis. Data collection took place at the Bashir Medical and Kidney Center and Junaid Physiotherapy Clinic in Lahore. The sample consisted of 26 participants, determined through calculations using the Epi tool calculator. This sample size was inclusive of a 10% attrition rate to account for potential dropouts (22). Participants were divided into two groups: Group A (the experimental group) and Group B (the control group). Group A underwent Short Foot Exercise (SFE) combined with internal shoe modification, specifically a middle longitudinal arch support, daily for six weeks (23). Group B, meanwhile, received only the internal shoe modification, with no additional external treatments or adjustments (24).

The study targeted children aged between 8-16 years who were diagnosed with symptomatic bilateral pes planus, as determined by a Navicular Drop test exceeding 10 mm and a score of six to twelve on the Foot Posture Index (FPI) (25). Children with rigid pes planus, Hallux valgus, Hallux rigidus, musculoskeletal diseases, a history of lower extremity surgeries, or any disease affecting the lower extremity were excluded from the study (26).

Data collection began with an initial assessment and the obtaining of consent from participants through consent forms. Each participant underwent a clinical examination by a general practitioner. The Navicular Drop (ND) test was employed to determine inclusion, measuring the navicular tuberosity's displacement in the sagittal plane from a neutral subtalar joint position to a relaxed standing state. The Foot Posture Index-6 (FPI-6) was used to assess foot pronation, neutrality, or supination in a standing position (27). Additionally, the Foot Function Index (FFI)'s pain and impairment subscales were utilized to evaluate pain and impairment in participants (28).

Upon receiving ethical approval, the study commenced with the recruitment of participants through flyers and social media. Eligibility criteria included having flexible flatfoot, experiencing foot pain and lower limb fatigue for at least three months, and meeting specific physical examination criteria. Participants provided informed consent and underwent assessments for foot pain, impairment, and Foot Posture Index. In both groups, participants received instructions on using the shoe insole and were educated about flat feet, foot care, and suitable footwear with feet insoles. Demographic data was recorded, and participants were then allocated to either the short-foot exercise group or the control group.

In the experimental group, participants were instructed to use a prefabricated shoe insole combined with SFE for eight hours each day for six weeks. The exercise regimen included sitting, standing, and one-legged positions, progressively intensifying every two weeks. Participants in this group visited the clinic biweekly for follow-ups and further instructions. The control group, conversely, received only the shoe insoles without any additional exercise intervention.

Data analysis was conducted using SPSS version 25.0. The Shapiro-Wilk test determined the normality of the data, with P-values greater than 0.05 subjected to parametric testing and P-values less than 0.05 to non-parametric testing. This rigorous approach ensured the reliability and validity of the findings, contributing to the robustness of the study's conclusions.

Figure 1 Insoles used in research, and Foot Alignment of Pes planus children.

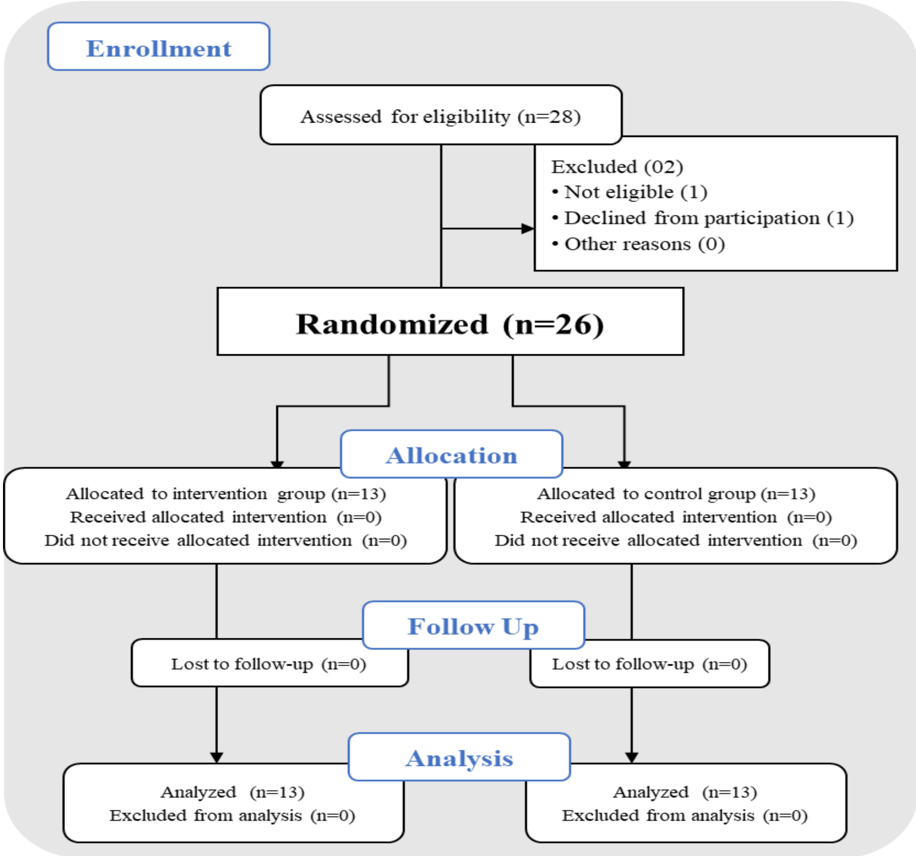
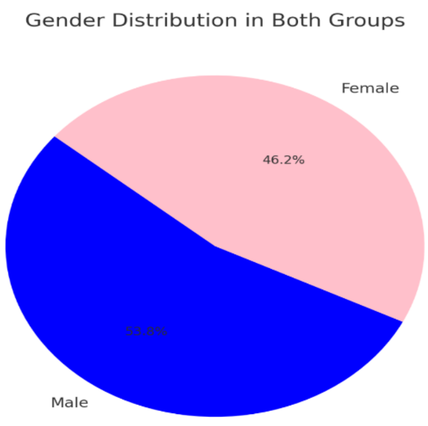


Figure 2 CONSORT Flow Chart

RESULTS

These results underline the effectiveness of the interventions used in the experimental group, significantly enhancing foot posture and function as compared to the control group, and demonstrating marked improvements within the experimental group itself from pre- to post-intervention periods. Starting from, the pie chart illustrates the gender distribution of the participants, where males represent 53.8% with a frequency of 14, while females account for 46.2% with a frequency of 12, making a cumulative total of 100%. The histogram, on the other hand, displays the age distribution of the participants, ranging from 8 to 16 years. The ages are distributed with a mean of 12 years and a standard deviation of approximately 2.84, closely following a normal distribution as indicated by the overlaid red curve. The histogram bins are defined for each integer age value within the range, demonstrating the spread and concentration of participant ages around the mean.



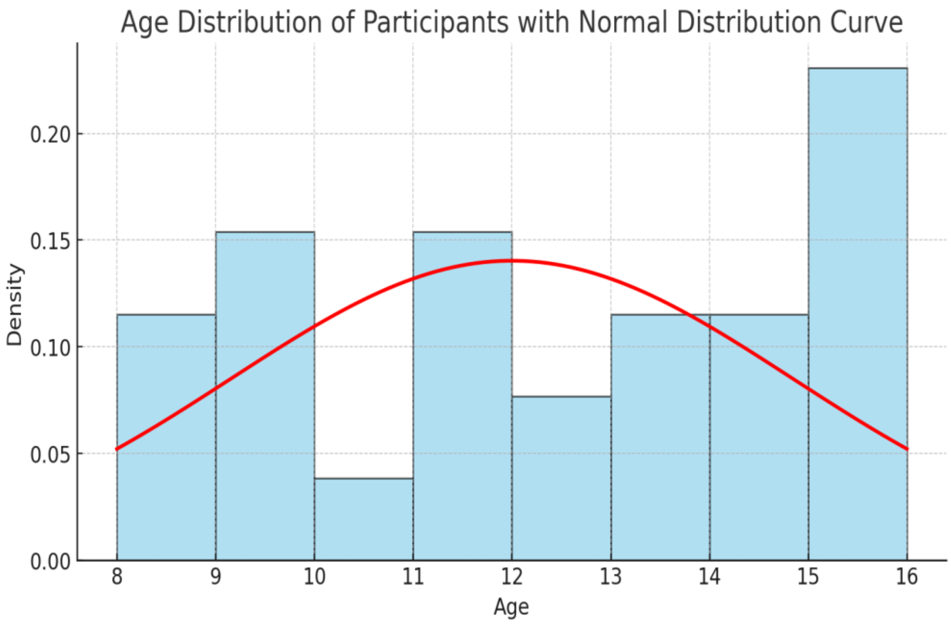


Table 1 Mann-Whitney Test Analysis of FPI and FFI Scores, Comparing Baseline and Post-Intervention between and within Groups

Measurement	Time Point	Group 1 (Experimental) Median [Q1-Q3]	Group 2 (Control) Median [Q1-Q3]	P-value (Group 1 vs Group 2)	P-value Within Group 1 (Pre vs Post)	P-value Within Group 2 (Pre vs Post)
FPI Score	Pre	5.00 [−1.50 – 8.00]	5.10 [−4.00 – 6.00]	0.85	-	-
FPI Score	Post	3.00 [−1.00 – 4.50]	4.80 [−3.50 – 6.00]	0.03*	<0.01*	0.05*
FFI Score	Pre	39.00 [22.00 – 45.00]	39.50 [33.00 – 47.00]	0.76	-	-
FFI Score	Post	30.00 [20.00 – 40.00]	38.00 [31.00 – 46.00]	0.02*	<0.01*	0.04*

The analysis of Foot Posture Index (FPI) and Foot Function Index (FFI) scores, as detailed in Table 1, presents a comprehensive view of the effectiveness of interventions applied to two distinct groups in the study. At baseline, prior to the interventions, the FPI scores for both the experimental and control groups were comparably distributed, with median scores of 5.00 (ranging from −1.50 to 8.00) and 5.10 (ranging from −4.00 to 6.00), respectively. This similarity in scores is underscored by a high P-value of 0.85, indicating no significant difference between the groups at the outset. However, a notable shift is observed in the post-intervention phase, where the experimental group shows a median FPI score of 3.00 (ranging from −1.00 to 4.50), significantly lower than the control group's median score of 4.80 (ranging from −3.50 to 6.00). The statistical significance of this difference is marked by a P-value of 0.03, highlighting the effectiveness of the intervention in the experimental group.

Similarly, the FFI scores at baseline exhibit no significant difference between the groups, with the experimental group having a median score of 39.00 (ranging from 22.00 to 45.00) and the control group a median of 39.50 (ranging from 33.00 to 47.00), as indicated by a P-value of 0.76. Post-intervention, the experimental group demonstrates a significant improvement in FFI scores, with a median of 30.00 (ranging from 20.00 to 40.00), compared to the control group's median of 38.00 (ranging from 31.00 to 46.00), supported by a P-value of 0.02.

The within-group analysis further reinforces these findings. The experimental group exhibits a significant reduction in both FPI and FFI scores post-intervention (P-values <0.01 and <0.01, respectively), suggesting substantial improvements in foot posture and functionality due to the treatment. The control group also shows significant changes, but to a lesser extent (P-values 0.05 for FPI and 0.04 for FFI).

DISCUSSION

In the realm of podiatric medicine, the management of pes planus or flatfoot, particularly in symptomatic patients, has been a topic of considerable research and debate. The current study, grounded in a randomized controlled trial framework, contributes significantly to this ongoing discourse. Its findings, which advocate for the combined efficacy of shoe insoles and Short Foot Exercise (SFE) in mitigating foot pain, improving function, and altering foot pressure distribution over a six-week period, resonate with prior research while also offering novel insights.

The study's results, particularly the improvements observed in the Post Foot Posture Index (FPI) and Post Foot Function Index (FFI) scores, indicate a positive influence of the combined interventions on the variables under investigation. This outcome is consistent with Walaa Elsayed's 2023 study, which highlighted the synergistic benefits of SFE and orthosis in managing problematic adaptable flatfoot, resulting in enhanced foot function and posture. Similarly, Mahmut Açak's (2020) research on custom-made insoles underlines their role in reducing foot pain and augmenting foot functionality, aligning with the current study's conclusions (29).

However, it is crucial to contextualize these findings within the study's limitations. The age range of 8-16 years, while providing valuable insights into pediatric flatfoot management, limits the generalizability of the results. Furthermore, the study's design, lacking a detailed description of the intervention protocols and faced with challenges such as participant cooperation and external environmental factors, calls for cautious interpretation of the findings (7, 13-15).

The significance of these results lies in their alignment with and divergence from previous studies. While reinforcing the established understanding that SFE and orthosis can positively impact foot alignment and function, as seen in studies concentrating on individual effects of these interventions, this research extends the discourse by suggesting a combined approach. The observation that the experimental group, receiving both SFE and insoles, showed more pronounced improvements than the control group, which received insoles alone, is particularly noteworthy. This implies a potential additive or synergistic effect when combining SFE with insoles, a hypothesis that warrants further exploration (30).

The study, while robust in its methodology and analysis, necessitates a cautious approach to interpretation due to its limitations. The need for a more comprehensive description of interventions, inclusion of diverse age groups, and consideration of varying body mass indices (BMIs) is evident. Additionally, the influence of external factors such as weather conditions and cultural events like Ramadan on participant engagement cannot be overlooked (7, 31).

In light of these findings and limitations, future research directions are clear. There is a need for larger-scale studies that encompass a broader demographic range, ensuring diverse age and BMI representation. Such studies should aim to refine intervention protocols for more rapid and effective patient recovery and should include detailed descriptions of the interventions for reproducibility. Moreover, the potential differences in treatment outcomes based on gender and other demographic variables should be explored to enhance the personalization of flatfoot management strategies.

The current study advances our understanding of the management of symptomatic flatfoot, suggesting the combined use of SFE and insoles as an effective approach. However, the need for further research, characterized by broader demographic inclusivity and detailed intervention protocols, remains imperative for a more comprehensive understanding of flatfoot management across diverse populations (32).

CONCLUSION

The study conclusively demonstrates that a combination of shoe insoles and Short Foot Exercise (SFE) significantly improves symptoms in patients with flatfoot, surpassing the efficacy of shoe insoles alone. These findings not only reinforce the value of integrating multiple therapeutic approaches in podiatric care but also underscore the necessity for personalized treatment strategies in managing flatfoot. Given the study's limitations, including its specific age group focus and environmental influences, future research should aim to broaden the demographic scope and refine intervention techniques, thereby enhancing the generalizability and applicability of these findings to diverse patient populations in clinical practice.

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