

Foot & Ankle RESEARCH REVIEW™

Making Education Easy

Issue 60 – 2024

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Abbreviations used in this issue

CI = confidence interval
CoP = centre of pressure
RICE = rest, ice, compression, elevation
RR = relative risk

Welcome to Issue 60 of Foot and Ankle Research Review.

In this issue I have included a publication investigating burnout and job satisfaction amongst Australian podiatrists, the research showing that one-third of the participants experienced burnout. There is also an interesting analysis by Tehan et al., examining trends in diabetes-related foot research in Australia, showing research has grown at a steady rate despite limited research funding opportunities.

I hope you enjoy this issue.

Noho ora mai

Professor Matthew Carroll

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Research Review thanks Foot Science International for their sponsorship of this publication and their support for ongoing education for healthcare professionals.

How far has diabetes-related foot disease research progressed in Australia? A bibliometric review (1970-2023)

Authors: Tehan PE et al.

Summary: This review examined Australian research publications investigating diabetes-related foot disease (DFD) over the 50 years from 1970 to 2023. A total of 332 eligible publications were identified, with largest volume of publications (78%) during the last decade. The most common research types were aetiology (38%), treatment evaluation (25%) and health services research (13%). Most studies received no funding (60%), or internal institutional funding (16%) and only 10% received industry, philanthropic or international funding.

Comment: This review examined bibliometric trends in Australian DFD research over the past decade, revealing a seven-fold increase in publications, with notable contributors being Peter Lazzarini, Vivienne Chuter, and Jon Golledge, and Queensland University of Technology leading in institutional output. Aetiology, treatment evaluation, and health services research were the primary research types. Despite the increase, Australian DFD research lacks proportional funding compared to the disease's impact, potentially hindering larger-scale trials and preventive studies. International collaboration, particularly with the UK, Netherlands, US, and New Zealand, has strengthened, likely influenced by organisations like the International Working Group for the Diabetic Foot and Diabetes Feet Australia. While the Journal of Foot and Ankle Research remains a prominent outlet, there's a need for more support for open-access publishing. The study underscores the importance of addressing funding disparities to sustain and advance DFD research, especially in preventive studies and new treatment development, to alleviate the significant burden imposed by DFD on individuals and society. Despite limitations such as potential under-reporting of funding sources and publication selection bias, the study highlights the resilience of Australian DFD researchers amidst funding challenges, but emphasises the necessity of increased support to drive further progress in the field.

Reference: *J Foot Ankle Res.* 2024;17(2):e12012

[Abstract](#)

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Burnout in podiatrists associated with individual characteristics, workplace and job satisfaction: A national survey

Authors: Bonanno DR et al.

Summary: The Australian Podiatrists in Australia: Investigating Graduate Employment (PAIGE) study used four online surveys (848 responses) administered between 2017 and 2020 to identify factors associated with burnout in podiatrists. Overall, 268 podiatrists (31.6%) experienced burnout, these podiatrists were slightly younger, had more recently started practice, had poorer health, and greater mental distress. They also had lower scores for resilience, extraversion, agreeableness, conscientiousness, emotional stability, and openness to experiences. Participants experiencing burnout were less likely to display financial and clinical risk-taking behaviour and more likely to show career risk-taking behaviour. The accuracy of these individual variables to predict burnout was 72.4%. They were more likely to work in private practice over more work locations, work more hours with more direct patient hours, see more patients, and have shorter consultation times, and were more likely to bulk bill chronic disease management plans. They had less access to sick leave and professional development and were more likely to intend to leave patient care and the profession within 5 years. The accuracy of these workplace-related variables to predict burnout was 67.1%. Participants experiencing burnout had less job satisfaction and this predicted burnout with 78.8% accuracy.

Comment: This study investigated burnout among Australian podiatrists, finding approximately one-third experiencing burnout, with various personal and workplace factors contributing. Individual characteristics such as younger age, mental distress, and resilience were associated with burnout, along with workplace factors like higher workloads and longer hours. Strategies to address burnout included targeted interventions, professional support programmes, and workload adjustments. Work satisfaction emerged as a significant predictor of burnout, indicating its importance in identifying at-risk individuals. While the findings provide valuable insights, caution is warranted in generalising to the entire profession, and longitudinal research is needed to better understand burnout dynamics over time. Overall, the study underscores the need for comprehensive strategies to address burnout among podiatrists, considering both individual and organisational factors.

Reference: *Foot Ankle Res.* 2024;17(2):e12003

[Abstract](#)



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Evaluating the impact of an interdisciplinary integrated limb preservation service operating concurrently with a single-specialty service

Authors: Bazikian S et al.

Summary: This American retrospective study (2017-20) assessed an interdisciplinary limb preservation service (LPS) compared to traditional care for improving surgical outcomes for 731 diabetic foot ulcer (DFU) patients (80.4% male; 89.3% Hispanic). There was a decrease in major amputation rates by 45.5% (95% CI 15.4-8.4; $p = 0.001$), and outpatient procedures increased five-fold (3.3% to 18.7%; $p < 0.001$). Length of hospital stay declined from 10.1 to 8.5 days and the major to minor amputation ratio declined from 22.4% to 12.7%.

Comment: This American study highlights the significant impact of an LPS on the management of DFUs, showing a substantial decrease in major amputation rates and Hospitalisation Index to Length of Stay (Hi/Lo) ratio following LPS implementation. Multivariate analysis revealed a 50% reduction in major amputation risk post-LPS, accompanied by increased outpatient procedures and vascular interventions. Notably, the study compares outcomes with a Standard Specialty Service (SSS), demonstrating the effectiveness of interdisciplinary care teams in reducing major amputations. The LPS's success in a population with a high percentage of Hispanic patients addresses disparities in DFU outcomes. Cost savings and increased outpatient procedures further emphasise LPS benefits. Limitations include single-institutional focus, patient homogeneity, and lack of long-term outcome evaluation. However, the study advocates for the coexistence of LPS and SSS, highlighting the complementary roles they play in limb preservation. The interdisciplinary approach underscores the importance of collaboration among healthcare specialists to optimise patient outcomes, urging adoption of similar strategies in healthcare settings to enhance DFU management and improve patient quality of life.

Reference: *J Foot Ankle Res.* 2024;17(2):e12013

[Abstract](#)

Hindfoot joint kinematics analysis after the resection of talocalcaneal coalition

Authors: Boo J et al.

Summary: This study analysed joint kinematics, obtained using biplane fluoroscopic imaging and an intensity-based 2- and 3-D registration method, during the stance phase of walking in five patients who underwent talocalcaneal coalition (TCC) resection to quantitatively assess the results of surgery using joint kinematics. During a loading response period, eversion range of motion (ROM) of the subtalar joint and tibiocalcaneal motion increased after TCC. A post-operative increase was also observed in subtalar and tibiocalcaneal inversion ROM during the pre-swing period. TCC resection surgery increased the ROM of the subtalar joint, which in turn contributed to the increase in tibiocalcaneal ROM.

Comment: This study aimed to investigate changes in joint ROM after resection surgery for TCC. Postoperatively, significant increases were observed in inversion/eversion ROM of the subtalar joint and tibiocalcaneal motion during walking, indicating restoration of normal joint kinematics. These findings align with previous research and suggest that increased subtalar joint motion contributes to pain relief and reduced risk of ankle sprains post-surgery. Generalisability is limited by the small sample size and absence of a control group. Overall, the study highlights the beneficial effects of surgery on joint motion and emphasises the importance of restoring normal joint kinematics in patients with TCC.

Reference: *Gait Posture* 2024;111:48-52

[Abstract](#)

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The effects of vibrating shoe insoles on standing balance, walking, and ankle-foot muscle activity in adults with diabetic peripheral neuropathy

Authors: Hatton AL et al.

Summary: This randomised cross-over study in 18 ambulant men and women with a diagnosis of diabetic peripheral neuropathy (DPN) assessed whether vibrating insoles altered measures of balance, gait, and ankle-foot muscle activity. Relative to non-vibrating insoles, vibrating insoles reduced (improved) centre of pressure (CoP) elliptical area on a foam surface with eyes closed ($p = 0.03$). Perceptible vibrations on the soles of the feet when standing with eyes closed on firm and foam surfaces also reduced electromyography amplitude in the soleus ($p = 0.01$ and $p = 0.04$) and medial gastrocnemius ($p = 0.03$ and $p = 0.09$).

Comment: The study suggests that wearing vibrating insoles for the first time may reduce CoP sway and ankle-foot muscle activity during challenging balance tasks in individuals with DPN. Vibratory stimulation led to a decrease in CoP elliptical area, indicating potentially greater postural stability. However, caution is advised in interpreting this result, as it is only one of several CoP outcomes and the significance level was modest. Contrary to expectations, vibrating insoles did not affect walking measures in DPN individuals, possibly due to differences in gait assessment tasks. The study also explores the underlying mechanisms, suggesting that perceptible vibrations may enhance sensory re-weighting towards proprioceptive cues, leading to more efficient muscle control. Limitations include the short-term assessment period and the lack of assessment under free-living conditions. Overall, the results provide insight into the potential therapeutic effects of vibrating insoles on balance and muscle activity in individuals with DPN, warranting further investigation.

Reference: *Gait Posture* 2024;111:8-13

[Abstract](#)

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Flatfoot arch correction with generic 3D-printed orthoses at different body weight percentages

Authors: Lavoie-Turcotte T et al.

Summary: This cross-sectional study assessed the effect of generic 3D-printed foot orthoses on flatfoot arch correction in participants with normal and flatfeet (10 normal feet and 10 flatfeet) under different static loading conditions (0% when sitting; 50% standing on both feet; 125% when standing on one foot with a weighted vest). Compared to flatfeet without orthosis, 3D printed orthoses increased arch height in all loading conditions. An orthosis also reduced medial arch angle, but not significantly.

Comment: This study assessed the efficacy of a 3D-printed generic orthosis in correcting arch collapse in flatfeet individuals under various static loading conditions. Two types of orthoses, categorised as soft and rigid based on stiffness and honeycomb height, were evaluated. Results showed that both orthoses effectively prevented arch collapse across loading conditions, restoring arch height similar to normal-arched feet. The study's findings align with previous research demonstrating the effectiveness of 3D-printed orthoses in correcting arch deformities and improving biomechanics in flatfoot patients. However, no significant difference was observed between the soft and rigid orthoses in correcting arch height or angle, though a trend favouring the rigid orthosis was noted. The study highlighted the reliability of 3D surface imaging techniques in assessing arch height and angle, suggesting its potential clinical utility.

Reference: *Foot (Edinb)* 2024;59:102093

[Abstract](#)

Fatigue of the intrinsic foot core muscles had a greater effect on gait than extrinsic foot core muscles: A time-series based analyze

Authors: Keklicek H et al.

Summary: This prospective, cross-sectional study examined whether the fatigue of the intrinsic foot core (ICO) and extrinsic foot core (ECO) muscles affect gait parameters in 22 sedentary individuals (44 feet). Gait measured over at least 500 consecutive steps before and after a heel rise endurance test and paper grip endurance test indicated that ECO and ICO fatigue led to increases in step ($p < 0.05$) and stride length ($p < 0.05$), and in single support ($p < 0.05$), and terminal stance durations ($p < 0.05$). ICO fatigue had a greater effect ($d = 0.313$ - 0.646) than ECO fatigue ($d = 0.524$ - 2.048).

Comment: This study examined the impact of fatigue induced by two different endurance tests, heel rise endurance and paper grip endurance, on gait parameters in sedentary individuals. Both tests led to increases in step length, stride length, single support, and terminal stance durations, with ICO fatigue having a greater effect on gait compared to ECO fatigue. The study considered compound muscle function rather than isolated muscle movements and found that fatigue in the core muscle groups significantly influenced gait, potentially increasing the risk of injury. Interestingly, individuals compensated for fatigue-related changes by increasing step and stride lengths. Endurance training targeting ICO muscles, particularly in sports-related activities, may help maintain performance without increasing injury risk. Despite limitations, including a lack of severity evaluation of fatigue and the focus on sedentary individuals, the study provides valuable insights into the effects of different muscle fatigue on gait parameters.

Reference: *Foot (Edinb)* 2024;59:102088

[Abstract](#)



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Independent commentary by Professor Matthew Carroll

Matthew is a Professor of Podiatry within the School of Clinical Sciences at Auckland University of Technology (AUT). His research focus is on chronic long-term conditions that affect the lower limb and foot. His postgraduate qualifications include a PhD (AUT), a Master of Educational Leadership (AUT), a Master of Podiatry (Curtin) and a Postgraduate Diploma in Sports Medicine (Otago). **FOR FULL BIO** [CLICK HERE](#).



The effect of foot somatosensory loss in postural control during Functional Reach Test in patients with diabetic polyneuropathy: A controlled study

Authors: Kahveci A et al.

Summary: This study examined postural control differences and neuromuscular adaptations in 14 patients with diabetic polyneuropathy (DPN) and 14 healthy controls during a functional reach test (FRT). DPN patients reach length (FR), FR to height ratio, absolute moment arm (MA), and displacement of centre of mass (CoM) were shorter than healthy controls, while displacement of CoP did not differ between groups. Arch height ratio was lower in DPN patients. CoM was lagged CoP in patients (MA = +0.89), but led in healthy controls (MA = -1.60). DPN patients' muscles had earlier activation, but root mean square surface electromyography amplitudes were found to be similar.

Comment: This study investigated the impact of distal lower extremity sensorimotor impairment, specifically DPN, on postural stability and muscle activation during the FRT. Patients with DPN exhibited reduced functional reach and moment arm distance, along with smaller changes in hip, knee, and ankle joint motion during FRT. Early muscle activation of bilateral tibialis anterior, medial gastrocnemius, and flexor hallucis longus was also observed in the DPN group. The study suggested that sensorimotor deficits in DPN negatively affect postural stability, with postural control strategies potentially shifting due to altered foot function. Changes in joint range of motion, particularly at the ankle, knee, and hip joints, were noted, possibly due to histopathological alterations in DPN affecting collagen deposition. Muscle activation patterns revealed compensatory strategies in the DPN group, highlighting the importance of foot somatosensory information in maintaining postural control during dynamic tasks. The findings underscored the need for targeted interventions to improve foot function and proprioception in DPN patients to enhance postural control and reduce fall risk.

Reference: *Foot (Edinb)* 2024;59:102097

[Abstract](#)

Anatomic variations of the calcaneofibular ligament

Authors: Ruzik K et al.

Summary: This study of 120 paired human cadaver (30 male, 30 female; mean age 62.3 years) lower limbs was conducted to propose a classification of calcaneofibular ligament (CFL) morphology. A four-part method for anatomic classification was proposed; type 1 (48.3%) had bandlike morphology, type 2 (9.2%) had a Y-shaped band, type 3 (21.7%) had a V-shaped band, while type 4 (20.8%) had 2 or 3 bands. Types 2 and 4 were further subtyped based on origin footprint.

Comment: The study presents a comprehensive classification of the CFL based on morphological types. It introduces a novel four-fold classification of the CFL and examines gender and laterality differences. Anatomically, the CFL originates anteriorly from the lateral malleolus and extends posteriorly to the lateral calcaneus. Notably, the CFL's angle with the fibula and its interaction with the anterior talofibular ligament (ATFL) influence ankle stability. Previous classifications lacked detail or photographic documentation, and studies often focused on specific aspects of CFL anatomy. Ankle sprains, commonly caused by inversion, underscore the importance of understanding CFL anatomy for effective treatment. Conservative approaches like RICE therapy are standard, but combined ATFL and CFL ruptures may require surgical intervention.

Reference: *Foot Ankle Int.* 2024;Apr 8 [Epub ahead of print]

[Abstract](#)

Walking speed and the risk of type 2 diabetes: A systematic review and meta-analysis

Authors: Jayedi A et al.

Summary: This systematic review and meta-analysis examined the association between walking speed and the risk of type 2 diabetes mellitus based on 10 studies. Compared with easy or casual walking (<3.2 km/hour), type 2 diabetes was less likely with average or normal walking (3.2-4.8 km/hour) speed (relative risk [RR] 0.85; 95% CI 0.70-1.00; risk difference [RD] 0.86 fewer cases per 100 patients; 95% CI 1.72-0), fairly brisk (4.8-6.4 km/hour) walking (RR 0.76; 95% CI 0.65-0.87; RD 1.38 fewer cases per 100 patients; 95% CI 2.01-0.75) and brisk/striding (>6.4 km/hour) walking (RR 0.61; 95% CI 0.49-0.73; RD 2.24 fewer cases per 100 patients; 95% CI 2.93-1.55). There was no credible difference across subgroups in terms of total volume of physical activity or time spent walking per day.

Comment: This meta-analysis of prospective cohort studies examined the relationship between walking speed and type 2 diabetes risk in adults. Findings from low-certainty evidence indicated that both average and brisk walking were modestly linked to a lower risk. Notably, brisk/striding walking showed a 39% reduced risk, equivalent to 2.24 fewer cases per 100 patients, surpassing the minimally important difference threshold. Additionally, each 1 km/hour increase in walking speed correlated with a 9% lower type 2 diabetes risk. No prior systematic review has specifically addressed this association. Faster walking speed is associated with better overall health status, enhanced cardiorespiratory fitness, improved muscle strength, and reduced inflammation, all factors linked to lower type 2 diabetes risk. Dose-response analysis indicated a linear reduction in risk from 4 to 8 km/hour walking speeds. These findings suggest that encouraging brisk walking, alongside total volume of physical activity, could further decrease type 2 diabetes risk in adults.

Reference: *Br J Sports Med.* 2024;58(6):334-342

[Abstract](#)

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