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Issue 67 – 2026

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Welcome to Issue 67 of Foot and Ankle Research Review.

This issue covers diverse topics, including gait variability and its relationship to walking speed, strategies for reducing patellofemoral joint load during running, and the biomechanical implications of osteochondral lesions and leg-length discrepancies. I also review interventions for juvenile idiopathic arthritis, flatfoot-related postural stability, and the long-term effects of anti-pronation insoles. Finally, research investigating decision-making frameworks for diabetes-related amputations and podiatric approaches to foot osteoarthritis is highlighted.

I hope you enjoy the 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.

Footwear recommendations for runners: Influencing factors and professional perspectives

Authors: Jackson A et al.

Summary: This online cross-sectional survey involving 264 podiatrists, physiotherapists, running coaches, and footwear retailers working in New Zealand aimed to identify factors influencing individualised running footwear recommendations and measured the relative importance placed on footwear characteristics related to comfort and injury management. Injury prevention and comfort were identified by 86% and 96% of respondents, respectively, as important considerations in the selection of footwear. Arch height and foot motion were emphasised as important by retailers more often than by the other groups. Respondents believed that the most influential characteristic for both comfort (99%) and injury management (94%) was cushioning. The majority of respondents (91%) believed that medial posting had an influence on injury management, while forefoot stiffness (93%) and shoe/upper width (95%) were linked to comfort. While only 29% of coaches, 42% of physiotherapists and 55% of podiatrists believed that footwear could reduce pronation, this belief was held by 82% of retailers.

Comment: This study, of which I am a co-author, surveyed 264 New Zealand-based professionals, including podiatrists, physiotherapists, footwear retailers, and running coaches, to identify factors influencing running shoe recommendations. Comfort (96%) and injury prevention (86%) were the most cited priorities. Cushioning emerged as the dominant feature for both comfort (99%) and injury management (94%). Retailers placed greater emphasis on arch height and foot motion compared to clinicians, reflecting divergent approaches between commercial and clinical perspectives. Interestingly, beliefs about pronation control varied widely, despite limited evidence supporting its efficacy for injury prevention. The findings highlight inconsistencies in advice and the influence of professional background on recommendations. The survey indicates that clinicians should prioritise comfort and cushioning when advising on footwear and avoid overreliance on pronation-control features. Evidence-based guidelines are needed to standardise recommendations and reduce variability in practice.

Reference: Phys Ther Sport 2025;75:65-71

Abstract

Gait variability is more strongly associated with walking speed than with age

Authors: Bowersock CD et al.

Summary: This study involving 34 adults aged 23-71 years investigated relationships between age and various measures of gait across the adult lifespan. Participants undertook a 6-minute walk at their preferred speed and 17 measures of gait including mean spatiotemporal measures of gait and linear and non-linear measures of gait variability were performed. A positive correlation was observed between older age coefficient of variation of stride length and sample entropy of stride time (R^2s = 0.12 and 0.15, respectively, $p \leq 0.05$). Age was most strongly associated ($p < 0.05$) with slower preferred gait speed ($R^2 = 0.23$), and compared to age, gait variability measures were more strongly associated with preferred gait speed. There was an association between slower walking and increased coefficient of variation of stride length ($R^2 = 0.34$), sample entropy of stride length ($R^2 = 0.14$), the correlation dimension of knee motion and vertical pelvis motion ($R^2 = 0.34$ and $R^2 = 0.26$, respectively), and decreased sample entropy of stride time ($R^2 = 0.51$) and dynamic stability of mediolateral pelvis motion ($R^2 = 0.11$).

Comment: This study explored whether non-linear gait variability metrics are more sensitive to age-related changes than traditional measures. Thirty-four adults aged 23-71 years walked at their preferred speed, and 17 gait variables were analysed. Findings revealed that age was moderately associated with slower walking speed and shorter stride length, accounting for 23% of the variance. Preferred walking speed emerged as the strongest predictor of variability: slower speeds correlated with increased stride length variability, reduced stride time regularity, greater movement complexity, and decreased dynamic stability. These results suggest that variability is not a primary marker of ageing; rather, walking speed is a more influential marker. Clinically, monitoring gait speed offers a practical, sensitive indicator for neuromotor decline and fall risk, making it a valuable tool for early intervention in older adults.

Reference: Gait Posture 2025;125:110086
Abstract

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Effects of running technique characteristics on the patellofemoral joint load: A systematic review and meta-analysis

Authors: Yu S et al.

Summary: This systematic review and meta-analysis included 32 studies reporting on patellofemoral joint contact force (PFCF) and patellofemoral joint stress (PFJS) identified via PubMed, Web of Science, EBSCO, CNKI, and the Wanfang database. Subgroup analysis revealed that while some running technique characteristics significantly increased PFCF (standardised mean difference [SMD] 0.46; 95% CI 0.29-0.62; z = 5.47, p = 0.000), including increased step length, decreased step rate, increased speed, and trunk backward lean, PFCF was significantly decreased by other running technique characteristics (SMD -0.60; 95% CI -0.71 to -0.49; z = 10.98, p = 0.000), including forefoot strike (FFS), decreased step length, increased step rate, decreased speed, trunk forward lean, backward running, and running softer. Similarly, PFJS was increased by some running technique characteristics and decreased by others; increased step length, decreased step rate, and trunk backward lean increased PFJS (SMD 0.43; 95% CI 0.24-0.62; z = 4.39, p = 0.000), while FFS, decreased step length, increased step rate, decreased speed, and trunk forward lean decreased PFJS (SMD -0.59; 95% CI -0.72 to -0.47; z = 9.02, p = 0.000).

Comment: This systematic review and meta-analysis evaluated the impact of running technique characteristics on patellofemoral joint load, analysing 32 studies. The pooled results demonstrated that certain techniques significantly reduced PFCF and PFJS. FFS, decreased step length, increased step rate, reduced running speed, trunk forward lean, backward running, and running softer were associated with notable reductions in PFCF (SMD -0.60) and PFJS (SMD -0.59), with low heterogeneity and no publication bias. Conversely, increased step length, decreased step rate, increased speed, and trunk backward lean significantly increased PFCF (SMD 0.46) and PFJS (SMD 0.43). Subgroup analyses confirmed that FFS and cadence adjustments were among the most effective strategies for reducing knee load, while changes in trunk posture and running speed also played important roles. The article highlights that gait retraining, particularly promoting FFS and increasing cadence, should be considered for patellofemoral pain management and injury prevention, with attention to compensatory loads on other joints.

Reference: Gait Posture 2026;124:110025
Abstract

Osteochondral lesion of the talus amplifies plantar pressure alterations and postural instability in chronic lateral ankle instability: A cross-sectional study based on a wearable smart plantar pressure system

Authors: Zhu T et al.

Summary: This cross-sectional study investigated plantar pressure and stability deficits during single-leg stance (SLS) in patients with chronic lateral ankle instability (CLAI) with (n = 29) and without (n = 30) osteochondral lesion of the talus (OLT) compared to healthy controls (n = 29). Plantar pressure parameters and postural stability metrics were collected using a shoe-integrated sensor system during SLS. Both CLAI (p = 0.028) and CLAI + OLT (p = 0.001) groups exhibited elevated medial midfoot normalised peak force versus controls, and those in the CLAI group demonstrated higher normalised peak force in the third metatarsal region (p = 0.015). Postural stability metrics including reduced time-to-boundary (p = 0.032) and greater centre of pressure variance (p = 0.026) in the anterior-posterior direction were observed in patients with CLAI + OLT. The unaffected foot in the CLAI + OLT group exhibited higher normalised peak force in the fifth metatarsals (p = 0.030) and lower normalised peak force in the posterior heel (p = 0.012). Normalised peak force in the third metatarsal was identified via receiver operating characteristic (ROC) curve analysis as a moderate diagnostic marker for OLT (area under curve [AUC] = 0.700 and p = 0.026). Patients in the CLAI + OLT group with a BMI ≥25 exhibited increased normalised peak force in the posterior heel (p = 0.043) and among those in the CLAI group, male sex (p = 0.047), BMI <25 (p = 0.010), and Beighton scores <5 (p = 0.004) were associated with elevated normalised peak force in the third metatarsal compared with the CLAI + OLT group.

Comment: This study assessed how OLT amplify biomechanical alterations in CLAI. Eighty-eight participants were divided into healthy controls, CLAI, and CLAI + OLT groups. Using a smart plantar pressure system during single-leg stance, the results showed increased medial midfoot pressure in the CLAI and CLAI + OLT groups compared with controls. CLAI patients exhibited higher third metatarsal pressure, while CLAI + OLT patients demonstrated reduced time-to-boundary and greater centre-of-pressure variance, indicating impaired postural stability. ROC analysis suggested third metatarsal pressure as a moderate diagnostic marker for OLT. The results suggest that monitoring third metatarsal pressure can help identify patients at risk for OLT, guiding early rehabilitation to prevent osteoarthritis progression and improve stability.

Reference: Foot Ankle Res. 2025;18(4):e70110
Abstract

Physical and mechanical therapies for lower limb problems in children with juvenile idiopathic arthritis: A systematic review with meta-analysis

Authors: Fellas A et al.

Summary: These authors undertook a systematic review and meta-analysis of RCT evidence for physical (for e.g., strengthening) and mechanical (for e.g., foot orthoses) therapies for lower limb problems in children with juvenile idiopathic arthritis (JIA). A total of 11 studies were included; seven explored physical therapies and four explored the effect of foot orthoses. Compared with control, foot orthoses were found to significantly reduce both parent and child reported foot and ankle pain at 3 months (-11.08 and -21.45, respectively); this effect was sustained beyond 3 months. Pilates and underwater exercises also significantly reduced lower limb pain after 3 months.

Comment: This systematic review analysed physical and mechanical interventions for lower limb issues in children with JIA. Eleven RCTs (510 participants) were included. Custom foot orthoses significantly reduced pain at 3 months, though effects diminished over time. Pilates and underwater resistance training also improved pain and functional outcomes. Other therapies showed mixed results and long-term efficacy remains unclear. Clinically, the review suggests that foot orthoses and selected physical therapies offer short-term benefits for children with JIA.

Reference: J Foot Ankle Res. 2025;18(4):e70096
Abstract

Relationship of flatfoot to physical performance and postural stability in children: The Yamanashi Adjunct Study of the Japan Environment and Children's Study

Authors: Wako M et al., on behalf of the Yamanashi Adjunct Study of the Japan Environment and Children's Study Group

Summary: This Japanese study investigated the relationship between flatfoot, physical performance, and postural stability in 196 8-year-old children enrolled in the Japan Environment and Children's Study. Boys had a higher rate of flatfoot compared with girls (8.6% vs 3.9%). There was a significant correlation between flatfoot and increased body weight and fat percentage, and between flatfoot and postural stability; children with more severe flatfoot had greater postural instability and this was particularly evident in girls. There was no correlation between flatfoot and physical performance measured via sports tests including jumping and sprinting.

Comment: This study examined 196 8-year-old children to explore associations between flatfoot, physical performance, and postural stability. Flatfoot prevalence was 8.6% in boys and 3.9% in girls, with higher rates associated with higher body weight and BMI. Sports performance measures, including sprinting and jumping, showed no significant differences between flatfoot and normal-arch groups. However, postural stability was compromised in children with flatfoot, particularly among girls, suggesting neuromotor control challenges rather than functional performance deficits. Clinically, the results indicate that management should focus on improving balance and neuromotor development rather than solely correcting foot structure. The research also highlights the importance of early screening for postural instability.

Reference: Gait Posture 2026;124:109992
Abstract

Gait asymmetries in children and adolescents with mild leg length discrepancy

Authors: Dobler F et al.

Summary: The relationship between mild leg length discrepancy (LLD; < 2 cm) and gait asymmetry in children and adolescents (n = 475; mean age 13.1 years) was examined in this retrospective study from Switzerland. Subjects were divided into four groups based on leg length; 1-4 mm, 5-9 mm, 10-14 mm, and 15-20 mm. Findings were compared to those of 40 typically developing children. An association was observed between increased LLD and greater pelvic obliquity, hip adduction, and internal hip rotation on the longer leg side, along with increased ankle dorsiflexion, hip flexion and knee flexion, and delayed heel rise. Compared with typically developing children, those with the aforementioned gait asymmetries experienced clinically relevant effects when the LLD was ≥1 cm.

Comment: This retrospective study analysed gait data from 475 children and adolescents (mean age 13.1 years) with mild LLD <2 cm and compared them to 40 typically developing children. Participants were grouped by LLD magnitude: 1-4 mm, 5-9 mm, 10-14 mm, and 15-20 mm. Results showed that increasing LLD was associated with progressive gait asymmetries, particularly pelvic obliquity, hip adduction, and internal rotation of the hip on the longer-leg side. In the sagittal plane, greater LLD correlated with increased hip and knee flexion, ankle dorsiflexion, and delayed heel rise. These adaptations suggest functional shortening of the longer limb. Clinically relevant asymmetries, defined as exceeding normal ranges observed in typically developing children, were evident when LLD exceeded 10 mm, particularly for pelvic obliquity and hip adduction. Kinetic differences were minimal and generally within normal ranges. Spatial-temporal changes, such as stance phase and single support duration asymmetry, were significant only in the highest LLD group (15-20 mm). Mild discrepancies (<1 cm) did not produce meaningful gait changes. The research highlights that LLD changes may predispose individuals to long-term musculoskeletal complications if left unaddressed. Additionally, non-operative interventions, such as shoe lifts, should be considered for LLD ≥1 cm to restore symmetry and prevent secondary complications.

Reference: Gait Posture 2025:Sep 4 [Epub ahead of print]
Abstract

INDEPENDENT COMMENTARY BY

Professor Matthew Carroll

Matthew Carroll is Head of School – Allied Health and Professor of Podiatry at Auckland University of Technology. His research focuses on chronic lower-limb and foot conditions, with an emphasis on improving clinical outcomes and quality of life. Matthew has published extensively in peer-reviewed journals and presented at national and international conferences. He has held associate editorial positions with the Journal of Foot & Ankle Research, PLoS ONE, and BMC Musculoskeletal Disorders. He is recognised as an experienced academic leader, having held several senior leadership roles. In acknowledgement of his contributions to learning and teaching, Matthew is a Senior Fellow of the Higher Education Academy and a Fellow of the Faculty of Podiatric Medicine at the Royal College of Physicians and Surgeons of Glasgow.

Long-term use of anti-pronation insoles enhances inter-joint coordination in individuals with flat feet

Authors: Soltani N et al.

Summary: These authors examined whether prolonged use (6 weeks) of anti-pronation insoles improves interjoint coordination in individuals with flat feet. A total of 12 individuals with flat feet and 12 controls with normal arches were included in the analysis which involved the evaluation of gait kinematics and spatiotemporal and interjoint coordination parameters investigated under four gait conditions: normal gait, post-test normal gait, walking with shoes, and post-test walking with shoes. At 6-week follow-up, phase-dependent changes in ankle-hip coordination were observed in the flatfoot group compared to baseline, with higher angles during push-off under the normal-gait condition and lower coupling angles than controls during loading response and swing ($p \leq 0.01$, $\eta^2p = 0.28$-0.33). Observed changes in knee-hip and ankle-knee coordination were smaller and were generally confined to specific gait phases. Overall, there was an increase coupling angles across conditions, reflecting these phase-specific effects. Longer single-support times and greater baseline stride length were seen in controls, longer double-support times in the flatfoot group with insoles, and there was no between-group difference in walking speed.

Comment: This study investigated the long-term effects of anti-pronation insoles on inter-joint coordination in individuals with flat feet. Twenty-four participants (12 flatfoot, 12 controls) underwent gait analysis before and after a 6-week intervention. Results revealed phase-specific improvements in distal joint coordination for the flatfoot group following prolonged insole use. Ankle-hip coupling angles decreased significantly during loading response and swing phases, while increasing during push-off, suggesting enhanced propulsion and improved control of excessive pronation. Ankle-knee coordination also improved, with notable increases in coupling angles during push-off and swing phases, indicating better synchronisation in the sagittal plane. Knee-hip coordination showed minimal changes, remaining largely unaffected by insole use. Spatiotemporal analysis demonstrated longer double-support times in the flatfoot group with insoles, along with shorter single-support times than in controls, reflecting a more conservative gait strategy. Walking speed remained unchanged between groups, while stride length differences persisted. Overall, insoles produced immediate and sustained effects on distal coordination, but their influence on proximal joints was limited. I am interested in the authors' use of the term "anti-pronation" in this study, as it positions pronation as a movement that must be prevented. Modern literature indicates that pronation should be considered a normal variation and not labelled as a pathology.

Reference: J Foot Ankle Res. 2026;19(1):e70124
Abstract

Using Nominal Group Technique to gather recommendations in the decision-making for amputation due to diabetes

Authors: Ong EKM et al.

Summary: This study used the Nominal Group Technique to gather recommendations from people with lived experience of a diabetes-related foot ulcer or amputation and their family members (n = 4), and health practitioners and experts (n = 5) to guide decision-making for amputation due to diabetes. Workshops were undertaken and research findings and feedback from other people with lived experience of diabetes-related foot ulcer or amputation and health experts were presented to participants to gather iterative feedback. Thirteen recommendations were agreed upon by people with lived experience and their family members, and 15 from health experts. Combined, the recommendations fell into seven categories representing priority considerations that highlight the importance of early and transparent discussions to enable person-centred and evidence-based decisions.

Comment: This study used the Nominal Group Technique to develop recommendations for decision-making regarding non-emergency lower extremity amputation in people with diabetes-related foot ulcers. Two cohorts participated: individuals with lived experience and family members, and health practitioners/experts. Across three workshops, participants generated and ranked 28 recommendations, which were synthesised into seven priority categories. These included: *"(1) Consider timing, with early discussions to move forward; (2) Address every element of quality of life; (3) Understand individual goals and priorities to make personalised decisions; (4) Collaborate with support networks; (5) Provide information and options; (6) Communicate with respect and transparency; and (7) Offer functional person-centred systems"*. Timing was ranked as the most critical factor, emphasising early conversations to identify the "sweet spot" for amputation that maximises recovery potential. Quality of life considerations, pain, function, emotional, and financial impacts were central to both cohorts' recommendations. Participants stressed the importance of holistic, culturally sensitive care, continuity of staff, and clear, honest communication tailored to health literacy levels.

Reference: J Foot Ankle Res. 2025;18(4):e70095
Abstract

Experiences of New Zealand podiatrists providing podiatry care to people with foot osteoarthritis

Authors: Molyneux P et al.

Summary: This study aimed to evaluate New Zealand podiatrists' knowledge of foot osteoarthritis (OA) and how they assess and manage patients with this condition. Ten New Zealand registered podiatrists participated in semi-structured interviews. Data collection and analysis was undertaken via a qualitative descriptive approach. Reflexive thematic analysis identified key meanings and patterns within the data and five key themes were derived on the assessment of foot OA: *"(1) Chief complaint versus incidental finding; (2) Obtaining patient history through subjective interviews; (3) Targeted objective assessments for foot OA; (4) Determining individual biomechanical factors; and (5) Further investigations"*. A further five themes were identified relating to the management of foot OA: *"(1) Knowledge and language used to provide education about OA; (2) Clinical uncertainty necessitates an iterative approach; (3) Podiatry administered treatments; (4) Referral pathways to other health professionals; and (5) Management influences"*.

Comment: This qualitative study, of which I am a co-author, interviewed 10 experienced New Zealand podiatrists to understand assessment and management strategies for foot OA. The absence of standardised diagnostic criteria and evidence-based guidelines was a recurring concern, leading to variability in care. The study highlights the need to develop clear, evidence-based guidelines to reduce uncertainty and improve consistency in OA management. The authors advocate a holistic approach that combines education, footwear optimisation, and orthotic support.

Reference: J Foot Ankle Res. 2025;18(4):e70108
Abstract