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A first step to defining a measurement method for footwear comfort in children

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key information of arch variances and toes orientations, which are linked with dynamic functions (Mei et al., 2020).

Based on the parameterised 3 D foot statistical shape, knowledge could provide implication for evaluation foot deformity or quick diagnosis of foot disorders in clinics, and development of customised or population-based footwear and orthotics customisation.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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A first step to defining a measurement method for footwear comfort in children

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KEYWORDS Comfort; children's footwear; children; design; footwear

Introduction

Footwear has essential roles in modern society including protecting feet and supporting foot health. In childhood, these are important as feet may react more sensitively to external factors. Wearing shoes in childhood influences spatiotemporal parameters of gait and lower limb kinematics (Wegener et al., 2011). Concurrent with the influence of footwear on biomechanics is the influence on comfort. This has been explored in adults using Visual Analogue Scales (Mündermann et al., 2002), Likert Scales (Au & Goonetilleke, 2007) and ranking (Mills et al., 2010). These scales relate to factors considered important for comfort in adults

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(e.g. heel cup fit) and wording that is comprehensible and relevant (e.g. cushioning). Understanding and measuring footwear comfort in children is important for manufacturers, researchers or clinician trying to provide a comfortable footwear experience. To be able to quantify comfort in children, we need a tool that is specific to both their physical and emotional development.

Purpose of the study

This study aimed to explore which physical and psychological factors children identify as influencing their footwear comfort and the language children use to describe aspects of both footwear and comfort. This is part of a wider aim to develop tools to reliably measuring footwear comfort in children.

Methods

A pragmatic qualitative design was used. 23 children were recruited 1–3 years ($n = 2$); 4–6 years ($n = 10$) and 7–12 years ($n = 11$) when trying on new footwear. Following parental consent, passive observation and short interviews were undertaken to record children's non-verbal (observed) and verbal communication (with parental input). Following transcription of results, content analysis was used to code, and thematic analysis to analyse data (Braun & Clarke, 2006).

Results

Thirty-one codes were identified, which were organised into five overlapping themes:

1. Aesthetics
2. Psychological influences
3. Comfort/discomfort
4. Practical issues
5. Predictive concerns

Children (4–12 years) verbally identified specific footwear regions including the toe box, heel and sole as influential: 'I don't like hard soles, they are heavy' (age 12). Non-verbal communication was also used: one child pointed at the 5th metatarsal indicating pain (age 5) and another to the toe box indicating discomfort (age 11). Children aged 1–3 years referred more generally to the whole shoe: 'These are comfy, good' (age 3). Discomfort was related to footwear slipping, a lack of softness and not accommodating the foot: 'The shoe is too hard' (age 4). Older children (7–12 years) also identified footwear being stiff as uncomfortable: 'They are hard, I like shoes that are softish and soft tongue' (age 11). Psychosocial aspects were addressed, particularly enabling children to undertake physical tasks: 'I can jump in these … the sole is soft' (age 5). These descriptions became more practical and predictive with age: 'I prefer trainers, I can move about in them more, I slide around in hard soles' (age 12).

Discussion and conclusion

The data has provided us with age-appropriate words to describe foot and footwear comfort. Concepts such as 'soft' 'hard' relate to comfort for children and are appropriate language for all ages. Older children could identify regions that contributed to comfort and discomfort specifically. They could also articulate what was facilitated by comforts such as gross motor skills and sport participation. Addressing our aim of defining a comfort measurement tool; these findings have shown that younger children (<4 years) require a simple tool which cannot isolate foot or footwear regions and is a snapshot in time. Older children can describe comfort sensations linked to foot and shoe regions, think about how footwear influences activities and changes over time as footwear degrades.

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Ironmen competitors exhibit unique gait patterns

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KEYWORDS Ironman; homogeneous population; individual gait pattern

Introduction

Human gait patterns have been shown to be stable over prolonged periods (Horst et al., 2017) and unique to individuals (Lin et al., 2011). Commonly, such insights were derived from data collected within a controlled laboratory environment and a heterogeneous study population (i.e. males and females; Horst et al., 2019). It remains unclear if comparable insights can be derived from a more homogenous study population (i.e. elite male athletes) and from data collected within a natural environment (i.e. outdoors). Especially, since the running styles of elite athletes may be more similar as they have evolved to be most economic (Folland et al., 2017) and may reside within a narrower solution space.

Purpose of the study

The purpose of this study was to explore the uniqueness of running patterns within a homogenous population of high-caliber ironman competitors.

Methods

Twenty-two healthy male triathletes (age: 31.1 ± 5.4 yrs; height: 1.83 ± 6.8 m; weight: 74.3 ± 7.3 kg) provided written and informed consent to participate in this study. Three-dimensional joint angle trajectories of 18 joints were collected using the Xsense MVN Link system during three runs: a 10-min cold run, a 10-min warm run, and a 4 km transition run after a 90-min cycling session. Individual step cycles (defined as the period between touch-down of the standing leg and touch-down of the swinging leg) were identified and all joint angle trajectories were normalised to 100 values and concatenated into a single vector per step cycle with 5400 values. All step cycles of all participants were then combined into a single matrix (93,493 × 5400) which was used for a principal component analysis.

Results

The first three principal components combined explained 80.57% of the total variance (Table 1), while 29 principal components were needed to explain 95% of the variance contained within the dataset.

A preliminary visual inspection of the principal component loadings on the first three principal axes showed that individual step cycles of one participant clustered together. It further revealed that step cycles of multiple participants did not cluster together (Figure 1).

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