



Factors Associated with Pain Severity in Children with Calcaneal Apophysitis (Sever Disease)

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Objective To identify any association between the pain experienced as a result of calcaneal apophysitis, anthropometric data, and lower limb measurements.

Study design This study was a cross-sectional study, nested within a wider randomized, comparative efficacy trial. One hundred twenty-four children between the ages of 8 and 14 years with a clinical diagnosis of calcaneal apophysitis were recruited for this study. Of the participating children, 72 were male. The measures recorded were height, weight, waist circumference, body mass index, foot posture, and ankle joint range of motion; comparison with normative values was also completed. Univariate and multivariable regression analyses were undertaken to identify factors associated with the severity of pain experienced (visual analog scale).

Results The children within this study had a higher mean body mass index ($P < .001$), increased weight ($P < .001$), and were taller ($P < .001$) compared with normative values. The children also demonstrated differences in foot posture and ankle joint range of motion. Multivariable regression analyses identified that older participants ($P = .046$) and those who had experienced pain for longer ($P = .043$) reported higher pain severity.

Conclusions Children presenting with calcaneal apophysitis were anthropometrically different from their peers and had experienced a lengthy period of pain. Therefore, early management focussing on the anthropometric differences may minimize the intensity and duration of pain experienced. (*J Pediatr* 2015;167:455-9).

Trial Registration Registered with Australian New Zealand Clinical Trials Registry: ACTRN12609000696291.

Calcaneal apophysitis, also known as Sever disease, was described in 1908.^{1,2} Calcaneal apophysitis is the most common pathologic entity in this age group,³ commonly presenting as pain in the heel with physical activity.⁴

Several theories seek to explain the pathomechanics of calcaneal apophysitis. In each theory, it is hypothesized that trauma takes place to the apophyseal tissues through movement of the apophysis relative to the diaphysis. Although there is uncertainty surrounding the causative mechanisms of calcaneal apophysitis, identifying and quantifying them will allow for targeted treatment and preventative approaches. High levels of athletic activity^{5,6} and obesity (increased weight or body mass index [BMI]) have both been identified as additional risk factors,⁷ which would support theories relating to active contraction of the gastrocnemius/soleus complex and higher ground reaction forces. In addition, although 1 prospective study demonstrated no significant difference in the amount of foot pronation (Foot Posture Index [FPI]-8) between children with and without calcaneal apophysitis, it did identify a difference in the amount of ankle dorsiflexion range of motion of the left foot, indicating support for the passive length theory.⁸

This study aimed to identify factors that may be associated with the development of calcaneal apophysitis and, therefore, when examined with the biological gradient of the Bradford Hill criteria suggest a causation relationship.⁹ We sought to compare anthropometric characteristics of a sample of children with clinically diagnosed calcaneal apophysitis with normative age and, where possible, ethnicity comparable data. We also sought to examine the association between anthropometric, demographic, and causative factors with the severity of pain experienced within the sample of children with clinically diagnosed calcaneal apophysitis.

BMI	Body mass index
FPI	Foot Posture Index
ICC	Intraclass correlation coefficient
OxAFQ-C	Oxford ankle foot questionnaire for children
VAS	Visual analog scale
WBL	Weight bearing lunge

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Methods

This study was designed as a cross-sectional study, nested within a wider randomized comparative efficacy trial.¹⁰ The randomized trial had a 4-group design and focused on pain reduction and activity maintenance with footwear, orthoses, or heel lifts in children experiencing pain associated with calcaneal apophysitis.¹⁰ The present study utilized observational data collected from participants at their first appointment (prior to randomization). The utilized observational data collected from participants was compared with the available normative values for the anthropometric and lower limb measures. The normative values were sourced from the published literature on healthy Australian children of comparable age and demographics.¹¹⁻¹⁴

Children between the ages of 8 and 14 years and who were experiencing heel pain consistent with calcaneal apophysitis (positive squeeze test)^{1,15} were recruited for this study. The utilization of the clinical diagnosis for calcaneal apophysitis is based upon the known limitation of imaging. The squeeze test has been found to have high sensitivity and specificity.¹⁵ Four experienced podiatrists (A.J., C.W., M.L., and R.H.) conducted the clinical assessment and confirmed the diagnoses of calcaneal apophysitis. Children were excluded from the study if they had a history of fracture or tumor of the foot or leg within the last 12 months, a diagnosis or clinical signs of infective, reactive, or rheumatoid arthritis, or had a FPI-6 equal to or less than -1 (supinated foot type). An FPI-6 equal to or less than -1 was contradicted for one of the treatment modalities for the subsequent study.¹⁰

Recruitment advertising was undertaken in schools and local sporting club newsletters and also through 2 metropolitan health services (Monash Health and Peninsula Health) and local private allied health clinics. Ethics approval was obtained from Monash Health Human Research Ethics Committee (HREC 09271B) and Peninsula Health Research Ethics Committee (HREC/09/PH/65). The parents of the children within the study provided signed consent and the children provided verbal assent for participation.

Demographic data were collected from each child, comprising age (years); sex; weight (kg); height (cm); waist circumference (cm); and duration of heel pain. The BMI (kg/m^2) was then calculated.

Lower limb assessments were explored using the FPI-6¹⁶ and a weight bearing lunge (WBL) test in a straight leg and knee bent position.¹⁷ The FPI-6 evaluated the static weight bearing foot posture, which accounted for the 3 planes of movement. The FPI-6 reported a 6-point scale and provided a total score from -12 (highly supinated) to $+12$ (highly pronated). The intra and inter-rater reliability has been determined within a number of studies in both adult and pediatric feet.^{16,18,19} The inter-rater reliability when used on the pediatric foot has been found to have a weighted kappa of 0.86.¹⁶

The available ankle dorsiflexion was assessed through the WBL test and was measured with a digital inclinometer

(LS160 S-Digit Mini Digital Inclinometer; Laser Depot, Adelaide, Australia). Prior to the measure being taken, the digital inclinometer was calibrated. To obtain the measurement, children placed hands on the wall in front of them, shoulder width apart, and then placed the right leg behind them as far as they comfortably could, placing it parallel to the left leg while keeping the right heel on the ground. The foot was placed perpendicular to the wall to minimize subtalar joint pronation of the foot and the knee was aligned over the second toe. The straight leg and bent knee measurements were then recorded using the digital inclinometer. A single measure was taken for each ankle in both the straight and bent knee position and data from the right limb was used for analysis because of high correlation between left and right limb measures. The intra-rater reliability of experienced raters conducting this test on children has been shown to be high intraclass correlation coefficient ([ICC] = 0.80 and 0.83).^{19,20}

Participation in physical activity was measured using the Child Leisure Activities Study Survey.²¹ The amount (in minutes) the child participated in physical activity in a given week was recorded; this included community-based activity, school sports, and play-based activity. The footwear worn to the appointment was categorized by the treating clinician. The footwear was compared with the footwear supplied in the larger study and recorded as similar or dissimilar to the subsequent intervention footwear.¹⁰ The footwear was either categorized as athletic footwear or not based on the appearance and features.

The Oxford ankle foot questionnaire for children (OxAFQ-C)²² was utilized to measure health related quality of life and disability associated with the foot and ankle condition. This assessment is taken from both the child's and the parent's perspective, though only the child's responses were utilized within this study. The OxAFQ-C contains "physical (ailment interfering with physical activity)" (6 items, Cronbach alpha = 0.92, parent child ICC = 0.72), "school and play (ailment interfering with school and play)" (4 items, Cronbach alpha = 0.89, parent-child ICC = 0.73), "emotional (ailment interfering with emotional well being)" (4 items, Cronbach alpha = 0.86, parent child ICC = 0.72) domains area, and a single footwear question (ailment affecting footwear choice). The OxAFQ-C is collated by recording the frequency of the problem for each item in the questionnaire using a 5-point scale and scores calculated and transformed into a scale of 1-100 as per the scoring system. A higher domain score is representative of better functioning.²³

Pain was measured using a 7-point faces visual analog scale (VAS).²⁴ The VAS test retest reliability data has been examined for 6-year-old children and yielded a rank correlation of 0.79, indicating that scores obtained using this measurement tool are reproducible over time.²⁴

Each child was assessed and questioned regarding their pain, ensuring that the inclusion criteria were met. The confirmed diagnosis of either unilateral or bilateral calcaneal apophysitis was made by the clinical assessment squeeze test (medial and lateral compression of the calcaneus). Excluded

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