INTRODUCTION
Thong style flip-flop footwear and sandals are the preferred footwear of 22% of children in Australia [1]. However, little is known about the effects of thong wearing on the growing child, despite thongs being identified by parents as a primary contributor to children’s total foot complaints with 15% of forefoot and 22% of rearfoot foot complaints attributed to thong and sandal wear combined [1].

Previous research describing children’s foot motion has focused on barefoot and shoe conditions and comparisons between the two. When walking in supportive shoes compared to barefoot, children walk faster with increased stride length and ankle motion and have reduced hallux, and midfoot motion [2]. Thong research has focused on adult populations and has shown that when adults walk in thongs compared to barefoot, ground reaction forces [3-5] and hallux plantar pressure are reduced [3].

The influence of thongs on the sagittal plane foot kinematics of children may have important ramifications for the developing foot. Children growing up in unshod communities are known to have fewer incidences of flat-feet and toe deformity [6-7]. Foot kinematics when wearing thongs may approach the barefoot more than other shoes. However during gait it is necessary to maintain the thong in position on the foot perhaps by altering barefoot hallux motion. This paper aimed to quantify children’s hallux motion while wearing thongs during walking and running.

METHODS
Eight children (6 girls and 2 boys) aged between 8 and 12 years (mean age 10.31 ± 1.68 years) were recruited from Sydney Australia. Inclusion criteria stipulated healthy prepubescent children free of known foot deformity, foot-posture-index within 2SD of normal [8] and within WHO guidelines for healthy weight [9]. The University of Sydney Human Research Ethics Committee granted approval and each participant gave written consent prior to participation.

Participants conducted five walking trials and five jogging trials while barefoot, or wearing thongs with the condition order randomised. Motion analysis was conducted, defining body segments using 3 non-collinear reflective markers per segment. Markers located at navicular, first and fifth metatarsal phalangeal joints and hallux were combined with a rearfoot wand defining 3-segments: rearfoot, forefoot and hallux. The first metatarsophalangeal joint was defined using forefoot and hallux segments.

RESULTS AND DISCUSSION
A repeated measure ANOVA found no significant effect of thongs on hallux range of motion when compared to barefoot, during walking or jogging as illustrated in Figure 1.

![Figure 1: Mean first metatarsophalangeal joint range of motion data with standard error for walking and jogging in footwear conditions; barefoot and thongs.](image)

![Figure 2: Mean hallux range of motion data from -20% to +20% of the stance phase of gait for barefoot (including ± 95% CI), and thong during walking.](image)
Figure 2 illustrates that while wearing thongs, the hallux was less dorsiflexed prior to and post the contact phase. Prior to and at initial contact the hallux was significantly more dorsiflexed while barefoot than when thongs were worn. Hallux motion was unaffected by footwear during midstance. At terminal midstance thong hallux plantarflexion was increased into heel lift and the propulsive phase.

CONCLUSIONS
While walking in thongs children enter initial contact and move into foot-flat with significantly less hallux extension than barefoot. The reduced hallux extension prior to contact has implications for arch function in attenuating loads during weight acceptance.

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REFERENCES
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