Female netball player's perceptions of the shoes they wear for netball

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Abstract

Introduction/Objectives

Lower limb injuries are a common occurrence in netball players. Appropriate footwear is often recommended as part of injury prevention programs for netball players. Despite this, there is limited evidence regarding netball players' understanding of what features are important and the rationale behind wearing netball shoes. The aims of this work were to determine netball players perceptions surrounding netball-specific footwear, and to determine the characteristics of footwear worn by netball players.

Methods

This mixed methods study was conducted in two stages. In stage one, a qualitative descriptive methodology guided semi-structured interviews to gain insight into the perspectives of participants surrounding their netball footwear. In stage two, the characteristics of participants' footwear was assessed using a reliable and validated footwear assessment tool. Participant interviews were analysed through thematic analysis. Footwear characteristics were analysed using descriptive statistics.

Results

Nine female netballers with a mean age of 40 years old and mean playing experience of 22 years participated in the study. Three themes were derived from the data (1) thoughts

and experiences when purchasing footwear, (2) key features of footwear, (3) effects of footwear on feet. Finding footwear that was fit for purpose was important when purchasing footwear, with brand loyalty a key factor in decision-making. A lack of options and high costs were identified as challenges to findings suitable footwear. Comfort and fit were key features that participants looked for in their footwear, which were linked to the construction of footwear. Footwear was reported as being a cause of foot problems but also for enhancing performance and injury prevention. Assessment of the participants' current netball footwear found the majority was netball-specific and well fitted, with moderate midsole stability, cushioning, and minimal outsole wear.

Discussion/Conclusion

The findings of the study identified that netball players encounter numerous challenges with their footwear both on and off the netball court. Health care professionals working with netball players should consider these findings when helping people find footwear for netball. Manufacturers of netball-specific footwear should also consider incorporating players' perceptions and preferences when designing footwear, to ensure that these meet the needs and expectations of netball players.

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Attestation of Authorship

‘I Megan Catterall hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgements), nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning.’

Megan Catterall 20 June 2023

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Chapter 1: Introduction

1.1 Netball-related injuries

Netball is a popular sport in New Zealand with approximately 140,000 affiliated players (Netball New Zealand, 2019). Netball is similar to basketball, involving running, jumping, changes of direction, rapid acceleration, and deceleration (Belcher et al., 2022). Poor technique during these tasks, tripping, slipping and contact with other players are common causes of netball-related injuries (Downs et al., 2021). Netball-related injuries are prevalent with Accident Compensation Corporation New Zealand data indicating 11,575 moderate-to-serious claims at a total cost over $75,000,000 over a 4-year period (King et al., 2018). Of these injuries, over 80% affect the lower limb (King et al., 2018), which is consistent with previous literature reporting the ankle as the most common site of injury, followed by the knee (Downs et al., 2021); (Hume & Steele, 2000; McManus et al., 2006). A survey of 2,925 netball players reported 57% of players experienced foot problems (blisters, ankle sprains, nail pathology, calluses, plantar heel pain, bone stress injury and bunions) (Kirk et al., 2022).

There are several factors that have been linked with netball-related injuries. Intrinsic risk factors for injury include increased body fat, poor balance, lack of agility, limited explosive power (Ferreira & Spamer, 2010), lower limb asymmetry (Maulder, 2013) and lack of core stability (Coetzee et al., 2014). Extrinsic risk factors contributing to injury include not adhering to injury prevention strategies (Barnsley et al., 2005), poor utilisation of neuromuscular and proprioceptive training (Coetzee et al., 2014), as well

as previous injury and reduced training (McManus et al., 2006). A recent systematic review reported that injury rates increase with age, with those over the age of 16 more likely to have an injury affecting the lower limb (Downs et al., 2021). Injury rates are also influenced by the level of competition. A survey of 254 netball players at club, provincial, and national-level found that national-level players reported a higher prevalence of injuries (84%), compared to provincial-level (59%), and club-level (55%) players (Pillay & Frantz, 2012). Specific to the lower limb, injuries to the ankle and knee are more prevalent in provincial-level players rather than both club level and national players (Pillay & Frantz, 2012). The evidence linking playing position to injury is inconclusive (Downs et al., 2021).

Strategies for lower limb injury prevention in netball include warm-up prior to training and games (McManus et al., 2006), programs targeting effective landing techniques (Stuelcken et al., 2013), movement screening (Elphinston & Hardman, 2006), bracing (Vanwanseele et al., 2014) and appropriate footwear selection (Hume & Steele, 2000; Smyth et al., 2019). Despite the positive uptake for warm-up and stretching guidelines, adherence to footwear recommendations is generally poor (Hume & Steele, 2000). Whilst the strategies are still implemented in current injury prevention programs, some of these recommendations are over 20 years old and need to be reviewed with current footwear available to players.

1.2 The role of netball-specific footwear

Netball-specific footwear contains characteristics including cushioning, support and a greater interface between the midsole and foot, with the goal to enhance performance and reduce injury (Sinclair et al., 2015). Currently, there is no established link between

netball-specific footwear and reduced injury rates, nor any studies investigating the effectiveness of footwear as an intervention for netball-related injuries. Previous work has suggested that benefits of netball-specific footwear on injury prevention may be attributed to the design features of the shoe (Hume & Steele, 2000; Sinclair et al., 2015; Smyth et al., 2019).

1.3 Design features of netball footwear

The construction of athletic footwear can be divided into the upper, midsole, and outsole (McPoil, 2000). The function of the upper is to provide protection and fixation of the foot (usually through laces). The upper is typically constructed of breathable materials. The primary role of the midsole is to offer cushioning by providing a barrier between the foot and ground, reducing impact by increasing the time over which the force is absorbed (Lake, 2000; McPoil, 2000). The midsole is typically constructed out of foam-based materials. The function of the outsole is to provide protection to the plantar aspect of the foot and traction. The outsole is typically constructed out of rubber. Netball- specific footwear contains unique design features at the upper, midsole and outsole, as displayed in **Figure 1**.

Figure 1. Key parts of netball-specific footwear

1.3.1 Upper

The upper of netball-specific footwear is designed to provide support to the foot, optimise fit, and made from strong materials which help to prevent ripping and make the shoe durable (Asics, 2023). The fit of netball-specific footwear is important as blisters are a common foot problem experienced by netball players (Smyth et al., 2022). Another feature of the upper is the collar height, which will influence fit around the ankle. Historically, low-cut netball-specific footwear has been discouraged due to the perceived lack of support to the ankle, with high-top footwear suggested as a preventative tool for ankle injuries (Hume & Steele, 2000). However, there are no prospective studies that show high-top footwear prevent injuries in netball players.

Vanwanseele et al. (2014) compared the effects of bracing, a high-top footwear and a low-cut netball footwear on ankle and knee joint load during single leg landing in netballers with no current lower limb injury. No differences were observed in peak vertical ground reaction forces between the three conditions, however, high-top

footwear increased loading at the knee. The increased internal rotation at the knee and limited influence on ankle joint motion observed in the high-top footwear may be factors in the poor uptake of high-top netball footwear reported previously by Hume and Steele (2000). The use of external ankle braces is currently recommended in best practice guidelines to reduce the risk of ankle injuries in netball players, low-cut footwear accommodates for the co-use of the external brace, unlike the high-top footwear (Rowe et al., 2021). Additionally, options for netball specific high-top footwear are limited (Kirk et al., 2023)

1.3.2 Midsole

The midsole of netball-specific footwear provides cushioning and support to the foot (Asics, 2023). Shoe midsoles are typically made from foam materials like ethylene vinyl acetate (EVA) and polyurethane (PU). Manufacturers can use compression or injection moulding techniques to create them. PU foams resist compaction, while EVA foams are lightweight. By adding water, gas, and gel, cushioning properties can be improved. These foams have viscoelastic properties that provide spring-like qualities, motion damping, and heat dissipation. These properties are important for cushioning the foot and allowing the midsole to bounce back after impact (McPoil, 2000).

The use of EVA and PU foams that include water, gas and gel have been proposed as design features that may help to reduce injury (Asics, 2023). Sinclair et al. (2015) compared the effects of a netball shoe and minimalist shoe on impact forces during running, cutting, and jumping in healthy netballers. Impact forces across all three tasks were reduced in the netball shoe, with reduced rearfoot eversion observed during running only. Both increased impact forces and rearfoot eversion have been identified as risk factors for the development of lower limb injuries (Davis et al., 2016; Murphy et

al., 2003). The authors suggested that the cushioning and support in the midsole of the netball shoe were responsible for reducing impact forces and the magnitude of rearfoot motion during netball-specific tasks (Sinclair et al., 2015).

1.3.3 Outsole

The outsole of netball-specific footwear acts as the interface between the foot and the ground, providing grip and increased stability through a wrapped outsole (Asics, 2023; McPoil, 2000). The tread patterns of the outsole are a key feature in netball footwear as it assists with traction, grip, and durability. The outsole may play a key role in injury prevention as tripping and slipping are common mechanisms of injury in netball players (Downs et al., 2021). Netball is played on a variety of surfaces (asphalt and hardwood), meaning the requirements for outsole construction will vary depending on the playing surface (Netball New Zealand, 2019). As noted by (Steele, 1990) the playing surface should have enough friction to allow players to execute the fast acceleration and deceleration movement specific to netball, while preventing slipping and sliding. However, if there is too much friction, there may be an increased risk of injury especially the risk of injuring the ankle and knee ligaments and possibly blisters caused by the foot being fixed (Apps et al., 2020).

1.4 Footwear worn by netball players

Information on the type of footwear worn by netball players is limited. A study of 3,108 netball players reported the footwear worn by players at the time of injury (Hopper, 1986). Data collected on footwear was limited to the brand, age, and condition of the footwear. Most shoes were either Adidas or Dunlop branded, over six months old, with a third displaying signs of wear. Interestingly, less than ten percent of players viewed their footwear as a contributing factor to their injury. A limitation of this work is that it was conducted over 30 years ago, with significant advances occurring in footwear design since the study was published. Hume and Steele (2000) surveyed 131 players injured during a three-day tournament. Most players wore either low- or mid-cut footwear, with 5% wearing high-cut footwear. Eighty-one percent of participants indicated that they wore footwear specifically for netball; however, there was no further information reported on the characteristics of the chosen netball shoe or what factors influenced this decision.

Kirk et al., 2022surveyed approximately 3,000 netball players finding that 80% of netball players wore netball-specific footwear, with females over 13 times more likely to wear netball-specific footwear compared to males. Most players (84%) wore ASICS branded footwear. Foot problems were frequently reported with 84% of participants reporting foot problems and 57% reporting foot pain. Of those reporting foot pain, 58% noted that their foot pain was caused by their footwear. Two thirds of the participants also associated their foot pain with diminished performance. The authors suggesting that the footwear worn by netball players may not be meeting their needs, due to the high prevalence of foot problems and foot pain.

A survey of 279 male netball players explored satisfaction with footwear worn during netball (Kirk et al., 2023). Participants were most satisfied with the comfort, fit (length) and toe space of their footwear. Participants were dissatisfied with the durability, fit (width), and breathability of their footwear. Thematic analysis of the open-ended survey questions identified shoe design features (related to fit, form and function) and non-shoe design features (individual and availability) as key reasons for not wearing netball-specific footwear. Non-shoe design features were more commonly reported as the reason for not wearing netball specific footwear. The most common reasons being a preference of other footwear (41%), lack of netball-specific footwear options for men (33%), size not available (11%), limited range (8%) and, cost (7%) most prevalent reasons.

1.5 Identified knowledge gaps

Lower limb injuries are a common and costly occurrence for netball players. Footwear may be used as a strategy to help reduce injury whilst playing netball, due to specific design features of the netball footwear (Greene et al., 2014; Sinclair et al., 2015; Vanwanseele et al., 2014). Data from surveys indicates that netball-specific footwear is commonly worn by netball players, however, there is limited research regarding the reasons for use of netball-specific footwear by netball players. Recent research has highlighted factors that influence footwear selection in men, however, those findings may not be applicable to women due to differences in foot profile and performance demands. Gaining deeper insight into the factors influencing footwear selection in

netball players may help to improve the design of netball-specific footwear and develop insight into the role footwear has in preventing netball-related injuries. A greater understanding of players perception of netball footwear and their thoughts around netball shoe design features and the role shoes play in injury prevention is required.

1.6 Research aims

1. To determine netball players perceptions surrounding netball specific footwear.
2. To determine the characteristics of footwear worn by netballers.

1.7 Research question

1. What factors do netballers perceive are important in netball specific footwear?

Chapter 2: Methodology

2.1 Introduction

This chapter will provide an overview of the methodological design and approach used in the study. The methodology is described in two parts, Part A detailing the methodology related to the participant interviews and Part B the assessment of netball footwear characteristics. The two studies detailed in this chapter were approved by the Auckland University of Technology Ethics Committee (AUTEC) (reference number 20/329) (**Appendix 1**). All participants read the Participant Information Sheet for the study (**Appendix 2**) and signed a Consent Form (**Appendix 3**). Participants were provided with a $20 NZD gift voucher for participating in the study.

2.2 Mixed methods design

The concept of mixed methods research involves combining both qualitative and quantitative approaches in order to obtain a more meaningful understanding of a particular topic. By utilising a parallel mixed methods design, which involves independently collecting and analysing data from both paradigms, researchers can obtain different but complementary data on the same topic (Creswell & Clark, 2017). In this study, a parallel mixed methods design was applied to explore the issues of footwear amongst netballers **(figure 2.1)**. The use of qualitative data was necessary to quantify extent to which netballers perceive footwear to be related to injury. while quantitative data was used to gain insight into the characteristics of their current netball footwear.

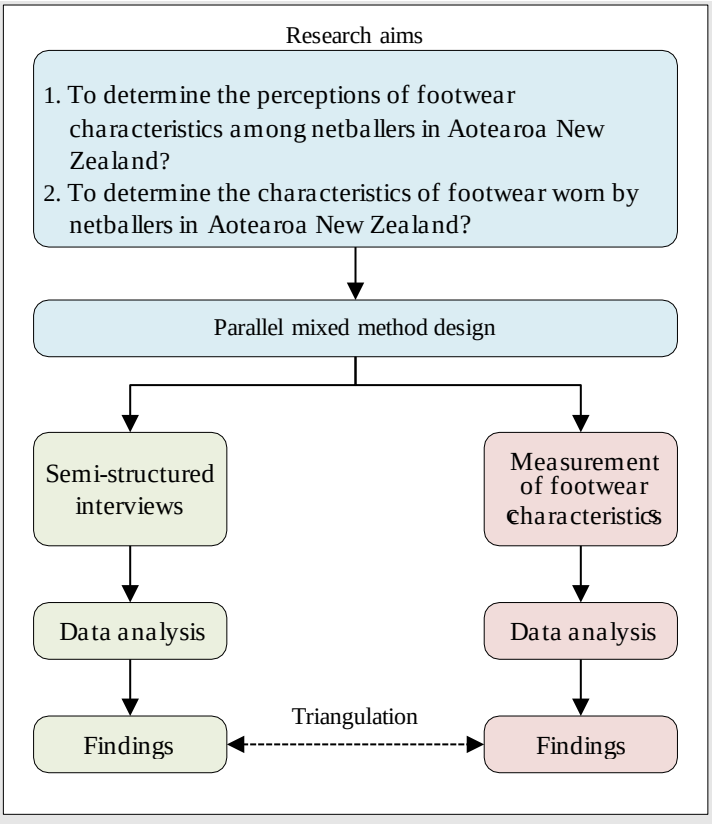

Figure 2. Overview of mixed methods study design

2.3 Recruitment

Participants were recruited through an advertisement (**Appendix 4**) displayed at netball clubs within the Netball North Harbour region (Auckland, New Zealand). Potential participants that responded to the advertisement were assessed for eligibility by the researcher (MC). Purposeful sampling was used to ensure diversity across the following characteristics: age, ethnicity, years playing netball, current netball grade, current netball footwear, previous netball injuries and netball position. Those eligible to participate sent the Participant Information Sheet and Consent Form. Potential participants read the Participant Information Sheet and had opportunity to ask questions

regarding the study. Those that decided to take part in the study provided written consent by signing the Consent Form.

2.4 Inclusion and exclusion criteria

The inclusion criteria for this study were:

1. Female netball players affiliated with Netball North Harbour
2. Over the age of 20 years
3. English speaking

The exclusion criteria for this study were:

1. Players under the age of 20 years old
2. Male netball players
3. Players not affiliated with Netball North Harbour
4. Non-english speaking players

2.5 Procedure

Participants attended a single study visit. Data collection occurred over two stages:

1. Participant interview (Aim 1)
2. Footwear assessment (Aim 2)

2.6 Stage 1 Participant interview (Aim 1)

A qualitative descriptive methodology (Sandelowski, 2000) was used to gain insight into the perspectives of participants. Qualitative descriptive studies aim to explore the phenomena of interest (footwear perceptions) using a naturalistic approach (that there is subjectivity and variation between individuals).

An interview guide (**Appendix 5**) was used during interviews. Participants were asked to disclose their age, ethnicity, number of years playing netball, their current playing grade, positions played, their current footwear used for netball and to list their injuries sustained through netball.

Participants were also invited to use their own footwear as a prop during the interview. A definition of footwear was determined between the researcher and participant to help direct participants towards the topic of interest. Participants were then asked the following questions:

1. "Tell me about your experience/thoughts when purchasing footwear for netball"
2. Tell me about your experience/thoughts when wearing footwear playing netball."

This was followed by additional open-ended questions to further explore footwear perceptions.

3. "What are your feelings about your current netball footwear?"
4. "What are the most important things you look for in netball footwear?"
5. "What are your thought on the current netball footwear available to you?"

6. “What barriers have you experienced related to netball footwear?”
7. “What effect has netball footwear had on your feet?”
8. “What impact has netball footwear had on your ability to play netball?”

Prompts were used when conversation stalled or to gain further insight into participant’s perceptions. Participants were given an opportunity to raise additional points that they felt were important to the research question. The researcher then summarised the key points from the discussion for confirmation from the participant. Field notes from the interview were recorded by the researcher. Open ended questions were used to ensure that there was no room for interpretation from the researcher and to gain full insight into the players perceptions of their footwear. After the piloted semi-structured interview, questions were worded slightly differently to ensure that participants were describing features in their own words.

2.7 Stage 2 Footwear assessment (Aim 2)

Participants footwear was assessed using the footwear assessment tool (Barton et al., 2009) (**Appendix 6**). This tool is a reliable and valid method to assess footwear that examines the fit, general features, general structure, motion control properties, cushioning and wear patterns of footwear.

2.7.1 Footwear fit

All footwear characteristics related to fit were assessed with the participant standing in their natural base of gait in order to capture any elongation of the foot and splaying of the digits that accompanies weightbearing (Houston et al., 2006).

a) Fit of the shoe in length was measured subjectively using the 'rule of thumb' technique which involved the researcher assessing the distance between the toes and the end of the shoe. This was graded as too short (< ½ thumb's width), good (between a ½ and 1 ½ thumb's width) or too long (> 1 ½ thumb's widths) (Barton et al., 2009). Fit of the shoe in length was also measured objectively. This involved comparing the difference between the length of the foot (measured using a Brannock-style device) and the length of the inside of the shoe (measured using a flexible ruler).
b) Fit of the shoe in width was measured subjectively using the 'grasp test' in which the researcher grasped the upper shoe at the level of the metatarsophalangeal joints. The fit of the shoe was graded as too wide

(excessive bunching of upper), good (slight bunching of the upper) or too narrow (tight upper unable to be grasped) (Barton et al., 2009).

c) Finally, fit of the shoe related to depth was assessed by the ability of the participant to be able to move their toes and joints freely and the absence of any pressure across the toe box area. This was graded as adequate or too shallow.

2.7.2 General features

a) General features of the shoe were assessed include the participant's self-reported age of the shoe which was recorded in months if less than 12 months, or > 12 months.

b) The style of the shoe was also assessed using the validated Footwear Assessment Form which contains diagrams representing each footwear category (Menz & Sherrington, 2000). The style of the shoe was graded as: walking shoe, athletic shoe, oxford shoe, moccasin, boot, ugg boot, high heel, thong, slipper, backless slipper, court shoe, mule, sandal, or surgical/bespoke footwear.

c) The upper materials of the shoe were categorised as leather, synthetic, mesh, or other, and the outsole of the shoe, was categorised as rubber, plastic, leather or other (Barton et al., 2009).

d) The mass of the shoe was measured in grams using standard kitchen scales with an accuracy of +/- 1g. Finally, the length of the shoe was measured using a Brannock-style device. The length between the most posterior aspect of the heel counter and the most anterior aspect of the toe box was recorded in mm.

2.7.3 General structure

a) The heel height of the shoe was measured as the distance between the base of the heel and the heel/sole interface. If this differed between the medial and lateral aspects of the heel, the average of the two measurements was used and recorded as 0-2.5cm, 2.6-5cm, or >5cm (Menz & Sherrington, 2000).

b) The forefoot height was measured at the level of the metatarsophalangeal joints. A measurement was taken from both the first and fifth metatarsophalangeal joints and the average was used and recorded as 0-0.9cm, 1-2cm, or >2cm (Barton et al., 2009).

c) The pitch of the shoe, also called the longitudinal profile, was calculated from the above two measurements as the distance between the heel height and the forefoot height. This was categorised as flat (0-0.9cm), small heel rise (1-3cm), or large heel rise (>3cm) (Barton et al., 2009).

d) The angular difference between the heel bisection and forefoot bisection of the shoe was assessed as a measure of last shape using a goniometer. The last shape was categorised as straight (0-5°), semi-curved (5-15°), or curved (>15°) (Barton et al., 2009).

e) The method used to fix the upper of the shoe to the sole of the shoe was recorded as board lasting, slip (stitch) lasting, or combination lasting (McPoil Jr, 1988).

f) The forefoot flexion point of the sole of the shoe was also assessed. This involved the researcher applying a sagittal force to the sole of the shoe and noting the point at which the shoe bended. The sole flexion point was

categorised in relation to the metatarsophalangeal joints as level with, proximal to, or distal to (Barton et al., 2009).

2.7.4 Motion control properties

a) Midsole density: was assessed and graded as single density (if one density of material was used throughout the sole), or multiple density (if multiple densities were present).

b) Fixation: was assessed using the Footwear Assessment Form categories of none, laces, straps/buckles, Velcro, or zips (Menz & Sherrington, 2000). For laced footwear, the number of eyelets on each side was also recorded.

c) Heel counter stiffness was assessed subjectively by the researcher. This involved applying force to the posterior aspect of the heel counter (20mm from its base) and observing the level of displacement. This was recorded as minimal (>45°), moderate (<45°) or rigid (<10°) (Menz & Sherrington, 2000). Similarly, midfoot sole sagittal stability and frontal stability was assessed using the same categories. Sagittal stability was assessed by bending the shoe whilst grasping the rearfoot and forefoot components and observing the degree of sagittal plane bend at the midfoot. Frontal stability was assessed by twisting the shoe while grasping the rearfoot and forefoot components and observing the degree of frontal plane twist at the midfoot.

In addition to assessing each of the motion control properties outlined above, a total motion control properties score was determined using the scale displayed in **Table 1**.

Table 1. Motion control properties scale

	Score			
Item	**0**	**1**	**2**	**3**
Midsole Density layers	Single density		Dual density	
Fixation (upper to foot)	None	Alternative to laces (Velcro)	Laces (min 3 eyelets)	
Heel counter stiffness	No heel counter	Minimal	Moderate	Rigid
Midfoot sagittal stability	Minimal	Moderate	Rigid	
Midfoot torsional stability	Minimal	Moderate	Rigid	

2.7.5 Cushioning

The presence of cushioning was assessed subjectively and recorded as none, present in the heel only, or present in the heel and forefoot. In addition, cushioning specific to the lateral and medial aspects of the midsole and the inferior heel-shoe interface. This involved the researcher applying firm pressure with the thumb. This was categorised as hard (minimal to no indentation <0.5mm), firm (moderate indentation 0.5-1.5mm), or soft (marked indentation >1.5mm) (Barton et al., 2009). In addition to the subjective measure of cushioning, a durometer (Shore A) was also used to record the material hardness in each of the above regions.

2.7.6 Wear patterns

Upper wear patterns of the shoe were graded as neutral, medial tilt greater than 10, or lateral tilt greater than 10 (Vernon et al., 2004). Similarly, midsole wear was graded as

neutral, medial tilt/midsole compression, or lateral tilt/midsole compression (Robbins et al., 1992). The tread pattern on the outsole of the shoe was also assessed and graded as textured or smooth, while the outsole wear pattern was graded as normal (wear at posterior lateral heel moving medial towards first ray), medial (greater medial to lateral wear at rearfoot and forefoot), or lateral (greater lateral to medial wear at rearfoot and forefoot) (Barton et al., 2009)

2.8 Data analysis

2.8.1 Stage 1 - Participant interview (Aim 1)

Interviews were audio recorded using a Dictaphone with an additional recording device used as back-up. Audio recordings were transcribed externally by Korina Tuahine with the researcher verifying the accuracy of the transcripts. All identifiable information was removed from transcripts, with the transcribing company signing a confidentiality agreement (**Appendix 7**).

Manifest content analysis was used to analyse transcripts (Graneheim & Lundman, 2004). Manifest content analysis provides an interpretation of the visible and obvious components of the data to provide further understanding of the phenomenon of interest (perceptions of footwear characteristics). Analysis was undertaken using a three-step process described by (Elo & Kyngäs, 2008).

1. Preparation: specific statements from transcripts, small enough to have contextual meaning were identified as units of analysis prior to coding.
2. Organisation: transcripts were then read and re-read to immerse the researcher with the data. An inductive approach was used where text was coded, organised into mutually exclusive categories, and named using content-characteristic words (abstraction).
3. Reporting: results from the analysis were described by the content of the categories describing the phenomenon. Supporting excerpts from transcripts were used to accompany each category representing the truthfulness of the data. Key themes and subthemes were represented in a text summary using representative quotes to support each category. Themes and subthemes were also presented using thematic maps.

As the researcher was a clinician who also belongs to the cohort of participants, an interview of the researcher by the supervisory team was undertaken place prior to data collection to assist with procedures and protocols and to assess potential researcher biases (Chenail, 2011).

2.8.2 Stage 2 - Footwear assessment (Aim 2)

Categorical outcomes relating to each footwear characteristic were reported descriptively for each individual participant and presented in tables.

Chapter 3: Results

3.1 Participant characteristics

Nine female participants with a mixture of experience and playing levels were recruited from Netball North Harbour (**Table 2**). The majority of participants wore netball-specific footwear, with one participant wearing running footwear. Previous netball injuries were common with the ankle and knee most prevalent.

Table 2. Participant characteristics

Participant	Age	Ethnicity	Years playing	Current grade	Positions	Current Netball shoe	Previous netball injuries
1	33	European	16	Senior 1	C; WA	Asics Gel Burner	Knee meniscus, ankle sprains, Achilles
2	42	Māori	35	Premier 1	GS; GA	Asics Netburner	Ankle sprains
3	47	European	12	Senior 4	WD; GD	Asics Netburner	Ankle sprains, calf tear
4	47	Māori	10	Senior 5	C; WA; WD	Hoka Clifton	Nil
5	38	European	15	Senior 3	GA; WA	Asics Netburner	Rolled ankles
6	44	European	20	Senior 4	WD; GD; GK	Asics Gel Burner	Ankle sprains
7	54	European	44	Senior 7	GA; GS	Asics Gel Burner	Ankle sprains, knee sprains
8	20	European	12	Senior 5	GK; GS	Asics Gel Burner	Ankle sprains
9	37	European	30	Senior 6	WA; C	Asics Netburner Ballistic	Foot strain

C = Central; WA = Wing Attack; GS = Goal Shooter; GA = Goal Attack; WD = Wing Defence; GD = Goal Defence; GK = Goalkeeper.

3.2 Themes

Figure 3 shows the three themes that were derived from the data: (1) thoughts and experiences when purchasing footwear, (2) key features of footwear and (3) the effects of footwear on feet.

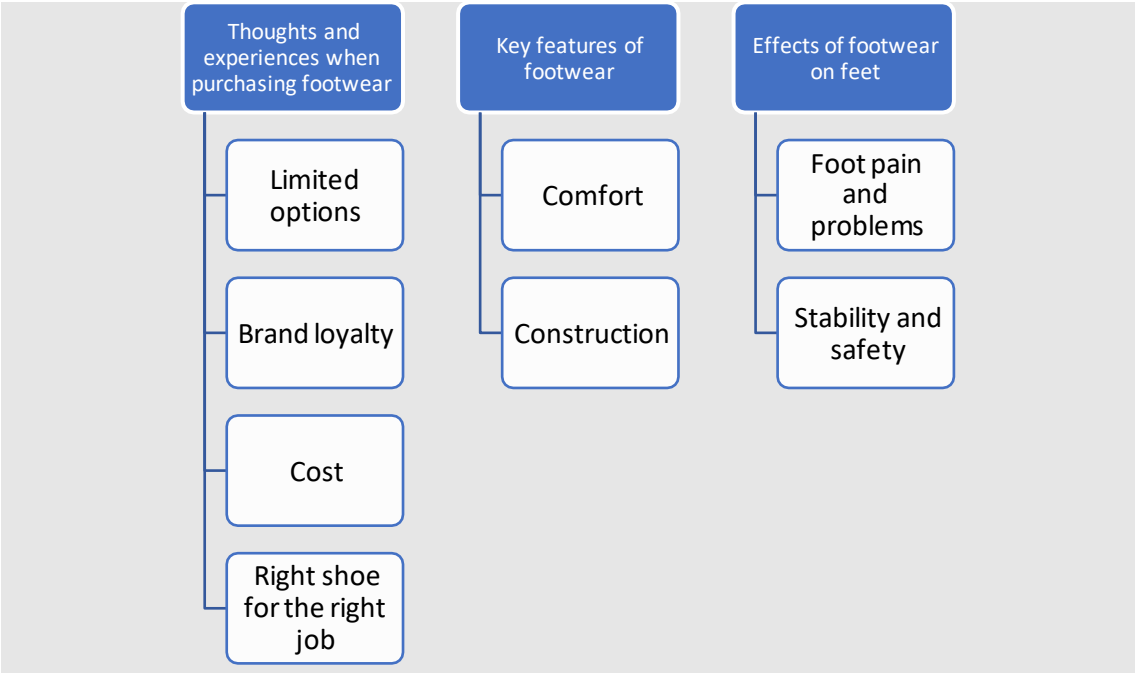

Figure 3. Overview of themes and subthemes

3.2.1 Thoughts and experiences when purchasing footwear

The four subthemes relating to this theme are shown in **Figure 4**.

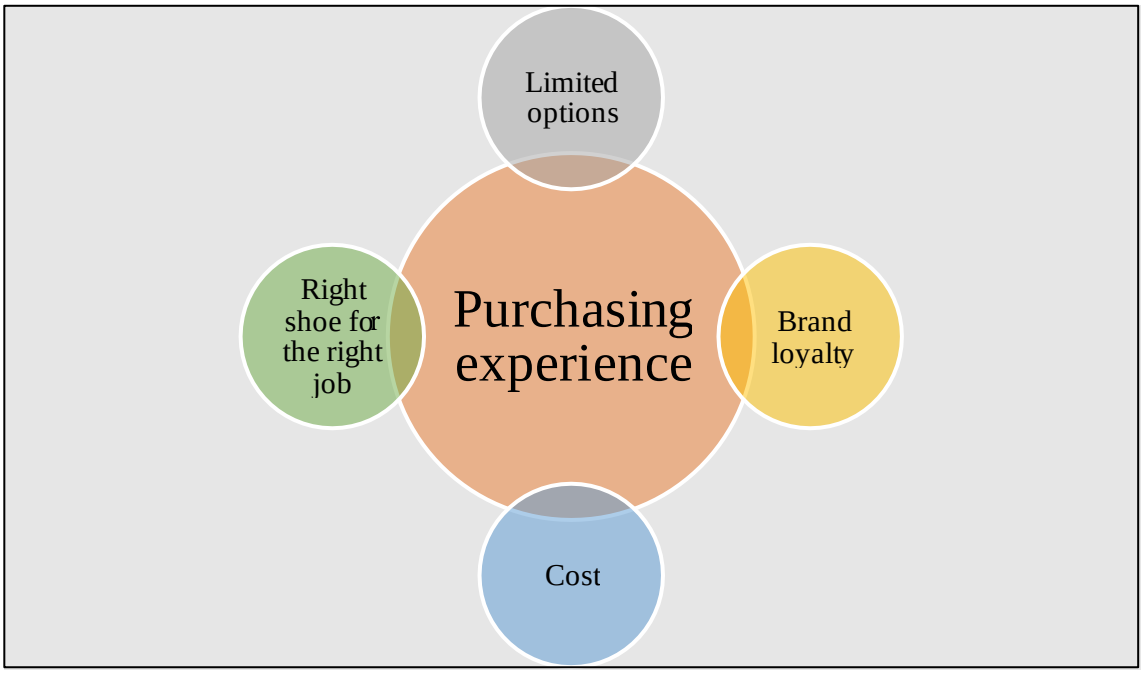

Figure 4. Thematic map showing thoughts and experiences when purchasing footwear.

3.2.1.1 Limited options

Most participants felt that compared with other sports, there was a limited selection of netball shoes available to players for purchase.

"When you look at the football boots and you look at all the running, tennis and squash shoes, for netball, I only really have the choice of four or five shoes, which is not many" (P6)

"There is a lot of variety when I am choosing my running shoes, but I don't have that luxury when choosing my netball shoes" (P1)

"Asics are the only netball shoes around; I feel like that makes the choices even harder when buying a new pair of shoes" (P5)

"It's a nightmare going from shop to shop to shop just to get the right fit with the right size and there's just not as much selection compared to if you go to the runner's section" (P5)

Participants that described their feet as long or wide struggled with a lack of options available to them, often having to compromise and choose anything that fits.

"Availability, all the bigger size shoes are always gone…. I wear more of a man's shoe for the width, but obviously netball isn't made for wide feet I guess" (P2)

"My biggest challenge with my shoes is getting length; I often don't have a lot of selection, when I bought my current pair, they were the only style I could get in my size… I mostly end up taking what I can get" (P3)

"*I have to wear two pairs of socks to get the shoes to fit sometimes" (P5)*

"What I don't like about my netball shoes is the sizing. Sizing for netball shoes is really hard for someone who's got small feet" (P9)

Whilst colour may not directly affect the function of footwear, several participants voiced their thoughts around the lack of colour choices and its impact when buying footwear.

"It's hard to sometimes find the right combination of leather, comfort, and colour it either has one thing I like but not the others… I tend to get drawn to the colour I like first, and then look at the other things like cost, fit and comfort" (P8)

"Colour – but when you are limited in choice, you have to take what you can get" (P3)

"Some of the colours really clash with our uniform, I can't really wear a blue uniform with orange sneakers" (P5)

"There is such an awesome colour selection available in running shoes, it's a shame that there is not the same in netball shoes" (P2)

3.2.1.2 Right shoe for the right job

Most participants reported that if they were purchasing netball shoes, they would buy a shoe that was marketed as a netball shoe.

"*I feel more supported in a netball shoe, so I will always buy a netball shoe... Suppose I always have the rationale, you know, to get the shoes for the job" (P6)*

"I will go into an Asics store, and they will discuss playing position and weight before showing me the netball shoes. (P1)

Being a shooter, I do also look at the sole, but again that does tend to be when you go into um the shoe shop. You sort of, that's one of the things you say, "I'm a shooter." So, they tend to take you straight to um the shoe range that has been designed for shooters. (P8)

"I bought my last pair of shoes because they had the little circle at the bottom, which apparently is meant to be good for pivoting (P2).

"We get told to play netball in a netball shoe right from school and so that's just stuck with me" (P5)

3.2.1.3 Brand loyalty

Participants displayed a trend towards brand loyalty. This included sticking with the same brand or model, placing trust in the manufacturer to deliver footwear that was fit for purpose. This pattern was often based on positive past experiences.

I've always worn Asics since I was in high school, and I've never deviated from that. I have trust in the brand that I don't have any issues… I think I've always stuck with the Netburner and go the new model every year" (P1)

"I have tried other brands of netball shoes, and when I am breaking it all down, it does tend to fall to Asics, I actually wear Asics football boots as well" (P7)

For others, the reputation of the brand, its visibility and associations with performance were also key factors.

"I am an Asics girl traditionally, because it's always been the brand to buy netball shoes" (P5)

"To be honest, I look at what the Silver Ferns are wearing because they are the best of the best playing at such a competitive level, so for me brand is important because I think who wears it. If most people are wearing Asics, then they must be good" (P9)

A lack of awareness of other brands was also evident from the discussions, with a limited number of brands manufacturing netball-specific footwear.

"I always go to Asics because I don't really know anywhere else that does netball shoes, I don't actually know if any other brands do them" (P1)

"I've only ever used Asics." (P2)

"It would be nice for other brands to make netball shoes, sometimes they just fit better" (P4)

"I always go to Asics; I think they are the only ones that actually make a netball shoe" (P8)

For some, the brand of footwear was not important in their decision-making.

"I've never been too concerned knowing the brand of the shoe – not really going to be an issue" (P1)

"*I have never felt comfortable in netball shoes, that is why I play in Hoka which are so comfortable" (P4)*

3.2.1.4 Cost

Most of the participants were concerned about the cost of footwear when choosing their footwear.

"Price point – can make the decision for me" (P6)

"When playing a lot of different sport, you need to buy multiple pairs of shoes, it becomes expensive when only wearing netball shoes for one game a week" (P4)

"I usually buy them at the end of the season when they are on sale as they can be expensive at the beginning of the season" (P7)

"I shop around online, that's all due to cost, and convenience a little too I guess" (P8)

"I tend to replace shoes near the end of the season preparing for the next season cause that's when they're all cheap" (P5)

3.2.2 Key features of footwear

Many of the participants were able to discuss their specific requirements when selecting netball footwear (**Figure 5**).

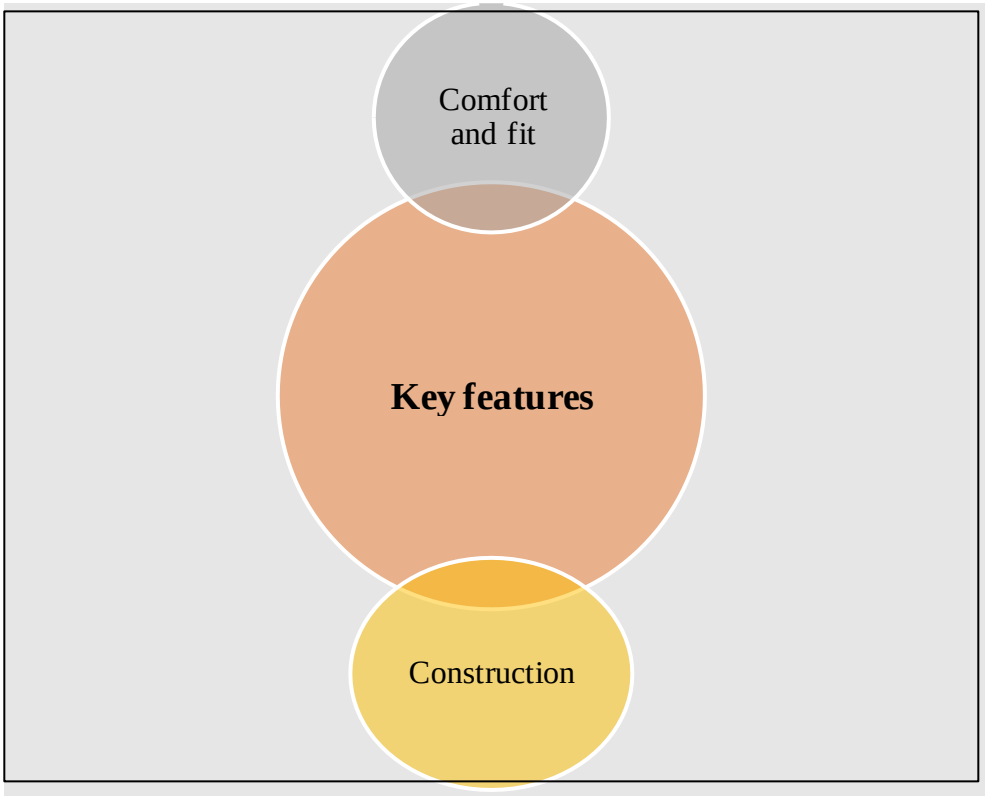

Figure 5. Thematic map showing key features you look for in a netball shoe.

3.2.2.1 Comfort and fit

Comfort was also discussed frequently with participants indicating that it was a significant factor when buying shoes.

"100% comfort" (P2)

"Comfort is a really big thing for me, if they are not comfortable, then they are no good" (P3)

"*To make sure you have a good fit you I simulate some of the movements, court, typical court movements when you try your shoes on, how does your foot feel in the movement? I know when you first try a new pair of shoes on it's like walking on air and that lasts for about the first three or four games, you feel like you've got better elevation and everything because nothing has compacted yet" (7)*

Fit also featured throughout discussions, often using the terms comfort, and fit interchangeably.

"The fit, for me, the fit's really important" (P8)

"For netball, um definitely you need to get your fit right and when, and when you're trying them on um you need to be um jarring your foot. Like so it, um mimicking that um sharp stop, because netball is a stop-start game. It's not continual movement. You're stopping that change of direction and if if you don't mimic that when you're picking your shoe, you're gonna get out on court and just, your shoes are gonna be no good. Um so very much about making sure you get your fit right for that and that you wear the right socks when you go. So, the socks that you'll be playing in. I think it's really important to take your actual socks you're playing in when you pick your shoe, because if you've gotta thinner or a thicker sock on when you're trying it, you're not getting a real picture of what you're gonna face with on court" (P7)

"Make sure my toes aren't going to hit the front of the shoe if I have to stop" (P9)

"Support around the arches because I have quite a high arch, so comfort is obviously a key thing so that my foot and heel area feels nice and secure" (P3)

For some of the participants, the lacing of their shoes can play apart in the overall feel of the shoes.

"*I always use the double eye up the top to give you extra support and stop the ankle from rolling" (P9)*

"I start my lacing from the second eyelet, I always use the last one to do the ankle lock (P1)

"I like my laces to be quite firm and that provides me with the feeling that my feet are safe" (P4)

"I do the lace lock, that was from Jo at our clinic" (P6)

"Doing the ankle locks, because as well it is a personal thing, I am very clumsy, so I am falling over a lot. So, it is having that extra, that extra layer of support for your ankle as well" (P8)

"Yeah, that extra eyelet to enable the lace lock, because um when I actually chose this pair of shoes, it came down to the two different models and they actually both felt great, but then I realised the other one didn't have the extra eyelet to do the lace lock" (P7)

"I like the lace lock cause it helps support my ankle, my current shoes are high top, and I really like the way it sits on my ankles" (P2)

Participants found that the lacing of their footwear could possibly be a contributing factor in why they needed to take them off in a hurry.

"*The shoe felt loose no matter how tight I did the shoelace or how loose I did it, it would either feel really loos in here and really tight up there to cut the circulation off" (P5)*

"I think maybe because the laces go up higher or something like that that cuts off the circulation in my toes" (P6)

3.2.1.2 Construction

When discussing comfort and fit, participants identified the heel counter, cushioning, support, outsole, and upper as key design features of footwear. The heel counter was frequently cited as an important feature, especially in the prevention of blisters.

"Stiffness at back of the shoe is not important, I would probably prefer that it not be too stiff as I get blisters at the start of the season" (P5)

"I don't like the shoe to be too stiff at the back of the shoe, cause I used to get blisters when it rubbed if it was too stiff" (P9)

"I do go to the back of the shoe and check out the softness or sponginess" (P2)

The heel counter was also perceived as being important for stability.

"Heel counter needs to be firm to help support my ankles" (P1)

"The shoe needs to have more solid stiffness around the heel, that would sway me to the netball shoes rather than anything else" (P6)

However, for others the heel counter was not an important feature.

"I've never checked the back of the shoe when buying it" (P3)

"I think the only time I'd ever have issues was wearing out the heel counters when I used to wear custom orthotics and it used to chew the back out of the shoe" (P1)

Cushioning featured as an important feature, along with the outsole wear it is usually used as an indicator to purchase new footwear.

"Cushioning is very important – if it's not cushioned enough, it's time for a new pair" (P5)

When that's happening, the padding, the cushioning is getting lower and that's probably when I start looking for a new pair" (P6)

The outsole was identified as playing a key role for grip, which was linked to performance.

"I guess it's just always been an assumption that Asics will cover the right grip and I'm getting the optimum use out of it" (P5)

"I know about grip because of the circles and all that stuff help you to turn properly, the moment you don't have grip, you start freaking out and you don't concentrate on your game" (P2)

"I've picked up a shoe, I've put it on, I've run in it and then I look at the bottom and there is no pivot ball, and I'm like um, so now consciously I always look first to see if it has a pivot ball" (P8)

"The pivot ball helps with the movement kind of in the rotating, as a shooter and defender you're moving a lot and you're on your toes and it kind of just helps with that more – that's what I've been told" (P8)

"They've kind of got a pivot ball, it's not actually a ball but they've got that pivot area in the centre of the foot, and I just found it really good for wear as well, the stronger pivot focus in the centre the shoes the longer they lasted" (P7)

Participants also discussed how the outsole needed to be appropriate for the surfaces that netball was played on.

"Always need to have good tread and structure for water" (P2)

"*I find I need the outsole for the grip, especially on the outside courts compared to the indoor courts" (P1)*

The construction of the upper was identified as being important for fit, although user preferences regarding the ideal materials for upper construction was more varied.

"Mesh upper was really good, but that's not around anymore…. Leather is good and I get that it moves, but it also breaks down quicker" (P2)

"I prefer it not to be synthetic leather because it might fit better" (P3)

"I like the leather cause I like to feel quite closed in, especially in the front, but then the mesh is also good, cause it doesn't smell as bad during the winter" (P5)

"The leather look, whether it's actual leather, I've always found that just gives me better stability and because I'm in a shooting position, it stops that movement at the front of the foot" (P7)

Similar to points raised about the outsole, the upper needed to be fit for purpose and appropriate for the conditions that netball is played in.

"I look for leather for some sort of waterproofing" (P6)

"Using something other than synthetic leather would be good, you play a winter sport – drying can be a nightmare, it can take days for them to dry out, whereas compared to running shoes they don't take as long to dry out, and therefore don't get as smelly" (P3)

3.2.3 Effects of footwear on feet

Figure 6 displays the subthemes related to this theme.

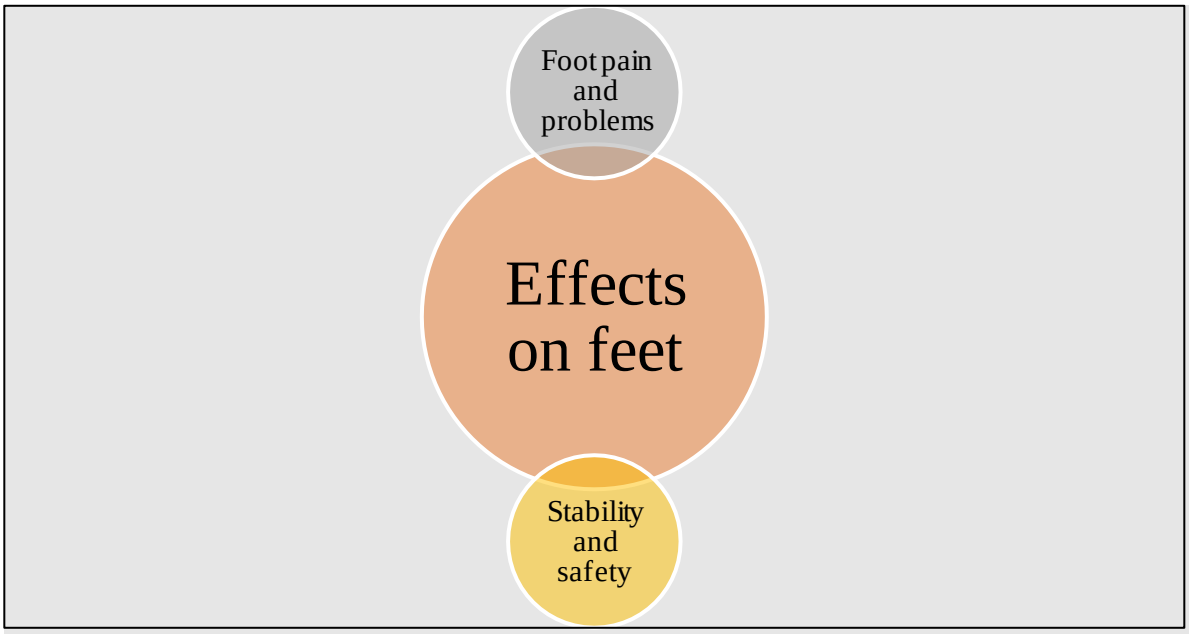

Figure 6. Thematic map showing effects of footwear on feet.

3.2.3.1 Foot pain and problems

Foot pain and problems were commonly reported with many participants stating that issues arose after removing their footwear.

"I can't wait to kick them off after the end of the game. I don't know whether it's just this material is so much stiffer than the previous pair that I had. I probably wore this pair for too long so they're probably too soft. I find these really tight, and I've got bunions as well so really across those metatarsal heads it feels really, really tight" (P1)

"Sometimes my feet can hurt after the game, can't wait to get them off, particularly in the front" (P3)

"They don't hurt while I play, it's only when you stop playing. I don't know if that's because the front of my foot doesn't get really much support, cos the shoe doesn't fit snug around the front of my foot" (P8)

Issues including pins and needles, black toenails, and aching feet were also mentioned.

"Numbness, as I'm driving home it's a numbness and pins and needles, I don't tie them tightly, but it is numb around the toes and front of my foot" (P2)

"...my foot would squish up and so my big toenail would end up turning black and that season was when I lost my toenail" (P5)

"I find on the Sunday, my feet are aching after my netball, when they ache a lot, that's probably when I start to look for another pair of shoes" (P6)

3.2.3.2 Stability and safety

The feeling of being stable and safe were associated with netball-specific footwear compared to other types of footwear. This influenced performance, as people could play confidently and freely instead of worrying about if they were going to slip or suffer an injury.

"I don't have a problem investing in the right footwear, especially in a sport like netball which is played outdoors in the wet, if you're playing in a shoe that has no grip on it, it's not just your foot that your compromising, you compromise your ability, you know your whole ability to be injured and stay on

your feet…. I've just always found that if the shoe is leather, it just gives me better stability and because I am in a shooting position it stops that movement at the front of the foot" (P7)

"I find that if I play in netball shoes, I feel like I have more stability dodging" (P5)

"I've played in running shoes before because I forgot my netball shoes, I was definitely more aware of my surroundings" (P3)

"I have played in running shoes before and I definitely felt like my ankles were going to roll, I didn't play my best game that day" (P8)

Participants spoke about the relationship between footwear and other interventions used to help prevent injury. For some this was a challenging experience resulting in discomfort, with others indicating that these interventions were needed to improve their overall comfort.

"I am wearing my ankle braces to protect my ankles and it is really uncomfortable, I think more and more players are wearing braces and you have a lot of bulk at the back of the shoe, Asics maybe need to look at this because they are the only ones who make netball shoes" (P3)

"I have used my orthotics in my netball shoes in the past, you know, it's definitely more comfortable" (P6)

Participants also shared views on the footwear selection of other players and links to injury. One participant advocated that better education is needed.

"One area of player safety would have to be going to the powers that be, it's education around people choosing their shoes. I think Asics brought out a high-ankle shoe and I know quite a few people really like that, had more of a basketball look, and would be great for people with ankle issues. I see people playing in all sorts of shoes – education could be done better" (P7)

"I have watched people play in all sorts of shoes and it's not a pretty sight, I am thankful that I can play with netball specific shoes because I don't think my ankles would be able to handle the flexibility in other shoes" (P9)

3.3 Footwear characteristics

Six participants underwent assessment of their footwear. Due to restrictions with COVID-19, the footwear of three participants were not able to be assessed.

3.3.1 Footwear fit

Most of the footwear that was measured appeared to be a good fit for the participants foot type, only one of the participant's footwear measured too narrow for their foot type (**Table 3**).

Table 3. Footwear fit

ID	Foot length (mm)	Thumb width (cm)	Fit of shoe (length)	Fit of shoe (width)	Fit of shoe (depth)
1	253	1.9	Good	Good	Good
2	265	2.6	Good	Too narrow	Good
3	257	2.4	Good	Good	Good
4	236	2	Good	Good	Good
5	240	2	Good	Good	Good
6	224	2.5	Good	Good	Good

3.3.2 General features

The general features of all footwear assessed is displayed **Table 4**. All footwear was over 12 months old, all with an outsole made from rubber, with the majority having a synthetic upper. In terms of weight, the heaviest footwear weighed 380g, which was also the longest in length measuring 305mm.

Table 4. General features

ID	Age of shoe	Style	Materials (upper)	Materials (outsole)	Mass (g)	Length (mm)
1	>12months	Athletic	Synthetic	Rubber	274	273
2	>12months	Athletic	Synthetic	Rubber	380	305
3	>12months	Athletic	Leather/ Synthetic	Rubber	371	276
4	>12months	Athletic	Synthetic	Rubber	252	241
5	>12months	Athletic	Synthetic	Rubber	366	270
6	>12months	Athletic	Synthetic	Rubber	276	266

3.3.3 General structure

Table 5 displays the general structure of the footwear. All footwear was remarkably similar, except for the heel heights of the shoes that show slight variations in the height. Most shoes consisted of a combination of fixation of the upper to the sole of the footwear.

Table 5. General structure

ID	Heel height (cm)	FF height (cm)	Longitudinal profile (cm)	Last (°)	Fixation of upper to sole	FF sole flexion point
1	0-2.5	0-0.9	>3.0	5.0-15.0	Combination	Level of MTPJ
2	>5.0	>2.0	1.0-3.0	5.0-15.0	Combination	Level of MTPJ
3	0-2.5	1.0-2.0	1.0-3.0	5.0-15.0	Combination	Distal to 1stMTPJ
4	2.6-5.0	>2.0	>3.0	5.0-15.0	Combination	Level of MTPJ
5	2.6-5.0	>2.0	1.0-3.0	<5	Slip-lasted	Distal to 1stMTPJ
6	0-2.5	0-.9	>3.0	5.0-15.0	Combination	Level of MTPJ

FF = forefoot; MTPJ = metatarsophalangeal joint

3.3.4 Motion control properties

The MSSS (Midfoot sole sagittal stability) torsional control property of all footwear were the same (**Table 6**), with all having laces as the method of fixation. There was a mixture of single and dual density midsoles, however, the total score of the motion control properties were relatively consistent (**Table 7**).

Table 6. Motion control properties

ID	Density	Fixation	Heel counter	MSSS	MSSS torsional
1	Dual	Laces (6)	Minimal (>45°)	Moderate (<45°)	Moderate (<45°)
2	Single	Laces (6)	Moderate (<45°)	Moderate (<45°)	Moderate (<45°)
3	Dual	Laces (7)	Minimal (>45°)	Moderate (<45°)	Moderate (<45°)
4	Single	Laces (6)	Moderate (<45°)	Moderate (<45°)	Moderate (<45°)
5	Dual	Laces (7)	Moderate (<45°)	Minimal (>45°)	Moderate (<45°)
6	Dual	Laces (6)	Minimal (>45°)	Moderate (<45°)	Moderate (<45°)

MSSS=Midfoot sole sagittal stability

Table 7. Motion control properties score

ID	Density	Fixation	Heel counter	MSSS	MSSS torsional	Total score
1	2	2	1	1	1	7
2	0	2	2	1	1	6
3	2	2	1	1	1	7
4	0	2	2	1	1	6
5	2	2	2	0	1	7
6	2	2	1	1	1	7

MSSS=Midfoot sole sagittal stability

3.3.5 Cushioning

There was a mixture of cushioning presence through the heel and foot, with a combination of cushioning recorded as soft or firm **(Table 8)**.

Table 8. Cushioning

ID	Presence	LMH	MMH	HSH
1	Heel/foot	Soft	Soft	Soft
2	Heel/foot	Firm	Firm	Firm
3	Heel/foot	Soft	Firm	Firm
4	Heel/foot	Soft	Soft	Soft
5	Heel	Soft	Soft	Soft
6	Heel/foot	Soft	Soft	Firm

LMH = Lateral midsole hardness; MMH = Medial midsole hardness; HSH = Heel sole hardness

3.3.6 Wear patterns

The majority of footwear had a textured tread, with wear most commonly observed on the lateral aspect of the outsole (**Table 9**). The midsole wear was consistent across all footwear assessed.

Table 9. Wear patterns

ID	Upper	Midsole	Tread	Outsole
1	Lateral tilt	Neutral	Textured	Lateral
2	Neutral	Neutral	Textured	Lateral
3	Medial tilt	Neutral	Textured	Lateral
4	Neutral	Neutral	Textured	Lateral
5	Medial tilt	Neutral	Textured	Medial
6	Lateral tilt	Neutral	Textured	Lateral

Chapter 4: Discussion

This is the first study to explore the perceptions of NZ (New Zealand) netball players surrounding their footwear choices. Three main themes were discovered and explored further, these included, (1) thoughts and experiences when purchasing footwear, (2) key features of footwear and (3) the effects of footwear on feet. The results from this study have shown that netballers wear netball-specific footwear that are appropriately fitted, yet they are still experiencing issues that they attribute mostly to their footwear. Participants expressed their frustration with the lack of choice available when purchasing netball footwear, often defaulting to trusting a brand of netball shoes.

The research uncovered numerous factors that contribute to the decision-making process when choosing netball footwear. Many of the participants found that the selection of shoes that were available often did not meet their requirements, attributing this to the limited range of netball footwear when compared to other sports such as running and football. These findings align with prior research conducted among male netball players (Kirk et al., 2023). Kirk et al. (2023) showed that female netball players face similar challenges as males in terms of footwear design, particularly related to the narrow width of netball-specific shoes and a scarcity of colour choices. Issues with inadequate footwear choice was linked to the elevated incidence of foot problems and pain reported by participants. Recent research has indicated that nearly two-thirds of netball players associate their footwear with foot problems (Kirk et al., 2022), indicating that pain is influenced by a broader set of factors impacting the adoption of netball- specific footwear. The association between footwear fit and foot pain was highlighted in this study with some participants reporting the need to remove their footwear after

playing due to experiencing pain. Contrary to this, some participants perceived their footwear as essential for preventing injuries, which aligns with biomechanical studies demonstrating that wearing netball-specific footwear reduces impact forces during netball-specific tasks (Sinclair et al., 2015).

Footwear affordability emerged as a significant barrier during the footwear buying process, aligning with findings from previous research (Kirk et al., 2023). Several participants expressed challenges in justifying the costs associated with netball-specific footwear, given its limited usage exclusively for the sport of netball. Some participants stated that they would buy their netball shoes at the end of the season as that is when they were discounted in price but then also limited their selection. Price point was a key factor in selecting footwear with participants often opting for the shoes on sale or last season's styles. Participants also perceived that the cost of a shoe is often suggestive of its superior technology, implying that a more expensive shoe is likely to contribute towards the player feeling safe and supported, therefor able to take more risks when playing..

Brand loyalty emerged as a significant factor influencing footwear decisions, driven by favorable first-hand experiences associated with specific brands. This finding represents a novel contribution to the field, as it has not been previously reported in the context of netball research. Similar patterns have been observed in studies focusing on runners, where footwear choices were influenced by past experiences and recommendations from trusted individuals (Ramsey et al., 2022). Previous survey data has indicated a growing trend towards brand loyalty among consumers (Hopper, 1986).

While the underlying reasons behind this phenomenon are unknown, it is plausible that these trends are attributed to a scarcity of brands offering netball-specific options in the market. Additionally, the perceived quality of athletic products has been recognised as a significant factor contributing to brand loyalty (Shezi & Redda, 2022). Positive brand associations, such as endorsements by professional athletes, have also been found to exert influence on brand loyalty. This was highlighted by participants as a reason for their footwear choice, particularly copying the footwear choices of international level players. The influence of athlete endorsement on brand loyalty regarding sporting equipment utilisation has been extensively documented (Kim et al., 2020). Consumers form brand-consumer relationships based on their perception of the endorsement source's credibility, which is influenced by the source's attractiveness and expertise. The consumer often associates a brand or product that is endorsed by an athlete (in this context the Silver Ferns) to be superior and has an impact that enables them to perform at the highest level (Kim et al., 2020). This observation suggests a potential association between the marketing strategies employed by brands and the promotion of netball-specific footwear.

Cushioning and motion control are desirable properties for netball (Sinclair et al., 2015), and this likely reflects the majority of footwear assessed in this study being netball-specific footwear. The good fit of the footwear assessed may be attributed to netball-specific footwear being available through speciality retailers, that typically offer a fitting process. Participants identified the importance of comfort and fit in footwear selection. This finding aligns with previous survey studies that have reported issues related to fit and comfort when wearing footwear for netball (Kirk et al., 2023; Kirk et

al., 2022). Comfort, being a subjective experience, poses challenges in terms of objective measurement (Miller et al., 2000). Hence, participants in this study often associated comfort with footwear fit, sometimes even using these terms interchangeably, likely due to the inherent difficulty in distinguishing between the two.

Within this study, the heel counter, upper, and outsole emerged as crucial design features influencing comfort. The heel counter specifically, was recognised for its role in enhancing the fit around the rearfoot and providing ankle support (McPoil, 2000). Participants expressed that they felt the greatest support in their shoes came from the heel counter, however, also acknowledged that if the heel counter was rigid, it could potentially contribute to issues such as blisters. The emphasis placed on the heel counter may be indicative of the performance requirements in netball, where ankle sprains and blisters are commonly reported injuries among players (Downs et al., 2021). Notably, shooters and defenders preferred a firmer heel counter, whereas midcourt players disliked the stiffness at the back of the shoe. The findings surrounding positional preference and the need for specific features was a novel finding of this research and emphasises the significance of selecting footwear that is appropriate for their specific playing position.

The upper component of footwear serves a crucial role in ensuring fit and stability during athletic activities (McPoil, 2000). The observed variation in preferences concerning the upper, including fit and construction materials, may be attributed to the individualised nature of preferences regarding footwear comfort and fit. Footwear with

a high top has often been associated with increased ankle support and subsequent reduced risk from ankle injury (Hume & Steele, 2000). However, only two participants commented on the limited availability in supply of high-top shoes. Most participants stating that they were comfortable with the low-cut variety due to the space needed for their ankle braces. In addition to the potential support from a high-top shoe the closure system also adds to the overall stability of the shoe. Participants commented on a variety of lacing techniques used to increase the feeling of stability, accommodate for their foot width and height, and adjust when their feet felt swollen. The advice given to NZ netball players with regards to lacing is to use the "lace lock" technique to increase ankle support and prevent heel slippage (Netsmart, 2023). Four of the participants indicated that they used the ankle lace lock, but only used it as they were told to by their physiotherapist or podiatrist.

Durability of the outsole of netball-specific footwear was highlighted as important by participants. The significance attributed to the outsole may be linked to its crucial role in delivering on court traction. (McPoil, 2000). This is clinically important as tripping and slipping are common mechanisms of injury in netball (Downs et al., 2021). These findings align with the reported advantages of netball-specific footwear in terms of injury prevention (Sinclair et al., 2015). Thus, emphasising the design and functionality of the outsole can contribute to improved safety and performance for netball players.

4.1 Methodological strengths and limitations

Strengths of this study included using an established qualitative research methodology and a reliable tool to assess footwear characteristics. This study has limitations. Data collection was undertaken during the Covid-19 pandemic. A small sample of participants were recruited from a specific location (North Shore, Auckland), meaning the findings may not be generalisable to other settings (such as rural settings or those from lower socio- economic backgrounds). All participants had a playing history of more than 20 years, meaning that the findings may not reflect the views of less experienced netball players.

4.2 Implications for clinical practice

The main findings from this study indicate that netball players experience difficulties when purchasing footwear for netball, so helping people to find suitable footwear should be a priority for people working with this population. Finding appropriate footwear may help to reduce the high prevalence of foot pain and foot problems seen in netball players (Kirk et al., 2023). Improved understanding of netball players perspectives of footwear design features and their relationship with comfort and fit may aid in the selection process of appropriate footwear. Podiatrists are well placed to help manage footwear and foot problems experienced by netball players.

4.3 Future directions

This study adds to the existing body of evidence including lab-based biomechanical studies, epidemiological and survey data regarding associations between footwear and injury in netball players. Prospective studies should look to investigate the effectiveness

of netball-specific footwear to reduced netball-related injuries. Despite good uptake of netball-specific footwear, foot problems are common. Footwear manufacturers should look to integrate the perspectives of netball players into the design of netball-specific footwear. Although most of the footwear being identified as fitting well, foot problems were commonly reported. This suggests that traditional methods of quantifying fit may not be appropriate for meeting the needs to netball players.

Chapter 5: Conclusion

Appropriate footwear is commonly recommended as part of injury prevention programmes for netball players. Despite this, there is limited evidence regarding netball player's understanding of what features are important and the rationale behind wearing netball shoes. The aims of this work were to determine netball players perceptions surrounding netball-specific footwear, and to determine the characteristics of footwear worn by netball players, using a mixed methods design.

Semi-structured interviews were used to explore the thoughts and perceptions of the footwear worn by netball players. When purchasing footwear, the importance of finding footwear that was fit for purpose was evident, with brand loyalty a key driver in participant's decision-making. Limited selection and the high costs associated with netball-specific footwear presented challenges for participants when trying to find suitable footwear. Comfort was identified as being highly important and linked to the construction of footwear. Despite this, footwear was also identified as a cause of foot pain and foot problems. Some participants described netball-specific footwear as being critical for performance, safety, and injury prevention. Objective assessment of footwear revealed that participants wore netball-specific footwear that was well-fitted. These findings demonstrate diversity in footwear experiences of netball players and the impact of footwear on foot health.

The findings of this study are clinically important, suggesting that netball players encounter numerous challenges when try to find appropriate footwear for netball. Health

care professionals working with netball players should consider these findings when making footwear recommendations. Manufacturers of netball-specific footwear should also consider incorporating players' perceptions and preferences when designing footwear, to ensure that these meet the needs and expectations of netball players. Further work should look to investigate the relationship between netball-specific footwear and injury prevention.

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APPENDIX 1

Auckland University of Technology Ethics Committee (AUTEC)

Auckland University of Technology
D-88, Private Bag 92006, Auckland 1142, NZ
T: +64 9 921 9999 ext. 8316
E: ethics@aut.ac.nz
www.aut.ac.nz/researchethics

4 November 2020

Michael Frecklington
Faculty of Health and Environmental Sciences

Dear Michael

Re Ethics Application: **20/329 What are the perceptions of footwear characteristics amongst netball players**

Thank you for providing evidence as requested, which satisfies the points raised by the Auckland University of Technology Ethics Committee (AUTEC).

Your ethics application has been approved for three years until 4 November 2023.

Standard Conditions of Approval

1. The research is to be undertaken in accordance with the Auckland University of Technology Code of Conduct for Research and as approved by AUTEC in this application.
2. A progress report is due annually on the anniversary of the approval date, using the EA2 form.
3. A final report is due at the expiration of the approval period, or, upon completion of project, using the EA3 form.
4. Any amendments to the project must be approved by AUTEC prior to being implemented. Amendments can be requested using the EA2 form.
5. Any serious or unexpected adverse events must be reported to AUTEC Secretariat as a matter of priority.
6. Any unforeseen events that might affect continued ethical acceptability of the project should also be reported to the AUTEC Secretariat as a matter of priority.
7. It is your responsibility to ensure that the spelling and grammar of documents being provided to participants or external organisations is of a high standard and that all the dates on the documents are updated.

AUTEC grants ethical approval only. You are responsible for obtaining management approval for access for your research from any institution or organisation at which your research is being conducted and you need to meet all ethical, legal, public health, and locality obligations or requirements for the jurisdictions in which the research is being undertaken.

Please quote the application number and title on all future correspondence related to this project.

For any enquiries please contact ethics@aut.ac.nz. The forms mentioned above are available online through http://www.aut.ac.nz/research/researchethics

(This is a computer-generated letter for which no signature is required)

The AUTEC Secretariat
Auckland University of Technology Ethics Committee

Cc: Megan.catterall@aut.ac.nz

Participant Information Sheet

Date Information Sheet Produced:

14 06 2020

Project Title

What are the perceptions of footwear characteristics amongst netballers?

An Invitation

Kia Ora, my name is Megan Catterall and I am currently undertaking a research study at AUT as part of a Master of Philosophy qualification. I have a passion for netball, and I am interested in discovering how footwear can play a role in reducing injury and improving performance. Suitable footwear is strongly recommended by several injury prevention programmes specific to netball. However, I would like to explore what you consider to be important characteristics when selecting your netball shoes. I would like to invite you to participate in my research study.

What is the purpose of this research?

Lower limb injuries are a common and costly occurrence for netball players. Footwear may be employed as a strategy to help reduce injury whilst playing netball, due to design features of the netball shoes. Despite the observations from lab-based studies, there is limited evidence surrounding the shoes that netballers choose to wear whilst playing. Gaining insight into the factors influencing footwear selection in netball players may help to improve the understanding of its role in the prevention of netball-related injuries. The aim of the research is to explore the perceptions of footwear characteristics in netballers. This research is contributing to a Master of Philosophy qualification and the findings of this research may be used for academic publications and presentations.

How was I identified and why am I being invited to participate in this research?

To understand the perceptions of footwear characteristics amongst netballers, I am inviting volunteers from netball clubs, who currently play at Netball North Harbour. You are invited to participate if you are over the age of 18 and are currently playing netball.

How do I agree to participate in this research?

Your participation in this research is voluntary (it is your choice) and whether or not you choose to participate will neither advantage nor disadvantage you. You are able to withdraw from the study at any time. If you choose to withdraw from the study, then you will be offered the choice between having any data that is identifiable as belonging to you removed or allowing it to continue to be used. However, once the findings have been produced, removal of your data may not be possible.

What will happen in this research?

You will be involved in looking at your footwear and answering some questions. This will be done in an interview format and these will be audio recorded

What are the discomforts and risks?

There will be minimal discomfort and/or risks, you may withdraw from the research at anytime.

How will these discomforts and risks be alleviated?

AUT Health Counselling and Wellbeing is able to offer three free sessions of confidential counselling support for adult participants in an AUT research project. These sessions are only available for issues that have arisen directly as a result of participation in the research and are not for other general counselling needs. To access these services, you will need to:

- drop into our centres at WB219 or AS104 or phone 921 9992 City Campus or 921 9998 North Shore campus to make an appointment. Appointments for South Campus can be made by calling 921 9992
- let the receptionist know that you are a research participant, and provide the title of my research and my name and contact details as given in this Information Sheet

You can find out more information about AUT counsellors and counselling on http://www.aut.ac.nz/being-a-student/current-postgraduates/your-health-and-wellbeing/counselling.

What are the benefits?

Your answers will assist in identifying some of the key characteristics that are important to netballers.

How will my privacy be protected?

Your name, birthdate and any personal information that could identify you as an individual will not be used in this study or published in any medium. All of the information you provide will be treated as confidential and strict access will only be available to the researcher or yourself upon request.

What are the costs of participating in this research?

Participation in this research will cost you 1 hour of your time

What opportunity do I have to consider this invitation?

You will have 1 month to decide whether or not you would like to accept this invitation. If you decide to participate, I will arrange an appointment time with you.

Will I receive feedback on the results of this research?

If you are interested in the results of this research, please indicate on the applicable section of the consent form. The results will be sent to you in the form of a written summary and any papers that may be published as a result of this study can be accessed upon request.

What do I do if I have concerns about this research?

Any concerns regarding the nature of this project should be notified in the first instance to the Project Supervisor, *Dr Mike Frecklington, mike.frecklington@aut.ac.nz, (09) 921 9999 ext 7832.*

Concerns regarding the conduct of the research should be notified to the Executive Secretary of AUTEC, *ethics@aut.ac.nz* , (+649) 921 9999 ext 6038.

Whom do I contact for further information about this research?

Please keep this Information Sheet and a copy of the Consent Form for your future reference. You are also able to contact the research team as follows:

Researcher Contact Details:

Megan Catterall

Email: megan.catterall@aut.ac.nz

Project Supervisor Contact Details:

Dr Mike Frecklington

Email: mike.frecklington@aut.ac.nz

Approved by the Auckland University of Technology Ethics Committee on *type the date final ethics approval was granted*, AUTEC Reference number *type the reference number*.

AUT
TE WĀNANGA ARONUI O TĀMAKI MAKAU RAU

Consent Form

Project title: *What are the perceptions of footwear characteristics amongst netballers?*

Project Supervisor: *Dr Michael Frecklington*

Researcher: *Megan Cattera/1*

0 I have read and understood the information provided about this research project in the Information Sheet dated 23/07/2020

0 I have had an opportunity to ask questions and to have them answered.

0 I understand that notes will be taken during the interviews and that they will also be audio-taped and transcribed.

0 I understand that taking part in this study is voluntary (my choice} and that I may withdraw from the study at any time without being disadvantaged in any way.

0 I understand that if I withdraw from the study then I will be offered the choice between having any data that is identifiable as belonging to me removed or allowing it to continue to be used. However, once the findings have been produced, removal of my data may not be possible.

0 I agree to take part in this research.

0 I wish to receive a summary of the research findings (please tick one}: YesO NoO

Participant's signature:

Participant's name:

Participant's Contact Details (if appropriate}:

Date:

Approved by the Auckland University of Technology Ethics Committee on *type the date on which the final approval was granted* ***AUTEC Reference number*** *type the AUTEC reference number*

We are seeking volunteers!!

We are seeking netball players over the age of 20 to participate in a research study to find out the perceptions of footwear characteristics amongst netball players

To participate in the study, you must:

- Be over the age of 20 years old
- Play netball at Netball North Harbour
- Wear shoes when playing netball

Participation in this study will involve attending a 60min single visit at Akoranga Integrated Health. At this visit you will:

- Participate in a discussion about your footwear
- Have your footwear assessed

To obtain more information about this study please contact Megan Catterall at megan.catterall@aut.ac.nz

Approved by the Auckland University of Technology Ethics Committee on xxxx, AUTEC Reference number xxxxx

APPENDIX 5

What are the perceptions of footwear characteristics amongst netballers?

Eligibility Criteria	
Meets the inclusion criteria	Y/N
Sent Participation information sheet and consent form	Y/N
Opportunity to ask questions	Y/N
Signed written consent form	Y/N

Date
Study Number
Age (DOB)
Ethnicity
Years playing netball
Current level played (grade)
Position (s) played
Current footwear for netball
Previous injuries

What are the perceptions of footwear characteristics amongst netballers?

1. Opening question (with additional prompts/probes)
   1.1. What shoes do you wear for netball?
   (invite participant to bring out their netball shoes to aid in discussion)

2. Trigger questions (with additional prompts/probes)
   2.1. What are your thoughts about footwear?
   2.2. What are the most important things you look for in footwear?
   2.3. What thoughts do you have about the footwear currently available to you?
   2.4. What barriers have you experienced related to footwear?
   2.5. What effect has footwear had on your feet?
   2.6. What impact has footwear had on your ability to do the things you wanted to do?

3. Participant driven questions/topics.
   3.1. Any other points that the participant wishes to raise and/or discuss.

4. Conclusion of interview
   Check with participant that you have collected the right information by summarizing what has been said.

Do not lead the questions.

Tell me more about……

Let us expand on……

Breakdown of features

Have you ever considered?

- Grip
- Upper
- Cushioning
- Heel Counter
- Lacing

APPENDIX 6

Appendix 1: FOOTWEAR ASSESSMENT TOOL

1. FIT

Foot length ☐ ***Thumb width*** ☐

Fit of shoe (length) – rule of thumb (wearer's thumb)

Palpation:	good ☐	too short (< ½ thumb) ☐	too long (> 1 ½) ☐
Straw =	good ☐	too short (< ½ thumb) ☐	too long (> 1 ½) ☐

Fit of shoe (width) – grasp test	good ☐	too narrow ☐	too wide ☐
Fit of shoe (depth)	good ☐	too shallow ☐	

2. GENERAL

Age of shoe 0 – 6 months ☐ 6 – 12 months ☐ > 12 months ☐

Footwear style

walking shoe ☐	athletic shoe ☐	oxford shoe ☐	moccasin ☐
boot ☐	ugg-boot ☐	high heel ☐	Thong/flip-flop ☐
slipper ☐	backless slipper ☐	court shoe ☐	mule ☐
sandal ☐	surgical/bespoke ☐	other (specify)	

Materials (upper)	leather ☐	synthetic ☐	mesh ☐	other	
Materials (outsole	rubber ☐	plastic ☐	leather ☐	other	

Weight ☐ ***Length*** ☐ ***Weight/length*** ☐

3. GENERAL STRUCTURE

Heel height =

0 – 2.5 cm ☐ 2.6 – 5.0 cm ☐ > 5.0 cm ☐

Forefoot height (measured at point of the 1st and MTPJs) =

0 – 0.9 cm ☐ 1.0 – 2.0 cm ☐ > 2.0 cm ☐

Longitudinal profile (heel – forefoot difference) =

flat (0 – 0.9 cm) ☐ small heel rise (1 – 3 cm) ☐ large heel rise (> 3 cm) ☐

Last (centre goniometer at 50% shoe length) =

straight (< 5°) ☐ semi-curved (5 – 15°) ☐ curved (> 15°) ☐

Fixation of upper to sole

board ☐ combination ☐ slip-lasted ☐

Forefoot sole flexion point

at level of MTPJs ☐ proximal to 1st MTPJ ☐ distal to 1st MTPJ ☐

4. MOTION CONTROL PROPERTIES

Density single ☐ dual ☐

Fixation none ☐ laces ☐ straps/buckles ☐ Velcro ☐ zips ☐
Number of eyelets ☐

Heel counter stiffness (20mm above bottom or upper)

no heel counter ☐ minimal (> 45°) ☐ moderate (< 45°) ☐ rigid (0-10°) ☐

Midfoot sole sagittal stability

minimal (> 45°) ☐ moderate (< 45°) ☐ rigid (0-10°) ☐

Midfoot sole frontal stability (torsional)

minimal (> 45°) ☐ moderate (< 45°) ☐ rigid (0-10°) ☐

5. CUSHIONING

Presence none ☐ heel ☐ heel/forefoot ☐

Lateral Midsole hardness	soft		firm		hard		
Durometer readings	1st		2nd		3rd		mean	
Medial Midsole hardness	soft		firm		hard		
Durometer readings	1st		2nd		3rd		mean	
Heel sole hardness (centre of inside heel shoe interface)	soft		firm		hard		
Durometer readings	1st		2nd		3rd		mean	

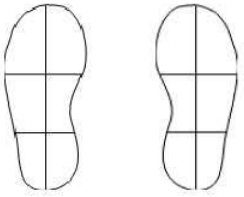
6. WEAR PATTERNS

Upper medial tilt (> 10°) ☐ neutral ☐ lateral tilt (> 10°) ☐

Midsole medial compression signs ☐ neutral ☐ lateral compression signs ☐

Tread pattern ***A*** textured ☐ smooth (i.e. no pattern) ☐
B not worn ☐ partly worn ☐ fully worn ☐

Outsole wear pattern none ☐ normal ☐ lateral ☐ medial ☐

R  L

Confidentiality Agreement

For someone transcribing data, e.g. audio-tapes of interviews.

Project title: *What are the perceptions of footwear characteristics amongst netball players?*

Project Supervisor: ***Mike Frecklington***

Researcher: ***Megan Catterall***

- ○ I understand that all the material I will be asked to transcribe is confidential.
- ○ I understand that the contents of the tapes or recordings can only be discussed with the researchers.
- ○ I will not keep any copies of the transcripts nor allow third parties access to them.

Transcriber's signature: ……

Transcriber's name: ……

Transcriber's Contact Details (if appropriate):

……

……

……

……

Date: 24 July 2021

Project Supervisor's Contact Details (if appropriate):

……

……

……

……

Approved by the Auckland University of Technology Ethics Committee on 4th November 2020 AUTEC Reference number 20/329

Note: The Transcriber should retain a copy of this form.