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Original research

The influence of joint hypermobility on functional movement control in an elite netball population: A preliminary cohort study

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ABSTRACT

Objectives: To ascertain the prevalence of General Joint Hypermobility (GJH) and Joint Hypermobility Syndrome (JHS) in elite level netballers. To investigate whether GJH influences functional movement control and explore whether symptoms of dysautonomia are reported in this population.
Design: Observational within-subject cross-sectional design.
Setting: Field based study.
Participants: 27 elite level netballers (14–26 years).
Main outcome measures: GJH and JHS were assessed using the Beighton scale, 5 point questionnaire and the Brighton Criteria. Functional movement control was measured using posturography on a force platform and the Star Excursion Balance Test (SEBT).
Results: The prevalence of GJH was 63% ($n = 17$) (Beighton score ≥4/9) and JHS was 15% ($n = 4$). Symptoms of dysautonomia were minimally prevalent. A trend was observed in which participants with GJH demonstrated increased postural instability on the functional tests. Following Bonferroni adjustment, this was statistically significant only when comparing posturographic data between the distinctly hypermobile participants and the rest of the group for path area ($p = 0.002$) and velocity ($p = 0.002$) on the left side.
Conclusions: A high prevalence of GJH was observed. A trend towards impairment of functional movement control was observed in the netballers with GJH. This observation did not reach statistical significance except for posturographic path area and velocity.

1. Introduction

The prevalence of General Joint Hypermobility (GJH) differs between different sporting populations but appears to be higher than in the general population (Russek, 1999; Simmonds & Keer, 2007). Joint hypermobility is often considered an asset in sports for which performance requires a high degree of flexibility (Gannon & Bird, 1999), with estimates as high as 90% in ballet dancers (McCormack, Briggs, Hakim, & Grahame, 2004) and 66% in dance students (Scheper et al., 2013). Research has reported estimates between 33 and 42% in professional football (Collinge & Simmonds, 2009; Konopinski, Jones, & Johnson, 2012) and 24% in amateur rugby (Stewart & Burden, 2004). One previous study has investigated GJH in netball (Smith, Damodaran, Swaminathan, Campbell, & Barnsley, 2005). This involved 200 children (6–16 years), of which 40% were reported as distinctly hypermobile (Beighton score 5–9/9) and a further 26% as moderately hypermobile (Beighton score 3–4/9).

There is a paucity of epidemiological data for Joint Hypermobility Syndrome (JHS) in sport. In a group of ballet dancers, 38% were reported to have JHS (McCormack et al., 2004).

It has been suggested that a degree of autonomic neuropathy may afflict the cardiovascular system in people with joint hypermobility (Bird, 2011; Hakim & Grahame, 2004). Reported symptoms include dizziness, syncope, palpitations, temperature dysregulation and fatigue (Gazit, Nahir, Grahame, & Jacob, 2003;

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Kanjwal, Saeed, Karabin, Kanjwal, & Grubb, 2010). Studies of patients with JHS in rheumatology clinics have reported a high occurrence of orthostatic symptoms (Gazit et al., 2003; Hakim & Grahame, 2004). Potential explanations for this include increased vascular distensibility, weakened vascular tissue elasticity, impaired central sympathetic control and deconditioning secondary to inactivity (Grubb, 2008; Hakim & Grahame, 2004; Kanjwal et al., 2010). It is currently unknown whether deconditioning is a causative or secondary factor in dysautonomia, therefore it is of interest to explore whether symptoms of dysautonomia are prevalent in a sporting population.

People with hypermobility are anecdotally observed to incur recurrent injuries such as joint dislocations, tendinopathies and ligament ruptures (Keer, 2003; Russek, 1999; Simpson, 2006). Whilst this is a common clinical observation, research evidence is inconsistent. Prospective studies have found no additional risk of injury in hypermobile individuals in professional football (Collinge & Simmonds, 2009), lacrosse (Decoster, Bernier, Lindsay, & Vailas, 1999) or collegiate athletes (Krivickas & Feinberg, 1996). An increased absence from sport following injury was observed in hypermobile dancers (Briggs, McCormack, Hakim, & Grahame, 2009) and footballers (Collinge & Simmonds, 2009). Conflicting evidence concluded hypermobile athletes have a significantly higher risk of injury in an ensuing study in professional football (Konopinski et al., 2012), amateur rugby (Stewart & Burden, 2004), female football (Söderman, Alfredson, Pietilä, & Werner, 2001) and netball (Smith et al., 2005). A recent well designed systematic review with stringent inclusion criteria and meta-analysis concluded that hypermobile individuals have an increased risk of injury of the knee during contact sports, but not the ankle (Pacey, Nicholson, Adams, Munn, & Munns, 2010).

It has been hypothesised that impaired proprioception and neuromuscular control may contribute towards an increased risk of injury in hypermobile individuals (Ferrell et al., 2004; Rombaut, De Paepe, Malfait, Cools, & Calders, 2010). Whilst it is widely accepted that hypermobility may compromise static collagenous components of joint stability such as ligaments and joint capsule, it is now thought that dynamic components, controlled by the central and peripheral nervous system, may also be affected (Bird, 2011; Ferrell, Tennant, Baxendale, Kusel, & Sturrock, 2007).

Research has demonstrated impaired proprioception at the knee joint in people with hypermobility compared to matched controls in both adults (Hall, Ferrell, Sturrock, Hamblen, & Baxendale, 1995; Rombaut et al., 2010), and children (Fatoye, Palmer, Macmillan, Rowe, & van der Linden, 2009). Previous research found that 22 participants with Ehlers Danlos Syndrome (EDS) had significantly impaired postural control and increased dependency on visual information compared to age matched controls when investigating displacement of centre of pressure (COP) on a force platform in a variety of standing conditions (Rombaut et al., 2011). Similar results were replicated in a subsequent study (Galli et al., 2011).

The applicability to an elite athletic population has limitations as these studies involved older participants with high levels of impairment. A programme of closed kinetic chain exercise has been demonstrated to improve proprioception, balance and musculoskeletal reflex function in hypermobile individuals (Ferrell et al., 2004, 2007; Sahin et al., 2008). It is therefore of interest whether impairments persist in well-conditioned hypermobile athletes.

1.1. Study objectives

- To ascertain the prevalence of GJH and JHS in an elite netball squad.
- To compare performance in a series of functional tests of movement control between participants with and without GJH.
- To critically appraise the current criteria for defining GJH and JHS in a sporting population.
- To explore whether symptoms of dysautonomia are reported in this population.

2. Methods

27 elite level netball players (age 14–26 years, mean 19.3) were recruited from a UK superleague franchise. It was specified that the participant must be a minimum of 14 years old, national or international standard, have had a minimum of 3 years netball experience and understand English. Injured players (who were not fit to participate in full training or match play) were excluded as they would be unable to safely complete the testing protocol.

All testing was completed before training, ensuring that the participant had not exercised for at least 12 h prior. This was important as activity is thought to affect tissue viscoelastic properties and fatigue is known to influence functional movement control (Fox, Mihalik, Blackburn, Battaglini, & Guskiewicz, 2008; Gribble, Robinson, Hertel, & Denegar, 2009; Springer & Pincivero, 2009). The start leg was pre-randomised for all tests. Testing was completed by the lead researcher, who is well practiced in all testing methods.

A self-reported questionnaire was completed to record basic demographic information such as age, netball experience, playing position, ethnicity, participation in other sports and injury history. The 5 point questionnaire was integrated into the self-reported questionnaire as an additional screen for hypermobility (Hakim & Grahame, 2003a). A series of questions exploring the athlete's experience of dysautonomic symptoms was also included. These were developed in conjunction with a paediatrician with an interest in hypermobility. To the researcher's knowledge, no standardised method for self-reporting of dysautonomia is available. The presence, location and severity of musculoskeletal pain was recorded using a body chart and the Visual Analogue Scale (VAS) (Burckhardt & Jones, 2003). Participants in pain were not excluded from the study as pain is known to be a common feature in joint hypermobility (Murray, 2006).

Height was measured with the participant standing with their feet together and back against the wall. Arm span was measured between the most distal points of the third fingers with the arms supinated and outstretched horizontally against the wall (standardised with a spirit level). Leg length was measured in supine from the anterior inferior iliac spine to the medial malleolus following standardisation of the pelvic position (Plisky, Rauh, Kaminski, & Underwood, 2006).

2.1. Screening for hypermobility

The Beighton score (Beighton, Soloman, & Soskolne, 1973) is a screening tool for GJH which assesses range of motion of the elbows, knees, thumbs, 5th fingers and lumbar spine (Fig. 1). Joint range of motion was measured passively with a goniometer. The Brighton criteria (Grahame, Bird, & Child, 2000) was used to assess for JHS. The Brighton criteria is yet to be validated in children under 16, but remains the best available tool (Grahame et al., 2000; McCormack et al., 2004). Previously published standardised protocols were followed (Boyle, Witt, & Rieger-Krugh, 2003; Juul-Kristensen, Røgind, Jensen, & Remvig, 2007).

2.2. Single leg stand and posturography

The participant stood on the force plate (ICS balance platform 400 mm × 400 mm x 42 mm, Otometrics, Denmark) without shoes, with their feet on the marked area on the platform and their arms folded across the chest. They were asked to move onto one leg by