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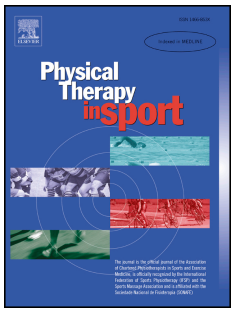

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Perceptions of low back pain in elite gymnastics: a multi-disciplinary qualitative focus group study

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Title

Perceptions of low back pain in elite gymnastics: a multi-disciplinary qualitative focus group study

ABSTRACT

Objectives

To explore the multidisciplinary team experience of Low Back Pain (LBP) in elite gymnastics.

Design

A qualitative focus group.

Setting

British Gymnastics.

Participants

Ten coaching, sports science and medicine multidisciplinary team members working with British gymnasts.

Main outcome measures

A topic guide informed by literature/expert opinion enabled discussion that was recorded/transcribed verbatim. Initial inductive analytic process developed theoretical insights. Manual coding using constant comparative methods categorised meaningful themes and sub-themes.

Results

Two key aspects were identified. Emerging themes for **LBP presentation** included: early identification LBP and influence of multidisciplinary team members on outcomes, factors influencing LBP reporting e.g. coach-athlete relationship; frequent

presentations of LBP and accepted norms; athlete history and physical examination e.g. training load. Emerging themes for **causation of LBP** included: intrinsic risk factors e.g. growth and maturation; extrinsic risk factors e.g. equipment.

Conclusions

Individual responses of a gymnast to experiencing LBP were important across all themes. Some LBP was perceived as normal. The coach-athlete relationship and support team are crucial decision-makers around training load and adaptation. Early detection will help minimise time loss from training/performance to expedite healing.

Key words

Low back pain, elite gymnastics, multi-disciplinary, focus group, qualitative

INTRODUCTION

Prevalence of Low Back Pain (LBP) in the athletic population has high estimates of 30-50% [1,2] contributing 30% of total reported injuries.[3] Higher rates are documented in sports requiring extreme ranges of spinal movement such as gymnastics with prevalence estimates of 25-85%,[4,5,6,7] depending upon definitions used and populations investigated. Gymnastic routines are complex, with repetitive directional movements placing stress on the spine.[8,9,10,11]

In the adult population disc pathology and degenerative changes are predominantly associated with LBP, whereas athletic populations are more predisposed to posterior element derangement, including spondylolysis and spondylolisthesis.[12] being the most common cause of LBP in adolescents.[13] Specifically, repeated hyper-extension and rotation forces predispose gymnasts to spondylolysis or spondylolisthesis with prevalence of 13.9% and 47.5% respectively.[14,15] This contrasts with rates in asymptomatic non-athletic populations of 6-11.5% of spondylolysis that can progress to spondylolisthesis.[16]

Understanding the early onset and detection of LBP will inform athlete examination and decision making regarding precision management, recovery time and optimisation of outcomes.[3,17] Early detection of spondylolysis is associated with higher healing rates.[18,19,20,] Knowledge of gymnast specific factors would inform clinical reasoning using history taking and physical examination,[21] with evidence supporting accurate diagnosis from patient history data in 76% outpatient cases and

physical examination in just 12%.[22] One recent rigorous systematic review concluded that no patient history or physical examination data currently has the diagnostic utility to confidently identify spondylolysis or spondylolisthesis in athletes.[23]

The experience of the multidisciplinary team (MDT) in managing LBP in the elite sport population is unknown, with existing research focused on the experiences of athletes with LBP.[24] Additional knowledge for MDT teams (including coaching, sports science and medicine staff) could improve early identification and management of LBP with the goal of improving athlete performance and health.

Objective

To explore the MDT experiences of LBP in elite gymnastics to inform precision management.

METHODS

Design

A qualitative exploratory focus group was designed and is reported according to the Consolidated Criteria for Reporting Qualitative Research (COREQ).[25] This design enabled exploration of the MDT's perceptions in their own surroundings to understand the presentation of LBP from the "gymnastics world" themselves. The design actively sought any variation in perceptions to enable full understanding of the phenomenon.[26] By inviting a variety of professionals to participate, interactions and connections could be made [27,28] so that perception, perspective and interpretation could enable development of patterns or theories around the presentation of LBP in gymnastics.

Research team and reflexivity

The focus group was facilitated by an experienced researcher in musculoskeletal rehabilitation (XX) to ensure all perspectives were considered.[29] The observer (XX) recorded field notes[30] to document group dynamics, verbal and non-verbal communication.[31] Emerging themes and outcomes were documented and displayed during the focus group to promote further reflection and discussion.

Theoretical framework

Underpinned by phenomenology[32] the "lived experience" of participants yielded exclusive understanding and meaning allowing the opportunity to debate, discuss and explore participants' experiences. Researchers were fully immersed to explore any pre-conceived beliefs or opinions whilst remaining open to how participants constructed meaning from their experiences. The common thread of "gymnastics" enabled application to occurrences in their daily lives.[28,33]

Participant selection

Purposive sampling drew on those with expertise in gymnastics and across the MDT to achieve depth, diversity and a rich discussion.[34] Specific and broad overviews of the topic areas were discussed;[30,35,36] minimising sampling bias. Twelve MDT members (comprising coaching, physiotherapy, medicine, strength and conditioning, psychology, nutrition and performance lifestyle disciplines) were invited to participate by email, being specifically drawn together for this research; [27] as they were all working to support elite gymnasts preparing for the 2020 Olympic Games with a minimum of two years' experience within their roles. Ten members of the MDT consented to participate.

Data collection

The topic guide (Supplementary file 1) consisted of open questions. In the absence of existing evidence, questions were broad focussing on presentation of LBP in gymnasts, exploration of athlete history and physical examination, and experience of spinal pathologies. Informed consent was gained from all participants at the start of

the focus group, and the rights of participants were protected throughout. The group lasting 3 hours was audio taped and transcribed verbatim. Respondent validation and further comments were invited.

Patient and Public Involvement

It was not appropriate or possible to involve patients or the public in this work.

FIGURE 1: Data analysis process

RESULTS

Participants

Ten MDT members participated (4 females, aged 25-65 years) comprising coaching, physiotherapy, medicine, strength and conditioning, psychology, nutrition and performance lifestyle disciplines. Three participants additionally contributed personal experiences of being an elite gymnast.

Presentation of LBP in gymnasts

TABLE 1 details the themes and subthemes focused to the presentation of LBP in gymnastics.

Theme	Subtheme
Early identification of LBP	Decision making of the coach Different coaches' abilities and approaches The sports science and medicine team perspective
Factors influencing pain reporting	Age of the gymnast Psychological factors Psychosocial factors

	The coach-athlete relationship
Frequent presentations of LBP in gymnasts	Gymnasts individual response What is normal in gymnastics Lumbar spine pathologies in elite artistic gymnastics
Athlete history examination	Present condition (Pain location, severity and behaviours/ Neurological signs and symptoms/Red flags assessment) History of present condition/Current and previous training load/Recent changes to skills, apparatus or surface/Mechanism of injury) Past medical history (Previous treatment/investigations and effects)
	Growth Sleep issues Recent travel Menstrual cycle status Medication
Athlete physical examination	Observation (Posture, demeanour or training session skills)
	Movement assessment (Active range of movement pattern and quality) Profiling data and body composition

Early identification of LBP

Early identification was viewed as the coach's role.

P10 "the coaching eye is key in perhaps in observing a change in skill technique"

The coach's varying abilities and approaches would affect their decision-making.

P3 "The less experienced coach has to go through certain situations and some pick up on them and make the changes and some will never see it"

Some of the medical team welcomed early identification but acknowledged that their response could heighten gymnast anxiety by raising awareness of LBP to the wider team for something that may require minimal, if any intervention:

P11 "we can heighten it (LBP) even just by all trying to do the best job we can make the gymnast feel that it becomes a systemic thing…. then as a system how are we responding or talking about injury to them because that naturally has a psychology to it?"

It was agreed that an individual gymnast would need varying levels of information from the medical team and this would be critical in minimising their stress and/or emotional response.

Factors influencing pain reporting

Age was a prominent sub-theme that could influence reporting and affect early identification of pathology. Older gymnasts were perceived as more likely to report and understand their symptoms. For younger gymnasts, coaches commonly make decisions to stop/continue training. One coach argued that if changing skills did not improve LBP they would stop training, irrespective of age.

> *P10 "I think with the older ones might say they are happy to continue (with training), whereas the younger ones, you might take decision out of their hands and actually say I want you to have a few days off."*

Psychological aspects including gymnast anxiety around impending competition/selection could influence reporting of LBP. Competition outcomes also impacted pain reactions.

> *P3 "Some still perform the skills perfectly but their pain level is very high, that's the problem, they can still do it and you don't see the pain and they don't talk about the pain but if you did examine them and talk to them in depth*

they might go well this pain is level 8 but I am still performing at this level - that's a scary moment"

A gymnast's competitive experience was thought to influence coping strategies to report or compete with pain, with gymnast experiences of pain catastrophizing and team selection affecting pain coping behaviors.

P11 "It will come down probably to the individual gymnast and whether they perceive it as a pain and they can manage, or do they actually think they are at risk and does then the pain get heighted through the anxiety?"

Psychosocial factors affected pain reporting.

P6 "That's just not career context. Its family context, other stresses in life context."

The coach-athlete relationship in knowing the gymnast and understanding context affected reporting.

P2 "I suspect there is probably a delay in reporting either through the athlete to the coach or from the coach to a physio in terms of what the consequence of reporting might be, taking them out of training or further examination and things and I think that the coaches often hinder the process."

Frequent presentations of LBP

A gymnast has an individual response to LBP and owing to extreme postures some symptoms should be expected; recognizing that some gymnasts would not report LBP at onset.

> *P9 "gymnasts don't always report when they've got a pain because you have a lot of niggles and if you are constantly telling your coach that something is hurting, for every little pain, but actually back pain might be low reporting but it might be higher because the gymnasts don't always say, and it can get to the point when actually it is an injury and that's when they say.."*

The coaches would adapt training depending on the presentation. Language associated with "pain" created greater concern, but the coaches agreed that if pain resolved quickly they would be less concerned. Remarkably, they identified acceptable levels of pain due to intensive levels of training but concluded that persistent pain into the next training session was not acceptable, and if pathology developed this would then limit the gymnasts' ability to train.

> *P6 "When does back pain become pathological back pain in terms of when do you choose to see a medical professional about it versus I wake and my*

back's stiff or I've done a training session and my back's sore, what's an injury and what's pain?"

If symptoms were reported early, physiotherapy assessment was key to assisting training load management. The coach-athlete relationship would provide context to understand the gymnast's behavior. Some coaches would seek medical team support to assist decision-making depending on their own skills/experience. The medical team agreed that diagnosing LBP in gymnastics was challenging with complex presentations of "neural arch, facet, pars and disc pain" and evidence of repetitive biomechanical stresses negatively affecting different anatomical structures leading to pain.

P5 "I think it's end range biomechanical postures repetitively under high loads, probably seem to be a precursor as opposed to high loading in neutral postures".

Discussion arose around the challenges of investigating LBP with MRI imaging.

P6 "the debate is whether pathology causes pain because if you scan normal people they have pathology"

Athlete history examination

The medical team would tailor the physical examination according to the patient history, which is common practice amongst musculoskeletal physiotherapists.[42] Areas to consider included pain location, severity, irritability and behaviour of symptoms. Age and growth stage were explored along with the sports specific context.

> *P5. "You have got athlete history which is gained acutely and then you have got a much broader wider context which is usually known that is applied to the history. If you didn't understand the context, the history in isolation it becomes harder to unpick, causality etc."*

Areas to be evaluated were neurological signs and symptoms, red flag assessment, sleep issues, menstrual cycle status, recent travel and medication; with the gymnast and coach adding valuable contextual insight. Within the 'history of present condition' the mechanism of injury, treatment effects or interventions and investigations were identified along with the current and previous training load. Recent changes to their club environment or training surface would be noted as a contributing factor.

> *P11. "Where they are at in terms of a training phase, what else have they got going on in their life at the moment, at home, stresses, proximity to major comp?"*

Athlete physical examination

Within the physical examination, an appreciation of the gymnastic postures was important. Observation of training was thought advantageous to fully understand pain severity and irritability to see if symptom modification could retain some level of training along with the evaluation of active range of movement for range, quality and pain. Video analysis with movement evaluation assessment advanced the decision-making process.

> *P5. "…observe the movement, if the severity and irritability is low and you can do that is like incredibly valuable and if you can, modify something and change the symptoms becomes almost diagnostic in a sense"*

Coaching perspectives indicated that a gymnast may vary techniques slightly if they are experiencing LBP but may still perform a required skill; information which would be useful for the medical practitioner. Technical skill coaching adaptation was recognised as a successful solution; however, it was acknowledged that the experience and ability of a coach would influence this.

> *P3. "For something like a free walkover, for a gymnast that is learning to land under rotated so if they start going under rotated the experienced coach*

would lift the take-off section slightly, so they don't land in an arched position with weight going through their back"

Causation of LBP in gymnastics

TABLE 2 details the themes and sub-themes focused to the causation of LBP in gymnastics.

Theme	Subtheme
Intrinsic risk factors	Growth and maturation Physical capabilities of the gymnast
Extrinsic risk factors	History of the training load Nature of the training load Equipment

Intrinsic risk factors

Growth and maturation

Bone development, menstrual cycle, monitoring of growth and diet were considered significant intrinsic risk factors, and where appropriate required support from medical or nutritional expertise. Weight changes with evidence of eating restriction may be linked to illness, injury or LBP so that any alteration to diet should be noted.

> *P8 "I'd be looking at the bone development and looking at the young developing athlete and their growth and maturation so when they are going through their peak high velocity"*

Physical capabilities

Concerns were raised regarding the physical capability of a gymnast linked to their technical abilities to train in the artistic gymnasium combined with additional strength and conditioning sessions.

> *P10. "…they are obviously using their backs all day… that physical load through their back you could just see in terms of their posture and demeanour… they were just not happy…so we changed the approach to a different (strength and conditioning) approach".*

Assessment of physical capacity is explored during bi-annual athletic profiling (including physical tests, trunk endurance tests, body composition etc.) but the group concluded that adaptation to load within their physical capacity may require further consideration to mitigate risk of LBP. Awareness or acknowledgement of symptoms appears critical in identifying the development of pathology.

> *P10. "You can re-test them based on your (physical) profiling data you will have the numbers they produced….. you can look at that and say ok have we improved, got better got worse, you have some basic benchmarks"*

Extrinsic risk factors

History of training load

Dose-response relationships are a fundamental aspect when designing well-tailored, population specific exercise programmes.[43] The training history and the gymnast's response to training overload anticipates optimal adaptation. The group affirmed this as "symptoms settling by the following day". However, if insufficient recovery occurred, they agreed that spinal symptoms, stress or pathology could develop.

> P5 "*You get a response to a load that either causes adaptation and the gymnast recovers from and can train again, or you have the response to the*

load that becomes pathological and means that they can't load again the following day".

Nature of training load

Significant sharp alterations to training load or changes to environment could increase the risk of LBP.

P5 "the nature of the load associated with that skill, so the volume, intensity of that and the relationship between chronic exposure of load versus the acute exposure and the balance of both of those…and what impacts that has then biomechanically on the load of the back".

Equipment

Any changes in the manufacturer of apparatus or equipment was a possible precursor of pain including the surface or floor that gymnasts train on and the springs within the vaults that they impact on. This information could be gleaned from the history. Most injuries would occur during landing and selection of landing surfaces could influence spinal load. Whilst learning a skill, imperfect landings with too many repetitions would increase injury risk. The gymnasts' physical capacity to "suck up" this error in landing was believed to determine the outcome.

P2 "It could even be a change of apparatus, type of make or manufacturer (of equipment). Or the floors particularly, the change of the spring"

DISCUSSION

This is the first study to offer understanding of MDT perceptions of LBP in elite gymnastics. Key insights gained will inform understanding of the presentation and causation of LBP to inform precision rehabilitation.

Presentation of LBP

Early identification of LBP relied on the coaching eye detecting behavior or skill changes. It should be acknowledged from the focus group findings that gymnasts may not actually report symptoms they experience. Consistent with the existing literature, communication between athlete and coach can affect athletic outcomes,[44,45] highlighting that the coach-athlete relationship is a critical factor in early identification.

As continuous pain or the inability to re-load in training were considered indicative of risk and possible pathology, the experience, ability and coaching philosophy was influential to a gymnast's decision to seek medical advice. The skill of the medical team to detect subtle variances within the athlete history is also important for early detection to minimise time loss from training/performance and to expedite healing.[46]

A range of factors influences pain reporting. Findings suggest that younger gymnasts would be guided by their coaches as to whether they would continue to train. As

gymnastics is an early maturation sport, the findings acknowledge the challenges of working with young athletes[47] including early identification of pain catastrophizing behavior linked to selection. The negative effect of catastrophizing on coping behavior and overall prognosis in susceptible individuals when challenged by painful disorders is well known,[48] and relates to emotional distress, increased pain and disability;[49] all factors known to affect performance. Detailed knowledge of the gymnast, context of reporting, history of injury and physical findings all inform clinicians' clinical reasoning.[21]

Common presentations and a degree of LBP in elite gymnastics was considered normal. Differentiation between early onset pain and pathology was important, but it was acknowledged that clinical decision-making is challenging. Our previous study found that no patient history or physical examination data currently has the diagnostic utility to identify spondylolysis or spondylolisthesis in athletes[23] highlighting this challenge. Skill modification in early presentations was advocated but persistent LBP symptoms required investigation, with imaging findings perceived as valuable when interpreted in the context of clinical data. For the clinician, the gymnast's history and physical examination were critical components of decision-making with further valuable contextual insight provided by the coach. A large proportion of asymptomatic individuals (37% 20-year-olds) demonstrate spine degeneration on imaging findings that increases with age.[50] Such features are likely to be part of normal ageing but increased prevalence is documented in gymnastics,[51,52] cricket,[53] and tennis.[54]

Causation of LBP

Intrinsic risk factors linked to the physical capabilities of the gymnast, and participation in gymnastics is a risk factor for LBP owing to excessive loading during growth spurts,[55] linking very closely to the "growth and maturation" sub-theme. Children of the same age can vary significantly in biological maturity, resulting in marked differences in size, shape and function[56] and consequently impacts athletic development and injury risk. The findings highlighted understanding of bone development, monitoring of growth, and support through appropriate nutritional and medical methods important to high training loads. Key areas of consideration within the female athlete are bone health, menstrual function, metabolic rate, immunity, protein synthesis and cardiovascular health caused by relative energy deficiency (RED-S).[57] Long term implications to an athlete's health such as low bone density with impaired bone accumulation needs to be addressed early.[58]

Extrinsic risk factors are important in gymnastics owing to repetitive directional movements placing stress on the spine.[8,9] Training the wrong skill at the wrong phase of development could have significant negative health effects. As an early specialisation sport, characterised by intensive athlete involvement at an early age including participation and competition, an early focus on performance improvement and success is important. Training loads and overuse injury problems are reported as high within young age groups suggesting long training duration as a source.[55] This adds to the current body of knowledge surrounding training load whereby consideration of each component of the full training load needs to be considered and

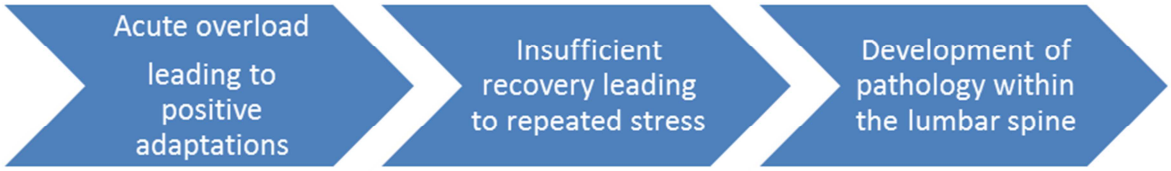
evaluated to minimise injury risk. Adaptation to the load with the understanding of an individual's response are taken into account to assess fatigue in order to minimise injury and illness. [59]

It is reported that the landing phase or surface is important to spinal load and risk of injury, with greatest frequency of injury from floor apparatus.[60,61] During skill acquisition training, trial and error are common with injury risk factors influenced by physical capacity. Floor exercise routines consisting of dynamic tumbling skills with increasing levels of difficulty, multiple twists and flipping somersaults contribute to high impact forces with ground reaction forces x13 body weight, contributing to significant spinal load and potential pathology.[10.11] Consideration to the surfaces and progression of skill upon the variety of gymnastics surfaces need to be assessed and progressed carefully. Each surface has a different ground reaction force applied to the gymnast[62] so the coaching expertise could prove vital during this phase of adaptation. This study evidences that the maturation, skill acquisition and loading tolerance of the gymnast must be mediated, as imbalance within these variables are likely to increase the risk of injury.

Model of adaptation

Findings illustrate a model of adaptation relating to understanding LBP presentations in gymnastics to inform clinical decision-making processes (Figure 2).

FIGURE 2: LBP in gymnastics adaptation model



Strengths and limitations

A key strength is this study's access to the elite environment. It was limited by a single national focus group. Three focus group members contributed their experiences as a previous elite gymnast and highlighted that further investigation into the perspectives of gymnasts, particularly their barriers to early reporting is needed. Findings can inform a gymnast-specific history and physical examination process to inform precision management.

CONCLUSION

Gymnasts have an individual response to LBP with some pain considered normal with context, age and background as key factors in their pain reporting. The coach and medical team can positively influence early detection and outcome. Clinical

practice, coaching methods and athlete's careers could all benefit from this greater understanding of LBP. Importantly, potential modifiable risk factors in gymnastics require further study to reduce burden.

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Highlights

- First understanding of elite gymnastics multidisciplinary team's perceptions of low back pain
- Gymnasts have an individual response to low back pain
- Some pain is considered as normal for elite gymnastics
- Coach and medical team can positively influence detection and outcome
- Potential modifiable risk factors require investigation to address burden

Ethical approval

The study protocol was approved by the University of Birmingham Research Ethics Committee, UK) (**ERN_16-0269)**.

Conflict of interest

I affirm on behalf of all authors that we have no financial affiliation (including research funding) or involvement with any commercial organization that has a direct financial interest in any matter included in this manuscript. There are no other conflicts of interest (i.e. personal associations or involvement as a director, officer, or expert witness).

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