Examining injury prevalence in the world of badminton. A study of engagement, exposure and injury.

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Introduction

The activities athletes participate in during their development and career contribute significantly to the attainment of expert performance (Ford et al., 2010). Players take part in a range of different types of developmental activities throughout training which have different types of focus and objectives (i.e., deliberate practice, play and competition), with each type of activity placing a specific physical load upon an athlete. For example, a session focussed on refining a back hand serve will place significantly different physical demands on the athlete compared to a session focussed on enhancing physical capabilities. A common theme across racket sports, and specifically badminton, is the notion of overtraining leading to injury (Goh et al., 2013). Richardson, Andersen and Morris's (2008) *overtraining risks and outcome model* suggests factors can be divided into intrapersonal (e.g., personality traits), interpersonal (e.g., relationships), situational (e.g., poor performance) and sociocultural influences (e.g., sport culture). As a result, the stress-recovery balance of athletes can be impacted and consequently lead to overtraining, burnout or injury risk. Furthermore, in contrast to other sports, the relative injury risk in badminton is higher during training than in competition per se (Jorgensen et al., 1990). Specific to badminton, Yung et al. (2007) reported that on average elite players suffer an injury every 135 hours of engagement in badminton activity. Therefore, understanding specific links between the type, intensity, load and volume of developmental activities and the experience and severity of specific types of injury is critical so that activities can be adapted to reduce the risk of injury.

Alongside the activities athletes engage in during practice, the environment created by coaches has also been shown to impact the potential for injury. Athletes who feel supported, trusted and of value are significantly less likely to suffer severe injuries as those who perceive their coaches to be unsupportive, to demonstrate limited trust, and to under-value them as people and players (Ekstrand et al., 2018). As a result, the leadership style adopted by coaches has been found to correlate with the occurrence of injury (Ekstrand et al., 2018). Athletes who perceive their coach to exhibit transformative type leadership attributes (i.e. communicating a

clear and positive vision; support staff members; and give players encouragement and recognition) are significantly less likely to suffer severe injuries as opposed to athletes who perceive coaches to demonstrate less of these transformational type behaviours. However, work to date has only examined this in a team-based setting, specifically football, therefore it is of interest to identify if these findings hold in an individual sport where the coach-athlete relationship is different (Coaching, 2003).

Researchers have examined the developmental activities of athletes by having them retrospectively recall their practice history from their entry point into the sport. This can be done effectively by completion of a sport-specific practice history questionnaire (Ford et al., 2010). The typical types of activities reported and applied examples are reported in Table 1.

Table 1: Typical types of activities and examples collected in the Past History Questionnaire (as per Ford et al., BWF report 2014; 2010)

Type of activity	Definition	Applied example
Match-play	Organised badminton competition in a group, engaged in with the intention of winning and supervised by adult(s).	National tournament
Coach-led practice	Organised group badminton practice, engaged in with the intention of performance improvement and supervised by coach or adult.	Match training or specific drills
Individual practice	Badminton practice engaged in alone with the intention of performance improvement	Practicing serves alone
Peer-led play	Play-type badminton games with rules supervised by yourself/peers and engaged in with the intention of fun and enjoyment	Playing a game with friends

Using this approach, researchers have identified that expert athletes accumulate more hours in sport-specific deliberate practice when compared to lesser-skilled athletes (for a review, see Baker & Young, 2014). However, debate still exists as to the optimal time to accumulate the hours of deliberate practice activities in the sport, as well as whether childhood engagement should involve a variety of sports or not. The debate is reflected in two proposed

pathways to expertise, known as *early specialisation* and *early diversification*. Early specialisation suggests that children at an early age should engage solely in deliberate practice in a single sport so as to accumulate more hours than others by adulthood (Baker, Cobley, & Fraser-Thomas, 2009; Mosher, Fraser-Thomas, & Baker, 2020). Previous work has shown individual-sport athletes who report higher training volumes in one sport (i.e. early specialization) have greater rates of overuse injuries (Pasulka et al., 2017). Early diversification on the other hand involves play activities across a variety of sports in childhood, with later specialisation in adolescence (Côte & Vierimaa, 2014). In this pathway, the time point of specialisation is dependent on a number of factors including the popularity of the sport, the attributes required to be an expert performer in the sport, the age when peak performance is typically reached, and the culture of the sport (Baker, Côte, & Abernethy, 2003). For example, Ford et al., (BWF Research grant, 2014) created a badminton specific questionnaire aimed at identifying the developmental activities of elite badminton players from across the world. Ford and colleagues identified differences between European and Malaysian players, specifically the European players started in the sport later and engaged in less practice during childhood and adolescence than the Malaysian players. It appears the Malaysian players followed the early specialisation pathway as they engaged in a very low number of other sports during childhood and accumulated a large number of deliberate practice hours from an early age. While the early specialisation pathway may be common in badminton, there is mounting evidence that this pathway increases the likelihood of over-use injury and burnout (Bell et al., 2018). Therefore, findings from multiple studies have led researchers to suggest a developmental activity pathway for aspiring athletes that produces a balance between the greatest performance improvements and reduced likelihood of injury (see Systematic Review by Drew et al., 2017). It has been coined the *early engagement* pathway and involves a progression from engaging mainly in play activity during childhood in one specific sport towards engaging mainly in deliberate practice and competition from adolescence onwards.

The impacts of injury on participation, continuation and skill development is known to be significant (Jorgensen et al., 1990). Moreover, empirical research suggests that the type of injury suffered by players tends to depend on level of expertise. For recreational players, there tends to be a prevalence of minor, low risk injuries, such as stiffness in the shoulder (Muttalib et al., 2009), whereas the report of injury in elite players has identified more major injuries to be prevalent, such as anterior cruciate ligament damage (Sasaki et al., 2018) and Achilles

tendon rupture (Fahlstrom et al., 1998). The *impact* an injury has on players is also expertise dependent. For recreational players, injury is cited as a major contributor to player burn out (Grylls & Spittle, 2008) and drop out (Crane et al., 2015; DuRant et al., 1991; Johns et al., 1990), whereas, unsurprisingly, for elite players injury limits the opportunity to compete and to maximise potential (Rechel et al., 2008).

Whilst a body of work has identified the *types* of injury suffered by Badminton players (see Phomsoupha et al., 2020), it remains unclear as to the impact of both developmental activities and the leadership style of the coach on the risk of injury in badminton. Therefore, this project will identify relationships between player practice history, perceived coach leadership styles and the experience of injury burden and dropout in badminton. The aim is to compare the type and amount of badminton-specific activities players have completed across their lifespan and the coaching leadership styles they had been exposed to with the frequency, type and seriousness of badminton-specific injuries. Highlighting the type of practice activities and coaching leadership styles that might make players susceptible to injury provides players, coaches and policy makers with formative knowledge to take direct steps to reduce the risk of injury.

Method

Participants

To take part in the study, participants had to be badminton players, however, all skill levels were eligible. A total of 78 participants completed the questionnaire. There were 273 recorded responses, indicating a 71.4% drop out rate. Moreover, two individual sets of data were removed due to participants being under the age of 16, taking the total responses to 76, comprising of 50 males (65.8%) and 26 females (34.2%). Skill levels varied as followed: 9 recreational (11.8%), 27 local club (35.5%), 8 county (10.5%), 10 regional (13.2%), 9 national (11.8%) and 13 international (17.1%). Table 1 details how each skill level was defined. The age range of participants were from 16 to 67 years, with a mean age of 31.47 years. The breakdown of participant ethnicity can be found in Table 2.

Table 2. Skill level definitions

Skill Level	Definition
Recreational	Participating in badminton for fun/recreational purposes only, not attached to a club
Local club	Training and playing at a club in local area
County	Participating at county level
Regional	Participating at regional level
National	Participating in National competitions
International	Representing country in International competitions

Table 3. Ethnicity demographic

Ethnicity	Total (%)
White British/Irish	21 (27.6%)
Indian	9 (11.8%)
Pakistani	1 (1.3%)
Chinese	7 (9.2%)
Mixed Race	2 (2.6%)
White European	23 (30.3%)
White – Other	2 (2.6%)
Asian – Other	7 (9.2%)
Other	4 (5.3%)

Procedure

Before any data collection could commence, ethical approval was granted by Leeds Beckett University. The computer software Qualtrics (Version XM) was used to create the online questionnaire. A detailed information document was presented before participants decided whether to take part. Participants were asked to read this information and then confirm their consent to participate. Following this, participants were asked to complete questions in the following four sections: demographics, injury burden, developmental activity and coach leadership. The questionnaire took approximately 30 minutes to complete.

Measurements

The questionnaire comprised of pertinent demographic questions and incorporated previously used questionnaires around developmental activity, injury burden and transformational leadership.

1) Demographic information: This included participant age, gender, current and highest playing level, playing hand and badminton form e.g. singles, doubles, both.

2) Injury burden questions (Broadbent et al., BWF research project 2019): asked participants to report the frequency, type (fracture, ligament damage), severity (number of training sessions & matches missed) and how the injury was treated (hospitalisation, self-treated) in the last 24 months.

3) The questions derived from the developmental activity questionnaire (adapted from Ford et al., BWF research project, 2014) comprised of three focus areas. The first identifies badminton-specific milestones, such as the start age in badminton training and competition. The second set of questions looked at the level of engagement in badminton-related developmental activities, including competition and different types of practice (match play, coach-led practice, individual practice and peer-led play). Estimated volume hours per week and months per year were recorded. The final section asked participants about their engagement in other sports.

4) The Global Transformational Leadership questionnaire is a validated instrument to capture athletes' perceptions of the transformational leadership approach of their coach (Carless et al., 2000). It contains seven statements, which players answer on a five-point Likert scale in relation to each coach they had worked with. Subscale scores range from 1 (Never) to 5 (All the time) being the highest. Leadership scores could range from 7 being the lowest to 35 being the highest. These questions were asked repeatedly across different age ranges of their badminton participation e.g. up to 12 years old, 13-15 years old, 16-18 years old, 19-23 years old and over 24 years.

Distribution of the questionnaires were accompanied with an instructional video (see link to video here).

Results

Of the 76 participants, 47 (61.8%) had sustained a badminton-related injury in the last 24 months. These were split into the following: severe (N = 10), moderate (N = 22) and minor (N = 15). Table 1 displays the total number of different injury types reported within this timeframe. The most cited injury regions reported were in the shoulder, knee or ankle (see Figure 1).

Table 4. The % of different type of injury type reported

	Muscle/ Tendon Strain	Joint/ Ligament Sprain	Joint/ Ligament Tear/Rupture	Fracture	Dislocation	Contusion/ Haematoma	Laceration	Other
% of reported injuries	36	21	7	2	3	4	1	9

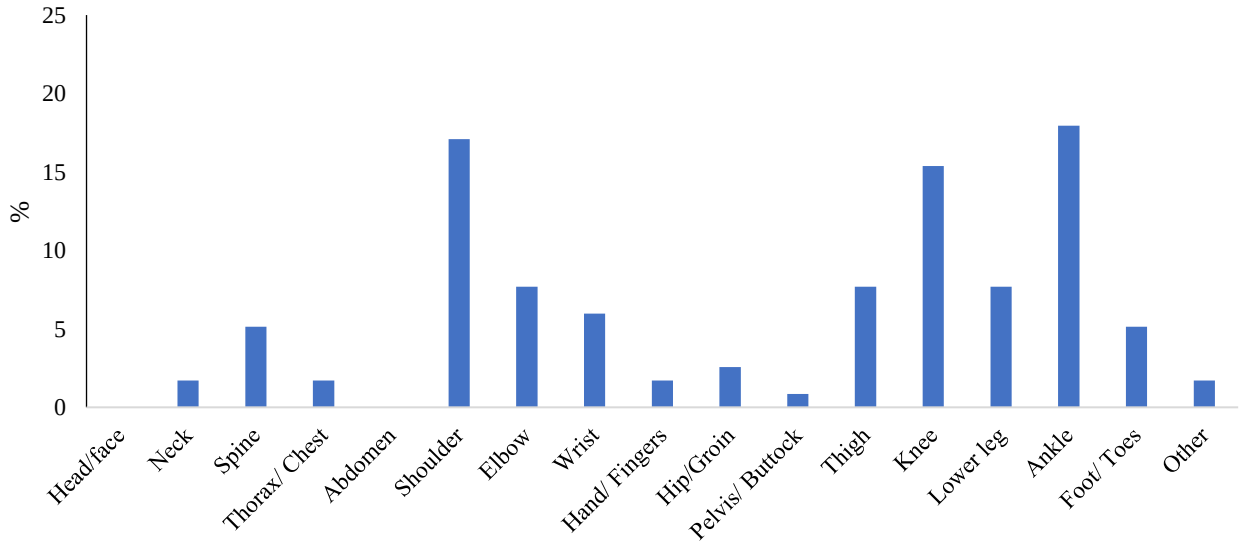
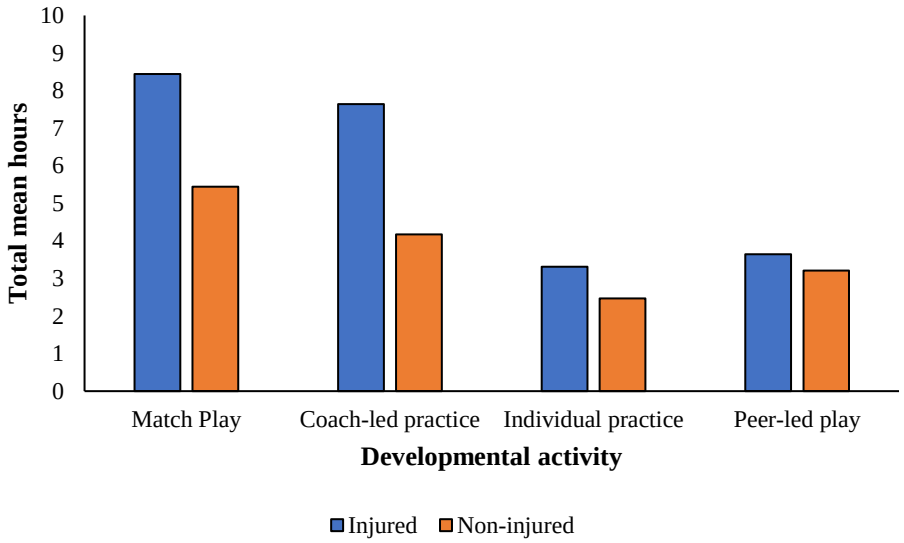


Figure 1: % Injury regions reported within the last 24 months.

Participants were asked to report the number of injury weeks during each age phase and practice activity. Those who reported injury weeks ≥1 were defined as 'injured' and those who reported 0 were defined as 'non-injured'. The top panel of Figure 2 displays the mean number of hours per week for players who did and did not report injuries in each different activity type

for each age phase. Overall injured players reported higher amount of engagement in each of the different activity type compared to non-injured players (see figure 2 below).



The number of injured vs. non-injured players for each age phase were as follows: 0 – 12 years (injured = 9, non-injured = 21), 13 – 15 years (injured = 11, non-injured = 33), 16 – 18 years (injured = 18, non-injured = 23), 19 – 23 years (injured = 15, non-injured = 14) and >24 years (injured = 12, non-injured = 12). Observation of the figure suggests that the average coach-led practice hours were higher for those who had sustained an injury compared to those who had not across the age phases. Moreover, in certain age phases, reported match play hours appear higher in those during 13-15 and 16-18 years. The bottom panel of Figure 2 displays the breakdown of each type of activity as a percentage of total activity. Observation of the figure fails to identify a consistent pattern across the age phases in the balance of activities of injured and non-injured players. There are some notable differences which would warrant for further exploration, for example, between activity types in the 0-12 years phase, in which non-injured participants appear to have more play hours and less coach-led practice hours. In contrast, those non-injured over the age of 24, reported less match-play and more coach-led practice which could raise question around age differences mediating the impact of coach leadership and required developmental activity.

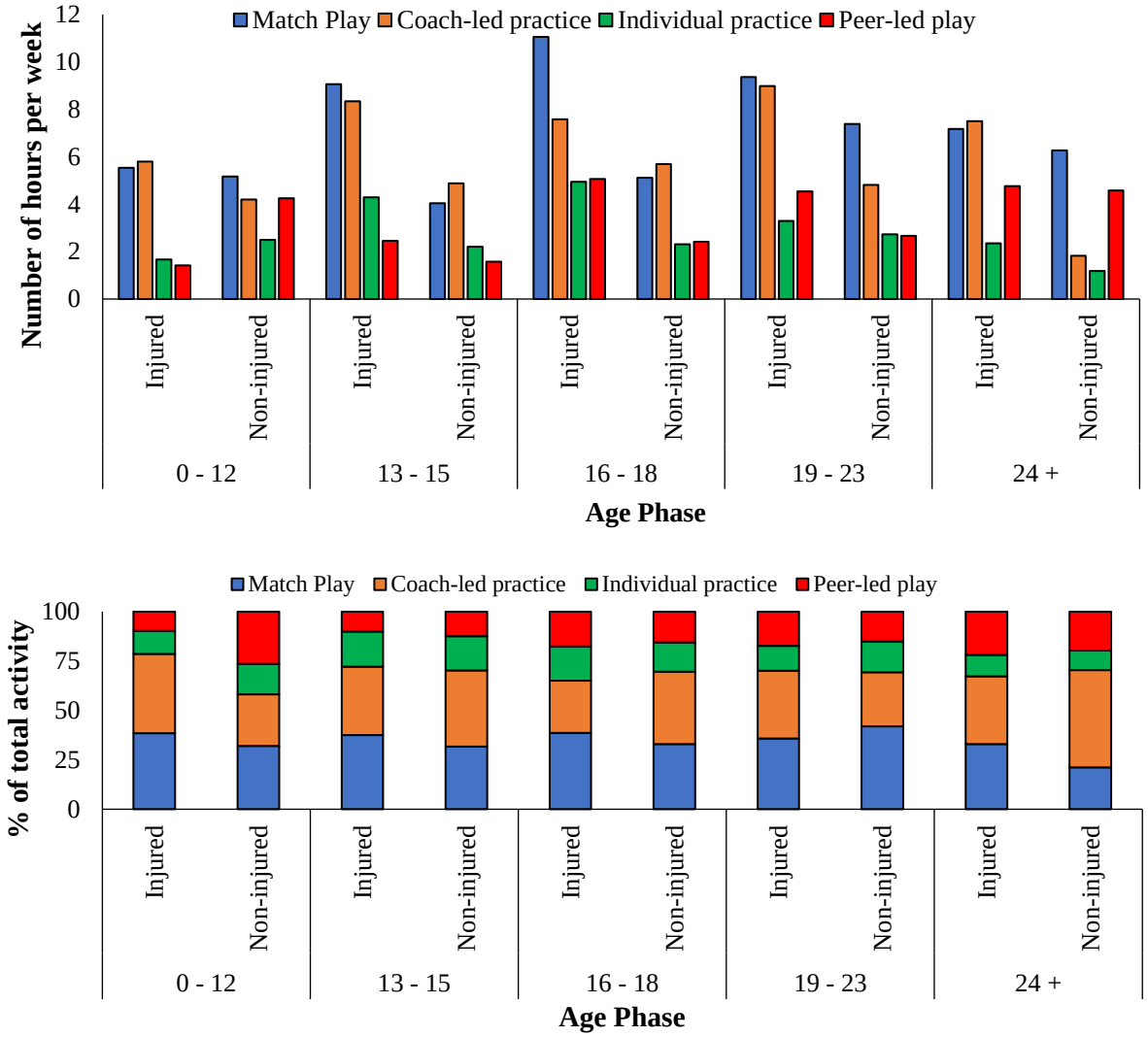


Figure 3: Mean number of hours per week of badminton activity (top) and the breakdown of each type of activity (bottom) as a percentage (%) of total activity for injured and non-injured players across the age phases.

The total mean scores reported on the Global Transformational Leadership questionnaire across each age phase were: 0-12 years (*M* = 76.4 %, *SD* = 6.4), 13-15 years (*M* = 78.1 %, *SD* = 6.4), 16-18 years (*M* = 80.9 %, *SD* = 6.4), 19-23 years (*M* = 81.2 %, *SD* = 6.4) and 24+ years (*M* = 67.2 %, *SD* = 7.4). Figure 4 breaks this score down for players who did and did not report injuries for each age phase.

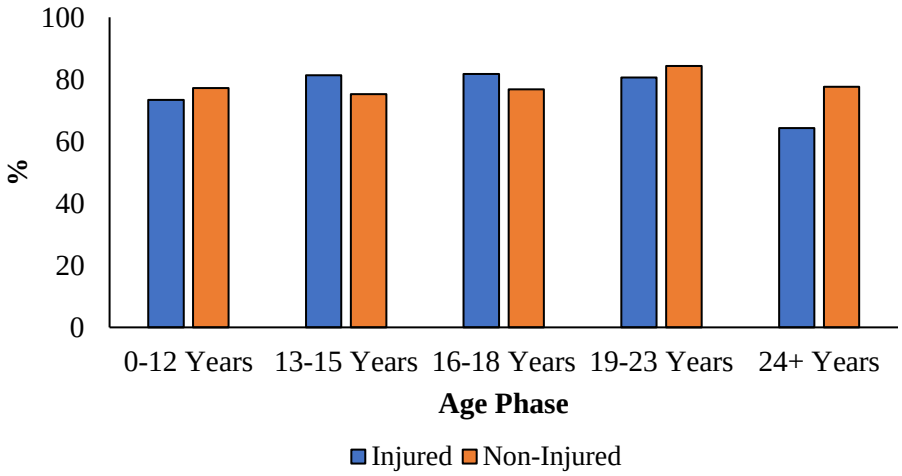
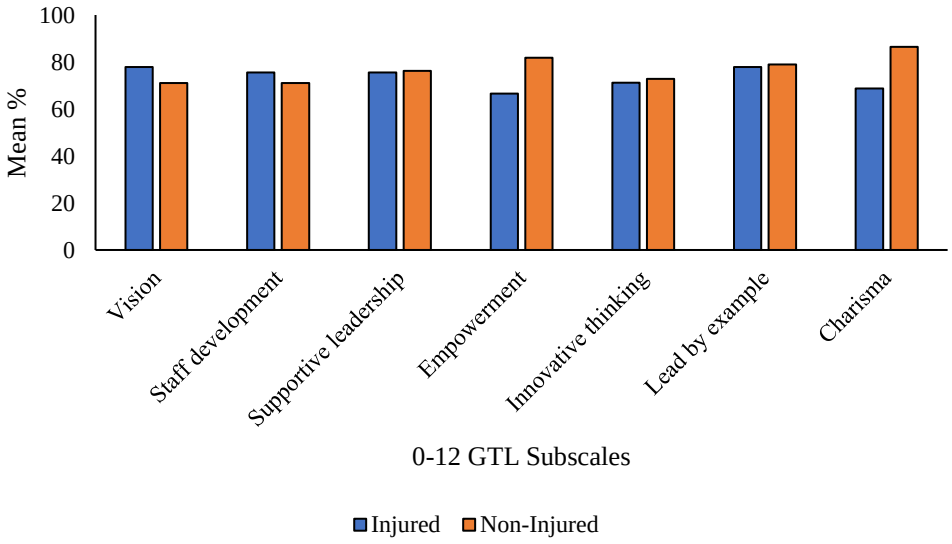
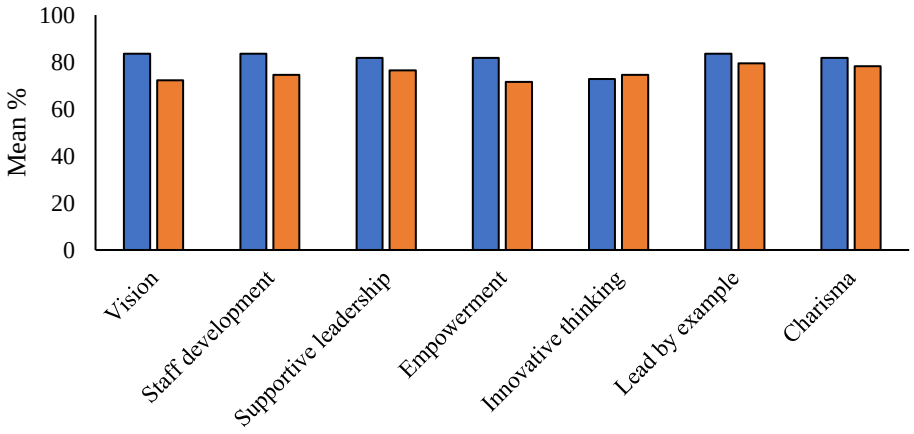


Figure 4: Mean (%) score reported on the Global Transformational Leadership (GTL) questionnaire reported for players who did and did not report injuries in each different activity type for each age phase.

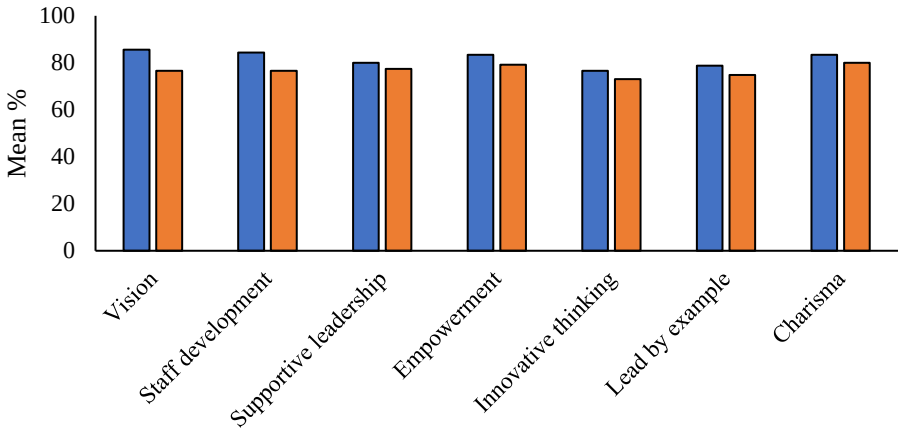
Figure 5 below displays the mean (%) score reported for each subscale on the GTL questionnaire reported for players who did and did not report injuries in each different activity type for each age phase. However, in the 24+ years age phase, the average scores for each of the seven subscales were higher for the non-injured participants. This suggests that adult athletes who perceive they are more exposed to GTL may be less likely to get injured than athletes who have perceive less exposure to GTL.





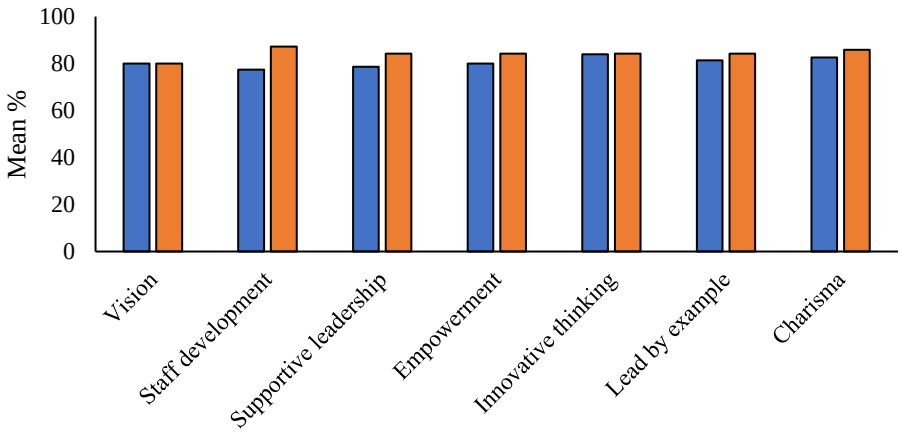
13-15 GTL Subscales

Injured Non-Injured



16-18 GTL Subscales

Injured Non-Injured



19-23 GTL Subscales

Injured Non-Injured

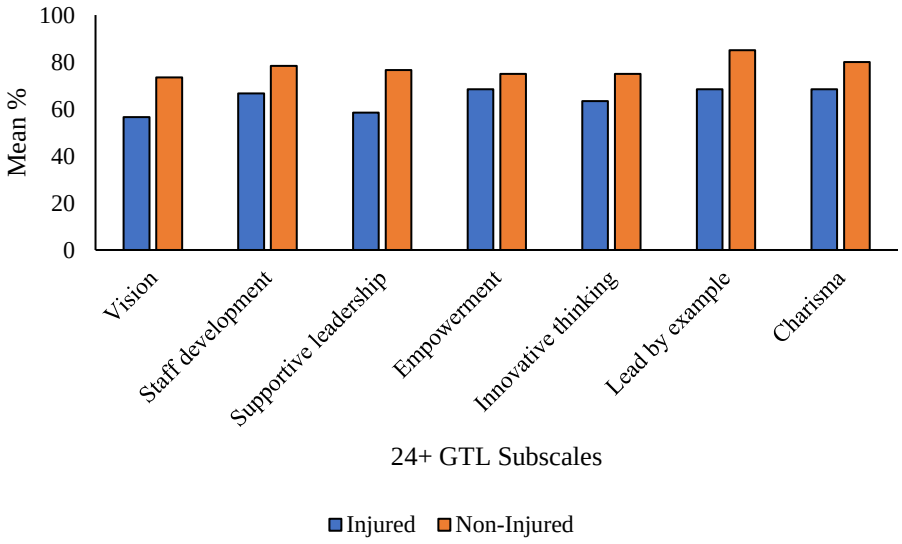


Figure 5: Mean (%) scores reported on each of the Global Transformational Leadership (GTL) subscales reported for players who did and did not report injuries in each different activity type for each age phase.

Discussion

The overall aim of this research was to compare the type and amount of badminton-specific activities players have completed across their lifespan and various coaching leadership styles they had been exposed to with the frequency, type and seriousness of badminton-specific injuries. Participants were asked to complete a self-report questionnaire around injury burden, their practice history, participation level and perceived exposure to coach leadership styles. Descriptive statistics allowed for average practice hours for each type of developmental activity, across each age phase to be compared in addition to reported injury prevalence and coach leadership scores. Participants were also asked to recall details around injuries that had occurred in the last two years.

The most common injury regions reported by participants were the shoulder, knee or ankle, aligning with previous findings concluding most badminton injuries involved the lower limb (e.g., Goh et al., 2013; Jorgensen & Winge, 1990; Kroner et al., 1990). In addition to this, Goh et al. (2013) reported the most common injury type to be that of sprain and strains; with the same trend emerging in the current data. Overtraining has been linked with an increased risk of overuse injury such as the commonly reported muscle strain in this study (e.g., Richardson et al., 2008). The prevalence of these injuries in this population could suggest that badminton players are particularly vulnerable to overtraining and in turn, sustain overuse

injuries. Factors to reduce risks of overtraining should be explored and shared with athletes, coaches and trainers.

There appeared to be no differences across age-phases comparing injured and non-injured leadership subscale scores. However, for those reporting in the 24 years and over phase, all leadership subscales scores were higher in those without injury, implying a slightly higher exposure to transformational leadership behaviours. Past research explains how coach leadership style can result in increased stress levels in athletes and an inability to cope (e.g., Fletcher & Hanton, 2003; Hanton, Fletcher, & Coughland, 2005), which consequently can result in heightened injury risk (e.g., Ivarsson & Johnson, 2010; Ivarsson, Johnson, & Andersen, 2017; Ivarsson, Johnson, & Podlog, 2013). Previous interviews with athletes reveal noted stressors of unrealistic coach expectations, attitude and lack of understanding (Hanton et al., 2005) whilst Ivarsson and colleagues (2017) explained how implementing a non-transformational leadership style can heighten the psychosocial stress experienced by athletes. In turn, stress responsivity can impact movement, attention and increase distractibility (e.g., Williams & Andersen, 1998). Therefore, it was important for the current study to explore perceived exposure to leadership styles in relation to injury prevalence.

An interesting observation which warrants further attention is those who reported an injury in the last 24 months, disclosed, on average, a higher amount of coach-led practice hours compared to those who did not report any injuries. There was a similar trend found across all age-phases in those who had reported injury, which may demonstrate *early specialisation* amongst these athletes. Explanations from previous research would suggest that perceived coach expectation can increase the chances of overtraining or overloading in athletes (e.g., Peterson, 2009) and consequently, do not leave time for adequate recovery. It is understood that insufficient recovery from high stress demands put athletes at this heightened risk of overtraining and it is this very imbalance which results in overuse injury (e.g., Bertollo, Nakamura, Bortoli & Robazza, 2017). On the other hand, attentional and technique-related injury causes may be influenced by coach expectation and inability to cope. This could be explained by Wiese-Bjornstal's (2009) Sport Injury Risk Profile which, alike the Overtraining Risks Model (Richardson et al., 2008), considers overtraining, coaching quality and environment to be risk factors of injury. Coaches are known to play an important role in fostering the culture in which an athlete trains and performs, which ultimately, is influenced by their leadership behaviours and expectations. It is also the athlete stress-response behaviour

that should be considered here when looking at injury risk factors, as noted in Appaneal and Perna's (2014) Biopsychosocial Model of Stress, Athletic Injury and Health. With what is already known around coach leadership, stressors and injury risk, it is plausible that those who reported injury were also reporting a higher exposure to coach-related stressors in the form of development activity and/or leadership style.

Interpretations of the current findings could be compared to the findings shared by Ekstrand et al. (2018) suggesting athletes are more likely to suffer severe injuries if their coaches do not demonstrate transformational leadership. A point to consider within injury research is how injury severity is defined. In this particular study this was determined through injury time-loss data. It is important that within future study there is consistency in terms of injury severity measures, to allow for accurate comparisons to be made. Ekstrand and colleagues' (2018) data was collected within football, a team-sporting setting. Individual athletes have previously reported that their coach felt closer, more committed and complimentary towards them than their team sport counterparts (Rhind, Jowett, & Yang, 2012). In addition, those who engage in individual sports have been found to rate their coaches higher in regard to training and instruction, social support and positive feedback leader behaviour than those from team sports (Veljkovic, Djurovic, Dimic, Mujanovic, & Markovic, 2016). This could add some clarity to the minor differences found amongst injured and non-injured GTL scores, suggesting a perceived closeness to their coaches despite injury occurrence.

Due to the small sample size of the research, it is difficult to make accurate inferences from the yielded results. That being said, certain findings within the data begin to show weak trends that align with previous research. The current study warrants further exploration and a larger sample size in order to draw more sound conclusions. Type 1 error and inflated effective sizes have been a common issue in previous sport and exercise psychology research and can occur as a result of small sample size (Schweizer & Furley, 2016). To avoid reporting 'false positives' and considering the higher likelihood of confirming an effect that may not exist, statistical analysis was not conducted with the current data set. To increase sample size and reduce dropout rate, it would be beneficial to revisit the sport-specific practice history questionnaire and sampling methods to achieve higher engagement and a larger dataset. In addition, there was also the occurrence of missing data in parts of the dataset, which brings into question the bias and accuracy of the data represented (Little, Jorgensen, Lang, & Moore, 2014).

The present research begins to acknowledge documented gaps exploring links between injury prevalence, practice history and coach leadership style. As previously stated, current published work focuses on a team-sport setting and also sought data from medical professionals working within the sporting environment as opposed to athletes themselves (e.g. Ekstrand et al., 2018). This study also takes into consideration all skill levels of badminton players from recreational to international performers, in which previous research suggests can influence injury characteristics, causes and outcomes (e.g., Muttalib et al., 2009; Sasaki et al., 2018; Crane et al., 2015).

Future recommendations include developing and testing the sport-specific measurement tools used to measure injury burden, developmental activities and coach leadership styles to aid ease of completion and participation levels. Repeated study is warranted within badminton and other individual sports to understand whether similar findings and conclusions can be drawn around leadership style and injury risk. The need to further explore these patterns also lends itself to qualitative research moving forwards, where player experiences of injury risk factors and perceived coach leadership styles can be looked at through a closer lens.

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