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The influence of biological maturation on injury in male academy football.

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Abstract

There are many studies on professional male football and injuries, including injury risk, patterns and injury prevention strategies. However, only a handful have examined youth male academy players. A research gap exists in this area due to the period of rapid growth, peak height velocity and biological maturation that occurs throughout every player of academy football.

This study examines injury and illness characteristics in the youth development phase and differences between injury and illness characteristics related to growth rate and maturity status. The research question is: 'what are the differences between injury symptoms and biological maturity groups?'.

This quantitative, single cohort, longitudinal design study had participants complete weekly questionnaires reporting their injury or illness, converted into an Oslo Sports Trauma Questionnaire severity score. Each participant was also placed into a growth group and a maturity group. Data was screened, descriptive statistics were analysed, bivariate correlations examined, Cohens d was interpreted and ANOVA (significance of $p<0.05$) with Bonferroni adjustment was applied. Pairwise comparisons and multiple linear regressions further examined predictive relationships.

Results showed a significant relationship between the low and moderate growth rate group and injury incidence and between pre-PHV (peak height velocity) and mid-PHV maturity group and injury incidence. No significant differences were found between biological maturity and ill-health. Overall, findings suggest that growth rate and maturation significantly influence injury risk in academy football.

This novel study provides an incremental contribution to the research area, emphasising that growth and maturation significantly influence injury risk within youth academy

football. This will benefit practitioners to group players by maturity to identify higher injury risk and implement injury prevention strategies. Future research may replicate this study with a larger sample size across multiple seasons and clubs to increase validity and reliability.

Contents

1. Introduction

1.1. Advanced Operator

In this thesis we look to examine the relationship between injury and biological maturity and try and discover whether there is any way to predict injury as academy football players enter and progress through their maturation stages during the season of football. This research is being completed because not only is there a significant lack of research within all levels of academy football, but a very high amount, if not all players, experience a major or minor injury throughout the season, which include injuries that have been linked to a growing phase.

1.2. Injury Burden and Impact in Adult Football

It is clear that there is countless research based on male football and injury. This is due to male football being one of the most popular sports in the world, both played and spectated, with five billion football fans across the world (FIFA, 2021). On the other hand, football pumps billions of pounds into different countries' economies every year and therefore, research in the sport is very well funded with studies being completed around different clubs and the sport as a whole every season and year. Injury burden can be very high in adult football, more specially in Professional European Football. Pulici et al (2022) reported that, from 22 studies completed, all reported burden, incidence and severity. The highest burden from injury was ligament-joint injures with 37.9 days/1000 hours and muscle injuries at 34.7 days/1000 hours. Furthermore, locations with the highest injury burden included knees, quadriceps, hamstrings, hip and groin and ankle injuries with each injury averaging more than 7.4 days/1000 hours. Pulici et al (2022) then concluded that high injury risk has many negative consequences for, not just the player, but the club as well, therefore, conducting research in many areas of professional male football benefits the players and the club’s financial situation greatly.

Specific negative consequences for the players and clubs include the economic cost of injured players with the mean cost of a professional injured player at €500,000 a month (Ekstrand et al, 2020), which, with months building up and potentially multiple players being injured at the same time, will cost clubs millions over a season. Team success is also negatively impacted during injury. Eirale et al (2013) discovered that football clubs with lower injury incidence rates have a strong correlation with higher league position, match success, increased goals scored, greater goal difference and finally, total points. Overall, showing that the less injuries a team face, the more successful the team will be throughout the season. Long absences due to injury reduces the athletes’ time to develop skills and increase their overall fitness, therefore, preventing them from progressing into more successful teams (Monasterio et al, 2024). Mental health can be negatively impacted by injury, with 68% of more than 1000 male and female Professional Footballers’ Association members were found to have a fear of injury which impacts mental health. Along with 41% of players having a fear of being dropped and 45% having concerns around on pitch performance, all impacting mental health (Professional Footballers’ Association, 2024). Resulting in players stepping away from the sport for their own health.

1.3. Injury Burden and Impact in Academy Football

Football academies are divided into four categories, category 1 and 2 includes past and present Premier League clubs and Championship clubs which process hundreds of players in age groups and eventually picking and eliminating players from the Academy programme. Category 3 and 4 clubs are often partnered with community facilities and other schools and universities to provide a football environment. Players are more likely to make it into category 3 and 4 academies as there is a lot less competition to join and keep places within the club (Academy Football.info, 2024).

It is very difficult to know exactly how many youth male football players are in football academies across the United Kingdom but an estimate of 1.5 million boys play organised youth football (McGlinchey et al, 2022). Alongside this, only 180 are professionally signed which equates to a success rate of 0.012% (Calvin, 2017). The only journal article on Football Academy numbers is by McGlinchey et al (2022) and states that in 2011, 13,612 athletes made up the professional football academy, which are category 1 and 2 clubs. However, in 2024, this will be a lot higher, then having to estimate the players in category 3 and 4 clubs, final numbers will be astronomical.

In comparison to high level adult male football, significantly less research has been completed in academy football. Football academies are schemes set up, usually, by professional clubs in order to scout and train the next generations of elite football players and is one of the only ways players get recognised by clubs to chase the dream of becoming a professional football player. Less than 1% of academy football players make it to become a professional footballer as the industry is highly competitive (Academy Football.Info 2024). Becoming a professional football player has many factors such as, skills, fitness and most importantly, injuries and illness.

There are many factors as to why youth football players drop out of the academy system. Firstly, the chance of being deselected and forced to drop out of academies, this can happen at any point during the season and can be due to underperforming, a lack of technical skills, players outshining others and many more.

Edwards and Brannagan (2023) explain that deselection is very common in academy football, there is a lack of research around the rate of deselection. However, with a professional contract rate of 0.012% it can be predicted that deselection has a large impact on the dropout rate of players.

Another factor of dropout rate in academy football may include the stress and anxiety that comes with optimum performance within the academy environment. Sæther (2018) discovered that 12–13-year-old players experience higher levels of development stress due to the competitive nature of academy football with the preceding reasons including trying to outperform other players within the academy. This is supported by Blakelock, Chen and Prescott (2016) with 55% of ex academy players suffer from clinical levels of psychological distress within 21 days of their release from the academy. The 12–13-year-old players have low academic stress, this is due to players not having exams taking place at school during this age.

Dropout can also be a decision based on the athlete's time, for example, trying to balance academy football with exam season at school, or other sports. It can also be difficult for family members to commit to multiple nights a week along with weekend games due to work and, potentially ,other sibling's commitments. Sæther's research also found that players who had been at the specific football academy for a long amount of time were reporting less evaluation and development stress. Therefore, players who are at risk of being released from academies relatively soon after being signed may be experiencing higher levels of stress and anxiety to work to keep their place and playing time in the academy. Overall, this can influence the player when it comes to planning whether to stay or drop out of the football academy. Increased stress and anxiety levels have a huge impact on the players mental health and overall happiness and enjoyment of the sport. This point also relates to burnout which is defined as emotional, psychological and physical exhaustion that causes withdrawal from the sport that was once enjoyable and has become an unpleasant source of stress (Smith, 1986).

Burnout negatively impacts the athlete's psychological wellbeing, increasing the chance of drop out. Nicholls, Madigan and Earle (2022) found that athletes who do not have coping psychological strategies are more likely to not enjoy the sport and drop out.

Finally, injury and illness are one the most prominent reasons for drop out in academy football. One study by Bangert et al (2024) discovered that a cohort of academy players in the 2012-13 season had an injury incidence rate of 2.7 injuries per 1000 hours of exposure and 50% of players experiencing an injury with days lost surging from under 14s to U16 teams which is during player's peak height velocity and maturation. For academy players to build up to premier league academies and securing a professional contract they must train many days a week along with increased training loads. If players are not partaking in injury prevention and recovery sessions there will be increased chance of and injury and may be catastrophic to their chances of making it to the professional level (Soares and Carvalho, 2023). It is a common misconception that early specialization and high training levels increase the rate of injury but Moseid et al (2018) researched that this is not the case. The reason athlete's drop out due to injury is that sports programmes may not adjust training exposure and load to the individual athlete's capabilities. Overall, the non-specific and non-personalised training will increase the chance of injury and, in turn, increase the dropout rate of academy football (Hohmann et al, 2014, Platvoet et al, 2023 and Schroepf and Lames 2018). McGlinchey et al (2022) conducted qualitative research and former academy players were interviewed on why they decided to drop out of academy football, with one player experiencing a hip injury and another with multiple knee injuries. This would have forced both players out of training and games for a long period of time and in the long run would have been outshone by their teammates and other players wanting to join the academy, making a larger risk of being released from the academy or developing too high levels of stress and anxiety, eventually, leading to dropout.

It is common for academy clubs to train and develop their own players and trial new players to create the new generation of elite footballers, however, little is done during this period to predict injury risk and adopt injury preventative measures to keep players as healthy as possible during season (Johnson et al, 2022). Jones et al (2019) explain how non-contact injuries are prominent in academy football players, with 53% to 72% of injury being non-contact. Impact and contact injuries are almost impossible to predict the timing of and need to be dealt with when and where they happen.

As discussed previously, there is a lack of research on injuries and academy football, however, to express the high burden and impact of injuries on academy football players, Materne et al (2021) conducted a study that recorded the incidence and burden of all injuries by age group over four football seasons. 2204 injuries were reported with growth related injuries recording an injury incidence of 4.3 per squad per season which was amongst the most common injury reported. Overall, each 25-player team averaged 30 injuries per season and 574 days lost due to injury. This, therefore, shows that there is a high burden and impact on all players in academy football and research needs to be conducted in order to create injury prevention strategies to reduce the injury incidence rate in all academy football. Academy football players can be at high risk of injury and any injury can occur in youth academy football but Price et al (2004) suggest that common injury locations include lower limb injuries such as thigh (19%), ankle (19%) and knee (18%) in their study. Also, 5% of all total injuries included growth related conditions including Sever’s disease and Osgood- Schlatter’s disease, which peaked in the under 11 age group and under 13 age group respectively. Injuries showed to peak in January and October which are both months where players have had some time off for summer and Christmas, therefore, injuries can relate to overuse situations due to not participating in the same amount of exercise they normally do during season.

When discussing the burden of injuries on youth football players Bangert et al (2024) concluded that both characteristics of injuries and the impact on career development vary between age groups. Injuries lasting more than 28 days had a negative impact on career progression when compared to minor injuries. Also, injuries were found to significantly decrease the probability of the athlete reaching the professional level. The conclusion of this study was that practitioners need to be aware of potential injuries and create prevention strategies to be able to develop young athletes. The more time loss injuries an athlete experiences, the less football they will play and will not be picked for the starting 11 at matches. Being out with injury for a long time also, especially with higher level clubs, increases the chance of being released for the club to make room for a healthy and uninjured player. Although it is difficult to estimate how many players drop out of football academies due to injuries due to lack of research done on the subject. One report found that 50% of all academy football players leave the academy system before they are 16 years old (Este, J, 2022).

The more injuries and physical setbacks athletes encounter during childhood the more likely it is to develop into adulthood, such as long-term injuries and health risks (Maffulli, Longo and Gougoulias et al, 2010). Therefore, injury prevention strategies are key in youth athletes and are often overlooked as research has primarily focussed on professional athlete’s injuries.

There are many positives of young athletes joining a football academy which includes getting professional training from coaches which, in turn, improves overall physical fitness when combined with subjects likes physical education at school. Technical skills are also improved in football academies, focussing on accuracy and control. Linking to the training and coaching aspect, athletes are also given guidance and mentoring to help them develop as athletes and individuals. Teamwork and social skills also improve when being in a team environment, improving communication and leadership which will carry over into future life. Finally, the exposure to competition allows the players to develop physically and mentally and allows the ability to problem solve on the spot and allow for evaluation of performance and to be able to develop weaker parts of performance (titansadmin, 2023).

1.4. Aetiology of Injury in Football

Aetiology is defined as the cause of an injury or illness, including abnormal stress on particular areas of the body and can be caused by specific actions of the body (Tomlinson, 2010). The aetiology of injuries in football can be very similar between academy football and elite football. Intrinsic; related to the player, physical and psychological and extrinsic; related to the environment and external factors. Both are related to the aetiology of injury in football (Wang et al, 2017). Firstly, intrinsic factors can include: age, as younger players (academy players) have less developed musculoskeletal systems and older players are more susceptible to overuse injuries and not able to heal as fast as younger players (Taimela, Kujala and Osterman, 1990). Low fitness levels that include low muscle flexibility and strength all increase the risk of injury. Relating to fitness levels of the imbalance of muscles, whether that be strength, flexibility or others can be a risk factor (Gurau et al, 2024). Practitioners have the ability to intervene and impact intrinsic risk factors, for example, assisting the player to change their technique that may be putting them at risk for injury or preventing them from performing to their maximum potential. Extrinsic factors that can cause injury in football include the playing surface, such as artificial ground becoming a risk for injury as overly hard surfaces can cause shin splints in players (Gurau et al, 2024 and Aborukbah et al 2023). Weather conditions can make surfaces slippery and hot weather conditions put athletes at risk of dehydration and sun stroke. Players that are in play for the majority of a game can be at higher risk of obtaining an injury as fatigue increases and more strain on the whole body can be a risk of acute injuries. Other players are also an extrinsic factor as a player may get tackled and collided with and this can cause fractures, concussions and more. Psychological factors are neither intrinsic nor extrinsic, some of these factors that can increase injury risk include the athlete partaking in risk taking behaviour, such as playing recklessly and aggressively tackling other players. The player becoming mentally fatigued is also an injury risk factor as it can reduce concentration and focus on the game which can cause injury (Mandorino et al 2023).

Franks (2017) explain that injuries during football matches occur from a combination of high-speed running and full contact and some causes include impact, trauma and concussion. Impact includes players potentially being hit by other players body parts such as knees, elbows and feet of which the sudden pain can put the athlete out of the match. Sudden trauma is described as the most prominent reason for injury in football (Lopez-Valenciano et al (2020). These injuries most often result in knee injuries such as posterior or anterior cruciate ligament injuries (PCL and ACL) along with knee cartilage where the meniscus can be severely damaged. It is not just lower extremities that can be injured but the shoulder can be at risk too. Overuse injuries are also extremely common in football. Overuse injuries are caused by over training or overusing a certain part of the body as this makes the athlete unable to heal completely from the training. An example of this is an overuse injury in the knee that can result in tendinitis.

1.5. Biological Maturation Status

Biological maturation is defined as the tempo and timing of the progress to achieve a mature state, in other words becoming 100% grown (Towlson et al, 2021). Maturation is a non-modifiable internal risk factor of injury, which may predispose an athlete to getting injured (Parry et al, 2024). Salter, Johnson and Towlson (2021) explain that biological maturation is the continuous progression toward adulthood and includes significant development in anthropometric, physiological and psychological statuses. Past research has thoroughly understood the type and order of biological maturation, however, the timing and tempo of biological maturation changes massively from athlete to athlete which makes the overall understanding and management needing to be specific for each athlete (Sullivan et al, 2023). Light et al (2021) concludes from different studies maturation status relates to the type, location and severity of injury in academy football players. However, Light et al (2021) depicted that there is an issue with methodological differences within studies including maturity measures and injury classification. When athletes reach adolescence, they will experience a period of rapid growth, also known as peak height velocity (PHV) (Malina and Bouchard, 2004). This results in changes to limb length, mass and physical and psychological skill, which all affects the chance of injury, increasing injury risk (Quatmann-Yates et al, 2012). Peak height velocity has been defined as the period of the fastest growth during puberty and during PHV there is a higher incidence rate of injury, more severe injuries and the most time loss from training and matches (Mills et al, 2017). Specific maturation phases such as PHV can differ by 3 to 4 years between athletes. This means, without clubs researching and predicting PHV in its players, it is difficult to prepare for phases like PHV. PHV phases occur in such a short amount of time and have been researched to show that they affect all the stability, coordination and overall movement of an athlete which results in athletes not developing skills at the rate they would normally and the need to spend more time on certain skills and drills increases (Towlson et al, 2020).

Biological maturity is the growth and development towards becoming a fully grown adult and pertains to the timing and tempo of developing to the fully mature status (Malina et al, 2004 and Laureys et al 2021). Everything in the body matures but at different rates (Malina et al, 2015). Light et al (2021) determined that, in their study, maturation status at the time of injury was the U13 to U16 teams. Therefore, supports the data collection groups of this study. During growth and maturation long bones grow at a more rapid rate compared to the muscles attached via the tendons (Satoh and Hasegawa, 2022 and Blumer, 2021). Therefore, it is common for muscular injuries to take place which results in time loss for young athletes (Patel, Yamasaki and Brown, 2017). The most common injury locations in maturing football players occur in the lower limbs, more specifically, the feet, ankles and knees (Wik, 2022). The diagnosis of these injuries usually being Osgood Schlatter's disease and Sever's disease. Whilst the most common injury types include strains, sprains and contusions (Wik, 2022). These overuse injuries are caused by the growth of the player and their tendons and muscles not growing at the same rate as the long bones, and therefore, stretching over the bones. As the individual begins to play sport, the muscles become inflamed, tender, and painful (Johnson, 2008). Unfortunately, these 'growing pains' cannot be completely healed but instead can be treated to lessen the negative symptoms the player experiences (Launay, 2015). One of the treatments that is suggested is temporary suspension of sport participation, which increases the players' time loss.

Growth rate is a term used to describe standing or sitting height over a certain amount of time, specific to the time of measurements (Monasterio et al, 2024). Some clubs may take a measurement every month and some only a few times in the season to monitor their players growth spurts. The fastest and highest point is known as peak height velocity (PHV) and during PHV injury incidence is higher as well as a higher risk of severe injuries, increasing time loss for the athletes (Mills et al, 2017). In males, PHV usually occurs at the ages of 13 to 14 years old and the maximum growth rates being 5.6 to 12.4 cm per year (Monasterio et al, 2024). Growth rates are categorised into fast (>7.2cm per year), moderate (3.5 to 7.2cm per year) and slow (<3.5cm per year) (Monasterio et al, 2024). Athletes are also categorised based on their PHV and overall predicted height development. Athletes are pre PHV if they are <88% of their predicted adult height (PAH), mid PHV if they are 88-95% of their PAH and post PHV if they are >95% of their PAH (Monasterio et al, 2024).

As mentioned previously, a limited number of studies have investigated the relationship between growth rates and injury, especially in academy football. However, Rommers et al (2019) found that overuse injury risk increases when leg length increases in academy football. Additionally, Wik et al (2020) also found in track and field athletes found that both leg length and growth rate related to a higher risk of bone and growth plate injuries. Therefore, this research suggests that during PHV of athletes there is an increase of injuries (Bult et al, 2018 and Van der Sluis et al, 2014). Johnson et al (2019) concluded that players between 88% and 95% of their predicted adult height (PAH) showed a higher injury incidence rate compared to the athletes in the group of pre-PHV. However, this was only calculated with only match exposure and not total exposure which should include matches and training.

Rommers et al (2020) and Kemper et al (2015) concluded that injured adolescent males had a higher growing rate compared to the non-injured equivalent. It was also discovered that there was a positive correlation between injury risk and growth rate along with Wik et al (2020) reporting growth rate positively correlating to greater risk of bone and growth plate injuries in athletics.

Johnson et al (2022) and Monasterio et al (2024) suggested that players with a fast-growing rate (>7.2 cm per year) were more at risk and more likely to get injured compared to athletes in the moderate and slow growth rate categories, 3.5 to 7.2cm per year and <3.5cm per year respectively. There was also a linear increase in injury risk when compared with growth rate (Monasterio et al, 2024 and Johnson et al, 2022), with Wik et al (2020) identifying that overall growth rate was connected to greater risk of growth plate and bone injuries in adolescent athletics.

Growth and maturation of male academy football players occurs during the ages of 9 and 14 (Breehl and Caban, 2018) with the adolescent growth spurt beginning at 10 to 12 years old in boys and the peak height velocity (PHV) occurring at ages 13 to 15 (Wik, E.H. 2022), with the exception of early or late developers who may start and finish growing many months or years before or after the rest of the cohort (Gasser et al, 2001). All bones, particularly long bones such as the femur and humorous go through different paces of growth via the epiphyseal plates. Once the epiphyseal plates close, bone growth concludes in length and the athlete’s height is at its maximum however, bones will still grow in thickness through appositional growth and increase new bone tissue to the bone surface in the event of broken bones or bone damage. There is also an increase in bone density during maturation and peak is often reached at the end of maturation and beginning of adulthood (Riggs, Khosla and Melton, 1999). Bone remodelling is crucial for the maintenance of bone strength and adapting to day-to-day physical demands and sport specific demands (Rowe, Killer and Sharma, 2018 and Hadjidakis and Androulakis, 2006). Muscles also develop significantly during growth and maturation, being an increase in muscle mass (hypertrophy), in males this is significant due to increased levels of testosterone (Schoenfeld, 2010). There is also an increase in muscle strength and muscle power during growth and maturation and can be increased even further with relation to training for strength in specific sports or training sessions (Yapici et al, 2022). Joint growth is also a factor. As joints develop, the surface area of joints increase, and ligaments develop to create a more stable joint and therefore reducing injury risk such as dislocations (Decker, 2017). Flexibility will naturally decrease as players grow and muscle mass and bone density increase (Radnor et al, 2017), however, flexibility can be maintained and bettered by regular stretch regimes.

Light et al (2021) found that knee bone injuries peaked in U13 players and hip/groin injuries peaking in U15 players. This, therefore, supports the science of bones growing distally, beginning at ankle and over the years moving to knees and hips, rather than proximally.

Adolescents are likely to experience a phase of motor awkwardness which may increase the risk of injury (Rommers et al, 2021). Motor awkwardness occurs when the athlete is going through a growing phase, often PHV, and experience an increase in limb length, mass and strength. Sustaining an injury during this time has the ability to affect the child for the rest of their lives such as early onset osteoarthritis (Quatmann-Yates et al, 2012 and Davies and Rose, 2000). An example of common injuries during the adolescence awkwardness phase are distal radius fractures as they are at their incidence peak at the same time of PHV in children (Bailey et al, 1989). This is another category in where there are a lack of studies and research and much more needs to be done to keep young athletes fit and healthy for their future careers. Quatmann-Yates et al (2022) also explains how collated current evidence suggests that certain sensorimotor mechanisms such as neurocognitive and neuromuscular abilities are not fully developed during growth and maturation of youth athletes, and this is known to be associated with increased injury risk. There are many different issues that may be associated with maturation as discussed previously and another issue is injury.

There are many methods to monitor growth and maturation in youth athletes, starting with more invasive options such as a hand and wrist x-ray which will be difficult for more clubs to conduct due to a longer period of time needed and a specific piece of equipment required (de Almeida-Neto et al, 2022). Sex characteristics can also be a reporting mechanism however this is not only physiologically but psychologically invasive and could be unethical towards the participants. The more ethical and non-invasive method is to take accurate measurements of the athlete’s height, sitting height and body mass, along with both parents’ height (Sherar et al, 2005). Maturity offset is used to predict how far the athlete is from their PHV (Malina et al, 2021). With this result, athletes can then be placed into PHV groups, being pre, mid and post PHV. Predicted adult height (PAH) can also be used to predict maturity timing which Monasterio et al (2024) report to be 88 and 95% of PAH. More recent data suggests that PAH% produces greater accuracy compared to the maturity offset method (Salter et al, 2022).

From this information it is clear that increased research is needed in football academies, especially between the ages of 13 and 16 as previous research has identified that the most time loss injuries occur during those ages (Faude, Rößler and Junge, 2013, Monasterio et al, 2024, Johnson et al, 2022 and Wik et al, 2020), due to periods of rapid growth or peak height velocity (PHV). Light et al (2021), expresses the lack of literature on the whole academy cohort, ages U9 to U21 with the relationship between injuries and growth and maturation timing. Also, Jones et al (2019) found that injury incidence numbers within high-level youth football players were 3.7 injuries per 1000 hours for players aged between under 9 to under 16 years and match injury incidence rate increased the older the youth athletes got, from 0.4 to 80.0 injuries per 100 hours and 18% of all injuries were classed as severe which included more than 28 days recovery to get back to full time play.

1.6. The Oslo Sports Trauma Questionnaire

There are multiple methods of reporting injuries within the sport of football, such as the medical injury surveillance which requires the athlete to inform the sports therapist/physiotherapist about the present injury as soon as the issue arises which is then investigated, diagnosed and then submitted and logged on the medical reporting system, one example being Medinotes. This primary surveillance system allows practitioners to identify and establish the magnitude of the injury or illness (Bonnie, Fulco and Liverman, 1999). This medical approach, that it completed by the medical department within the club, follows a traditional audit type approach and the consensus statement for epidemiology which summarises the agreement and understanding of experts in epidemiology. However, most injuries that are submitted onto a medical reporting system are injuries that are either trauma or severe and need multiple weeks of treatment and rehabilitation to get the player integrated back into training and matches. Most often, football clubs and injury studies use the time loss from sport approach as their main practice of injury frequency, severity and time duration. Clarson et al (2020) concluded that this method of injury reporting underestimates the full impact of overuse injuries because of the high likelihood of players being able to continue to train despite the persistent injury symptoms.

The self-reported method, in this case the Oslo Sports Trauma Research Centre Questionnaire, which was created in 2013 by Clarsen et al and developed to record the symptoms, magnitude and consequences of injuries in sport (Clarsen et al, 2020) and relies on the participants, or their parents, to report injury and illness through the questionnaire.

A strength of the self-reported method is that injuries are recorded which are not time loss injuries. On the traditional medical approach, recorded by medical staff, the injury would not have been reported if it didn’t incur time loss and therefore, the athlete would not have missed training or matches. The weakness of using the medical/ time loss approach is the athletes would not miss training 100% of the time with overuse injuries which impacts their overall mood and mental health. Using a ‘time-loss’ measurement approach has been described as an injury or injuries leading to the athlete being unable to participate in matches or normal day to day training. The time loss approach for reporting injuries is only effective for the worst injuries a player could get and would not reveal the whole picture of injury. Most overuse injuries allow athletes to take part in training but with adapted features to best fit their injury situation and would work back up to regular day to day training. Time loss only forms the very basics of reporting injuries (Clarsen, Myklebust and Bahr, 2020).

The Oslo Sports Trauma Research Centre Questionnaire is a reliable and effective measure of injury severity and has high compliance rates amongst participants. Clarsen, Myklebust and Bahr (2020) reported that compared to the traditional injury registration method, 40 injury reports, the Oslo Sports Trauma Questionnaire resulted in 419 injury reports. The completion of the questionnaire less frequently resulted in fewer injuries being identified, therefore, putting more athletes at risk of worsening their injury and potentially being out of training and competition completely.

To begin with, Oslo Sports Trauma Questionnaire was only used to collect data on overuse injuries, but the benefits soon became clear to the reporting questionnaire that it could be used to collect illness data as well as injury data. It also assisted in allowing players to continue participation after acute injuries and illness. It is therefore a strength that athletes report injury or illness even though it did not result in time loss. It is appropriate to assume that players and parents will not be as accurate as medical staff in the reporting of injuries and illness, but it captures a larger scope of injuries, such as non-time loss injuries. The illness sections were adapted into the Oslo Sports Trauma Questionnaire on Health Problems. When completing the questionnaire, the player would report the illness they had along with further information such as the symptoms they are experiencing and location. Bailon et al (2020) explain that the Oslo Sports Trauma Questionnaire has shown that there is a greater ability to identify athletes with injury and health problems and be able to estimate the severity of the illness and injury when compared to traditional methods such as the medical surveillance method.

The Oslo Sports Trauma Questionnaire was developed and validated in a 13-week study (Clarsen, Myklebust and Bahr, 2013). Specific questions around the categorisation of injury are included in the questionnaire, such as "Is this the first time you have reported this issue through this monitoring system?" and "To what extent has injury, illness or other health issue affected your performance during the past 7 days?", participants are also given an extensive list of injuries, illnesses and locations to select. Therefore, players and parents do not need medical knowledge or need to report specific medical diagnosis, they only need to report symptoms. The final page in the questionnaire reads “I have reported this issue to… (you should always discuss this with the club sports therapist)”, which directs them to the club medical staff and to have an appointment to diagnose the injury and plan the next steps.

Over the last 10 years, the questionnaire has become popular in many countries but has only been used for adults in sport. It has not yet been used on children. Therefore, this study has adapted the Oslo Sports Trauma Questionnaire to include questions relating to injury and illness so no matter what symptoms players experience, they can always answer on the same survey. The questionnaire is also being adapted into language that children will find easier to understand and questions will be in simpler terms. The benefit of using this questionnaire is that players can report injuries that have been bothering them at the start of the week, then the physiotherapist/ sports therapist can talk to the player and be updated on how they are doing throughout the week. Using this questionnaire makes it more likely that players will report injuries and illness no matter the severity, which will increase the duty of care in the club.

To be its most effective the Oslo Sports Trauma Questionnaire should be completed by the entire team or teams regularly, such as every week, as the severity, location and time loss of the injury can be monitored from week to week. The medical team and coaches then have the ability to create personalised training sessions and rehabilitation plans to allow the athlete to continue training but also nurse the given injury.

The main benefit of the Oslo Sports Trauma Questionnaire is that it allows the players to complete the questionnaire weekly and report all injuries, including the overuse injuries that allow them to continue training. The questionnaire also allows for the physiotherapist/sports therapist to know how the injury is affecting them in regard to how much the player has changed their training and competition in the last week, how much the injury or illness has affected their performance over the last week, the extent of the health issues over the last week and then answering more specific to their injury or illness. The location of injury or diagnosis of illness. This allows the nature of the injuries to be tracked over time and multiple weeks if the injury or illness persists.

It is important to conduct research in this area to, in the future, be able to prevent injuries and not just respond to and treat them after they have occurred. Issues that this creates within a group of athletes includes biological diversity between everyone and rapid growth creating a high risk of injury. Creating and using a novel injury reporting system is aiming to allow early intervention when treating athletes and discovering trends amongst injuries and maturation of athletes.

1.7. The Present Study

The research question that will be answered through this study will be; what are the differences between injury symptoms and biological maturity groups? With three further research aims of; (1): an examination of injury and illness characteristics across the youth development phase, (2): an examination of the differences in injury and illness characteristics related to growth rate, (3): an examination of the differences in injury and illness characteristics related to maturity status.

This study provides novelty in the subject due to it collecting and analysing injury and illness data from a single academy football season combined with collecting and using past and present growth and maturation data from fitness testing sessions, done three times a year. In turn, having the ability to compare both sets of data and analyse and discover if one variable affects the other and if, in the future, injuries can be predicted and what practitioners can do within their club for injury prevention and not only reacting to the injury when it occurs. This study is also the only one to compare traditional injury reporting systems, such as the Medinotes system to a more contemporary system, such as the adapted Oslo Sports Trauma Questionnaire which is quick and easy to complete and allows the athlete to express the injury in their own words as well as reporting time loss each week along with recording injuries that do not always result in time loss. This research is also completed on a lower category football academy, described as more entry level football, compared to category 1 and 2 academies as this means the results can be applied to a larger scope of youth football players instead of only the elite players in high level clubs.

2. Method

2.1. Research Approach

This project is a quantitative, single cohort, longitudinal design. Benefits of longitudinal study design include; compared to cross-sectional studies which interview new samples of people each time the questionnaires are done, longitudinal studies follow the same sample of participants over a period of time. In this case, following four academy football age groups over a full season. Another benefit of longitudinal study designs is the ability to analyse change between variables and relationships between changes in variables as it is not just one single time point. Based on the present study, as growth is dynamic, adopting a longitudinal design is more realistic because growth is not a fixed variable. Growth is a variable that will change throughout the season.

Quantitative studies are described by Yilmaz (2013) as explaining specific phenomena according to numerical data of which are analysed by mathematically based methods, such as statistics. Unlike qualitative research, quantitative research over the years has developed and well-established data collection and analysis methods. Quantitative research tests a hypothesis which contains multiple variables in order to conclude whether the hypothesis is supported.

In quantitative research the researcher agrees to philosophical assumptions (Creswell and Poth, 2018) and they explain how it is important to understand the assumptions and how they affect the research from start to finish. There are different philosophical approaches to research. This project adopts the ontological and methodological approach.

In this research, the ontology approach was undertaken. Ontology, in quantitative research, is the nature of phenomena (Creswell & Poth, 2018; Yilmaz, 2013 and Jones, 2022). This approach relates to this study via the overall research question, the style of data collection being a cross-sectional analysis of a group of people in their normal environment and there being no way of changing of taking them out of the environment. It also analyses the injury and illness of players, not only in their age group teams but also in their own maturity groups (Jones, 2022). Overall, ontology is critical to understanding how researchers understand their collected data, and this affects how the research questions develop and how to approach data analysis.

Methodology is a guide of philosophies for data collection and in quantitative research the researcher creates a general explanation of their investigation by using statistical tools (Yilmaz, 2013), and using experimental methodology (Slevitch, 2011). This process starts with research questions, aims and operator interventions followed by analysing the results and determining if they support the hypothesis or not. Reliability, defined as the consistency of a measure, and validity, defined by the accuracy of a measure, are both used to evaluate the research done (Yilmaz, 2013) as it is important that all results from the research are collected fairly and not a result of bias or negatively influenced by controllable factors. This approach relates to the study by having specific aims and a specific question that the study will answer concerning injury symptoms and maturity groups and gathering numerical questionnaire data followed by analysing such data to answer the question and aims of the study.

Quantitative research uses deductive reasoning rather than inductive reasoning and involves the research first creating a research question or hypothesis then collecting and analysing the data and finally theorising the analysing and concluding if the results support the hypothesis or not. Therefore, the deductive method narrows the information from general to more specific (Kim, 2021).

Positives of quantitative research include objectivity and generalizability to evaluate research. Objectivity in research is conducting the study without being influenced by any personal opinions or being impacted by bias. Generalizability is defined as the ability for the findings of the study to be generalised and applied to the entire population of who the study was conducted on (Myers, 2000).

In conclusion, quantitative research allows for the researchers to test any hypothesis and not be influenced by any bias or personal subjectivity, however, does not allow for personalised details of participants' experiences to be recorded (Moroi, 2021).

2.2. Participants and Sampling

The sampling strategy of the study is male players at an anonymised football club academy in the age groups of under 12s to under 15s, meaning the ages are 11-15 by the end of the data collection. Whole group mean and standard deviation age of 12.72 ± 1.13, height of 163.52 ± 12.17, weight of 50.02 ± 11.80, biological age of 13.42 ± 2.11 and growth rate per year of 4.93 ± 3.31.

These age groups have been specifically chosen as the adolescent growth spurt begins at 10-12 years old in boys and the peak height velocity (PHV) occurs at ages 13-15 (Wik 2022). Therefore, collecting data on the under 12s to under 15s age groups, the average age at the adolescent growth spurt and peak height velocity is included in collecting injury and illness data on the players. Collected data on these age groups will allow to find trends in injury location, severity, and frequency along with illnesses that may become common in certain age groups. The participants will be recruited through the football club academy using information sheets, mobile application posts and word of mouth.

Convenience sampling was the main sampling strategy used in the study as it involved using participants and respondents who were convenient to the researcher, in this case, recruiting all under 12 to under 15 football players at the academy (Elfil and Negida, 2017). All participants in the study held the same feature, therefore, criterion sampling was another main sampling strategy used. Criterion sampling involved selecting a certain population that held characteristics that related heavily to the study rather than selecting participants randomly. This style of sampling has been said to allow for purposeful sampling and allows for the researcher to collect detailed information from the selected participants (Das et al, 2022). Quota sampling is defined as choosing a population on the basis of specific characteristics that are of interest and relate to the study and are not chosen at random (Bhardwaj, 2019). Participant number in quantitative research varies on what is being investigated, however, Delice (2010) suggest sample size should be no less than 30 included in the final data analysis, therefore, recruiting more than 30 participants is crucial if some participants either drop out of the study or not enough data is collected from certain individuals and cannot be used in the final data analysis and discussion. Bahr and Holme (2003) have also suggested 20-50 participants are required in quantitative studies to create moderate to strong relationships between variables, therefore, the participant number in this study is adequate.

2.3. Measures

Height was measured to 0.1 of a centimetre (Casadei and Kiel, 2019) using the Seca Stadiometer and the participant stood up straight, looking forwards without their nose in the air and asked to take a deep breath in and the measurement was taken. This was completed three times for reliability and validity. Sitting height was also taken using the Seca Stadiometer and to 0.1 of a centimetre (Casadei and Kiel, 2019) with the participant sat on a wooden box that was placed directly in front of the stadiometer with their feet positioned flat on the floor. The participant then sat up completely straight and asked to take a deep breath in and the measurement was taken three times. The height of the box was subtracted from the final sitting height measurement (UK Biobank, 2011).

Weight was measured using the Tanita BC-543 Body Composition Monitor and recorded to 0.01 of a kilogram (Casadei and Kiel, 2019). The participant was asked to remove their shoes and any heavy hoodies or jumpers and breathe out once they had stepped onto the composition monitor. Three weights were recorded for validity and reliability.

All were measured according to the guidelines of the International Society for the Advancement of Kinanthropometry (ISAK) guidelines (ISAK, 1986).

Growth rate was calculated by the most current recorded height of the youth athlete being subtracted from the previous height of the youth athlete at the previous fitness testing session to discover the athlete’s most up to date growth rate per year. The participants were measured three times throughout the year; therefore, we had a growth rate for the first half of the season and a growth rate for the second half of the season. Once growth rate had been calculated they were then put into one of three categories; slow growth rate (growing less than 3.5cm per year), moderate growth rate (growing between 3.5cm and 7.2cm per year) or fast growth rate (growing more than 7.2cm per year) as used and suggested by Monasterio et al (2024).

Predicted adult height (PAH) was calculated using the Khamis-Roche method. This method uses the child’s height, weight and gender along with the parent’s height.

(Khamis and Roche, 1994). The formula that was used was: Predicated Adult Height = β_o + stature* β_1 + body mass*(β_2) + corrected mid-parent stature *β_3.

Note: β_o, β_1, β_2, and β_3 are the gender specific intercept and coefficients by which age, stature (in), body mass (lbs) and mid-parent stature (in) respectively should be multiplied from the coefficients table accessible in Khamis and Roche (1994). Correction factor for self-reported height in males is (Parental Height [cm]*0.955) + 2.316. (Salter et al, 2022).

Then we had the ability to estimate whether they had experienced their peak height velocity (PHV), defined as the time when the annual height increase is maximized (Tsutsui et al, 2022). They were then put into one of three categories depending on their PHV percentage. Pre PHV at <88% of PAH, circa PHV at 88% to 95% and post PHV at more than 95%. Biological age was calculated by current percentage of adult height and the difference of this compared to UK growth charts (UK 1990 dataset) (Cole, Freeman and Preece 1998). The participants' biological age was calculated by their chronological age minus their biological age.

Athlete exposure was calculated as a team-based average, with two 90-minute training sessions and 60 minutes per athlete in a match, equalling 4 hours of football playing time a week per athlete. Injury and illness incidence was calculated by the number of injuries reported divided by the total potential number of hours of athlete exposure multiplied by 1000. Injury and illness prevalence was calculated by determining how many athletes from each age group had reported an injury of any severity and transforming that number into a percentage for the age group. Both injury and illness incidence and prevalence were sub grouped into age groups which included calculating the number of injuries reported by the age group and dividing by the total potential number of hours of athlete exposure, then multiplied by 1000 for incidence. For prevalence, the number of athletes in each age group that had reported an injury or illness throughout the season were collected and created into a percentage. The reason for this was to be able to visibly see which age groups were more prevalent to injuries.

From the sample, 5 players did not have a recorded growth rate due to them having only one set of growth data. They needed to have attended at least 2 testing session throughout the season to have acquired a growth rate. Additionally, 5 players did not have a reliable estimated maturity status and, were therefore, left out of the maturity data analysis.

2.4. Procedure

Prior to data collection, this study was given ethical approval from York St John ethics committee (Ref- SPO6001M_ 209025215). Participants needed to undertake one short questionnaire every week during football season to self-report and declare if they had experienced either an injury, illness or fully participated in training and matches for that week. A guidance document containing simple definitions for injury, illness and symptoms was provided to each participant to ensure both the participant and parent understood what they or their child was suffering from. Injury was defined as “physical damage to your body caused by sport, falls and impacts”. Illness was defined as “a period of time where a part of the body is unable to work as normal, causing sickness or feeling unwell”. Finally, symptoms were defined as “something that a person feels that may express that they have an injury or illness”. Each participant was provided with a small information card with a QR code on so they could scan it with either their smart phone or parents’ smart phone to be able to complete the questionnaire each week. The questionnaire would have taken no longer than three minutes to complete as it was constructed as mostly tick boxes and the opportunity to give further details on any injury or illness reported.

All data collected was stored on a password protected computer and OneDrive file which was only accessed by the principal researcher and supervisors. Participants were anonymised with a participant unique identity number and data will not be able to be tracked back to the original source.

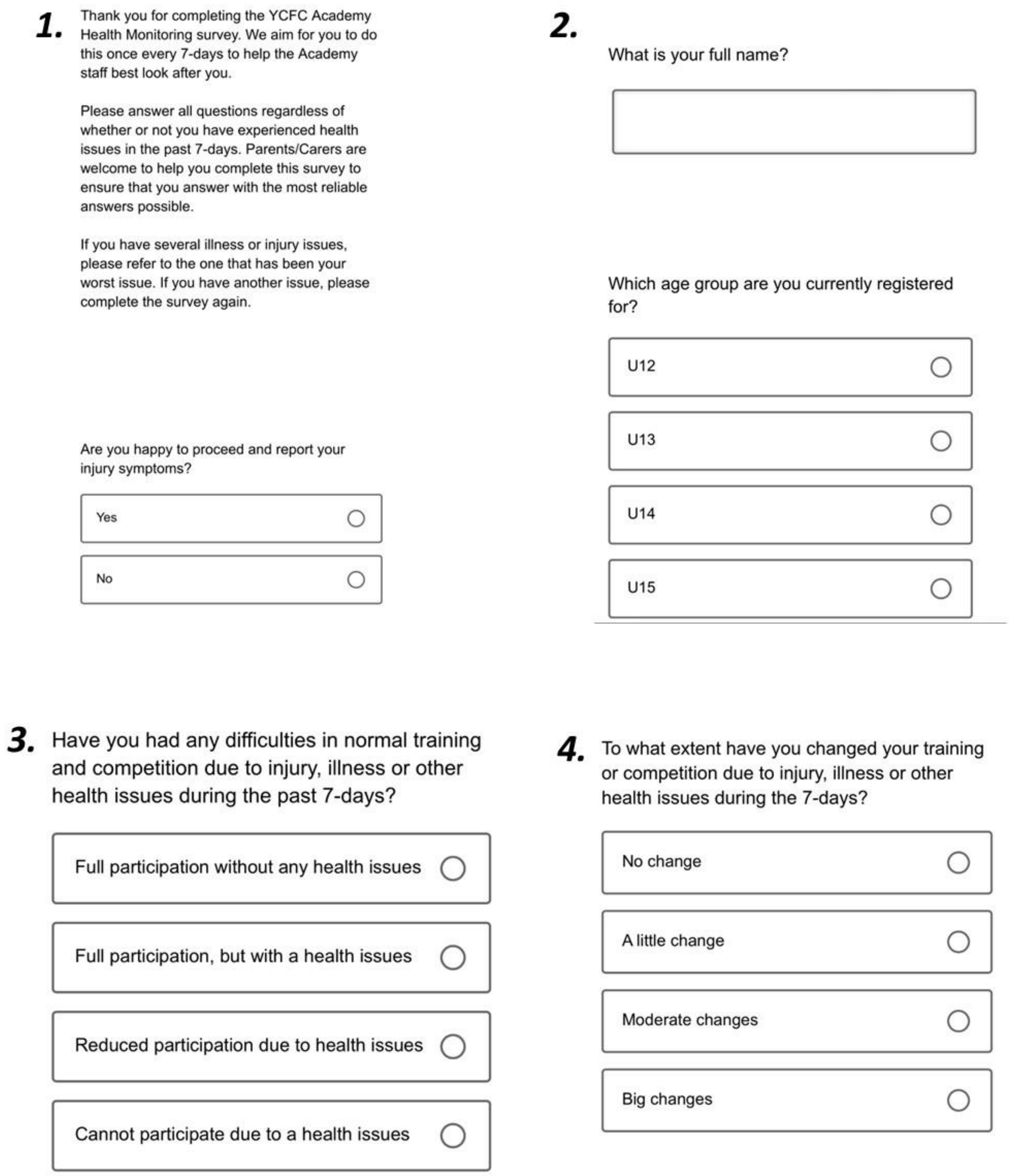
Prior to completing the questionnaire weekly, all participants and parents of the participants were given a parental information sheet and a participant information sheet which included all the information about the study and how the data that was collected will be used as well as the known right to withdraw their child from the study at any time without giving a reason. Consent was recorded by both parents and players at the point of registration for the club and is repeated annually.

Ethical considerations have been acknowledged, the first being autonomy where both the participant and parent know that participation is completely voluntary and have the right to withdraw at any time without giving a reason. The participant could also request their data to be removed from the investigation until four weeks, or 28 days, after the date they took part in the study. Consent was also gained at the start of each questionnaire completed. There were minimal risks of taking part in the study beyond those of normally completing the participant’s sport.

There was an application of a validated injury symptom reporting system, the Oslo Sports Trauma Research Centre questionnaire (Clarsen et al 2020) and was used as a guide to collect data on the four age groups. The data that was collected will monitor the different illness, injury, and health issues across the age groups (Wik, E.H. 2022). The objectives of this study and design would allow for discovery and application of early intervention of injuries and if injury symptoms change throughout early maturation.

Figure 1, below, shows each page of the adapted injury and illness symptom reporting survey that the participants completed every week with the club that participated being anonymised.

Figure 1:



1. Thank you for completing the YCFC Academy Health Monitoring survey. We aim for you to do this once every 7-days to help the Academy staff best look after you.

Please answer all questions regardless of whether or not you have experienced health issues in the past 7-days. Parents/Carers are welcome to help you complete this survey to ensure that you answer with the most reliable answers possible.

If you have several illness or injury issues, please refer to the one that has been your worst issue. If you have another issue, please complete the survey again.

Are you happy to proceed and report your injury symptoms?

- Yes
- No

2. What is your full name?

Which age group are you currently registered for?

- U12
- U13
- U14
- U15

3. Have you had any difficulties in normal training and competition due to injury, illness or other health issues during the past 7-days?

- Full participation without any health issues
- Full participation, but with a health issues
- Reduced participation due to health issues
- Cannot participate due to a health issues

4. To what extent have you changed your training or competition due to injury, illness or other health issues during the 7-days?

- No change
- A little change
- Moderate changes
- Big changes

5. To what extent has injury, illness or other health issue affected your performance during the past 7-days?

- No effect on performance ○
- Little impact on performance ○
- Moderate impact on performance ○
- Big impact on performance ○

6. To what extent have you experienced health issues during the past 7-days?

- No symptoms/health issue ○
- A little ○
- Moderate symptoms ○
- Severe symptoms ○

7. Is the health problem referred to in the four questions above an injury or an illness?

- Injury ○
- Illness ○

8. Please state the number of days over the last 7-days that you have had to completely miss training or competition due to this problem.

0 1 2 3 4 5 6 7

Days missed

9. Is this the first time you have reported this issue through this monitoring system?

- Yes, this is the first time ○
- No, I have reported the same issue in one of the previous four weeks ○
- No, I have reported the same issue previously, but it was more than four weeks ago ○

10. I have already reported this issue to...
(you should always discuss this with the club sports therapist)

- Academy Sports Therapist ○
- Other Sports Therapist/Physiotherapist ○
- General Practitioner (GP)/Doctor ○
- Other (Please provide details) ○

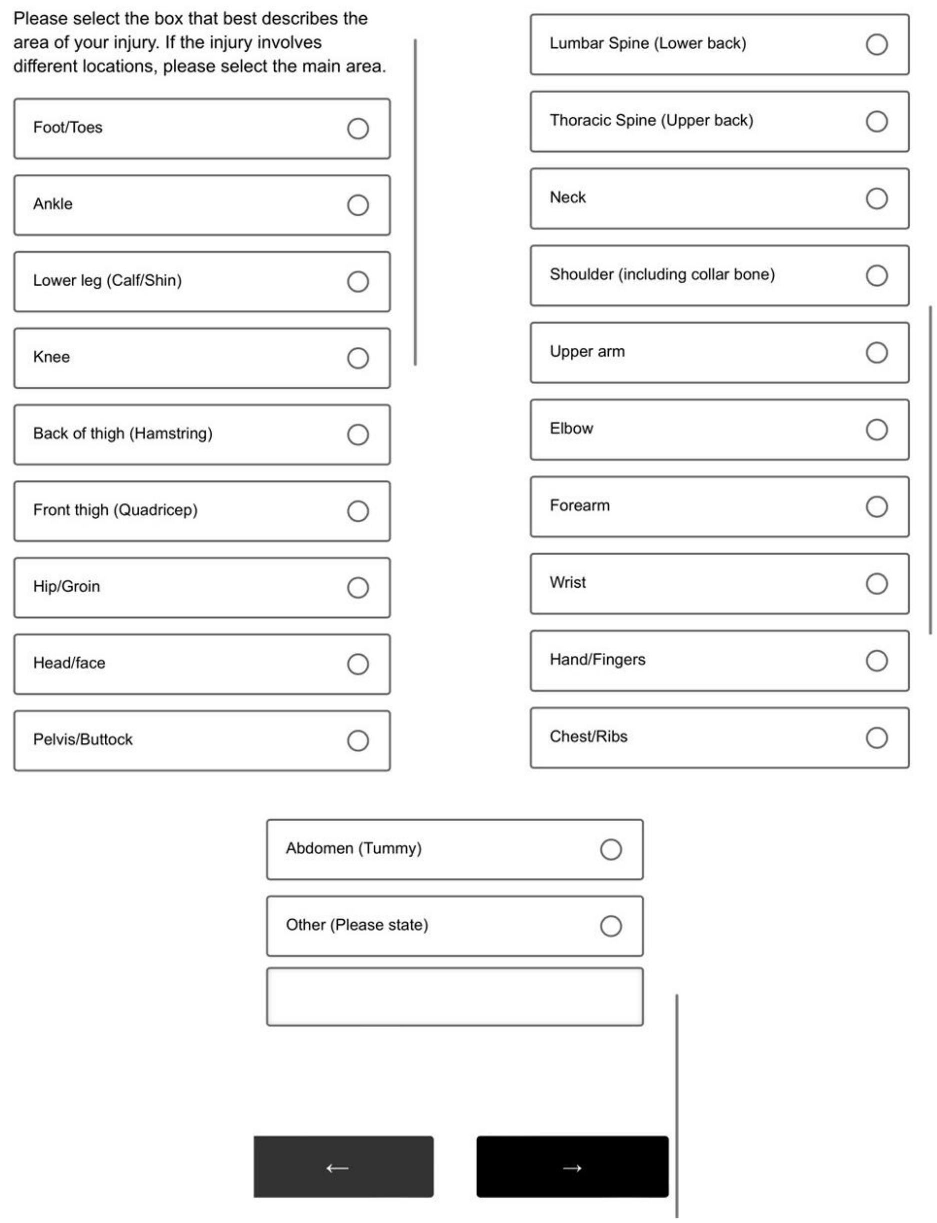
11. Please use this field to report any additional information regarding this problem to the Academy medical team

12. We thank you for your time spent taking this survey.
Your response has been recorded.

Powered by Qualtrics

Figure 2 shows the options of injuries the participants can select when completeting the survey with an option to type in their own answer. These injuries are written in a simplified language to make it as easy for them as possible to complete, such as ‘back of thigh’ being used for the scientific word, hamstring.

Figure 2:

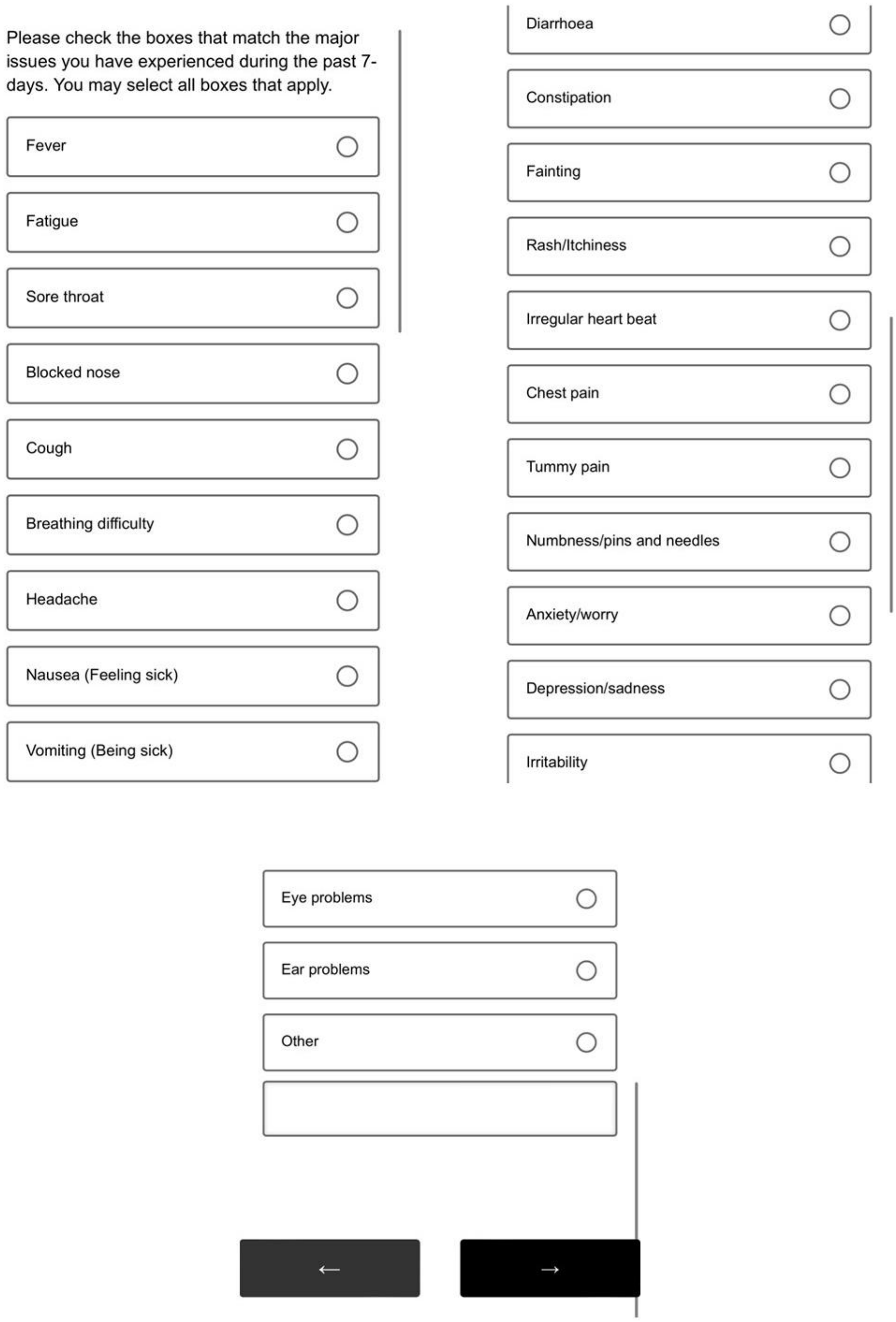

Please select the box that best describes the area of your injury. If the injury involves different locations, please select the main area.

- Foot/Toes
- Ankle
- Lower leg (Calf/Shin)
- Knee
- Back of thigh (Hamstring)
- Front thigh (Quadricep)
- Hip/Groin
- Head/face
- Pelvis/Buttock
- Lumbar Spine (Lower back)
- Thoracic Spine (Upper back)
- Neck
- Shoulder (including collar bone)
- Upper arm
- Elbow
- Forearm
- Wrist
- Hand/Fingers
- Chest/Ribs
- Abdomen (Tummy)
- Other (Please state)

← →

Figure 3 shows the options of illnesses the participants can select when completing the survey with the option to type in their own answer. These illnesses are written in a simplified language to make it easy for the participants to understand, such as ‘nausea’ being written with the less scientific way of ‘feeling sick’.

Figure 3:



Please check the boxes that match the major issues you have experienced during the past 7-days. You may select all boxes that apply.

- Fever
- Fatigue
- Sore throat
- Blocked nose
- Cough
- Breathing difficulty
- Headache
- Nausea (Feeling sick)
- Vomiting (Being sick)
- Diarrhoea
- Constipation
- Fainting
- Rash/Itchiness
- Irregular heart beat
- Chest pain
- Tummy pain
- Numbness/pins and needles
- Anxiety/worry
- Depression/sadness
- Irritability
- Eye problems
- Ear problems
- Other

2.5. Analytical strategy

There were several steps of data analysis for this study. Firstly, raw data was screened for missing or incomplete data. These included participants missing questions in the survey and therefore leaving out key details such as the injury location or illness type or completing the survey more than once weekly, this would then include talking to the participant and clarifying which survey entry is the correct one. Survey entries were removed from the data collection if information was missing, and steps had been missed. For example, skipping the question ‘to what extent have you changed your training or competition due to injury, illness or other health issues during the 7 days?’ and other questions. This is due to the final injury or illness severity number being affected and not reporting the true value. This was not a major issue in the data collection as there were only 4 instances where participants submitted more than one response per week. This issue was easily resolved as sometimes the survey completion was a duplicate of the first response they submitted or just a very quick conversation to confirm which survey answer was the correct one that they wanted to be recorded for the study. Data was also screened for compliance rates, and participants who had completed the questionnaire less than 60% of the time were cut from the final data. This left the participant number going from 69 participants down to 37, which is 53.62%. Both injury and illness recorded on the adapted Oslo Sports Trauma Questionnaire were calculated and given a severity scale number with 0 being ‘full participation without any health issues’ and 100 being 'cannot participant due to health issues’ and a variety of numbers relating to the options of ‘full participation but with a health issue’ and reduced participation due to health issues’. The Oslo Sports Trauma Questionnaire severity score was calculated by the responses to each of the four main questions listed above is assigned a numerical value ranging from 0 to 25. Together, these values are added to calculate the overall severity score from 0 to 100. A participant being allocated a severity score of 0 represents that they had no problems with injury or illness that week and 25 represents the maximum score for each of the questions. Intermediate responses such as ‘full participation but with health issues’ were given values to ensure a balance distribution of values and remaining with whole numbers. Specifically, questions one and four were scored 0-8 – 17-25 and questions two and three were scored 0-6-13-19-25. Overall, the severity score serves as an objective indicator of the impact of an injury or illness on a player and has the ability to be used multiple times to track the progression of the injury or illness (Clarsen, Myklebust and Bahr, 2013).

Secondly, the descriptive statistics were analysed, computing the means and standard deviations of valid responses. Thirdly, bivariate correlations were used to examine the relationships between variables and used Cohens d (Cohen, 1988) to interpret. Between group ANOVA was completed using a significance of $p<0.05$ using a Bonferoni adjustment and differences were determined using pairwise comparisons. The differences were interpreted using Cohens d with a scale of 0-0.2 = trivial, 0.2-0.5 = small, 0.5-0.8 = moderate and >0.8 = large (Cohen, 1988, Hedges and Olkin, 1985 and Lakens, 2013).

Finally, multiple linear regressions were conducted, further examining the predictive nature of the relationship between variables with injury/illness characteristic set as the dependant variable. All analyses were computed using Jeffrey’s Amazing Statistical Package, JASP (2024). The threshold for statistical significance for the p-value was $p< 0.05$. Interpreting Cohens d included having a small effect size if the lower and upper values did not cross 0.

To address aim one of ‘an examination of injury and illness characteristics across the youth development phase’, descriptive statistics were undertaken and a visual representation of all injuries and illnesses, including, percentages of all injuries and illnesses reported. To address aim two of ‘examining the differences in injury and illness characteristics related to growth rate’ and aim three of ‘examining the differences in injury and illness characteristics related to maturity status’, between group ANOVAs were completed of injury and illness symptoms in growth groups and maturity groups.

3. Results

3.1. Descriptive statistics

Data was collected over the 32-week competitive period with 37 participant's data being included in the final analysis. Due to absence, injury or illness it was not possible to calculate growth rate on five participants and therefore they were excluded from analysis. A total of 842 survey responses were collected, the average compliance rate was 22.7 survey responses per participant over the 32 weeks. 53.6% of the cohort was included in the final data with 46.4% of the initial sample excluded as they fell below the 60% minimum benchmark of survey completion. Table 1 shows the descriptive statistics of the 37 participant's characteristics across the age-groups.

Table 1: Participant Characteristics

Age Group	U12 (N = 8)	U13 *(N = 6)*	U14 (N = 11)	U15 (N = 12)	Overall (N = 37)
Height (cm)	148.7 ± 5.4	157.3 ± 5.8	165.5 ± 9.7	174.5 ± 6.5	163.52 ± 12.17
Body Mass (kg)	36.7 ± 2.6	45.3 ± 8.6	49.6 ± 8.4	61.6 ± 7.2	50.02 ± 11.80
Predicted Adult Height (%)	83.7 ± 1.5	87.5 ± 1.8	91.5 ± 2.8	95.3 ± 2.7	90.90 ± 5.05
Biological Age (years)	11.8 ± 0.3	13.0 ± 0.4	14.0 ± 0.7	15.1 ± 0.8	13.42 ± 2.11
Growth Rate (cm/year)	3.6 ± 1.0	7.3 ± 3.3	6.7 ± 3.1	3.2 ± 2.6	4.93 ± 3.31
Injury Incidence (no. injuries per 1000 hours)	9.7	23.4	9.2	15.6	13.7
Illness Incidence (no. illness per 1000 hours)	3.9	9.1	4.9	2.6	4.6
Injury Prevalence (%)	75	66.6	72.7	91.6	78.37
Illness Prevalence (%)	37.5	33.33	36.36	8.33	27.02

3.2. Injury Type, Location and Frequency

Figure 4: Visual representation for the injury type, location and frequency reported across the whole sample.

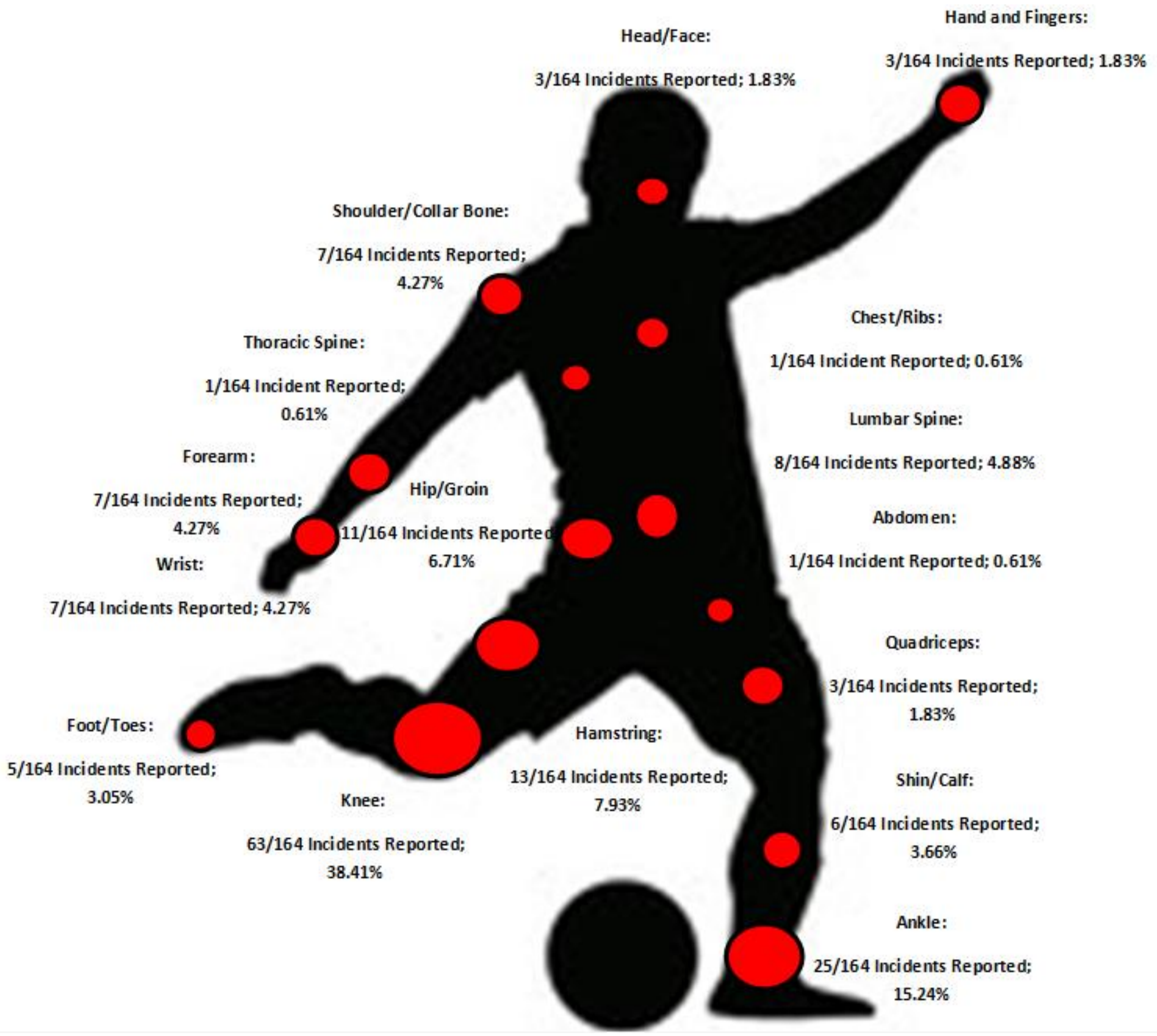


Figure 4 shows a visual representation of injury type, location and frequency reported on the survey throughout the 32 weeks of data collection. The results concluded 164 injuries reported on the survey and grouped into 16 categories. The variation in red circle size gives a visual representation of reported injury frequency throughout the data collection period, larger red circles indicate a higher frequency of reports. The knee showed the highest prevalence of injury followed by the ankle then the hamstring.

3.3. Illness Type and Frequency

Figure 5: Visual representation of illness type and frequency across the sample.

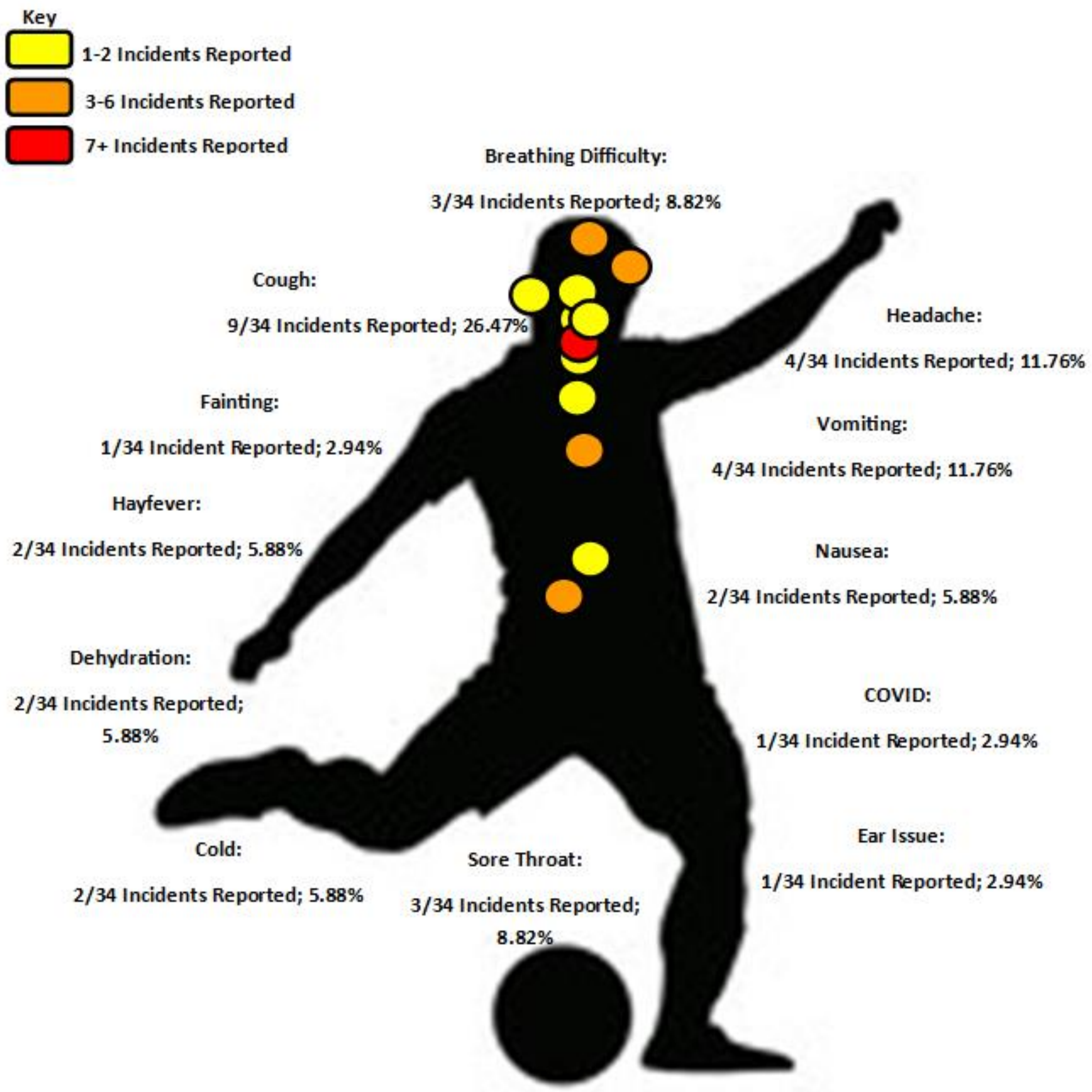


Figure 5 shows a visual representation of illness type and frequency reported on the survey throughout the 32 weeks of data collection. The results concluded 34 overall illnesses reported on the survey and grouped into 12 categories. The yellow, orange and red circles give a clear visual representation on the frequency of specific illnesses reported during the data collection period. This is due to all the illnesses being in either the head, throat, chest or stomach area and no colour difference would make it difficult to differentiate the illness reporting frequency. A cough had the highest illness prevalence followed by headache and vomiting.

3.4. Growth Group Comparison to Injury and Illness

Table 2: Between growth group comparisons of injury and ill-health incidence (mean ± SD)

	Low Growth Rate (N = 4)	**Low-Mod Comparison P-value *Cohens d***	**Mod Growth Rate (N = 19)**	**Mod-High Comparison P-value *Cohens d***	**High Growth Rate (N = 9)**	**Low-High Comparison P-value *Cohens d***
Injury Incidence	7.5 ± 22.4	0.027* *0.245 [-0.471,-0.020]***	14.6 ± 32.9	0.137 *0.202 [-0.041, 0.444]*	8.8 ± 25.6	1.000 *-0.04 [-0.319, 0.232]*
Health Incidence	1.4 ± 8.0	1.000 *0.015 [-0.209, 0.240]*	1.3 ± 9.3	0.095 *-0.217 [-0.460, 0.025]*	3.7 ± 17.0	0.236 *-0.20 [-0.478, 0.074]*

*p<0.05 **small effect size

Table 2 shows growth group in comparison to injury and ill-health incidence and results show there being a statistical significance between the low-mod comparison group and injury incidence with the p-value being less than 0.05. There is also a small effect size between the low-mod growth group and injury incidence due to the lower and upper values of Cohens d not crossing 0.

3.5. Maturity Group Comparison to Injury and Illness

Table 3: Between maturity group comparisons of injury and ill-health incidence (mean ± SD)

	Pre-PHV (N = 4)	**Pre-Mid Comparison P-value *Cohens d***	**Mid-PHV (N = 19)**	**Mid-Post Comparison P-value *Cohens d***	**Post-PHV (N = 9)**	**Pre-Post Comparison P-value *Cohens d***
Injury Incidence	8.0 ± 23.1	0.031* *0.20 [0.013, 0.403]***	13.7 ± 32.0	0.094 *-0.20 [-0.430, 0.023]*	8.1 ± 23.5	1.000 *0.00 [-0.230, 0.240]*
Health Incidence	2.0 ± 12.9	1.000 *0.02 [-0.173, 0.216]*	2.3 ± 12.0	0.313 *-0.15 [-0.379, 0.073]*	0.5 ± 5.5	0.538 *-0.13 [-0.367, 0.103]*

*p<0.05 **small effect size

Table 3 shows maturity group in comparison to injury and ill-health incidence and results show there being a statistical significance between the pre-mid comparison group and injury incidence with the p value being less than 0.05. There is also a small effect size between the pre-mid comparison group and injury incidence as the Cohens d values do not cross 0.

4. Discussion

4.1. Primary and Secondary Findings

The aim of this study was to investigate the impact of biological maturation on injury and health incidence across a full season in an academy setting. The primary findings of this study are threefold: a). there is a significant relationship between the low and moderate growth rate group related to injury incidence, b) there is a significant relationship between pre-PHV and mid-PHV maturity group and injury incidence, and c) there are no significant differences between biological maturity and ill-health within an academy setting. In other words, both growth rate and maturity status are important factors that contribute to injury risk in adolescent players, relating back to aim one and two of the study. Secondary findings show that the most prevalent injury sites as being knee and ankle injuries, both major and minor and time loss injuries and non-time loss injuries. Finally, injury prevalence was in the mid 30% for all age groups apart from the U15 age group which declined significantly to 8.33% of all participants in the U15 age group having experienced an injury in academy football season.

Injury characteristics and growth rate and maturity status were examined from a descriptive point of view and then ANOVAs were completed to compare the relevant groups, and the magnitude of difference was interpreted with Cohens d.

4.2. Injury Incidence and Prevalence

Injury incidence was at its peak during in the U13 group, who are almost all in the mid maturity group. As these youth athletes are in the middle of maturation, there is a risk of maturation and growth-related injuries such as minor and major muscular injuries. This relates to Parry et al (2024) with their results showing an increase in injury incidence and burden as maturation advances with a variation of injury type, which matches the results of the present study.

Injury prevalence was at its peak in the U15 group, with 91.6% of players reporting an injury at some point in the season. All of these players were in either the mid or post PHV groups and in the moderate to high growth rate groups. High injury prevalence can be related to the youth athletes either picking up impact injuries during matches or training, or small muscular injuries due to overuse. Bult, Barendrecht and Tak, (2018) matched this data by reporting that young football players, 6 months after peak height velocity, are more prone to injuries and the U15 group having the second highest injury burden percentage, 28%, of the whole study. It has been suggested that more research is conducted on injury factors and preventative measures be implemented on more specific age groups.

4.3. Growth Rate and Injury

Results in relation to growth rate and injury show that injury incidence rates increased in participants who were between the low and moderate growth rate group, with a significant p-value of 0.027, in comparison to those participants classified in the moderate to high growth rate group which was not a significant value. Therefore, it is shown that growth rate is a significant issue in relation to injury incidence. Players with a low to moderate rate of growth are not only statistically significant but have a small effect size of Cohens d at -0.471, -0.020. This relates to previous research as players get more musculoskeletal injuries because of the change in tissues and bones (Johnson et al, 2022). From an injury perspective, when growth rate begins, this is when both minor, major and overuse injuries begin to happen. Injuries during low to moderate growth can be caused by the ‘awkward phase’ as discussed earlier (disordered neuromuscular control) or an imbalance in the muscle and tendon growth (Parry et al, 2024) which can be caused by muscles being overused and becoming fatigued, or, relating to bone growth, muscles being overstretched during growth and the youth athlete not keeping up with their stretching to assist the natural stretching of the muscles during bone growth. This result matches Monesterio et al (2024) with a higher injury incidence rate in players with moderate growth. They also found that the participants with higher growth rates were at greater risk of growth-related injuries and found that incidence rates and joint and ligament injuries were common with participants with slow growth rates, such as post PHV when being compared to participants with moderate growth rates. However, the present study disagrees with Wik et al (2020) who found that rapid growth is associated with increased injury rates. The rest of the data has no statistical difference because of the small groups.

Towlson et al (2021) explains how post-PHV injuries tend to be less traumatic and severe, and are usually more overuse injuries, however, other studies say injury incidence increases in the post peak height velocity group with youth athletes growing faster because of the athletes moving with more power, including being faster therefore resulting in bigger impacts and resulting in more traumatic injuries (Monesterio et al, 2024). This disagrees with the present study’s findings as there was no relationship or small effect size in relation to post peak height velocity and injury, possibly due to smaller participant numbers. Additionally, Parry et al (2024) found that injury incidence and burden for growth related and lower back injuries increased during peak height velocity.

This study has conflicting results in comparison to Monesterio et al (2024) as they found that injury incidence and burden rates were increased in pre PHV (<88% of predicted adult height) athletes who were growing quickly, rather than slow to moderate growth rates have the highest incidence and burden rates. Then follows up with all players who are growing rapidly and are at risk for growth related injuries, such as muscular strains and tears no matter which growth group they are in, which is where the argument is for the present study results to agree with what was found in the previous research with higher injury incidence in relation to low to moderate growth rate. Therefore, players that are in the low (less than 3.5cm per year) to moderate (3.5 to 7.2cm per year) growth group should be taken into account by practitioners, such as coaches, physiotherapists and strength and conditioning coaches, that players growing a maximum of 7.2 cm per year should be monitored.

4.4. Maturation Status and Injury

Although the results were analysed, the findings are limited due to the smaller sample size. The results show injury incidence, and severity is higher in the pre to mid maturity group with a significant p-value result of 0.031, therefore, maturation status is a significant issue within injury incidence. Results show that academy football players with a lower injury incidence are in either the maturity groups of pre-PHV or post-PHV with the highest injury incidence rates in players are mid-PHV. There is a significant difference when comparing pre and mid PHV with the p value being less than 0.05 at 0.031. This is due to bones growing first and naturally they will pull on tendons and tighten the tendons which creates a higher risk of injury. During this time the athletes would be experiencing stretching in their tendons which may lead to injury in the period when they have a heavy frame due to heavy bones and their muscular system, including tendons, ligaments and muscles haven’t adapted. Due to this, for a period of 6 to 9 months, as the athletes have heavy frames, they don't have the musculoskeletal system to deal with the growth and have poor coordination and therefore are at higher risk of injury compared to other athletes. They also have a relative strength deficit so they may be heavy but are physically weak because their muscle system hasn't developed or is in the middle of developing. This may include not decelerating effectively, not landing correctly from jumps and this results in the athletes having more non-contact injuries. Once the athletes go through that phase and their muscular system catches up again, injuries reduce to pre maturation levels. This is explained by the stretch shortening cycle where muscles eccentrically stretch before then concentrically shorten. In youth athletes, this can cause muscular injury as during growth and maturation muscles grow a lot slower than the bones they are attached to. Therefore, the explosive movements youth athletes do during their sport, such as maximum jump and quick acceleration when sprinting, can be a risk of injury if the youth athlete does not have a regular stretching regime to assist the muscles when bones are growing more rapidly (Radnor et al, 2018 and Harrison and Gaffney, 2004).

The age at which an athlete is skeletally mature is age 18 and is at 100% of their adult height, therefore, all participants in this study were skeletally immature. Materne (2021) explains how European research shows a link between skeletal maturity status and injury incidence and pattern in youth football academies. With Johnson, Doherty and Freemont (2009) suggesting that injury could be predicted in youth football players by using skeletal maturity along with training and match hours. During the growth spurt, also known as rapid growth, before closure of the growth plates, youth athletes are at risk and vulnerable to many overuse and traumatic injuries due to the immature skeleton (DiFiori et al, 2014 and Merkel, 2013). This can explain the results discovered in this study with a significant relationship between injury incidence and the comparison of pre to mid maturity groups. High and significant injury incidence rates in that group support the immature skeleton theory as the youth athletes are beginning and in the middle of their maturation, therefore skeletons are developing and fragile, making injury chances greater. However, this would also be expected, although not as high and aggressive, for the mid to post comparison group. Materne (2021) reported that players who are skeletally mature had a lower risk of lower extremity apophyseal injuries, however, they were still at risk of pelvis and hip apophyseal injuries. Even though data is not statically significant (at a value of 0.094) in this group the data is not far from being a significant value, 0.044 off being significant.

The use of mechanotransduction can be very useful during this time. Mechanotransduction is described as physical cues, such as exercises that are transformed into biological responses (Martino et al, 2018). The process of mechanotransduction involves the athlete exercising which creates circling hormones, also called mechanocoupling and biochemical coupling, and the mechanical load that is experienced by the muscles and tendons etc stimulates the growth change in tissue and effector cells. Growth in the tissue takes time to do so, therefore, this leaves the body exposed for a period of time before the effector cell response. Once the athlete's body has adapted, they are then better to handle the demands of their sport (Ramaswamy and Misch, 2015).

4.5. Injury Type, Location and Frequency

This study revealed that 167 injuries were reported throughout the data collection season and grouped into 16 categories. The four most common injury sites were knees (n=63 38.41%), ankles (n=25, 15.24%), hamstrings (n=13, 7.93) and hips/groins (n=11, 6.71%). All the listed injuries are lower extremity, this being due to football being a primarily lower extremity sport with the exception of upper extremity injuries reported such as the shoulder/collar bone (n=7, 4.27%), forearms (n=7, 4.27%) and wrists (n=7, 4.27%). These findings agree with Price (2004), as their most common injury sites included the thigh (19%), ankle (19%) and the knee at (18%).

It was very common to see injuries such as ankle sprains and minor hamstring discomfort being reported as these injuries are mostly experienced during matches when contact is made to the player, tackles, jumps and the factor of unpredictability of movement of the ball. Knee injuries were at such an increase in reports due to growing pain in the knee, also known as Osgood Schlatters which causes pain below the patella caused by the youth athletes growing, with the femur growth a lot faster than the quadriceps, causing irritation with the quadriceps and femur having an impingement, making the youth athlete feel different levels of discomfort when running and jumping (Smith and Varacallo, 2017).

These results matched injury types, location and frequency reported in past studies, with Light et al (2021) reporting that knee, ankle and hip/groin injuries were amongst the highest frequency of injury reported within a cohort of U9 to U21 academy football players. Weishorn et al (2023) also found that knee and ankle were two of the highest reported injuries within their cohort of 138 youth football players.

Ultimately, it is clear that the lower extremity injuries, as listed above, are a problem when it comes to injuries in academy football and result in high time loss from training and matches for players. Therefore, practitioners should work to strengthen these areas so even the unpredictable injuries from tackles can be as minor as possible. Growing pains such as Osgood Schlatter's and Severes' disease should also be taken into account. Stretching and exercise regimes should be done with the athletes who are susceptible to higher pain and inflammation levels.

4.6. Illness Type and Frequency

This study discovered that the most reported illness type during the data collection season was coughs (n=9, 26.47%) followed by headaches (n=4, 11.76%) and vomiting (n=4, 11.76%). These are all illnesses that would prevent the athlete from participant in training or games. It is increasingly difficult to prevent youth athletes from catching or developing an illness; therefore, practitioners have no control over illness prevention strategies. Youth athletes should prioritise health and focus on recovery when nursing an illness, instead of participating in strenuous tasks and training which, in the end, may make them feel worse.

In closing, there has been no past research on illness in relation to growth and maturity status alongside illness type and frequency. Therefore, there is not any previous research to compare the findings of this study to. As such, past and present trends cannot be identified. Future research should investigate illness compared to growth and maturity status to discover if there is a trend in the topic.

4.7. Growth Rate, Maturity Status and Health

There are no significant relationships between growth rate and health incidence rate or maturity status and health incidence. This was expected as there is no past research to give any indication as to such and no research papers which have suggested or proven that because academy football players are experiencing growth and maturation, they are going to experience more health and illness issues. One of the only reasons that some participants may have encountered and reported more illnesses is they may have been in the presence of school peers, friends or sport teammates who may have been carrying and passing on illness. Furthermore, this is not to say there is not any relationship between illness and growth rate and maturity status. There may be no statistical significance because of the small participant groups. Future research should be completed on the topic with the assistance of larger and more diverse samples and data sets; this could cause a significant relationship to be discovered.

4.8. Adapting and Implementing the Oslo Sports Trauma Questionnaire

As this study was completely novel, adapting and implementing a novel injury reporting system, the Oslo Sports Trauma Questionnaire has allowed for injury and illness results in relation to maturation status and growth rate to be analysed and discover significant relationships between. It has allowed for the ability of early intervention when athletes report any injury or illness and the ability to discover different trends in different group such as age groups, maturation groups and growth groups. It is one of the most effective injury and illness reporting surveys and can be adapted to suit any cohort, as demonstrated with this study, creating an adapted version to accommodate U12's to U15's academy football teams. Standard injury reporting methods only grasp a small number of injuries and illnesses and without intervention would turn into time loss injuries and illnesses, this is counterproductive. The Oslo Sports Trauma Questionnaire allows for a very detailed reporting of injury and illness in all cohorts (Clarsen, Myklebust and Bahr, 2013).

4.9. Practitioner Applications

Practitioners should track their player's growth and maturation every one or two months to monitor their maturity status to be able to best predict when they will reach their peak height velocity and be able to reduce the chance of injury (Monesterio et al 2024). One of the most accurate ways to do this is taking an Xray of the hand and wrist in order to examine the bone development and conclude the percentage of maturation. However, this is a more invasive strategy and includes exposing the athlete to small radiation levels. A less invasive method would be the Khamis-Roche method which includes the height and weight of the child and the height of their parents, which was used in the present study.

Practitioners also have the ability to place each athlete into the pre, mid and post peak height velocity and identifying the more high-risk players that may be more susceptible to injury. To make it more visual and understandable to coaches and other members of staff, athletes should be colour coded in red for the most high-risk players. Consequently, staff in the football academy can then begin to implement more injury prevention and management strategies for those players who are higher risk. This could include adaptations to training loads, exercises and competition loads when the athletes are experiencing vulnerable times such as fast peak height velocity. Bio-banding is an effective strategy where players that are entering a growth spurt are given a specialised training programme which focusses on coordination, strength and balance and reducing the training load. This aids the players when going through the growth, maturation and the awkward phase to reduce injury risk (Wormhoudt et al, 2017).

This study also highlighted the most prominent and troublesome injuries throughout the whole cohort. This information can allow coaches and other staff members to create specific exercises and training sessions that either target weaker areas of the body to make them stronger or to reduce the amount of load on the body part. As mentioned previously, bones grow distal to proximal, therefore, athletes in their pre-PHV should be more aware of ankle and knee injuries and prevention. Athletes in the mid-PHV should focus on their hips, pelvis and lower back. Finally, athletes in their post-PHV stage should focus on reducing the impact of spondylolysis as well as their muscles, joints and ligaments (Salter et al, 2021). Again, with this, training load could be controlled and creating neuromuscular training plans can both reduce injury risk (Read et al, 2016).

4.10. Strengths

A strength of this study is that it was completed on a lower category football academy in the United Kingdom and for an academy that is better described as more ‘entry level’. This is compared to other football academies who are category 2 and 1 and have higher training and match exposure. Using category 3 and 4 academies gives the study a larger scope of youth football players to compare to the research conducted and therefore put in place preventative measures for injury related to growth and maturation.

Another strength is that this study is completely novel, from adapting and using a novel injury reporting system which allows early intervention when athletes report injury and illness and the ability to discover the trends within different groups such as age groups, maturation groups and growth groups. Another example of a novelty strength is from the collecting and analysing both illness and injury data from a single academy football season which was combined with using past and collecting present growth and maturation data of the participants from fitness testing sessions which updated their current growth and maturation status multiple times a year. This, therefore, allows researchers and practitioners to compare all data and analyse whether one or more variable affects illness and injury. In conclusion, allowing practitioners within the club to develop injury prevention strategies and not just react to the injury after it has occurred.

The final strength is, based on the present study, as growth is dynamic, adopting a longitudinal design is more realistic to day-to-day life as growth is not a fixed variable. Growth is a variable that will change multiple times throughout the season. Therefore, keeping up to date on the participants height, peak height velocity and maturation status allowed for a more accurate representation and study to take place and allowing for more reliable results.

4.11. Limitations

One limitation of this study was that it was very challenging to account for and be 100% accurate with each participant’s sporting exposure down to the exact minute and second. Therefore, as stated by the International Olympic Committee Injury and Illness Epidemiology Consensus Group et al (2020) statement, the individual athlete’s exposure was estimated based on training session duration and competition squad size and duration. Each individual participant will get different game time during matches along with potentially missing training sessions due to other commitments. Furthermore, the participants could also participant in physical education at school along with other sporting clubs such as cricket and tennis.

Another limitation was participant compliance rates. The conclusion was that as many participants were needed as possible for the research, however, there were 32 weeks of data collection and participants ranging from 100% survey completion rate to 0%

completion rate. Therefore, the decision was made to only include participants in the study that completed the survey over 60% of the time which reduced the participant number to 37/69, 53.62% which was still enough to complete the research. However, in future, compliance rates need to be increased to allow more data to be analysed and finalised, to increase validity and reliability.

4.12. Future Research

There are three stages for future research in this topic. Firstly, there needs to be more prevalent monitoring of growth rates and injury interactions within academy football. This could include practitioners monitoring growth rate monthly, to keep more up to date on even the smallest changes in the youth athlete’s growth rate and maturation status. Also, with this, many youth athletes go through a stage of peak height velocity and grow many centimetres in a very short amount of time. Therefore, keeping track of those athletes can be key in injury prevention methods.

Secondly, a consensus on injury surveillance approaches in academy football systems. Analysing and coming to a conclusion on which injury reporting system is the most effective for both time loss and non-time loss injuries. An example is using the Oslo Sports Trauma Research Centre Questionnaire to gather data on non-time loss injuries and assess the effectiveness of doing so, and using the questionnaire, or an adapted version, to keep track of athletes with non-time loss injuries.

Finally, to repeat the study but data share more effectively to mitigate the single-academy data to increase the generalizability. This could include completing data collection and research in a range of football academy club levels to be able to obtain a more generalised answer of how growth and maturation have an impact on injury and illness. Increasing generalizability allows for coherent interpretations to be made in all situations (Polit and Beck, 2010 and Writing@CSU, 2024). Practitioners, parents and athletes can then use the findings from the research to track their child's progress through growth and maturation and stay up to date with potential injuries they could encounter and to analyse the best way to prevent or reduce the chance of injury.

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6. Appendix
6.1. Participant Information Sheet

Participant Information Sheet

Name of school: School of Science, Technology & Health, York St John University
Title of study: Do Injury Symptoms Change Based on Biological Maturity?

Introduction
You have been invited to take part in a research project examining the relationship between injury symptoms and biological maturity. Before you decide whether or not to take part, it is important that you understand why this research is being done and what it will involve. Please take time to read this information carefully and discuss it with others if you wish. If there is anything that is unclear or if you would like more information, please contact me (Georgia Hutchinson, postgraduate student in the School of Science, Technology & Health, York St John University) or my supervisor (Jamie Salter, School of Science, Technology & Health, York St John University) using the contact details on the following page.

What is the purpose of this investigation?
The aims of this investigation are, do injuries, location of injuries and health change based on biological age?

What will you do in the project?
In this project, you will complete a short questionnaire (taking no more than a few minutes) once a week (up until week commencing 27/05/2024) that includes questions around illness and injuries you have experienced that week.

Do you have to take part?
No. It is up to you to decide whether you would like to take part in this study, but your contribution would be greatly appreciated. If you choose not to take part in the study, it will not negatively influence their involvement in the football club academy, for example, team selection. If you do decide to take part, you may later withdraw from the study without giving a reason and without penalty.

Why have you been invited to take part?
You have been invited to take part in this project because you are involved in an organised sports team that is looking to reduce the injury risk and improve the performance of its players.

What are the potential risks to you in taking part?
There are minimal risks to taking part in this study beyond those of you normally completing in your sport. You do have the right to withdraw from this project at any point, without giving a reason. You can withdraw from the project by informing me (the researcher) via email that you wish to do so and quote your unique code. If you withdraw from the research, any words used by you will be removed from the data that has been collected. You may request that the information you have provided is removed from the study at any point until the data has started to be analysed. This

means that you can request that your data be removed from the investigation until four weeks (28 days) after the date that you took part in the study.

What happens to the information in the project?

The research team (researcher and supervisor) as well as medical staff at the football club will have access to the information from the study. All your data will remain confidential. All data collected whilst conducting this investigation will be stored securely on the password-protected OneDrive storage system and on a password-protected computer account, which is used for the storage of research data at York St John University, in line with the requirements of the General Data Protection Regulation. The information collected whilst conducting this project will be stored securely for a minimum of 6 months. Any published outputs will be uploaded to RaY and anonymised data will be added to RaYDaR which is the YSJ open science repository.

Any GDPR concerns please contact:

University Secretary
Email: us@yorksj.ac.uk

Thank you for reading this information – please ask any questions if you are unsure about what is written in this form.

What happens next?

If you are happy to take part in this project, you will start completing the questionnaire It is possible that the results of this research project will subsequently be published. If this is the case, appropriate steps will be taken to ensure that all participants remain anonymous.

If you do not want to be involved in the project, I would like to take this opportunity to thank you for reading the information above.

Any GDPR concerns please contact:

University Secretary
Email: us@yorksj.ac.uk

Researchers contact details:

Georgia Hutchinson
School of Science, Technology & Health
York St John University,
Haxby Road Sports Park,
York,
YO31 8TA

Jamie Salter
School of Science, Technology & Health
York St John University,
Haxby Road Sports Park,
York,
YO31 8TA

Email: georgia.hutchinson@yorksj.ac.uk Email: j.salter@yorksj.ac.uk

If you have any questions/concerns, during or after the investigation, or wish to contact an independent person to whom any questions may be directed or further information may be sought, please contact:

Dr Charlotte Haines-Lyon
Chair of the Ethics Committee for the School of Education, Language and Psychology,
York St John University,
Lord Mayors Walk,
York,
YO31 7EX

Email: c.haineslyon@yorksj.ac.uk

Consent Form

Name of school: School of Science, Technology & Health, York St John University
Name of researcher: Georgia Hutchinson
Title of study: Do Injury Symptoms Change Based on Biological Maturity?

Please read and complete this form carefully. If you are willing to participate in this study, please circle the appropriate responses and sign and date the declaration at the end. If there is anything that you do not understand and you would like more information, please ask.

- I have had the research satisfactorily explained to me in verbal and / or written form by the researcher. **YES / NO**
- I understand that the research will involve completing a short questionnaire about my experience of sports injury and illness. **YES / NO**
- I understand that I may withdraw from this study at any time without having to give an explanation. This will not affect my future care or treatment. I understand that I should contact you via email and quote my unique code if I wish to withdraw from the study and that I can request for the information that I have provided to be removed from your investigation for a period of four weeks (28 days) after the date that I took part in your study. **YES / NO**
- I understand that all information about me will be treated in strict confidence and that I will not be named in any written work arising from this study. **YES / NO**
- I understand that any hard copy material of me will be used solely for research purposes and will be destroyed on completion of your research. **YES / NO**
- I understand that you will be discussing the progress of your research with your dissertation supervisor at York St John University. **YES / NO**
- I consent to being a participant in the project. **YES / NO**

Print Name:	Date:
Signature of Participant: Unique code (first three letters of mothers maiden name – first three letters of your current street name)	

6.2. Parental Information Sheet

Georgia Hutchinson
Sport MSc by Research
School of Science, Technology & Health
York St John University,
Haxby Road Sports Park,
York,
YO31 8TA
georgia.hutchinson@yorksj.ac.uk

Dear Parent or Guardian,

I am completing a research project examining the relationship between injury symptoms and biological maturity as part of my postgraduate research degree. I request permission for your child to take part in this study. The football club is aware of the project and has agreed to allow me to conduct my research with them.

What does the study involve?
The study will involve you and/or your child completing a short questionnaire online, that takes no more than two minutes to complete, once a week that will include questions about illness and injuries you child has experienced throughout the season. The data collection period will last until the end of the football season (week commencing 27/05/2024). Further information about the study is included in the accompanying Participant Information Sheet. Participation in this study is voluntary. Your decision whether to allow your child to participate is also voluntary. The project will be explained to your child in terms that they can understand. If you and/or your child does not consent to taking part in the study, it will not negatively influence their involvement in the football club academy, for example, team selection.

What happens with the study findings?
The research team (researcher and supervisor) as well as medical staff at the football club will have access to the information from your child. Your child will be kept anonymous in any work that is produced from this research. All information will be stored in line with the requirements of the General Data Protection Regulation (GDPR). The study should not encourage conversations of a personal nature. If your child discloses any information that needs to be reported, the sports club's safeguarding policy will be used. Any published outputs will be uploaded to RaY and anonymised data will be added to RaYDaR which is the YSJ open science repository.

Any GDPR concerns please contact:
University Secretary
Email: us@yorksj.ac.uk

Who can I contact if I have any questions?
If you have any questions about this project, my contact details are included at the top of this page. Alternatively, you can contact my supervisor:

Jamie Salter

School of Sport,
York St John University,
Lord Mayor's Walk,
York,
YO31 7EX.

Email: j.salter@yorksj.ac.uk

If you have any concerns, queries or complaints regarding the research project please contact Dr Charlotte Haines-Lyon, Chair of the Ethics Committee for the School of Education, Language and Psychology via c.haineslyon@yorksj.ac.uk.

Thank you for taking the time to read this information.

Yours sincerely,

Georgia Hutchinson
Sport MSc by Research, York St John University.

Participant Information Sheet for Parents

Name of school: School of Sport, York St John University
Title of study: Do Injury Symptoms Change Based on Biological Maturity?

Introduction
Your child has been invited to take part in a research project examining the relationship between injury symptoms and biological maturity. Before you decide whether they can take part, it is important that you understand why this research is being done and what it will involve. Please take time to read this information carefully and discuss it with others if you wish. If there is anything that is unclear or if you would like more information, please contact me (Georgia Hutchinson, postgraduate student in the School of Sport, York St John University) or my supervisor (Jamie Salter, School of Sport, York St John University) using the contact details on the previous page.

What is the purpose of this investigation?
The aims of this investigation are, do injuries, location of injuries and health change based on biological age?

What will you do in the project?
In this project, your child will complete a short questionnaire once a week that includes questions around illnesses and injuries you have experienced that week throughout the season.

Do you have to take part?
No. It is up to you to decide whether or they take part in this study, but your contribution would be greatly appreciated. Your child will not be treated any differently, whether they choose to take part, or decide not to do so. If your child does decide to

take part, they may later withdraw from the study without giving a reason and without penalty.

Why have you been invited to take part?
Your child has been invited to take part in this project because they are involved in an organised sports team that is looking to reduce the injury risk but improve the performance of its players.

What are the potential risks to you in taking part?
There are minimal risks to taking part in this study beyond those of you normally completing in your sport. You do have the right to withdraw from this project at any point, without giving a reason. You can withdraw from the project by informing me (the researcher) via email that you wish to do so. If you withdraw from the research, any words used by you will be removed from the data that has been collected. You may request that the information you have provided be removed from the study at any point until the data has started to be analysed. This means that you can request that your data be removed from the investigation until four weeks (28 days) after the date that you took part in the study.

What happens to the information in the project?
All data will remain confidential. All data collected whilst conducting this investigation will be stored securely on the password-protected OneDrive storage system and on a password-protected computer account, which is used for the storage of research data at York St John University, in line with the requirements of the General Data Protection Regulation. The information collected whilst conducting this project will be stored securely for a minimum of 6 months.

Thank you for reading this information – please ask any questions if you are unsure about what is written in this form.

What happens next?
If you are happy for your child to take part in this project, fill in the consent form below and please complete the online questionnaire every week before Tuesday's training session.

It is possible that the results of this research project will subsequently be published. If this is the case, appropriate steps will be taken to ensure that all participants remain anonymous.

If you do not want your child to be involved in the project please inform me and I would like to take this opportunity to thank you for reading the information above.

Please sign below if you consent your child to participate in the research described above.

I have read and understood the above information and consent to my child taking part in this research investigation.

Print Name: ……………………………………………… Date: ....

Signature: ....

Researcher contact details:

Georgia Hutchinson
School of Sport,
York St John University,
Lord Mayor's Walk,
York,
YO31 7EX.

Email: georgia.hutchinson@yorksj.ac.uk

Jamie Salter
School of Sport,
York St John University,
Lord Mayor's Walk,
York,
YO31 7EX.

Email: j.salter@yorksj.ac.uk

If you have any questions/concerns, during or after the investigation, or wish to contact an independent person to whom any questions may be directed or further information may be sought, please contact:

Dr Charlotte Haines-Lyon
Chair of the Ethics Committee for the School of Education, Language and Psychology,
York St John University,
Lord Mayors Walk,
York,
YO31 7EX

Email: c.haineslyon@yorksj.ac.uk

6.3. Gatekeeper Information Sheet

Georgia Hutchinson
Sport MSc by Research
York St. John University
School of Science, Technology & Health
Haxby Road Sports Park
York
YO31 8TA
georgia.hutchinson@yorksj.ac.uk

Dear Manager and Coaches,

As part of my postgraduate thesis, I am completing a research project examining the relationship between injury symptoms and biological maturity. I request your permission to use your club to complete my research study.

What does the study involve?
The study will involve a short questionnaire that that the children and their parents will complete once a week until the end of the season (week commencing 27/05/2024) about illness and injuries that they experience during the current week. I have included further information about the study in the accompanying Participant Information Sheet.

What happens with the study findings?
The research team (researcher and supervisor) as well as medical staff at the football club will have access to the information collected. All information will be stored in line with the requirements of the General Data Protection Regulation (GDPR). Pseudonyms will also be used to protect the anonymity of all participants, people and organisations who take part in the study. Any published outputs will be uploaded to RaY and anonymised data will be added to RaYDaR which is the YSJ open science repository.

Who can I contact if I have any questions?
My details are at the top of the page. Alternatively, you can contact my supervisor:

Jamie Salter
School of Sport,
York St John University,
Lord Mayor’s Walk,
York,
YO31 7EX.

Email: j.salter@yorksj.ac.uk

Dr Charlotte Haines-Lyon, Chair of the Ethics Committee for the School of Education, Language and Psychology’ Email c.haineslyon@yorksj.ac.uk.

Thank you for taking the time to read this information.

Yours sincerely,

Georgia Hutchinson.
Sport MSc by Research, York St John University.

Please sign below if you are happy for me to complete my research in your club.

I have read and understand the above information and **do give my consent** to this study taking place.

Print Name: ……………………………………………… Date: ....

Signature: ....

6.4 Participant Information Sheet for Gatekeepers

Participant Information Sheet for Gatekeepers

Name of school: School of Science, Technology & Health York St John University
Title of study: Do Injury Symptoms Change Based on Biological Maturity?

Introduction
I would like to invite your club to take part in a research project examining the relationship between injury symptoms and biological maturity. Before you decide whether to take part, it is important that you understand why this research is being done and what it will involve. Please take time to read this information carefully and discuss it with others if you wish. If there is anything that is unclear or if you would like more information, please contact me (Georgia Hutchinson, postgraduate student in the School of Science, Technology & Health York St John University) or my supervisor (Jamie Salter, School of Science, Technology & Health, York St John University) using the contact details on the following page.

What is the purpose of this investigation?
The aims of this investigation are, do injuries, location of injuries and health change based on biological age?

What will you do in the project?
In this project, your players will complete a short questionnaire once a week that includes questions around illness and injuries they have experienced that week.

Do you have to take part?
No. It is up to you to decide whether you would like your club to take part in this study, but your contribution would be greatly appreciated. You will not be treated any differently, whether you choose to take part or decide not to do so. If you do decide to take part, you may later withdraw from the study without giving a reason and without penalty.

Why have you been invited to take part?
Your club has been invited to take part in this project because you are involved in an organised sports team that is looking to reduce injury risk and improve the performance of its players.

What are the potential risks to you in taking part?
There are minimal risks to taking part in this study beyond those your club normally experiences competing in your sport. You do have the right to withdraw from this project at any point, without giving a reason. You can withdraw your team from the project by informing me (the researcher) via email that you wish to do so and quote your unique code. If you withdraw from the research, any words used by you will be removed from the data that has been collected. You may request that the information you have provided be removed from the study at any point until the data has started to be analysed. This means that you can request that your data be removed from the investigation until four weeks (28 days) after the date that you took part in the study.

What happens to the information in the project?
All questionnaire data will remain confidential. All data collected whilst conducting this investigation will be stored securely on the password-protected OneDrive storage system and on a password-protected computer account, which is used for the storage of research data at York St John University, in line with the requirements of the General Data Protection Regulation. The information collected whilst conducting this project will be stored securely for a minimum of 6 months.

Any GDPR concerns please contact:
University Secretary
Email: us@yorksj.ac.uk

Thank you for reading this information – please ask any questions if you are unsure about what is written in this form.

What happens next?
If you are happy for your club to take part in this project, you will be asked to sign a consent form/letter to confirm this.
It is possible that the results of this research project will subsequently be published. If this is the case, appropriate steps will be taken to ensure that all participants and organisations remain anonymous.
If you do not want to be involved in the project, I would like to take this opportunity to thank you for reading the information above.

Researcher contact details:

Georgia Hutchinson
School of Science, Technology & Health
York St John University,
Haxby Road Sports Park,
York,
YO31 8TA

Email: georgia.hutchinson@yorksj.ac.uk

Jamie Salter
School of Science, Technology & Health
York St John University,
Haxby Road Sports Park,
York,
YO31 8TA

Email: j.salter@yorksj.ac.uk

If you have any questions/concerns, during or after the investigation, or wish to contact an independent person to whom any questions may be directed or further information may be sought, please contact:

Dr Charlotte Haines-Lyon
Chair of the Ethics Committee for the School of Education, Language and Psychology,
York St John University,
Lord Mayors Walk,
York,
YO31 7EX

Email: c.haineslyon@yorksj.ac.uk

6.5 Definition Guidance Document

Definition Guidance Document

Injury- Physical damage to your body caused by sport, falls and impacts.

Illness- A period of time where a part of the body is unable to work as normal, causing sickness or feeling unwell.

Symptoms- Something that a person feels that may express that they have an injury or illness.

If participant or parent needs extra help with understanding the questionnaire or other certain aspects, please do not hesitate to contact me or my supervisor:

Georgia Hutchinson
School of Science, Technology & Health
York St John University,
Haxby Road Sports Park,
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