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Opinion Paper

"Heading Towards a Solution": Is Futsal the Perfect Training Alternative for Soccer to Reduce Heading Frequency?

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Soccer is the most popular sport in the world, with ~260 million participants. Recently the impact of heading in soccer has been subject to increased scrutiny as governing bodies seek to protect the welfare of participants. Concern has arisen due to the reported neurocognitive deficits potentially emanating directly from soccer participation and specifically the heading action. Acute concussions are more easily diagnosed compared to the very subtle symptoms some researchers associate with frequent heading. The more elusive influence of repeated sub-concussive impacts from purposefully heading the ball has become a debate however. Overall, research has not definitively concluded this discussion, made recommendations for protocol modifications, or provided clear justification to ban heading. Despite this, governing bodies have begun to make strategic policy changes to mitigate any possible negative side-effects, i.e., FA Premier League heading guidelines. Governing body changes are most notable in youth soccer, with US soccer banning heading altogether for the youngest players.

To our knowledge, the sport of futsal has not yet been considered as an alternative for training or match-play until research provides clarity. With naturally low frequencies of heading during match-play (~8 per-game per-team) compared to soccer (~55.6 per-game per-team) and constraints which reduce overly aggressive physical contact, futsal represents a possible alternative. Meanwhile, evidence suggests futsal is advantageous to soccer player development due to its constraints encouraging skills that successfully transfer to soccer. Therefore, we advocate futsal as a positive training/match-play alternative for soccer which we believe governing bodies should consider.

INTRODUCTION

The safety and welfare of soccer players has received increased academic scrutiny, with notable focus on heading the ball.[1,2] Soccer is one of the few sports where players intentionally use their head to strike the ball and recently there has been strengthening debate examining its impact on longitudinal player health, with inconclusive findings.[3–6] Concern has grown due to the potential for concussions to occur, with performance and medical protocols drawn into discussion.[3] An acute concussion and the potentially severe symptoms may be more easily recognised when they arise compared to repeated sub-concussive events such as heading. Additionally, the symptoms emanating from a concussion incident are potentially exacerbated by continued heading of the ball. Recently, data examining mixed gender youth soccer (U9/11/13) showed that, of 791 injuries, only 11 were concussion incidents which as a total amount of exposure to soccer match-play was stated as <0.07 per 1000 hours of performance. Objective statistics of this nature suggest that concussion injuries, although serious, appear to be relatively uncommon[7] and are more likely to occur from player-to-player collisions as opposed to heading.[4]

However, researchers have increasingly focussed on the more subtle influence of repeated sub-concussive impacts from 'purposefully' heading soccer balls.[8] Apprehension has arisen due to possible neurocognitive deficits emanating directly from participation in soccer and specifically the heading action.[4,9] With the powerful and alarming anecdotal perspectives suggesting a possible correlation between frequent soccer participation and serious health problems, this topic has become a contemporary research theme.[4,6,7,10] Research has yet to provide definitive consensus on heading with issues in research design. For example, the type of header (velocity the ball travels) may be pertinent, alongside factors such as neck strength helping to mitigate any negative effects, both of which future research should include in a broad examination.[11] Given the lack of consensus stakeholders are compelled to consider sensible alternatives for training and/or match-play in the interim. Based on these concerns, National Governing Bodies (NGB's) have begun to initiate further research and, in some cases, make strategic policy recommendations.[12]

Recently the English, Scottish and American governing bodies have all banned or made restrictions to heading in male and female youth soccer.[13,14] Despite this, research has shown heading is less frequent in young performers.[1] The occurrence of heading typically increases with age, with one study calculating the incidence rates (IR) per 1000 match/training hours across eight European countries.[1] During match-play Under-10 teams showed the lowest average headers per-match (8.8), followed by Under-16 female (17.7), Under-12 (18.4), and Under-16 male (35.5). Meanwhile during training, differences in ages and genders were also observed, with the lowest number of headers found in Under-10 males (21.3), followed by Under-16 females (34.1), Under-12 males (35.8), and Under-16 males (45.0). Research also measured the type of header stating that most were intentional, over shorter distances (80% < 5m, 14% 5-10m, 4% 10-20m, 2% > 20m) and used frontal contact (forehead) suggesting appropriate heading technique. Data therefore concluded that, on average, female players are less likely to head the ball than male counterparts, whilst younger players head less frequently than older players.[1] With data such as this, knowledge on heading has evolved. Despite these advances, notable gaps in evidence exist with research yet to quantify a frequency or velocity of heading which could be considered 'damaging'. In addition, further research is needed to explore the effects of concussions in younger players compared with adults, with longer recovery periods needed, whilst injury prevention methods such as neck strengthening potentially mitigating some negative effects of heading.[11]

Overall, research from key large-scale papers have concluded that currently there is not enough evidence to provide decisive justifications to advise modifications or support the banning of heading.[1,2] It is apparent that expanding the quality and quantity of research is vital to inform strategic policymaking, yet some NGB's have already made changes to their recommendations.[12–14] Removing heading completely would change the core fabric of soccer altogether and would be tantamount to a full ban on soccer and its historical identity. Compromises, notably in youth soccer, often focus on adaptations to training and match-play to reduce heading frequency and velocity. For example, in England, The Premier League has made recommendations for adult soccer. They aim to reduce high velocity headers from long passes, crosses, corners & free-kicks (over 35m) to 10 per-week in training recommending that coaches seek alternatives. Thus, examining suitable alternatives represents a logical step to support NGB's.[8,12]

It is not in the scope of this paper to draw conclusions on whether heading in soccer is safe, nor would we wish to undermine the seriousness of this discussion. However, suggesting a possible training/match-play alternative which would naturally reduce heading frequency and retain the holistic benefits of participation is warranted. This is vital until researchers reach a consensus, and potentially in the long-term also.

To our knowledge the sport of futsal has not yet been considered as a partial solution during this debate. Originally created in South America, futsal is a 5v5 version of soccer which typically takes place indoors, on a hard surface, with smaller 3x2m goalposts and has seen substantial global expansion with participation numbers estimated ~60 million. The evolution of this small-sided game (SSG) has allowed for its rules to be standardised with governance from FIFA, while recent research has proposed futsal's potential wider contribution to soccer talent development.[15–17] The rules and environment of futsal provide its distinctive identity, separating it from 11v11 soccer and other SSG's and for the purposes of this article, influencing heading frequencies. The constraints placed on performers are known to impact player behaviours, with the ecological dynamics perspective recently considered a useful 'lens' to observe player behaviours.[18] Practising with particular constraints can limit/promote specific behavioural responses to the dynamic system, which is vital when examining heading and potential collisions.[18]

One distinctive futsal constraint is the ball which has a reduced 'coefficient of restitution' (reduced bounce height).[19] The influence of this constraint means that typically the ball will stay on the floor more, promoting shorter ground passes rather than long aerial passes, more common in soccer and associated with higher velocity headers.[12,20–22] Alongside futsal ball characteristics, typical court dimensions for adults of 20x40m also limit the amount of space,[23] further encouraging shorter passes, with implications to heading frequency. A recent paper examined soccer match-play scenarios which create longer passes that result in heading at higher velocities, concluding that limiting actions such as goal-kicks could help reduce heading 'burden'.[8] In addition, scenarios including 'secondary headers', or 'bounces' took place at much lower ball velocities with less burden. Concomitantly, futsal laws require goalkeepers to restart play by throwing the ball (goal-clearance) from the back of the court replacing goal-kicks, which we believe could limit heading frequencies and also velocities when they do occur, especially given the court size.[8,24] Due to the low bounce characteristics of the futsal ball and the limited space, aerial duels and 'secondary headers' are also less likely in futsal, potentially reducing the probability of player-to-player collisions in those moments. Comparatively, research on adult male and female soccer found that aerial challenges contributed to 55% of the 248 head and neck injuries.[25]

Furthermore, futsal laws discourage overly aggressive play with an 'accumulative foul' rule in each period. Following the fifth foul each subsequent foul provides the opponents a 'free-shot' from the 10m penalty mark with only the goalkeeper to beat.[24] The implications to defending styles are notable, with teams seeking to be less aggressive and overtly physical, instead focussing on team shape and decision-making. Additionally, if a head injury was sustained by a player, futsal laws permit unlimited substitutions, allowing for a player to come off-court for medical assessments without damaging the team's competitiveness, potentially supporting adherence to medical protocols.[23]

Importantly, research has analysed injury frequencies in 136 elite, senior, male futsal matches during the 2000, 2004 and 2008 World Cups, with pertinent findings.[26] Data re-

ported 165 injuries, which is the equivalent to 195.6 injuries per 1000 player hours or 130.4 injuries per 1000 player matches. This is a higher injury frequency (2.6 times more likely) compared to soccer World Cups (1998, 2002, 2006).[26–29] Of the injuries reported from three futsal World Cups 7 were concussion injuries with half the incidents classed as foul-play and all emanating from player-to-player contact. In comparison 6 concussions were reported in three men's soccer World Cups,[26–29] with female soccer World Cups reporting 12 concussion incidents from 387 injuries in seven women's tournaments.[30] Officials stringently adhering to the laws is vital in limiting injuries that occur due to foul play.[27]

A key limitation to these comparisons is the methodological challenges when considering injuries per player hours due to soccer using a running clock whereas in futsal the clock is stopped when it is out of play.[26,31] If futsal is only examined during intense match-play and filters all moments when the ball is off the court, then this will condense the highly competitive nature of futsal. If compared to soccer where the ball is regularly out-of-play, then data normalised per-time could present misleading data. Furthermore, research suggests that 50% of the futsal injuries were expected to prevent participation compared to 66.6% in soccer concluding that time-loss was significantly lower in futsal than soccer.[26] Additionally, the location and types of injury in futsal are similar to soccer, although in futsal fewer injuries derived from player contact and foul-play. When considering futsal's inclusion in talent development curriculums, governing bodies should also consider the impact of competing on hard surfaces on injury frequency and type. Overall, research seems to suggest the frequency of injuries in futsal is higher, but the time-loss per player is lower. It should be acknowledged however that commonly elite international soccer teams typically access a wide range of sports science support seeking to prevent injuries and rehabilitate quickly when they do occur. Concomitantly futsal is less well funded and thus differences in provisions are an additional influencing factor. Overall, these points should be considered if futsal is to be strategically included as an alternative training or match-play format in youth or adult soccer specifically seeking to reduce the number of potential headers.

Crucially, a recent paper quantified player behaviours during an international level, senior, men's futsal tournament allowing heading frequencies to be calculated.[32] Data shows an average of 8 (±3.46) headers per-game in a reference team which compared to an average of 111.2 per-game in soccer (~55.6 per-game per-team) (The Premier League) which is markedly lower.[33] Differences can be seen between countries and positions, but heading is broadly a much more frequent occurrence in soccer than futsal.[33] With such a naturally infrequent technical action in futsal it is highly unlikely that coaches would focus on it during training, with low heading burden on players in training and match-play without the need for restrictions. Alongside this, research in soccer has considered alternative methodologies to reduce heading through modifying rules.[3,8,12,14] In the USA players aged U10 and younger are prohibited from heading altogether, with referees instructed to stop play in this circumstance.[11] Meanwhile, U11-13 players in the USA are permitted limited exposure defined as 20-25 headers per-week, preparing players for U14+ soccer which has no limitations.[11] However, we suggest that futsal represents a simple alternative with naturally low heading frequencies without the need for modifications. Furthermore, recent research has supported the multiple benefits of futsal to soccer talent development at all ages making it a positive modality to safely prepare players for soccer.[15,16,20]

Futsal is a high-intensity intermittent sport, with substantial internal and external loads which are potentially beneficial to physical preparation for soccer.[32,34,35] Players will produce an average of ~87.69% of their maximum heart rate during match-play, peaking ~98.30% during intense moments.[32] Relatively frequent accelerations and decelerations are also evident with 2.16±0.25 accelerating (>1.5 $m{\cdot}s^2$) and 2.78±0.13 decelerating (>1.5 $m{\cdot}s^2$) events per-player per-minute.[32] Recent research has associated the frequency of accelerations and decelerations with match outcomes in soccer, concluding that specific preparation strategies should be considered to optimise these factors.[36] With high internal and external loads, futsal could be a useful method of physical preparation for soccer.

Futsal will condense the frequency of many technical actions allowing participants to train in realistic conditions, gaining a myriad of holistic benefits without a heading burden.[32,37,38] Passing is a vital element of futsal with match-analysis reporting relatively high amounts of passes per-team ~647 (~54 actions per-player) and high pass completion rates of ~90%.[32] Comparatively elite soccer data shows a lower figure of ~76% success rate in passing actions although data evidently includes longer passes, a key characteristic of soccer.[32] Finally, the futsal court boundaries, influence the occurrence of set-play events with match-analysis reporting frequencies of set-plays per-team per-game; including kick-ins (~43), corners (~10), penalties (~1.33), goalkeeper restarts (~17), free-kicks (~6) and set-pieces resulting in the creation of a shot (~8).[32] These benefits are removed if SSG formats use walls instead of boundaries, preventing set-play events and would be comparatively suboptimal. Research provides evidence of the multiple benefits of futsal participation in player development for soccer, compelling greater reflection from stakeholders.[16,17,20,32]

It is however important to acknowledge the soccer behaviours which are diluted in futsal reducing transfer of those specific skills. Long passing, a common feature in soccer is an infrequent technical action in futsal due to the court size. Additionally, with no offside rule passes and forward runs 'in-behind' defenders are an action not commonly observed in futsal. Coaches should be well informed of the impact of futsal constraints and the behaviours which it dilutes/condenses, allowing for an informed and skilful delivery. Supporting the delivery of futsal, some countries possess a unique potential due to facility stocks (such as the USA with abundant basketball courts) and large soccer participation to advance swiftly in futsal whilst gleaning the benefits of both formats. Including both for-

mats simultaneously is often referred to as 'twin-tracking' in talent development systems seeking to benefit from their complementarity,[39] with many anecdotal examples of players exposed to both soccer and futsal in their practice histories.[40,41]

Critically, research has sought to examine this complementarity, measuring whether skills developed in a futsal environment transfer to soccer (skills transfer).[20,42] Results show that players successfully modified their behaviours from a futsal task enhancing performance in a soccer task showing improved passing accuracy.[20,43] With high similarity and supporting preliminary research, practitioners can be confident that many skills developed in futsal will transfer to soccer if used as a training/match-play alternative. To glean these benefits, it is vital that futsal is delivered faithfully, inclusive of all the constraints, which have a direct impact on player behaviours and learning.

Overall, research has yet to provide clarity on the possible dangers of heading in soccer, with more evidence needed to support practitioners and stakeholders. Until a consensus has been reached, we believe that futsal provides a SSG, which, due to its constraints will have naturally low levels of heading within a game that discourages overly aggressive physical play. Furthermore, research shows that futsal supports technical, tactical, psychological, and physical player development for all ages and genders, with likely skill transfer to soccer. Given the growing evidence-based research in futsal and whilst NGBs seek viable alternatives to reduce heading frequency, futsal should be considered as an alternative which NGB's, and clubs should reflect upon.

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