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At what age are English Premier League players at their most productive? A case study investigating the peak performance years of elite professional footballers.

Abstract

Seasonal statistics for 637 professional football players performing in the English Premier League (EPL) across 3 intermittent seasons were analysed via a series of Kruskal-Wallis tests in order to determine the most productive (peak) years of players' careers. Contrary to previous research, results revealed that age had no bearing on the technical performance levels of goalkeepers, full-backs, central defenders or central midfielders performing in the EPL. Wingers aged between 16-20 and 21-25 have significantly more shots on target ($p = 0.022$, $p = 0.040$) and more attempts from open play ($p = 0.012$, $p = 0.028$) than wingers over the age of 26. Results also revealed that strikers aged between 21-25 are more adept at executing specific attacking actions such as scoring goals from outside the box ($p = 0.024$) and shooting on target from outside the box ($p = 0.021$) than older strikers aged between 26-30. Evidence is discovered proving that aging trends are present but not uniform across the sport of football. The authors conclude that further league specific case studies are required in order to identify the unique characteristics and peculiarities of foreign leagues enabling a more objective approach to recruitment decisions and individualised coaching plans.

Keywords: Football, player performance, peak career years, soccer, aging trends, match analysis, performance analysis

Introduction

Knowing when athletes peak and perform at their very best has been the focus of much research in previous years. In a seminal study by Schulz and Curnow (1988) it was determined that in sports such as swimming, sprinting and tennis, that require strength, speed, explosive power and body coordination, performers will peak in their early 20s. On the contrary, Schulz and Curnow (1988) also stated that in sports such as baseball and golf that require endurance and more complex motor and acquisition skills, athletes will peak in their late 20s. Although Schulz and Curnow (1988) acknowledged that performances have improved significantly throughout the 20th century they stated that peak performance years across these sports have in the main remained steady citing the physiological limits of the human body as the primary determinant for the window of peak performance.

Subsequent research on the topic of peak performance years across various sports has since been conducted with studies on golf (Tiruneh, 2010), tennis (Kovalchik, 2014), baseball (Fair, 2008), ice hockey (Brander et al., 2014); track and field events (Hollings et al., 2014) and the triathlon (Knechtle et al., 2012). In the main the results of these studies have confirmed the findings of Schulz and Curnow (1988) and further emphasised how aging trends in these sports vary significantly. As stated by Allen & Hopkins, (2015) this is to be expected as each sport requires different biological capabilities as well as varying skill sets needed to be a successful performer in their sport.

Knowing when athletes peak and particularly when football players are performing at their best has substantial value for the football industry (Kalén et al., 2019). This knowledge of when players reach their peak or optimal age can affect a club's personnel decisions, particularly with regards to length of contracts, player recruitment, player wage negotiations

and team selection (Dendir, 2016; Kalén et al., 2019). Furthermore knowledge of when a player reaches their optimal age can aid coaches in developing individualised coaching plans and design strategies for training load periods in order to better prepare athletes (Hollings et al., 2014; Kalén et al., 2019). Due to these benefits, determining a player's optimal age in football has also been the focus of recent research. In a study on female football, Barreira (2016) utilised FIFA data from the Olympic games 2012 and determined that the teams with older players had more success than the those with the younger athletes. Similarly, Dendir (2016) uses men's soccer performance ratings to assess when players peak and discovered the average peak age to be between 25-27 years of age, with forward players peaking earlier and defenders peaking later. In a more recent study, Kalen et al., (2019) utilised UEFA Champions league data in order to determine the optimal performance age and concluded this to be between 26-30, with goalkeepers and defenders again peaking later than attacking players. The findings of this research is in line with research focussing on the physiological demands of competitive sport where it has been determined that biological function and peak physical performance reaches a peak after which it declines with age (Hawkins & Wiswell, 2003; Signorelli et al., 2012). Football is a sport that requires frequent high-intensity aerobic actions such as high speed running (Beato & Jamil, 2018) and therefore speed endurance fitness is crucial (Barreira, 2016) as is a build-up of resistance strength (Mujika et al., 2009). Optimal performance in football is therefore dependent upon a combination of endurance and explosive power necessary to cope with physical and physiological demands of modern day football (Kalén et al., 2019).

Something that has been relatively overlooked in previous research however is the technical development of players and the physical and physiological demands of football in the specific nation and league it is played in. Previous research on peak performance ages in football have tended to collate information from several European football teams, but football is practiced differently in every country due to various reasons such as differences in the

technical skill levels of players, tactics, the quality of coaching, individual player development as well as historical, social and cultural aspects of each country, the influence of which vary nation to nation (Gai et al., 2019; Jamil, McErlain-Naylor, et al., 2020; Mitrotasios et al., 2019; Sarmento et al., 2013). In a recent study, inter-league and inter-nation variations were discovered between strategies adopted to score penalty kicks, emphasising the varying tactical approaches exhibited in different footballing leagues and nations (Jamil, Littman, et al., 2020). Each league therefore possesses its own unique characteristics, for example, football in England is more aggressive than in foreign leagues (Sapp et al., 2017) and is traditionally played at a higher tempo and with a more direct style which involves a greater number of aerial duels (Mitrotasios et al., 2019).

The authors of this paper therefore argue that the optimal age of player performance in football may not be uniform across every league and a player's optimal performance age may depend on the varying technical, tactical, physical and physiological demands of the league they are playing in. Consequently this case study will comprehensively investigate what the optimal age is for peak performance of players across several positions in the English Premier League and whether or not these conform to the general findings previously discovered.

Methods

Experimental Design and Data

In this retrospective case study, technical performance data was utilised in this study as it has been previously suggested that technical variables can be more informative than physical parameters when conducting research in football (Liu et al., 2016). Performance data utilised in this study was provided by Opta sports, renowned for having a high degree of accuracy (Jamil, 2019; Jamil, McErlain-Naylor, et al., 2020; Liu et al., 2013).

The sample for this study consisted of seasonal statistics for 985 player representations[1] across three intermittent seasons between 2013-14 and 2017-18 in the English Premier League. Due to the five year gap between the 2013-14 season and the 2017-18 season no players represented the same age group more than twice. This study only included players that performed regularly in 25% or more of the season (minimum of 10 games).

It has been previously discovered that playing in different positions in football requires different physical characteristics (Bloomfield et al., 2007; Di Mascio & Bradley, 2013; Di Salvo et al., 2009). Players were consequently categorised into one of 6 positions, Goalkeepers (n= 79), Centre Backs (n= 195), Full Backs (n= 167), Central Midfielders (n= 265), Wingers (n= 145) and Forwards (n= 134). These classifications were done via a combination of the UEFA website (Kalén et al., 2019) and the increasingly popular Transfermarkt website (Peeters, 2018).

Variables

Variables for each position were identified by previous literature (Hughes et al., 2012; Jamil, 2020; Jamil, McErlain-Naylor, et al., 2020; Liu et al., 2013, 2016; Oberstone, 2010; Zhou et al., 2018) and therefore consisted of 13 variables for goalkeepers, 14 variables for full-backs, 11 variables for central defenders, 16 variables for central midfielders, 18 variables for wingers and 8 variables for forward players. Table 1 presents a list of variable definitions; all definitions were obtained from either the official Opta F24 appendices or the Opta website*[2]. Similarly to Dendir (2016) and Kalen et al., (2019) players were divided into 4 age groups, *GROUP* 1 (16 – 20), *GROUP* 2 (21 – 25), *GROUP* 3 (26 – 30) and *GROUP* 4 (31+) and categorisation depended on each players age on the 1st August in the year of the season being analysed (i.e. the player's age going into the season being analysed). Data on player ages was also obtained from Transfermarkt.

[1] The sample consisted of 637 different players; however some players were represented multiple times due to their consistent presence in the EPL in the sample seasons, resulting in 985 player observations in total.

[2] *www.Optasports.com – Staff at Opta were contacted directly to clarify definitions for a select few variables

Insert Table 1 here

Statistical Analysis

Parametric assumption tests such as the Kolmogorov-Smirnov test for normality and the Levene test for homogeneity of variance were conducted for the technical measures analysed throughout this study and many assumption violations were discovered meaning a non-parametric method was required. Consequently, Kruskal-Wallis tests were conducted to test for differences in means (mean ranks) between each of the age groups for each of the 51 technical measures of performance analysed in this study (Bewick et al., 2004). A 95% ($p \leq 0.05$) significance value was set initially, with significance values adjusted by the Bonferroni correction when determining the pairwise comparisons. Effect sizes, assessed as Pearson's r, were also calculated as they provide an objective measure of the magnitude of an effect following a Kruskal-Wallis analyses (Jamil, McErlain-Naylor, et al., 2020)**.** The widely used thresholds for *small* (0.1 – 0.3), *medium* (0.3 – 0.5) and *large* effects (> 0.5) set by Cohen, (1992) were utilised in this study. This analysis was conducted using IBM SPSS version 25 **(***IBM Corp. Released 2017. IBM SPSS Statistics for Macintosh, Version 25.0. Armonk, NY: IBM Corp*).

Results

Insert Tables 2, 3 and 4 here

The results in table 2 revealed that there were no significant differences in mean ranks between age groups for goalkeepers, full-backs, centre backs and central midfield players, implying age had no bearing on technical performance for any athlete performing in any one of these positions in the EPL. On the contrary, the younger age groups (16-20) and (21-25) were revealed to be more adept than their older counterparts at performing specific technical actions in attacking positions such as wingers (table 3) and strikers (table 4). Both group 1 (16-20) and group 2 (21-25) had more shots on target from wide positions and thus more attempts at goal than their older counterparts in group 4 (31+), ($p = 0.022$, $p = 0.040$). Similarly, wingers

in group 2 aged between 21-25 had significantly more shots off target than their older counterparts in group 4 (31+), ($p = 0.01$). The two younger age groups, group 1 (16-20) and group 2 (21-25) had significantly more attempts from open play on target than group 4 wingers over the age of 31 ($p = 0.012$, $p = 0.017$). Group 1 (16-20) wingers also had significantly more attempts from open play on target than group 3 (26-30) wingers ($p = 0.028$). Younger wingers in group 1 (16-20) and group 2 (21-25) executed significantly more successful dribbles than group 4 (31+) wingers ($p < 0.001$, $p = 0.008$). Younger wingers in group 1 (16-20) also executed significantly more successful dribbles than group 3 (26-30) wingers ($p = 0.015$). Younger wingers in group 1 (16-20) and group 2 (21-25) also executed significantly more unsuccessful dribbles than group 4 (31+) wingers ($p < 0.001$, $p = 0.012$). Younger wingers in group 1 (16-20) also executed significantly more unsuccessful dribbles than group 3 (26-30) wingers ($p = 0.002$). Group 1 (16-20) wingers won significantly more ground duels than group 4 (31+) wingers ($p = 0.016$). Younger wingers in group 1 (16-20) and group 2 (21-25) both lost significantly more ground duels than group 4 (31+) wingers ($p < 0.013$, $p = 0.046$). The results for the variable take-ons overrun revealed that wingers in age group 1 (16-20) made significantly more unforced errors than wingers in either group 2 (21-25), group 3 (26-30) or group 4 (31+) ($p = 0.033$, $p = 0.002$, $p < 0.001$). Group 1 (16-20) wingers also had significantly more open play touches in the opposing team's final third than group 4 (31+) wingers ($p = 0.028$). Younger wingers in group 1 (16-20) and group 2 (21-25) both had significantly more open play touches in the opposing team's box than group 3 (26-30) and group 4 (31+) wingers ($p < 0.046$, $p = 0.007$). Strikers in group 2 (21-25) scored significantly more goals from outside the box and had more shots on target from outside the box than their older counterparts in group 3 (26-30) ($p = 0.024$, $p = 0.021$). However strikers in group 2 (21-25) lost significantly more ground duels than their older counterparts in group 3 (26-30) ($p = 0.03$). A study of the effect sizes reveal that age had a greater impact upon the technical performances of wingers as the

vast majority of effects discovered are either *medium* or *large*. Age had a significant but *small* effect upon the technical performances of strikers.

Discussion

The aims of this case study were to investigate what the optimal (peak) performance ages of football players performing in various playing positions in the English Premier League were and whether these were consistent with the findings of previous studies focussing on football. The authors hypothesised that the optimal age of player performance in football may not be uniform across every league as football is practiced differently in every nation (Jamil, McErlain-Naylor, et al., 2020; Mitrotasios et al., 2019; Sarmento et al., 2013). Results have revealed that whilst some aging trends discovered in previous studies also apply to the EPL, there is also evidence to suggest that the EPL has unique characteristics which has led to the discovery of some unexpected results that challenge those previously discovered.

In line with previous research, the results of this study revealed that from a purely technical perspective attacking players such as strikers and wingers peaked prior to the age of 25 (Dendir, 2016; Kalén et al., 2019), suggesting that this general trend discovered in previous research is also applicable to the English Premier League. The results also revealed that younger attacking players performed certain actions more frequently, for example, although the two younger age groups completed more successful dribbles than their older counterparts, they also completed more unsuccessful dribbles. These results can be explained by the physical demands of these playing positions. Attacking players have been revealed to perform more frequent high intensity actions such as sprints for longer durations than those performing in other positions (Bloomfield et al., 2007; Bradley et al., 2011; Di Salvo et al., 2009). Younger athletes also tend to have increased physical capabilities as they have a higher VO2 max ability (Botek et al., 2016) enabling them to complete high-intensity actions such as dribbles more

frequently than their older counterparts. The greater physical demands placed upon attacking players is therefore most probably the cause for their earlier peak (Kalén et al., 2019).

Contrary to results in previous literature, the results of this study revealed that a goalkeeper's age had no impact upon their technical performance in the English Premier League. This result reinforces the notion that aging trends in football are not likely to be uniform across all international leagues. One potential reason for this result could be that there were not many goalkeepers in the youngest age group (16-20) suggesting that the goalkeepers position, the most specialised position in football (Frick, 2007) is not entrusted to younger athletes in the EPL. Furthermore, average height and body mass is significantly lower for goalkeepers under the age of 19 (Nikolaidis et al., 2015), suggesting coaches and managers wait until a goalkeeper has fully matured physically, before regularly selecting them. Finally, the goalkeeping position requires very little high-intensity activities such as sprinting ((Di Salvo et al., 2008) relative to outfield players therefore goalkeepers are not likely to be as physically disadvantaged as outfield players would be in the later years of their career.

Results for defenders revealed that age had no impact upon the technical performances of defenders performing in the full back position, a somewhat surprising result considering the full back position involves much more high intensity running than centre back positions and they often have to run the length of the pitch to overlap wide midfielders (Di Mascio & Bradley, 2013). Age also had no bearing upon the technical performances of defenders performing in the centre back position in contradiction to the results obtained by Dendir (2016) and Kalen et al., (2019). Similar results were discovered for central midfielders, another somewhat surprising result considering central midfield players have often been revealed to cover the greatest distances of all players on the playing field and cover greater distances at high intensities (Di Salvo et al., 2009). However, Frick (2007) reports that central midfielders are the least specialised of all positions which could partly explain no significance differences in technical performance being discovered between the age groups for this midfield position.

This case study on the EPL has shed more light on how age can impact the technical abilities of elite football players and specifically at what age peak performances tend to occur according to player positions. This study however, was limited in the main by an absence of physical parameters which may influence some of the trends discovered in this study. Future research therefore could expand on this investigation and incorporate physical performance data in order to further inform the individualised coaching plans and strength and conditioning programs of players as well as their clubs' recruitment policies.

In summary, the results have confirmed that aging trends in football are not uniform and leagues such as the EPL have characteristics and peculiarities that are only revealed when optimal peak performance ages are analysed on a league-by-league basis, justifying the need for further case study approaches in future research. The need for future researchers to adopt case study approaches when assessing optimal performance ages in football is further reinforced by the fact that the levels of revenue earned in international leagues vary considerably (Deloitte Football Money Report, 2020). These varying levels of revenue are likely to impact investments decisions regarding the construction of modern-day training facilities and the hiring of non-playing staff such as nutritionists and strength and conditioning departments that have contributed to the increase of the average playing age in football (Kalén et al., 2019).

Conclusion

Evidence has been discovered confirming that the EPL has unique characteristics that influence when football players performing in this league reach their optimal performance age. It has been discovered that forwards and wingers reach their peak performance age prior to the age of 25 in line with those results discovered in previous studies. However, contrary to these previous studies, evidence is also discovered confirming that age has no bearing upon the technical performances of goalkeepers, defenders or midfielders. The authors conclude that

more case study approaches are needed in order to determine the unique characteristics and peculiarities of foreign leagues which would enable more objective decisions to be made with regards to player recruitment and individualised coaching plans.

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