Explorative Analysis into the Relationship between Age and Peak Player Performance in the NBA

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Abstract

Historically the NBA has been filled with many prominent players and stars, but one of the longest standing questions has been when these specific NBA players reach their maximum player performance. Previous research suggests that player performance reaches its greatest point from the ages of 24 to 27, with a dropoff occurring around 30 years of age. Utilizing Python 3.10, an analytical study was performed, generating visuals from data collected on the top 100 NBA players from the 2013 to 2020 seasons and evaluating the trends of points per game (PPG) and player efficiency rating (PER) as players aged. Ultimately, the study concluded that from the ages of 24 to 27 peak player performance was observed in regards to offensive output and efficiency rating, as was concluded by previous studies. Further exploration into additional metrics in combination with PPG and PER could provide further insight into how performance changes as players age, while also aiding front office decision making within trades and other team adjustments.

Introduction

From old legends like Bill Russell and Wilt Chamberlain to the 90's greats of Jordan and Magic. From modern day superstars Stephen Curry and Lebron James to young phenoms of the likes of Victor Wembenyama and Anthony Edwards. Throughout the history of the National Basketball Association (NBA), the league has been littered with talented and skilled players. These players encapsulate viewers' attention, "oohs" and "ahhs" following their every action. They stuff the box score every game, seemingly dominating at ease. Yet, there comes a time when even the greats begin to see a decline in performance. Kobe Bryant dominated the association his first 17 years before a steep dropoff in performance his 18th season ("Kobe Bryant Stats", n.d). Michael Jordan averaged nearly 32 points per game over his career before his first retirement. When he returned, his average dropped to less than 23 a game ("Michael Jordan Stats", n.d).

The NBA showcases the meteoric rise and fall of these stars, and fans are often left watching the twilight years of legendary players. Why do we see player performance dropoff significantly? When do we see these top players perform at their prime? To what degree do players ascend and descend from their peak performance? To truly understand when and how the premier players in the NBA reach their athletic peaks, crucial metrics that best evaluate player performance must be analyzed throughout the years. By looking in depth at age trends and picking apart the numbers, we can allow for both viewers and front office decision makers to better understand the game infront of them. Such insight would allow for teams to make more efficient trades and better analyze player value, simultaneously aiding the casual viewer with key statistics. The necessity to analyze the trends of age and performance has increased in recent years given the rise of ever-younger superstars. Examples of stars. Hypothesize that players are reaching their peak performance at a younger age. How best to evaluate performance.

In order to maximize the accuracy and efficiency of the study, the two metrics selected to analyze were points per game (PPG) and player efficiency rating (PER). PPG serves as a simple but glaring statistic that could be looked at. Wins and losses in the NBA are determined solely on which team scores more points. When the NBA was created in 1946, the stats kept were very basic- points scored, shots made and attempted, free throws made and attempted and fouls ("Basic/Traditional", 2016) . As one of the core statistics in the NBA, points are one of the most accurate ways to analyze players. A player's contribution to team and individual performance can be most directly observed and evaluated through points per game. Thus, points per game is one of the most pivotal and important stats to analyze, and will be one of the bases of the study. From a more advanced metrics standpoint, player efficiency allows for an accurate all-in-one basketball rating. PER allows for all of a player's productivity and statistics to be measured, summarizing a player's statistical accomplishments into a single number. PER takes into account field goals, free throws, 3-pointers, assists, rebounds, blocks and steals, while also factoring missed shots, turnovers and personal fouls ("What Is Player Efficiency". 2024) . Although PER isn't particularly indicative of a player's defensive contributions due to its emphasis on offensive contribution, it allows for a generally accurate representation of a players worth, and condenses an expansive pool of stats to a manageable metric.

The aim of this report was to discover and further analyze the average age at which the top NBA players perform at their peak. For the 2013-2020 seasons, the top 100 NBA players were grouped and filtered by taking the highest ranked in PER and PPG, respectively. Two separate data pools were created for analysis based upon these two metrics. Basic and in-depth

analysis was conducted on each of these data sets, including the gathering of general information, as well as a thorough visual analysis and the inspection of possible trends.

Methods

Data Acquisition

Player data was collected from basketball-reference.com. Overall, 51 player metrics were collected with a focus on two separate player output metrics – points per game (PPG) and player efficiency rating (PER). The remaining 49 player metrics and their accompanying variable names can be found in the data dictionary (Appendix A). The desired player pool was the top NBA players, thus only the top 100 players in the PPG and PER metrics were observed in the data sets. In addition, data was observed from 8 NBA seasons collectively, 2013-2014 to 2020-2021. This was to ensure there would be a large enough sample size to strengthen our model and mitigate possible data abnormalities. The desired data was not downloadable in a table format; as a result, the data was transposed into csv format, pasted into a google sheets document, and separated into columns. This process was then repeated twice for each statistic being measured (PPG and PER), and that process repeated 8 times for each season being accounted for.

The data collected was sorted into two separate Google Sheets files, PPG and PER. The files were then converted into .csv, and imported to a Google Colab file. The PPG data and PER data were assigned variable names, ppg_file and per_file, respectively. Using the command pd.read_csv(), the data files were displayed, and our output was the data file that was requested.

Data Cleaning

Once read into Colab, all analyses were performed using Python 3.10. After the acquisition of the two data sets, cleaning operations and basic data analyses were conducted. Null values were identified using the print(ppg.isnull().sum()) and print(per.isnull().sum()) commands to detect null values within the data sets. In the ppg data set, 11 null values for 3P% and 789 non null values were identified, representing that in 11 instances, players did not have a 3P%. This was the result of attempting and making zero 3 pointers, meaning there would be no applicable percentage. To fill out the null values, the command ppg['3P%'].fillna(value=0)was applied, replacing all na values with zero. This new version was re-saved as the value ppg['3P%'=ppg['3P%'].fillna(value=0) meaning that the ppg data set no longer had null values for 3P%. Within the PER data set, there were 2 columns in the original csv file with zero inputs. Therefore, when checking for null values, there were 800 null values under the titles, Unnamed: 20 and Unnamed: 25. To eliminate null values in this data set, the command per = per.drop(columns=['Unnamed: 20', 'Unnamed: 25']) was used to remove the “Unnamed: 20” and “Unnamed: 25 columns”.

In addition, the datasets took into account midseason player trades, calculating combined stats from players throughout the entire season, regardless of team. Furthermore, the datapool eliminated all players who did not meet the prerequisite of games played (60 games). This was in an attempt to take into account performances that might have been injury-influenced, allowing for a more accurate player pool.

General and Specific Analysis

To conduct a basic analysis on the data pool, general information on each data file was required. The PER data was analyzed first using the command, per.describe(). This gave generalized information about the PER data set, providing count, mean, standard deviation (std), minimum, lower quartile, median, upper quartile, and max value of each statistic in the file. Due to the goal of the report, the Age and PER columns were prioritized, thus attention was focused upon values in those two statistics specifically.

Among the given measures of central tendencies, mode was not provided. As a result, the command per['Age'].mode() was used to discover the most repeated age value within the PER player pool. With the desired basic PER data acquired, focus was shifted onto the PPG data set. Using the same describe command, ppg.describe() was used to provide measures of central tendency for each statistic in the PPG file. Likewise to the PER pool, PPG and Age were the two stats prioritized. The command per['Age'].mode() was used to determine the most common age within the PPG player pool. With the conclusion of basic analysis, the count, mean, standard deviation, minimum, lower quartile, median, upper quartile, and max value were gathered for the PPG and PER files, taking into account all 8 seasons.

To perform a further in-depth analysis on the data pool, the two data sets were subset by season. This allowed for each season to be analyzed individually, providing more specific and in-depth breakdown of the numbers. Another reason for this action was to allow for the analysis of the possible trends throughout the seasons. To assess each season within the timeframe, both the PPG and PER data pools needed to be separated. To do so, the columns were broken up and separated by the yearly values from 2013 to 2020. Using the ‘loc’ command, columns were separated to isolate seasons. The PPG data set was separated first. The first season collected was 2013, so the command ppg.loc[ppg['Yr'] == 2013,] was used to take only data entries from the 2013 season. This command was saved as the variable name ppg_2013 by setting the command equal to ppg_2013. The ‘loc’ command was used for each of the 8 seasons and set to a variable name of ppg_(desired year). The end product was 8 values (ppg_2013, ppg_2014, ppg_2015…ppg_2020) each containing only PPG data from their respective season.

With each season separated, the ability to analyze each season specifically arose. By using the describe command, each season's individual descriptive statistics are given. Since mode is not given using .describe(), the command ppg_2013[‘Age’].mode() was used to determine the most common player age of the top 100 PPG players in 2013. The same command was used for the rest of the seasons, resulting in descriptive PPG statistics for each separate season in the NBA from 2013-2020. A similar process was followed for the PER player pool, with the loc command being applied to every season again. This time, the command followed the format ppg.loc[ppg['Yr'] == (desired year),]. These commands were saved as “per_(desired year)”, giving 8 separate seasons of top 100 PER player statistics from 2013 to 2020. To analyze each of these new values, the command .describe() gathered mean, median, upper/lower quartiles, max/min, and count for PER data set, while per_(year)[‘Age’].mode() accounted for the mode of the age in a season. By the end of this process, there were 8 individual seasons worth of data, with each season from 2013 to 2020 having its own data breakdown from both PPG and PER statistics.

Visual Analysis

In-depth and visual analysis was conducted on the data pool using a multitude of commands from separate libraries. Models and visual graphs were generated using

matplotlib.pyplot and seaborn, while pandas and numpy allowed for the restructuring and analysis of our data. To begin, a scatter plot for PER and PPG was necessary to visualize the general spread of player age in relation to player performance (Figure 4 and Figure 8). This also allowed for detecting obvious and clear trends throughout the data. Using matplot, the commands plt.scatter(x=per['Age'],y=per['PER▼']) and plt.scatter(x=ppg['Age'], y=ppg['PTS▼'])output a PER vs Age scatter plot and PPG vs Age scatter plot, respectively. The X axis for both graphs represent the age range from the player pool, from 17.5 to 40 years of age. The Y axis graphs represent the metrics being compared with age, PER and PPG.

In order to create a more visually organized graphic, box plots were utilized (Figure 3 and Figure 7). By creating age bins to bunch together players of the same age group, the data was compiled to be more easily interpreted. Furthermore, box plots presented a more direct way to decipher each data set, providing quartiles, medians, maximums, and outliers within each age range. A dotted red line representing the overall mean of PER or PPG (dependent on which graph) throughout the entire data set was also implemented to aid with analyzing the individual plots. The vertical axes were PER and PPG, respectively, while the horizontal axes represented separate age groups.

Finally, histograms were created that visualized age distributions for the PER and PPG data sets (Figure 2 and Figure 6) in addition to histograms that visualized the PER and PPG distributions themselves (Figure 1 and Figure 5). The x-axes specified a predetermined statistics range, while the y-axis represents the quantity of players within the range. The red line in each graph represented the mean value for the statistic being measured. These graphs allowed for a more general interpretation of the data pool, also helping to explain possible trends or outliers in previous charts and data.

Results

PER

Over 8 cumulative seasons of PER player data, the age ranged from 19 years to 39 years, with the median age of 26 years old (std: 3.81) . The upper and lower quartiles of the data set were 29 years and 24 years, respectively. It can also be seen that from 2013 to 2020, 26.57 years old was the average age of a player ranked in the top 100 PER (Table I). The most represented age within the top 100 PER of a season was 25 years old. As presented in Figure 1, the PER distribution histogram has a right skew. The Age vs PER histogram displays a normal or “bell curve” distribution (Figure 2).

Given the 800 entries of player seasons, the average PER rating was 19.19, with a minimum of 14.6, a lower quartile of 16.3, a median of 18.25, an upper quartile of 21.2, and a maximum of 31.9 (Table I).

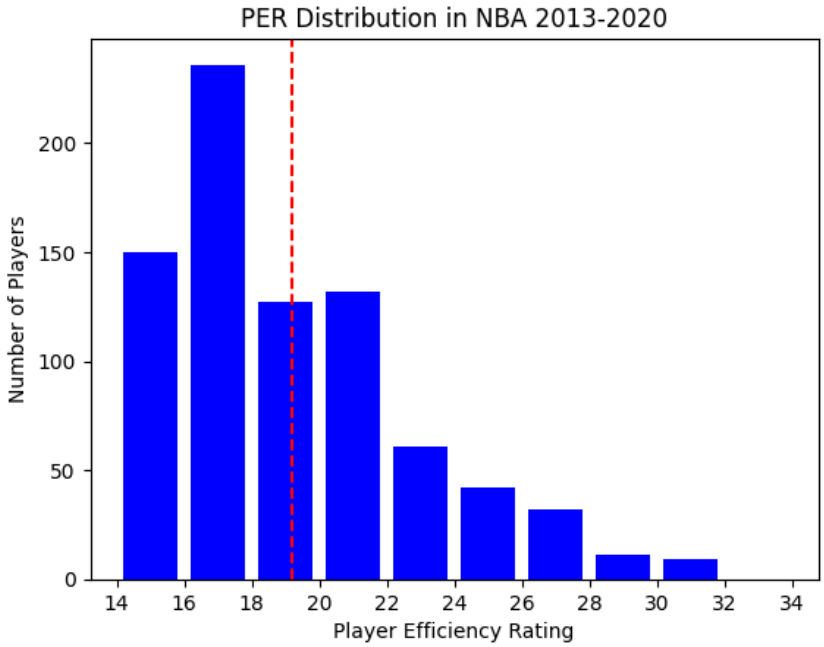

Figure 1. Histogram of Player Efficiency Rating count for the top PER NBA players from 2013-2020.

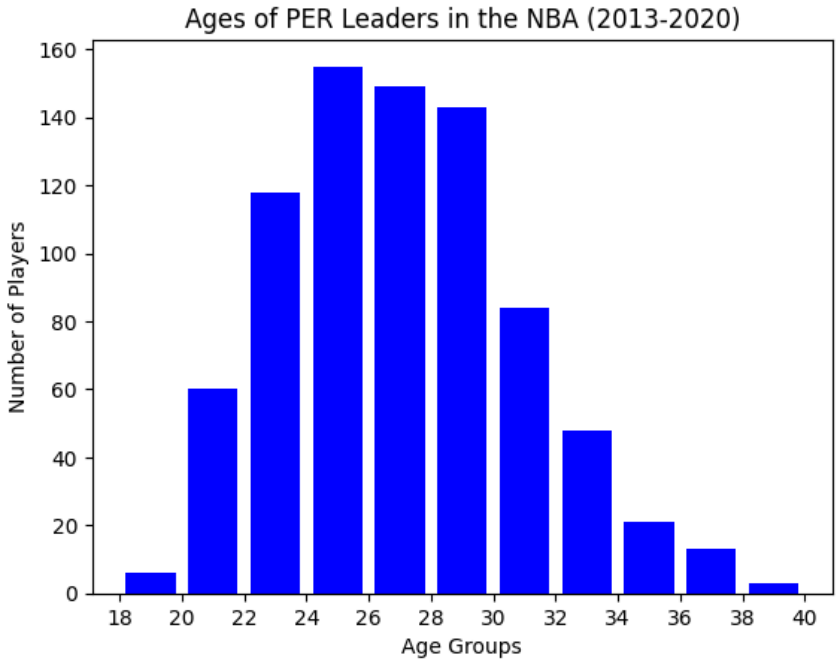

Figure 2. Histogram of Age groups for the top PER NBA players from 2013-2020.

When observing the 2013 season alone, the average age of a player was 26.66 years old with the oldest being 37 and youngest 20. The mode of the 2013 season was 3 years greater than the overall dataset, with 28 being the most common age of a player in the list. The 2014 season had a mean player age of 26.97, with the oldest and youngest players being 38 and 21. The mode of the top 100 PER ranked players was 25. The following season, 2015, the average age was 26.48. The oldest player in the PER pool was 39, and youngest 20. The average age for players in 2016 was 26.43 years, with 20 and 36 being the maximum and minimum. The 2013, 2014, 2015, and 2016 season all shared the same lower, middle, and upper quartiles as the general dataset. The 2017 season had a mean player age of 26.40, with a minimum of 19 and a maximum age of 39. The 2017 season had 3 modes, meaning 3 ages appeared most frequently an equal amount. Thes ages were 23, 25 and 27, with lower and upper quartiles 23 and 29 respectively. There was an increase in average player age of .16, resulting in a mean age of 26.56 years. The minimum of the 2018 season was the same as 2017, with a maximum of 2 years younger (37 years). The upper and lower quartiles of the 2018 season were 23.75 and 29.25. In the 2019 season, the mean, median and mod of the data set were 26.54, 26, and 27 respectively. The minimums and maximums of 2019 were 20 and 34, with quartiles of 23.75 and 29.25. The final season data was gathered for the 2020 season, with the average PER leader age being 26.52. The minimum was 19 years, while the maximum was 36. The entirety of the general and individual PER data is displayed in Table I.

Table I. Data breakdown and descriptive statistics of age vs season from 2013-2020 of the top 100 PER ranked players each season.

	Mean	Min	Lower Quart.	Median	Upper Quart.	Max	Mode
Overall	26.57	19	24	26	29	39	25
2013	26.66	20	24	26	29	37	28
2014	26.97	21	24	26	29	38	25
2015	26.48	20	24	26	29	39	25
2016	26.43	20	24	26	29	36	25
2017	26.40	19	23	26	29	39	23, 25, 27
2018	26.56	19	23.75	26	29.25	37	26
2019	26.54	20	23.75	26.5	29	35	27
2020	26.52	19	24	26	29	36	28

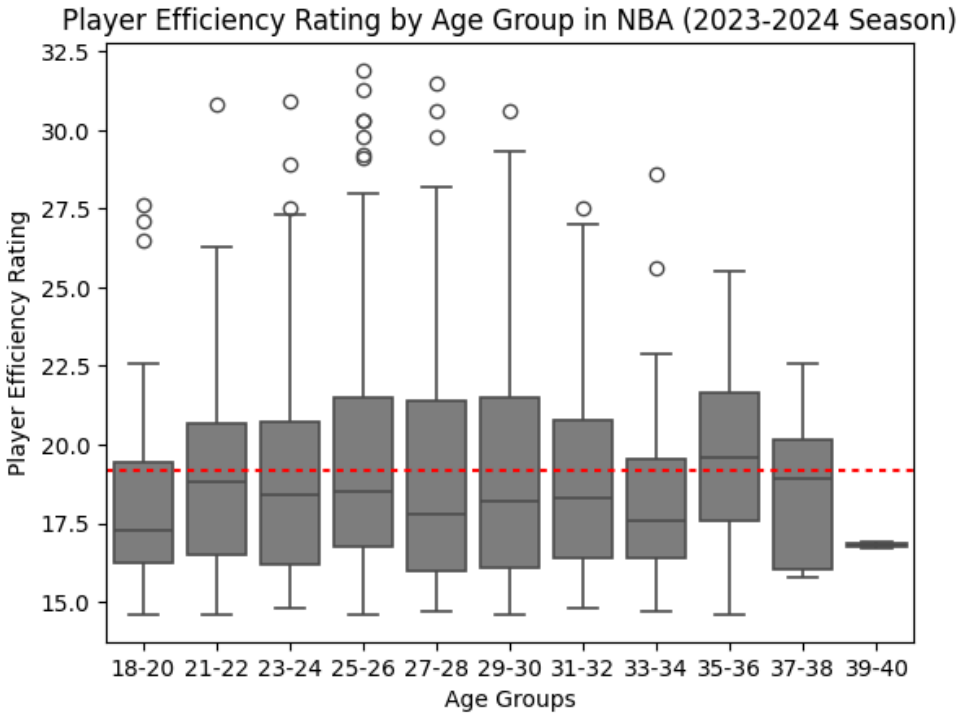

Figure 3. Box plot of NBA age groups compared to PER for players each year from 2013-2020

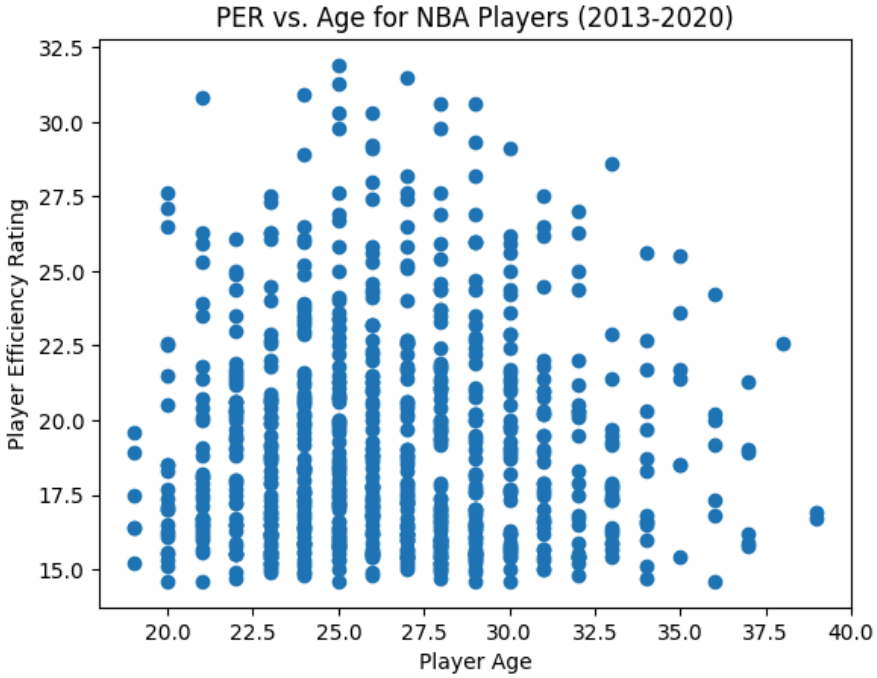

Figure 4. Cumulative scatter plots of top 100 PER rated players each year from 2013-2020 by Player Age vs. Player Efficiency Rating (right)

The PER scatter plot has a slight right-skew, with the highest recordings appearing to the left of 27.5 years (Figure 4). Furthermore, as you look at the right side of the plot, the players are more scarce and appear less in general, with only 3 players after 37.5 years. This compared to the very high frequency of players between 20 and 30. All age groups median, quartiles, maximums, minimums, and outliers in PER are displayed in Figure 3.

PPG

From the 8 years worth of PPG leader data, the age range spanned 20 years, a maximum age of 39 and minimum age of 19. The median was 26 years old (std: 3.87). The upper and lower quartiles over the 8 years were 23 and 29. From 2013 to 2020, 26.2 years old was the average age of a points per game leader. The most represented age within the top 100 PPG leaders of a season was 24 years old. As presented in Figure 3, the left PPG distribution histogram has a heavy right skew, representing that the highest quantity of players averaged between 14 to 16 points. Nearly all players average less than 24 points, with the quantity of players above that range diminishing significantly. The age variable in the PPG data set was observed to have a normal distribution with a range from 18 to 40 (Figure 3).

The average points per game (ppg) for PPG leaders over the 8 seasons was 17.2 points per game. Within the data set, the maximum ppg was 36.1 (registered in 2018), and the minimum 11.7 points (registered in 2013 & 2014). Lower and upper quartiles were 13.6 and 19.82 ppg respectively, with a median of 15.9 points.

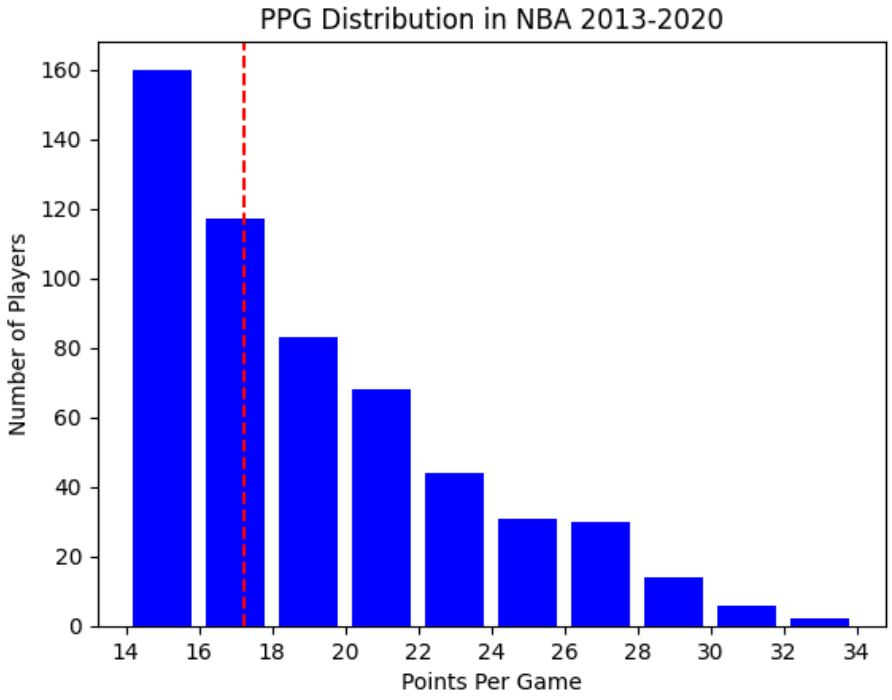

Figure 5. Histogram of Points Per Game count for the top PPG NBA players 2013-2020.

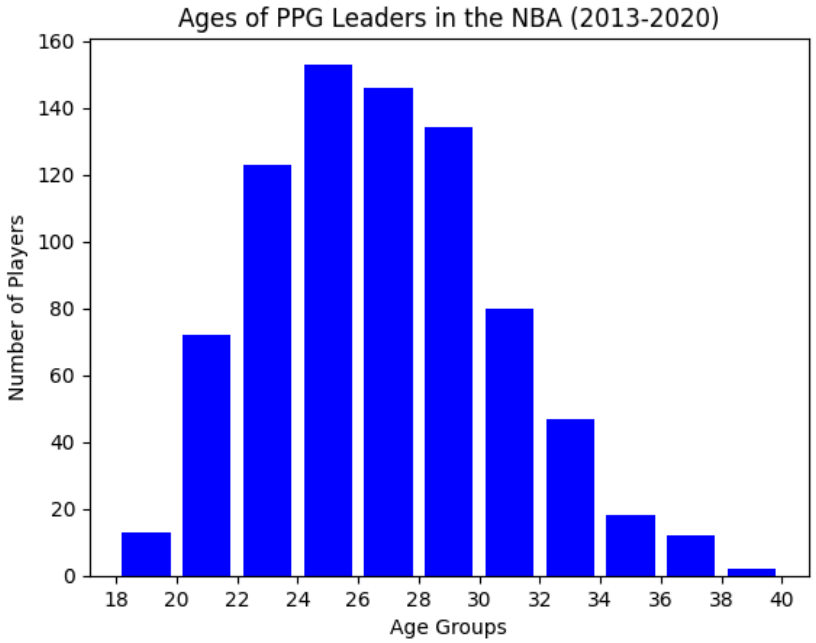

Figure 6. Histogram of Age groups for the top PPG NBA players 2013-2020.

In analyzing individual seasons, the 2013 season had an average PPG leader age of 26.58, with a minimum of 19 and maximum of 37 years old. The lower quartile and upper quartiles of the season were 24 and 29 years. The median age of 2013 PPG leaders was 26, and the mode 25. The 2014 season shared the same minimum, median, and upper quartile as 2013, with a higher lower quartile by 1 year (24 years), and a max of 1 year older (38). The mean of 2014 was 26.52, with a mode of 24. In 2015, the minimum was 20, and the maximum age was 37 years old. The median of the data set was 25.5, with a mode of 28 years old. The average age of a top 100 ppg scorer in 2015 was 26.08 years old. The mean, median, and mode ages for the 2016 season were 26.49, 26, and 26. The lower and upper quartiles were 24 and 28.25, with a max of 20 and 36. In 2017, the minimum and maximum ages of players in the top 100 PPG was 19 and 39, with an average age of 26.25. The lower, middle, and upper quartiles of the 2017 season were 23, 25, and 29 years old. The most common age in the player pool was 25 years old. In the 2018 season, the quartiles were 23, 26, and 29 respectively, with a minimum and maximum of 19 and 37. The average age was 26.31, with a mode of 25 years. The 2019 season featured a mean of 26.17, a minimum of 19 and a maximum of 35. The lower, middle, and upper quartiles were 23, 26, and 29. The mode of the 2019 season was 25 years old. In the final season of the study, the average age of the PPG leaders was 25.83. The 2020 season had a minimum and maximum age of 19 and 36 years. The lower and upper quartiles of the 2020 season were 22.75 and 28.25 years. The mode for 2020 was 22 and 28, with those two ages appearing most frequently.

Table II. Data breakdown and descriptive statistics of age vs season from 2013-2020 of the top 100 PPG ranked players each season.

	Mean	Min	Lower Quart.	Median	Upper Quart.	Max	Mode
Overall	26.2	19	23	26	29	39	24
2013	26.59	19	24	26	29	37	25
2014	26.52	19	24	26	29	38	24
2015	26.08	20	23	25.5	28	37	28
2016	26.49	20	24	26	28.25	36	26
2017	26.25	19	23	25	29	39	25
2018	26.31	19	23	26	29	37	25
2019	26.17	19	23	26	29	35	25
2020	25.83	19	22.75	26	28.25	36	22,28

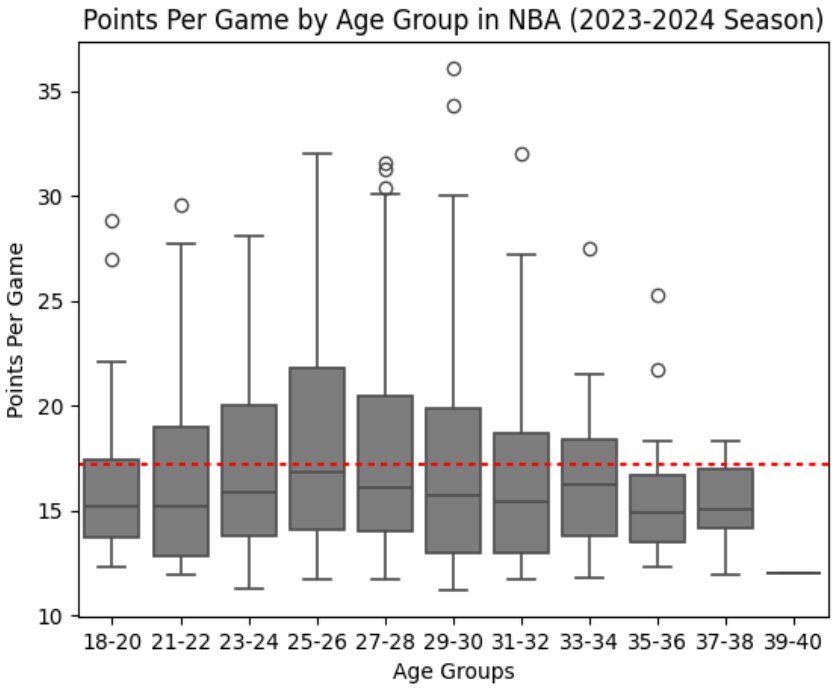

Figure 7. Box plot of NBA age groups compared to PPG for players each year from 2013-2020

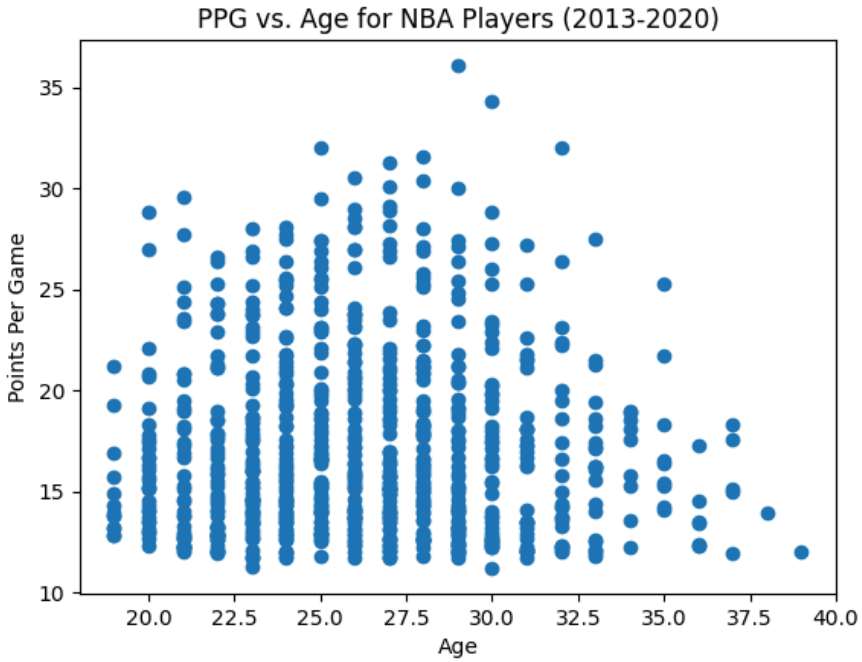

Figure 8. Cumulative scatter plots of top 100 PPG rated players each year from 2013-2020 by Player Age vs. Points Per Game

As can be seen in the PPG scatter plot in Figure 8, a normal distribution was observed, with the highest PPG recordings occurring between 27.5 to 30 years (Figure 8). In addition, the highest density of players occurs around 27.5 years old. All age groups median, quartiles, maximums/minimums, and outliers are displayed (Figure 7), as well as a red line drawn across to visualize the universal average points per game for all players in the data set.

Discussion

PER

As a result of the PER leader analysis, it can be seen that the most common age among top 100 PER leaders from 2013 to 2020 was 25 years old. This meant that within all 800 entries of player seasons, the most frequent age was 25. However, in only 4 out of the 8 individual seasons was 25 the mode of the data set, and in one of those instances, 25 shared the same number of entries as ages 23 and 27 (Table I). In addition, the 2013 and 2020 season had the highest mode of age, with 28 being the most common player age in PER leaders, However, when looking at the average player age of each season, the 2020 season had the 4th lowest mean age (26.52), and the 2013 season had a lower average age (26.66) than 2014 (26.97) which had a mode of 25 years old. This meant that even though the 2013 and 2020 season had the highest mode, the overall age spread of the two seasons resulted in a lower average age than 2014 (26.97).

The median age, or the middle player (in terms of PER score) of every season was 26 with the exception of the 2019 season, when the median was 26.5. This meant that despite the most common age amongst PER leaders being 25, if one were to take the 50th/51st player in age each season, they would have all been 26 years old barring one season. It can also be seen that the average age of a PER leader in every season, including the cumulative

measurement, was between 26.4 and 27 years old (Table I). Thus, despite the most common age being 25 throughout all PER leaders, if you were to take the average age or median age, you would be left with an age between 26 and 27 years old. From the table we can determine that the most frequent range of player age among the PER leaders was 25-27 years old.

There was no trend in terms of PER leader player age throughout the years, with the average age, mode, and median all showing no specific growth pattern.

The overall PER distribution by age can be seen to have a normal distribution, with a slight right skew (Figure 2). From this graph, you can determine that most players in the PER leaders are between the ages of 22 and 30. It can also be concluded that the largest population of PER leaders is within the 24-26 age range, with the 2nd and 3rd largest groups being 22-24 and 26-28. This supports the findings of our table, with the two age groups sharing similar age ranges. By evaluating PER vs age we can see a higher concentration of players within the ranges of 22.5 to 32.5 (Figure 4). We see a significant dropoff of players after the 32.5 year old mark. This shows that after 32.5 years old, the number of PER leaders decreased heavily. The highest PER average value was registered by a player that was 25 years old, and the highest PER averages in general were located between 25 and 27.5 years. The boxplot however (Figure 3) yields interesting results: The highest general “maximum” values were recorded by the 29-30 age group, with the 25-26 age group having the largest number of outliers. When assessing the mean vs median, we can see that the mean PER of all 800 entries - represented by the red line - was greater than the median PER for every age group except the 35-36 age group. This is the result of outliers increasing the mean PER value, while the median PER value for each group was simply the middle player’s PER rating. This also means that out of all the age groups, the 35-36 group was the only age group that had more than half of its players average greater than the mean PER of all PER leaders from 2013-2020. This is due to the fact that because the median was greater than the mean, the upper half of the age group would all have PER’s greater than the mean PER.

PPG

The PPG table concluded that the most common age among top 100 PPG leaders from 2013 to 2020 was 24 years old. When comparing the general mode to the mode of each individual season, it can be seen that 24 was the mode of a singular season in only 1 out of the 8 seasons. This meant that despite 24 not being the mode in 7 out of 8 seasons, when combining the number of 24 year olds each season over the 8 years, it emerged as the most common age throughout the time frame.

The 2015 and 2020 season had the highest mode of age, with 28 being the most common player age. Despite that, the average age of the two seasons represented the two lowest mean ages in the dataset. The 2020 season had a mean age of 25.83, the lowest in all 8 years. The 2015 season had a mean age of 26.08, the 2nd lowest. Within the 2020 PPG leaders, the mode age was shared between 28 and 22 years, explaining why the average was the lowest in the study. Because the mode of the 2020 season had both the highest and lowest ages, the overall mean averaged out to a lower value than the rest of the seasons. In the 2015 season, the low average can be attributed to the overall spread of PPG leader ages. Compared to the rest of the data, the 2015 season had the lowest upper quartile value (28 years). This meant that 75% of the players were aged 28 or less, resulting in a lower average age than all years except 2020.

The mean age of all seasons ranged from 25.83 to 26.59 years old (Table II), meaning that the average age group of a PPG leader was between 25-27 years old. The median age ranged from 25 years to 26 years, proving that the mean and median shared a similar age group. This meant the middle aged player of the PPG leaders each season was an accurate representation of the average age of PPG leaders. This also showed that despite the most common age of a player being 24, the average age of a PPG leader was greater than the most common age. The player distribution also shows how most PPG leaders fell between the 24-26 range, with the 26-28 range and 28-30 range being the 2nd and 3rd most frequent age groups (Figure 6).

Overall, there was a slight downwards trend in age when evaluating mean player age of PPG leaders. The 2020 season yielded the lowest player average, and apart from the 2015 and 2018 season, the 8 year trend was one that had a consistent decrease in age.

The PPG vs Age scatter plot distribution has a right skew (Figure 8). Most PPG leaders are between the ages of 22.5 and 30. From the concentration of markers, we can determine that the greatest number of PPG leaders are within 24 to 30 years old. This supports the findings of Figure 6 and Table II, with the two age groups sharing similar age ranges. There is also a significant dropoff of players after the 30 year old mark. However, the frequency of outliers after 30 years old seems to increase, with the highest PPG average registered by a 29 year old and the 2nd highest PPG average registered by a 30 year old.

The boxplot (Figure 7) supports our findings by displaying the highest overall maximum and upper quartile values in the 25-26 age group, with 29-30 yielding the highest singular value due to outliers. Furthermore, when comparing the mean vs median for PPG leaders, the mean PPG was greater than the median PER for every age group. This meant the average points scored universally was greater than the points scored of the middle PPG leader in an age group. This is the result of the highest PPG players scoring an amount that was much greater than other players, thus the difference between any value and max PPG was great enough to raise the mean PPG value higher than the median.

Previous Studies

In a previous study conducted (Salameh, 2023) investigating the prime performance age of NBA players from the perspective of general managers, the age of peak performance was found to be between 24 and 27 with a slight decline in performance after the age of 29 (Salameh 10). This aligns with the results of this study: The age at which we see player efficiency decrease for PER was 32.5, and 30 for PPG. In addition, the general age where we saw peak performance was from 24-27 for PPG and 25-27 for PER, which is almost completely agreeable to Salameh's findings. Furthermore, the variables evaluated altered from study to study. In this study, PER and PPG were evaluated, while Salameh used PER, Box Plus Minus (BPM), and Games Played (GP). Despite the differences in stats measured, the findings of peak player performance remained the same.

Conclusion

From 2013-2020, it can be concluded that the peak performance age of a PER leader was between 25 and 27 years old. The overall "maximum" in PER production was between 29-30 years, but at 25-26 years we saw players reach the greatest heights in terms of rating. Each season, the average age of a PER leader was from 26.4-27 years old. It can also be

deduced that 25 year olds most frequently output high PER rankings, as a result of them being most commonly represented among PER leaders. After around 32.5 years old, there was a noticeable dropoff in PER rating, as well as the quantity of PER leading players as well.

The prime performance of a PPG leader from 2013-2020 was between 24-27 years old. The highest output of points scored for players was between the ages of 24-26, with the age group representing both the largest number of players and highest “maximum” and upper quartile values. The 29-30 year old age group contained the singular highest scoring outputs, with multiple outlier seasons producing the greatest PPG values. The average age of a PPG leader each season was 25.8-26.6 years old. The most frequent appearance amongst PPG leaders came from 24 year olds, with a dip in PPG averages and quantity of players occurring after 30 years old.

This study can be evaluated and further tested to encompass more metrics and parameters, allowing for a full analysis of when NBA players reach their athletic primes. These results and conclusions can be used when evaluating a players market value, when the ideal time to trade for a player might be, as well as aiding in a plethora of other front office or fantasy decisions.

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Appendix A

Variable	Description
Yr	Season Year
Rk	Player Ranking
Player	Name of player
Pos	Position
Age	Age of player
Tm	players team
G	games played
GS	games started
MP	minutes player per game
FG	field goals per game
FGA	field goal attempts per game
FG%	field goal percentage
3P	3 pointers per game
3PA	3 pointer attempts per game
3P%	3 point percentage
2P	2 pointers per game
2PA	2 pointer attempts per game
2P%	2 point percentage
eFG	effective field goal percentage
FT	free throws per game
FTA	free throw attempts per game
FT%	free throw percentage
ORB	offensive rebounds per game
DRB	defensive rebounds per game
TRB	total rebounds per game
AST	assists per game
STL	steals per game
BLK	blocks per game
TOV	turnovers per game
PF	personal fouls per game
PTS	points per game

MP	minutes player total
PER	player efficiency rating
3PAr	3 point attempt rate
FTr	free throw rate
ORB%	offensive rebound percentage
DRB%	defensive rebounds percentage
TRB%	total rebound percentage
AST%	assist percentage
STL%	steal percentage
BLK%	block percentage
TOV%	turnover percentage
USG%	usage percentage
OWS	offensive win shares
DWS	defensive win shares
WS	win shares
WS/48	win shares per 48 minutes
OBPM	Offensive box plus minus
DBPM	Defensive box plus minus
BPM	Box plus minus
VORP	Value over replacement player