

Shorter Footballers: Better Suited for the Sport?

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Introduction

A common phrase you hear in basketball is, “You can’t teach size.” The meaning of this phrase is that a player has physical attributes that benefit their ability to play the sport. The goal of basketball is to put the ball inside the rim; the rim is set at 10 feet tall; the closer you are to the rim, the easier it is to put the ball in the rim; taller people are closer to the rim than shorter people; therefore, it is better to be taller in basketball. If you were to pose this hypothesis to a person who knew nothing about basketball, based on the information that you have given them, they would inherently agree that tall basketball players have an advantage over short basketball players. Regardless of its over simplistic nature, the argument is raised to prove this point: physical advantages exist in sport. No two bodies are physically equal, some bodies have physical attributes that others do not. Many athletes will train their bodies in a way that will help them gain a physical advantage over their opponent; but unfortunately for some, something a fully grown adult athlete will never be able to change is their height. It is easy to assume taller players have a height advantage in basketball due to the nature of the sport being centered around two baskets at 10 feet tall, but what about a sport like football? Football is a sport where the ball is predominantly on the ground due to players primary tools being their feet. In the context where football is a sport that relies on high-speed precision movements and tight body control, one is likely to assume that shorter footballers have an advantage over taller opponents. Shorter athletes’ stature allows for them to react more quickly, accelerate better, move with more agility, and have a greater strength-to-weight ratio compared to their taller counterparts. This paper will discuss the biomechanical advantages that short football players have over taller football players. Most specifically, it will be talking about how shorter players have a lower center of mass which allows for peak performance in the sports key physical movement attributes such as balance,

acceleration, and agility. Shorter footballers have a competitive advantage over taller opponents due to their body's center of mass being lower to the ground which allows them to generate power and move their muscles quicker than players that have a higher center of mass.

Introduction to Data

To help support the claims theorized throughout this paper, a dataset featuring player ratings from Electronic Arts (EA) Sports Federation International of Football Association (FIFA) 22 will be used to conduct statistical research. All players in the dataset are replicas and interpretations of what players are in real life. To get the ratings, EA's FIFA scouting team has about 30 producers and more than 400 freelancers as well as more than 6,000 data reviewers to create a unique database that can evaluate all the different leagues and players as objectively as possible (Sohns, 2021).

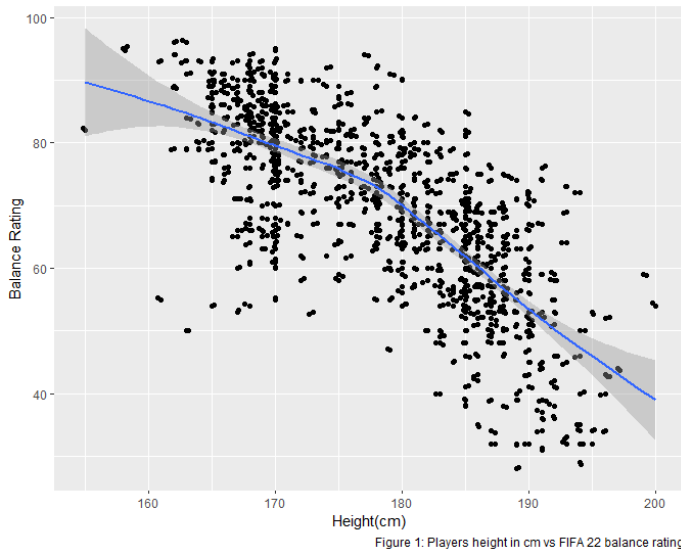
The dataset features a categorical variable called body type which will be used to evenly distribute the range of players selected from the dataset. Players are grouped into three different heights (less than 170cm, between 170cm and 185cm, and greater than 185cm) and from those heights they are grouped into three body types (lean, normal, and stocky). There is also a group featuring players with unique body types. The data used throughout this paper will contain 81 (minimum number of players from the groups) players from each of the 10 groupings. A player's height(cm) will be the main predictive variable to investigate various ratings as response variables.

Balance

Dynamic balance represents the ability to perform an action while maintaining or restoring a stable position (Winter et al., 1990). Balance represents a crucial aspect that supply's

the foundation for enhanced footballing performance (Pau et al., 2015). Throughout essentially every match situation, the lower limbs assume distinct roles in which of them is required to provide the body necessary support and stability when the other one, kicks, dribbles, passes, etc. (Teixeira et al. 2011). A player can consistently successfully achieve a stable body if good postural control (especially on one leg) exists, and if balance can be easily and quickly recovered after sprints, jumps and cutting maneuvers which all routinely happening during both training and matches (Pau et al., 2015).

What about the differences in body structure of small and tall football players? The laws of physics allow a shorter player, with their lower center of mass, to be better able to resist falling and to have the advantage greater stability (Samaras, 2007). This is due to their ability to produce a strong counter-torque to restore their balance during scenarios where an internal or external force moves their body off center (Samaras, 2007). In these situations, gravity is pulling their body in a direction (normally toward the ground) and a shorter individual is capable of producing a strong enough force in the opposite direction to reset their body's mass to a balanced center (Samaras, 2007). Taller players will struggle more to regain balance in unnatural situations because the counter torque to restore the upright position is proportional to the individuals height³ (Samaras, 2007). Meanwhile, the torque due to the force of gravity is proportional to body weight and the distance between the body's center of mass and distance to the spine (Samaras, 2007). As a result of all this, the gravitational torque pulling the body off center towards the ground increases, therefore, the amount of force required to bring the body to center is greater (Samaras, 2007). Shorter players are able to restore their balance better because they need to provide less counter force to restore themselves to their upright position compared to taller players.



The balance attribute in EA Sports FIFA is referred to as the players ability to maintain balance after a physical challenge (FIFAUteam, 2020). In game, a player with high balance stats controls the responsiveness of the player (FIFAUteam, 2020). When looking at figure 1, a very clear trend is exhibited that as the height of a player increases, their balance rating decreases.

There is a slight decrease in balance when heights range from less than 170cm to around 180cm but as height increases taller than 180cm, balance ratings take a steeper decline. There appears to be a strong correlation that the taller a football player is, the worse his balance will be as a result of a higher center of mass which requires them to provide greater amounts of counter force when pushed off center through physical contact.

Acceleration

The maximum acceleration rate occurs during the initial phases of sprinting when athletes demonstrate the greatest changes in velocity (Loturco et al., 2019). Specifically in football, players regularly initiate their all-out sprints from movements of moderate speeds, covering distances of approximately 6 meters for approximately 25 to 60 times per game (Loturco et al., 2019). The capacity to achieve higher velocities at very short distances (less than 5 meters) is a critical component of successful performances in the sport (Loturco et al., 2019). Studies have shown that straight sprinting is actually the most frequent action that precedes goal situations in soccer (Faude et al., 2012).

Contact time and stride frequency are referred to as the two most important kinematic parameters for acceleration (Lockie et al, 2011). A player who can accelerate faster will have lower contact times and may also have a higher step frequency (Lockie et al, 2011). Athletes who accelerate the fastest start their acceleration with very fast short strides with far faster and shorter ground contact times on the ball of the forefoot (Wall, 2016). The ability to reach peak force as quickly as possible is indicative of a great efficiency of force production (Lockie et al, 2011).

Acceleration is the rate of change in velocity and is defined by force divided by mass (Samaras, 2007). For the human body, force is proportional to the cross-sectional area of the muscle, which increases as the square of height (Samaras, 2007). Meanwhile, mass increases as the cube of height increases (Samaras, 2007). If these parameters are substituted into the acceleration equation, acceleration is inversely related to height; as height increases speed of acceleration decreases (Samaras, 2007). For example, a 20% shorter player can accelerate their limbs at a 20% greater value than the taller player (Samaras, 2007).

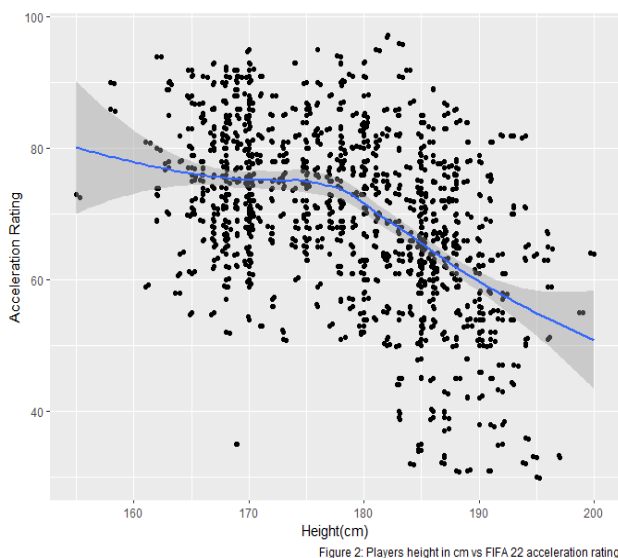


Figure 2: Players height in cm vs FIFA 22 acceleration rating

EA Sports FIFA's acceleration rating is defined as the increment of a player's running speed; the higher the value, the shorter the time needed to reach maximum speed (FIFAUTeam, 2020). When looking at figure 2, there is a decrease in acceleration rating as players get taller. There is not much of a difference in acceleration ratings for players that have heights less than

approximately 177cm, but as players get taller than that, acceleration ratings suffer a steep drop.

As a result of shorter players being able to effectively use their shorter legs to shrink contact time

and increase stride frequency, it can be seen that there is a trend that shorter players accelerate more quickly than taller players.

Agility

Agility refers to the players capability to perform rapid whole body movements with a change of direction as a result of impulse reactions of the surroundings (Goral, 2015). Good agility requires a combination of speed, balance, power, and coordination (Goral, 2015). Being agile is one of the most important factors of a great footballer because of the high number of rapid direction changing situations that need to be successfully completed in relatively small spaces on the field (Goral, 2015).

Height could potentially have an effect on change of direction performance in regards with relative limb lengths and the height of the players center of gravity (Sheppard et al., 2006). A player with a low center of gravity could conceivably be able to apply horizontal force more quickly than a taller player due to shorter players requiring less time to lower their center of gravity in preparation for a lateral direction change (Sheppard et al., 2006). This could mean that a faster change of direction is possible (Sheppard et al., 2006).

In a study submitted to The Sport Journal by Dr. Kemal Goral, the researchers used the Illinois Agility Test to examine the agility performances of players according to positions (Goral, 2015). The test features 4 sprints, 4 changes of direction and weaving through 4 cones, all within 10 meters (Goral, 2015). The results of the study found significant positional differences in players height and weight where midfielders were the shortest and lightest with averages of 175.32 cm and 71.73 kg (Goral, 2015). According to the assessment of the Illinois Agility Test, midfielders got significantly lower times compared to the other positions (Goral, 2015).

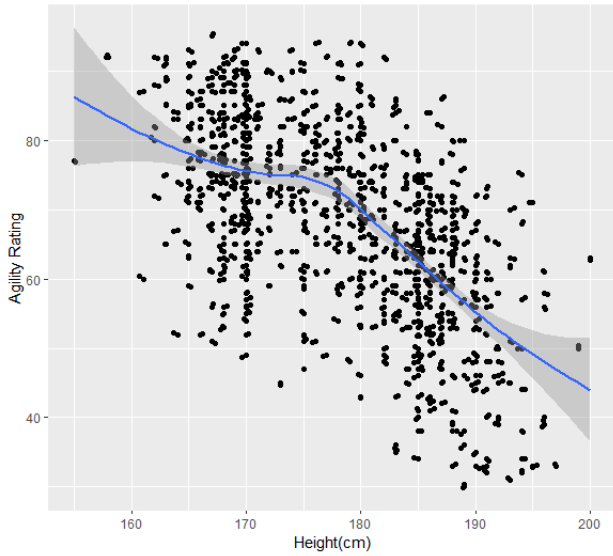


Figure 3: FIFA 22 Agility Ratings vs Height

The agility rating in EA Sports FIFA measures how agile the player is while moving or turning. In other words, how fast and graceful a player is able to control the ball (FIFAUteam, 2020). When looking at figure 3, a decreasing trend can be seen in agility rating as players get taller. The graph is practically constant for shorter players until approximately 177 cm where the graph exhibits a marginal decrease in agility

ratings. When it comes to maneuvering rapid change of directions in tight areas on the pitch, shorter players have the advantage of being able to change directions faster as a result of a lower center of gravity speeding up the process of applying horizontal force.

Pre-Conclusion

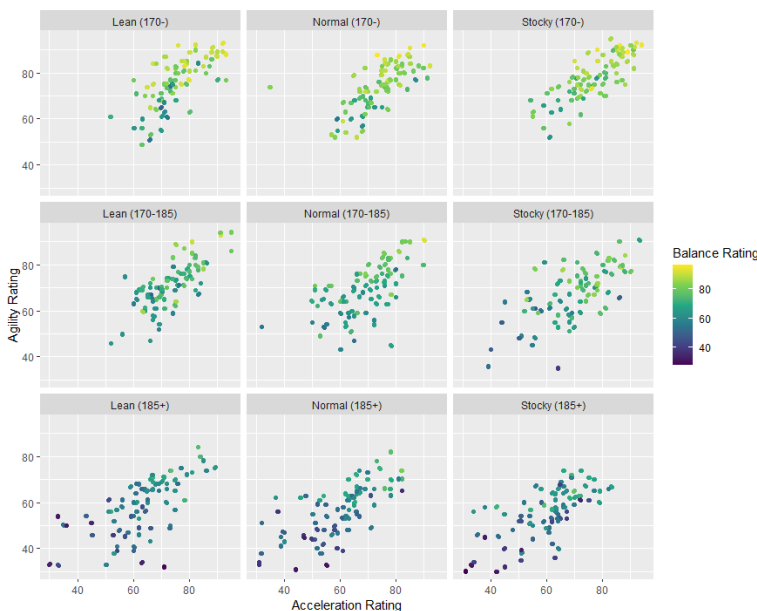


Figure 4: FIFA 22 Acceleration, Agility, and Balance Ratings based on Height and Body Type

Figure 4 revisits the initial data groupings of heights based on their body types and uses the different groups to create 10 plots where FIFA acceleration rating is on the x axis, FIFA agility rating is on the y axis and all points are colored by FIFA balance ratings where dark yellow is best and dark blue is worst.

Consistent high ratings are prominently

seen in the top row where height is less than 170 cm. The tight clusters of players in the graphs are closest to the top right corner of the graph meaning high ratings in acceleration and agility

and they also contain the most highly rated balance players. When moving down to the middle row where height is between 170 cm and 185 cm, the clusters of players are slightly more spread out and there is a downward and leftward shift in acceleration and agility ratings. Rarely any players are considered to have a high balance rating as well. When looking at the bottom row where height is greater than 185 cm, there is now greater variability in the groups of players. No players appear to be exceling in any of the variables being investigated and there are multiple players who appear to be struggling.

Conclusion

In football, shorter players subjectively have advantages over taller players as results of lower center of gravities. Shorter players are able to restore balance better because they do not have to provide as much counter torque when their center of gravity is knocked outside of the bodies upright position. They can also accelerate quicker due to the fact that they can move their limbs faster allowing them to decrease contact time with the ground and increase stride frequency. Their agility is also enhanced because of having to lower their center of gravity less which allows for quicker preparation for lateral change.

With all being said about physical advantages shorter players have in football, one should keep in mind that the tactical style (possession, long ball, counter-attacking, etc.) in which the game is played can have a comprehensive impact on a player effectiveness. For short footballers to be successful, it is essential that the ball is on the ground. The relative probability of shorter players winning aerial duels is slim compared to those of a larger stature. If a team is keeping the ball on the ground (most likely a possession style), shorter players are better suited for that team's system because of the physical competitive advantages their lower center of mass gives them against players that are taller and have a higher center of mass.

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