Name: _____ Date: _____

Measuring a Soccer Sprint

Reading level 14 · 1967 words

Kylian Mbappé has been timed at several different top speeds by sources that all sound official. He is a French forward, born on December 20, 1998, who through November 2026 plays for Real Madrid and captains France. UEFA's report on Euro 2024 gives 36.7 kilometers an hour, and an earlier UEFA tally gave 36.5. News reports, one of them citing FIFA's list, give 37.61 for the 2026 World Cup. A single run against Argentina in 2018 appears as 37, as an average of 32.4, and as a peak of 38, and the figure 38 is also attached to a league game in 2019. These are not slips of arithmetic. They answer different questions: peak or average, which system, which filter, which threshold. His speed is famous enough that the question is fair: how fast is he, and who says so? This book takes a sprint apart to show how a speed is measured and what it can and cannot tell us.

Units come first. Tracking systems report kilometers per hour, scientists often prefer meters per second, and the conversion is a division by 3.6, so 36.7 kilometers an hour is 10.2 meters per second, or about 22.8 miles an hour, by our arithmetic. Then the word sprint. The studies of Euro 2024 and Qatar 2022 count a sprint as 25.0 kilometers an hour or faster and high-speed running as 20.0 to 24.9. A 2026 scoping review of twenty studies lists sprinting above 25.2 kilometers an hour as one example of its thresholds and concludes that considerable methodological heterogeneity limited cross-study comparability. Of the Euro 2024 data, the authors write that UEFA have yet to publish any detailed operational definitions. Neither threshold is wrong, but each is a choice, and a count of sprints changes whenever the line moves.

Most tournament speeds come from cameras. In a 2020 validation of the TRACAB system, the older design used two stereo units, each of three high-definition cameras, on either side of the halfway line, and the newer used sixteen cameras. Both recorded each player's position as x and y coordinates 25 times a second. Euro 2024 used an optical system from Hawk-Eye, which researchers say has been independently checked against gold-standard methods. FIFA's offside system at Qatar 2022 used twelve roof cameras to follow up to 29 points on each player 50 times a second, plus a sensor in the ball that sent data 500 times a second. Speed is never seen directly. It is calculated, as the rate of change of position, from smoothed coordinates.

How good is that calculation? In the 2020 test, twenty players ran two drills in a stadium while an infrared motion-capture system, accurate to about a millimeter, recorded the same movement. Differences in peak speed were trivial for both camera systems. But the authors say their tests left out the most challenging situations for optical tracking, such as players

hidden behind one another, and that optical tracking is prone to errors when players hide one another or swap identities. They add that the size of instantaneous acceleration depends heavily on smoothing choices. Frame rate sets another limit. By our arithmetic, a player at 10.2 meters per second moves 0.41 meters between frames at 25 per second, 0.20 meters at 50, and about 2 centimeters between readings from a sensor that reports 500 times a second.

Sky Italia's two numbers for the 2018 run, an average of 32.4 and a peak of 38, show why the question matters. A peak is one instant. An average depends on where the run is cut: the same page calls the sprint 55 meters in seven seconds, which by our arithmetic averages about 28 kilometers an hour, not 32.4. Usain Bolt's 100 meters in Berlin in 2009 took 9.58 seconds, which averages 10.44 meters per second, or 37.6 kilometers an hour by our arithmetic. A physics paper using IAAF data reports his maximum as 12.27 meters per second, at 65 meters, about 44 kilometers an hour. Sky gives 44.72, so even Bolt's peak has two published values. Bolt's maximum came deep into a straight race, while Mbappé's run began in open play with a ball at his feet, so the two figures are not like for like.

How far do soccer runs go? In a study of 50 Premier League matches in 2018-19, the table average for a lone center forward was about nine runs in behind the defense a match, each about 21 meters, with a spread of about 9 meters either way. In a study of one Norwegian team, sprints averaged 12.8 meters, by our arithmetic from 213 meters over 16.6 sprints. In the Premier League from 2006-07 to 2012-13, the mean sprint shortened from 6.9 meters to 5.9 meters. A 21-meter run is about a third of the 65 meters at which Bolt peaked, so much of a soccer sprint is acceleration. That is our reading, not a finding. A 2014 review does find that both acceleration and maximal speed separate groups of different standards, and the Norwegian players made 91 accelerations a match.

How many sprints does a player make? The published answers differ by more than a factor of three at the extremes. The Norwegian study, which used microwave tracking of 15 players over 15 home games, found 16.6 sprints a match, and players in wide positions tended to sprint more often than central ones, 21.6 to 13.0. A study of 14,700 Premier League player-matches found 31 sprints in 2006-07 and 57 in 2012-13, an increase of about 85% in six seasons. The two differ in league, years, equipment and thresholds, so neither contradicts the other, and the 2026 review warns about exactly that problem. A count means something only with its threshold and its system stated beside it. Sprint totals for any player at any tournament need the same two labels before they can be compared.

Are tournament top speeds rising? At Qatar 2022, nine of the ten fastest sprints came from players in wide positions, at 35.3 to 35.7 kilometers an hour. At Euro 2024 UEFA reported 36.7 for Mbappé and 35.9 for the next three players, and the academic team that re-filtered the data warns that its figures can differ from UEFA's. In that team's own top ten, six sprints by full-backs and wing-backs fell between 34.8 and 35.7. For the 2026 World Cup, news reports, one of them citing FIFA's list, give 37.61. From 35.7 to 37.61 is about 5% by our

arithmetic. Sprint tests of 939 players in Norway found that players of 2006 to 2010 were only 1 to 2% faster than earlier groups. So the tournament gap is larger than that trend, but it compares different tournaments, systems and filters. These sources cannot settle it.

Why count sprints at all? In 360 goals in the German top league in 2007-08, researchers coded the action just before each goal. For the scorer it was most often a straight sprint, 161 times, or 45% of the goals, and most of those sprints came without an opponent (109) and without the ball (121). For the player who made the pass, the straight sprint was also the commonest action, but mostly with the ball. A sprint without the ball is the run onto a through ball, which Opta defines as a pass splitting the defense for a teammate to run on to. The study was hand-coded from video in one league over half a season, and it counts what came before goals. It does not show that speed caused them.

The offside line turns that run into a timing problem. Law 11 says that being in an offside position is not an offense, that a player level with the second-last opponent is not in one, and that the position is judged when a teammate plays the ball. The assistant referee must see the runner and the last defender at the instant of the pass. In 337 offsides at the 2002 World Cup, assistants were wrong 26.2% of the time, and 86.6% of the errors were flag errors, as the flash-lag effect predicts, since a moving object is perceived ahead of where it really is. By our arithmetic, a one-frame mistake about the instant of the pass would move a runner 0.41 meters at 25 frames a second, but only about 2 centimeters with a sensor that reads 500 times a second.

Defenses answer in space. A 2021 study of the top five European leagues found that offside offenses per match fell over ten seasons, and its author writes that many unsuccessful teams stopped playing the offside trap and began defending deeper and closer to the penalty box. That is the author's interpretation, not a measured cause, and the same paper says offenses fell after video review arrived. The trade-off is easy to state. A defender who steps up leaves room behind, and a defender who drops gives up room in front. By our reading, a runner at 10 meters per second raises the price of either choice. The paper counts offenses, not runs in behind, so it cannot show that fast forwards caused the shift.

Sprinting is also where many injuries happen. The UEFA injury study followed 3,909 players in 54 teams across 21 seasons and recorded 2,636 hamstring injuries, which made up 19% of all injuries. Their share rose from 12% in the first season to 24% in the latest. Running or sprinting was the most common mechanism, 62% of structural injuries and 51% of functional ones. The authors write that they postulate the rise is due to a greater number of high-risk activities in later years. That is a hypothesis from clubs in the Champions League group stage, not a trial. A meta-analysis of 15 studies and 8,459 athletes found that programs including the Nordic hamstring exercise cut hamstring injuries by up to 51%, across many sports. None of this concerns any named player.

What does research say about speed in young players? Sprint tests of 939 Norwegian players found velocity peaking between ages 20 and 28, and forwards 1.4% faster than defenders over 0 to 20 meters. A small 2026 study of 44 youth players found that those past peak height velocity beat the others in every test, including 10-meter and 30-meter sprints, with large effects. In a sample this small, growth can look like talent in a sprint test. A 2024 perspective article on the relative-age problem in youth sport concludes that there are no clear solutions, and that proposed solutions may come with unintended consequences. None of these studies measured Mbappé as a boy. A coach's remark that he could scorch the ground in the last 40 metres is an impression, and the sources do not say whether speed, growth or something else brought him to Monaco's first team at 16 years and 11 months.

Through November 2026, the largest speed attached to Mbappé at a World Cup is the 38 kilometers an hour in Italian television's report on 2018, and the fastest reported for 2026 is 37.61, in news pages, one of which cites a FIFA list this book could not open. Every figure here has the same shape: a camera system, a smoothing choice, a threshold and an instant chosen from a run. A reader comparing his figures should ask four things: which camera system, how it smoothed the positions, where it set the sprint line, and whether the number is a peak or an average. UEFA's 36.7 and the reported 37.61 differ by about 2.5%, by our arithmetic, a gap far smaller than the one between the 2018 run's average, 32.4, and its peak, 38. The 2030 World Cup will add another number. Whether the fastest players are getting faster, or the cameras are getting sharper, is a question these sources leave open.

Questions

1. Why can one 2018 run be reported as 32.4 and also as 38 km/h?

A. One is an average over the run and the other is a peak

B. One is in miles and the other in kilometers

C. The run was measured twice by the same camera

2. In this book, what is a threshold?

A. A kind of camera

B. A cutoff value that defines something, such as a sprint

C. A type of injury

3. What does the 2020 test of the TRACAB system NOT show, according to its authors?

A. That peak speed differences were trivial

B. That speed is calculated from changing position

C. That the system works in the most challenging situations

4. According to the goals study, what was the scorer's most common action just before a goal?

A. A change-in-direction sprint

B. A jump
C. A straight sprint

5. What do the authors of the injury study say about why hamstring injuries rose?

A. They postulate it is due to more high-risk activities
B. They proved it was caused by sprint training
C. They found that it was random

6. Why does the book say a ball sensor that reports 500 times a second matters for offside?

A. It makes the ball move faster
B. Its readings are so close in time that a timing mistake moves a runner very little
C. It replaces the referee

Words to know

threshold: cutoff value
optical: camera-based
peak: highest point
sensor: measuring device
smoothing: evening out

Answer key: Measuring a Soccer Sprint

1. A. One is an average over the run and the other is a peak
2. B. A cutoff value that defines something, such as a sprint
3. C. That the system works in the most challenging situations
4. C. A straight sprint
5. A. They postulate it is due to more high-risk activities
6. B. Its readings are so close in time that a timing mistake moves a runner very little