

An Observational Study of the Effect of Nike Vaporfly Shoes on Marathon Performance

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Abstract

We collected marathon performance data from a systematic sample of elite and sub-elite athletes over the period 2015 to 2019, then searched the internet for publicly-available photographs of these performances, identifying whether the Nike Vaporfly shoes were worn or not in each performance. Controlling for athlete ability and race difficulty, we estimated the effect on marathon times of wearing the Vaporfly shoes. Assuming that the effect of Vaporfly shoes is additive, we estimate that the Vaporfly shoes improve men’s times between 2.0 and 3.9 minutes, while they improve women’s times between 0.8 and 3.5 minutes. Assuming that the effect of Vaporfly shoes is multiplicative, we estimate that they improve men’s times between 1.4 and 2.8 percent and women’s performances between 0.6 and 2.2 percent. The improvements are in comparison to the shoe the athlete was wearing before switching to Vaporfly shoes, and represents an expected improvement rather than a guaranteed improvement.

1 Introduction

There is a growing consensus that Nike Corporation’s new line of marathon racing shoes, which are commonly referred to as Vaporflys, provide a significant performance advantage to athletes who wear them. While several different versions of the shoes have appeared in races, including the Vaporfly 4%, the Vaporfly Next%, the Alphafly, and several prototype shoes, each iteration of the shoes has in common a carbon fiber plate stacked inside of a highly responsive foam sole.

Several research studies have investigated the magnitude of the Vaporfly performance benefit. [Hoogkamer et al. \(2018\)](#) and [Barnes and Kilding \(2019\)](#) tested highly trained distance runners in laboratory studies, measuring various biomechanical and physiological variables while subjects wore Vaporflys and several other shoes in trial runs on a treadmill. Although the measured benefits varied somewhat from athlete to athlete, both studies found a roughly 4% average reduction in energy expenditures while wearing Vaporflys, in comparison to other popular racing shoes such as the Adidas Adizero Adios Boost line of racing shoes, and Nike Zoom Matumbo track spikes.

The Upshot, a division of The New York Times, collected data from actual marathon performances recorded on Strava, a popular running log and GPS tracking website. Their study included hundreds of thousands of marathon performances, and dozens of different shoes. The Upshot found that the Vaporflys imparted a 4 to 5% advantage in finishing time over an

average shoe and a 1.5 to 2.5% advantage over the second-best shoe (Kealy and Katz, 2018, 2019). A study published by Wired Magazine found that a sample of runners in the 2017 New York City Marathon were more likely to run the second half of the race faster than the first if they were wearing Vaporflys (Thompson, 2017).

Our study is most similar to the Upshot study in that we analyze data from marathon performances and compare people’s performances with and without the Vaporflys. However, our study differs in a few ways. First, instead of relying on a convenient sample of athletes who upload their data to Strava, we take an exhaustive sample of athletes who met a minimum performance standard at one of 22 of the largest marathon venues in 2015 and 2016 in the US and Canada. Second, instead of relying on self-reported shoe data, we searched the internet for photos of races and visually identified the shoes that runners wore. Third, we focus only on athletes who performed at an elite level before the Vaporflys were released to the public. Thus, we are only considering accomplished runners with marathon experience who, most likely, settled on a suitable shoe before the Vaporflys were released. These runners are also those most likely to be affected by shoe regulations because many of them compete in national Olympic qualifying races subject to regulations.

2 Study Design

We selected athletes who recorded a sufficiently fast marathon time—men under 2:24 and women under 2:45—at a collection of 22 distinct marathon venues in 2015 or 2016, including the 2016 U.S. Olympic Marathon Trials, which were contested in Los Angeles in February of 2016. The list of marathons is included in the Appendix. This resulted in a sample of 270 distinct women and 308 distinct men after matching names and our best effort to correct alternate spellings of names. We recorded these athletes’ performances in the same 22 marathon venues over the period 2015 to 2019, and searched publicly available online photographs, manually identifying whether or not each athlete was wearing a Nike Vaporfly shoe by visual inspection. All marathon times were downloaded from the website www.marathonguide.com.

Our criteria for inclusion in the study were meant to satisfy certain objectives. First, we wanted to study elite and sub-elite athletes, since shoe regulations are motivated by performance advantages for athletes in this group. Second, we wanted to study athletes who had achieved success in the marathon before the Nike Vaporfly shoes had been released to the public. This ensures that inclusion in the study is unrelated to whether an athlete was wearing the shoes in the race where they qualified for inclusion in the study. This is important because, if any shoe effect exists, the magnitude of the effect may differ among different athletes. If we were to use performances potentially aided by the shoes to select the athletes, that might have biased our sample towards athletes who benefit most from the shoes.

To identify shoes worn by the runners, we used photos posted on public websites such as marathonfoto.com, marathon-photos.com, sportphoto.com, and flashframe.io. We also collected photographs from social media sites such as [facebook.com](https://www.facebook.com) and [instagram.com](https://www.instagram.com). We assumed that Vaporfly shoes were not worn in 2015 or 2016 by any runners except for a few