Will a human ever run 100m in under nine seconds?

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Record breaking. Credit: EPA/Christophe Karaba

It is never easy to run 100m in less than ten seconds, as the recent Commonwealth Games demonstrated. However, as the world record stands at 9.58 seconds, the attention in recent years has turned to whether a human will be able to run 100m in less than nine seconds one day.

Our thoughts, based on 20 years of investigating the biomechanics of sprinting, are "of course they can". There is no limit to human sprinting in sight yet. Humans have run competitively (with time records available) for only about 100 years. In the context of human evolution, this is far too short a period to analyse with a view of making long-term predictions for the future. Records are still being broken, and training and technology (for example, track surfaces and running spikes) are continuously developed further.

In fact, from Jim Hines' beating the ten-second barrier for the first time in 1968 to Maurice Green in 1999, the world record improved by 0.16 seconds in 31 years, but since then the record has been improved by 0.21 seconds in only ten years. This does not necessarily imply that the development of the record is speeding up, just that we cannot consider human limits in a short-term perspective.

There have always been and there will always be humans who make new leaps in these kinds of records. To develop the argument against a set limit in human performance further, why would not Usain Bolt have a son who is just a bit taller, stronger and faster than Usain himself, and so on?

Better training and techniques

The issue of improving performance is also down to better training and improving running technique. In a recent scientific paper we highlighted the importance of powerful gluteus (buttock) muscles for the start performance in sprinting. Athletes and coaches can then train and strengthen these key muscle groups to get out of the starting blocks better.

Overall, the sprinting velocity is a product of step length and step frequency. In his world record run in Berlin 2009, Usain Bolt ran at 12.4m/s in his fastest phase. He did this with a step length of 2.77m and step frequency of 4.49Hz.

For a human to run 100m in under nine seconds, this would require maximum velocity to reach about 13.2m/s. Such velocity would require, for example, step length to be 2.85m and step frequency 4.63Hz – just "modest" increases from Usain Bolt's values.

But the progress is not so easy, as when athletes start to increase step length in the maximum velocity phase, it has a negative effect on step frequency. Longer steps take longer time to make and thus step frequency will go down and vice versa. Thus, it will likely take time before we see that kind of performance. The main issue is how much power (large forces in the shortest possible time) humans can produce and what the requirements are to achieve this.

Long steps at a high frequency

To produce long steps at a high frequency an athlete has to produce a huge amount of force (approximately 4.5 times body weight) in a very short period of time (around 0.1s). To do this they must maintain a very stiff leg and accelerate it into the ground at foot contact. Recent research has shown that it is this difference in the forces generated in the early part of the stance phase (just after foot contact) that distinguishes very fast sprinters from the less fast ones.

The ability to maintain a stiff limb is determined by how muscle force can be generated in the muscles of the leg. This in turn is a function of muscle size, the types of fibres which make up the muscles and the co-ordinated activation of the muscles of the leg to optimise the use of elastic mechanisms and amplify the power from the muscles. A muscle with a high proportion of large, fast twitch muscle fibres will be able to generate larger amounts of force more quickly than a muscle with a lower proportion.

Therefore to reach the point at which enough force can be generated quickly enough to produce the step lengths and frequencies suggested above a combination of genetics and training would need to produce bum, thigh and calf muscles which are a little bit stronger and faster than the current best sprinters.

The record will start to plateau at some point and it will get harder and harder to outrun the previous record holder. But, it's safe to say that someone will break the nine second barrier – not necessarily in our lifetime, but it will happen one day.

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