Change in Stride Length & Stride Rate with Running Velocity

1. Aim of experiment

To understand how Stride Rate (SR) and Stride length (SL) change over different speeds of locomotion.

2. Introduction:

Stride length and stride rate are among the most commonly studied linear kinematic parameters. The distance covered by one stride is the stride length. A stride is defined as the time between two consecutive specific discrete events as shown in Fig. 1, and the number of strides per minute is the stride rate (frequency). Running and walking velocity is the result of the relationship between stride rate and stride length. That is:

Running speed = Stride length × Stride rate

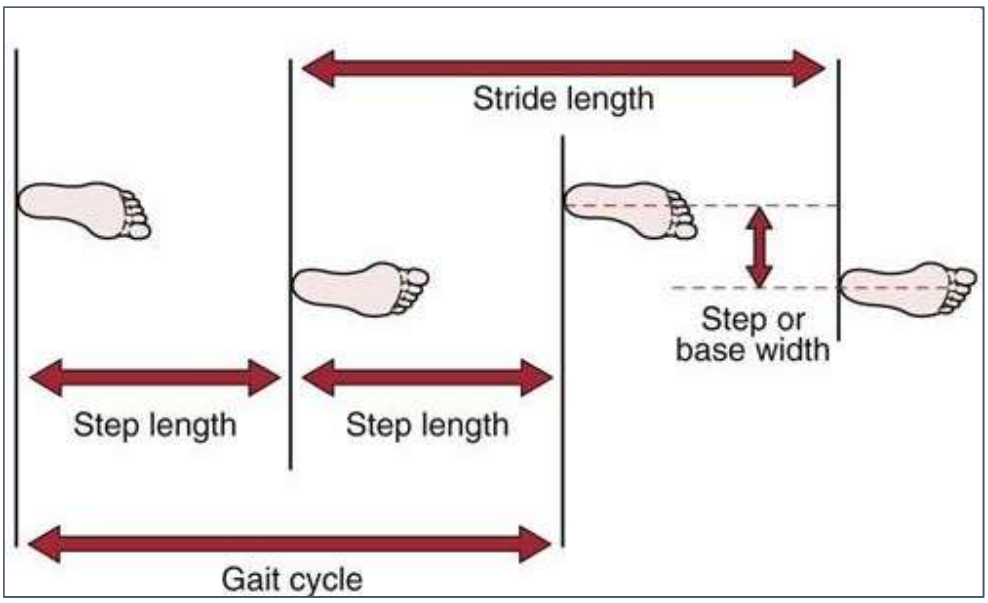

Fig. 1. Stride parameters during gait.

Many studies have shown that in running, both stride rate and stride length increase with increasing velocity, but the adjustment is not proportional at higher velocities as shown in in Fig. 2. . For velocities up to 7 m/s, increases are linear, but at higher speeds, there is a smaller increment in stride length and a greater increment in stride rate. This indicates that when sprinting, runners increase their velocity by increasing their stride rate more than their stride length. A runner initially increases velocity by increasing stride length. However, there is a physical limit to how much an individual can increase stride length. To run faster, therefore, the runner must increase his or her stride rate.

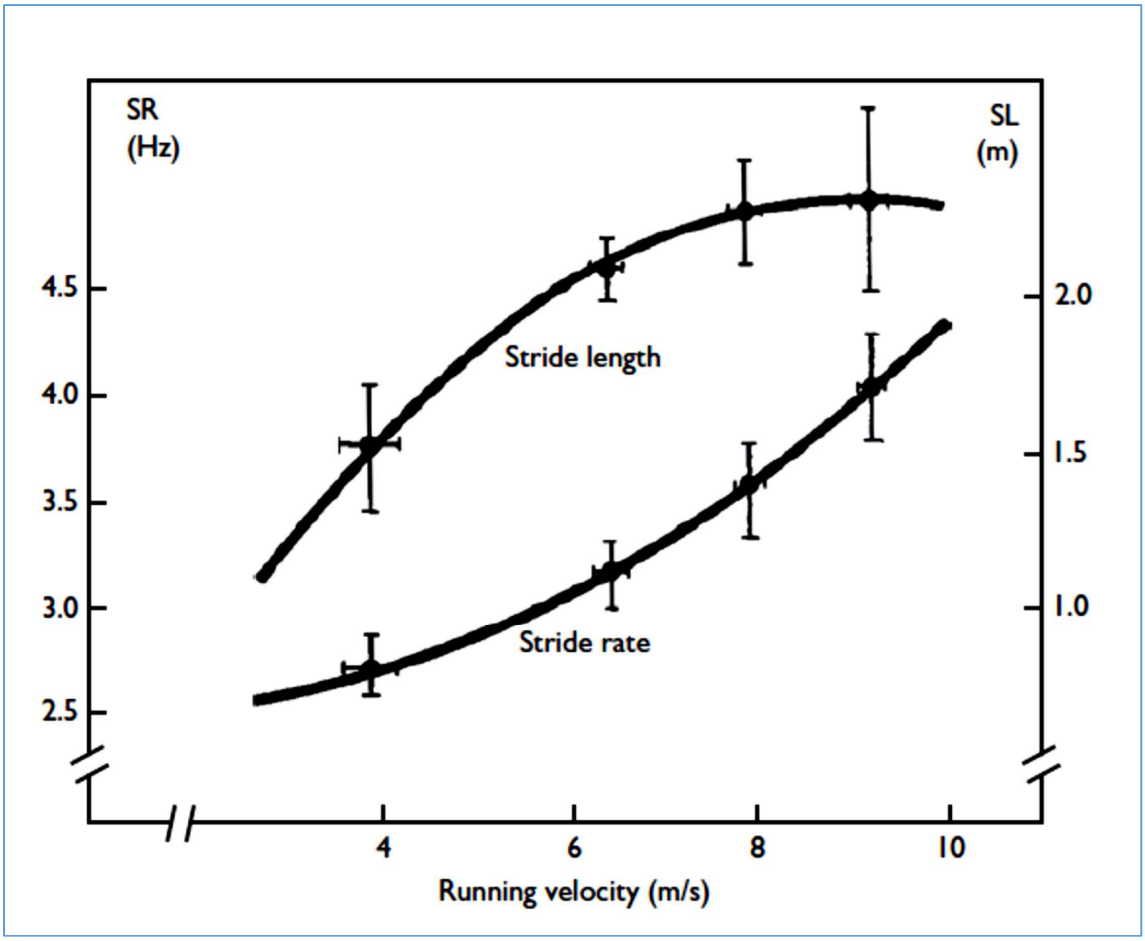

Fig. 2. Changes in stride length (SL) and stride rate (SR) as a function of running velocity.

3. Experimental Procedure:

This experiment is divided in to two parts:

3.1. Part a

1) Prepare tape measure, stopwatch and chalk,
2) Mark the beginning and ending point for a 40m run course,
3) Run the 40m in as constant a speed as possible,
4) Start your watch at the beginning of the run and stop it at the end of the run,
5) Count your strides (each right foot strike = +1) during the run,
6) Record the number of strides completed to the nearest ½ stride,
7) Repeat procedures for at least four different running speeds.

3.1.1. Calculations:

1) Calculate your average velocity: $\mathbf{V} = \Delta d/\Delta t$
2) Calculate your frequency of strides: Stride Frequency (SF) = (number of strides)/(time)
3) Calculate the length of stride: SL = **V**/SF or SL= 40m/ number of strides,
4) Plot velocity vs. SF and velocity vs. SL.

Table 1

Trail	Time (s)	Number of strides	Velocity (m/s)	Stride frequency (Hz)	Stride length (m)

3.2. Part b

1) Prepare stopwatch and a treadmill keeping in mind attaching the magnetic safety piece to the runner.

2) The person running will select a comfortable running speed.
3) Once the speed is selected, the person measuring will time how long it takes to complete 20 right foot strikes. Be sure to count the very first foot strike as '0' as the timer starts and then stop the timer when you count to '20' foot strikes.
4) Record the running speed.
5) Repeat for at least four different running speeds.

3.2.1. Calculations:

1) Calculate SF by dividing 20 by the time to complete the 20 strides.
2) Calculate SL by dividing running speed by SF.
3) Plot velocity vs. SF and velocity vs. SL

Table 2

Trail	Treadmill speed (km/hr)	Treadmill speed (m/s)	Time to complete 20 strides (s)	Stride frequency (Hz)	Stride length (m)

3.3. Discussion

1) What are the factors that affect running speed for healthy persons?
2) Discuss the difference between the results obtained from part (a) and part (b).
3) Based on your intuition, make a hypothesis for how increased speed is achieved in running.