Effect of Stride Length Alterations on Heart Rate and Ratings of Perceived Exertion during Treadmill Running

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ABSTRACT: This study describes results of exercise physiology research intended to examine the effects of running at normal, less than normal, and greater than normal stride lengths on heart rate (HR) and rating of perceived exertion (RPE). The objective of this study was to determine how running above or below the normal stride length influences HR and RPE, and we hypothesized that any alterations to normal stride patterns would result in increases in both HR and RPE. Three males and three females of moderate fitness were asked to run on a treadmill for three 10-minute periods, each separated by 10 minutes of recovery. The first trial allowed the volunteers to become familiarized with the running environment, the remaining two trials were conducted with a metronome set at either 15% above or 15% below their normal gait. A significant increase in HR was found in all participants above and below normal stride length. RPE increased during the below-normal stride length trial compared to other trials. We concluded that altering the normal stride length results in increased cardiac exertion and further studies into the negative physiological consequences of this are warranted.

INTRODUCTION & HYPOTHESES:
A theory explaining the coordination of bipedal locomotion suggests that locomotion is accomplished in such a way that energy expenditure is minimized. When running at a given speed, runners will tend to adopt a running technique which will result in minimizing the rate of oxygen consumption for running at a certain speed. 1There are many different factors that play a role in each runner’s technique, including stride length, which researchers are looking more and more into. Altering stride length is associated with an increase in oxygen consumption.2,3,4,5 It has been suggested that subjects using a freely-chosen stride length exhibit minimal oxygen uptake. Alterations in stride length over time result in increased oxygen consumption.6,7 A new study by researchers suggested that normal (self-selected) stride length may represent a more economical pattern of running for an individual.8

The purpose of this experiment was to determine the effects of running at normal, greater than normal, and less than normal stride length on heart rate (HR) response and rating of perceived exertion (RPE) during treadmill running.

DATA collected in this study will be beneficial in making recommendations on how runners should train. Runners will then have a better understanding of running scenarios can be beneficial to one’s health. It was hypothesized that running above or below the normal stride length would result in an increase in both HR and RPE.

MATERIALS & METHODS:
Subjects: Drake University IRB approved this study (IRB 2007-0180). Six participants participated. All participants were of normal to above-average fitness and were given a baseline fitness assessment. Table 1 shows the anthropometric data for all participants. The participants were all male, and were of average body build and height. All participants were in good health and were not taking any medication that could affect their heart rate or exercise performance.

The treadmill was calibrated for each participant before the trials began. The treadmill was set at a desired speed and grade for the first trial. The participants were then instructed to run at their comfortable pace. The second and third trials were conducted with a metronome set at either 15% above or 15% below their normal gait. A significant increase in HR was found in all participants above and below normal stride length. RPE increased during the below-normal stride length trial compared to other trials. We concluded that altering the normal stride length results in increased cardiac exertion and further studies into the negative physiological consequences of this are warranted.

RESULTS:
Mean HR significantly increased during both the below and above normal stride length trials as compared to control trials (Figure 1). Average HR increased by 11 and 25 beats per minute over the normal stride length for the 15% above and 15% below trials, respectively. There was a significant effect of RPE at each minute of the trial (Figure 2); therefore, the RPE rating during the below-normal pace trial was significantly higher than RPE at normal or above-normal pace trials (p<0.001).

DISCUSSION & CONCLUSIONS:
Statistical analysis of the data was conducted using an ANOVA test. Post hoc analysis of variance indicated that HR significantly increased in the 15% above and 15% below trials as compared to the normal stride length trial (both p<0.05). Figure 1 shows a significant increase in HR for the 15% below trial compared to the 15% above. This indicates that running at a 15% below normal pace is more beneficial than running at a 15% above normal pace. A significant difference in heart rate between the 15% below and 15% above trials was also found. Similarly, the physiological variability observed in this study was HR (though some researchers have also noted increases in other physiologically significant factors such as volume of oxygen consumed (VO2)) in both normal and above-normal pace trials. Ratings of Perceived Exertion (RPE) results indicated that there were significant differences in normal pace RPE (Figure 2, p<0.05). Ratings of RPE were highest when running at 15% below normal stride length compared to the other two trials (both p<0.001).

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LITERATURE CITED: