Comparing step length between motorized and non-motorized treadmills during walking, jogging, or running

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Abstract

Research is often conducted on motorized treadmills instead of overground due to the ability to control specific variables in the laboratory. With controversy over whether or not motorized treadmills do in fact replicate overground running, non-motorized treadmills are becoming increasingly popular for athletes and the general population for training, and fitness purposes. The non-motorized treadmill requires the participant to self-propel the treadmill belt in order for the exercise to be performed. Although more non-motorized treadmills are becoming readily available, the advantages and disadvantages over a motorized treadmill are still being investigated. **PURPOSE**: The purpose of this study was to examine if differences occur in step length at various speeds between motorized and non-motorized treadmills. **METHODS**: Nine healthy college-aged individuals walked at 1.34 $m \cdot s^{-1}$, jogged at 2.23 $m \cdot s^{-1}$, and ran at 3.13 $m \cdot s^{-1}$ on three different treadmills; two motorized, a belt driven (BT) and a slatted (ST), and a non-motorized treadmill (CT). The participants achieved the prescribed speed and then the time to complete 25 steps was measured. Average step length was calculated for each speed on each treadmill. Statistical analysis was performed using repeated measures ANOVAs with post hoc Tukey test to determine where significant differences occurred ($P < 0.05$). **RESULTS**: There was no significant difference in step length between the three treadmills at the walking, jogging, or running speeds.

	1.34 $m \cdot s^{-1}$	2.23 $m \cdot s^{-1}$	3.13 $m \cdot s^{-1}$
BT	0.69 ± 0.04 m	0.82 ± 0.03 m	1.11 ± 0.04 m
ST	0.70 ± 0.05 m	0.83 ± 0.04 m	1.12 ± 0.07 m
CT	0.70 ± 0.06 m	0.83 ± 0.05 m	1.10 ± 0.07 m

CONCLUSION: There appears to be no difference with the individuals step length between treadmills at a given speed. Whether or not this is due to the construction of this particular CT remains to be investigated.

Introduction

Motorized treadmills (MT) have been extensively used in research studies because of the ability to easily control running and walking speed in the research laboratory. However, controversy exists as treadmill running has been argued to be different than overground running (Riley, Paolini, Croce, Paylo, & Kerrigan, 2006; Nelson, Dillman, Lagasse, & Bickett, 1972; Alton, Baldey, Caplan, & Morissey, 1983). Recently, non-motorized treadmills (NMT) have been used in research and are commonly found in fitness centers with the idea that they model overground running better than MT.

NMT require self propulsion of the treadmill rather than keeping pace with an already moving belt, much like overground locomotion requires self-forward propulsion. Previous literature has looked at NMT that require the participant to be tethered to a wall (Hughes, Doherty, Tong, Reilly, & Cable, 2006) or hold on to the handle bars to not run off the front of the treadmill. A new curved NMT (Curve, Woodway, Waukesha, WI) does not require a tethering system or holding on because of its unique curved shape.

There is question, however, if the curved treadmill (CT) replicates overground locomotion because of the curved shape.

Purpose

The purpose of this study was to examine if differences occur in step length at various speeds between motorized and non-motorized treadmills.

Methods

Subjects
- Nine healthy, adults (4 females, 5 males) with no lower extremity injury
- Age 24.1 ± 2.2, weight 149.2 ± 31.5 lbs, height 67.3 ± 4.1 in

Protocol
- Subjects were previously familiarized with CT and MT's from previous study
- Testing was conducted on three treadmills
  - Curve non-motorized treadmill (CT)(Woodway, Waukesha, WI)
  - Slatted motorized treadmill (ST) (Woodway, Waukesha, WI)
  - Belt driven motorized treadmill (BT)(Welch Allen Schiller, Newton, KS)
- Subjects performed on all three treadmills, testing order was randomized
- Three speeds were performed on all three treadmills
  - Walking- 1.34 $m \cdot s^{-1}$
  - Jogging- 2.23 $m \cdot s^{-1}$
  - Running- 3.13 $m \cdot s^{-1}$
- Once at speed indicated, time to complete 25 steps was measured

Data Analysis
- Mean step length was calculated with equation 1 where *t* is the time to complete 25 steps

Eq. 1 . *t/25 steps = step length*

- Repeated measures ANOVAs followed by post hoc Tukey tests for analysis between significant measures were used to determine significant differences between treadmills for a given speed and between speeds on the same treadmill. Reported as mean ± SD
- $\alpha < 0.05$

Results

- No significant differences between treadmills at 1.34 $m \cdot s^{-1}$ ($P = 0.629$), 2.23 $m \cdot s^{-1}$ ($P = 0.773$), or 3.13 $m \cdot s^{-1}$ ($P = 0.458$)
- For each treadmill, there were significant differences between speeds ($P < 0.05$)

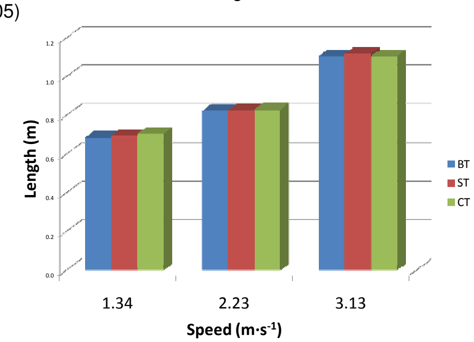

Figure 1- Mean step length while walking, jogging, and running on two motorized and one non-motorized treadmills. No significant differences were found between treadmills. Step lengths were significantly different between speeds (P = 0.05).

	1.34 $m \cdot s^{-1}$	2.23 $m \cdot s^{-1}$	3.13 $m \cdot s^{-1}$
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Table 1- Mean step length values for belt driven motorized treadmill (BT), slatted motorized treadmill (ST), and Curve non-motorized treadmill (CT) at walking, jogging, and running.

Conclusion

- Because foot contact is made at a higher point than on a regular, flat treadmill, it was thought the step length may be shorter. However, despite the curved shape of the CT, the step length was not different between the motorized and the non-motorized treadmill.
- As expected, step length increased with increasing speed.
- Further understanding of the biomechanical factors of locomotion on the CT are necessary to better understand how it compares to overground gait.

References

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