CORRECTION FACTOR TO IMPROVE THE ACCURACY OF ISO-EFFICIENT TREADMILL VELOCITY DURING INCLINED TREADMILL RUNNING

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ABSTRACT

As inclined treadmill running becomes more popular among trained runners, the ability to maintain a metabolic iso-efficient velocity has gained importance. Treadmill velocity (TMV) for a specific incline and intensity can be determined by solving the ACSM running equation for speed as opposed to relative VO_2, but this may underestimate iso-efficient TMV in trained runners as they may respond to speed and grade differently from the general population. Purpose: The purpose of this study was to identify an appropriate correction factor to improve iso-efficient TMV identification during inclined running in trained runners. Methods: 11 collegiate distance runners (7 male, 4 female; 63.2±9.5 kg; 174.8±7.5 cm; 64.6±6.5 mlO_2/kg/min) completed 3 x 4 min treadmill runs at 0%, 4%, and 8% incline, with a 4 min recovery period between runs. Expired gases were collected during the final minute of each run to determine relative VO_2. Actual TMV at 0% was inserted into the ACSM running equation to determine predicted VO_2 for the 0% run (VO_2=(Sx0.2)+(SxGx0.9)+3.5). That value was then divided by the actual VO_2 measured at 0% to develop a correction factor. TMV for the 4% and 8% trials was determined by inserting the measured 0% VO_2 value into the ACSM equation (S=(VO_2-3.5)/(0.2+0.9G)) and multiplying the resultant velocity by the correction factor to maintain iso-efficiency. Differences within 0%, 4%, and 8% values were assessed using a paired sample t-test, while a one-way ANOVA compared VO_2 values between grades ($p<0.05$). Results: Actual VO_2 at 0% grade was 15% lower than predicted by the ACSM equation (55.2±2.7 vs. 46.8±5.0 mlO_2/kg/min; $p<0.05$), resulting in a correction factor of 1.2±0.1. Predicted TMV at 4% (183.6±21 m/min) and 8% (159.3±18.3 m/min) was 18% lower ($p<0.05$) than the corrected velocities for each grade (216.9±2 and 188.2±10.4 m/min). VO_2 values for each grade were 46.8±5, 46.6±4.8, and 48.0±4.9 mlO_2/kg/min, respectively, with the 8% VO_2 being greater than 4% ($p<0.05$). Conclusion: The ACSM running equation may underestimate TMV when attempting to maintain metabolic iso-efficiency during incline running. These data suggest that application of a correction factor to the TMV derived from the ACSM equation may provide a closer approximation of TMV to maintain iso-efficiency during incline running.

INTRODUCTION

- As inclined treadmill running becomes increasingly popular among trained runners, the ability to maintain a metabolically iso-efficient speed has gained importance.
- Treadmill velocity for a specific incline and intensity can be determined by solving the ACSM running equation [1] for speed as opposed to relative VO_2, but this may underestimate iso-efficient speed in trained runners as they may respond to speed and grade differently from the general population.
- The purpose of this study was to develop a correction factor to improve iso-efficient speed during inclined running in trained runners.

METHODS

- 11 collegiate distance runners (Table 1) completed 3 treadmill runs of 4 minutes each at 0, 4, and 8% incline, with a 4 minute recovery period between runs. Expired gases were collected during the final minute of each run to determine relative VO_2.
- After the 0% trial, actual treadmill speed [268.2 m/min (10 mph) for males and 241.4 m/min (9 mph) for females] was inserted into the ACSM running equation [1] solved for VO_2 to determine a predicted VO_2 at 0% grade:

$$Predicted\ VO_2 = Actual\ Speed\ (0.2 + 0.9 * Grade) + 3.5$$

- Then, this predicted VO_2 was divided by the measured VO_2 at 0% grade to develop a correction factor:

$$Correction\ Factor = \frac{Predicted\ VO_2}{Actual\ VO_2}$$

- Our goal was to maintain VO_2 during each condition. So, the measured VO_2 for 0% was inserted into the ACSM running equation [1] to determine the predicted speed at 4% and 8% grades:

$$Predicted\ Speed = \frac{VO_2 - 3.5}{0.2 + 0.9 * Grade}$$

- This predicted speed was multiplied by the correction factor to determine the corrected speed subjects ran at for 4% and 8% inclines.
- Differences within 0, 4, and 8% values were assessed using a paired t-test, while a one-way ANOVA compared VO_2 between grades ($p<0.05$).

FIGURES and TABLES

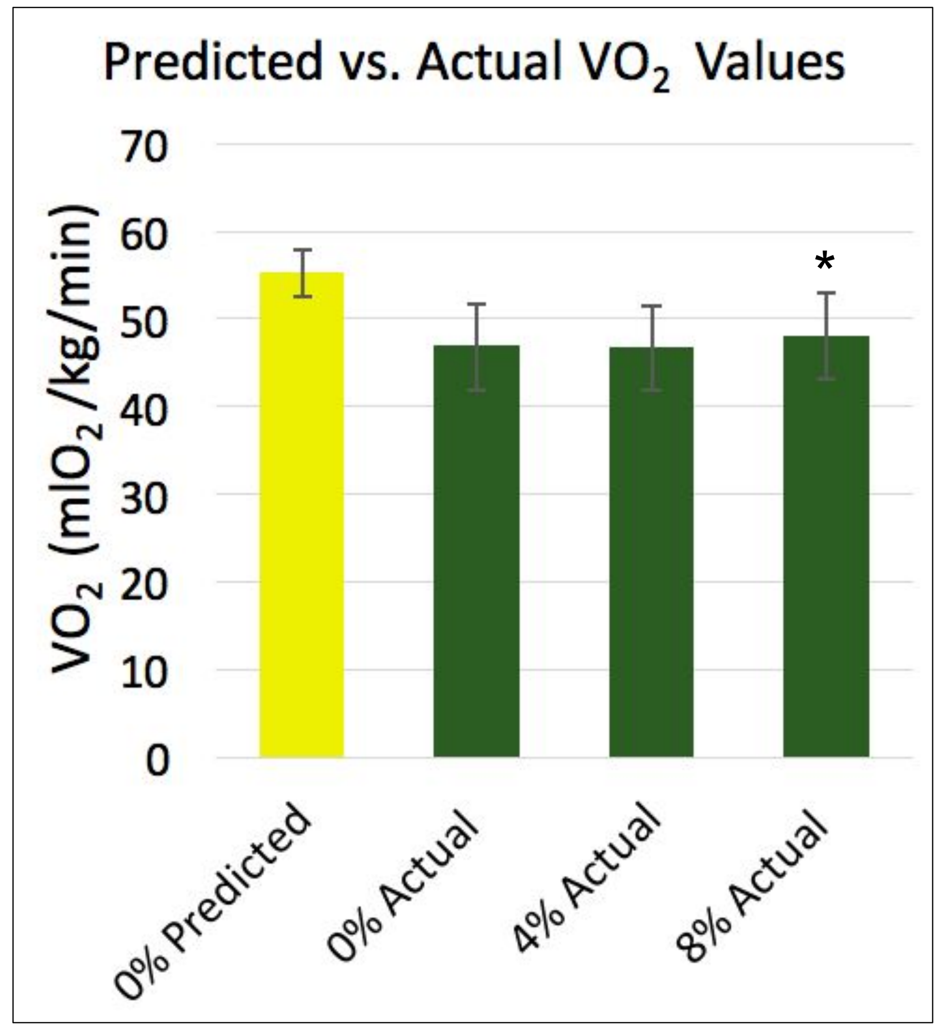

*Figure 1. Predicted vs. Actual VO_2 * indicates significant difference from 4% ($p<0.05$).*

Subject Characteristics	Males	Females
N	7	4
Body Mass (kg)	68.5 ± 5.7	54.0 ± 7.3
Height (cm)	178.9 ± 4.6	167.6 ± 5.9
VO2 Max (mlO2/kg/min)	67.7 ± 5.9	59.2 ± 2.9

Table 1. Subject Characteristics (Mean ± SD)

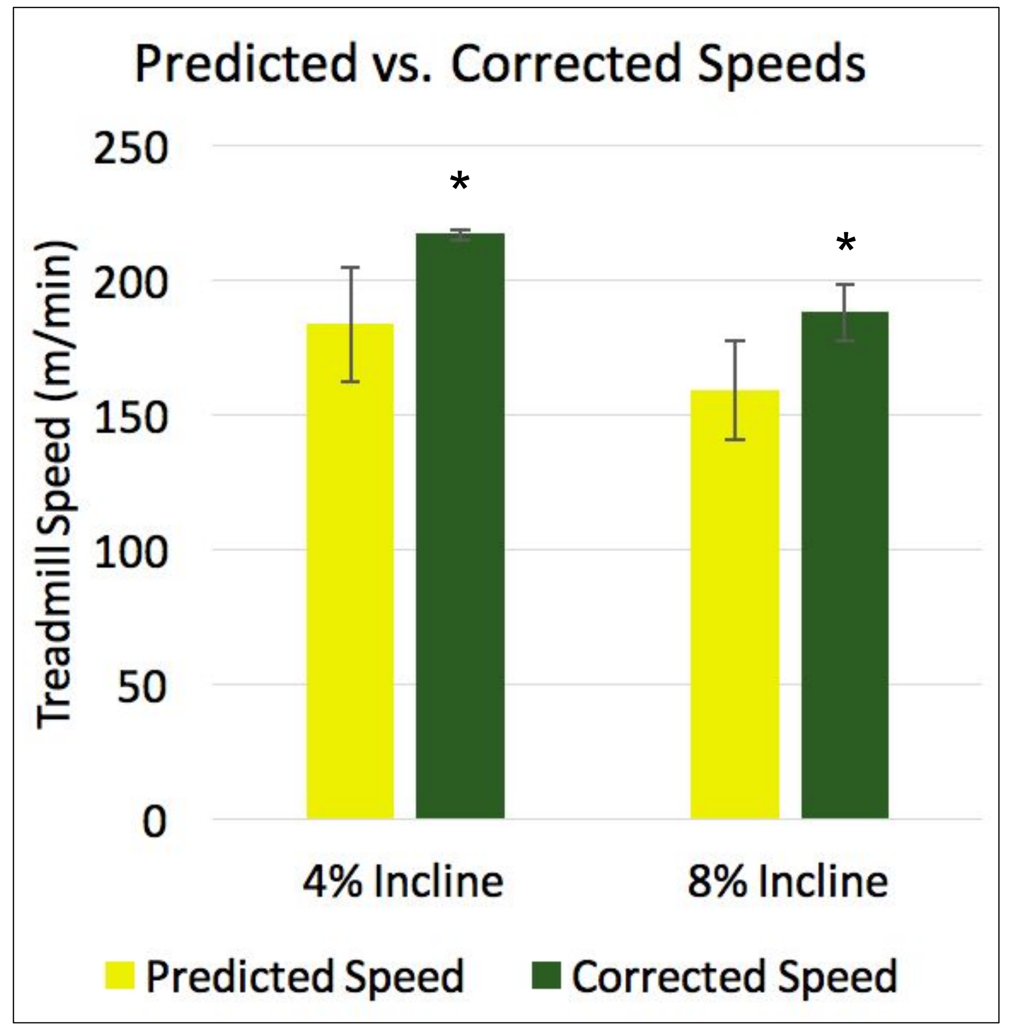

Figure 2. Predicted vs. Corrected Speed
** indicates significant difference ($p<0.05$).*

RESULTS

- Actual VO_2 at 0% grade was 15% lower than VO_2 predicted by the ACSM equation (55.2±2.7 vs. 46.8±5.0 mlO_2/kg/min; $p<0.05$), resulting in a correction factor of 1.2±.0.1 (Figure 1).
- VO_2 values for 0, 4, and 8% were 46.8±5, 46.6 ±4.8, and 48.0±4.9 mlO_2/kg/min, respectively, with 8% VO_2 being greater than 4% ($p<0.05$) (Figure 1).
- Predicted speed at 4% (183.6±21 m/min) and 8% (159.3±18.3m/min) was 18% lower ($p<0.05$) than the corrected speeds for each grade (216.9±2 and 188.2±10.4 m/min, respectively) (Figure 2).

CONCLUSION

- The ACSM running equation [1] may underestimate treadmill speed when attempting to maintain metabolic iso-efficiency during incline running for trained runners.
- These data suggest that application of a correction factor to the speed derived from the ACSM equation may provide a closer approximation of the speed necessary to maintain iso-efficiency during inclined running.
- Investigators using the ACSM equation to determine an isoefficiency speed might develop a subject-specific correction factor by dividing the predicted VO_2 by the measured VO_2 during the base-line condition.

REFERENCES

1. American College of Sports Medicine. *ACSM's Metabolic Calculations Handbook.* Lippincott Williams & Wilkins, 2007.