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The Effects of Height on a Margaria-Kalamen Stair Step Test

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INTRODUCTION

Anaerobic power output can be measured in a laboratory setting, but it requires a great deal of expensive equipment. While not as accurate, field tests are much more useful in settings outside of an exercise physiology lab. One field test commonly used is the Margaria-Kalamen Power test, which requires individuals to sprint up several stair steps, striding three stair steps at a time (MK3). This can be challenging for shorter individuals. The investigators developed a modified Margaria-Kalamen test that may be more appropriate for shorter individuals and requires participants to sprint up several stairs striding two at stair steps at a time (MK2). Participants were placed into groups based on height (Short ≤168 cm, Tall >168 cm). All participants performed both the MK2, and MK3 in duplicate to determine power. The participants performed a 5-second wingate test (WG5) using a Velotron cycle on a separate day. A 2 (height) x 3 (trial) repeated measures ANOVA was performed to determine significant differences. The criterion reference for significant differences was set at $p<0.05$.

PURPOSE

The purpose of this study is to determine if there was a difference in the power output measured during a traditional Margaria-Kalamen test and a modified test with smaller steps in participants of differing heights.

METHODS

- Sixteen participants (165.6±10.4cm; 70.7 ± 13.6 kg) participated in the study. Participants who had a negative response to all seven questions on the 2020 Participant Activity Readiness Questionnaire+ were admitted into the study.
- The two exercise tests were performed at least 24 hours apart in random order. Participants were asked to avoid stimulants and caffeine for four hours prior and to avoid eating or drinking anything other than water for 3 hours prior to both trials.
- Participant were assigned groups based on height. Particpants in the TL group were 168cm or taller. Participants who were shorter than 168cm were assigned to the ST group.
- Each participant performed a Margaria-Kalamen (MK3) power test and a modified Margaria-Kalamen (MK2) power test. Each participant performed a familiarization trial running from the starting line, 6 meters from the stairs, continuing up the stairs 3 stair steps per stride for the MK3 and 2 stair steps per stride for the MK2. Two time trials for that test were performed in random order. The time for each trial was an average of two times recorded by two investigators using hand-held stopwatches.
- A 5s sprint cycling test (WG5) similar to the start of a Wingate test was performed on a Velotron cycle ergometer. A 5-min cycling warm up was performed before the WG5. Participants were given a 5 second ramp up period to reach peak pedaling frequency immediately prior to 7.5% of the participant's body mass was applied to the electronically braked ergometer.
- A 2 (trial) x 2 (height) Repeated measures ANOVA was employed to determine if significant differences existed between the MK3, MK2, and WG5. A Pearson product moment correlation was performed between run time, absolute peak power, and relative peak power. The criterion for statistical significance was set at $p<.05$.

PARTICIPANT CHARACTERISTICS

Participants	ST Height (cm)	TL Height (cm)	ST Body Mass (kg)	TL Body Mass (kg)
n = 16	160.4 ± 6.4	175.1 ± 9.0	63.9 ± 11.8	82.1 ± 7.2

Table 1. Participant demographics. All data presented as mean ± sd

RESULTS

Absolute power (MK3 1499±262 vs 938±190W; MK2 1239±138 vs 802±142W; WG5 1007±103 vs 645±150W) and relative power (MK3 18.2±2.3 vs 15.2±2.8W/kg; MK2 15.1±.8 vs 12.9±1.1W/kg; WG5 12.5±.5 vs 10.3±1.2W/kg) were significantly greater ($p<.05$) in TL compared to ST in each test. In both TL and ST groups for absolute power and relative power, there were significant differences ($p<.05$) between all three tests (MK3>MK2>WG5). There was a significant correlation ($r=.614$, $p<.05$) between height and power during WG5, but height was not correlated to power during the MK3 or MK2. Taller individuals may be able to produce more power, both absolute and relative, than shorter individuals during sprint stair running.

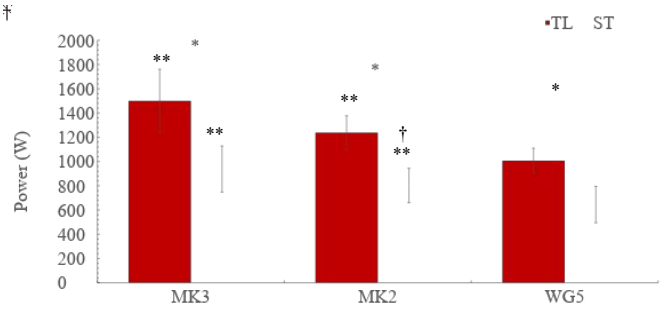

Fig 1. Absolute power (W) for participants taller than 168 cm (TL) and equal to or shorter (ST) than 168 cm for all three tests. *Significantly difference between TL and ST for each test ($p<.05$). **Significantly different than the same group for MK2 and WG5 ($p<.05$). † Significantly different than the same group for WG5 ($p<.05$).

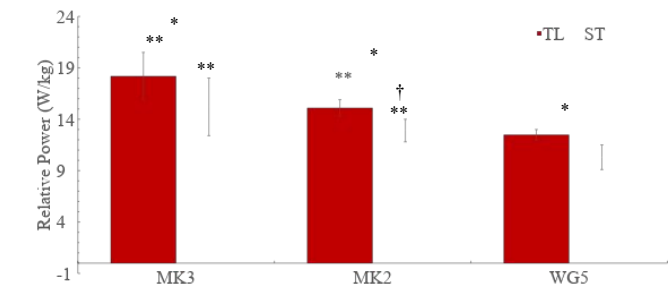

Fig. 2. Relative power (W/kg) for participants taller than 168 cm (TL) and equal to or shorter (ST) than 168 cm for all three tests. *Significantly difference between TL and ST for each test ($p<.05$). **Significantly different than the same group for MK2 and WG5 ($p<.05$). † Significantly different than the same group for WG5 ($p<.05$).

Participants	WG5	MK3	MK2
n = 16	r=.614, p=.011*	r=.427, p=.10	r=.464, p=.07

Table 2. Correlation between height (cm) and relative power (W/kg). All data presented as correlation, significance.

CONCLUSIONS

- There was a significant correlation ($r=.614$, $p<.05$) between height and power during WG5, but height was not correlated to power during the MK3 or MK2.
- Absolute and relative power produced during stair running may be greater than power output during the first 5 s of a Wingate test.
- Taller individuals may be able to produce more power, both absolute and relative, than shorter individuals during sprint stair running but more testing is required.

REFERENCES

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