Running-Specific Prostheses Permit Energy Cost Similar to Non-amputees

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ABSTRACT

BROWN, M. B., M. L. MILLARD-STAFFORD, and A. R. ALLISON. Running-Specific Prostheses Permit Energy Cost Similar to Nonamputees. *Med. Sci. Sports Exerc.*, Vol. 41, No. 5, pp. 1080–1087, 2009. Improvements in prosthesis design have facilitated participation in competitive running for persons with lower limb loss (AMP). **Purpose**: The purpose of this study was to examine the physiological responses of AMP using a run-specific prosthesis (RP) versus a traditional prosthesis (P) and cross-referenced with nonamputee controls (C) matched by training status, age, gender, and body composition during level treadmill running (TM). **Methods**: Twelve trained runners completed a multistage submaximal TM exercise during which HR and oxygen uptake ($\dot{V}O_2$) were obtained. Steady state measures at 134 $m \cdot min^{-1}$ were compared between RP and P in AMP. AMP using RP (AMP–RP) and C also performed a continuous speed-incremented maximal TM test until volitional fatigue. **Results**: RP elicited lower HR and $\dot{V}O_2$ compared with P in AMP. Using RP, AMP achieved similar $\dot{V}O_{2max}$ and peak TM speed compared with C but with higher HR_{max}. Relative HR ($\%HR_{max}$) and oxygen uptake ($\%\dot{V}O_{2max}$), the regression intercept, slope, SEE, and Pearson's *r* correlation were not different between AMP–RP and C. $\%HR_{max}$ calculated with the published equation, $\%HR_{max} = 0.73(\%\dot{V}O_{2max}) + 30$, was not significantly different from actual $\%HR_{max}$ for AMP–RP or C in any stage. **Conclusions**: RP permits AMP to attain peak TM speed and aerobic capacity similar to trained nonamputees and significantly attenuates HR and energy cost of submaximal running compared with a P. Use of RP confers no physiological advantage compared with nonamputee runners because energy cost at the set speed was not significantly different for AMP–RP. Current equations on the basis of the relative HR–$\dot{V}O_2$ relationship seem appropriate to prescribe exercise intensity for persons with transtibial amputations using RP. **Key Words:** EXERCISE TESTING, LIMB LOSS, DISABLED SPORTS, FITNESS

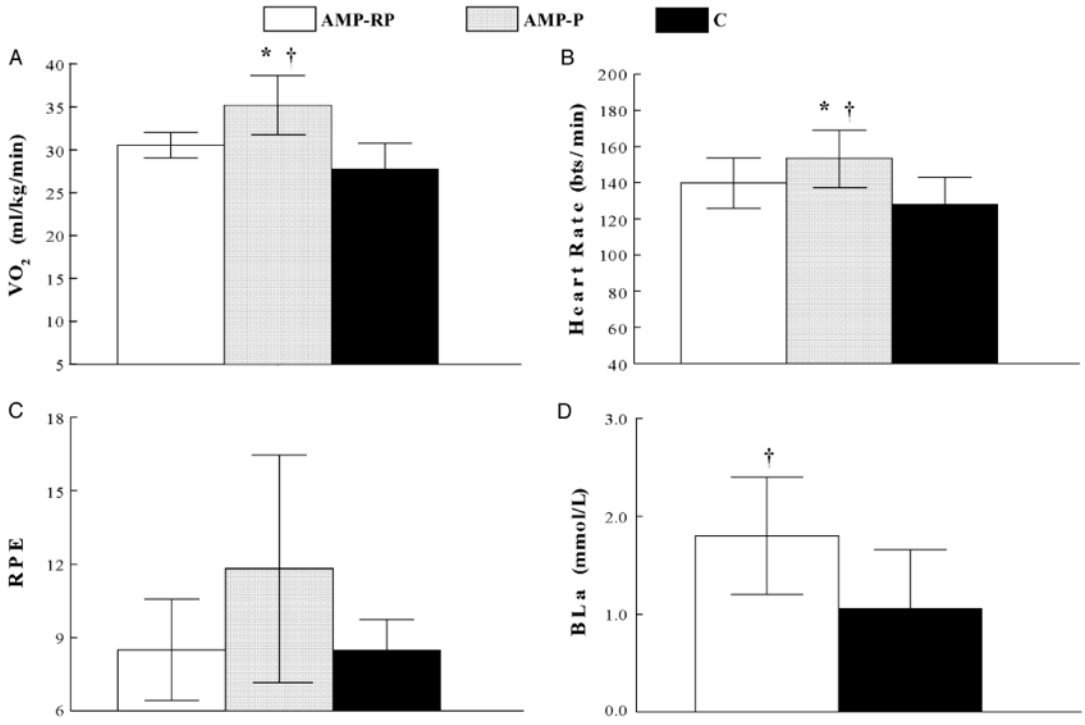

FIGURE 2—Steady state oxygen uptake ($\dot{V}O_2$) (A), heart rate (HR) (B), rating of perceived exertion (RPE) (C), and blood lactate (BLa; D) for amputees (AMP) under two different prosthesis conditions, traditional prosthesis (P) and running-specific prosthesis (RP), versus matched nonamputees (C) during treadmill (TM) running at 134 $m \cdot min^{-1}$. *Significant difference from RP, $P < 0.05$. †Significant difference from C, $P < 0.05$.

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