The size-independent oxygen cost of running

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Purpose: The purpose of this investigation was to determine if differences in running economy among children, adolescents and adults can be explained by differences in resting metabolism, mass and stature. Methods: Participants were 36 children, 23 adolescents, and 24 adults. Mass-specific gross oxygen cost per minute (\(\dot{V}O_2\)gross\(\cdot\)M\(^{-1}\)), mass-specific gross oxygen cost per kilometer (\(\dot{V}O_2\)gross\(\cdot\)M\(^{-1}\)), mass-specific net oxygen cost per kilometer (\(\dot{V}O_2\)net\(\cdot\)M\(^{-1}\)), and a dimensionless index called the size-independent cost (SIC) were compared for level treadmill running at speeds ranging from 1.6 to 3.1 m\(\cdot\)s\(^{-1}\). SIC was defined as the net oxygen cost to move a mass of 1 kilogram a distance equal to stature (mL\(\cdot\)kg\(^{-1}\)). Results: Children generally had higher \(\dot{V}O_2\)gross\(\cdot\)M\(^{-1}\), \(\dot{V}O_2\)gross\(\cdot\)M\(^{-1}\), and \(\dot{V}O_2\)net\(\cdot\)M\(^{-1}\) than adolescents who similarly had greater costs than adults. When SIC was used to control for size-related differences in resting metabolism, mass and stature the costs of children and adults were similar (0.323 ± 0.034 and 0.338 ± 0.035 mL\(\cdot\)kg\(^{-1}\), respectively, \(P = 0.54\)). However, adolescents had significantly higher SIC (0.360 ± 0.026 mL\(\cdot\)kg\(^{-1}\), \(P < 0.001\)) than both children and adults. Analysis of data from the literature indicated SIC peaks around 15 yr of age and changes were parallel to changes in the ratio of leg length to stature. Conclusions: We conclude that when resting metabolism and the dimensional effects of mass and stature are controlled, the running economy of adolescents is greater than in children and adults, which are similar. Therefore, differences in \(\dot{V}O_2\)gross\(\cdot\)M\(^{-1}\), \(\dot{V}O_2\)gross\(\cdot\)M\(^{-1}\), and \(\dot{V}O_2\)net\(\cdot\)M\(^{-1}\) among children, adolescents, and adults do not solely reflect qualitative differences in running performance.
Keywords: bipedal locomotion, body size, dimensional analysis, economy