TACSM Abstract

Preliminary Data Regarding how Wheelchair Axle Position Effects the Energy Cost of Assistants Pushing Wheelchairs Designed for Low-Resource Settings.

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ABSTRACT

A study at Letourneau University was performed to compare the energy cost of pushing wheelchairs with differing axle positions in relation to the occupant's center of gravity (COG). In less-resourced areas of the world, powered wheelchairs are rarely feasible, requiring an assistant to push the chair. Often these assistants themselves are disabled, making any means of minimizing energy cost imperative. Research has indicated that as the rear axle comes closer to the COG, the energy cost of self-propelling the chair decreases. We hypothesized that able-bodied assistants pushing wheelchairs could provide valuable insight into the effect of axle position on energy cost. Research was conducted using two types of wheelchairs designed for low-resource settings, Motivation *Rough Terrain* and Whirlwind *RoughRider* wheelchairs. One of each type of wheelchair was adjusted to have a more posterior axle position (PAP) with a COG 15 to 19 cm forward of the rear axle, and the other to have a more anterior axle position (AAP) with a COG 8 to 12 cm forward of the rear axle. COG varied according to individual occupant's body mass distribution. Able bodied college students (n=29, 18M, 11F) pushed a researcher in each wheelchair in random order for six minutes over rough ground. Heart rate and distance traveled in six minutes were measured. Non-exercise and exercise heart rates were obtained using *PolarPro* heart rate monitors and the physiological cost index (PCI) was calculated. Subject feedback was obtained using Visual Analog Scale (VAS) questions. Data was analyzed with two-way within subjects ANOVA and post-hoc paired T-tests. Within subjects ANOVA indicated significant difference for subject heart rate between PAP and AAP. Post-hoc T-tests indicated that the two axle positions produced significant difference for subject heart rate for the Whirlwind chair and nearly significant difference for the Motivation chair. For distance traveled and PCI there was no significant difference between the axle positions; able-bodied subjects appear to tolerate a higher heart rate, in order to maintain a comfortable speed, rather than slowing their pace. Subjects VAS data indicated a preference for the AAP. Based upon our findings, and in view of the many users who cannot self-propel or obtain access to a powered wheelchair, manufacturers of wheelchairs for low-resource settings should consider a more forward axle configuration to reduce energy cost for assistant pushers.