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Effects of Reduced Strength on Self-Selected Pacing for Long-Duration Activities

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Strength and aerobic capacity are predictors of astronaut performance for extravehicular activities (EVA) during exploration missions. It is expected that astronauts will self-select a pace below their ventilatory threshold (VT). **PURPOSE**: To determine the percentage of VT that subjects self-select for prolonged occupational tasks. **METHODS:** Maximal aerobic capacity and a variety of lower-body strength and power variables were assessed in 17 subjects who climbed 480 rungs on a ladder ergometer and then completed 10km on a treadmill as quickly as possible using a self-selected pace. The tasks were performed on 4 days, with a weighted suit providing 0% (suit fabric only), 40%, 60%, and 80% of additional bodyweight (BW), thereby altering the strength to BW ratio. Oxygen consumption and heart rate were continuously measured. Repeated measures ANOVA and post-hoc comparisons were performed on the percent of VT values under each suited condition. **RESULTS:** Subjects consistently self-paced at or below VT for both tasks and the pace was related to suit weight. At the midpoint for the ladder climb the 80% BW condition elicited the lowest metabolic cost (-19±14% below VT), significantly different than the 0% BW (-3±16%, *P*=0.002) and the 40% BW conditions (-5±22%, *P*=0.023). The 60% BW condition (-13±19%) was different than the 40% BW condition (*P*=0.034). Upon completion of the ladder task there were no differences among the conditions (0%BW: 3±18%; 40%BW: 3±21%; 60%BW: -8±25%; 80%BW: -10±18%). All subjects failed to complete 5km at 80%BW. At the midpoint of the treadmill test the three remaining conditions were all significantly different (0%BW: -20±15%; 40%BW: -33±15%; 60%BW: -41±19%). Upon completion of the treadmill test the 60% BW condition (-38±12%) was significantly different than the 40% BW (-28±15%, *P*=0.024). **CONCLUSIONS:** Decreasing relative strength results in progressive and disproportionate decreases (relative to VT) in self-selected pacing during long-duration activities. Thus, during prolonged, endurance-type activities, large reductions in strength cause notable performance decrements despite no changes in aerobic capacity. These data highlight the importance of both aerobic capacity and muscle strength to the performance of prolonged EVA in exploration mission scenarios.