THE EFFECTS OF WHEELCHAIR CAMBER AND HANDRIM SIZE IN WHEELCHAIR BASKETBALL MOVEMENT

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INTRODUCTION: Improving the wheelchair design can be an important determinant of high performance in the wheelchair basketball. Researchers have focused on increasing the efficiency of the wheelchair, looking at the factors such as the seat position, handrim size, and wheel camber. Most handrim and wheel chamber studies, however, have focused only on the propulsive phase. Quick turn as well as fast propulsion is essential to the success in a wheelchair basketball game and the energy efficiency becomes particularly important in a prolonged wheelchair use. The purpose of this study was to investigate the effects of wheelchair camber and handrim size on the linear propulsion, turn velocity, and efficiency.

METHODS: Nine male non-handicapped collegiate wheelchair basketball players (age: 24.1 ± 2.3 years, experience: 37.3 ± 11.1 months) participated in a 4-week familiarization/training program (3 session/week, 50 min/session) with four different wheelchairs: two cambers (16° and 20°) x two handrim diameters (61cm and 66cm). At the conclusion of the training program, each participant performed a series of propulsion/turn maneuvers with each type of wheelchair in a randomized order. The task consisted of two 10-m propulsive phases separated by a turn phase. The phase times were measured and two-dimensional video motion analysis of the propulsive stroke cycles was performed. The efficiency of the wheelchair propulsion was assessed afterward using a sub-maximal exercise protocol on a large wheelchair treadmill. The efficiency was calculated external power output divided by energy expenditure from Weir method (McArdle, 2000). Two-way ANOVA (2 cambers x 2 handrim sizes) with repeated measures was used to detect significant ($p<0.05$) factor effects/interactions.

RESULTS AND DISCUSSIONS: Both the handrim size and the camber generated significant factor effects. The small handrim (61 cm) showed significantly larger propulsion velocities than the large handrim (66 cm) in the first propulsion phase, but smaller values in the second propulsive phase. In other words, the small handrim demonstrated advantages in terms initiating motion and developing velocity for a short period of time (Phase 1) while the large handrim is more advantageous in terms of developing a maximum velocity once the motion is initiated sufficiently (Phase 2). On the other hand, the 16° camber produced significantly larger turn velocities than the 20° camber in the first turn phase. It was speculated that this was mainly due to the increased radius (and length) of the circular path the wheels form about the rotational axis, in spite of the advantage in terms of the increased stability due to the increased base of support. The wheelchair with small camber and handrim was characterized by a shorter stroke distance and a higher frequency while the wheelchair with small camber and large handrim was characterized by a relatively lower stroke frequency, a longer stroke distance, a smaller trunk range of motion, and a larger elbow range of motion. The estimated efficiencies of the wheelchair propulsion ranged from 4 to 10%. The efficiency increased as the velocity (1.11 1.39 m/s) and inclination (2 4°) of the treadmill increased. Although not significant, the 16° camber showed higher efficiencies than the 20° camber.

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