

Comparison of upper limb asymmetry between ballistic or cycling movement: Relationship with sport and impairment on para-athletes

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The assessment of asymmetry in sports practices in the able-body population was studied to understand this impact on performances [1]. However, upper limb asymmetry remains little explored and even less in people with impairments. The aim of this study was to investigate the interlimb asymmetry in force production among para-athletes and the impact of gesture and functional abdominal capacities. 29 male para-athletes participating wheelchair basketball (WB), wheelchair rugby (WR), or handbike (HB) from the French team were grouped in ABDO for those with abdominal capacities and NABDO for those without. Participants underwent two tests: horizontal upper limb push-offs (HBP) on a frictionless sled with force plates and arm cranking sprints (ACE) with an arm ergometer. The tests involved three individualized resistance levels [2]. An instantaneous symmetry index (ISI) was calculated for each resistance level. Significant differences were identified using $p < 0.05$. A Strong relationship between theoretical power and force was observed in both tests (respectively, $r = 0.86$, $p < 0.001$; $r = 0.9$, $p < 0.001$), and no relationship was found between ISI in each test ($r = 0.16$, $p = 0.142$). WB displayed greater power than HB, and HB reached more power than WR. ABDO were more powerful than NABDO ($p > 0.0001$) but there was no difference in ISI. WR's ISI was higher than HB and WB (respectively $p = 0.012$ and $p = 0.003$). ISI was higher on ACE compared to HBP ($p < 0.0001$) and greater during trials without resistance on ACE compared to trials with high resistance ($p < 0.0001$). WR showed larger asymmetries in both tests, suggesting due to upper limb physical asymmetries or motor impairments. Trunk imbalances did not appear to affect force production asymmetry during ballistic movements or arm crank exercises. Authors observed an increase of ISI with an increase in crank velocity which differs from observations in the lower limbs with able-body subjects [4]. Despite the differences in performance among different sports, it is more likely that asymmetry is related to motor impairments in the upper limbs rather than the trunk. A more complex movement, such as crank exercise compared to ballistic pushing, leads to greater force asymmetry, especially at higher movement velocities. Therefore, the asymmetry observed in this study appears to be associated with the motor coordination of the athletes.

1. Bishop, C. et al., *JSCR* **2021**.
2. Brassart, F. et al., *SJMSS* **2023**.
3. Chénier, F. et al., *J Biomech* **2017**.
4. Smak, W. et al., *J Biomech* **1999**.