

Article

Hogarth L, Payton C, Nicholson V, et al. (2018). Classifying motor coordination impairment in Para swimmers with brain injury. *J Sci Med Sport*, 22(5), 526-31.
<https://doi.org/10.1016/j.jsams.2018.11.015>.

Adaptive Sports/Recreation Topic Categories

- Brain injury
- Classification
- Motor coordination impairment
- Para swimming

Research Question

- What is the predictive and convergent validity of instrumented tapping tasks to classify motor coordination impairments in Para swimming?

Methodology

- Participants: 21 Para swimmers with congenital or acquired brain injury and 30 non-disabled participants.
 - Para swimmers had received national or international classification and undertaking planned training regimes at time of testing.
 - Non-disabled participants were between ages of 18-35 years and undertaking planned exercise, training, or competition at least twice a week for minimum of 80 minutes.
- Cross-sectional study.
 - Participants completed questionnaire providing information on demographics, typical training regime, and training activity on day of testing.
 - Para swimmers also provided information on training experience, competition standard attained, current sport class, and physical impairment type.
 - Motor coordination assessments consisted of having participants perform four novel tapping tasks using custom-made wireless Bluetooth tapping pads that were secured to a table (upper limb) or foot rest (lower limb). They were instructed to tap as rapidly and accurately as possible between the two pads within 15 seconds test duration (multiple trials).
 - 1) Bilateral upper limb tapping (seated participant extended arms with hands in a fist and index finger extended, with pads centered on table below index finger, and participant alternated tapping between the two pads).
 - 2) Dominant and non-dominant upper limb tapping (similar set-up as for bilateral upper limb tapping, except each arm tested separately. Tested arm's index finger would alternate tapping between the two pads while the non-tested arm rested in their lap).
 - 3) Bilateral lower limb tapping (seated participant extended legs at knee and ankle, with pads centered on 30° incline footrest below great toe, and participant alternated tapping with great toes between two pads).
 - 4) Dominant and non-dominant lower limb tapping (similar set-up as for bilateral lower limb tapping, except each leg tested separately. Tested leg's great toe would alternate tapping between the two pads while the non-tested leg was relaxed with foot positioned outside of tapping pads on a stable surface).

- Para swimmers also performed a maximal clean swim speed over a 10 meter calibrated test zone for their preferred freestyle swim stroke (two trials); speed determined using two dimensional video analysis.
- Primary outcome measures: Scoring of best trial of each of the above tapping tests based on number of complete cycles within 15 seconds; Para swimmers' fastest maximal 10 metre freestyle clean swim speed out of the two trials
- Secondary outcome measures: Repeat testing within a week of initial testing of non-disabled participants' tapping tasks to measure reliability.
- Three Para swimmers with diplegic cerebral palsy were unable to complete the lower limb tapping due to severe spasticity.

Results

- Test measures for tapping found to be reliable in subsample of 15 non-disabled participants.
- Significant difference in all test measures for tapping between Para swimmers and non-disabled participants, with larger differences reported for non-dominant limb tapping compared to dominant limb tapping.
- Random forest algorithm, that included test measures as predictor variables, successfully classified 96% of participants with and without brain injury.
- All test measures had significant correlations with maximal freestyle swim speed, except for bilateral upper limb tapping, upper limb symmetry score, and lower limb symmetry score.
- Dominant upper limb tapping, non-dominant upper limb tapping, and bilateral lower limb tapping were the most important predictors of maximal freestyle swim speed and showed the best prediction accuracy.

Discussion/Conclusion

- Para athletes with congenital or acquired brain injury present some of the most challenging cases in Para swimming classification.
- The development of valid tests of strength, range of motion and motor coordination is a key research objective that is required to guide an evidence-based classification system for these Para athletes.
- The instrumented tapping tasks demonstrated predictive and convergent validity when classifying motor coordination impairment, supporting the test's inclusion in a revised Para swimming classification system.
- The instrumented tapping tasks presented in this study were able to differentiate between participants with and without brain injury for the most part, with less certainty in persons with mild/moderate hemiplegic cerebral palsy or athetosis.
- Motor coordination tests relevant to upper limbs were more significant predictors of freestyle swim speed than lower limbs test performance.

Article Strengths

- One of very few studies to look at an evidence-based approach to evaluate para swimmers' impairments and their relation to swimming performance in freestyle to potentially use in classification in the future.

Article Weaknesses

- Small study size (n), especially when breaking down by Para swimmers' sport classes.

- While the study included both congenital and acquired brain injury diagnoses, brain injury coordination impairment overall can be quite variable depending on the patient's underlying diagnosis/location of brain injury lesion.
- Only looked at motor coordination driven from the shoulders and hips and how it relates to freestyle. Does not factor in coordination at other joints (e.g. elbow), which also affect swim biomechanics and performance in freestyle.
- Did not look at other strokes or identify swimmers' stroke preference.
- Peer comparison population did not consist of swimmers, which may have influenced differences in results even more widely.

Take Home Messages

- Instrumented tapping tasks provide an objective estimate of activity limitation in Para swimming resulting from motor coordination impairment and can be used to assign sport class in freestyle when measuring motor coordination is appropriate (diagnosis-dependent).
- Larger, more varied Para population samples will be needed to evaluate validity based on different strokes and its utility for classification.
- A revised Para swimming classification system due to be implemented following the 2020 Tokyo Paralympic games could include these tapping tasks to improve the objectivity and transparency of athlete classification.