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Title page

Potential benefits and safety of Tai Chi for balance and functional independence in people with cerebellar ataxia

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Running head: Tai Chi for balance and functional independence in cerebellar ataxia

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Abstract:

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Cerebellar ataxia (CA) results in incoordination, poor balance and walking difficulties. Evidence supports the use of Tai Chi to improve balance in stroke,¹ Parkinson's disease,² multiple sclerosis³ and spinal cord injury.⁴ Tai Chi has also been found to improve coordination, however, the finding is limited to older adults.⁵ Tai Chi improves balance by facilitating even weight distribution, improving knee joint proprioception, and increasing lower limb muscle strength.⁶ The principles of Tai Chi concur with Frenkel's exercise which is based on concentration, precision and repetition of movements for restoration of balance and co-ordination.⁷ Therefore, we hypothesize Tai Chi might improve balance and functional independence by reducing incoordination among people with CA. Our objective for this study was to assess the feasibility of the protocol and generate effect size to power a future large, randomized controlled trial (RCT).

Ten participants with spinocerebellar ataxia type 3 ($n=5$), type 6 ($n=3$) and post-infectious cerebellar degeneration ($n=2$) were recruited, which was approved by the Human Subjects Ethics Sub-committee of HK. Yang style 8-form Tai Chi (Appendix) was delivered for 12-weeks with 3 sessions per week each lasting 60 minutes. One session was institution-based, and the others were home-based. Balance was assessed using standardized measures for CA⁸ including the Berg Balance Scale (BBS); balance sub-components of Scale for the Assessment and Rating of Ataxia (SARAbal); sensory ratio of somatosensory, visual and vestibular inputs of Sensory Organization Test (SOT); reaction time and maximum excursion of Limits of Stability (LOS); SARA rated ataxia severity and Barthel Index assessed functional independence. Feasibility measures included recruitment rate, adherence to institution and home-based training, retention, safety and acceptability of the intervention. Mean differences between pre- and post-intervention were

calculated using Student's paired *t*-test, and Cohen's *d* estimated effect size. Shapiro-Wilk test was used to assess the normality of the data, and the intention-to-treat principle was used.

Our participants were aged 50.9 ± 6.6 years, disease duration was 12.4 ± 7.6 years, mean ataxia severity was 17.5 ± 5.5 on SARA, 50% were female, and 70% used assistive walking devices. Tai Chi significantly improved balance measured with BBS and SARAbal and ataxia severity measured with SARA (Table 1). The effect size for BBS and SARAbal was large ($d > 0.80$). Functional independence, SOT and LOS variables did not improve. Required number of participants were recruited in two weeks. Adherence to intervention was 83% and 71% for institution-based and home-based practice, respectively. Retention rate was 100%, and no adverse events were encountered. Positive comments indicating adequate acceptance of the intervention were received during interview.

This is the first study to test feasibility and safety of Tai Chi in people with CA. Heterogeneity among the participants with regard to CA types and physical abilities enables a wider generalizability of the findings among people with CA. The large BBS and SARAbal treatment effect could be a regression artefact, as this study was uncontrolled and non-randomized. The lack of improvement in balance measured with SOT and LOS may be due to a floor effect. Forty percent of participants were ineligible for testing, as they were unable to stand unsupported. Furthermore, a lack of reliability of SOT and LOS could not be ruled out for the insignificant results. Direct supervision of home-based practice was not done and this could have influenced the overall outcomes. However, a video demonstration of the Tai Chi moves was provided, which participants were encouraged to view to ensure correct moves during home-practice.

Tai Chi for CA is likely to improve balance and is feasible and safe to administer. Forty-eight participants will be recruited for the future RCT to compare Tai Chi against usual care to confirm these benefits.

(Insert Table 1 here)

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