

Background

- Visual impacts after concussion are common and can persist if left untreated^{1,2}
- Research suggests female persons express greater symptom load and delayed recovery³
- Increasing research suggests oculomotor rehabilitation (OMR) improves outcomes above natural recovery^{4,5}
- Digital platforms offer unique opportunities to deliver and monitor personalized and engaging OMR interventions, however adherence to it and tolerability in both male and female persons are unclear; we aimed to fill the gap.

Objectives

1. To evaluate the tolerability and adherence of weekly VR-delivered oculomotor rehabilitation in visually symptomatic adults following concussion
2. To examine sex differences in simulator sickness change following VR-delivered oculomotor rehabilitation.

Methods

- This study is part of a larger OMR study KITE-UHN
- Participants with visual symptoms after concussion were enrolled
- Six weekly sessions of OMR in office (Figure 1) with at home reinforcement (Figure 2)
- Activities were progressed weekly in duration and difficulty
- Tolerance monitored with simulator sickness questionnaire (SSQ)
- Change scores (baseline-final SSQ) were compared between sexes using independent samples t-tests.

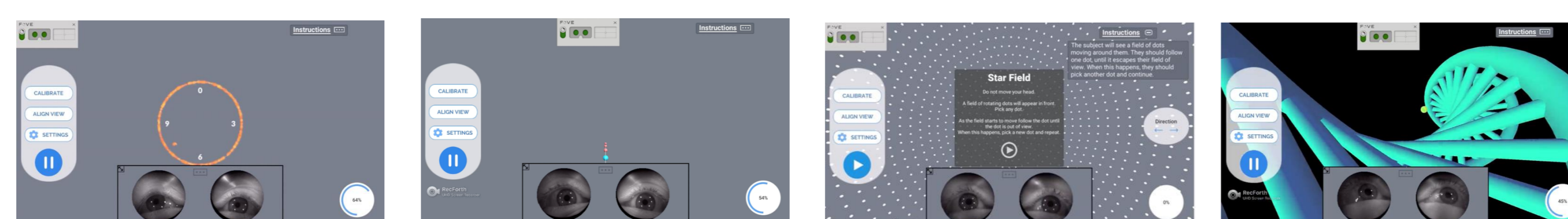
Table 1 Study according to PICOS framework where I=Experience

Population	Adults 18 - 42 yrs, 1 to 12 months post concussion
Intervention	6 weeks of VR-based OMR
Comparator	Sex (m/f)
Outcome	Tolerance to technology
Study Design	Prospective single arm trial

Abbreviations: HS=high school; Hx=history; LOC=loss of consciousness; MD=medical doctor; OM=oculomotor; OMR =OM rehabilitation; OPK=optokinetic reflex; SSQ=simulator sickness questionnaire; VIMSS=visually induced motion sickness susceptibility; yrs=years

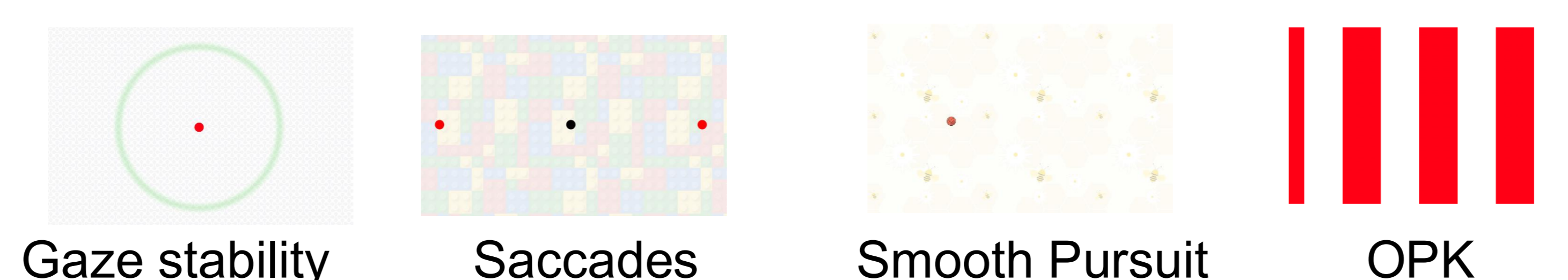
Methods

Figure 1 Examples of training modules



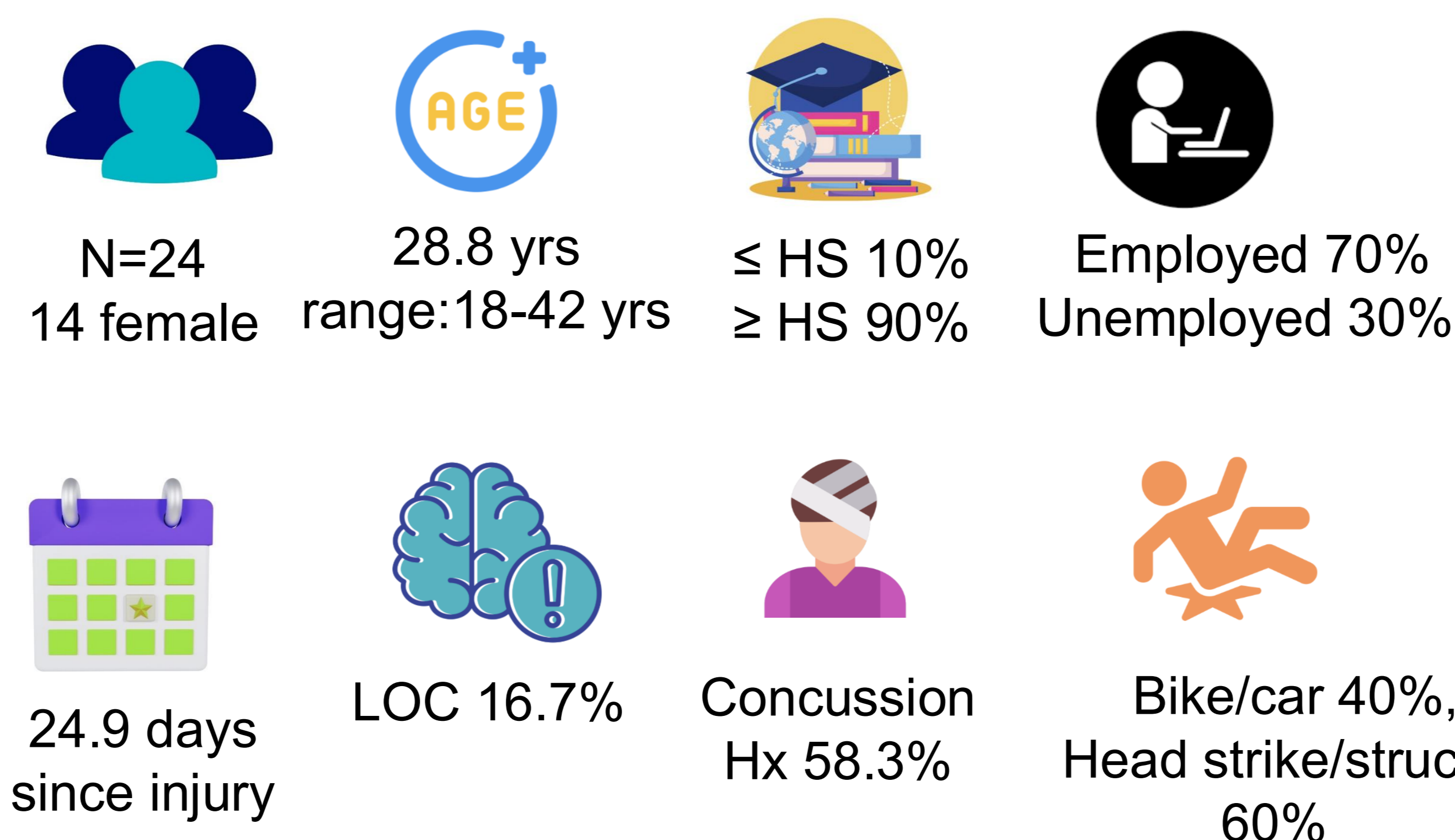
Saccade Clock Brock String OPK Star Field Multi Skill DNA

Figure 2 Examples of homework modules



Results

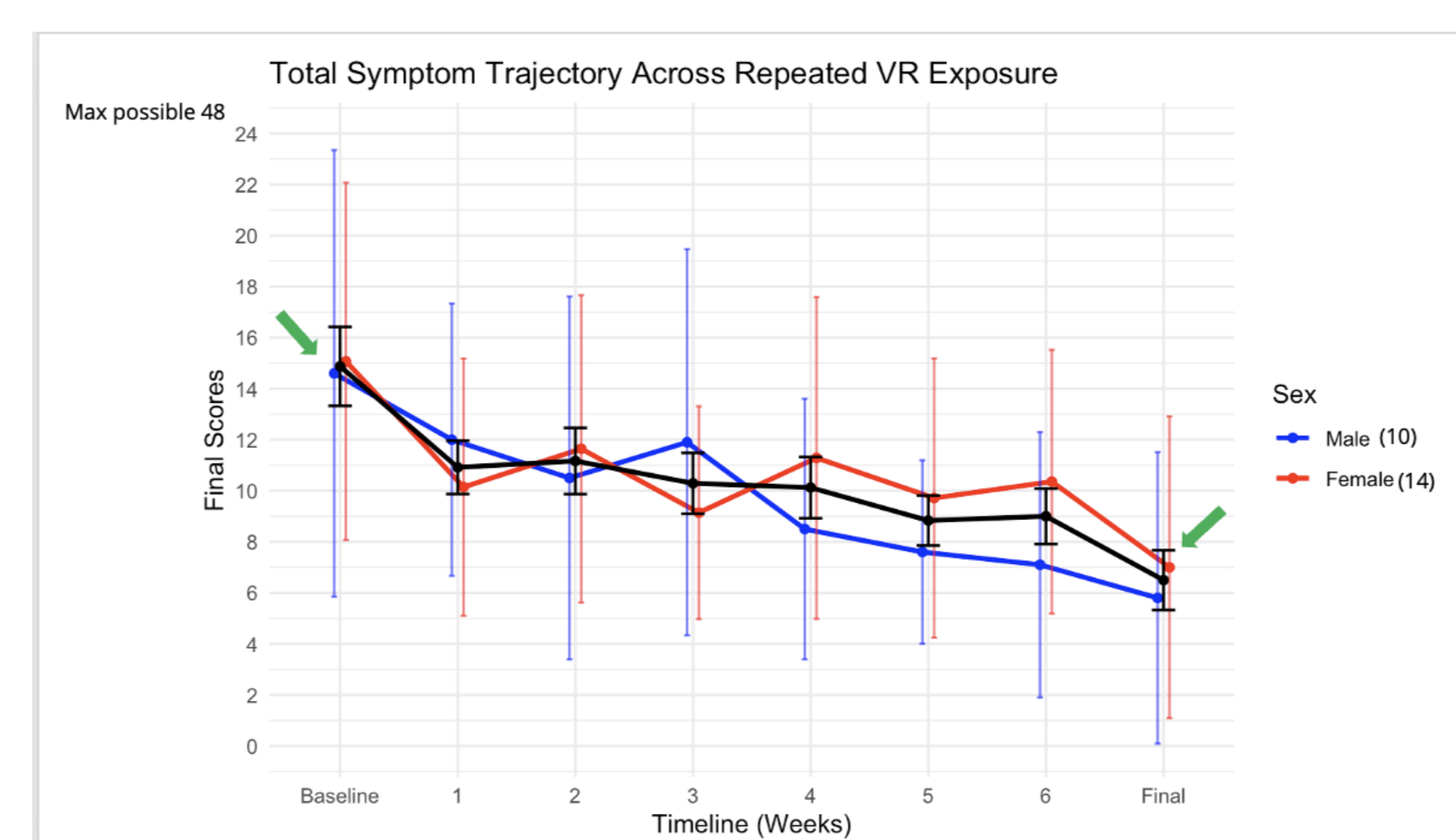
Figure 3 Participant characteristics



Sex differences in participant characteristics were not found

Figure 4 Tolerance to technology by week

- SSQ total scores declined from baseline to final assessment in
- Biggest reduction between baseline and week 1.



Results

Figure 5 Individual tolerance to VR based OMR over 8 weeks

- Males and females demonstrated different patterns of SSQ over time
- SSQ total scores decreased significantly from baseline to final assessment across males and females.

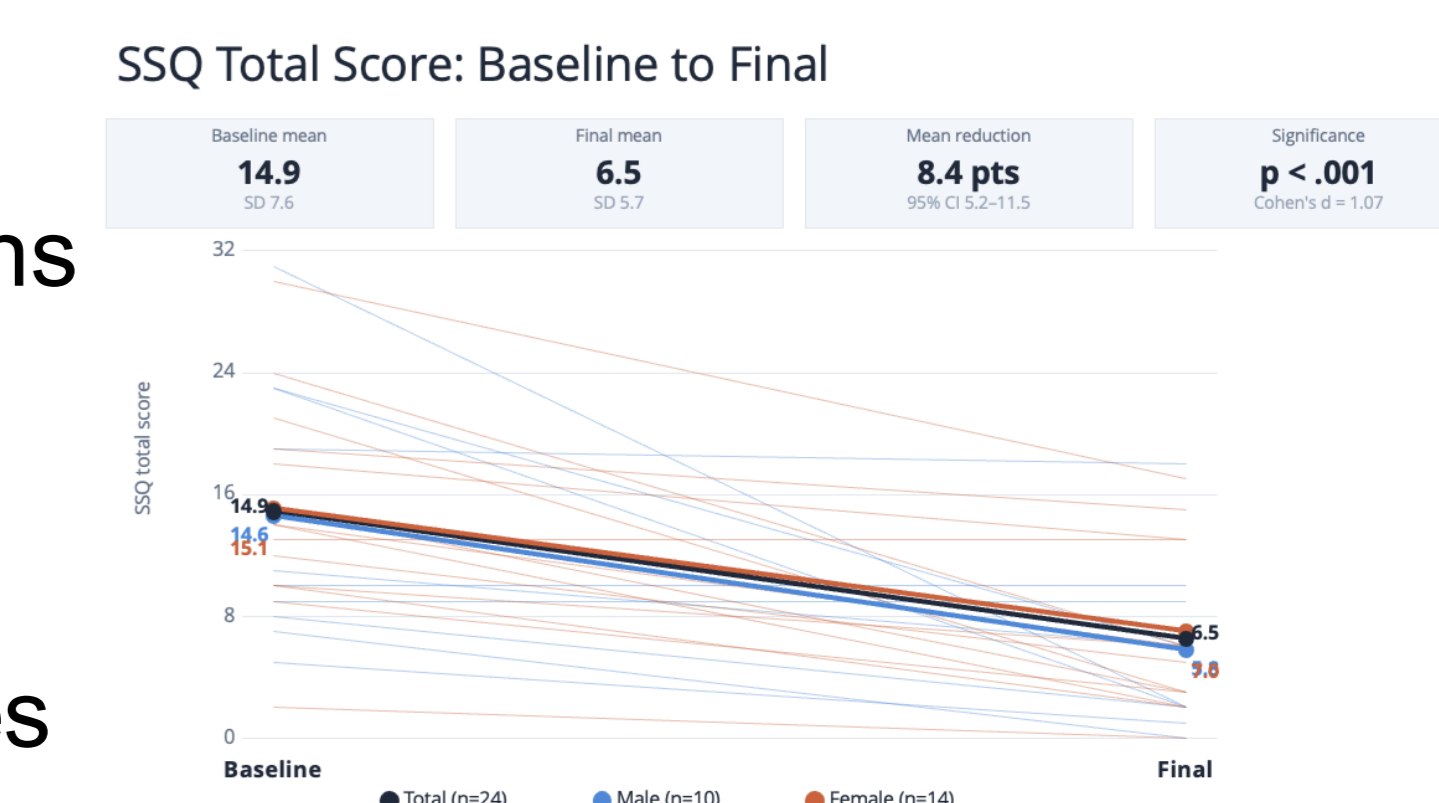
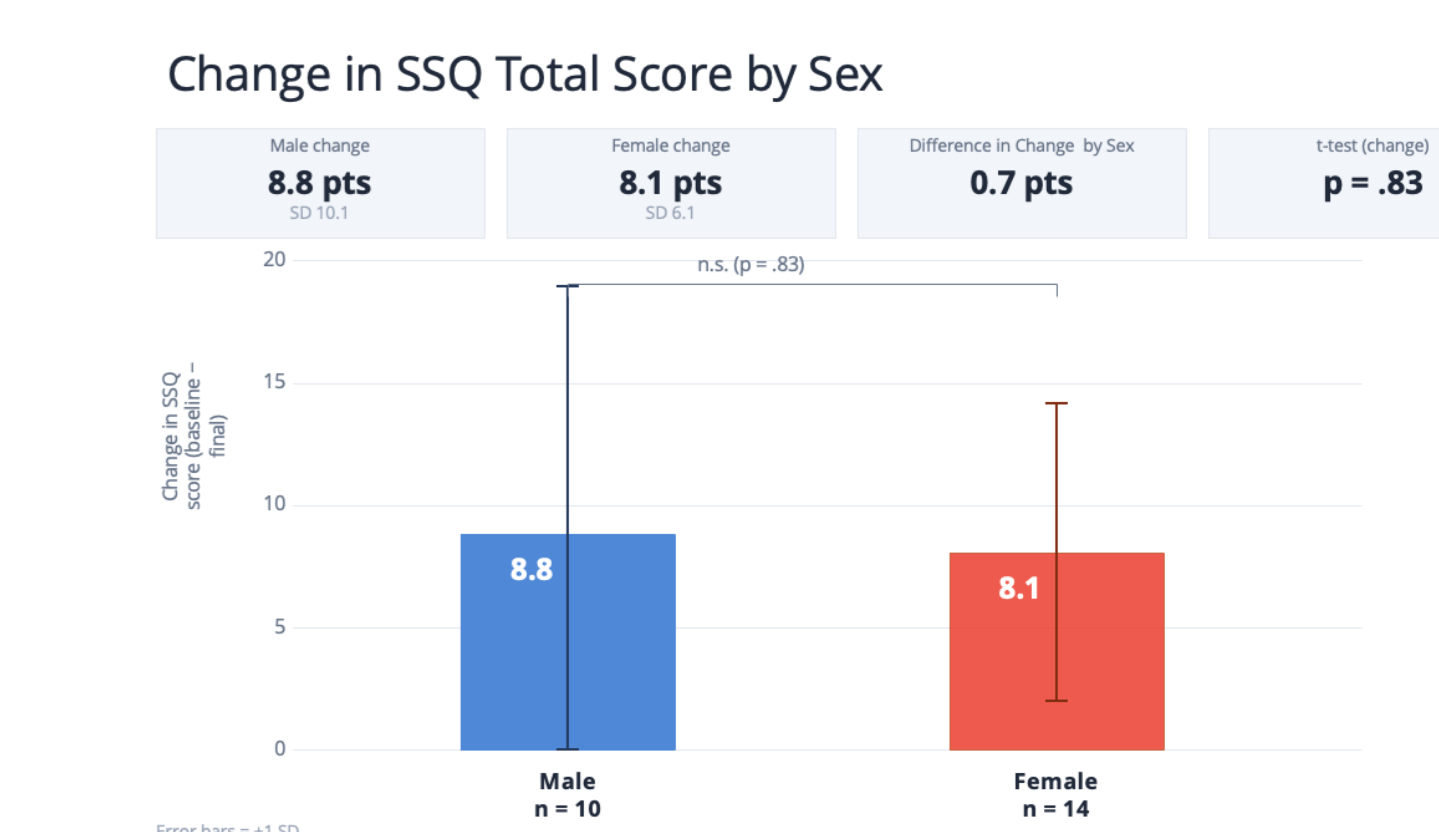


Figure 6 Tolerance to VR based OMR over 8 weeks by sex

- Change in SSQ total score did not differ significantly by sex.



Discussion

1. Repeated exposure to visual task-based head-mounted VR is well tolerated in adults with persistent post-concussion symptoms
2. Symptoms of simulator sickness decline over time despite increasing rehabilitation demands, suggesting habituation may occur with appropriate dosing and progression
3. These findings support the feasibility of head-mounted VR as a rehabilitation tool in OMR as part of concussion care when implemented within a structured, symptom-guided framework.

Future Directions

- Further research is needed to determine optimal timing, dosing, and progression strategies, particularly with more visually complex and fully immersive VR environments
- Investigation of hardware variables (interpupillary distance calibration, field of view) as potential contributors to sex differences in cybersickness.

References

1. Master et al. (2016) Vision diagnoses are common after concussion in adolescents. *Clin Pediatr (Phila)*, 55(3):260–67.
2. Moller et al. (2025) Evaluation of visual disturbances after mild traumatic brain injury: A one-year follow-up study. *The Journal of Head Trauma Rehabilitation*, 40(3), e208–e215.
3. Bunt et al. (2020). Sex differences in reporting of concussion symptoms in adults. *The Clinical Neuropsychologist*, 36(6), 1290–1303.
4. Alvarez, et al. CONCUS randomized clinical trial of vergence/accommodative therapy for concussion-related symptomatic convergence insufficiency. *British Journal of Sports Medicine*, bjsports-2025-109807. Advance online publication; 5. Trbovich et al. (2025). Randomized Controlled Trial of Brock String Vision Therapy for Receded Near Point of Convergence Following Concussion. *Journal of Neurotrauma*, 42(19-20), 1708–1718.