

Background

- Incidence of sport-related concussion (SRC) continues to rise in the United States.
- Following a SRC, impairments, such as reaction time (RT), persist even after subjective symptom reports return to baseline.
- Further, athletes that suffer a SRC are at a greater risk of future SRC.

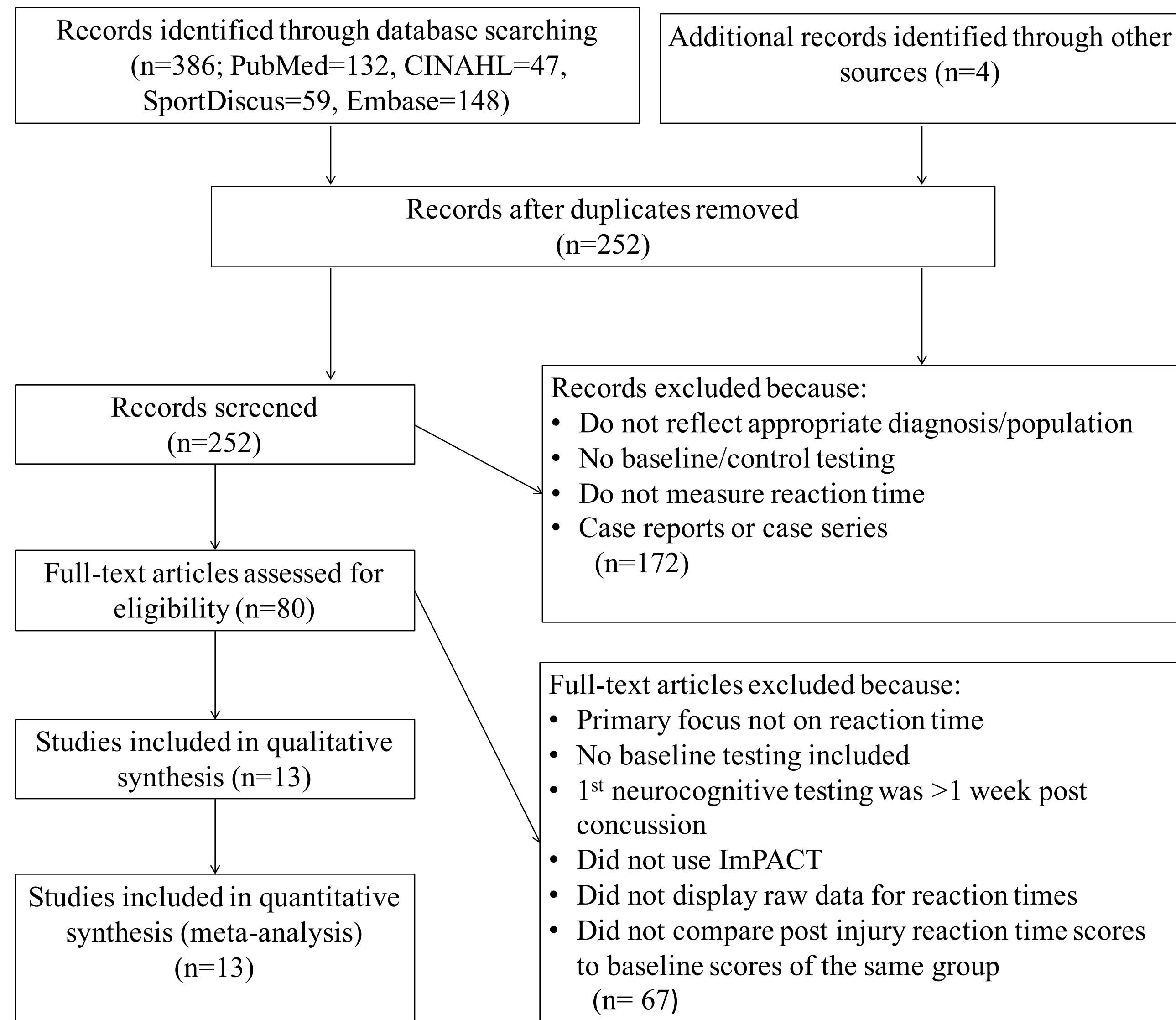
Purpose

- The purpose of this study is to systematically review the literature to examine early (0-3 days) and late (>3 days) assessment of RT following SRC.
- The secondary aim of this study is to explore RT by number of previous concussions

Methods

- 2-stage process including duplicate screening, eligibility, and inclusion
- Quality assessment conducted by two reviewers using The Quality Assessment Tool for Non-Randomized Studies of Interventions or Exposures
- Quality scores were stratified by selection, detection, attrition, reporting and confounding bias as well as overall quality of the study.

Figure 1: Flow Diagram for Study Inclusion



Analysis

- Data was pooled quantitatively using fixed effects models.
- Differences in RT baseline, early and late means with 95% confidence intervals (CI) were used in the primary analysis.
- Studies were stratified by number of previous SRCs.
- Heterogeneity was assessed with $I^2 > 50\%$ representing significant heterogeneity.

Results

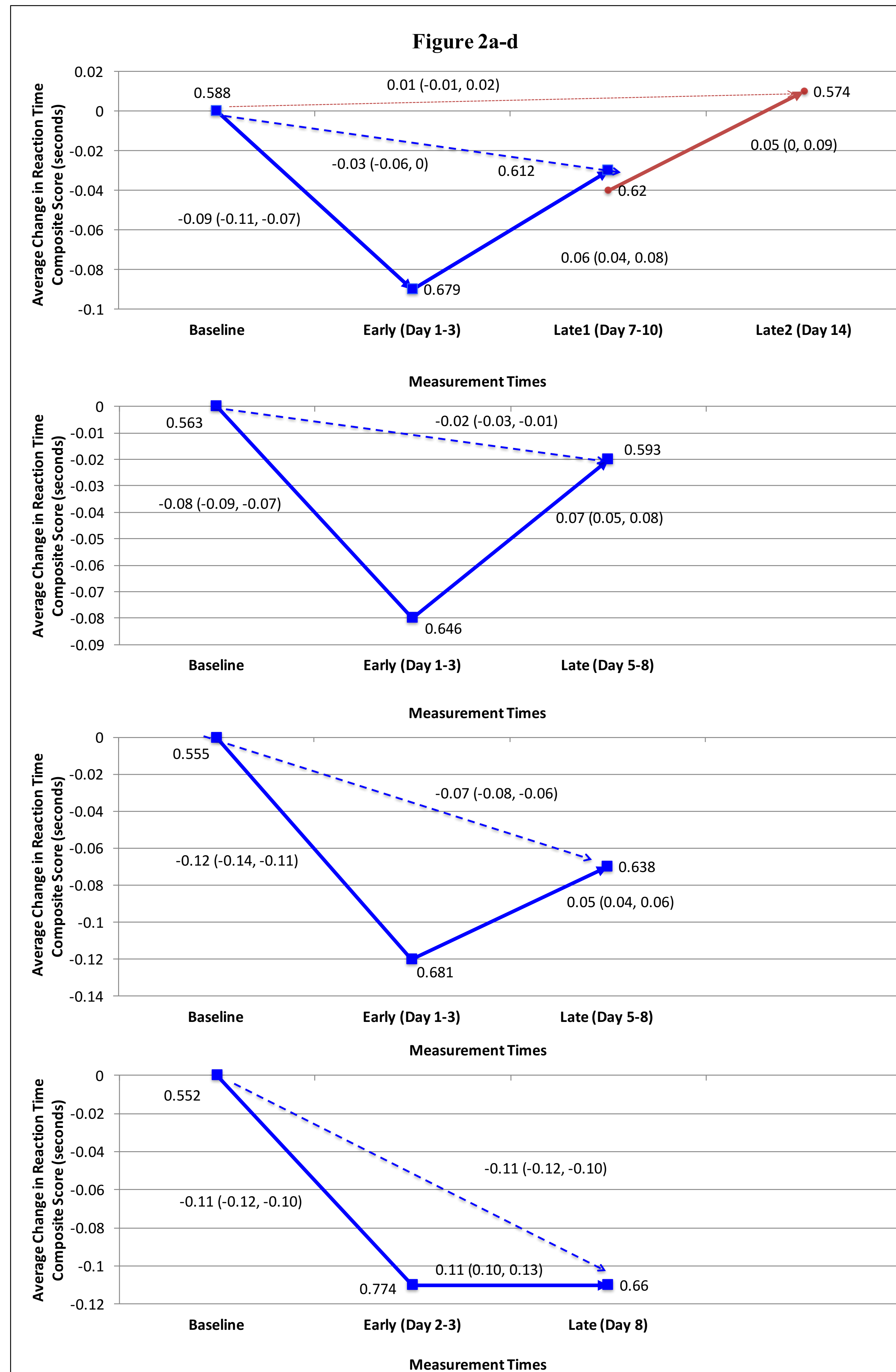


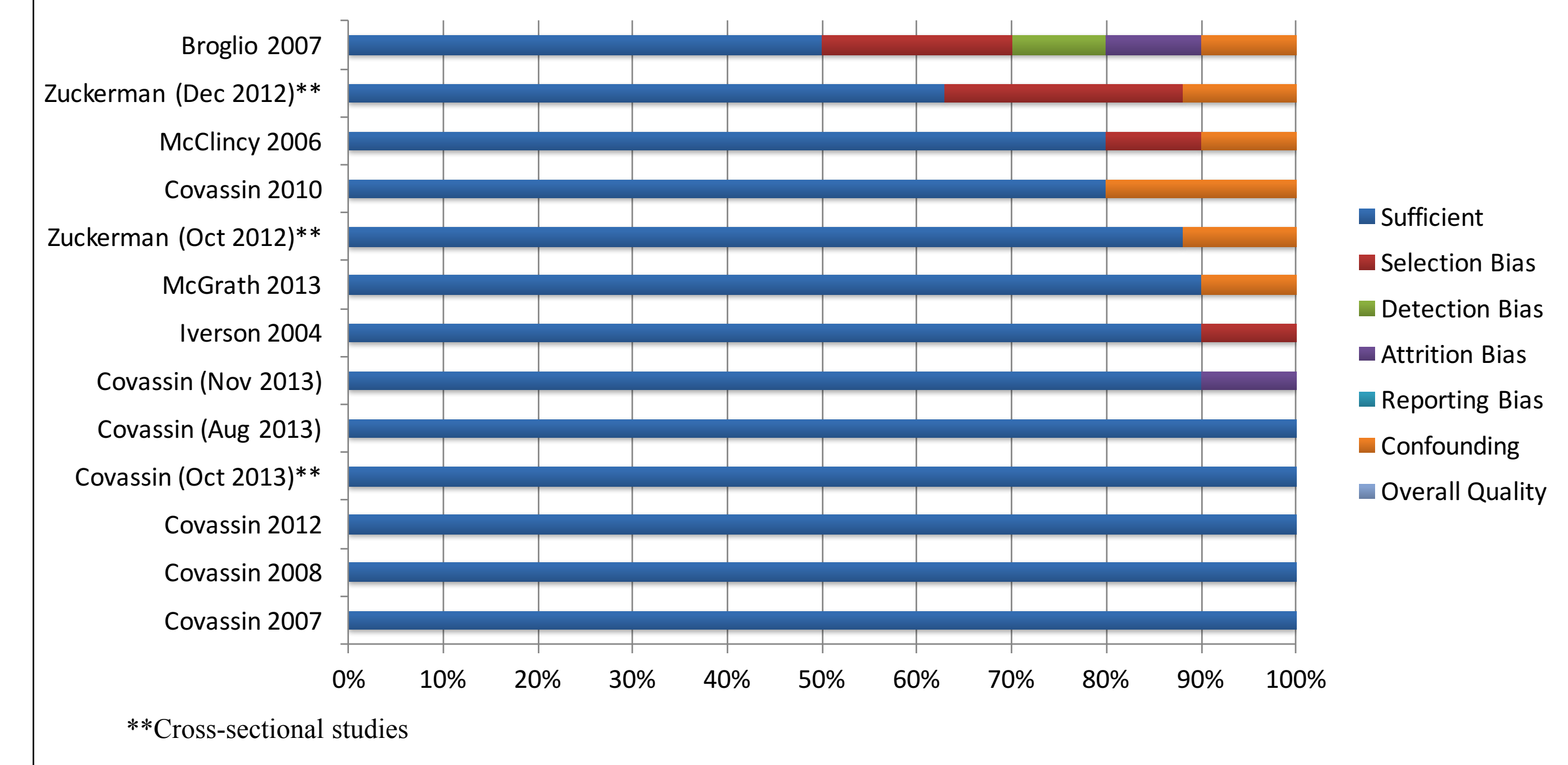
Figure 2a: Average Change in Reaction Time for Athletes, 2b: Average Change in Reaction Time for Athletes With a History of No Previous Concussions, 2c: Average Change in Reaction Time for Athletes With a History of 2 or More Concussions, 2d: Average Change in Reaction Time for Athletes With a History of 3 or More Concussions
 Figure 2a: Red circle data points are only from 2 of the 4 studies.

- Studies ranged from 21-598 athletes; Average age ranged: 14-22 years old
- All studies included: male and female athletes; only 4 studies differentiated results by sex
- Type of Sport:
 - 10 studies combined results across multiple sports
 - 2 studies only assessed soccer players; 1 study only assessed ice hockey players

Results

- Age/Education Level:
 - 7 studies assessed high school and college athletes together but only 2 studies compared between ages
 - 3 studies included only collegiate athletes
 - 3 studies included only high school athlete
- Baseline to early (Day 0-3) assessment: Deterioration of reaction time across all studies except 1.
- Baseline to late (Day 5-10) assessment: Subjects did not return to baseline in all studies except 2.
 - Reaction Time did improve toward baseline in all studies
- Baseline to Late₂ (Day 14) (2 studies): Reaction time returned to baseline
- Days until reaction time returned to baseline: 5-21 days

Figure 3: Quality Assessment



Conclusions

- RT scores were significantly lower from baseline at early and late assessments demonstrating that RT did not return to baseline by 7-10 days
- When stratified by the number of previous SRCs, late RT averages decreased from baseline as the number of previous concussions increased.
- Results suggest that with the increase in the number of previous SRCs, an athlete will show greater RT impairment at late assessment.

Clinical Relevance

- Health professionals should be aware of the lingering neurocognitive deficits, especially in RT, that exist up to two weeks after sustaining a concussion before making a decision to return an athlete to their sport.
- Returning to play 7-10 days post-concussion may be too soon especially for athletes with a history of multiple concussions.

Acknowledgements / References

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1. Covassin, Tracey, Ryan Moran, and Kristyn Wilhelm. "Concussion Symptoms and Neurocognitive Performance of High School and College Athletes Who Incur Multiple Concussions." *American Journal of Sports Medicine* 41, no. 12 (December 2013): 2885-89. doi:10.1177/0363546513499230.
 2. Covassin, Tracey, Bryan Crutcher, and Jessica Wallace. "Does a 20 Minute Cognitive Task Increase Concussion Symptoms in Concussed Athletes?" *Brain Injury* 27, no. 13/14 (December 2013): 1589-94. doi:10.3109/02699052.2013.823656.
 3. McGrath, Neal, Wayne Dinn M., Michael Collins W., Mark Lovell R., R. Elbin J., and Anthony Kontos P. "Post-Exertion Neurocognitive Test Failure among Student-Athletes Following Concussion." *Brain Injury* 27, no. 1 (2013): 103-13. doi:10.3109/02699052.2012.729282.
 4. Zuckerman S.L., Solomon G.S., Forbes J.A., Haase R.F., Sills A.K., and Lovell M.R. "Response to Acute Concussive Injury in Soccer Players: Is Gender a Modifying Factor? Clinical Article." *Journal of Neurosurgery: Pediatrics* 10, no. 6 (2012): 504-10.
 5. Covassin T, Elbin RJ, Bleecker A, Lipchik A, Kontos AP. Are there differences in neurocognitive function and symptoms between male and female soccer players after concussions? *Am J Sports Med.* 2013;41(12):2890-2895. doi:10.1177/0363546513509962.