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Determining the Appropriate Timing of Administration of Computerized Neurocognitive Testing Following Maximal Exertion- Preliminary Analysis

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Computerized neurocognitive testing (CNT) is part of a multi-faceted approach to sport-related concussion assessment. Accurate baseline (pre-injury) CNT scores aid post-concussion management which allows the athlete to serve as their own control. Prior research suggests maximal exertion negatively affects CNT scores immediately following exercise. However, the appropriate wait time for administering CNT following maximal exertion is unknown.

PURPOSE: To compare differences in neurocognitive performance and symptoms following maximal exertion with varied recovery intervals in healthy college-aged students.

METHODS: A prospective, randomized cross-over, repeated measures design was used for this study. Twenty-six participants (22 ± 2y) completed four experimental visits. Three visits consisted of a maximal effort graded exercise treadmill test (VO_2 max), with a prescribed post-exertion rest period, and CNT administration. Prescribed post-exertion recovery intervals were defined as: <2 min (immediate), 10-min, or 20-min. The fourth visit served as a control (baseline); participants performed a CNT without a preceding VO_2 max test. All four experimental visits occurred at least one week apart and were randomly counterbalanced. A series of one-way repeated measures analysis of variance (ANOVAs) were performed on CNT composite outcome and symptom scores. Statistical significance was set at a Bonferroni-corrected $p \leq .01$.

RESULTS: There was a significant within-subjects effect for prescribed post-exertion recovery intervals on total symptom scores (*Wilks* λ = .62, F [3, 23] = 4.64, p = .01, η^2= .38). Total symptom scores were significantly higher at the immediate (p < .001), 10-min (p = .02), and 20-min (p = .05) post-exertion recovery intervals compared to baseline. There were no significant differences for processing speed (p = .05), visual memory (p = .07), verbal memory (p = .06), or reaction time (p = .40).

CONCLUSION: Baseline symptom scores were negatively influenced by maximal exertion, and continued to be elevated 20 minutes post-exertion. However, cognitive performance was unaffected. Sports medicine professionals should wait at least 20 minutes following maximal exertion to obtain a more accurate representation of symptoms.

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Does Greater Susceptibility to Neck Injury Put Females at Higher Risk of Prolonged Sport-Related Concussion Recovery?

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(No relevant relationships reported)

PURPOSE: An increase in female participation in contact sports has resulted in an increase in female athletes presenting with sport-related concussion (SRC). It has been theorized that females have longer SRC recovery time related to lower neck strength compared to males, which may also relate to concomitant neck injury. We proposed that female athletes with SRC have a higher incidence of acute cervical strain, resulting in a longer duration of SRC symptoms. Additionally, we investigated if athletes with acute cervical injury were more likely referred to a neuropsychologist in the post-SRC period compared to those without neck injury.

METHODS: This retrospective study assessed male and female youth, high school, and collegiate athletes (n=431; ages=12-21 years old) for post-SRC symptoms. We analyzed whether females who suffer a SRC are more prone to having an accompanying neck injury in comparison to males. Additionally, we assessed whether athletes who suffer an SRC with a neck injury display longer post-SRC recovery times, leading to increased referrals to a neuropsychologist; Statistical analyses were conducted using chi- square tests.

RESULTS: Of the 431 SRC cases, 92 reported concomitant acute neck strain. When comparing recovery time between male and female athletes, a significant difference was seen with females requiring more time to recover (p<0.001). However, when comparing recovery time in males and females with SRC and acute cervical strain, no significant differences were found (p=0.416). Additionally, when comparing the initial symptom burden using the post-concussion symptom scale in athletes with acute neck injury, females have a non-significant increased number of symptoms compared to males (p=0.157). Athletes with an SRC and neck injury are more likely to need a neuropsychology referral compared to those without a neck injury (p=0.027).

CONCLUSIONS: Evidence has been established that females have an extended recovery time following SRC when compared to males. A sex-based difference in regards to neck injury altering the recovery time were not found in our study. However, a concomitant neck injury with SRC increases the likelihood of neuropsychology referral. Further research is warranted to determine etiologic factors contributing to more prolonged SRC recovery in females versus males.

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The Interrelationship and Diagnostic Utility of Memory and Reaction Time in Concussed Students

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More than 40 million American youth participate in interscholastic, community-based, and collegiate sports. A risk of participation is traumatic brain injury (TBI). In up to 40% of TBI cases, athletes experience persistent functional and cognitive deficits. It is important to understand the variables that lead to these deficits to improve diagnosis and prognostic management.

PURPOSE: To evaluate memory and reaction time as markers of TBI severity among patients experiencing prolonged recovery.

METHODS: We retrospectively analyzed student-athletes admitted to a Midwestern outpatient clinic for neuropsychological evaluation; 78 patients had relatively comprehensive profiles and were included in the analysis. We conducted a health history, a 22-item post-concussion symptom inventory, and the ImPACT computerized test, which evaluated memory and reaction time. Pearson's and point-biserial correlation coefficients tested the direction and strength of association between memory, reaction time, and markers of injury severity. Logistic, negative binomial, and linear regressions tested memory and reaction time as predictors of whether symptoms were reported, the number of reported symptoms, and the severity of symptoms.

RESULTS: Patients were 16.0 ± 2.6 years of age, 56.3% were male, and they had experienced 1.2 ± 1.5 previous concussions. Reaction time was 0.64 ± 0.13 seconds; visual motor speed score was 44.7 ± 34.6; visual memory score was 92.0 ± 69.3; verbal memory score was 98.0 ± 80.9; cognitive efficiency score was 0.34 ± 0.12. Reaction time was a significant predictor (p<0.05) of balance problems, dizziness, mental fogginess, and sensitivity to light and noise; it was a trending predictor (p=0.061) of the summed severity of symptoms. Verbal memory was a significant predictor (p<0.05) of balance problems, sleeping problems, and fatigue. Visual memory, visual motor speed, and cognitive efficiency index were poor predictors of injury severity.

CONCLUSIONS: Reaction time and memory are common components of testing batteries for concussed athletes. In our sample, reaction time and verbal memory emerged as useful predictors of severity among patients suffering long-term symptoms of TBI. It may be of value for coaches and athletic trainers to establish baseline values at the onset of a competitive season.

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No Increased Lower Extremity Injury Risk Following Concussion in Youth Tackle Football Players

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