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Evidence-Based Practice

The Value of Various Assessment Techniques in Detecting the Effects of Concussion on Cognition, Symptoms, and Postural Control

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Abstract

Reference/Citation: Broglio SP, Puetz TW. The effect of sport concussion on neurocognitive function, self-report symptoms, and postural control: a meta-analysis. *Sports Med.* 2008;38(1):53-67.

Clinical Question: How effective are various concussion assessment techniques in detecting the effects of concussion on cognition, balance, and symptoms in athletes?

Data Sources: Studies published between January 1970 and June 2006 were identified from the PubMed and PsycINFO databases. Search terms included *concussion, mild traumatic brain injury, sport, athlete, football, soccer, hockey, boxing, cognition, cognitive impairment, symptoms, balance, and postural control*. The authors also handsearched the reference list of retrieved articles and sought the opinions of experts in the field for additional studies.

Study Selection: Studies were included if they were published in English; described a sample of athletes concussed during athletic participation; reported outcome measures of neurocognitive function, postural stability, or self-report symptoms; compared the postconcussion assessments with preseason (healthy) baseline scores or a control group; completed at least 1 postinjury assessment within the first 14 days after the concussion (to reflect neurometabolic recovery); and provided enough information for the authors to calculate effect sizes (means and SDs at baseline and postinjury time points). Selected studies were grouped according to their outcome measure (neurocognitive function, symptoms, or postural control) at initial and follow-up (if applicable) time points. Excluded articles included review articles, abstracts, case studies, editorials, articles without baseline data, and articles with data extending beyond the 14-day postinjury time frame.

Data Extraction: From each study, the following information was extracted by one author and checked by the second author: participant demographics (sport, injury severity, incidence of loss of consciousness, and postconcussion assessment times), sample sizes, and baseline and postconcussion means and SDs for all groups. All effect sizes (the Hedge *g*) were computed so that decreases in

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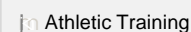
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neurocognitive function and postural control or increases in symptom reports resulted in negative effect sizes, demonstrating deficits in these domains after concussion. The authors also extracted the following moderators: study design (with or without control group), type of neurocognitive technique (Standardized Assessment of Concussion, computerized test, or pencil-and-paper test), postconcussion assessment time, and number of postconcussion assessments.

Main Results: The search identified 3364 possible abstracts, which were then screened by the authors, with 89 articles being further reviewed for relevancy. Fifty articles were excluded because of insufficient data to calculate effect sizes, lack of a baseline assessment or control group, or because the data had been published in more than one study. The remaining 39 studies met all of the inclusion criteria and were used in the meta-analysis; 34 reported neurocognitive outcome measures, 14 provided self-report symptom outcomes, and 6 presented postural control as the dependent variable. The analyzed studies included 4145 total participants (concussed and control) with a mean age of 19.0 ± 0.4 years. The quality of each included study was also evaluated by each of the 2 authors independently using a previously published 15-item scale; the results demonstrated excellent agreement between the raters (intraclass correlation coefficient = 0.91, 95% confidence interval [CI] = 0.83, 0.95). The quality appraisal addressed randomization, sample selection, outcome measures, and statistical analysis, among other methodologic considerations. Quality scores of the included studies ranged from 5.25 to 9.00 (scored from 0–15).

The initial assessment demonstrated a deficit in neurocognitive function ($Z = 7.73$, $P < .001$, $g = -0.81$ [95% CI = $-1.01, -0.60$]), increase in self-report symptoms ($Z = 2.13$, $P = .03$, $g = -3.31$ [95% CI = $-6.35, -0.27$]), and a nonsignificant decrease in postural control ($Z = 1.29$, $P = .19$, $g = -2.56$ [95% CI = $-6.44, 1.32$]).

For the follow-up assessment analyses, a decrease in cognitive function ($Z = 2.59$, $P = .001$, $g = -26$ [95% CI = $-0.46, -0.06$]), an increase in self-report symptoms ($Z = 2.17$, $P = .03$, $g = -1.09$ [95% CI = $-2.07, -0.11$]), and a nonsignificant decrease in postural control ($Z = 1.59$, $P = 0.11$, $g = -1.16$ [95% CI = $-2.59, 0.27$]) were found.

Neurocognitive and symptom outcomes variables were reported in 10 studies, and the authors were able to compare changes from baseline in these measures during the initial assessment time point. A difference in effect sizes was noted ($Q_B^{(1)} = 5.28$, $P = .02$), with the increases in self-report symptoms being greater than the associated deficits in neurocognitive function.

Conclusions: Sport-related concussion had a large negative effect on cognitive function during the initial assessment and a small negative effect during the first 14 days postinjury. The largest neurocognitive effects were found with the Standardized Assessment of Concussion during the immediate assessment and with pencil-and-paper neurocognitive tests at the follow-up assessment. Large negative effects were noted at both assessment points for postural control measures. Self-report symptoms demonstrated the greatest changes of all outcomes variables, with large negative effects noted both immediately after concussion and during the follow-up assessment. These findings reiterate the recommendations made to include neurocognitive measures, postural control tests, and symptom reports into a multifaceted concussion battery to best assess these injuries.

Keywords: [patient-oriented evidence](#), [POEM](#), [clinical outcomes](#), [children](#)

Tamara C. Valovich McLeod, PhD, ATC, provided conception and design; analysis and interpretation of the data; and drafting, critical revision, and final approval of the manuscript.

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