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Biopsychosocial characteristics and neurocognitive test performance in National Football League players: An initial assessment

Gary S. Solomon [a,*], Richard F. Haase [b]

[a] *Psychiatric Consultants, P.C., 310 25th Avenue North, Suite 309, Nashville, TN 37203, USA*
[b] *The University at Albany, State University of New York, Albany, NY, USA*

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Abstract

The use of neurocognitive testing in the assessment of professional athletes sustaining sports-related concussions has become widespread over the past decade. Baseline neurocognitive testing is now a requirement for athletes in the National Football League (NFL). We present preliminary normative data on a computer based neurocognitive test (Immediate Post Concussion Assessment and Cognitive Testing; ImPACT) for 159 NFL athletes. Also included are summary data on basic biopsychosocial characteristics, including medical, psychiatric, chemical dependency, concussion, learning disability/attention deficit disorder, and symptom variables, and the relevance of each to baseline neurocognitive test scores.

Keywords: Neurocognitive testing; Sports concussion; Mild traumatic brain injury; ImPACT; Professional football athletes

1. Introduction

Since the initial efforts by Barth and colleagues at the University of Virginia in the late 1980s (Barth et al., 1989), neuropsychological testing has gained widespread acceptance as a valid strategy for assessing the cognitive effects of sports-related concussion. There now exists a wealth of studies attesting to the utility of neurocognitive testing in the assessment of sports-related concussion (Echemendia, 2006; Lovell, Echemendia, Barth, & Collins, 2004). Clinical researchers and scientists are now focusing efforts on addressing possible demographic and biopsychosocial variables that may affect baseline neurocognitive test scores in various athletic groups. Brown, Guskiewicz, and Bleiberg (2007) recently investigated the effects of sex, SAT scores, level of alertness, and type of sport on NCAA collegiate athletes' baseline neuropsychological test scores. Using the Automated Neuropsychological Assessment Metrics sports medicine battery (ANAM, originally developed and published by the Army Medical Research and Materiel Command, Fort Detrick, MD), Brown and colleagues found that sex, SAT scores, and alertness level had differential effects on various baseline scores (for a more complete discussion of the ANAM sports medicine battery, see Cernich, Reeves, Sun, & Bleiberg, 2007).

* Corresponding author. Tel.: +1 615 250 6784; fax: +1 615 250 6782.
E-mail address: Gssolomon1@yahoo.com (G.S. Solomon).

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In the general population of young adults, epidemiologic studies have shown prevalence rates of about 4% for attention deficit disorder (ADD; cited in Wilens, Faraone, & Biederman, 2004), 6% for a serious psychiatric illness (NIMH, 2008), .5% for a seizure disorder (Sander & Shorvon, 1996), 26.6% for any substance abuse/dependence (Kessler et al., 1994), and 13–16% for headache (Duckro, Tait, & Margolis, 1989; Kryst & Scherl, 1994). According to the fourth edition of the *Diagnostic and Statistical Manual* of the American Psychiatric Association, the prevalence of learning disabilities ranges from 2% to 10% "... depending on the nature of ascertainment and the definitions applied." (American Psychiatric Association, 1994, p. 47). The Centers for Disease Control reported a prevalence rate of 1.56 million concussions resulting in emergency department visits, hospitalization, and/or death in the United States in 2003, which translates to a base rate of 538.2 concussions per 100,000 individuals (CDC, 2008). It is safe to say that the prevalence of sports concussion is not truly known, given that many concussions are unrecognized, un- or under-reported, or treated by certified athletic trainers, primary care physicians, and other medical specialists in the office setting.

Studies from the sports concussion literature have shown that age (Pellman, Lovell, Viano, & Casson, 2006), gender (Covassin, Swanik, & Sachs, 2003), learning disability/attention deficit disorder (Collins et al., 1999), headache status (Mihalik et al., 2005; Register-Mihalik, Guskiewicz, Mann, & Shields, 2007), and concussion history (Broglio, Ferrara, Piland, & Anderson, 2006; Collie, McCrory, & Makdissi, 2006; Iverson, Brooks, Lovell, & Collins, 2006; Moser, Schatz, & Jordan, 2005) may have effects on baseline and postconcussion neurocognitive performances. What is lacking at present is a study assessing the potential effects of various demographic and biopsychosocial factors on neurocognitive performance in professional football players, as the bulk of studies to date (including those listed above) have focused on high school and collegiate athletes.

Given that routine baseline neurocognitive testing of professional athletes is a relatively recent phenomenon, very few normative studies of this population exist, and even less information is available as to the potential effects of demographic and subjects factors on baseline neurocognitive test performance. Pellman, Lovell, Viano, Casson, and Tucker (2004) presented normative data for National Football League (NFL) athletes on paper and pencil neurocognitive tests. Their study was focused on the utility of these tests in assessing neurocognitive changes post-concussion in a convenience sample of professional football players. The tests included the Hopkins Verbal Memory Test, the Brief Visuospatial Memory Test-Revised, Trail Making Tests Part A and B, Controlled Oral Word Association Test, the Digit Span subtest from the Wechsler Adult Intelligence Scale-III and the Symbol Digit Modalities Test. The number of subjects for each test ranged from 155 to 646. The authors noted a mean age of 25.4 years (range of 20–44, with a median of 24 years). A subset of athletes ($n = 95$) who incurred a concussion and had follow-up neurocognitive testing was available. Athletes were grouped into those with a reported history of three or fewer concussions and those with fewer than three concussions, but overall concussion rates were not provided. Similarly, little else was reported in terms of demographics or other biopsychosocial variables of those athletes who underwent baseline testing or baseline testing plus post-concussion testing. In a follow-up paper, Pellman et al. (2006) reported on 68 NFL (and 125 high school) athletes who underwent baseline and post-concussion neurocognitive testing with a computer based program (ImPACT—Immediate Post Concussion Assessment and Cognitive Testing; Lovell et al., 2002). Again, the focus of the study was to assess the utility of a computerized platform in the assessment of concussed high school and professional football players who had undergone baseline cognitive testing. Theses athletes ranged in age from 20 to 34 (mean = 24.3), years of education ranged from 14 to 22 (mean = 15.8), and number of prior concussions ranged from 0 to 4 (mean = .65). Baseline ImPACT raw scores were presented (along with ImPACT scores for two post-concussion follow-up assessments), and are, to our knowledge, the only published normative data on computerized neurocognitive test performance for NFL athletes. It should be noted that normative ImPACT data for high school athletes (mean age = 16.5 years, S.D. = 2.3, and mean education = 10.4 years, S.D. = 2.0) has been published by Schatz, Pardini, Lovell, Collins, and Podell (2006), and for a mixed high school (71%) and collegiate sample (mean age = 17.3 years, range = 14–22, and mean education = 10.9 years, range 8–16) by Van Kampen, Lovell, Pardini, Collins, and Fu (2006).

At the time of the above referenced studies of Pellman et al. (2004, 2006), neuropsychological testing was a "recommended" but not a mandatory requirement in the NFL. On June 19, 2007, the NFL held a "Health and Safety" meeting in Chicago, and was attended by NFL team physicians, certified athletic trainers, other team medical personnel, NFL League Office representatives, and members from the NFL Players Association (Cason, Viano, & Pellman, 2008). In addition, expert presenters from the fields of neurology, neurosurgery, neuropsychology, neuroradiology, sports medicine, biomechanical engineering, and athletic training participated in the discussion of mild traumatic