Identifying Dyslexia Risk in Student-Athletes: A Preliminary Protocol for Concussion Management

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Learning disability (LD) has been identified as a potential risk factor for a sport-related concussion, yet students with LD are rarely included in concussion research. Here, we draw special attention to dyslexia, a common but often underdiagnosed LD. Reading and learning problems commonly associated with dyslexia are often masked by protective factors, such as high verbal ability or general intelligence. Hence, high-achieving individuals with dyslexia may not be identified as being in a high-

risk category. To ensure that students with dyslexia are included in LD concussion research and identified as LD in baseline testing, we provide athletic trainers with an overview of dyslexia and a preliminary screening protocol that is sensitive to dyslexia, even among academically high-achieving students in secondary school and college.

Key Words: learning disability, self-report, screening assessment, neuropsychological tests

Key Points

- Dyslexia is a risk factor for sport-related concussion.
- Current methods of identifying dyslexia in student-athletes are potentially problematic.
- Reading fluency and rapid-naming tests are sensitive to detecting dyslexia through early adulthood. Adding these standardized measures to preseason assessments would improve identification efforts.

A number of organizations, including the National Athletic Trainers' Association, have identified learning disability (LD) as a potential complicating factor in concussion management.^{1–3} Learning disability is associated with an increase in the lifetime prevalence of concussion.^{4,5} Evidence that LD status has an additive effect on concussion recovery in students with a history of multiple concussions has also been noted in at least 1 widely cited study.⁶ Additional research is needed to explore reasons why students with LD are at risk for sustaining concussions. Until then, athletic programs are called upon to identify athletes with LD during preseason testing^{1–3} so that, in the event of a concussion, identified students would receive appropriate educational accommodations, as indicated by existing return-to-class decision protocols that outline specific procedures for students with LD.⁷

To that end, the purpose of this report is to assist clinicians in identifying risk factors associated with dyslexia, the most common type of LD. We provide an overview of dyslexia, discuss unique challenges programs may face when identifying the dyslexia risk in high-achieving students, and close with recommendations for improving current screening methods.

Defining Dyslexia

Dyslexia is a neurodevelopmental disorder affecting approximately 7% of the general population.⁸ Although dyslexia is slightly more prevalent in males, females with dyslexia are twice as likely to be undiagnosed.⁸ The primary symptoms of dyslexia are poor reading and

spelling. Dyslexia commonly co-occurs with attention-deficit/hyperactivity disorder (ADHD) and specific language impairment. A popular misconception is that dyslexia results from a visual disturbance that causes an individual to “see words or letters backwards.”^{9,10} However, it is now widely acknowledged that dyslexia is caused by a cognitive deficiency in phonological processing.^{11,12} This deficit is not related to general intelligence and ranges from mild to severe, even in students with high IQs.¹³ The phonological-processing deficit is most detrimental to academic skills related to reading and writing but also affects other aspects of language and learning. Nonreading problems, such as difficulty retrieving known words (*anomia*), mispronunciation of complex or multisyllabic words, poor handwriting (*dysgraphia*), and poor math skills (*dyscalculia*), are common. Cognitive performance on working memory, executive function, and processing speed tasks is often impaired.^{14–16} Because the majority of the cognitive measures used to assess concussion impairment also tap these functions, it is not surprising that athletes with dyslexia perform worse than their peers on preseason computerized neuropsychological (NP) tests.¹⁷

Dyslexia is an inherited, lifelong disorder and cannot be “outgrown.”¹⁸ However, the behavioral manifestations of dyslexia often change over the course of schooling in response to changing academic demands; some problems improve, while others may worsen or reappear.¹¹ For example, handwriting and spelling deficits in the early school grades may become less noticeable in high school as students transition from pencil-and-paper output to computers. Deficits in phonological processing, manifesting in

elementary school as reading and spelling problems, may resolve with proper intervention, only to resurface in high school or college as difficulty learning a foreign language.

Compensated Dyslexia

Approximately 24% of individuals diagnosed with dyslexia are able to achieve reading comprehension skills that are commensurate with nondyslexic peers.¹⁸ The term *compensated dyslexia* is used to describe these people because they use strengths in other areas to compensate for deficits in phonological processing. Compensation has been linked with the brain's ability to forge new neural pathways for reading, although the exact mechanisms of compensation are not fully understood.¹³ Dyslexia is underidentified in this population because the primary cognitive deficit associated with dyslexia—phonological processing—does not manifest as an overt problem with reading or learning. Rather, the most pervasive deficit in compensated dyslexia is slow reading.^{11,19} Individuals with compensated dyslexia frequently remain in mainstream classes and attend higher education institutions. Dyslexia can be masked by strengths in vocabulary and intelligence, making it especially difficult to identify in high-achieving individuals.¹³ Students with compensated dyslexia are less likely to seek a formal diagnosis and are therefore less likely to self-identify or to be aware of their own risk.²⁰

Problems With Diagnostic Labels and Self-Reporting

Identification of dyslexia is problematic for a number of reasons. Diagnostic terminology for dyslexia is highly inconsistent across states and school districts as well as between clinical and educational settings.²¹ Also, participation in special education classes is known to be a poor indicator of LD.²¹ Although dyslexia is the most common type of LD,²² students with learning and attention problems in the general population are more likely to self-identify as "LD" than as "dyslexic."²³ At the postsecondary level, 10% of the total student body was registered with the disabilities office.²² Of those, 31% had LD and 18% had ADHD, yet to our knowledge, no reports have indicated the number of students with dyslexia, LD, or ADHD participating in high school or collegiate sports programs. Questionnaires that include numerous indicators have been shown to reliably predict the presence of dyslexia.^{24–26} However, current protocols for most sports programs request that students self-identify by checking a single box. Whether these self-reporting methods are reliable or valid is unknown.²⁷

Additionally, a potential problem for athletic programs is intentional nondisclosure of dyslexia, and this may be especially problematic in postsecondary students. Many students with dyslexia have faced formidable challenges in school, both academic and social-emotional,¹¹ and may see college as a fresh start and a chance to leave the stigma of their dyslexic identity behind. A recent survey²³ of 1221 graduating high school students with LD found that more than half of the respondents needed academic accommodations in college, but only 26% requested these services once they arrived on campus.

Whether they receive academic accommodations through a 504 Plan or not, college students are under no legal obligation to disclose their diagnosis to their academic

advisors, instructors, or coaches. Similarly, school faculty cannot legally ask a student why he or she is in need of academic accommodations.^{28,29} With regard to student-athletes, disclosure of LD or dyslexia during preseason baseline testing for the purposes of concussion management is neither required nor encouraged by the National Collegiate Athletic Association.³⁰ In fact, documentation of an education-impacting disability is required only when students are taking additional course work after high school graduation.³⁰ Moreover, documentation for an education-impacting disability is required only at Division I schools.³⁰ Considering that students with LD attend 2-year colleges at twice the rate of the general population,³¹ these concerns have particularly important implications for community college athletic programs.

Screening Protocol

In order to develop appropriate concussion-management guidelines for student-athletes with dyslexia, more research is critically needed. In the meantime, clinicians can be vigilant about detecting risk factors for dyslexia by adding a few short tasks to current baseline assessments.

Questionnaires. An easy first step toward improving identification efforts is to include more thorough questioning with regard to dyslexia risk factors. A number of questionnaires have been created that capture the classic symptoms of dyslexia and dyslexia-associated traits (eg, problems with organization, word finding, attention) in adolescents and adults.^{32–34} Overall, self-report of these traits correlates well with measures of reading and spelling, and self-report inventories can be used as reliable indicators of dyslexia in college-aged students.^{25,26} Because validity, sensitivity, and specificity have been previously established for adults,^{25,26,34} we recommend these inventory methods over current, single-question methods. Links to 2 free questionnaires^{32,33} are provided in the References section of this paper. In our program, we identify student-athletes as *at risk* if they voluntarily (a) self-identify as having a previous diagnosis of LD or dyslexia on the baseline demographic questionnaire or (b) check more than 9 symptoms on a more extensive dyslexia self-report inventory.

Oral Reading Fluency and Rapid Automatized Naming Tasks. Two tasks widely used in dyslexia research and clinical practice can also be added during baseline testing. These tools tap deficits that are persistent and stable in adolescents and adults. These instruments include normative data for students through college age. The tests require B-level qualifications (ie, master's degree), meaning the tests can be purchased and used by the same licensed health care providers who administer computerized NP and sideline tests. Procedural safeguards provided in the Individuals with Disabilities Education Act²⁸ and Section 504 of the Rehabilitation Act²⁹ stipulated that adults and the parents or guardians of minors must give informed consent to the screening. It is important to note that the purpose of administering these tests is not to diagnose dyslexia but to identify individual differences in cognitive processing that are commonly associated with dyslexia. Slow performance on reading and naming tests, such as those included in this protocol, often indicate neurologic differences commonly associated with dyslexia.

These screening tools, along with the selection rationale, are described in the next sections.

Oral Reading Fluency. *Reading fluency* is typically defined as the number of words one is able to read correctly in a given time limit. Correctness is crucial to the calculation. Slow word reading is a clinical marker for dyslexia, especially in adolescents^{11,14} and in college students with compensated dyslexia.¹⁵ Reading fluency does not respond well to treatment¹¹ and begins to plateau at around eighth grade. Together, these factors make reading fluency a particularly stable measure in older adolescents and young adults.

A widely used, commercially available test that could be used clinically to measure word reading speed is the Test of Word Reading Efficiency.³⁵ Normative values are available for students ages 6 through 24 years. Students are asked to read the vertical list of words on a single page as fast as possible within a 45-second time limit, and the participant is timed with a stopwatch. Inaccurate responses are discarded, so the total score reflects only correctly read words. Test-retest reliability for adolescents and adults ranges from 0.83 to 0.92.

Rapid Automatized Naming. Rapid automatized naming (RAN) is commonly used in reading research as well as in clinical and educational assessments. For this task, participants are asked to name an array of repeating stimuli (colors, pictures, letters, or digits) across a page. Performance on RAN aligns with deficits on timed tasks of word reading efficiency but does not require reading.³⁶ This deceptively simple task separates dyslexic from nondyslexic groups in multiple languages, even after controlling for general processing speed.³⁶ The RAN format is similar to that of the King-Devick test, which is used in some athletic programs as a sideline screen for concussion management. The King-Devick test taps visual processing, whereas the RAN is thought to measure not only visual processing but also the phonological retrieval speed of words stored in long-term memory.³⁷

Rapid automatized naming circumvents many of the identification challenges noted earlier. First, it is an excellent test for identifying underlying phonological deficits in participants with compensated dyslexia. In dyslexia, RAN deficits are pervasive and stable and persist in adolescents and adults, even after reading remediation.³⁸ Compared with typically developing peers, slower RAN times were also reported for highly accomplished university students with childhood histories of reading impairment.^{12,39} Evidence also showed that individuals with normal reading ability but with family histories of developmental dyslexia had slower RAN times than readers with no such history.¹⁶

Performance on RAN was generally unassociated with overall intelligence.^{12,16} Performance on the digit and letter versions of RAN reaches asymptotic levels by at least age 16 years; thus, task performance should be stable in college-aged students.⁴⁰ A widely used version of the RAN task is included in the Comprehensive Test of Phonological Processing-2 (CTOPP-2).³⁷ The CTOPP-2 is commonly included in test batteries used by speech-language pathologists, reading specialists, and educational psychologists, and the subtests can be administered in less than 1 to 2

minutes. The average alternate-form reliability of this test is 0.92.³⁷

In our pilot program, we identify students as *at risk* if they perform below the 16th percentile on 2 of 3 timed tests of naming or reading. For individuals aged 17 through 25 years, the 16th percentile corresponds to a cutoff score of >15 seconds on the digit- and letter-naming tests of the CTOPP-2 and a score of <84 sight words in 45 seconds on the Test of Word Reading Efficiency.³⁵ Again, we emphasize that the purpose of this screening is not to inform concussion diagnosis but to improve efforts for identifying athletes who may need vigilant monitoring in the case of a concussion.

Implications for Practice

During baseline NP testing, athletic trainers and academic support staff should ensure that student-athletes understand the importance of providing complete and accurate demographic information regarding dyslexia, LD, or ADHD status and concussion history. Clinicians should emphasize that the purpose of gathering this information is to protect the health and safety of the student's brain. As with all preseason baseline testing, students should be assured that demographic information and test results will not be used to make educational diagnoses or day-to-day academic or athletic-play decisions, except in the unlikely but serious event of a concussion. The screening protocol can act as a second step in identifying "under-the-radar" students with dyslexia risk factors who may be vulnerable to complications but are not identified on demographic screens. Because NP testing is twice as likely to be invalid in students with LD,²⁷ this additional information can also help to differentiate between an inadequate effort ("sandbagging") and true outlier performance.

For postconcussion management, students with LD/dyslexia should be managed conservatively.¹⁻³ In addition to delaying play until physical symptoms and NP test results return to baseline, clinicians must ensure that gradual return-to-class protocols are followed and that cognitive symptoms (eg, cognitive fatigue) are closely monitored. Understanding that all language processing (reading, writing, speaking, listening) is cognitively taxing for students with dyslexia, regardless of their academic achievement levels, athletic trainers and academic support staff should advocate for immediate academic accommodations, including reduced homework.

Challenges and Future Directions

The time and cost associated with purchasing additional tests and finding qualified personnel to administer them and interpret the results are important considerations. Logistics may be especially challenging in smaller athletic programs with limited resources, but as we pointed out, LD students are twice as likely to attend smaller schools.³¹ Institutions will need to weigh such costs against the value of the potential benefits. A cost-effective initiative for a collegiate program of any size would be to simply add a more thorough dyslexia questionnaire, which is both free and easy to score. An additional challenge is how to best handle confidentiality, notification, and follow up. As in other baseline testing

programs, these concerns will need to be coordinated by qualified personnel within the confines of existing institutional procedures. These issues will be especially important for student-athletes who are still minors. For example, the Zurich guidelines suggest that assessments of minors, and especially those with LD or ADHD, should be supervised by psychologists or neuropsychologists specializing in pediatrics.³

Finally, more research in this area is critically needed. To date, few authors⁴¹ have differentiated the effects of LD, dyslexia, and ADHD on concussion risk and recovery. Because athletic trainers are on the front lines of identification and managing concussions, they can play a crucial role in advancing research efforts.

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