How Evidence on the Developmental Nature of Attention-Deficit/Hyperactivity Disorder Can Increase the Validity and Utility of Diagnostic Criteria

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In this issue of the *Journal,* Vande Voort *et al.*[1] report the implications of extending the age of onset of attention-deficit/hyperactivity disorder (ADHD) symptoms from 7 to 12 years of age, as stipulated by the *DSM-5,* using retrospective reports by parents.

The age-of-onset criterion, first introduced in the *DSM-III,* has been one of the most controversial aspects of ADHD diagnosis, essentially because there is no body of knowledge to support 7 years of age as the developmental frontier that distinguishes whether new-onset symptoms are primary to ADHD or secondary to another condition.[2] As the *DSM* was updated, defining a specific age limit to symptom onset became reified. The *DSM-IV* created further confusion by changing "onset of symptoms" to "onset of symptoms producing impairment." In addition to the question of criterion validity, questions about reliability arose. Studies after the introduction of the *DSM-IV* showed that parents have poor ability to recall the onset of their child's symptoms.[3] One study reported that 46% of children initially diagnosed with ADHD who continued to meet criteria at 5-year follow-up were no longer recognized as having presented symptoms before 7 years of age.[4] Even more concerns about the age-of-onset criterion were raised as ADHD increasingly became viewed as a chronic disorder affecting adults. Most adults with ADHD never received a childhood diagnosis. These adults are asked to recall symptoms that occurred decades ago, frequently with no corroborating informants available. This situation creates obvious difficulties in establishing the diagnosis.[5] Subsequent evidence has suggested that ADHD without evidence of onset before 7 years of age is a valid diagnosis.[5,6]

As empirical evidence about the fragility of the age-of-onset criterion accumulated, suggestions were made that the *DSM-5* should extend the age of onset from 7 to 12 years.[7] On the one hand, the 12-year cutoff was expected to preserve the nature of ADHD as a neurodevelopmental disorder with childhood onset; on the other hand, the 5-year extension was expected to benefit the assessment of adults by shortening the recall period. One concern was that this modification would result in a large number of individuals with false-positive results who are not affected by ADHD but who present inattentive or hyperactive symptoms secondary to environmental stressors, academic problems, or other mental disorders. In 2010, we reported an investigation of the impact on the prevalence of extending the age limit to 12 years.[8] We used the E-Risk Study, a birth cohort of 2,232 British children who were prospectively evaluated at 7 and 12 years of age for ADHD using information from mothers and teachers. Only 2 children who fulfilled the diagnostic criteria for ADHD presented new-onset symptoms after 7 years of age according to mothers and teachers. Thus, extending the onset age to 12 years resulted in an absolute increase of 0.1%, or a relative increase of only 3% in the prevalence rate. In addition, children with different ages of onset showed similar patterns of clinical and cognitive features and risk factors.[8] This study showed that there are virtually no children with a full ADHD diagnosis at 12 years old whose mothers or teachers had not reported symptoms at or before 7 years of age, supporting the nature of ADHD as a disorder that begins early in life. What our study did not address is the modification of prevalence rate when onset of symptoms is assessed through parents'

retrospective recall, i.e., when children are older than 12 years, their symptoms were not assessed at younger ages, and there is no additional information from school.

The study of Vande Voort *et al.*[1] addresses the question of prevalence rates and validity of the ADHD diagnosis when parents retrospectively report symptoms. The investigators analyzed data from the National Health and Nutrition Examination Survey, a nationally representative sample of US children and adolescents. Analysis included 1,894 participants who were 12 to 15 years old and therefore had the opportunity to have new occurring symptoms from 7 and 12 years of age. To assess ADHD, lay research assistants interviewed parents using the Diagnostic Interview Schedule for Children-IV. Two 12-month prevalence rates of ADHD were generated from the same criteria, except that one required symptoms causing impairment before 7 years of age (according to the *DSM-IV*) and the other required symptoms before 12 years of age (according to the *DSM-5*). Prevalence rates were 8.7% and 10.84%, respectively, representing a 47% relative increase in prevalence for the *DSM-5*. Comparisons of subgroups of children with ADHD based on age of onset ("early onset," up to 7 years of age; "late onset," 7 to 12 years of age) showed no differences in sex or age distribution. Children in the early-onset group were more likely to be white (non-Hispanic) and from higher-income families than children in the late-onset group. Subgroups did not differ in the frequencies of ADHD subtypes, comorbid disorders, or severely impaired cases. Children with a combined subtype and early onset were more symptomatic compared with those with the same subtype but late-onset symptoms. Rates of treatment and medication use were generally not significantly different between the 2 subgroups, but the late-onset group had less treatment, as expected. An exception was the children with the hyperactive-impulsive subtype whose treatment rate did not vary by onset age. Analysis included a final number of 163 participants with ADHD, limiting the statistical power of specific comparisons.

This new study contributes to the field by showing that extending the age-of-onset criterion increases prevalence when retrospective recall of onset of symptoms is required. A note of caution is necessary: only parent-reported symptoms were investigated, and a more modest prevalence increase could have been found if teachers had been interviewed. However, the prevalence rate per se should not be the main focus of concern. More important is whether children impaired by the disorder are correctly identified by the new criterion. The study shows that the same proportion of severely affected cases are found in the 2 age-of-onset subgroups, suggesting that the extension of age limit aids recognition of children in need of care. Nonetheless, if we assume, based on results from the E-Risk Study, that there are virtually no children with full ADHD diagnostic criteria at 12 years of age who did not present any symptom at or before 7 years of age, this new study has important implications for recognition of ADHD. In other words, "late-onset cases" are likely simply to be "late-recognized cases." Interestingly, these children are more likely to be from non-white ethnic backgrounds and from lower-income families. In this respect, extending the age limit to 12 years may especially benefit children with ADHD from less advantageous home environments and poorly resourced schools, whose symptoms are recognized later during development, after a longer period of functional impairment.

Studies relying on retrospective recall of symptoms are important because they reflect what happens in clinical assessments. However, several studies have reported the limitations of retrospective assessment of age of onset of ADHD[3,4,7] and of several other mental disorders.[9,10] Retrospective recall risks under-detection because individuals forget childhood symptoms, but it also may risk over-detection.[11] In the Dunedin Study, 1,000 18-year-olds who had just completed a diagnostic interview for ADHD were asked to retrospectively rate their hyperactivity when they were in elementary school. These retrospective ratings were compared against archived prospective reports of hyperactive symptoms by parents, teachers, and study children; correlations were near 0 and nonsignificant. Among cases of disagreement, half the 18-year-olds believed they had not been overactive as a child, despite having been diagnosed previously with combined-type ADHD by the study. However, the other half of the 18-year-olds believed they had been a problem hyperactive child despite no evidence of hyperactivity from repeated parent, teacher, or self-reports recorded during childhood.[11] Retrospective recall of onset age generates false-positive and false-negative results.

Studies aggregating prospective assessments and retrospective reports are needed to address

the utility and validity of the new age-of-onset criterion. Longitudinal studies are necessary to replicate the finding that there are virtually no ADHD cases with new-onset symptoms from 7 to 12 years of age. If there are true new-onset cases at 7 to 12 years of age, the validity of the diagnosis for this late-childhood onset group should be investigated, including neurobiological and genetic comparisons. If late-onset childhood cases are rare, then comparing cases discordant (and concordant) for retrospectively and prospectively reported symptoms will help to assess the utility of the age-of-onset extension. Moreover, longitudinal studies should monitor throughout development individuals with new-onset symptoms, and those with ADHD whose first symptoms are noted in adolescence or adulthood should be described. In this way, it may be possible to identify the most appropriate age limit for the diagnosis of ADHD. In addition, in view of the difficulties of diagnosing ADHD in adulthood and the public concerns about overdiagnosis of the disorder, improved clinical methods are needed to augment accurate recall of childhood symptoms. These studies will be essential to integrate data about the developmental nature of the disorder into diagnostic criteria that are valid and useful. &

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