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ADHD grows up

ADHD is the most common neurodevelopmental disorder in children, yet despite a large increase in awareness and in the number of diagnoses, much less is known about how this disorder affects adults. More research is needed to understand how ADHD may present differently as a function of age or how the experience of ADHD may change in people as they age.

It has been nearly 20 years since the Time Magazine cover exclaimed "Disorganized? Distracted? Discombobulated? Doctors Say You May Have Attention Deficit Disorder — It's not just kids who suffer from it." Wresting the attention deficit label away from 'youngsters', news outlets introduced the general public to the notion that this disorder could also be experienced in adulthood. The intervening decades have seen the name of the disorder changed from 'attention deficit disorder (ADD)' to the present moniker 'attention-deficit/hyperactivity disorder (ADHD)' and refinement of the definition, which has been expanded to include three main types: inattentive, hyperactive/impulsive, and combined presentation. There has been notable progress in clinical characterization, as well as in identifying some of the neurobiological pathways that are probably involved, yet there is much about ADHD that is not well understood, particularly about the disorder in adulthood.

One likely explanation for the gaps in knowledge about ADHD in adults is that it has long been classified as a neurodevelopmental disorder that emerges during childhood. It is certainly the case that the experience of symptoms of ADHD in childhood can profoundly interfere with social and academic activities and development. Estimates of ADHD prevalence can vary substantially by age group, gender and socioeconomic factors, which suggests that adverse social determinants, such as poverty, can increase risk and lead to poorer outcomes. Recent nationally representative data from the United States indicate that 11.3% of children and adolescents 5–17 years of age had received a diagnosis of ADHD (C. Reuben & N. Elgaddal. *National Center for Health Statistics* https://doi.org/10.15620/cdc/148043; 2024). By contrast to high-income countries such as the United States, however, global data indicate that closer to 5% of children and adolescents are affected by ADHD.

Determining the prevalence for ADHD in adulthood is even more challenging. Population-based estimates place the prevalence between 2% and 7%. Yet there are indications that in the United States, for example, the prevalence may be higher and climbing. The demand for diagnosis and treatment of ADHD in adults has surged, possibly because of an exceptional increase in public awareness. Interaction with digital and social media provides multifaceted exposure to direct-to-consumer marketing for medications, the proliferation of telehealth organizations offering diagnosis and treatment services, apps that incorporate artificial intelligence technology as attentional and productivity aids, and highly viewed video content featuring lived experience ADHD influencers.

Although the longer-term consequences of the greater visibility of ADHD are unknown, it has prompted more scrutiny about how and in whom ADHD is diagnosed. For both children and adults with ADHD, in addition to psychotherapy or behavioral therapy, the current standard of care includes medication, typically stimulants. For the past 2 years, the United States has seen widespread shortages of stimulants, including Adderall (amphetamine and dextroamphetamine) and Ritalin (methylphenidate), in part because of pandemic-related supply-chain issues, in addition to limitations imposed by the Drug Enforcement Agency, which regulates the production of controlled substances. Measured by the number of stimulant medications filled as a proxy for ADHD diagnoses, prescriptions for groups such as girls and women between 15 and 44 years of age increased by more than 10% between 2020 and 2021 alone (M. L. Danielson et al. *MMWR Morb. Mortal. Wkly. Rep.* **72**, 327–332; 2023).

Despite the large and rapid increases in ADHD diagnoses in adults, accompanied by calls to re-evaluate stimulant prescription policies, there are no clinical recommendations for diagnosing adults thus far. A diagnosis of ADHD in an adult by the most recent DSM criteria is contingent on the presence of ADHD symptoms during childhood. Indeed, DSM-5-TR indicates that "ADHD begins in childhood." But it does not necessarily end there — about two thirds of children with ADHD have symptoms that persist into adulthood. Other recent work challenges the assumption that the disorder can begin only in childhood or adolescence. Longitudinal data suggest that there may be at least three sets of cases of ADHD that can be distinguished by when symptomatology emerges: ADHD with onset in childhood, ADHD with onset in childhood that persists into adulthood, and ADHD with no childhood history. Although these distinctions are under debate because of factors such as retrospectively self-reported symptoms or the potential of sub-threshold symptomatology that is exacerbated by the experience of stressors in adulthood, the question remains of whether childhood ADHD is a distinct entity from ADHD that may be diagnosed in adulthood. Other critiques of the diagnostic criteria of ADHD in adults suggest that they fail to encompass some of the potential differences in presentation, such as more substantial subjective impairment and emotional dysregulation. The results of efforts to produce clinical guidance and diagnostic tools designed for primary care practitioners and mental health specialists, led by the American Professional Society for ADHD and Related Disorders Association, are likely to be released sometime in 2024.

Other limitations apply to the existing research investigating the neurobiological bases of ADHD. For example, relatively fewer studies have been conducted that have identified structural and functional differences in brain imaging associated with ADHD than for

other psychiatric disorders, such as depression. Many of these studies of ADHD have been conducted exclusively with children or adolescents. Because of the cascade of developmental changes that occur in the brain during maturation, compounded by the high degree of heterogeneity in ADHD symptom presentation, it is an open question whether neurofunctional and neuroanatomical differences that may be associated with childhood ADHD are representative of ADHD in adulthood. Much more work also needs to be done to identify consistent brain signatures and biomarkers associated with ADHD, irrespective of the age of onset.

In this issue of *Nature Mental Health*, work from Parlatini and colleagues seeks to provide some answers and some intriguing new insights into the neurobiology of ADHD in adults and how these differences may underlie response to medication treatment. Using a longitudinal design, the study assessed cortical anatomy with structural magnetic resonance imaging in adults with ADHD compared with that of matched neurotypical control participants. The authors then examined whether regional brain differences were associated with the response to methylphenidate, finding that the brains of people with ADHD who did not respond to treatment were characterized by reduced volume and thickness mainly in temporo-parietal areas that are implicated in attentional control. These findings indicate potential brain-based targets for future exploration.

Although not everyone with ADHD responds positively to medication, there is substantial evidence indicating that pharmacological and psychosocial treatments can be effective in managing symptoms in both children and adults. 'Management' is the operative word, as ADHD is not a curable condition but is a chronic condition that may require continued treatment over time. There is, however, little research about how best to provide support for youth with ADHD as they navigate the transition to adulthood. In a Review in this issue, Bui and coauthors present both the challenges of helping young people with ADHD cultivate self-management as they become adults, and possible supportive scaffolding that parents and caregivers can provide to achieve this. The piece highlights the incorporation of strategies such as motivational interviewing and environmental restructuring, but also emphasizes the need to tailor these approaches in socioeconomically and culturally meaningful ways.

As a means of better curating the work that has been published in *Nature Mental Health* and to track the progress made in unpacking some of the crucial questions about ADHD, we are pleased to announce the launch of a new Collection of papers, including primary research and commentary. We hope it will serve as a living repository for ADHD-focused content, and for researchers, clinicians and people with ADHD, and although limited now, we hope that understanding and management of the disorder will continue to grow.

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