Modern Concepts of ADHD
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Introduction

My subject is ADHD – attention-deficit/hyperactivity disorder.

I'm going to discuss:

- how it is recognised and diagnosed
- whether that should change in the light of recent thinking,
- what underlies it
- whether its definition should change

I want to make specific comments on how

- adults with ADHD differ from children,
- females differ from males,
- to what extent it is appropriate to regard people with ADHD as having a medical condition.

What it is

- ADHD is a *listed diagnosis* in the major medical diagnostic systems.
- Its name has changed over time but children who are hyperactive and have poor concentration have been recognised for over a century and successful medical treatment has been employed for over 80 years.
- It's persistence into adulthood has been known for over 40 years and formally recognised in the UK for 14 years (NICE 2009)
- It causes substantial distress to people who have the diagnosis and to those around them. By definition it is associated with impaired personal functioning in schools, workplaces, families and society generally.
- It costs a country because of the burden on education services, the prison service, health services, unemployment and poor productivity, families, and accidents. The national burden of the condition in wealthy countries runs into billions of dollars (Chhibber et al 2021). Medical costs are only a small proportion of this.

How the diagnosis is made

To have a diagnosis of ADHD a person has to be

- excessively hyperactive,
- impulsive (in the sense of suddenly responding to a situation without forethought in a rash or dangerous manner)
- show poor concentration and self-organisation on tasks they are set by others. ADHD was initially recognised in childhood and children with ADHD are noisy, restless, excitable, impatient and cannot settle easily to classwork or quite tasks around the home.

In order to make systematic sense of these characteristics, lists of features exist. The classic American lists, very widely used at present are two, each of 9 items.

Inattention: longstanding, excessive and across situations

1. Poor attention to detail/careless mistakes
2. Can't maintain attention/remain focused
3. Appears not to be listening
4. Doesn't complete tasks, easily sidetracked
5. Disorganised/messy/can't meet deadlines
6. Avoids tasks needing concentration
7. Loses things
8. Easily distracted
9. Forgetful in everyday tasks

Hyperactive/impulsive: longstanding, excessive and across situations

1. Fidgets/squirms in seat
2. Leaves seat when shouldn't
3. Runs/climbs
4. Noisy
5. On the go/can't stay still
6. Talks too much
7. Blurts out answers too quickly
8. Can't wait
9. Interrupts/intrudes on others

For classic (combined) ADHD there must be 6 (for children) or 5 (for age 17 and over) items on each list.

All these items are common failings in normal people, so for ADHD, they have to be

- persistent and present for more than six months
- frequent and severe,
- inappropriate for age.
- present in more than one situation.
- not explained by any other condition

Importantly, there also *has to be impaired functioning* (personal, social or academic). Just being excessively active, impulsive and inattentive is not enough – it has also to be disabling so that the individual cannot rise to the level of functioning expected of them. Because *the features of an ADHD pattern shade into the general population, it is impaired functioning that provides a diagnostic cut-off.*

When we make these two decisions –

1. are there enough symptoms (5-6 items on both lists)
2. impaired functioning,

then the rate of ADHD in the population comes out at about

- 5% for children,
- 2.5 % for young adults and
- 1% for middle-aged and older adults

There's no standard mix and no two individuals with ADHD look the same. *ADHD is a consistently recognised pattern of behaviours and difficulties but* ***heterogeneous*** *in the details from which that pattern is composed.*

There is ***no single diagnostic test****,* biochemical, radiological, genetic or psychological which can be used alone to confirm the diagnosis. The diagnosis of ADHD is therefore made by identifying a recognizable

pattern made by observations. The pattern has to be evident across different situations and by convention, has to have arisen in early life, before the age of twelve.

Why bother with a diagnosis?

- it provides an answer as to why the individual is not functioning as well as expected.
- It predicts a likely positive response to medication. I suggest that is this extraordinary positive response to medicine that has enabled the diagnosis to survive over decades, in spite of any uncertainties about cause, precise pattern of difficulties, and lack of an objective test

The pattern of ADHD was originally recognized in childhood and predominantly in boys so the above lists of items very much reflects how the combined presentation presents in 6-12 year-old boys.

Coexisting conditions and problems

Pure ADHD is unusual. About 80% of people with ADHD have another clinical issue as well.

In childhood this is most likely to be angry, oppositional or antisocial behaviour. Alongside this is the finding that there is overlap with other neurodevelopmental disorders:

- dyslexia,
- developmental co-ordination disorder (dyspraxia),
- autistic spectrum disorder,
- tics and Tourette's syndrome,
- developmental language disorder.

A neurodevelopmental disorder is evident early in life and is a continuing psychological problem rather than one that comes in episodes (such as depression) or develops in established adult life (such as dementia).

In adult life the pattern of coexisting issues changes to include

- anxiety,
- depression,
- substance abuse,
- sleep problems
- antisocial behaviour

Co-existing issues magnify the disabling effect of ADHD and *must be assessed when a diagnosis of ADHD is first made.* (They often are not).

What increases the risk of someone developing ADHD?

- Genetic factors are powerful: the heritability of ADHD is 74% by recent studies. Some 76 genes are detected on genome-wide association studies. There is no single gene that causes ADHD and no pattern of genes that can be used to assist diagnosis. *ADHD is a polygenic condition*.
- Environmental factors that are confirmed as causal are mainly to do with pregnancy, birth and very early infancy. No single factor predicts future ADHD. Some rare cases arise among children who have experienced very severe emotional and nutritional privation in very early life, e.g. in extremely poor orphanages in some countries. There are surely other environmental risk factors but research in this area is small scale with imperfect confirmation of findings.
- Excess maternal alcohol intake in pregnancy can cause foetal alcohol syndrome, within which hyperactivity and ADHD are very common. Similarly, brain injury can cause an ADHD picture.
- Hard evidence does not firmly support the idea that poor parenting, smoking in pregnancy, dietary abnormalities or excessive screen use are risk factors. The evidence for environmental toxins, especially lead, is interesting but based on too few and small studies to be convincing.

What is the fundamental cause of ADHD?

ADHD is the result of poor brain function leading to weak regulation of behaviour and impairment of higher cognitive functions such as attention (but not intelligence). There are key areas of the cortex of the brain that are underdeveloped, function below normal levels and show poorly organised nerve connections with the rest of the brain. These areas especially include

- inferior part of the frontal lobe (self-restraint, self-monitoring)
- dorsolateral frontal lobe cortex (planning, working memory)
- parietal lobe (attention)

These are areas that have extensive nerve tracts which use dopamine and noradrenaline as neurotransmitters. Some studies show that treatment of young adolescents with stimulant medication (which increases the effect of these neurotransmitters) results in growth in the thickness of the cortex in key areas,

In short, the 'ADHD brain' is immature in structure and functional development in key areas.

In some but not all (heterogeneity again) people with ADHD, the resting 'default mode' activity of the brain which is characterised by musing about oneself, daydreaming, and experiencing mind-wandering, fails to switch off when the brain enters 'task-centred' mode to accomplish a task, thus disrupting satisfactory work

Subdividing the combined ADHD picture

In the classic pattern of ADHD, hyperactivity/impulsivity and inattention are both present – the so-called *combined presentation* which is the usual form in childhood. But some individuals just have a high score (> 5 or 6 depending on age) on one list or the other so are termed

- predominantly hyperactive/impulsive presentation
- predominantly inattentive presentations (what used to be called ADD).

'Presentation' is used in formal diagnosis terms rather than 'type' as over the years the pattern of scoring on the two lists any one person with ADHD can change. 'Type' is still used informally.

These presentations react similarly to combined ADHD though look different from it. Both show similar genetic backgrounds, brain function and response to medication when compared to ADHD-combined presentation. For a diagnosis, they must be associated with impaired functioning. Most cases of inattentive ADHD were previously diagnosable as combined ADHD when younger. Predominantly hyperactive-impulsive presentation is less common and usually occurs in young children.

In adult life

More UK adults than children are now being prescribed ADHD medicines (Donnelly 2023).

With increasing age, the hyperactive component of ADHD often diminishes into minor restlessness and fidgeting, leaving an inattentive and impulsive picture.

Adults often complain particularly of problems such as

- forgetfulness,
- poor self-organisation
- not achieving what they want to do
- distractibility

A key issue for them is knowing what they have to do but being unable to do it properly - *weak cognitive executive function.* In other words, problems with

- setting goals and allocating priorities
- planning a complex task
- sticking with a plan
- systematically evaluating choices, progress and outcomes of actions

- time management
- completing a task

Adults are more able than children to describe the 'inner world' of ADHD such as active and exhaustive mind-wandering or 'going down a rabbit-hole' with overfocussed thinking. They may also confess to 'masking' – concealing their ADHD and attempting to function normally in the eyes of others. For many, the experience of ADHD is exhausting and demoralising.

Girls and women

The existence of ADHD among girls and women has been increasingly recognised (see Steer 2021, Young et al 2020).

- It typically presents as inattentive – so can be overlooked as it is not so strongly associated with problematic hyperactive-impulsive behaviour. In clinics girls present at a later age than boys,
- In childhood, boys have always outnumbered girls because they are more troublesome.
- The ratio of men to women with ADHD in adulthood shows only a small excess of men.
- ADHD is often misdiagnosed as anxiety, emotionally unstable personality disorder etc
- Girls and women are more likely to mask their difficulties and may pretend to be 'normal', which further gets in the way of it being recognised by others as a real difficulty.

Yet ADHD presenting as predominantly inattentive is composed of two patterns –

- those with a previous history of hyperactivity who present with a predominantly inattentive pattern of symptoms as they age; this is the major group
- those who have never been hyperactive.

This latter group is interesting because it contains a group of people who are slow processors of information and are typically dreamy, seem to be 'in a fog' and in a world of their own. They respond less dramatically to ADHD medicines, though can still benefit positively from them.

Does the current model of ADHD need amendment?

Modifications which have been suggested are the inclusion of

- **deficient emotional self-regulation (DESR)**
  Intense, often fierce, angry or emotional reactions, 'hot temper'
- **cognitive disengagement syndrome**
  Previously known as slow (or sluggish) cognitive tempo and characterised by apparent inattention with general slowness, dreaminess, being out-of-touch, and a somewhat sleepy demeanour. Becker et al. (2023) provide a review
- **working memory weakness**
  Difficulty holding in mind what has been experienced in the previous 30 seconds or so while re-organising and processing it
- **rejection sensitivity dysphoria**
  Exquisite sensitivity and intense, protracted emotional distress in response to criticism, personal slights or perceived rejection

All of the above are often found in in association with ADHD but none of them are constantly present in ADHD (but then nothing is…).

All can exist in their own right without fulfilling diagnostic criteria for ADHD. They show less (though some) responsiveness to ADHD medications compared with the striking response evident in core ADHD. Whether they respond when insufficient features for a diagnosis of ADHD are present is not clear.

Changing the diagnostic criteria could result in the loss of previous scientific data. I suggest they are recognized as associated features rather than core components and the present diagnostic formulation should stand.

The terrible cost of ADHD to a country

ADHD results in

- Academic underachievement
- High special education costs
- Occupational failure or loss of productivity
- Increased criminality and imprisonment
- Higher disability support costs
- Family and relationship breakdown
- Increased mental health and substance abuse problems
- Medical treatment costs

The financial cost to a developed country is billions of dollars/pounds. (Chhibber A et al. (2021), mostly because of untreated ADHD. For example, 1 in 4 UK prisoners have ADHD (Young and Cocallis, 2021) and reconviction rates are reduced by medical treatment: Liechtenstein et al 2012). UK prisoners cost the country £3.7 billion/year.

Neurodiversity

All the items on the diagnostic lists may be seen to some extent in the general population. Disability provides the critical cutoff and this varies according to judgement. There is no single diagnostic test for ADHD. The positive response to stimulant medication can apply to people with slightly fewer diagnostic items – subthreshold diagnosis – but those with few items will not show benefit. College students without diagnosed ADHD who use stimulants illicitly to boost their work do less well. On testing, neurocognitive benefits from medication are not seen in students without ADHD (Weyandt, 2014).

Some people with ADHD can offer important skills in entertainment, creativity and energy. Impulsive exploratory behaviour may benefit social groups (Williams and Taylor (2006), though individuals with ADHD can suffer distressing symptoms (e.g.sleep disturbance, exhausting mind-wandering) independently of any failure to meet social expectation. Exclusively focussing on symptoms and research into brain dysfunction is undoubtedly reductionist.

My suggestion is that the following statements hold:

- there are grounds for seeing sub-diagnostic ADHD as a difference within the whole population but ADHD itself is, by definition, a disability as this is incorporated in the diagnosis and cannot be denied
- biological risk factors (genetics) and dysfunction (brain) apply to both diagnostic and near-diagnostic (impairment but insufficient symptom counts) groups of people
- a moral argument exists for reducing demands placed on people with ADHD by adjusting some social and situational demands created for neurotypical individual. This is well-rehearsed in education and examinations by granting extra time etc.
- there is value in adopting a ‘medical’ or psychologically targeted approach to symptom reduction but this should never be the only assistance offered
- the positive contributions made and successes achieved by some people with ADHD should be recognised in an attempt to reduce stigma
- there are implications for research, especially on treatment outcome and the inclusion of people with ADHD in research design (Sonuga-Barke, 2023)
- neurodiversity and ‘medical’ approaches should not compete; both have benefit and are not mutually exclusive

The first step in encouraging a neurodiversity approach is education about ADHD for the general public.

Further Reading

Additude magazine www.additudemag.com hosts regular *updates for the general public* on current issues in ADHD. There is a back catalogue on research and helpful advice. It is an American publication.

Stephen Faraone organises *major scientific reviews* on ADHD which *contain many of the findings quoted in this lecture.* They are technical and scientific.

Faraone, S. et al. (2024) Attention-deficit/hyperactivity disorder. *Nature Reviews Disease Primers* **10**, 11 (2024). https://doi.org/10.1038/s41572-024-00495-0

Faraone S et al (2021) The World Federation of ADHD International Consensus Statement: 208 Evidence-based conclusions about the disorder, *Neuroscience & Biobehavioural Reviews,* **128**, 789-818, https://doi.org/10.1016/j.neubiorev.2021.01.022

Girls and women with ADHD *are addressed for the general reader in* Steer J (Ed) *Understanding ADHD in Girls and Women*. Jessica Kingsley, London 2021

Or, for a scientific summary:

Young, S et al (2020). Females with ADHD: An expert consensus statement taking a lifespan approach providing guidance for the identification and treatment of attention-deficit/ hyperactivity disorder in girls and women. *BMC Psychiatry* 20, 404). https://doi.org/10.1186/s12888-020-02707-9

References specifically cited in this lecture

Becker S et al. (2023) Report of a Work Group on Sluggish Cognitive Tempo: Key Research Directions and a Consensus Change in Terminology to Cognitive Disengagement Syndrome,*Journal of the American Academy of Child & Adolescent Psychia*try, **62**, 6, 629-645,

Chhibber A et al. (2021) Global Economic Burden of Attention-Deficit/Hyperactivity Disorder: A Systematic Review. *PharmacoEconomics* **39**, 399–420 (2021).

Connelly D (2023) Special report: Charting the rise in ADHD prescribing. *Pharmaceutical Journal* **311**, No 7975;311(7975)::DOI:10.1211/PJ.2023.1.191399

Lichtenstein P et al. (2012) Medication for attention deficit-hyperactivity disorder and criminality. *N Engl J Med* **367,**:2006-14.

Ramtvedt, B et al. (2013) Clinical gains from including both dextroamphetamine and methylphenidate in stimulant trials. *J Child Adolesc Psychopharmacol*, **23.** 597-604

Silk T et al. (2019) Network analysis approach to ADHD symptoms: More than a sum of its parts. *PLos One* e0211053

Sonuga-Barke, E (2023) Editorial. *J Child Psychol Psychiat,* **64**, 1405-8.

Weyandt L et al (2014) Pharmacological interventions for adolescents and adults with ADHD: stimulant and nonstimulant medications and misuse of prescription stimulants. *Psychol Res Behav Manag* 7, 223-249.

Williams, J and Taylor E.(2006) The evolution of hyperactivity, impulsivity and cognitive diversity. J. R. Soc. Interface (2006) 3, 399–413

Young S and Cocallis K, (2021). ADHD and offending. *Journal of Neural Transmision*, ***128***, 1009-1019