Children's Hospital of Philadelphia®

How Does Medication Affect Social Functioning ?

This supplemental handout provides an overview of available information about how medication may impact social functioning in children with ADHD.

In the presentations on ADHD and social functioning for professionals and parents/caregivers, we reviewed the ways that ADHD can impact social functioning. The clearest negative effects come from the core symptoms themselves; hyperactivity/impulsivity can increase the chance of intrusive behavior and emotional reactivity, while inattention can increase the chance of missing information and cues in social situations. The most important outcome of these effects can be difficulty forming and keeping quality friendships, which place children and adolescents with ADHD at risk of reduced engagement and success in school (Mikami et al., 2017), and long-term negative outcomes such as anxiety, delinquency, and poorer overall functioning (Mrug et al., 2012).

In the presentations, we focus on psychosocial treatments that may be helpful in improving social functioning in children with ADHD. In this pdf, we focus on medication effects.

First, it is important to understand how social functioning is measured. Almost all studies of medication effects on social functioning use parent or teacher rating scales that focus on social functioning, or the social "subscale" from a broader behavior rating scale. A smaller number (including the MTA studies) use observations and "counting" of specific positive or negative social behaviors. This means that we have little information about which specific aspects of social function are more or less likely to improve with a given intervention, and little information about the most important outcome of good social functioning- having quality friendships. This is important because psychosocial treatment is time- and resource-intensive for both families and providers, and it would be helpful to know how to design targeted programs that most directly address the aspects of social functioning that medication is less likely to help. At the level of the individual child, this highlights the importance of parents/caregivers and providers working together and with others who see the child in social situations (teachers, coaches, etc.) to evaluate the effects of medication on specific social behaviors when social functioning is a concern. Then, parents/caregivers and therapists can work together on the specific behaviors that have not improved with medication.

Most studies of medication effects on social function use methylphenidate. There are many fewer studies of amphetamine or atomoxetine, and very limited study at this time of viloxazine. Key points:

- Although medication can improve ratings of social functioning, this has not been found in all studies (Schweren, et al., 2019; Shang, et al., 2020)

- Social behaviors directly related to core ADHD symptoms are most likely to improve with medication treatment (Schweren, et al., 2019; Weiss, et al., 2005)
- Few studies evaluate medication effects on positive social behaviors such as sharing, helping, and interacting appropriately, and these also show mixed results (reviewed in Hinshaw, et al., 1989)
- Some, but not all studies find medication more effective than psychosocial treatment (Abikoff, et al., 2004; Hoza, et al., 2005; Molina, et al., 2009; Schweren et al., 2019; Van der Oord, et al., 2008). Psychosocial treatments are not the same across studies, however, except all studies from the MTA did have identical, intensive psychosocial treatment that included specific targeting of social functioning.
- Even when medication alone shows positive effects on social functions, some social impairments remain (Hoza et al., 2005; Shaw et al., 2012)
- A review of 351 studies of ADHD treatment (medication, psychosocial, or combined treatment) showed that at 2 or more years later, social functioning (relationships, peer ratings of likeability, marital status, divorces, and engagement in activities or hobbies) was better for treated than untreated participants (any treatment; Shaw, et al., 2012).
- Another review of 127 studies of treatment (medication, psychosocial, or combined treatment) showed that over 2 years later, treated participants showed better self-esteem and social functioning than untreated participants (Harpin, et al., 2016).
    - Studies that compare medication, psychosocial treatment, and the combination of both treatments generally find that combination treatment is more likely to improve social functioning (MTA Cooperative Group, 1999)
    - Lower doses of medication provided the same degree of improvement in social functioning as higher doses of medication when psychosocial treatment was also included (MTA Cooperative Group, 1999)
- There may be different effects of different doses of methylphenidate on social functioning in the same child.
    - Methylphenidate improves verbal/ physical aggression at low-moderate doses, but does not as reliably improve prosocial behaviors (Hinshaw, et al., 1989; Pelham, et al., 1987)
    - Lower doses of methylphenidate were more likely to improve social functioning, whereas higher doses had detrimental effects (Smith et al., 1998)
- Viloxazine may improve parent ratings of peer relations and social activities to a modest degree (Faraone et al., 2023)

- Atomoxetine has shown mixed results- from similarly effective to methylphenidate in improving social functioning (Shang, et al., 2020) to having no significant effect on social functioning even when there are positive effects on core ADHD symptoms (Waxmonsky, et al., 2010; Weiss, et al., 2005).

Social functioning has a brain-based component, though this research is in its infancy relative to research about executive functions in ADHD. As with ADHD and executive functions, social perception and behavior involves networks of brain regions.

- A key network that is important in allowing individuals to infer the mental states of others, including what they know, what they are thinking, and how they feel is called the mentalizing network. This ability to infer the mental states of others is often referred to as having "Theory of Mind" (Premak & Woodruff, 1978) which begins in preschool and increases in complexity through childhood.
- The mentalizing network includes several sub-areas of the prefrontal cortex and parts of the cingulate cortex, precuneus, and the junction of the temporal and parietal lobes (reviewed in Han, et al., 2021).
- Other circuits that are involved in social information processing include the connections between the lower parts of the prefrontal cortex and the subcortical structures, the amygdala and the lower portion of the striatum. These lower brain regions are important in assigning emotional value to incoming stimuli (reviewed in Ochsner, 2008).
- Collections of brain cells in various brain regions known as "mirror neurons" are activated when we perform a social function, but also when we observe another performing that social function, as if we are experiencing it ourselves (Bonini, et al., 2022). This is a mechanism that likely links the "learned component" and the brain basis for social functioning.
- The default mode network, discussed in the presentations in terms of its role in ADHD, also plays a role in emotion perception, empathy, Theory of Mind, and moral judgement (reviewed in Li, et al., 2014).
- Several brain chemicals and their receptors help to mediate activity in these networks, including the neurotransmitter dopamine and the dopamine receptor, DRD2, which is also the primary neurotransmitter impacted by methylphenidate.

In summary, medication may be modestly helpful for social functioning in ADHD, and the addition of psychosocial treatment may be additionally beneficial. There is insufficient evidence that medication improves prosocial behaviors or the quality and quantity of friendships, however. It is therefore very important to understand the specific behaviors that an individual child has that negatively impact social functioning, so that parents, providers, and educators can collaborate to evaluate the impact of medication and/ or psychosocial treatments on these specific behaviors.

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