Relationships between ADHD symptoms, hyposensitivity and social impairments.

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Master Thesis – Klinische Neuropsychologie

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February 2024

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Abstract

Attention Deficit/Hyperactivity Disorder (ADHD) is a common diagnosis among children which may carry over into adulthood. Some of the problems that come with it are attentional defects and hyperactivity. These symptoms also affect daily life and social functioning. In this study a sample of 134 adults was asked to rate ADHD symptoms and their own social functioning, in general and within their family. Participants took an online survey in which they rated their sensitivity to different sensory inputs. In this study we focused on hyposensitivity, so low registration of stimuli.

We found that ADHD symptoms were positively related to hyposensitivity. Furthermore, ADHD symptoms were also related to impairments in social functioning. Hyposensitivity showed a negative relationship with social impairments implying that it does not lead to further problems in the social domain. No interaction was found between ADHD and hyposensitivity on social impairments.

These results imply a relation between ADHD symptoms, low sensory registration and seeking of more sensory inputs. While these factors are related they each seem to have their independent effect on social impairments.

Keywords: ADHD Symptoms, Sensory Processing Deficits, Social Impairment, Model of Dunn, Hyposensitivity.

Introduction

Attention Deficit Hyperactivity Disorder (ADHD) is a neurodevelopmental disorder that affects between 3-11% of children (Semrud-Clikeman & Ellison, 2009). The disorder involves several symptoms including inattention and/or hyperactivity-impulsivity (American Psychiatric Association, 2013). The disorder can persist into adulthood, adult ADHD has a prevalence of 1.0-7.3% (De Zwaan et al., 2012). The symptoms that come with ADHD affect several aspects of daily life, including the educational, occupational and social domain (Semrud-Clikeman & Schafer, 2000). Many children with ADHD face problems at school and peer rejection due to their inattention, activity levels or lack of self-control. These problems may continue into adulthood (Semrud-Clikeman & Ellison, 2009). While activity levels often lower and hyperactivity is no longer apparent, adult ADHD is often characterized by the same inattention and impulsivity as its childhood predecessor. Social skills can also be affected in people with ADHD. ADHD can lead to problems later in life in a number of domains including social life, education and employment (De Zwaan et al., 2012). These problems can start at childhood with a slowed development of social competence which leads to underdeveloped social skills later in life (Ramos et al., 2013). The present study takes a closer look at one of the common symptoms of ADHD in regards to social functioning in an attempt to explain these effects.

Sensory processing deficits are present in ADHD as one of its features (Semrud-Clikeman & Ellison, 2009). ADHD is commonly comorbid with disorders such as Autism Spectrum Disorder (ASD) which is also linked to sensory processing deficits. ADHD, however, has been shown to determine levels of sensory sensitivity regardless of ASD being present (Bijlenga et al., 2017). For this reason it is interesting for the present study to look at these effects further. Sensory processing deficits can take several forms, hypersensitivity and

hyposensitivity to external stimuli. Hypersensitivity can be conceptualized as a heightened awareness of and reactivity to external stimuli (Isaacs et al., 2020). People with hypersensitivity may be more sensitive to certain stimuli over others, for example being sensitive to noise but not to light. These people may also have lower tolerance for stimuli in general, reaching the point of overstimulation more easily which can result in inattention in some and agitation in others. Hyposensitivity works in the opposite way, with people being less aware and less receptive to stimuli. These people have higher thresholds for input and may be less aware of certain stimuli than other people. They also tend to be unusually interested in features of the environment, referred to as sensory seeking (Zhou et al., 2021).

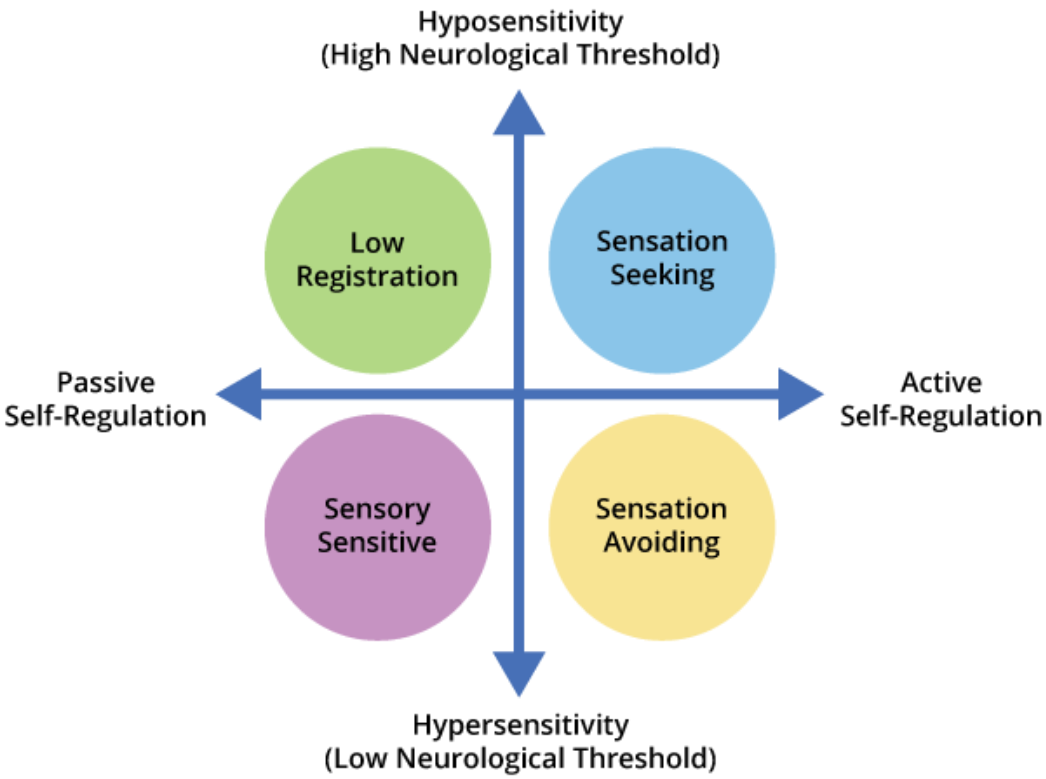
Both hypo- and hypersensitivity can affect daily life, including social life, in different ways. People with hypersensitivity may be easily overstimulated and attempt to avoid further stimulation by seeking out quiet environments and planning fewer events in their days. (Zhou et al., 2021). As these people are less likely to seek out busier environments they may be perceived as introverted or shy (Hoffman et al., 2022). Hyposensitive people on the other hand may need more input, they might not hear when someone is calling their name and may seek out busier environments to meet their sensory threshold. As they are more likely to explore and seek out more stimulation these people are more likely to be perceived as extroverted. Some behavioral manifestations of a hyper- or hyposensitivity to stimuli can be avoidance of certain textured fabrics or foods, or a fixation on lights and movement. These behaviors can get in the way of daily life, as avoidant behavior may remove an individual from a social setting and make them shut down more easily. On the contrary, seeking out more stimuli can be distracting to tasks at hand. Communication can be impaired by these features as well. Speech is the most obvious part of communication but it is paired with facial expressions, movements and tone of voice which all need to be taken into account and processed. While there are bodies of research referring to the effects of hypersensitivity on

social functioning the literature on hyposensitivity and social functioning is lacking. The assumptions made in the current study are thusly based on knowledge about the effects of hypersensitivity. In this study we assume that hyposensitivity leads to sensory seeking and a more extraverted appearance as Zhou et al. (2021) mention in their study.

For the purpose of this study sensory sensitivity will be conceptualized using the Model of Dunn (Dunn, 1997). This model proposes two dimensions of neurological thresholds, which we call sensory sensitivity, and behavioral responses, to seek or avoid stimuli. Based on these two dimensions the model forms four quadrants, these are low registration, high registration, sensory seeking and sensory avoidance. Where one falls within these quadrants determines and helps interpret performance and behavior in persons. Furthermore, the model conceptualizes the difference between hypo- and hypersensitivity in brief. With hypersensitivity combined with a lack of avoidance can lead to hyperactivity and hyposensitivity combined with a lack of sensation seeking can lead to lethargy and inattention (Dunn W., 1997). The stimuli in question can be any form of input, like sound, visual input, touch, smell or taste. Not each type of stimuli is perceived the same and while a person may be sensitive to one, they may not be to another.

Figure 1.

Illustration of the quadrants of the Model of Dunn



In this study we examine the relation between hyposensitivity, ADHD symptoms and impairments in social functioning. Prior research has linked ADHD to both hyper- and hyposensitivity (Bijlenga et al., 2017, Hoffman et al., 2022). While there has been research on sensory processing deficits in general and hypersensitivity, less is known about the effects of hyposensitivity on ADHD. We expect that ADHD affects social functioning negatively while hyposensitivity may have a more positive effect on social functions. The latter expectation comes from the perceived extraversion that may come with sensory seeking, however this may not mean actual extraversion. The interaction between ADHD and hyposensitivity will

be studied exploratively as we do not currently have strong hypotheses on what its effect would be.

Methods

Participants

A total of 134 participants took part in this study, using a convenience sample from social media and personal circles of the researchers. No financial compensation was offered for participation. The sample consisted of people over the age of 18 who did not suffer any sensory disorder that would significantly interfere with daily experience of stimuli. Participants were asked about any existing sensory disorders which may exclude them from the study (e.g. Do you have a visual disorder that cannot be corrected with the use of glasses?), none of the participants were excluded based on this criteria. Out of the 134 participants 21 were excluded due to failure to correctly answer the validation questions (see procedure) or failure to finish the questionnaire. Data of the remaining 113 participants (40 male, 70 female, 3 unknown/other) was used for this analysis. The mean age was 32.44 years (N = 34, SD = 12.96), not everyone disclosed their age so this is a partial estimation. Regarding education, some did not (yet) finish their high-school degree (n = 15), some were at MBO level 1 or 2 (n = 4), MBO level 3 or 4 (n = 5), HBO or University without diploma (N = 10), finished HBO (n = 38), a bachelor's degree (n = 21) or a master's degree (n = 18). 19 had a low education level (high-school or lower), 15 a medium education level (vocational or college without degree) and 77 a high education level (college or university bachelor or higher). One of the participants did not finish high-school education and another followed an in-service education and could not determine the level of this education. Out of the sample, 10.6% indicated to have received an ADHD diagnosis when asked.

Materials

To measure ADHD symptoms the DSM-IV criteria for ADHD was used (Kooij & Buitelaar, 1997). This screening questionnaire consists of 23 statements about the person's behaviors over the last six months (e.g. "When I'm sitting still I fidget with my hands or feet" and "I struggle to relax in my free time"). These statements were rated on a 4-point Likert scale (0 = rarely or never to 3 = very often). This questionnaire in full involves the same 23 questions but focused on childhood. As this study was focused on adult participants the part on childhood behavior was not used. For this study the total score on this questionnaire will be used in the analysis.

The Weiss Functional Impairment Rating Scale (WFIRS) was used to measure functioning across a number of domains of daily life (Weiss, 2005). In this questionnaire participants are asked to rate a number of statements about impairments in daily functioning over a number of domains (i.e., family, work, school, daily functioning, self-image, social functioning and risk behaviors). The statements in the WFIRS mostly concern problem behavior (e.g. "I often arrive late at work" and "I am dependent on others to do things for me"). Statements were rated on a 4-point Likert scale (0 = Never to 3 = Very often) with an added option of not applicable (NVT). For the purpose of this study only the domain of social impairment will be used. The mean score on this test will be referred to as the level of social impairment for the purpose of this study.

Sensory sensitivity was measured using the Adult/Adolescent Sensory Profile questionnaire (Brown & Dunn, 2002). In this questionnaire participants were asked to rate their behaviors in regards to a number of sensory modalities (i.e. visual, auditory, olfactory, tactile and movement stimuli). These statements (e.g. "I add spices to my food" or "I avoid elevators/escalators because I don't like the movement") were rated on a 5-point Likert scale (1 = almost never to 5 = almost always). For the analysis only the dimensions of

hyposensitivity and approaching behavior. The sum score of these two dimensions was combined into one variable we refer to as hyposensitivity.

Procedures

The questionnaire was administered through the online platform Qualtrics. The link was shared through social media and the personal circles of the researchers. Before taking part informed consent was provided and participants could decide whether they wanted to participate or not. If consent was given participants would be led to questions about gender, age, education and ADHD diagnosis. Thereafter questions were asked about sensory disorders with questions like: “Do you suffer from a visual dysfunction that cannot be corrected by wearing glasses?”. Similar questions were asked for auditory, olfactory, tactile and movement disorders. After this participants would fill out the adult section of the DSM-IV ADHD criteria self-report questionnaire. Following the DSM-IV questionnaire was the WFIRS. The last questionnaire used was the Adult Sensory Profile self-report scale. These were all administered in multiple choice format, split up per topic within the questionnaires.

To make sure participants filled out the questionnaires seriously a number of validation questions were added into the different parts (e.g. “Please fill in “almost never” here”). If these questions were not answered correctly the participant’s answers were not included into the final study.

In order to prepare the data for analysis the full scores of each participants needed to be calculated. For the WFIRS the full test score is a mean score of all questions answered and for the Sensory Profile and DSM-IV symptom scale these are the sum scores of all items. The Sensory Profile scores were not calculated as a whole, but as one separate score combining the Low Registration and Sensory Seeking quadrants of the Dunn model which are relevant for this study. This variable will be referred to as Hyposensitivity for the purpose of this study. This variable was calculated by adding the two scores together into a single variable.

For the WFIRS a separate mean score for the social sub-questions was created for the purpose of studying social impairment.

The dependent variable was social impairment as measured by the WEISS questionnaire sub-questions. The independent variables are ADHD symptoms, as measured by the DSM-IV questionnaire, and hyposensitivity, as measured by the Sensory Profile questionnaire. For this analysis a regression will be performed over these variables. Furthermore, a potential interaction effect of hyposensitivity, ADHD symptoms and social and daily impairment will be studied.

Analysis

For the individual test interpretation the norm scores of each test were used. For the Sensory Profile the sub scores on hyposensitivity and sensory seeking were used, these were then compared to the scores expected for most people ($24.0 \geq M_{hypo} \leq 35.0$, $43.0 \geq M_{seeking} \leq 56.0$) (Brown & Buitelaar, 2002). For the WFIRS the mean score was used, a mean falling under 1.0 would fall withing the unimpaired range (Weiss, 2000). Lastly, the DSM-IV symptom endorsement require a mean score below 36 which would mean most items are scored below 2. This would indicate a lack of symptom endorsement (Kooij & Buitelaar, 1997).

The variables used were as follows: For Hyposensitivity we created a variable consisting of the combined scores of the sub-scores on hyposensitivity and sensory seeking from the Sensory Profile. The mean score on the WFIRS was used, this was labelled as Social in our variable list. Lastly the DSM-IV sum score was added under the label ADHD.

First a correlation analysis was run between ADHD, Hyposensitivity and Social Impairments. Correlations were judged according to Cohen's interpretation of Pearson's r for low, medium and high levels of correlation (0.10, 0.30 and 0.50 respectively) (Cohen, 1992). After these correlations a regression analysis was run on Social Impairments using ADHD,

Hyposensitivity and the interaction ADHDxHyposensitivity as predictors. The enter method was used as input method. There were no notable violations of assumptions. For the purpose of this study a significance level of 5% was used.

Results

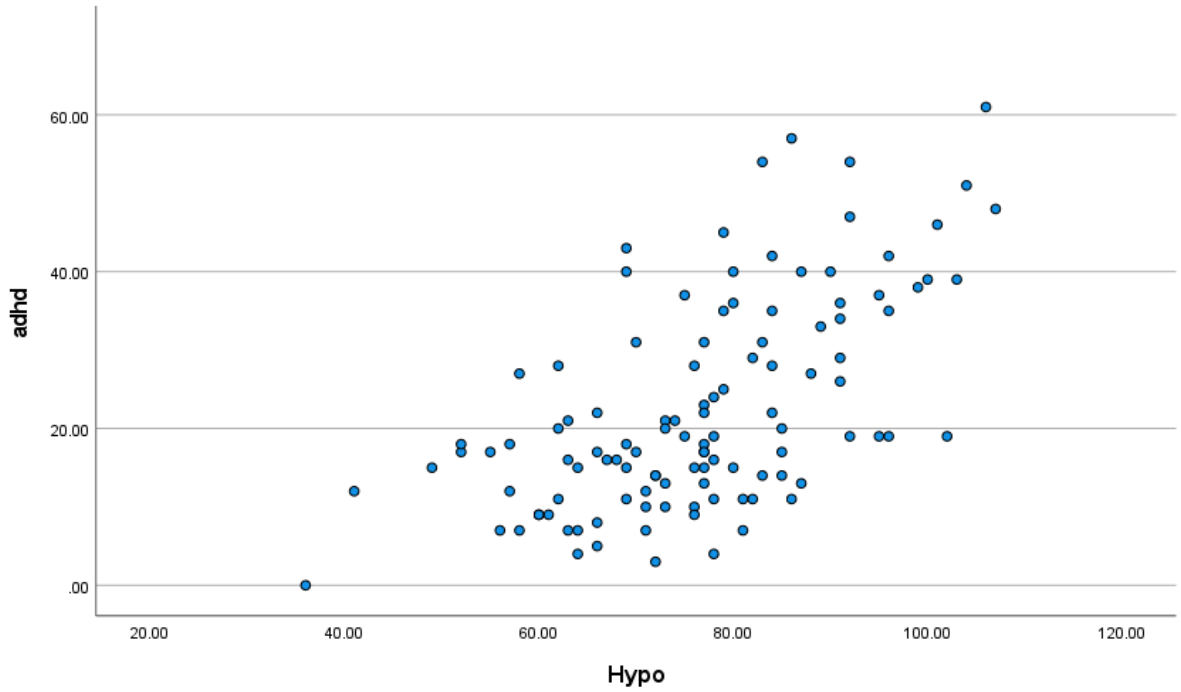
The sub-questions used for sensory seeking and hyposensitivity scored around what is expected for the average person ($M_{hypo} = 32.07$, $M_{seeking} = 44.51$). This sample showed above average approach tendencies (see analysis). The mean score on the WFIRS showed an unimpaired average across the sample (M = 0.10). For the DSM-IV the sample mean is low (M = 22.55). This means that, on average, most items were scored lower than 2. Generally this sample appears to consist of low to unimpaired individuals in the tested domains.

Correlations

Running a correlation analysis revealed no significant correlation between social functioning and hyposensitivity ($r = 0.053$, $p = 0.575$). The correlation between ADHD symptoms and hyposensitivity on the other hand was moderate to strong ($r = 0.606$, $p < 0.001$). This implies that hyposensitivity and ADHD symptom endorsement are related. ADHD symptoms and social impairment had a moderate correlation ($r = 0.474$, $p < 0.001$). Figure 1 shows the trend between ADHD symptom endorsement and Hyposensitivity ratings within this sample.

Figure 1.

Scatterplot of the relationship between ADHD and Hyposensitivity



Regression Analyis

The regression analysis shows that a significant proportion of variance can be explained through the model used (R^2 = .312, F(3, 112) = 16.49, p < 0.001). The regression also reveals that there is a significant negative effect of hyposensitivity on social impairment (t (111) = -3.66, p < 0.001). ADHD, on the other hand, shows positive effects with social impairment (t (111)= 6.41, p < 0.001).

The interaction between ADHD and Hyposensitivity did not yield any significant results (t(111) = .29, p = 0771, r^2 = .023). This shows us that there is no interaction between the two variables in the context of social impairment.

Discussion

This study examined the relationships between ADHD symptoms, hyposensitivity and impairments in social functioning.

ADHD and Hyposensitivity were the main predictors in this study. The two showed a moderate to strong relationship which may point to ADHD symptoms leading to a lower registration of stimuli. This relationship was expected since ADHD is commonly related to sensory processing deficits (Semrud-Clikeman & Ellison, 2009). People with ADHD are more likely to be either hypo- or hypersensitive to stimuli. While ADHD is also commonly comorbid with other disorders such as ASD, which is also linked to sensory processing deficits, it appears that ADHD itself determines the levels of these deficits irrespective of ASD (Bijlenga et al., 2017). These prior studies have looked at sensory processing deficits in general within patients with ADHD, however have not explored whether hypo- or hypersensitivity is more likely to occur. According to the research by Bijlenga et al. (2017) both types of sensory sensitivity are linked to an increase in ADHD symptom reports but they did not mention if there was a difference between the two dimensions.

The relationship between ADHD and social impairment was a positive one. This, too is according to our hypotheses. ADHD can lead to problems in psychosocial functioning, along with problems in education and employment. People with ADHD are less likely to complete an education and are more likely to remain unmarried or go through a divorce later in life (De Zwaan et al., 2012). Furthermore, lack of impulse control may also lead to lack of emotional inhibition which can lead to stronger emotional reactions, if these emotional outbursts are negative it can make the person more difficult to talk to and so impact social contact (Vuori et al., 2016). As previous research has shown people with ADHD run into a series of problems when it comes to social interaction. These problems start at childhood with a slower development of social competence which may lead to poorer social performance in later life (Ramos et al., 2013). These problems appear to mainly impact patients with inattentive or an inattentive/hyperactive combined subtype of ADHD. Patients showing mainly symptoms of hyperactivity appear to be less impaired when it comes to social

competence. It is possible that this is due to the hyperactive subtype being perceived as more extraverted (Hoffman et al., 2022). Inattention can appear as carelessness and in social interaction this will quickly get in the way however hyperactivity may make the person appear more bubbly and active instead.

Social impairments and hyposensitivity showed a significant negative relationship. This implies that hyposensitivity improves social functioning. From what we know about hyposensitivity this makes sense. Hyposensitivity is often linked to sensory seeking, this can be interpreted as the person being outgoing and extraverted as they seek out busier environments as opposed to the more evasive hypersensitive people (Zhou et al., 2021). Research on hypersensitivity shows that the opposite is true with hypersensitive people so it makes sense that hyposensitivity would follow the opposite trend.

Lastly an exploration of an interaction effect was looked at. There was no significant interaction between ADHD and Hyposensitivity. While ADHD and Hyposensitivity have their own effects on social impairment it does not appear that they have a combined effect. No hypotheses were formed for this interaction but since there seems to be less research on ADHD and hyposensitivity specifically we wanted to see if an interaction was present.

Limitations

It is important to keep a few limitations in mind for these conclusions and interpretations. The current study was done using self-report only which may affect results. Participants being asked about sensory experience may not realize their experiences are abnormal or they may not want to report it as such. Furthermore, the sample used consisted mainly of healthy individuals which means we could not check for the link between ADHD and sensory sensitivity but only for endorsed ADHD symptoms. Results may have differed if a sample of ADHD patients or people with other sensory dysfunctions were used. The sample also consisted of more female than male participants. Previous research used ADHD patients

to compare to a typically-developing sample (Hoffman et al., 2022). Furthermore, the current sample consisted largely of people with higher levels of education. Past research has mentioned that ADHD is commonly linked to problems with education and dropping out (De Zwaan, 2012). Perhaps the results would have been different if there was more variety in levels of education. This sampling issue also prevents the results from being generalized to the general population. Lastly, due to the lack of random assignment and sampling this research is only correlational. While the results showed relationships between the variables used it cannot offer a causal explanation for these relationships.

Future Research and Implications

This study showed a relationship between hyposensitivity and ADHD that is in line with previous research (Bijlenga et al., 2017). The results also showed that hyposensitivity and social impairments are negatively related. Since the research on hyposensitivity in this field is limited this paper serves as an extension to the existing literature. It confirms the finding that there is a link between hyposensitivity and ADHD and that hyposensitivity has an effect on social functions. For future research it may be interesting to use a sample of ADHD patients rather than a mixed sample. Considering the existing research on sensory processing deficits and ADHD is not specifically focused on either hypo- or hypersensitivity so studying those separately will expand on current literature. Furthermore, comparing different levels of education may be enlightening on differences between low and high education patients with ADHD. Lastly, gender differences may also play a role in sensory sensitivity as shown by Bijlenga et al. (2020). For this reason studying gender differences in ADHD symptoms and sensory processing deficits may also further expand on existing literature.

Conclusions

In conclusion, ADHD appears to lead to some social impairments. This is in line with our hypotheses and previous research. Hyposensitivity does not further affect social

impairment, it appears that hyposensitivity has a more positive effect on social functioning. ADHD symptoms and hyposensitivity are related which is in line with previous research on ADHD and sensory processing deficits. There does not appear to be an interaction between ADHD and hyposensitivity which affects social impairment. These results imply the relationship between ADHD and hyposensitivity previously found in other research. It shows that hyposensitivity does not have a negative effect on social functions but that it is related to ADHD symptoms.

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