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Relationship with adult ADHD symptoms: Stimulant medication and caffeine

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Abstract

The purpose of the present study was to investigate how adults with attention-deficit/hyperactivity disorder (ADHD) perceive stimulant medication and explore the differences in their relationship with caffeine. Participants with more ADHD-related symptoms were expected to have a greater motivation to consume caffeine, anticipate experiencing more of caffeine's stimulant effects, and have a more positive regard toward the effectiveness of their stimulant medication than those with fewer symptoms. Additionally, those with more inattentive symptoms were predicted to have more of a positive regard toward the effectiveness of their stimulant medication, have a greater motivation to consume caffeine, and anticipate experiencing more of caffeine's stimulant effects compared to those with less inattentive symptoms. Results determined that the number of ADHD-related symptoms and dominant symptom presentation increased the expectancy for caffeine to be stimulating. Motivation to consume caffeine and reception of medication was unaffected by symptom quantity or presentation type.

Keywords: attention-deficit/hyperactivity disorder, caffeine, stimulant medication, stimulants, self-medication

Relationship with Adult ADHD Symptoms: Stimulant Medication and Caffeine

Attention-deficit/hyperactivity disorder (ADHD) is a neurobiological disorder characterized by inattentive and hyperactive/impulsive behaviors that obstruct the daily lives of those with it (Advokat, 2010). ADHD is associated with symptoms such as: inability to sustain attention, being disruptive or fidgety, "spacey," forgetful, and poor organization skills. The symptoms of ADHD are evident in multiple settings including social, personal, professional, and educational. Symptoms typically present before age 12, and of the children diagnosed, approximately two-thirds have manifestations following them into adulthood (American Psychiatric Association, 2013). However, only about 4.5% of adults continue to meet the full diagnostic criteria (Advokat, 2010). As a result, the purpose of this study is to explore how individuals with adult ADHD view caffeine and stimulant medication, and whether they are effective in reducing ADHD-related symptomology. This study will add to the growing body of research regarding the relationship between ADHD and caffeine. Along with illustrating to the scientific world how the perceived effects of stimulant medications vary among symptomology presentations and severities of adults with ADHD.

One cohort that is still widely understudied in ADHD research is adults. Adults often do not meet the full diagnostic criteria for ADHD, despite being symptomatic. In general, adults with ADHD have problems with delay discounting, difficulties controlling their impulses, viewed as less hard-working than their neurotypical counterparts, and experience higher levels of neuroticism (Nylander et al., 2021). A recent study assessing long-term consequences of an adult ADHD diagnosis with subsequent psychiatric care found burdens caused by ADHD symptomology to be drastically reduced (Nylander et al., 2021). The researchers found that participants with the lowest level of baseline functionality saw the greatest improvements

following continuous post-diagnosis treatment. The study also found that most participants' day-to-day tasks were impaired the most by symptomology despite continued treatment. This further suggests that ADHD treatment should focus on its core symptoms as well as how daily activities are affected by symptomology. Similarly, comparisons of clinician versus self-report evaluations of symptomology suggest that clinicians have a greater tendency to note more significant improvements following treatment, whereas a general audience tends to minimize the gravity of their symptoms (Nylander et al., 2021).

Stimulant Medication

A hormone that has been thought to play a major role in ADHD symptomology is dopamine (DA). Within the body, DA is involved with learning, motivation, and placing value in certain activities such as reward (Berke, 2018). Brain imaging of individuals with ADHD has shown DA transmission dysfunction, which may explain hallmark symptoms as impulsivity and inattention. Professionals tend to believe this DA deficit may explain some of the issues experienced in areas of reward, attention, and motivation (Volkow et al., 2009).

Psychostimulants are a type of drug designed to minimize lethargy while simultaneously promoting alertness (Ng & O'Brien, 2009); done by working to promote DA production (dela Peña et al., 2015). These drugs are commonly referred to as cognitive and mood enhancers, and the stimulants' main effects include decreasing impulsivity and increasing concentration (Ng & O'Brien, 2009). Due to this, they are the primary treatment option for individuals with ADHD (Advokat, 2010). However, the specific pharmacological effect stimulants have on ADHD biochemically is still unknown (Bush et al., 2008). Although many assume that stimulants help in the integration and application of knowledge, they instead work to improve overall task performance (Advokat, 2010). Stimulants' effects are most accurately observed in the short term

(Advokat, 2010). Also, stimulants (particularly amphetamine) are known to enhance one's ability to recall information after they have already learned it and help the quality of their performance (e.g., better quiz grades or ability to take better notes; Advokat, 2010). Typically, stimulants are better at improving retention rather than acquisition.

The two most common forms of stimulant medications are amphetamine (AMP) and methylphenidate (MPH; Ng & O'Brien, 2009). Amphetamine blocks the reuptake of dopamine and norepinephrine, and directly stimulates the Central Nervous System (CNS). Regarded as the less aggressive of the two, methylphenidate binds to the dopamine active transporter in a neuron's membrane and increases the level of dopamine extrasynaptically. Due to its extrasynaptic diffusion, the specific manner by which MPH acts biochemically is not well known (Ng & O'Brien, 2009). Like AMP, MPH stimulates the CNS as well as the Peripheral Nervous System (PNS; Gahr & Plener, 2016).

For individuals with ADHD, stimulants can help them focus their attention and maintain it over a short amount of time (Advokat, 2010), as well as help their concentration (Costa & Aschner, 2014). Spencer and colleagues (2001) conducted a seven-week study to examine the potential dampening of ADHD symptoms by AMP and assessed 27 adults that met DSM-IV criteria for ADHD. Participants alternated between a placebo and increasing doses of Adderall on a one-week on and one-week off schedule. Week one ended with participants taking 10 mg twice a day. On week two, participants received 20 mg twice a day, and by week three were taking 30 mg twice a day. These increases occurred gradually throughout the week if participants did not begin experiencing negative side effects. During the weeks participants received Adderall, each were separated by a one-week gap to "wash out" any produced effects by the preceding week's dose(s). By the end of the study, 70.4% of participants saw at least a 30%

decrease in their symptoms when taking Adderall. Overall, Adderall was found to decrease the clinician-reported severity of symptoms as well. Results indicated that a little over half of the participants' symptoms worsened during placebo weeks. The study found that Adderall does appear to be, at least in short-term, an effective treatment method for reducing ADHD symptoms in adults with ADHD.

A previous study by Fosco and others (2021) examined whether MPH would alter cognitive task performance (CTP), and if there was a change, how different the pre-MPH (baseline) CTP compared to the post-CTP. Children ages 9 to 12-years-old with ADHD took part in this study, and researchers were examining the cognitive task known as delay discounting[1]. Results indicated that higher doses of MPH produced better CTP. Although, participants with poor baseline functioning had greater improvements following MPH administration than those with a better/good baseline functioning. MPH was found to decrease delay discounting, thus suggesting that impulsivity also decreased. Findings from this study highly suggest that stimulants (i.e., MPH) improve cognition in individuals with ADHD and are dependent on their CTP before intervention. This finding emphasizes the need to consider individual differences when monitoring responses to treatment (Fosco et al., 2021).

More recent research has been conducted concerning the lives of individuals with untreated ADHD (i.e., with no medication or therapeutic intervention). A meta-analysis of 127 studies published between January 1980 and December 2011, analyzed the long-term consequences of both treated (T) and untreated (UT) ADHD (Harper et al., 2013). Specifically focusing on two factors, social function and self-esteem. Social function includes aspects related to social skills, interpersonal relationships, and romantic relationship history. Themes for self-

[1] When a reward loses value the longer the recipient must wait to obtain it (Odum, 2011).

esteem included items like self-worth, psychological well-being, and self-perception. Their analysis found that compared to both non-ADHD controls and those with T-ADHD, participants with UT-ADHD had severe impairments in the aforementioned areas of life. Results showed that social function and self-esteem were better in those with T-ADHD. Overall quality of life and poorer outcomes were significantly more associated with UT-ADHD compared to T-ADHD. The analysis also found that there was an increase in the number of professional publications about self-esteem and social functioning in individuals with UT-ADHD and their long-term implications. Thus, suggesting there is an increased awareness regarding the importance of factors for those with ADHD, especially in overall treatment goals.

Caffeine

Caffeine is the most popular, socially accepted, and appears as the least harmful psychoactive substance that is available to purchase in society (Ágoston et al., 2017; Kruger, 1996). Nearly all U.S. adults consume at least one daily dose of caffeine. Caffeine is often ingested with the expectation of receiving its stimulant effects, being more alert and having faster reaction times. These stimulant effects are produced by caffeine antagonizing adenosine, a CNS-inhibiting neurotransmitter that prevents the release of dopamine (Ioannidis et al., 2014; Kruger, 1996). By counteracting adenosine's suppressant effects, caffeine facilitates dopaminergic neurotransmission, causing its analeptic effect (Solinas et al., 2002; Kruger, 1996). It is important to note that though there is a general CNS-exciting effect produced by caffeine, reactions vary among different people (Ioannidis et al., 2014).

Individuals with mental health disorders have been found to drink higher amounts of caffeine and consume it in a more unregulated manner than the general population (Kruger, 1996). While some disorders, such as bipolar or anxiety disorders, may see harmful

exacerbations of their symptomology following caffeine consumption, past studies suggest that caffeine may play a role in managing ADHD symptomology (Lara, 2010). The most prominent argument is that caffeine is used as self-medication, whether the user is consciously doing it or not (Ioannidis et al., 2014). Caffeine is typically used by individuals with ADHD, both diagnosed and undiagnosed, to help sustain their attention, especially when feeling less aroused and more sluggish. An up-side to caffeine is that though the potential to abuse the substance is still there, the likelihood is significantly less than MPH and AMP (Lara, 2010). However, more severe ADHD symptomology is associated with more problematic use of caffeine, such as instances leading to caffeine use disorder (CUD; Ágoston et al., 2022).

Ágoston and colleagues (2022) explored the motivation behind caffeine consumption in individuals with ADHD symptomology. The researchers questioned if caffeine would compound the effects of ADHD symptomology and produce more negative outcomes, or if caffeine would help to counter the negative effects associated with symptomology. They found that the amount of ADHD symptoms an individual experienced was negatively correlated with overall contentment and positively correlated with CUD symptoms (Ágoston et al., 2022). Altogether, caffeine was not found to regulate the connection between well-being and ADHD symptoms. However, while the results did not suggest caffeine self-medication in individuals with ADHD, they do imply that the more ADHD symptoms an individual has the more likely they are to abuse caffeine and develop disorders such as CUD.

Caffeine Versus Stimulants

Though caffeine is found to help alleviate some ADHD symptomology, it is still less effective than stimulant medications (Ioannidis et al., 2014). Caffeine is better than no treatment (i.e., in cases of undiagnosed ADHD), but it still does not improve cognitive performance nearly

as much as stimulants (Ioannidis et al., 2014). It is possible that taking stimulants and caffeine simultaneously may work to increase the effectiveness of the medication (Walker et al., 2010). Results from Looby and colleagues' (2021) study show another side to the relationship between caffeine and stimulants; out of all the conditions[2], participants that expected Adderall, but received caffeine saw the greatest drug-induced effect and CPE. This indicates that the effect a drug has on an individual may be due to what they are expecting out of the experience. The participants, in general, had a more pronounced reaction when expecting Adderall over caffeine because of the anticipation for the former to have a stronger stimulant effect than the latter. Though participants know both Adderall and caffeine are used for wakefulness augmentation and CPE, Adderall is regarded as the stronger of the two, resulting in greater response rates.

The Current Study

The purpose of the present study is to examine the relationship between ADHD symptomology and determine what makes these individuals consume caffeine. Also, to examine perceptions on their use of stimulant medication. It is believed that individuals with ADHD have impairments in executive functioning[3] (Advokat, 2010) and dopamine neurotransmission[4] (Volkow et al., 2009). The effects observed from caffeine consumption are analogous to that of stimulant medications, in that they produce analeptic effects (i.e., stimulating the CNS) and increase alertness in consumers (Ágoston et al., 2017). It has also been found that frequent

[2] 10 mg Adderall and 200 mg caffeine; take placebo and expect caffeine, take caffeine and expect caffeine, take placebo and expect Adderall, or take caffeine and expect Adderall.

[3] Allows you to change and plan, monitor your behavior, and get things done.

[4] Dopamine helps with learning and behavior, and a scarcity of it may underlie hallmark inattention and impulsivity symptoms associated with ADHD.

misusers of stimulant medication for non-medical reasons are inadvertently treating undiagnosed ADHD (Peterkin et al., 2011). Though caffeine's stimulant effects are inferior to those of stimulant medications, it has been suggested that caffeine might increase the effect of stimulants when they are taken jointly (Ioannidis et al., 2014; Walker et al., 2010). Based on previous research, the current study has three primary hypotheses:

1a: Participants with more ADHD-related symptoms will have a greater motivation to consume caffeine compared to those with less symptoms.

1b: Participants with more ADHD-related symptoms will expect to experience more of caffeine's stimulant effects compared to those with less symptoms.

2a: Participants with more ADHD-related symptoms will have a more positive regard toward the effectiveness of their stimulant medication compared to those with less related symptoms.

2b: Participants with more inattentive symptoms will have a more positive regard toward the effectiveness of their stimulant medication compared to those with less inattentive symptoms.

3a: Participants with more inattentive symptoms will have a greater motivation to consume caffeine compared to those with less inattentive symptoms.

3b: Participants with more inattentive symptoms will expect to experience more of caffeine's stimulant effects compared to those less inattentive symptoms.

Method

Participants

The study consisted of 146 participants (N = 146) and the ages ranged from 17 to 77 years old (M = 26.14, SD = 10.77). Of the participants, 84.9% were female (n = 124), and 14.4%

were male (*n* = 21). The ethnic composition was 81.5% White (*n* = 119), 6.2% Black (*n* = 9), 6% Mixed Origin (*n* = 6), 3.4% Latin American (*n* = 5), 2.1% South Asian (*n* = 3), 1.4% East Asian (*n* = 2), 0.7% Southeast Asian (*n* = 1), and 0.7% Indigenous/Native American (*n* = 1). Individuals were voluntarily recruited to participate in this study via social media posts, email, or flyers posted around the university campus. Some of the college students were also offered extra credit, as long as proof was provided for two sections of an introductory freshman seminar course. Inclusionary criteria for participants were to have had at least two of the following: professional ADHD diagnosis, consumes caffeine, and history of taking stimulant medication with a medical prescription.

Measures

The Wender Utah Rating Scale (WURS)

To assess ADHD-related symptomology in childhood, the Wender Utah Rating Scale (WURS) was employed (Ward et al., 1993). Though this tool asks questions about symptomology in childhood, it is regarded as a good, primary tool to retrospectively gauge adult ADHD severity based upon lived childhood experience. The full assessment is 61 questions and can be used to evaluate other psychopathologies. The current study only utilized the 25 questions that directly pertained to ADHD. The tool is especially useful given the current diagnostic criteria within the DSM-5 require symptoms to be present in childhood (Stanton & Watson, 2016). Scores range from 0 to 100, with 0 being little-to-no ADHD-related childhood experiences and 100 being a likely severe case of ADHD. To be considered as having ADHD symptomology, participants must score higher than 46 on the assessment. The measure has been shown to have high reliability and internal consistency (α = .94).

The Adult ADHD Self-Report Scale-V 1.1

Another tool used to assess ADHD-related symptomology was The Adult ADHD Self-Report Scale-V 1.1 (ASRS-V 1.1), which focuses specifically on current severity and presentations. Questions are broken into two different parts: Part A (6 items) and Part B (12 items). Participants were asked to rate, on a scale of 0 (Never) to 4 (Very Often), how much they related to each of the statements within the past six months. Ratings from all 18 questions were summed to form a total score. Total scores from 0 to 6 indicated a low likelihood of having ADHD (L-ADHD Group), total scores from 7 to 23 indicated a likelihood of having ADHD (Medium/M-ADHD Group), and total scores 24 and above indicated a strong likelihood of having ADHD (High/H-ADHD Group). A score of 17 or above indicates a high prevalence of ADHD-related symptomology and more prominent presentations of symptomology. The ASRS also included inattentive-symptom-based questions (10 items; INN questions) and hyperactive/impulsive-symptom-based questions (8 items; H/I questions) to help the clinician determine which presentation of ADHD the individual resonates with the most (Kessler et al., 2005). This measure also has high reliability and internal consistency (α = .91).

SNAP – IV

The Swanson, Nolan, and Pelham (SNAP)–IV[5] is a 26-item assessment that was also used, and adapted from the original 90-item assessment given to parents and teachers of children with ADHD. SNAO is used to review ADHD-related symptomology and measures the prevalence of each presentation type (Swanson et al., 2001). Adapted to the self-report nature of the present study, participants were asked to rate from 0 (Not at All) to 3 (Very Often) on how frequently they experienced each symptom along with prevalence. Questions were divided into inattentive (INN; 9 items; α = 0.95) and hyperactive/impulsive (H/I; 9 items; α = 0.86) subscales.

[5] It should be noted that the SNAP-IV is based on criteria from the fourth version of the DSM.

Participants' subscale scores were considered "Not Clinically Significant" if they were below 13, "Mild" if between 14 and 17, "Moderate" if between 18 and 22, and "Severe" if between 23 and 27. This 26-item version did include ODD-related symptomology, and analysis of scores from this subsection were not included in the present study, as it was not relevant to its main purpose.

The Motives for Caffeine Consumption Questionnaire

The Motives for Caffeine Consumption Questionnaire (MCCQ) was employed to assess participants' reason to seek caffeine and their consumption of it. Motivating factors were divided into specific sections[6], with questions pertaining to Habit (2 items; $\alpha = 0.76$), Alertness (9 items; $\alpha = 0.93$), and Mood (2 items; $\alpha = 0.87$; Ágoston et al., 2017).

The Caffeine Expectancy Questionnaire

The Caffeine Expectancy Questionnaire (CaffEQ) was used to evaluate what participants anticipated to feel after consuming caffeine. CaffEQ consisted of 47 questions, which were divided into subsections[7] to assess questions related to Withdrawal/Dependence (12 items; $\alpha = 0.96$), Energy/Work Enhancement (8 items; $\alpha = 0.95$), and Social/Mood Enhancement (6 items; $\alpha = 0.92$). Scores for each subsection were determined by adding responses for the corresponding questions, based on a per-item rating from very unlikely (0) to very likely (5; Huntley & Juliano, 2012).

The Drug Attitude Inventory

[6] The original scale has additional subscales of Symptom Management (2 items), Social (6 items), and Taste (2 items), though they were not assessed in the present study.

[7] The original scale has additional subscales of Appetite Suppression (5 items), Physical Performance Enhancement (3 items), Anxiety/Negative Physical Effects (9 items), and Sleep Disturbance (4 items), though they were not assessed in the present study.

The Drug Attitude Inventory (DAI)[8] was specific to individuals with ADHD that had a history of taking stimulant medication as part of their treatment plan. The present study used the full 30-question version of the DAI to assess how effective these participants believed their medication was and assess the overall experience they had taking the medication. Participants answered True (T) or False (F) to the 30 items and the baseline score was 0. If the participant selected an answer bolded in the initial inventory, formatting was counted as +1. Whereas not selecting the bolded answer for each question counted as -1. Each bolded answer choice represented the *correct* response a participant should make if they were fully adherent to their medication plan and had a positive subjective response. A total score was calculated by subtracting the total positive score (α = .90) from the total negative score (α = .85). A negative total score indicated a negative subjective experience when taking stimulant medication and non-adherence to treatment. However, a positive total score indicated a positive subjective experience when taking stimulant medication and adherence to treatment (Hogan et al., 1983).

Procedure

Participants were made aware of this study through social media posts, via promotional emails, or flyers posted around a university campus. The actual assessment was conducted using the online survey software, Qualtrics. The first page of the survey provided a description of the study's purpose, participant inclusion criteria and a general overview. Participants were asked to read over the informed consent form and to indicate if they consented to participate in the study. If provided consent, they were then presented with the questionnaires: WURS, ASRS-V 1.1, SNAP-IV, MCCQ, CaffEQ, DAI. All questionnaires were counterbalanced to help reduce order

[8] When taking the questionnaire, only participants that indicated a current prescription for stimulant medication took this assessment.

effects. At the end, participants were thanked for their involvement and given the researcher's contact information if they had any questions or concerns following the study.

Results

ADHD-Related Symptoms and Caffeine

Upon analyzing the findings, there was no evidence to support hypothesis 1a. There was no significant correlation between amount of ARS and motivation to consume caffeine. However, there was evidence to support hypothesis 1b. Individuals with M-ARS in childhood reported consuming more caffeine to not experience the negative withdrawal effects, r (125) = .26, $p < .01$, as well as for a social/mood boost, r (125) = .22, $p = .02$. Additional results found that individuals with M-ARS in adulthood had the same pronounced caffeine consumption motivations in withdrawal/dependence, r (125) = .28, $p < .01$, and social/mood enhancement r (125) = .21, $p = .02$.

Reception of Stimulant Medication

After examining the results, there was no evidence found to support hypothesis 2a. There was no significant correlation between amount of ARS and positive regard toward the effectiveness of stimulant medication. There was no evidence to support hypothesis 2b. No significant correlation was found between amount of IN symptoms and positive regard toward the effectiveness of stimulant medication.

Comparing ADHD Presentations

When comparing ADHD presentations, there was no evidence to support hypothesis 3a. There was no significant correlation between amount of IN symptoms and motivation to consume caffeine. Data was found to support hypothesis 3b. Participants with M-IN expected

caffeine consumption to help them prevent and/or alleviate withdrawal symptoms, r (124) = .27, $p < .01$.

Discussion

The current study aimed to understand the relationship between adults with ADHD and their usage of both caffeine and stimulant medication. This study was able to provide evidence on some of the consumption motivations and habits of those with ADHD. It also revealed how those with greater amounts of ADHD-related symptoms perceived the effectiveness of their stimulant medication.

Results from the present study revealed insights into the relationship individuals with ADHD have with both caffeine and stimulant medication. No evidence was found to support hypothesis 1a, which predicted that those with M-ARS would have a greater motivation to consume caffeine compared to those with L-ARS. A lack of correlation between M-ARS and greater consumption motivation may suggest that those with both M-ARS and L-ARS consume for similar reasons. The general expectation for consuming caffeine, regardless of the presence or lack of mental disorder(s), is that it will help you feel alert. The difference between caffeine consumption motivations in M-ARS versus L-ARS may not be in the exact motivation, but rather in the severity of what they are trying to combat with the caffeine. Those with L-ARS may only be trying to have a pick-me-up to help with their productivity, however individuals with M-ARS may be unknowingly self-medicating ARS. A study by Lara (2010) reveals this by stating that individuals with ADHD use caffeine to sustain attention and increase arousal levels. The differentiation appears to come from the etiology of sluggishness and lack of alertness.

Hypothesis 1b predicted that those with M-ARS would expect more of the stimulant effect of caffeine compared to those with L-ARS. Evidence was found to support this hypothesis,

as those with more childhood ADHD-related symptoms (M-CARS) and more ADHD-related symptoms in adulthood (M-AARS) had a greater expectation for caffeine to both improve their sociability and mood as well as prevent/alleviate symptoms of caffeine withdrawal. For those with M-CARS, higher levels within the subscales may suggest that they have been using caffeine to cope with their ARS for so long that they feel better when on it; this could be especially true considering the higher scores on the Withdrawal/Dependence subscale. Caffeine's stimulant effects may help them feel more socially competent, especially if their ADHD diagnosis came later in life. Moreover, in their childhood, all they may have understood about their ARS was that it made them feel "different" from their peers.

Since the present study gives insight into both CARS and AARS, results from the AARS may reveal a bleed-over from childhood to adulthood in the treatment of ARS via caffeine. Those with M-AARS likely have consumed it so regularly that it has become routine for them, and they do not want to go without it for whatever reason. This suggests that those with M-AARS have become partially, if not entirely, dependent on caffeine to help alleviate at least some of their ARS. Regarding social/mood improvement, adults with ADHD are often seen as less competent or less hard-working compared to their neurotypical peers (Nylander et al., 2021), and caffeine self-medication is considered a better alternative to no ADHD treatment whatsoever (Ioannidis et al., 2014). Harpin and others' (2013) findings revealed that individuals with no ADHD treatment had significantly poorer long-term consequences in the areas of social function and self-esteem, and an overall poorer quality of life compared to those with treated ADHD and non-ADHD controls. For those with no ADHD diagnosis, unintentional self-medication of ARS may be something that has become essential in their day-to-day functionality, especially if they have identified ARS that persisted after childhood.

Hypothesis 2a assumed that those with M-ARS would have a more positive regard toward the effectiveness of their stimulant medication compared to L-ARS participants. The data did not support this hypothesis; no difference was observed between the groups. These results suggest that perceived effectiveness of stimulants may not be linked to an individual's ARS. Regardless of which presentation patients present with, stimulant medication is the first line of treatment for those with ADHD (Advokat, 2010). Similar to the conclusion made by Fosco and colleagues (2021), it may not be that the amount of ARS is what impacts the perceived effectiveness of stimulants, but rather the individual's baseline cognitive performance before taking stimulants. Another factor to consider is that stimulants have been found to be most effective for people with ADHD in the short term rather than the long term. Further implying that the amount of ARS one has may not be a better indicator of effectiveness than the duration of treatment.

Hypothesis 2b predicted that participants with M-IN would have a more positive regard toward the effectiveness of their stimulant medication compared to L-IN participants. No evidence was found to support this hypothesis. In a similar line of thinking to the conclusion from hypothesis 2a, stimulants' effectiveness may not be determined by which presentation of ADHD a person gravitates more towards. After all, stimulant medication improves symptoms from both presentations such as decreasing impulsivity and increasing concentration (Advokat, 2010).

Hypothesis 3a expected those with M-IN to have a greater motivation to consume caffeine compared to those with L-IN. No significant correlation or data was found to support this hypothesis. These results suggest that even though caffeine's main stimulant effects are that of increasing arousal and sustaining attention longer (Lara, 2010) – cognitive deficits primarily

associated with Inattentive ARS – dominant symptom presentation does not appear to impact the motivation of those with ADHD to consume caffeine. There appears to be an equal amount of motivation among all ADHD participants. Another possibility is that, as mentioned previously, people may not connect consuming caffeine to self-medicating ARS (Ioannidis et al., 2014), especially depending on whether they are taking stimulants.

Finally, hypothesis 3b predicted that participants with M-IN would expect to experience caffeine's stimulant effects more strongly than those with L-IN. Data was found to support this hypothesis, as those with M-IN had a significant positive correlation with withdrawal/dependence expectancy. These results suggest that, whether intentional or not, individuals with M-IN have at least partially become dependent on caffeine to help alleviate their ARS. This is revealed by the fact that the withdrawal/dependence expectancy implies a heavy reliance on caffeine, so much so that the individuals are aware of the consequences of ceasing their long-term use. This is similar to results of Ágoston and colleagues (2022), which discovered that the severity of ARS is positively correlated to problematic caffeine consumption.

Limitations and Future Directions

The present study has multiple limitations that should be considered in future replications. First, due to the limited scope by which participants were recruited, the sample was not representative. This was also likely due to the relatively small sample size and participants that had to be removed from analysis due to incomplete responses. Additionally, given that the present study utilized an online convenience sample, this potentially lowered the likelihood of getting responses, as people could easily opt to not participate and scroll past information regarding this study. Lastly, given the limited outreach and low representation of the present study, the ADHD and non-ADHD groups were not equal.

Future researchers can obtain a larger sample size to ensure findings are more generalizable to the population. Also, researchers should consider utilizing an analog approach for the actual conduction of their assessment (i.e., in-person with the questionnaire on paper); this could potentially help reduce the number of incomplete surveys to be discarded from the final statistical analysis. Researchers may also want to put more of an emphasis on recruiting participants by non-online means to increase their outreach. Future replications may also want to consider additional factors such as age and sleep on average to further address the intersectionality of this topic. Finally, a longitudinal study following the caffeine consumption habits of those with childhood-diagnosed ADHD may be another way to expand upon conclusions from the present study; particularly the implication of results from Withdrawal/Dependence subscales.

Conclusion

To conclude, the current study found that the amount of ARS someone has does not appear to impact their motivation to consume caffeine or their reception of the effectiveness of stimulant medication. Furthermore, the amount of ARS one has does seem to increase the stimulant expectancy that follows from caffeine consumption. One's primary ADHD symptom presentation type does not appear to impact their perception of the effectiveness of stimulant medication or motivation to consume caffeine. Finally, dominant ADHD symptom presentation does appear to impact how stimulating someone anticipates caffeine to be.

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