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Executive Dysfunction and Anxiety in Adolescent Females with ADHD: A Study of Arab Israeli Students

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Abstract

This study examined the relationships between anxiety and executive functioning in Arab Israeli female adolescents diagnosed with Attention-Deficit/Hyperactivity Disorder (ADHD), compared to their typically developing peers. The aim was to explore differences in emotional and metacognitive executive functions, as well as how anxiety correlates with these cognitive domains within a culturally specific and gender-sensitive population. Eighty adolescent girls aged 15–18 (40 with ADHD and 40 controls) completed self-report measures assessing anxiety and executive functions using the BRIEF-SR and State-Trait Anxiety Inventory. No significant group differences were found in behavioral aspects of executive functions (inhibition, shifting, emotional control, and monitoring) or in overall anxiety levels. However, the ADHD group demonstrated significantly greater difficulties in all metacognitive executive function domains—including working memory, planning, organization, and task completion—as well as higher scores on the Metacognitive Index and Global Executive Composite. Correlational analyses revealed that anxiety was significantly associated with both behavioral and metacognitive executive dysfunction in the control group. In the ADHD group, however, anxiety was only significantly related to behavioral regulation, not metacognitive functioning. These findings underscore the importance of metacognitive support in interventions for adolescent girls with ADHD. Culturally tailored educational strategies that target working memory, planning, and organizational skills may help improve academic performance and overall adaptive functioning in this underserved population.

Keywords: ADHD; executive functions; anxiety; Arab adolescents; behavioral regulation

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1. Introduction

Adolescence is a pivotal developmental period marked by biological, psychological, and social changes [1–3]. Executive functions (EFs)—including self-regulation, emotional control, problem-solving, and goal-directed behavior—undergo rapid development and are critical for academic success, emotional health, and social functioning [4–6]. Adolescents with Attention-Deficit/Hyperactivity Disorder (ADHD) often experience disruptions in these processes, leading to persistent difficulties in attention, impulse control, and executive functioning.

ADHD affects an estimated 2%–14% of school-aged children worldwide, and affects approximately 5.6% of adolescents aged 12 to 18 years globally, depending on the

definition [7–9]. In Arab countries, reported variability across studies, with ADHD prevalence ranging between 0.46 and 19.6% [9,10], with symptoms often continuing into adolescence. While research has traditionally focused on males, females with ADHD frequently exhibit internalizing symptoms, such as anxiety and emotional dysregulation, rather than hyperactivity or impulsivity [11–13]. Consequently, ADHD in females is often underdiagnosed or mischaracterized. Females are generally less likely to be diagnosed with ADHD in childhood than males, often receiving a diagnosis later and exhibiting compensatory behaviors that mask symptoms [14].

Arab Israeli adolescent girls represent a particularly at-risk group due to intersecting cultural, societal, and educational pressures, including adherence to traditional gender norms and stigma surrounding mental health. These factors may affect the manifestation, reporting, and management of ADHD and anxiety [15,16]. Mental health stigma prevalent in Arab communities can discourage help-seeking behaviors, delay diagnosis, and limit access to culturally sensitive interventions [17,18]. Socioeconomic constraints may further exacerbate these challenges. Despite these pressing issues, research on ADHD, EF, and anxiety in this population remains scarce, although some studies have examined ADHD prevalence and associated social–emotional challenges among Arab Israeli children and adolescents [19,20].

1.1. ADHD and Executive Function in Adolescents

Executive Functions (EFs) are higher-order cognitive processes essential for goal-directed behavior, enabling individuals to regulate thoughts, emotions, and actions even under distraction, competing demands, or emotionally charged contexts [21,22]. EFs are typically categorized into two broad domains: metacognition and emotional regulation [23,24].

Metacognition refers to higher-order thinking processes used to monitor, control, and plan one's cognitive activities [25]. Key components include working memory (holding and manipulating information), planning and organization (structuring and sequencing actions toward a goal), and task initiation and completion [23–26]. These processes are foundational for academic achievement, problem-solving, and effective time management.

Emotional regulation, closely linked with metacognitive monitoring, includes inhibitory control (the capacity to suppress impulsive behaviors), cognitive flexibility or shifting (the ability to adapt to changing demands or perspectives), continuous self-monitoring, and modulation of emotional responses [27–29]. These abilities are critical for coping with stress, managing social relationships, and maintaining goal-directed behavior under emotional or cognitive pressure [30].

Adolescents with ADHD frequently exhibit deficits across both metacognitive and emotional regulation domains. Such impairments are often amplified during adolescence due to heightened emotional sensitivity and increasing academic and social demands [31–33]. Emotional dysregulation may manifest as impulsivity, mood instability, low frustration tolerance, and difficulty shifting attention between affective and cognitive tasks [34,35]. Metacognitive deficits typically appear as disorganization, poor planning, limited working memory capacity, and problems completing tasks or meeting deadlines [36,37].These deficits negatively impact academic performance, self-efficacy, and long-term outcomes if unaddressed.

1.2. Anxiety and Executive Functions

Anxiety is one of the most prevalent psychiatric conditions in adolescence and is particularly frequent among females [38,39]. Anxiety can impair cognitive processes central to executive functions, such as working memory, inhibitory control, and cogni-

tive flexibility [40–42]. By increasing cognitive load, anxiety reduces available attentional resources and interferes with problem-solving and planning.

The relationship between anxiety and EF is bidirectional: deficits in executive functioning can heighten vulnerability to anxiety, while anxiety symptoms may further disrupt the effective utilization of executive resources [43–45]. Adolescents with difficulties in emotional regulation are especially sensitive to stress and more likely to develop anxiety symptoms. Therefore, anxiety and EF dysfunction can form a mutually reinforcing cycle that exacerbates emotional and cognitive difficulties during adolescence, particularly among adolescents with ADHD.

1.3. Gender-Specific and Cultural Considerations

In the existing literature, female adolescents with ADHD are frequently described as exhibiting a subtler clinical profile compared to males [46]. Rather than displaying overt externalizing behaviors such as hyperactivity or impulsivity, they are more likely to present with internalizing symptoms, including anxiety, mood disturbances, and social withdrawal [12,13,47,48]. This underdiagnosis is further compounded by sociocultural pressures that shape symptom expression and recognition, particularly in populations where mental health stigma is prevalent [14]. As a result, ADHD in girls can remain undetected, delaying interventions and exacerbating academic and emotional difficulties.

Cultural background significantly influences the perception, expression, and management of ADHD and anxiety. Among Arab Israeli adolescents, particularly females, these conditions are shaped by intersecting psychosocial pressures, including traditional gender roles, elevated academic expectations, and pervasive mental health stigma. Such cultural dynamics may contribute to underdiagnosis, internalized distress, and reduced access to appropriate interventions [19,20,49,50].

Despite these challenges, research examining ADHD and anxiety in Arab Israeli adolescents—and in minority female populations more broadly—is limited. Most existing studies focus on Western, majority populations, and little is known about how ADHD and anxiety manifest within cultural contexts characterized by strong social norms and mental health stigma. Investigating these factors is therefore particularly crucial, as ADHD and anxiety may present differently in females, and sociocultural pressures can further obscure recognition and support.

1.4. The Current Study

Most existing research on ADHD has focused on Western, majority populations, leaving significant gaps in our understanding of how this condition manifests among minority adolescents [51,52]. Cultural and social environments can shape the presentation, diagnosis, and impact of ADHD and its related emotional difficulties. For Arab Israeli adolescent girls, these influences are particularly complex, as they navigate multiple, intersecting pressures—traditional gender norms, strong academic expectations, and stigmatizing attitudes toward mental health. Understanding the delayed and under-recognized presentation of ADHD in females [14] is therefore crucial for interpreting how executive dysfunction and anxiety interact in this population.

The current study seeks to address these gaps by examining the relationship between ADHD, executive functions (EF), and anxiety in Arab Israeli female adolescents aged 15–18. Specifically, it compares the emotional and metacognitive EF profiles and anxiety levels of girls diagnosed with ADHD to those of their typically developing peers. This integrative approach allows for a deeper understanding of how cognitive and emotional processes interact within a distinct cultural and gendered context. By highlighting the ways in which anxiety may intersect with executive dysfunction, the study aims to contribute to a more

comprehensive, culturally sensitive understanding of ADHD in female adolescents and to inform future diagnostic and intervention practices in minority populations.

1.5. Research Aims

The present study aims to examine the interplay between anxiety and executive functions (EF) among Arab Israeli female adolescents with and without ADHD. Specifically, it seeks to compare anxiety levels and both emotional and metacognitive aspects of EF across the two groups, and to explore how anxiety relates to behavioral aspects of EF in each group, as well as how anxiety relates to metacognitive aspects of EF in each group. Through this analysis, the study aims to deepen understanding of the cognitive–emotional dynamics associated with ADHD in female adolescents within a distinct cultural context.

1.6. Research Questions

1. Do Arab Israeli female adolescents with ADHD exhibit higher levels of anxiety compared to their typically developing peers?
2. Are there significant differences in behavioral aspects of executive functions (inhibition, shifting, emotional control, monitoring) between the ADHD and non-ADHD groups?
3. Are there significant differences in metacognitive executive functions (working memory, planning, organization of materials, task completion) between the two groups?
4. Is there a significant relationship between anxiety and behavioral aspects of executive functions in each group?
5. Is there a significant relationship between anxiety and metacognitive executive functions in each group?

2. Materials and Methods

2.1. Participants

The study included 80 Arab Israeli female adolescents, divided equally into an ADHD group and a non-ADHD control group. All participants were between 15 and 18 years of age and were enrolled in mainstream high schools (within regular classes). The control group was recruited to be broadly comparable to the ADHD group in terms of age, gender, and grade level; however, statistical comparisons of these characteristics were conducted as an additional verification step to ensure no significant group differences remained (see Table 1).

Before participation, all adolescents and their parents received a clear explanation of the study's goals, procedures, and confidentiality assurances. Written informed consent was obtained electronically from both the adolescents and their parents through secure online forms. Participation was voluntary, and participants were informed that they could withdraw from the study at any time without penalty. The study was conducted in accordance with the Declaration of Helsinki and was approved by the College of Education's Ethics Committee (Approval Number: 12/2024–97a).

2.1.1. ADHD Group

The ADHD group consisted of 40 adolescents aged 15 to 18 years (M = 16.85, SD = 0.80). Each participant had a formal diagnosis of ADHD established before recruitment by a licensed neurologist or psychiatrist, in accordance with the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) criteria.

These diagnoses were not made for this study but were based on pre-existing clinical records. To ensure diagnostic validity, only adolescents whose ADHD diagnosis was supported by comprehensive professional documentation were included. This documen-

tation, provided by parents or school psychologists, verified that the diagnostic process had involved: Clinical anamnesis and psychiatric evaluation, neurological examination, cognitive assessment using the Wechsler Scales [53] and behavioral assessments using both the Conners' Parent Rating Scale–Revised (CPRS-R) and the Conners' Teacher Rating Scale–Revised (CTRS-R) [54].

2.1.2. Non-ADHD Control Group

The control group comprised 40 Arab Israeli female adolescents aged 15 to 18 years (M = 16.75, SD = 0.87), all of whom were typically developing and had no reported neurodevelopmental, psychological, or sleep disorders. This group was matched with the ADHD group for age, gender, and school grade level to ensure comparability and strengthen the internal validity of group comparisons.

2.2. Procedure

Recruitment for the ADHD group was conducted in collaboration with school counselors and teachers from seven Arab Israeli high schools. Counselors identified students with a prior clinical ADHD diagnosis and, following school approval, contacted their families to explain the study and invite participation. Invitations were delivered verbally and through printed information sheets distributed during regular class hours. All recruitment and initial communication were conducted by school staff rather than by the researchers, in order to protect confidentiality and reduce perceived coercion.

Information about the type or timing of each participant's ADHD diagnosis was not collected, which may have introduced variability in their familiarity with professional support or coping strategies. To minimize potential medication-related confounds, adolescents currently receiving pharmacological treatment were excluded. Additionally, five participants from the ADHD group were excluded from the final analysis due to dropout or incomplete questionnaire responses.

Control participants were recruited through an online screening survey disseminated via school communication channels and social media platforms (e.g., WhatsApp, Facebook, and Instagram). Teachers, counselors, and parent representatives shared the survey link accompanied by both an audio explanation and a written description outlining the study's purpose, procedures, and inclusion criteria. This informational format was identical to that provided to the ADHD group, ensuring consistency in recruitment materials across both groups.

The screening survey included questions about participants' medical, neurodevelopmental, and psychological histories to confirm that respondents were typically developing and free from any diagnosed or suspected disorders. From the 78 eligible respondents who met all inclusion criteria, 40 were randomly selected to form the final control group. This process ensured comparability between the ADHD and control groups in age, gender, and educational background, thereby strengthening the study's internal validity.

2.3. Data Collection Procedure

After recruitment and eligibility verification, all participants completed the study materials online through a secure Google Forms platform. Each participant was provided with an individualized access link and clear instructions. The questionnaire package included: (1) a socio-demographic section, (2) a validated measure of state and trait anxiety for adolescents, and (3) a self-report scale assessing executive functioning.

2.4. Measures

2.4.1. Socio-Demographic Questionnaire

Participants or their parents completed a brief socio-demographic questionnaire that collected background information including age, grade level, class type (regular or special education), place of residence (urban or rural), current use of medication, and neurodevelopmental or psychological history.

2.4.2. Anxiety

State-Trait Anxiety Inventory (STAI)

The State-Trait Anxiety Inventory (STAI), developed by Spielberger et al. [55], is a widely used psychological tool to measure anxiety, consisting of two distinct 20-question scales. The State Anxiety Inventory (STAI-S) assesses an individual's current feelings of anxiety at a specific moment or under particular conditions, reflecting a temporary emotional state. In contrast, the Trait Anxiety Scale (STAI-T) measures an individual's general and enduring predisposition to experience anxiety, regardless of the immediate situation, thus reflecting a more stable personality characteristic.

For both scales, respondents indicate the intensity of their emotions or behaviors by choosing from options like "Not at all," "A little," "Somewhat," and "Very much so." Scoring involves a calculation where the total score from "opposite expressive expressions" is subtracted from "direct expressions," and a constant value is then added. The resulting total score for each scale can range from 20 to 80, providing a single composite measure of overall anxiety. In this study, the overall anxiety score was computed by averaging the STAI-S and STAI-T scores, with higher scores indicating greater anxiety. STAI scores were categorized based on established guidelines as follows: 20–37 = low anxiety, 38–44 = moderate anxiety, 45–80 = high anxiety [56–58]. These categories were used to interpret and report the proportion of participants exhibiting different levels of anxiety in the ADHD and control groups.

The STAI has been adapted and validated across various cultures. For the Arabic version of the standard STAI, validation studies reported moderate one-week test–retest reliability for State Anxiety (0.57 for males, 0.47 for females) and good reliability for Trait Anxiety (0.78 for males, 0.82 for females). Internal consistency, measured by Cronbach's alpha, was excellent for State Anxiety (0.91 for males, 0.94 for females) and acceptable to good for Trait Anxiety (0.77 for males, 0.91 for females) [59]. In this study, the standard Arabic STAI was used, which is appropriate for adolescent samples.

2.4.3. Executive Functions (EFs)

The Behavior Rating Inventory of Executive Function, Self-Report (BRIEF-SR) [60], which is composed of 80 items, particularly developed for adolescents, that assess behavior problems based on their frequency over the past month, using a three-point scale: (1) Never, (2) Sometimes, or (3) Often. It includes eight clinical subscales, which are grouped into two major indices: the Behavioral Regulation Index (Inhibit, Shift, Emotional Control, and Monitor) and the Metacognition Index (Working Memory, Plan/Organize, Organization of Materials, and Task Completion). These subscales also contribute to the Global Executive Composite, which reflects an overall measure of executive functioning. A higher score on the MCI and the BRI indicates more problems with executive functioning. Scores on the BRIEF-SR are reported as T-scores, with a mean of 50 and a standard deviation of 10. Higher T-scores reflect greater difficulties in executive functioning. Specifically, scores between 60 and 64 are regarded as mildly elevated, scores from 65 to 69 indicate potential clinical concerns, and scores of 70 or above are classified as clinically elevated.

The BRIEF-SR has demonstrated solid psychometric strength in studies involving adolescents, with Cronbach's alpha reaching 0.96 for the Global Executive Composite (GEC) and ranging from 0.72 to 0.96 across the individual clinical scales. Additionally, interrater reliability between the GEC scores of the BRIEF-P and BRIEF-SR was found to be moderate to strong, with a correlation coefficient of $r = 0.56$ [60].

2.4.4. Data Analysis

The data were analyzed using IBM SPSS Statistics (Version 28). Before conducting inferential analyses, data were screened for missing values, outliers, and assumptions of normality, linearity, and homoscedasticity. Although the variance of each variable under investigation did not differ significantly between the two groups, several variables violated the normality assumption due to skewed distributions. Normality was assessed using skewness and kurtosis values, along with the Kolmogorov–Smirnov test. Based on these assessments, non-parametric (ordinal) analyses were conducted using SPSS (Version 28) to compare groups and assess relationships between variables. Specifically, the Spearman rank-order correlation and the Mann–Whitney U test were used.

To examine whether there were significant differences in the distribution of age and grade level between the ADHD and control groups, Chi-square tests of independence were conducted. Age and grade were treated as categorical variables, and group (ADHD vs. Control) served as the independent variable.

Descriptive statistics (means and standard deviations) were computed for all demographic and study variables, including anxiety (state and trait), behavioral aspects of executive functions (Inhibit, Shift, Emotional Control, Monitor), and metacognitive executive functions (Working Memory, Plan/Organize, Organization of Materials, Task Completion). Although several variables were skewed and non-parametric tests were used, means and standard deviations are reported for descriptive purposes and to facilitate comparison with previous studies, as the distributions were approximately symmetric and no extreme outliers were detected. Medians and Interquartile Ranges (IQRs) were also computed in preliminary analyses, confirming similar patterns (See Supplementary Table S1).

To address the first research question, nonparametric Mann–Whitney tests were conducted to compare anxiety levels between the ADHD and non-ADHD groups.

For the second and third research questions, additional nonparametric Mann–Whitney tests were performed to assess group differences in emotional and metacognitive executive function domains, respectively.

To examine the fourth and fifth research questions, Nonparametric Spearman correlation analyses were conducted separately for each group (ADHD and non-ADHD) to explore the relationships between anxiety and both emotional and metacognitive executive function indices.

To account for the multiple Mann–Whitney U comparisons performed (N = 12), a Bonferroni correction was applied to control for the family-wise Type I error rate. Therefore, statistical significance for these comparisons was set at an adjusted alpha level of $p < 0.05/12 = 0.004167$.

Effect sizes (the *Cramer's V* effect size for chi-square, *nonparametric Mann–Whitney test*, and *r* for correlations) were calculated to determine the magnitude of group differences and associations. Statistical significance was set at $p < 0.05$.

A post hoc power analysis was conducted using G*Power 3.1 [61] to evaluate the sensitivity of the study given the final sample size ($N = 80$). Results indicated that the study had sufficient power ($1-\beta > 0.80$) to detect moderate-to-large effects (Cohen's $d \geq 0.50$).

3. Results

Table 1 shows the distribution of participants by age and grade for the ADHD and control groups. These comparisons served as an additional check to ensure that the groups were broadly comparable on these demographic characteristics. No significant differences were observed between the groups in terms of age ($X^2 = 0.77$, $p = 0.857$, $V = 0.10$) or grade ($X^2 = 0.50$, $p = 0.778$, $V = 0.08$).

Table 1. Age and Grade Distributions of the ADHD and Control Groups.

Variable	Category	Number		Percentage (%)	
		ADHD Group (n = 40)	Control Group (n = 40)	ADHD Group	Control Group
Age	15 years old	1	2	2.5	5
	16 years old	13	15	32.5	37.5
	17 years old	17	14	42.5	35
	18 years old	9	9	22.5	22.5
Grade	10th grade	7	9	17.5	22.5
	11th grade	24	21	60	52.5
	12th grade	9	10	22.5	25

Table 2 presents the results of the means and standard deviations of state-trait anxiety, executive functions scales, behavior regulation index (BRI), metacognitive index (MI) global executive composite (GEC), in the control (adolescents without ADHD) and ADHD groups, as well as the differences between the two groups in these measures.

Table 2. Means and Standard Deviations of the Study Variables, and Differences between the Control (Adolescents without ADHD) and ADHD Group.

	Control Group (n = 40)	ADHD Group (n = 40)	Mann–Whitney Test for Group Comparison		
	M (*SD*)	*M* (*SD*)	*z*	*p*	*r*
Anxiety					
State-Trait Anxiety Inventory	39.73 (6.87)	42.05 (6.39)	−1.02	0.310	−0.11
Executive Functions					
Inhibit	54.83 (4.03)	55.85 (4.19)	−1.09	0.275	−0.12
Shift	56.18 (3.92)	57.08 (4.06)	−0.92	0.356	−0.10
Emotional Control	58.25 (3.95)	58.48 (4.08)	−0.28	0.783	−0.03
Monitor	51.33 (3.76)	52.52 (4.03)	−1.30	0.193	−0.15
Working Memory	53.40 (3.73)	61.65 (3.79)	**−6.73**	**<0.001**	**−0.75**
Plan/Organize	51.85 (3.05)	61.50 (3.71)	**−7.25**	**<0.001**	**−0.81**
Organization of Materials	48.45 (3.82)	58.43 (3.93)	**−7.41**	**<0.001**	**−0.83**
Task Completion	45.80 (4.01)	62.43 (3.93)	**−7.44**	**<0.001**	**−0.83**
BRIEF-SR Behavior Regulation Index (BRI)	55.62 (3.88)	56.43 (4.02)	−0.95	0.343	−0.11
BRIEF-SR Metacognitive Index (MI)	50.29 (3.16)	61.25 (3.68)	**−7.37**	**<0.001**	**−0.82**
BRIEF-SR General Executive Composite (GEC)	52.82 (3.13)	58.96 (3.75)	**−6.11**	**<0.001**	**−0.68**

Bolded type denotes significance.

3.1. Anxiety

The findings reveal that 47.5% of adolescents in the control group (without ADHD) exhibited low levels of anxiety, compared to 30% in the ADHD group. Mild levels of anxiety were reported by 15% of participants in the control group, whereas a higher proportion (32.5%) was observed among those with ADHD. Additionally, 25% of participants in both groups reported moderate levels of anxiety. Similarly, 12.5% of participants in each group experienced high levels of anxiety. These results suggest that while there are observable differences in the distribution of low and mild anxiety levels between the groups, no substantial differences were found in the proportions reporting moderate or high levels of anxiety. A Mann–Whitney U test indicated no significant difference in total anxiety scores between the ADHD group and the control group ($U = 694.50$, $z = -1.02$, $p = 0.310$).

3.2. Executive Functions

3.2.1. Behavioral Aspects of Executive Functions

No significant differences were found between the ADHD and control groups on measures of behavioral aspects of executive functions. Specifically, there were no statistically significant differences in inhibition ($U = 687$, p = n.s), shifting ($U = 704.50$, p = n.s), emotional control ($U = 771.50$, p = n.s), or monitoring ($U = 665$, p = n.s). Consistently, no significant difference was found in the Behavior Regulation Index (BRI) of the BRIEF-SR ($U = 701.50$, p = n.s), suggesting comparable levels of behavioral and emotional regulation across groups (detailed values are presented in Table 2).

3.2.2. Metacognitive Executive Functions

In contrast, significant differences were found in all measures of metacognitive executive functions, with the ADHD group showing significantly higher (i.e., more impaired) scores compared to the control group. Participants with ADHD had significantly greater difficulties in working memory ($U = 103$, $p < 0.001$), planning/organizing ($U = 48$, $p < 0.001$), organization of materials ($U = 31.5$, $p < 0.001$), and task completion ($U = 28$, $p < 0.001$). These differences were also reflected in the Metacognitive Index (MI) of the BRIEF-SR, where the ADHD group scored significantly higher than the control group ($U = 34$, $p < 0.001$). (Detailed values are presented in Table 2).

Similarly, a significant difference was found in the General Executive Composite (GEC) score ($U = 165.5$, $p < 0.001$), indicating that adolescents with ADHD faced greater overall executive function challenges.

3.3. Correlations Between Anxiety and Executive Functions

Tables 3–5 present the correlations between the scale of anxiety and three measures of executive functions: the Metacognitive Index, the Behavior Regulation Index, and the General Executive Composite.

3.3.1. Overall Sample Correlations

In the overall sample, anxiety demonstrated significant positive correlations with all executive function measures from the BRIEF-SR. Specifically, there was a strong positive correlation with the Behavior Regulation Index (BRI), indicating that higher anxiety levels were associated with greater difficulties in behavioral regulation. A moderate positive correlation was also found between anxiety and the Metacognitive Index (MI), suggesting that anxiety was linked to increased challenges in metacognitive executive functions. The Global Executive Composite (GEC) also showed a moderate positive correlation with anxiety (see Table 3).

Table 3. Correlations between Anxiety, Behavior Regulation Index, Metacognitive Index, and General Executive Composite.

Variable	Anxiety	BRIEF-SR Behavior Regulation Index (BRI)	BRIEF-SR Metacognitive Index (MI)
Anxiety			
BRIEF-SR Behavior Regulation Index (BRI)	**0.69** **		
BRIEF-SR Metacognitive Index (MI)	**0.31** *	**0.51** **	
BRIEF-SR General Executive Composite (GEC)	**0.50** **	**0.73** **	**0.95** **

* $p < 0.05$, ** $p < 0.001$. Bolded type denotes significance.

3.3.2. Correlations Within the Control Group

Within the control group, significant positive correlations were observed between anxiety and both executive function indices. Anxiety had a very strong positive correlation with the Behavior Regulation Index (BRI). A moderate positive correlation was also present between anxiety and the Metacognitive Index (MI). The Global Executive Composite (GEC) was also very strongly correlated with anxiety (see Table 4). These findings suggest that among typically developing adolescents, higher anxiety is robustly associated with greater challenges across both behavioral regulation and metacognitive executive functions.

Table 4. Correlations between Anxiety, Behavior Regulation Index, Metacognitive Index, and General Executive Composite within the Control Group.

Variable	Anxiety	BRIEF-SR Behavior Regulation Index (BRI)	BRIEF-SR Metacognitive Index (MI)
Anxiety			
BRIEF-SR Behavior Regulation Index (BRI)	**0.81** **		
BRIEF-SR Metacognitive Index (MI)	**0.46** **	**0.72** **	
BRIEF-SR General Executive Composite (GEC)	**0.69** **	**0.90** **	**0.92** **

** $p < 0.001$. Bolded type denotes significance.

3.3.3. Correlations Within the ADHD Group

For the ADHD group, anxiety showed a moderate positive correlation with the Behavior Regulation Index (BRI), indicating that higher anxiety was associated with more behavioral regulation difficulties within this group. However, the correlation between anxiety and the Metacognitive Index (MI) was not statistically significant. This suggests that in the ADHD group, anxiety's relationship with metacognitive executive functions, as measured by the BRIEF-SR MI, was not significant. Finally, a weak but statistically significant positive correlation was found between anxiety and the Global Executive Composite (GEC) (see Table 5).

Table 5. Correlations between Anxiety, Behavior Regulation Index, Metacognitive Index, and General Executive Composite within the ADHD Group.

Variable	Anxiety	BRIEF-SR Behavior Regulation Index (BRI)	BRIEF-SR Metacognitive Index (MI)
Anxiety			
BRIEF-SR Behavior Regulation Index (BRI)	**0.51** **		
BRIEF-SR Metacognitive Index (MI)	0.28	**0.88** **	
BRIEF-SR General Executive Composite (GEC)	**0.38** *	**0.96** **	**0.97** **

* $p < 0.05$, ** $p < 0.001$. Bolded type denotes significance.

4. Discussion

This study examined the emotional and cognitive profiles of Arab Israeli female adolescents with ADHD, focusing on anxiety and executive functions (EF) in the emotional and metacognitive domains. The findings contribute to understanding ADHD within a culturally and clinically underrepresented population, partially supporting existing literature while revealing patterns specific to this group [62–66].

4.1. Anxiety Levels

Contrary to expectations based on previous studies indicating elevated anxiety among adolescents with ADHD [67–69], no statistically significant differences were found between the ADHD and control groups. Although descriptive data suggested slightly higher anxiety in the ADHD group, these trends did not reach significance, consistent with research showing that co-occurring anxiety in ADHD varies depending on context and population [70–72].

One possible explanation for the absence of significant group differences lies in the study's statistical power. While the sample size (N = 80) was adequate for detecting moderate-to-large effects, it may have been insufficient to detect smaller yet meaningful group differences in anxiety. A post hoc power analysis indicated that small effects (Cohen's $d < 0.30$) would likely remain undetected with the current sample size, suggesting the need for larger, more heterogeneous samples in future studies to better capture subtle emotional differences.

Cultural influences may also help explain this pattern. In Arab Israeli society, traditional gender roles and mental health stigma often discourage the open expression of emotional distress [50,73]. Girls are frequently socialized to exhibit emotional restraint and rely on internalized coping strategies rather than verbalizing anxiety, which can lead to underreporting in self-report measures [74,75]. Emotional experiences may also be expressed somatically or behaviorally rather than as self-identified anxiety [76]. These sociocultural dynamics may mask anxiety symptoms in self-report tools developed for Western populations, resulting in an underestimation of true emotional distress.

Methodologically, the exclusion of medicated participants and the reliance on self-report measures may have further limited the sensitivity of anxiety detection. Future studies should therefore employ multi-informant approaches (e.g., including teacher and parent ratings), performance-based measures (such as emotional Stroop or attention bias tasks), and physiological indicators (e.g., heart rate variability or cortisol levels) to provide a more comprehensive understanding of emotional functioning. Additionally, incorporating culturally adapted assessment tools may enhance the ecological validity of findings among minority populations.

In sum, these findings highlight both the methodological and cultural challenges in accurately capturing anxiety among Arab Israeli female adolescents with ADHD. They underscore the importance of using diverse assessment modalities and culturally sensitive instruments when investigating emotional comorbidities in underrepresented groups.

4.2. Behavioral Aspects of Executive Functions

In line with previous research emphasizing the role of emotional dysregulation in ADHD (e.g., [77–79]), behavioral aspects of executive function (EF) difficulties—such as problems with emotional control, shifting attention in emotionally charged contexts, or self-monitoring of affective responses—are commonly reported among adolescents diagnosed with ADHD. These functions are typically implicated in behavioral regulation, interpersonal functioning, and stress management [80]. However, the current study revealed no statistically significant differences between Arab Israeli female adolescents with ADHD

and their typically developing peers on measures of inhibition, shifting, emotional control, or monitoring.

This surprising finding suggests that, within this sample, emotional dysregulation may not be as pronounced or may manifest differently than previously documented in predominantly Western populations. Recent research highlights the nuanced nature of EF and emotional dysregulation in ADHD. Reference [81] that ADHD is associated with emotional dysregulation independently of cognitive functioning, indicating that standardized measures may not always capture behavioral EF deficits. Similarly, [82] reported that executive function impairments can vary across contexts and are influenced by comorbidities, emphasizing the importance of context-sensitive assessments. Reference [83] demonstrated that emotional dysregulation mediates the relationship between inhibitory control difficulties and aggressive behavior in children with ADHD, underscoring the interconnectedness of emotional and executive function challenges.

One possible interpretation of the present findings is that these specific domains of EF are less sensitive to group-level differences in this sociocultural and linguistic context. For instance, in a cultural context that prioritizes family honor and collective reputation, there may be a strong social pressure for Arab Israeli female adolescents—regardless of ADHD diagnosis—to mask or internally regulate outwardly expressive behaviors, such as emotional outbursts. This widespread conformity to socio-cultural norms could result in both the ADHD and non-ADHD groups endorsing similar, low levels of difficulty on the self-report measure of Emotional Control, thereby obscuring any clinical distinction between the two groups. Thus, cultural norms surrounding emotion regulation, gender roles, and social expectations may influence the expression and perception of emotional behaviors, potentially obscuring measurable differences [84–86]. Taken together, these results suggest that the manifestation of emotional executive difficulties in ADHD may be context-dependent, highlighting the need for culturally informed assessment approaches.

Another potential explanation may point to a developmental or gender-specific compensatory mechanism, wherein adolescent girls, especially in collectivist cultures such as Arab society in Israel, are socialized to suppress or modulate outward signs of emotional impulsivity to maintain social harmony and relational cohesion [86,87]. These socialization processes could lead girls with ADHD to internalize rather than externalize emotional difficulties, making them less observable through behavioral measures. Furthermore, the reliance on self-report instruments may limit the detection of subtle regulatory impairments, particularly in populations where emotional restraint is culturally valued or expected.

Taken together, these findings highlight the need for culturally responsive assessments and underscore the importance of integrating both behavioral observations and informant reports when evaluating behavioral aspects of executive functions in diverse populations.

4.3. Metacognitive Executive Functions

In contrast, significant group differences emerged in metacognitive EF domains, with girls with ADHD demonstrating pronounced difficulties in working memory, planning, organization, and task completion. These findings align with the literature identifying metacognitive impairments as a core feature of ADHD [88–91].

Such deficits are particularly consequential during adolescence, when academic success depends heavily on planning, organization, and sustained attention. Consistent with prior research, girls with ADHD may exhibit fewer overt behavioral symptoms but experience substantial cognitive inefficiencies that hinder academic functioning [12,92]. These results emphasize that metacognitive deficits may serve as a more sensitive indicator of ADHD in female adolescents, particularly in cultural contexts where externalizing behaviors are discouraged.

4.4. Correlations Between Anxiety and Executive Functions

Correlational analyses indicated positive associations between anxiety and EF difficulties across the full sample, supporting prior evidence linking emotional distress to reduced cognitive control [93,94]. Interestingly, within the ADHD group, anxiety correlated more strongly with behavioral regulation indices (BRI, GEC) than with metacognitive indices. This finding aligns with previous literature suggesting that emotional dysregulation and behavioral impulsivity are core features of ADHD that may be more sensitive to acute anxiety states than higher-order cognitive planning skills [95].

Several factors may account for this differential pattern. First, anxiety may exacerbate emotional reactivity, frustration tolerance, and inhibition difficulties, which are captured by behavioral regulation measures, while metacognitive functions such as planning, organizing, or task completion may be less immediately affected by fluctuating emotional states [62,96]. Additionally, cultural and contextual factors may play a role. In collectivist environments, such as Arab Israeli communities, adolescents may receive external support for planning and organization from family or school structures, potentially buffering metacognitive deficits. In contrast, emotional regulation is often more internally driven and may be less supported, making it more vulnerable to anxiety-related disruptions [97–99].

Overall, these results suggest that, in adolescents with ADHD, anxiety is particularly associated with difficulties in behavioral control rather than cognitive planning, highlighting the importance of targeting emotional regulation in interventions designed to reduce anxiety-related functional impairments. Future studies using multi-method assessments—including teacher ratings, behavioral tasks, and physiological measures—could clarify the nuanced ways in which anxiety interacts with different domains of executive functioning.

4.5. Cultural Considerations

The findings of the present study underscore the profound impact of sociocultural and gender contexts on the presentation of ADHD among Arab Israeli female adolescents. Collectivist values, emphasizing family honor, social harmony, and emotional restraint, may encourage the internalization of distress and suppression of overt symptoms [98]. Traditional gender expectations further reinforce reserved and compliant behavior, discouraging emotional expressiveness or disclosure of psychological difficulties [84]. In addition, pervasive stigma surrounding mental health in Arab communities [98,100] may lead families and adolescents to conceal difficulties to avoid social judgment or shame. These interwoven cultural pressures likely contribute to the underreporting of emotional symptoms and the underdiagnosis of ADHD-related difficulties among girls in this population.

This framework provides an important lens for interpreting the current findings, particularly the minimal group differences in anxiety and behavioral aspects of executive function, despite well-documented emotional dysregulation in ADHD. Arab Israeli girls may conform outwardly to social expectations while struggling internally with anxiety, planning, and attentional control. Such internalized distress may not be captured by standard self-report measures developed in Western contexts, which rely on explicit emotional self-awareness and open expression of distress [101].

To address these limitations, future research should adopt multi-informant and multimethod assessment approaches, combining teacher and parent reports with behavioral observations, performance-based EF tasks, and physiological or implicit emotion measures. Culturally adapted assessment tools that reflect local language nuances and social norms are essential for improving diagnostic accuracy and ecological validity. By incorporating these approaches, researchers and clinicians can better capture the internalized struggles of Arab Israeli female adolescents, providing a more nuanced understanding of ADHD and executive functioning difficulties within this unique sociocultural context.

4.6. Limitations and Future Directions

Several limitations must be acknowledged. First, the use of self-report measures (e.g., BRIEF-SR and STAI) may be influenced by social desirability or limited insight, particularly in a cultural context where mental health issues are stigmatized. This reliance on self-report introduces the risk of underreporting emotional symptoms, especially among Arab Israeli girls who may experience cultural pressure to suppress distress. In addition, while the STAI was administered in a validated Arabic version, it remains unclear whether cultural influences on emotional expression may have affected the sensitivity of the measure. This should be considered in interpreting the findings.

Second, the relatively small sample size ($n = 80$) limits generalizability and may have reduced statistical power to detect small-to-moderate group differences in anxiety. Third, the exclusion of adolescents currently receiving pharmacological treatment may further limit generalizability, as medicated individuals represent a significant proportion of the broader ADHD population. While this exclusion was intended to control for medication-related confounds, it likely reduced sample heterogeneity and may have obscured meaningful variability in anxiety and EF outcomes. Fourth, the cross-sectional design prevents causal inferences about the directionality between anxiety and EF impairments.

Additional limitations relate to sample characteristics and methodology. The ADHD group may have included individuals with comorbid psychiatric conditions; if present, these could have influenced both anxiety and EF outcomes, yet comorbidity was not systematically assessed in this study. Furthermore, all data were collected online, which may introduce methodological biases related to participant engagement, environmental distractions, or differential access to technology.

Finally, another potential limitation concerns the lack of data on the time elapsed since participants' ADHD diagnosis. Those diagnosed earlier may have had greater exposure to professional interventions or developed compensatory strategies for managing anxiety and executive function challenges. The absence of this information may therefore represent an unmeasured confounding factor influencing the observed relationships between anxiety and executive functioning in the ADHD group.

Future research should consider longitudinal designs to explore developmental trajectories and include both medicated and unmedicated participants to capture a more representative clinical picture. Triangulating findings through multi-informant approaches—such as parent or teacher evaluations, behavioral observations, and performance-based EF or neurocognitive tasks—would strengthen validity and mitigate self-report bias. It would also be valuable to examine cultural factors more explicitly, such as parental expectations, acculturation, and stigma, in shaping psychological outcomes among Arab adolescents with ADHD. Finally, systematically assessing comorbid conditions in both the ADHD and control groups would enhance the interpretability and generalizability of findings.

4.7. Practical Implications

The present findings carry important implications for both educational and clinical practice. The strong association between anxiety and executive dysfunction—particularly behavioral regulation difficulties—highlights the need for integrated interventions that address both emotional and cognitive regulation among Arab Israeli female adolescents with ADHD. From a practical perspective, culturally sensitive interventions should consider gendered expectations and provide safe, supportive contexts where girls can express emotional difficulties without fear of stigma. School-based programs that integrate psychoeducation about mental health, family engagement, and culturally grounded approaches to emotion regulation could promote earlier identification and more effective support. In educational settings, teachers and counselors should be trained to recognize internalized manifestations

of distress, which may present as quiet compliance or academic disengagement rather than overt hyperactivity. Incorporating anxiety management strategies, such as relaxation training or cognitive-behavioral techniques, within executive function interventions may enhance self-regulation and academic functioning. Clinically, culturally sensitive assessment tools that account for potential underreporting of emotional symptoms should be prioritized, and collaboration between educators, families, and clinicians can help reduce stigma and promote earlier identification and support for girls who might otherwise remain undiagnosed or misunderstood.

5. Conclusions

This study sheds light on the unique cognitive and emotional profiles of Arab Israeli female adolescents with ADHD—an understudied population in the current literature. While no significant differences were found in behavioral aspects of executive functions or overall anxiety levels between the ADHD and control groups, marked impairments were observed in the metacognitive domain among girls with ADHD. Specifically, difficulties in working memory, planning, organizing materials, and completing tasks suggest a profile of executive dysfunction that may significantly hinder academic performance and daily functioning. Furthermore, while anxiety was strongly correlated with both behavioral and metacognitive difficulties in the control group, in the ADHD group it was only moderately associated with behavioral regulation, indicating a distinct pattern of interaction between anxiety and executive function.

These findings highlight the importance of integrating metacognitive support strategies—such as scaffolding, explicit instruction in organization, and working memory training—into educational interventions targeting adolescent girls with ADHD. Addressing these core cognitive deficits may not only enhance academic outcomes but also support broader areas of self-regulation and adaptive functioning. Moreover, interventions must be culturally responsive and gender-sensitive, given that sociocultural norms can shape how ADHD symptoms are expressed and interpreted. By tailoring educational and clinical approaches to meet the specific needs of this population, we can better support their development, resilience, and long-term success.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/disabilities5040091/s1, Table S1: Medians, standard deviations, and IQR of the study variables.

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Data Availability Statement: The data presented in this study are available from the corresponding author upon request.

Conflicts of Interest: The authors declare no conflicts of interest.

Disability Language/Terminology Positionality Statement: This study employs person-first language (e.g., "adolescents diagnosed with ADHD") in accordance with APA (2020) guidelines and widely accepted psychological research conventions. This choice reflects an effort to emphasize the individuality of participants and reduce stigma, particularly within the cultural context of Arab Israeli society, where disability can carry significant social sensitivity. While we acknowledge the value of identity-first language in some neurodivergent communities, our use of person-first language aligns with the cultural, developmental, and disciplinary considerations relevant to this study.

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