Perceived Expressed Emotion and Irritability in Adolescents With Attention-Deficit/ Hyperactivity Disorder Inattentive Type

The Moderating Effect of Subtype

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ABSTRACT

The current study aimed to investigate perceived expressed emotion (EE) and irritability among adolescents with inattentive and combined type attention-deficit/ hyperactivity disorder (ADHD-I and ADHD-C, respectively), and to assess whether the subtype plays a moderating role in the relationship between perceived EE and irritability. The current cross-sectional, case-control study comprised 37 adolescents with ADHD-I, 62 adolescents with ADHD-C, and 58 age- and sex-matched adolescents without ADHD. After controlling for confounding factors, adolescents with ADHD-C were found to exhibit significantly higher levels of perceived lack of emotional support than adolescents with ADHD-I ($p = 0.029$). Results of moderation analysis showed ADHD subtype to be a moderating factor in the relationship between perceived EE and irritability. [*Journal of Psychosocial Nursing and Mental Health Services, xx*(xx), xx-xx.]

Attention-deficit/hyperactivity disorder (ADHD) is a major childhood disorder that may have profound effects on many areas of life (American Psychiatric Association [APA], 2013). Loss of function occurring in ADHD is classified according to the following subtypes (Bluschke et al., 2018): inattentive (ADHD-I), hyperactive/impulsive (ADHD-HI), and combined type (ADHD-C) (Ahmadi et al., 2014; Randall et al., 2009). Expressed emotion (EE) and irritability among individuals with ADHD are two of the foremost psychosocial difficulties associated with primary ADHD symptoms. EE has been evaluated in relation to emotional and behavioral problems in individuals with ADHD (Pauli-Pott et al., 2020; Psychogiou et al., 2007), whereas problems with emotional regulation and irritable mood have frequently been reported in children with ADHD (Shaw et al., 2014). Irritability, a problem of emotional regulation, is closely related to clinical impairment in children with ADHD (Ambrosini et al., 2013).

EE, an empirical concept indicating the emotional climate at home (Asarnow et al., 1993), is a measure of environmental stress. As such, it reflects how members of a family communicate and involves such characteristics as the amount of criticism, hostile attitudes, intrusiveness, and emotional over-involvement present in the family environment (Asarnow, 1992). *Perceived EE* refers to how adolescents perceive the attitudes of family members. Although previous studies have revealed the relationship between perceived EE and psychological problems (Eray et al., 2017), only one study has investigated perceived EE in adolescents with ADHD, finding that

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the perceived EE scores of the latter were higher than those of their healthy peers (Uçar et al., 2020).

Irritability is defined as the tendency of an individual to experience anger more readily than their peers (Vidal-Ribas et al., 2016), with high levels of irritability considered pathological (Brotman et al., 2017). Thus, the fifth edition of the *Diagnostic and Statistical Manual of Mental Disorders (DSM-5)* lists irritability as a symptom of internalizing and externalizing psychiatric disorders (APA, 2013). Irritability present during childhood is thought to be related to problems occurring in adulthood, such as academic issues, poverty, and suicidality (Copeland et al., 2014; Cornacchio et al., 2016; Stringaris et al., 2009). In one study, 38% of children with ADHD exhibited approximately 10 times the irritability of their peers (Stringaris et al., 2009). Although not included in the diagnostic criteria of ADHD in the *DSM-5*, irritability represents one of the primary characteristics associated with ADHD (APA, 2013). Studies investigating irritability in children with ADHD have evaluated the former in relation to a decrease in social functionality and an increase in symptom severity (Ambrosini et al., 2013; Biederman et al., 2012; Mick et al., 2005; Sobanski et al., 2010). One study identified irritability as the most harmful of all ADHD symptoms (Mick et al., 2005).

Irritability has been associated with behavioral, emotional, and social problems in studies incorporating parental and self-report scales (Mulraney et al., 2014; Stringaris et al., 2012). A child's irritability may generate negative emotions in their parents or peers in the form of fear and/or anger. In this sense, irritability can be described as a strong feeling affecting the irritable individual's interpersonal environment. The presence of irritability in the relationship between parents and children may negatively influence their social intercourse (Patterson, 1977). Therefore, a thorough assessment of the relationship between irritability (especially perceived irritability) and perceived EE may produce insights that contribute to effective intervention strategies. One controlled study evaluating the relationship between irritability and family attitudes in adolescents with ADHD found high irritability levels reported by parents to be associated with less egalitarian attitudes in parents of children with ADHD (Uçar & Vural, 2018).

Researchers have reported differences in ADHD subtypes in terms of epidemiology, how they present, and comorbidities (Sciberras et al., 2014; Willcutt, 2012). Regarding subtype, some studies have demonstrated that ADHD-I differs neurobiologically from the other subtypes and therefore may represent an entirely distinct disorder (Bluschke et al., 2018; Diamond, 2005). Those neurobiological differences are reflected symptomatologically as neuropsychological differences between ADHD subtypes (Kircanski et al., 2017). In a study comparing children and adolescents with ADHD-C and ADHD-I and their healthy peers, only the ADHD-I group scored significantly worse on controlled attention and cognitive flexibility than their healthy peers (Skogli et al., 2014). Studies have found differences between these two groups with respect to early motor development history, objectively measured motor skills, and cognitive control (Øie et al., 2014; Vasserman et al., 2014).

Numerous studies have compared ADHD-C and ADHD-I subtypes in terms of symptomatology, cognition, emotions, and motor skills, revealing significant differences (Øie et al., 2014; Skogli et al., 2014; Vasserman et al., 2014). However, a review of the literature has failed to unearth any studies investigating emotional difficulties and emotional regulation problems perceived by adolescents diagnosed with ADHD-C or ADHD-I. The relationship between ADHD subtypes and symptoms of irritability in adolescents has yet to be evaluated. As irritability is an important prognostic factor for diagnoses that may accompany ADHD, a better understanding of this relationship can guide treatment and intervention with regard to irritability. Concerning the concept of EE, an important prognostic factor in many psychiatric disorders, assessing the differences between ADHD-C or ADHD-I subtypes with respect to EE may contribute to follow up of ADHD. A deeper understanding of the relationship between EE and irritability in terms of the aforementioned ADHD subtypes may also constitute a useful contribution to the literature regarding ADHD follow up. For this reason, we believe that there is value in investigating the relationship between perceived EE and irritability in adolescents with ADHD-I and ADHD-C. The current study is the first to examine whether ADHD subtype moderates the effect of perceived EE on irritability. Our objective was to assess the differences in irritability and perceived EE in adolescents with ADHD-I compared to those of their healthy peers and those with ADHD-C, as well as to evaluate which ADHD subtype may play a moderating role in the relationship between perceived EE and irritability.

The hypotheses of this study are as follows: (1) the three study groups (ADHD-I, ADHD-C, and healthy controls) will show significant differences in irritability and perceived EE scores; (2) irritability will be associated with perceived EE in adolescents with ADHD-I and ADHD-C; and (3) the relationship between perceived EE and irritability will be moderated by ADHD subtype.

METHOD

Setting and Participants

A power analysis was conducted using G*Power 3.1 (Faul et al., 2007) to detect a moderate effect size (0.35) when $\alpha = 0.05$ for a power of 0.80 using an analysis of variance (ANOVA) with fixed effects. Based on these criteria, G*Power 3.1 estimated a minimum sample size of 84, with 28 in each group. The sample in the current study, designed as a single-center, cross-sectional case-control study, included 129 adolescents aged 12 to 17 years. The ADHD groups comprised 37 adolescents with ADHD-I and 62 adolescents with ADHD-C, with 58 healthy

adolescents in the control group. The Kiddie Schedule for Affective Disorders and Schizophrenia–Present and Lifetime Version (K-SADS-PL) was used to diagnose ADHD in the study sample (Kaufman et al., 1997). The K-SADS-PL, a semi-structured interview form, was administered by a child and adolescent psychiatrist (F.H.Ç.). The ADHD groups comprised adolescents who sought treatment at the Selçuk Medical Faculty Child and Adolescent Psychiatry Outpatient Clinic between February 1 and June 15, 2020. A total of 143 adolescents diagnosed with ADHD were evaluated with regard to their participation in the study. Of these, 44 adolescents were excluded from the study, eight refused to participate, and 36 did not meet inclusion criteria. The sample size was based on our previous experience with this design. Written informed consent was obtained from the parents of participants after they were apprised of the methods and goals of the study. Ethical permission and approval for this study were granted by the Selçuk Medical Faculty Ethics Committee (No: 2020/204).

Criteria for inclusion in the ADHD groups were: (a) diagnosis of ADHD; (b) aged 12 to 17 years; and (c) living with at least one parent. Adolescents with a diagnosis or history of other physical or neurological disorders or intellectual disability were excluded from the study.

A total of 94 adolescents admitted to the clinic for routine check-ups were evaluated for participation in the study as healthy controls. Of these, 36 were excluded from the study, with eight refusing to participate and 28 failing to meet inclusion criteria. The remaining 58 adolescents, who had not been diagnosed with any psychiatric or physical disorders, were included in the healthy control group. Criteria for inclusion in the healthy control group were: (a) no history of psychopathology, disorders of intellectual development, or neurological or chronic physical disorders; (b) aged 12 to 17 years; and (c) living with at least one parent. Adolescents with a diagnosis or history of physical, psychiatric, or neurological disorders or intellectual disability were excluded from the study.

Sociodemographic characteristics of participants were collected by means of a questionnaire prepared by the researchers. Perceived EE was evaluated using the Shortened Level of Expressed Emotion Scale (SLEES) and irritability was assessed using the Affective Reactivity Index (ARI). The scales were completed by adolescent participants under the supervision of the researchers.

Measures

Sociodemographic Data Form. A sociodemographic data form created by the researchers was used. This form included sociodemographic characteristics, such as age, sex, educational level, parental employment status, family structure, and socioeconomic status. Socioeconomic situation was evaluated according to the official hunger and poverty limits of 2019 in Turkey (TÜİK, 2019).

Kiddie Schedule for Affective Disorders and Schizophrenia–Present and Lifetime Version. The K-SADS-PL is a semi-structured diagnostic interview created to identify psychopathologies in children and adolescents according to *DSM-III* and *DSM-IV* diagnostic criteria. It was developed by Kaufman et al. (1997) and translated into Turkish by Gökler et al. (2004), who conducted validity and reliability studies of the schedule for Turkish children.

Affective Reactivity Index. To evaluate irritability, the parent-report (ARI-P) scale ($\alpha = 0.89$) and adolescent self-report (ARI-S) scale ($\alpha = 0.85$) of the ARI, developed by Stringaris et al. (2012), were used. The ARI comprises six items measuring such features as the frequency, duration, and threshold of irritability according to a 3-point Likert-type scale ranging from 0 to 2. Total score ranges from 0 to 12, with high scores indicating chronic irritability. A validity and reliability study of the ARI for Turkish children was conducted by Kocael (2016) (parent: $\alpha = 0.83$; adolescent self-report: $\alpha = 0.85$).

Shortened Level of Expressed Emotion Scale in Adolescents (SLEES). The SLEES, originally developed by Nelis et al. (2011) and adapted for the Turkish population by Vural et al. (2013), comprises 33 items that measure the EE of the individual perceived to be most important in the life of the participant during the preceding 3 months. The SLEES has three subscales: lack of emotional support (LES), irritability, and intrusiveness. The SLEES is completed by adolescents themselves, and responses are reported according to a 4-point Likert-type scale ranging from 1 (*not true*) to 4 (*true*). Higher scores indicate elevated levels of EE. Cronbach's alpha coefficients calculated for LES, irritability, and intrusiveness were 0.88, 0.82, and 0.70, respectively (Nelis et al., 2011). Vural et al. (2013), evaluating the reliability of the scale for Turkish adolescents, arrived at a maximum Cronbach's alpha of 0.90.

Data Analysis

Statistical analyses were performed using IBM SPSS version 22.0. Statistical data for the groups were expressed as means and standard deviations, together with minimum and maximum values. For continuous variables exhibiting normal distribution, comparison between groups was performed using ANOVA. The Tukey honest significant difference (HSD) test was conducted for post hoc comparisons and significance was evaluated after applying the Bonferroni correction in post hoc tests ($p = 0.017$). Chi-square tests were used for comparisons between categorical variables, and correlations between SLEES and ARI scores were performed using Pearson correlation analysis.

In this study, a multivariate analysis of covariance (MANCOVA) was used to account for the possibility of Type II errors from multiple tests and to control for confounding factors. This analysis examined the main effect of a group using the scores from all scales as outcome measures, controlling for potential confounders, defined as variables associated with outcomes with $p < 0.1$ or of theoretical relevance. Following MANCOVA, separate one-way analyses of covariance

TABLE 1

SOCIODEMOGRAPHIC CHARACTERISTICS OF PARTICIPANTS (*N* = 157)

	n (%)			
Characteristic	**ADHD-I (*n* = 37)**	**ADHD-C (*n* = 62)**	**Control Group (*n* = 58)**	***p***
Sex				0.198
Male	20 (54.1)	43 (69.4)	41 (70.7)	
Female	17 (45.9)	19 (30.6)	17 (29.3)	
Household income (TL)				0.786
<1,500	10 (27)	22 (35.5)	19 (32.8)	
1,500 to 4,500	23 (62.2)	35 (56.5)	31 (53.4)	
>4,500	4 (10.8)	5 (8.1)	8 (13.8)	
Parents' marital status				0.088
Married	31 (83.8)	57 (91.9)	56 (96.6)	
Divorced	6 (16.2)	5 (8.1)	2 (3.4)	
Maternal educational level				0.653
Primary school	16 (43.2)	28 (45.2)	35 (60.3)	
Middle school	8 (21.6)	12 (19.4)	9 (15.5)	
High school	9 (24.3)	17 (27.4)	10 (17.2)	
University	4 (10.8)	5 (8.1)	4 (6.9)	
Maternal employment status				0.068
Unemployed	30 (81.1)	51 (82.3)	55 (94.8)	
Employed	7 (18.9)	11 (17.7)	3 (5.2)	
Paternal educational level				0.304
Primary school	18 (48.6)	21 (33.9)	16 (27.6)	
Middle/high school	12 (32.4)	27 (43.5)	25 (43.1)	
University	7 (18.9)	14 (22.6)	17 (29.3)	
Paternal employment status				0.083
Unemployed	4 (10.8)	5 (91.9)	8 (13.8)	
Employed	33 (89.2)	57 (8.1)	50 (86.2)	

(ANCOVA) were performed on the outcome variables. The statistically significant p value was < 0.05 (two-tailed).

A moderation analysis using the SPSS PROCESS macro based on 5,000 bootstrapped samples was conducted (Model 1) (Hayes & Rockwood, 2017), the aim of which was to test whether the relationship between perceived EE and irritability was moderated by ADHD subtype.

RESULTS

Participants in the ADHD-I, ADHD-C, and control groups were similar in terms of age (F = 0.577, p = 0.563). Fifty-four percent (n = 20) of the ADHD-I group, 69.4% (n = 43) of the ADHD-C group, and 70.7% (n = 41) of the control group were male. Sex distribution among groups was homogeneous (p = 0.198). There were no statistically significant differences among groups in terms of parental cohabitation, educational levels, or employment status. No participants in the ADHD-I group had oppositional defiant disorder (ODD) compared to six participants in the ADHD-C group. Sociodemographic characteristics are presented in **Table 1**.

Hypothesis 1 predicted that adolescents with ADHD-I and ADHD-C would report higher perceived EE and irritability scores compared to healthy controls. To test this hypothesis, one-way ANOVA was performed to evaluate differences among groups based on their SLEES and ARI scores, which are presented in **Table 2**. Results of one-way ANOVA supported Hypothesis 1.

MANCOVA was conducted to control for confounding factors, such as age, sex, household income, parental educational level, and comorbidities. No significant difference was observed between ADHD-I and ADHD-C groups (Pillai's Trace V = 0.084, F [4, 84] = 1.921, p = 0.114, η^2p = 0.084). Following adjustment for ARI and SLEES scores, separate univariate ANCOVA were performed to compare the two ADHD groups. Results showed significantly higher LES subscale scores in the ADHD-C group than in the ADHD-I group (F [1, 87] = 4.931, p = 0.029, η^2p = 0.054). ANCOVA results for ARI and SLEES scores are presented in **Table 3**.

Hypothesis 2 predicted that irritability levels of adolescents with ADHD would vary according to perceived EE scores. To test this relationship, we conducted Pearson correlation analyses. In the ADHD-C group, a moderate positive correlation was observed between ARI-S scores and irritability (a subscale of SLEES) and between ARI-S and total EE scores. A mild positive correlation was also found between ARI-S scores and intrusiveness (another subscale of

SLEES) in the ADHD-C group. There was no significant correlation between ARI-S scores and perceived EE scores in the ADHD-I group. These correlations are shown in **Table 4**.

Hypothesis 3 predicted that the ADHD subtype would moderate the relationship between perceived EE and irritability. To test this hypothesis, the SPSS process moderation test was performed to evaluate the moderating factor between ARI-S and SLEES scores. Moderation analysis conducted with 5,000 bootstrapped samples was used to determine whether ADHD subtype moderated the effect of perceived EE on irritability. The model explained 14.3% of the variance in irritability ($F [3, 95] = 5.3$, $p = 0.002$), with perceived EE ($\beta = 0.19$, $t = 3.08$, $p = 0.002$) and ADHD subtype ($\beta = 7.16$, $t = 2.56$, $p = 0.012$) emerging as unique predictors. ADHD subtype was observed to have a moderating effect on the relationship between perceived EE and irritability ($\beta = -0.08$, $t = -2.23$, $p = 0.02$). Results of the moderation analysis are presented in **Figure A** (available in the online version of this article).

TABLE 1 (CONTINUED)

SOCIODEMOGRAPHIC CHARACTERISTICS OF PARTICIPANTS (*N* = 157)

	n (%)			
Characteristic	**ADHD-I (*n* = 37)**	**ADHD-C (*n* = 62)**	**Control Group (*n* = 58)**	***p***
Comorbidity	19 (51.4)	25 (40.3)	–	0.285
Conduct disorder and ODD	1 (2.7)	13 (21)	–	0.012
Enuresis	2 (5.4)	1 (1.6)	–	0.287
Tic disorder	1 (2.7)	1 (1.6)	–	0.709
Depression	7 (18.9)	6 (9.7)	–	0.188
Generalized anxiety disorder	6 (16.2)	3 (4.8)	–	0.075
Social phobia	2 (5.4)	0 (0)	–	0.137
Obsessive-compulsive disorder	1 (2.7)	2 (3.2)	–	0.883
	Mean (*SD*)			
Age (years)	14.37 (1.67)	14.16 (1.53)	14.48 (1.78)	0.563

Note. ADHD-I = attention-deficit/hyperactivity disorder inattentive type; ADHD-C = attention-deficit/hyperactivity disorder combined type; TL = Turkish liras; ODD = oppositional defiant disorder. One participant in the ADHD-C group had comorbid depression and conduct disorder, and one participant in the ADHD-I group had comorbid tic disorder and obsessive-compulsive disorder.

DISCUSSION

In the current study, adolescents with ADHD-I and ADHD-C exhibited significantly higher perceived EE and irritability levels compared to adolescents in the control group. Adolescents with ADHD-I and ADHD-C also scored higher on perceived LES, perceived intrusiveness, and perceived irritability compared to the control group. After controlling for confounding factors, perceived LES in adolescents with ADHD-C was found to be higher than in adolescents with ADHD-I. According to our findings, higher levels of total perceived EE, perceived intrusiveness, and perceived irritability were associated with higher irritability scores in adolescents with ADHD-C. No significant relationship was observed between perceived EE and irritability in adolescents with ADHD-I. Finally, ADHD subtype was determined to be a moderating factor in the relationship between perceived EE and irritability. Accordingly, perceived EE in the ADHD-C group had a significant effect on irritability, whereas it did not significantly affect irritability in the ADHD-I group.

Studies examining the relationship between EE and ADHD generally incorporate EE scales that rely on parental reports (Cartwright et al., 2011; Daley et al., 2003; Peris & Hinshaw, 2003; Richards et al., 2015; Richards et al., 2014). In some studies, high maternal EE levels have usually been associated with an increase in ADHD symptoms (Pauli-Pott et al., 2020; Peris & Hinshaw, 2003; Psychogiou et al., 2007). High EE scores have been shown to accompany emotional-behavioral problems in individuals with ADHD (Musser et al., 2016; Psychogiou et al., 2007). The scale used in the current study measured perceived EE. One study investigating the relationship between ADHD and perceived EE found that adolescents with ADHD had a significantly higher perceived EE than their peers without ADHD; there were also significant differences between the two groups with respect to LES, irritability, and intrusiveness subscales (Uçar et al., 2020). Results of the current study comparing a healthy control group with adolescents with ADHD also found that the latter group scored higher on total perceived EE and its subscales than the control group. When confounding factors were controlled for, the ADHD-C group was revealed to have higher perceived LES scores than the ADHD-I group. In the literature evaluating the relationship between EE and ADHD, high EE levels were associated with behavioral problems in individuals with ADHD (Musser et al., 2016; Psychogiou et al., 2007). Proceeding from such find-

TABLE 2

ARI-S[a] AND SLEES[b] SCORES BY GROUP

	Mean (*SD*)				
	ADHD-I (*n* = 37)	ADHD-C (*n* = 62)	Control Group (*n* = 58)	F[c]/*p* Value	Comparisons (*p*)
ARI-S	6.27 (3.49)	5.25 (3.79)	3.05 (2.55)	*F* = 12.213 *p* < 0.001	I = C (0.143) C > CG (<0.001) I > CG (0.001)
LES	28.91 (10.07)	32.08 (11.18)	22.22 (6.83)	*F* = 16.471 *p* < 0.001	I = C (0.112) C > CG (<0.001) I > CG (<0.001)
Irritability	22.24 (8.99)	21.83 (7.96)	14.79 (3.35)	*F* = 19.690 *p* < 0.001	I = C (0.779) C > CG (<0.001) I > CG (<0.001)
Intrusiveness	14.89 (3.93)	14.20 (3.78)	12.12 (3.17)	*F* = 8.119 *p* < 0.001	I = C (0.365) C > CG (0.002) I > CG (<0.001)
Total EE scores	66.05 (19.44)	68.12 (16.42)	49.13 (9.79)	*F* = 26.507 *p* < 0.001	I = C (0.512) C > CG (<0.001) I > CG (<0.001)

Note. ARI-S = Affective Reactivity Index Self-Report; SLEES = Shortened Level of Expressed Emotion Scale; ADHD-I = attention-deficit/hyperactivity disorder inattentive type; ADHD-C = attention-deficit/hyperactivity disorder combined type; I = inattentive type; C = combined type; CG = control group; LES = lack of emotional support; EE = expressed emotion.

[a] The ARI-S comprises six items with responses ranging from 0 to 2. Total score ranges from 0 to 12, with higher scores indicating chronic irritability.

*[b] The SLEES comprises 33 items divided into three subscales with responses ranging from 1 (*not true*) to 4 (*true*). High scores indicate elevated levels of EE.*

[c] One-way analysis of variance.

TABLE 3

COMPARISON OF ARI-S[a] AND SLEES[b] SCORES OF ADHD-I AND ADHD-C GROUPS BASED ON ANCOVA

	Mean (*SD*)		ANCOVA		
	ADHD-C (*n* = 62)	ADHD-I (*n* = 37)	F	*p*	$\eta^2 p$
ARI-S	5.25 (3.79)	6.27 (3.49)	1.328	0.252	0.015
LES	32.08 (11.18)	28.91 (10.07)	4.931	0.029	0.054
Irritability	21.83 (7.96)	22.24 (8.99)	0.058	0.810	0.001
Intrusiveness	14.20 (3.78)	14.89 (3.93)	0.534	0.467	0.006
Total EE Scores	1.48 (0.27)	1.05 (0.46)	1.128	0.291	0.013

Note. ARI-S = Affective Reactivity Index Self-Report; SLEES = Shortened Level of Expressed Emotion Scale; ADHD-I = attention-deficit/hyperactivity disorder inattentive type; ADHD-C = attention-deficit/hyperactivity disorder combined type; ANCOVA = analysis of covariance; LES = lack of emotional support; EE = expressed emotion.

[a] The ARI-S comprises six items with responses ranging from 0 to 2. Total score ranges from 0 to 12, with higher scores indicating chronic irritability.

*[b] The SLEES comprises 33 items divided into three subscales with responses ranging from 1 (*not true*) to 4 (*true*). High scores indicate elevated levels of EE.*

TABLE 4

CORRELATIONS BETWEEN ARI-S AND SLEES SCORES OF ADHD-I AND ADHD-C GROUPS

		LES	Irritability	Intrusiveness	Total EE Scores
ARI-S of ADHD-I	*r*	–0.079	0.208	0.026	0.061
	p	0.642	0.216	0.877	0.721
ARI-S of ADHD-C	*r*	0.216	0.459	0.288	0.436
	p	0.092	<0.001	0.023	<0.001

Note. ARI-S = Affective Reactivity Index Self-Report; SLEES = Shortened Level of Expressed Emotion Scale; ADHD-I = attention-deficit/hyperactivity disorder inattentive type; ADHD-C = attention-deficit/hyperactivity disorder combined type; LES = lack of emotional support; EE = expressed emotion.

ings, the LES observed to be higher in the ADHD-C group in the current study may be considered a subtype of high EE associated with behavioral problems in individuals with ADHD.

Children with ADHD are often not emotionally stable; they may exhibit a sudden response to events and/or overreact (APA, 2013). Irritability represents an important aspect of emotional lability, and children with ADHD often experience extreme irritability and are easily provoked. Not only are there strong bidirectional associations between irritability and ADHD, but emerging evidence also suggests that an irritable subgroup may be recognizable among individuals with ADHD, with major nosological, treatment, and prognostic implications (Kircanski et al., 2017). In a clinically referred sample of children with ADHD, Mayes et al. (2015) found that 39.3% (n = 570) of those with ADHD-C and 12.1% (n = 257) of children with ADHD-I experienced irritable/angry mood and temper outbursts often or very often. Furthermore, irritability in children with ADHD has been associated with more severe ADHD symptoms, more absences from school, and increased psychosocial distress in parents (Ambrosini et al., 2013; Mulraney et al., 2017; Sobanski et al., 2010). Thus, in addition to being common, irritability in individuals with ADHD carries important prognostic implications. In a study examining the relationship between ADHD and irritability using self- and parental-report scales, adolescents with ADHD exhibited more irritability than their peers without ADHD (Uçar & Vural, 2018). Findings of the current study also showed adolescents with ADHD to be more irritable than their peers without ADHD, consistent with the literature. In terms of irritability scores, no significant difference between ADHD-I and ADHD-C groups was observed. Irritability, an emotional regulation problem, is seen more in both of these ADHD subtypes than in adolescents without ADHD, suggesting that it should be evaluated regardless of ADHD subtype. Future follow-up studies may reveal differences in comorbid diagnoses of ADHD-C with irritability compared to ADHD-I with irritability.

In many studies, EE has been presented as an important prognostic indicator (Peris & Miklowitz, 2015). One study concluded that EE is stable for up to 2 years and predicts clinical impairment over time (Peris & Baker, 2000). In a twin study, maternal EE was shown to predict antisocial behavior occurring in follow ups after controlling for common environmental effects (Caspi et al., 2004). A study investigating maternal EE in mood disorders found that EE levels predicted the onset of depression in a clinical sample with high risk (Silk et al., 2009). EE has also been linked to the stability of mood symptoms in major depressive disorder (Asarnow et al., 1993) and bipolar disorder (Kim & Miklowitz, 2004). Irritability represents an important and common symptom in mood disorders during childhood. In the current study, perceived EE scores of the ADHD-C group were significantly higher than those of the ADHD-I group and were significantly correlated with irritability scores. Our findings also support a significant relationship between perceived EE and ADHD subtype; this critical interaction suggests that the relationship between perceived EE and irritability is related to ADHD subtype. Our analysis also revealed that individuals with higher perceived EE had higher levels of irritability when their ADHD subtype was the combined type (ADHD-C). This finding is noteworthy given that the moderating role of ADHD subtype with regard to the relationship between perceived EE and irritability has not been previously investigated. When these results are assessed together with those of the relevant literature, evaluating the relationship between EE and irritability in adolescents with ADHD-C may carry significant prognostic value considering the relationship of these two clinical conditions with mood disorders.

LIMITATIONS AND STRENGTHS

Our study has several limitations, among them the modest sample size of the ADHD-I group and not screening family members for psychopathology. In particular, the modest sample size of the ADHD-I group may have led to an inadequate evaluation in the diagnosis of ODD. Lack of follow up with participants may also constitute a limitation. Follow-up studies are thus necessary to improve our understanding of the moderating effect of ADHD subtype between

perceived EE and irritability. Our assessment of EE and irritability using self-report scales designed for adolescents represents a strength. This is also the first controlled study to examine the moderating effect of ADHD subtype on the relationship between perceived EE and irritability in adolescents with ADHD.

CONCLUSION

Results of the current study suggest that evaluating irritability and perceived EE in adolescents with ADHD may complement the assessment and treatment process. Irritability was higher in adolescents with ADHD-I and in those with ADHD-C compared to the control group. Similarly, ADHD-I and ADHD-C groups reported more negative perceptions of family climate than the control group. After controlling for confounding factors, adolescents with ADHD-C perceived lower levels of emotional support in the family environment than adolescents with ADHD-I. The most important result of this study was the finding that ADHD subtype plays a mediating role in the relationship between perceived EE and irritability. Hence, it may be beneficial to evaluate adolescents with ADHD in terms of irritability and perceived EE according to ADHD subtype. Providing adolescents with ADHD with the necessary support in view of the results of this study may complement the standard ADHD treatment process. Follow-up studies with larger sample sizes to assess the effectiveness of psychosocial interventions are recommended.

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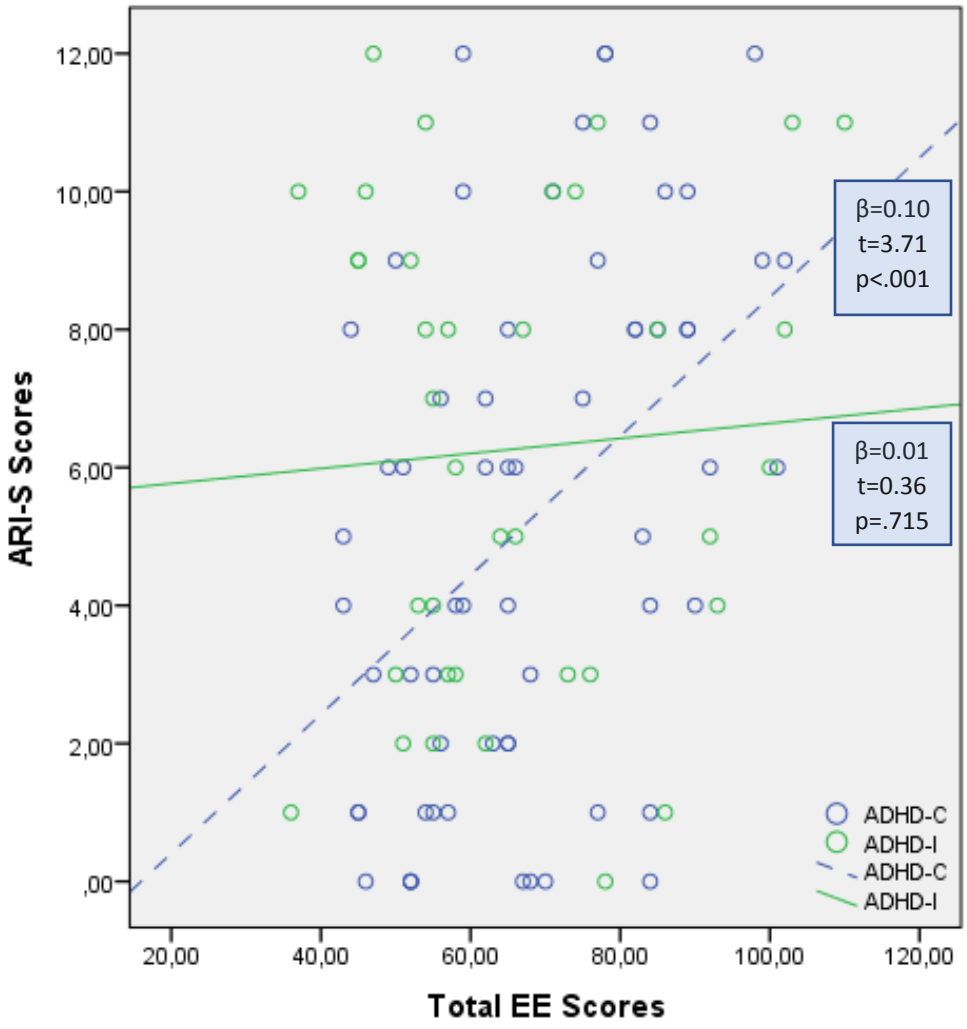
Figure A. Moderator Effect of ADHD Subtype.



Note. ARI-S = Affective Reactivity Index Self-Report; EE = expressed emotion; ADHD-C = attention-deficit/hyperactivity disorder combined type; ADHD-I = attention-deficit/hyperactivity disorder inattentive type.