Aggression, impulsivity, and plasma sex hormone levels in a group of rapists, in relation to their history of childhood attention-deficit/ hyperactivity disorder symptoms

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Abstract
The aim of this study was to investigate the relationships between retrospectively assessed childhood attention-deficit/hyperactivity disorder (ADHD) symptoms, aggression – impulsivity, and plasma sex hormone levels, in a group of 44 rapists. All participants completed the Wender Utah Rating Scale (WURS), the Aggression Questionnaire, the Life-Time History of Aggression, the Barratt Impulsivity Scale, the Suicide Risk Scale, and the Temperament and Character Inventory. Levels of testosterone, dihydrotestosterone, luteinizing hormone, and follicle stimulating hormone were estimated in plasma samples, and free androgen index was calculated. The subgroup of rapists with WURS score of 46 or higher ($n = 27$) evidenced significantly higher levels of self-reported aggression, life-time history of aggression, and impulsivity, as well as significantly higher scores on novelty seeking and self-transcendence and significantly lower scores on self-directedness and cooperativeness, in comparison with the subgroup with WURS scores of 45 and lower. The WURS score showed a positive correlation with aggression, impulsivity, and suicidality. Plasma sex hormone levels did not show any differences between the two rapist subgroups. History of childhood ADHD symptoms in this sample of rapists was linked to higher levels of aggression, impulsivity, and suicidality, a temperament profile characterized by frequent exploratory activity and quick loss of temper, and a character profile characterized by purposeless, difficulty accepting others, and lack of empathy. Lastly, a history of childhood ADHD symptoms does not seem to be linked to adult plasma sex hormone levels.

Keywords: *Rapist, ADHD, aggression, impulsivity, testosterone*

Introduction

Attention-deficit/hyperactivity disorder (ADHD) has prevalence rates ranging from 3 – 9%, depending on sampling strategies and diagnostic criteria (Szatmary, 1992), while 20 – 50% of children with ADHD continue to show residual symptoms in adulthood (Klein & Mannuzza, 1991; Shekim, Asarnow, Hess, Zaucha, & Wheller, 1990). In addition to this persistence of ADHD symptoms, there is evidence that ADHD in childhood plays a role in the later development of other specific disorders. Prospective studies showed that boys with ADHD diagnosis were more likely than controls to develop antisocial personality disorder and drug abuse syndrome in adulthood (Mannuzza, Klein, Bessler, Malloy, & LaPadula, 1993, 1998). These findings led some researchers to hypothesize that ADHD and antisocial behaviors could represent two points of the same process (Patterson, DeGarmo, & Knutson, 2000). Other researchers suggested an association between childhood ADHD symptoms and adult borderline personality disorder (Fossati, Novella, Donati, Donini, & Maffei, 2002). Ward, Wender, and Reimherr (1993) developed a psychiatric instrument, the Wender Utah Rating Scale (WURS), specifically designed retrospectively to assess ADHD symptoms in adult subjects. They proposed a cut-off score of 46 to discriminate between adults with ADHD and normal adults, as well as between adults with ADHD and depressed adults. In addition, Roy-Byrne et al. (1997) showed that the WURS is one of the few psychometric instruments that help to clarify the diagnostic distinction between adult subjects with or without ADHD, and entered it in their guidelines for the assessment of adult ADHD (a childhood history of ADHD is required for a diagnosis of the adult form).

Using the animal model of ADHD, King, Barkley, Delville, and Ferris (2000) suggested that early androgen treatment may support the neurobiology of animals with genetic predisposition to hyperactivity, impulsivity and inattention in a manner consistent with the enhanced expression of ADHD-like behaviors. Recently we found that both testosterone levels and aggression-impulsivity scores were higher in a group of rapists, as compared with the controls, and that the aggression-impulsivity scores were clearly associated with luteinizing hormone (LH) levels (Giotakos et al, 2003). In the same study we also found that the hyperactive hypothalamus-pituitary-gonadal (HPG) axis of these persons was associated with their novelty seeking behavior (Giotakos et al, 2004). In addition, Kafka & Prentky (1998), studying males with paraphilias using the WURS, found that childhood ADHD was the only Axis I disorder significantly associated with paraphilias, and with socially deviant and aggressive forms of sexual impulsivity.

The aim of the current study was to investigate retrospectively assessed childhood ADHD symptoms in a group of rapists. We hypothesized that

rapists with high ADHD symptoms during childhood will show higher aggression–impulsivity scores, a more antisocial personality profile, and higher plasma androgens levels than rapists with low ADHD symptoms during childhood. For this reason, we compared levels of self-reported aggression, life-time aggression, impulsivity, suicidality, temperament and character dimensions, and plasma sex hormone levels in these two rapist subgroups. Furthermore, we searched for relative associations between ADHD symptoms during childhood and aggression–impulsivity levels.

Method

Our sample consisted of 44 males convicted for rape. They consented to participate in this study after the procedure was fully explained. All participants were prison inmates in the only prison in Greece for sexual offenders. Basic demographic data were recorded and a full medical, social, criminological, and sexual history was obtained. The mean age was 30.7 years (*SD* 7.8) and the mean education was 8.7 years (*SD* 3.0). All rapists' victims were women and their mean age was 29.5 years (*SD* 15.4). Mean sentence length was 11.6 years (*SD* 9.5). A proportion of 46% had used drugs during the sexual offence; 54% had a history of general offence, and 12% had a history of homicide. Finally, 24% had a history of previous psychiatric drug therapy, and 17% had manifested suicidal behavior.

   All participants completed the following questionnaires:

1. The Wender Utah Rating Scale (WURS; Ward et al., 1993) consisting of questions, each with a five-item answer scale, concerning childhood attention-deficit/hyperactivity symptoms.
2. The Aggression Questionnaire (AQ; Buss & Perry, 1992), which consists of questions, each with a five-item answer scale. It contains four subscales measuring physical aggression, verbal aggression, anger, and hostility.
3. The Barratt Impulsivity Scale (BIS; Barratt, 1985; Patton, Stanford, & Barratt, 1995), which consists of four-item answer scale questions, and contains three subscales measuring motor (act without thinking), cognitive (making up one's mind quickly), and non-planning impulsiveness.
4. The Life-Time History of Aggression (LTHA; Brown, Goodwin, Ballenger, Gover, & Major, 1979), which consists of five-grade answer scale questions concerning life-time aggressive or violence acts.
5. The Suicide Risk Scale (Plutchik, van Praag, Conte, & Picard, 1989), which consists of true-false questions assessing the risk of suicidal behavior.
6. The Temperament and Character Inventory (TCI; Cloninger, Przybeck, Svarkic, & Wetzel, 1994) which is a self-reported inventory based

on Cloninger's seven-factor psychological model of the structure and development of personality. It consists of questions with a five-grade answer scale (= not true at all, = slightly true, = indifferent, = moderately true, and = extremely true). It measures the heritable temperament dimensions of novelty seeking (NS), harm avoidance (HA), reward dependence (RD), and persistence (PE), and the character dimensions of self-directedness (SD), cooperativeness (CO), and self-transcendence (ST).

The investigation was individually performed and conducted by the first author (O.G.). In all administered questionnaires higher scores indicate higher levels of the reported parameter. The questionnaires were administered after direct translation from English to Greek. The Cronbach alphas of the seven TCI dimensions ranged from 0.63 to 0.79, while the Cronbach alphas of the other psychometric questionnaires ranged from 0.69 to 0.84. Using the WURS cut-off score of 46, we divided the sample, creating two subgroups of 17 and 27 subjects. It should be noted that a WURS cut-off score of 46 or higher can discriminate individuals with a history of childhood attention-deficit/ hyperactivity disorder (Kafka & Prentky, 1998; Roy-Byrne et al., 1997; Ward et al., 1993; Wender, 1995).

A single blood sample was drawn between 8.00 and 10.00 am. Blood samples were centrifuged immediately, and 3 ml serum from each participant was frozen at $-30°C$ until determination. Radioimmunoassay methods by commercially available kits (BioChem ImmunoSystems and DiaSorin) were used for the determination of testosterone, dihydrotestosterone (DHT), sex hormone binding globulin (SHBG), luteinizing hormone (LH), and follicle stimulating hormone (FSH). Free androgen index (FAI) was calculated as $100 \times$ testosterone (nmol/l)/SHBG (nmol/l).

Means and standard deviations were calculated in order to describe the variables under investigation. The differences between variables in the two subgroups were tested by ANOVA with post hoc comparisons. Spearman's correlation coefficient test was used to investigate further the relationship between personality dimensions, psychometric questionnaire scores, and hormone levels.

Results

For the whole group of 44 subjects, WURS scores showed significant positive correlations (Spearman correlation coefficient test) to scores in the Aggression Questionnaire, the Impulsivity Scale, the Life-Time History of Aggression, and the Suicide Risk Scale ($R = .421 - .721$, $p = .004 - .0001$). In addition, WURS score showed significant positive correlations to novelty seeking ($R = .650$, $p = .0001$) and self-transcendence ($R = .507$, $p = .0001$),

and significant negative correlations to the persistence ($R = -.418$, $p = .004$), self-directedness ($R = -.676$, $p = .0001$), and cooperativeness ($R = -.594$, $p = .0001$) character dimension scores (Table I).

Analysis of variance revealed significant between-group differences across measures of self-reported aggression, life-time aggression, and impulsivity, as well as across measures of the personality dimensions NS, SD, CO, and ST.

The subgroup of rapists with WURS scores of 46 or higher evidenced significantly higher total scores of self-reported aggression (AQ, $p < .000$), life-time aggression (LTHA, $p < .000$), and impulsivity (BIS, $p < .000$), as compared with the subgroup with WURS scores of 45 and lower. The subgroup of rapists with WURS scores of 46 or higher showed higher scores of the aggression subscales physical aggression ($p < .002$) and anger ($p < .0001$), as well as higher scores on the no plan ($p < .0002$), motor ($p < .0001$), and cognition ($p < .0008$) impulsivity subscales, in comparison with the rapist subgroup with WURS scores of 45 and lower. Furthermore, the subgroup with WURS scores of 46 and higher showed significantly higher scores on novelty seeking ($p < .000$) and self-transcendence ($p < .000$), and significantly lower score on self-directedness

Table 1. Spearman correlation coefficients between WURS scores and scores in the other psychometric questionnaires for the 44 rapists.

Variables	Spearman R	t $(N-2)$	p
Aggression Questionnaire			
Total score	.607	4.95	.000
Physical	.593	4.78	.000
Verbal	.553	3.29	.002
Anger	.661	5.71	.000
Hostility	.421	3.00	.004
Impulsivity Scale			
Total score	.721	6.75	.000
No plan	.689	6.17	.000
Motor	.633	5.30	.000
Cognition	.621	5.13	.000
Life-Time History of Aggression	.711	6.55	.000
Suicide Risk Scale	.721	6.75	.000
Temperament and Character Inventory			
Harm avoidance	$-.070$	$-.45$	.65
Novelty seeking	.650	5.54	.000
Reward dependence	.038	.25	.80
Persistence	$-.418$	-2.98	.004
Self-directedness	$-.676$	-5.94	.000
Cooperativeness	$-.594$	-4.79	.000
Self-transcendence	.507	3.82	.000

and cooperativeness ($p < .000$ and $p < .02$, respectively), as compared with the subgroup with WURS scores of 45 and lower. The temperament dimensions harm avoidance, reward dependence, and persistence did not show any difference between the two subgroups. Finally, there was no difference in plasma sex hormones levels between the two rapist subgroups (Table II).

Discussion

The present findings can be discussed in relation to previous findings in personality disordered individuals, which showed personality profiles with

Table II. Mean values and standard deviations of the questionnaire scores, age, and plasma levels of sex hormones in the two subgroups of rapists (WURS scores less than 46 vs. WURS scores of 46 or more). Differences are evaluated by ANOVA.

	WURS ⩽ 45 $n = 17$ Mean ± SD	WURS ⩾ 46 $n = 27$ Mean ± SD	df = 1,42 F	p
Aggression Questionnaire				
Total score	88.3 ± 6.4	106.3 ± 20.9	11.79	.001
Physical	27.5 ± 3.1	34.4 ± 8.2	10.98	.002
Verbal	15.5 ± 2.1	18.4 ± 4.0	7.09	.11
Anger	20.2 ± 2.3	26.8 ± 6.1	18.18	.0001
Hostility	25.0 ± 2.4	26.6 ± 4.9	1.54	.22
Barratt Impulsivity Scale				
Total score	72.1 ± 9.0	90.0 ± 14.4	20.97	.0001
No plan	25.5 ± 3.3	31.3 ± 5.1	16.87	.0002
Motor	26.2 ± 4.7	34.0 ± 6.7	17.38	.0001
Cognition	20.3 ± 2.8	24.7 ± 4.4	13.03	.0008
Life-Time History of Aggression	7.9 ± 2.7	20.4 ± 11.9	18.27	.0001
Suicide Risk Scale	2.9 ± 3.1	3.8 ± 3.2	0.99	.33
Temperament and Character Inventory				
Harm avoidance	56.4 ± 7.9	53.1 ± 9.7	1.39	.24
Novelty seeking	60.2 ± 7.6	74.0 ± 11.7	18.48	.0001
Reward dependence	55.3 ± 10.2	57.8 ± 8.2	0.84	.36
Persistence	65.3 ± 9.6	59.9 ± 12.5	2.31	.14
Self-directedness	66.1 ± 7.0	55.9 ± 9.8	13.69	.0006
Cooperativeness	57.1 ± 9.9	48.8 ± 11.9	5.77	.02
Self-transcendence	47.7 ± 8.9	59.4 ± 7.4	22.26	.0001
Plasma sex hormone levels				
Age	29.6 ± 6.7	32.1 ± 10.7	0.78	.38
Body mass index	24.9 ± 2.3	26.0 ± 3.5	1.16	.29
Testosterone (ng/ml)	8.25 ± 2.7	9.03 ± 3.3	0.67	.42
Luteinizing hormone (mIU/ml)	3.33 ± 1.3	3.81 ± 1.6	1.03	.33
Follicle stimulating hormone (mIU/ml)	3.19 ± 2.1	3.02 ± 2.24	0.06	.80
Free androgen index	34.9 ± 12.5	39.9 ± 18.1	0.99	.33
Dihydrotestosterone (pg/ml)	551 ± 225	588 ± 221	0.28	.60

high levels of NS, HA, and ST and low levels of PE, CO, and SD (Ruchkin, Eisemann, Hagglof, & Cloninger, 1998; Wills, Vaccaro, & McNamara, 1994). Cloninger et al. (1998) suggested that low levels of SD and CO are ①
common to almost all personality disorders. HA levels, in the present study, did not differ between the two subgroups. Previous studies of HA levels in antisocial subjects showed controversial results (Cloninger, 1998; Ruchkin ②
et al., 1998), while the combinations of high NS/low HA/low RD and high NS/high HA/low RD were found to be characteristic of antisocial and explosive personalities, respectively (Cloninger, 1998). The highly increased levels of NS in the rapist subgroup with WURS scores of 46 and higher indicate behaviors characterized by impulsivity, intolerance of familiar routine, and difficulty in delaying gratification. A lower level of SD indicates a fragile and purposeless character and behavior dominated by external stimuli rather than by personal goals and values. The lower levels of CO indicate difficulty in identification and acceptance of other people, which could easily lead to aggressive hostility. Finally, the higher levels of ST indicate individuals with magical thinking, who can enjoy their activities ③
without feeling the need to control them. Thus, following Cloninger's theory, we could suggest that rapists with a history of childhood attention-deficit/hyperactivity symptoms have a temperament profile characterized by frequent exploratory activity, impulsivity, active avoidance of frustration, and quick loss of temper, while their character profile is characterized by purposeless behaviors not directed by personal goals or values, difficulty accepting others, and consequently a lack of empathy. The identification of such profiles may be helpful to the clinician in the assessment process, providing useful information about the cognitive process underlying the initiation, maintenance, and justification of sexual offending.

Barratt, Stanford, Kent, and Felthous (1997) defined impulsivity as a predisposition toward rapid and unplanned reaction to stimuli without regard to the negative consequences of these reactions. They suggested a three-factor model of impulsivity that includes less planning, greater motor activation, and less attention.

Buss and Perry (1992) suggested that the personality traits of aggression consist of four subtraits: physical and verbal aggression, which involve the hurting or harming of others and represent the instrumental motor component of behavior; anger, which involves physiological arousal and preparation of aggression, represents the emotional component of behavior, and is a kind of a physiological bridge between the instrumental and the cognitive component; and hostility, which consists of feelings of ill-will and injustice, and represents the cognitive component of aggressive behavior. Buss and Perry (1992), investigating these factors in relation to the temperament of normal subjects, found that all the aggression components were correlated with impulsivity; physical and verbal aggression were correlated with assertiveness and hostility was correlated with emotionality.

It is known that many sex offender therapists include management of aggression in the therapeutic process. Aggression is a mediator of cognitive distortions, such as minimizing and denying, as well as attitudes towards women or sex and towards the use of interpersonal violence to attain desired goals. This implies the need for a treatment which emphasizes empathy training – not just empathy for victims, but for other people generally (Marshall, 1993). In the current study, levels of aggression and impulsivity were highly increased in the subgroup of rapists with a retrospectively examined childhood history of ADHD. In particular, the rapists with higher ADHD symptoms during childhood showed significantly higher levels of physical aggression, which is the instrumental motor component, and anger, which is the emotional component of aggressive behavior, in comparison with the subgroup with low ADHD symptoms during childhood, while the cognitive component of aggressive behavior did not differ. These findings parallel those of Ernst et al. (2003), who suggested that the neural circuits engaged during decision making differ between subjects with ADHD and healthy comparison subjects, and, furthermore, that individuals with ADHD use primary processes more readily than complex processes in decision making.

In the present study, WURS score showed a strong positive correlation with all the aggression and impulsivity subscales, as well as with the risk of suicidality ($R = .721$). Similarly, in a study of males with paraphilias, although depressive disorders were the most common Axis I diagnoses across groups, childhood ADHD was the only Axis I disorder significantly associated with paraphilias, socially deviant and aggressive forms of sexual impulsivity (Kafka & Prentky, 1998). In the present study we did not assess the presence of Axis I and II diagnoses, or the persistence of ADHD into adulthood. Previous studies, however, have estimated that 20–50% of childhood-onset cases of ADHD will persist into adulthood, and that residual ADHD in adulthood is associated with higher prevalence of comorbid mood, anxiety, and antisocial disorders (Biederman, Faraone, & Spenser, 1993; Ratey, Greenberg, & Bemporad, 1992; Shekim et al., 1990).

There is evidence that circulating levels of androgens influence sexual function, aggression, and sexual aggression in males and females after puberty (Christiansen, 1998). A positive association between salivary testosterone and staff-rated aggression has been found in a group of ④ disruptive children (Scerbo & Kolko, 1995), while in a previous examination of the present sample of rapists, aggression–impulsivity scores and androgen levels were significantly higher than in controls (Giotakos, Markianos, Vaidakis, & Christodoulou, 2003). In the present study, although in the rapist subgroup with WURS scores of 46 or higher the aggression–impulsivity levels were higher, in comparison to the rapist subgroup with WURS scores of 45 or lower, androgen levels did not showed any difference between the two rapist subgroups. Testosterone

plasma levels were 8.25 ± 2.7 and 9.03 ± 3.3 ng/ml, both significantly higher ($p < .04$) than those of the group of 25 normal controls (6.73 ± 2.30 ng/ml) in our previous study (Giotakos et al., 2003, 2004). It should be noted that different factors, such as psychiatric comorbidity, imprisonment, and individual variability in the subjects' mood state, may influence their biochemical and psychological status. Also, there is evidence that antisocial behavior may influence the activity of the HPG axis (McEwen, 1992), and hormones may be considered potential causes, consequences, or mediators of aggression (Ramirez, 2002).

The present findings should be evaluated in the context of the limitations of retrospective design, although retrospective data are frequently useful in clinical practice and retrospective evidence of childhood ADHD is necessary for diagnosing adult ADHD, residual type (Roy-Byrne et al., 1997; Wender, 1995). It should be noted that the WURS, as a self-report questionnaire, does not provide objective verifications of childhood ADHD symptoms, but the LTHA provides many behavioral indices of aggression within the prison. Finally, the above findings should be interpreted with caution since they are not related to sexual crime *per se*, and similar results are found in non-rapist samples (Klein & Mannuzza, 1991; Shekim et al., 1990). However, the present findings strongly support the need for longitudinal follow-up studies on the relationships between ADHD and sexual aggression.

References

Barratt, E. S. (1985). Impulsiveness subtraits: Arousal and information processing. In J. T. Spence & C. E. Izard (Eds.), *Motivation, emotion and personality* (pp. 137–146). New York: Elsevier Science Publishers.

Barratt, E. S., Stanford, M. S., Kent, T. A., & Felthous, A. (1997). Neuropsychological substrates of impulsive aggression. *Biological Psychiatry*, *41*, 1045–1061.

Biederman, J., Faraone, S. V., & Spenser, T. (1993). Patterns of psychiatric comorbidity, cognition, and psychosocial functioning in adults with ADHD. *American Journal of Psychiatry*, *150*, 1792–1798.

Brown, G., Goodwin, F., Ballenger, J., Gover, P., & Major, T. (1979). Aggression in humans correlates with cerebrospinal fluid amine metabolites. *Psychiatric Research*, *1*, 131–139.

Buss, A. H., & Perry, M. (1992). The Aggression Questionnaire. *Journal of Personality and Social Psychology*, *63*, 452–459.

Christiansen, K. (1998). Behavioral correlates of testosterone. In E. Nieschlag & H. M. Behre (Eds.), *Testosterone: Action, deficiency, substitution* (pp. 107–142). New York: Springer.

Cloninger, C. R. (1998). The genetics and psychobiology of the seven-factor model of personality. In K. R. Silk (Ed.), *Biology of personality disorders* (pp. 63–91). Washington, DC: American Psychiatric Press.

Cloninger, C. R., Przybeck, T. R., Svarkic, D. M., & Wetzel, R. D. (1994). *The Temperament and Character Inventory (TCI): A guide to its development and use*. St Louis, MO: Washington University Center for Psychobiology of Personality.

Ernst, M., Kimes, A., London, E., Matochik, J., Elbeth, D., Tata, S., et al. (2003). Neural substrates of decision making in adults with ADHD. *American Journal of Psychiatry*, *160*, 1061–1070.

Fossati, A., Novella, L., Donati, D., Donini, M., & Maffei, C. (2002). History of childhood ADHD symptoms and borderline personality disorder: A controlled study. *Comprehensive Psychiatry*, *43*, 369–377.

Giotakos, O., Markianos, M., Vaidakis, N., & Christodoulou, G. N. (2003). Aggression, impulsivity, plasma sex hormones, and biogenic amine turnover in a forensic population of rapists. *Journal of Sex and Marital Therapy*, *29*, 215–225.

Giotakos, O., Markianos, M., Vaidakis, N., & Christodoulou, G. N. (2004). Sex hormones and amine turnover of sex offenders, in relation to their temperament and character dimensions. *Psychiatry Research*, *127*, 185–193.

Kafka, M. P., & Prentky, R. A. (1998). Attention-deficit/hyperactivity disorder in males with paraphilias and paraphilia-related disorders. *Journal of Clinical Psychiatry*, *59*, 388–396.

King, J. A., Barkley, R. A., Delville, Y., & Ferris, C. F. (2000). Early androgen treatment decreases cognitive function and catecholamine innervation in an animal model of ADHD. *Behavioral Brain Research*, *107*, 35–43.

Klein, R., & Mannuzza, S. (1991). Long-term outcome of hyperactive children: A review. *Journal of the American Academy of Child and Adolescent Psychiatry*, *30*, 383–387.

Mannuzza, S., Klein, R. G., Bessler, A., Malloy, P., & LaPadula, M. (1993). Adult outcome of hyperactive boys: Educational achievement, occupational rank, and psychiatric status. *Archives of General Psychiatry*, *50*, 565–576.

Mannuzza, S., Klein, R. G., Bessler, A., Malloy, P., & LaPadula, M. (1998). Adult psychiatric status of hyperactive boys grown up. *American Journal of Psychiatry*, *155*, 493–498.

Marshall, W. L. (1993). Á revised approach tï the treatment of men who sexually assault adult females. Én G. C. Í. Hall, R. Hirschman, J. R. Graham, & Ì. S. Zaragoza (Eds.), *Sexual aggression: Issues in etiology, assessment, and treatment* ($\rho\rho$. 143–165). Washington, DC: Taylor and Francis.

McEwen, B. S. (1992). Steroid hormones: Effects on brain development and function. *Hormone Research*, *37*, 1–10.

Patterson, G. R., DeGarmo, D. S., & Knutson, N. (2000). Hyperactive and antisocial behaviors: Comorbid or two points in the same process? *Developmental Psychopathology*, *12*, 91–106.

Patton, J. H., Stanford, M. S., & Barratt, E. S. (1995). Factor structure of the Barratt impulsiveness scale. *Journal of Clinical Psychology*, *51*, 768–774.

Plutchik, R., van Praag, H., Conte, H. R., & Picard, S. (1989). Correlates of suicide and violence risk. I. The suicide risk measure. *Comprehensive Psychiatry*, *30*, 296–302.

Ramirez, M. J (2002). Hormones and aggression in childhood and adolescence. *Aggression and Violent Behavior*, *266*, 1–24.

Ratey, J. J., Greenberg, M. S., & Bemporad, J. R. (1992). Unrecognized ADHD in adults presenting for outpatient psychotherapy. *Journal of Child and Adolescent Psychopharmacology*, *2*, 267–275.

Roy-Byrne, P., Scheele, L., Brinkley, J., Ward, N., Wiatrak, C., & Russo, J. (1997). Adult attention-deficit hyperactivity disorder: Assessment guidelines based on clinical presentation to a specialty clinic. *Comprehensive Psychiatry*, *38*, 133–140.

Ruchkin, V. V., Eisemann, M., Hagglof, B., & Cloninger, C. R. (1998). Interrelations between temperament, character and parental rearing in male delinquent adolescents in Northern Russia. *Comprehensive Psychiatry*, *39*, 225–230.

(4) Sarbo, A. S., & Kolko, D. J. (1995). Salivary testosterone and cortisol in disruptive children: Relationship to aggressive, hyperactive, and internalizing behaviors. *Journal of the American Academy of Child and Adolescent Psychiatry*, *34*, 535–536.

Shekim, W. O., Asarnow, R. F., Hess, E., Zaucha, K., & Wheller, N. (1990). A clinical and demographic profile of a sample of adults with attention deficit disorder, residual state. *Comprehensive Psychiatry*, *31*, 416–425.

Szatmary, P. (1992). The epidemiology of attention deficit hyperactivity disorder. In G. Weiss (Ed.), *Child and adolescent psychiatry clinics of North America: Attention deficit disorder* (pp. 361–372). Philadelphia, PA: Saunders.

Ward, M. F., Wender, P. H., & Reimherr. (1993). The Wender Utah Rating Scale: An aid in ⑦ the retrospective diagnosis of childhood attention deficit hyperactivity disorder. *American Journal of Psychiatry*, *150*, 885–890.

Wender, P. H. (1995). *Attention-deficit hyperactivity disorder in adults*. New York: Oxford University Press.

Wills, T. A., Vaccaro, D., & McNamara, G. (1994). Novelty seeking, risk taking and related constructs as predictors of adolescent substance use: An application of Cloninger theory. *Journal of Substance Abuse*, *6*, 1–20.

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