


A National Epidemiological Study of Offending and Its Relationship With ADHD Symptoms and Associated Risk Factors

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Abstract

Objective: The objective was to disentangle the relationship between offending, ADHD, and comorbid risk factors. **Method:** A total of 11,388 students in further education completed a questionnaire, which measured nonviolent and violent delinquency, current ADHD symptoms, conduct disorder, substance use, association with delinquent peers, emotional lability, anger problems, violent attitudes, and low self-esteem. **Results:** The nonviolent and violent delinquency measures correlated significantly with all the predictor measures, with small to large effect sizes. Multiple regressions showed that after controlling for age and gender, ADHD contributed 8.2% and 8.8% to the variance in nonviolent and violent delinquency, respectively, but these effects were largely mediated by the comorbid measures, particularly substance use, association with delinquent peers, and conduct disorder. **Conclusion:** The relationship between ADHD symptoms and offending among young people is largely explained indirectly by comorbid factors. A key prevention is to address substance use problems and association with delinquent peers. (*J. of Att. Dis.* 2014; 18(1) 3-13)

Keywords

ADHD, offending, comorbid problems, substance use, conduct disorder, peer delinquency, emotional lability, anger, attitudes, self-esteem

Introduction

ADHD is a childhood developmental disorder, and often one or more of the three core symptoms—inattention, hyperactivity, and impulsivity—persists into young adulthood (Faraone, 2005). The estimated worldwide-pooled prevalence rate of ADHD among persons 18 years or younger is 5.3% (Polanczyk, Silva de Lima, Horta, Biederman, & Rohde, 2007). Delinquency or criminal offending is commonly found in people who have grown up with ADHD (Barkley, Fischer, Smallish, & Fletcher, 2004; Barkley, Murphy, & Fischer, 2008; Biederman, Newcorn, & Sprich, 1991; Brassett-Grundy & Butler, 2004; Gudjonsson, Sigurdsson, Adalsteinsson, & Young, 2011; Gudjonsson, Wells, & Young, 2011; Sevecke, Kosson, & Krischer, 2009; Young & Gudjonsson, 2008; Young, Gudjonsson, Ball, & Lam, 2003; Young, Wells, & Gudjonsson, 2011).

The relationship between ADHD and offending is complicated by the fact that ADHD typically co-occurs with a number of other problems, which are known to be associated with offending (Young, Adamou, Bolea et al., 2011; Young & Gudjonsson, 2006). These include conduct disorder (CD);

Lynam, 1996; Mordre, Groholt, Kjelsberg, Sandstad, & Myhre, 2011; Sibley et al., 2011), substance misuse (Young et al., 2011), peer delinquency (Farrington, 1990; Fite & Colder, 2007; Keenan, Loeber, Zhang, Stouthamer-Loeber, & Van Kammen, 1995), violent attitudes (Gudjonsson, Sigurdsson, Skaptottir, & Helgadottir, 2011; Unnever, Cullen, & Agnew, 2006), and emotional lability (Farrington, Ttofi, & Coid, 2009; Sourander et al., 2006). Any of these associated problems could act independently in producing offending (independent effect), act jointly (interaction effect), or mediate the relationship between ADHD and offending (comorbid problems mediation effect).

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One way of interpreting the associations of ADHD and the comorbid problems with offending is through Gottfredson and Hirschi's (1990) general theory of crime, which attributes offending to low self-control (Unnever, Cullen, & Pratt, 2003), although there is also evidence to support social learning theory (Unnever et al., 2006). Both theories are important in explaining offending (Spiropoulos, 2010; Warr, 2010).

Unnever et al. (2003) found that the direct effect of ADHD self-reported medication status on offending was very small. Most of the ADHD effect was mediated by low self-control, which is theoretically linked to CD. Indeed, studies have found that the relationship between ADHD and offending is mediated by CD (e.g., Mordre et al., 2011; Satterfield et al., 2007), although Sibley et al. (2011) found that children with a combination of ADHD and CD had the highest risk of earlier, variety, and severe offending (interaction effect). ADHD alone was also found in this study to be a risk factor for later offending in contrast to children without ADHD and CD. Lynam (1996) suggested that ADHD may be a risk factor for offending, particularly when it develops in conjunction with CD.

Retz and Rosler (2009) have proposed distinct pathways from ADHD to delinquent behavior. They argue that ADHD is frequently associated with early-onset CD. Individuals with ADHD + CD are likely to develop antisocial personality disorder (APD). This developmental subtype of APD is only weakly related to psychopathic personality traits and more frequently associated with reactive-impulsive than with premeditated-proactive violent aggression. ADHD without CD also leads to social problems and is associated with minor rule breaking behavior with the rate of general delinquency and violent behavior not being elevated. Substance use disorders are construed as important moderators for offending related to ADHD.

The primary aim of this study was to investigate the extent to which offending among young people with ADHD is associated with common comorbid problems (e.g., CD, illicit drug use, peer delinquency, emotional lability, anger problems, violent attitudes, and low self-esteem), rather than being directly related to ADHD. This study aimed to disentangle the relationship between offending, ADHD, and comorbid risk factors. It was hypothesized that ADHD contributes significantly to both violent and nonviolent offending but that this relationship is substantially mediated by comorbid problems (i.e., a comorbid problems mediation hypothesis). In the current study, the comorbid problems were classified into two distinct groups: (a) behavioral risk factors (i.e., CD, illicit drug use, and peer delinquency) that theoretically have the strongest links to offending and (b) more dynamic emotional/psychological risk factors (i.e., emotional lability, anger problems, violent attitudes, and low self-esteem). It was further hypothesized that ADHD and the emotional/psychological risk factors would

contribute more to the variance in violent than nonviolent delinquency due to their more reactive nature (Retz & Rosler, 2010).

Method

Participants

The sample consisted of 11,388 students in further education in Iceland (upper secondary school), 95% of whom were 16 to 24 years of age. All 32 colleges of further education in Iceland were represented, and the current sample included 70.5% of all students registered in the colleges at the time. Data collection took place in November 2010, with the exception of one school in January 2011. There were 5,439 (47.8%) boys and 5,837 (51.3%) girls (112 participants did not indicate their sex).

Instruments

A 110-item questionnaire was assembled, which included questions about family circumstances, education, ADHD symptoms, anxiety, depression, CD, offending behavior, and substance use. This questionnaire included the following measures.

Barkley Current Symptoms Scale to screen for ADHD. This 18-item measure (Barkley, 1998) corresponds with *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.; *DSM-IV*; American Psychiatric Association, 1994) criteria for ADHD symptoms and consists of nine items relating to inattention and nine items to hyperactivity/impulsivity. The items are scored on a 4-point scale from "never or rarely" to "very often." Scores range between 0 and 27 for each of the two subscales (Inattention and Hyperactivity/Impulsivity) and 0 to 54 for the Total scale. The scale has been found to have good psychometric properties and to correlate well with informants' ratings of symptoms and interview-based diagnoses in childhood and adulthood (Magnusson et al., 2006). Cronbach's α for the Total scale in this study was .90, .84 for Inattention, and .83 for Hyperactivity/Impulsivity.

In the current study, a screening diagnosis for ADHD symptoms was based on six or more of the nine inattention or hyperactivity/impulsivity items endorsed as either "often" or "very often." This classification gave three possible outcomes: (a) predominantly inattentive, (b) predominantly hyperactive/impulsive, and (c) combined type (i.e., where both the inattention and hyperactivity had six or more items endorsed as either "often" or "very often"). The Total scale was also used in the current study as a continuous measure.

Unnever et al. (2003) reported that ADHD medication status was significantly related to offending, although this association was largely mediated through low self-control.

We therefore included questions about ADHD medication status for analysis. To this effect, participants were asked whether they had ever been diagnosed with ADHD (*yes/no*) and whether they were currently taking medication for ADHD (*yes/no*).

Emotional lability was measured by 22 relevant items (consisting of a combination of somatization, anxiety, and depression items) from the Symptom Check List (SCL-90), which had good factor loading on each of the three factors (Derogatis & Cleary, 1977). The items were rated on a 4-point Frequency scale (“nearly never,” “seldom,” “sometimes,” and “often”) to indicate severity of symptoms (Sigfusdottir, Farkas, & Silver, 2004). The items from the somatization (e.g., soreness in the muscles, numbness or tingling in parts of body, heavy feelings in arms and legs, hot and cold spells), anxiety (e.g., nervousness or shakiness inside, feeling tense and keyed up, suddenly scared for no reason), and depression (e.g., feeling low in energy, thoughts of ending your life, feeling blue, feeling hopeless about the future, feeling lonely) scales were combined into one scale in the current study (labeled *emotional lability*). The scores ranged from 22 to 88 with higher scores indicating greater emotional lability. Cronbach’s α was .92 in the current study for the Total score, .84 for somatization, .77 for anxiety, and .90 for depression.

Anger. This was assessed by a five-item measure (Sigfusdottir et al., 2004) designed to assess the severity of anger problems. Each item was rated on a 4-point frequency scale as for the emotional lability items. Scores ranged from 5 to 20 with higher scores indicating greatest severity. The scale has been found to be a reliable and valid measure of anger and is related to offending among Icelandic college students (Sigfusdottir, Gudjonsson, & Sigurdsson, 2010). Cronbach’s α was .84 in the current study.

Violent attitudes. These were assessed by a four-item scale measuring attitudes toward violence, each being rated on a 4-point scale from “totally agree” to “totally disagree.” The items are the following: “Sometimes circumstances arise which justify hitting or beating people,” “When someone treats me badly I find it ok to hit or beat him or her,” “Sometimes one needs to hit or beat someone in order to protect one’s honor in the peer group,” and “He or she who does not answer for himself or herself by hitting or beating when he or she is harassed is considered chicken or coward in my peer group.” Scores ranged from 4 to 16 with lower scores indicating more violent attitudes. Cronbach’s α was .83 in the current study.

The Oregon Adolescent Depression Project Conduct Disorder Screen (OADP-CDS). This is a six-item self-report screen of adolescent conduct behaviors rated on a 4-point Likert-type scale (Lewinsohn, Rohde, & Farrington, 2000). It provides a total score ranging between 6 (*no endorsement of any behavior*) and 24 (*maximum endorsement of each behavior*). The OADP-CDS has been shown to have good internal

consistency, test–retest reliability, and good screening efficiency for detecting lifetime CD (Lewinsohn et al., 2000). Young, Misch, Collins, & Gudjonsson (2011) found that ADHD and OADP-CDS were highly correlated (large effect size) in youth offenders and both correlate significantly with all offending, behavioral disturbance, and critical measures. Cronbach’s α was .75 in the current study.

Substance use. This was assessed by a 10-item measure of *lifetime illicit drug use*. The participants were asked, “How often (if ever) have you consumed the following substances?” Illegal sedatives (without prescription), hashish, marijuana, amphetamine, LSD (Lysergic acid diethylamide), e-tablet (ecstasy), cocaine, illegal ritalin (without prescription), mushrooms (as intoxicant), and sniffing substances (e.g., glue). Each question was rated on a 7-point scale from “never” to “40 times or more.” The total score ranged from 10 to 70 with higher scores indicating more extensive substance use. This measure has been used in other similar surveys (Gudjonsson, Sigurdsson, Asgeirsdottir, & Sigfusdottir, 2007). Cronbach’s α was .90 in the current study.

Illicit drug use past 30 days. This was additionally measured by a four-item measure of current substance use. The participants were asked, “How often have you consumed the following during the past 30 days?” hashish, marijuana, amphetamine, and e-tablet (ecstasy). Each question was rated on a 7-point scale from “never” to “40 times or more.” The total score ranges from 4 to 28 with higher scores indicating more extensive substance use. Cronbach’s α was .83 in the current study.

Rosenberg Self-Esteem Scale. This is a 10-item scale (Rosenberg, 1965) consisting of five positive and five negative self-appraisal statements rated on a 4-point scale ranging from “strongly agree” to “strongly disagree.” Scores range from 10 to 40 with higher scores reflecting lower self-esteem. This measure has high internal consistency among Icelandic college students (Gudjonsson, Einarsson, Bragason, & Sigurdsson, 2006). Cronbach’s α was .92 in the current study.

Nonviolent Delinquency Scale. This is a four-item measure (Sigfusdottir et al., 2004) designed to assess the extent of self-reported offending. Participants were asked “How often (if ever) have you done the following?” and four delinquent behaviors are rated (e.g., theft of something worth less than 5,000 kronur, theft of something worth more than 5,000 kronur, burglary, and vandalism) during the previous 12 months on a 7-point scale from “never” to “18 times or more often.” Total scores ranged from 4 to 28, with higher scores indicating greater involvement in delinquency. This measure has been validated in our previous research with this population (Sigfusdottir et al., 2010). The Cronbach’s α was .82 in the current study.

Violent Delinquency Scale. This is a nine-item scale intended to assess the extent of self-reported violent delinquency (e.g., punch, shove, kick, hit, chokehold, threaten

with violence, force someone to engage in sexual acts, force someone to have intercourse, used violence to rob) during the previous 12 months. Each item is rated on a 7-point scale from "never" to "18 times or more often." The scores are aggregated to make a scale of self-reported violent delinquency ranging from 9 to 63. Higher scores indicate more violent behavior. Cronbach's α was .90 in the current study.

Peer delinquency. This was assessed by a five-item delinquency measure designed to evaluate the extent of offending among the participant's peers. Participants were asked "How many of your friends do you think are involved in the following?" and rated five delinquent behaviors, that is, theft, burglary, vandalism, and acts of violence. Each offending behavior is rated on a 5-point scale from "none" to "all." Scores range from 5 to 25 with higher scores indicating more extensive peer delinquency. This measure has been used in our previous research with this population (Gudjonsson, Sigurdsson, Sigfusdottir, & Asgeirsdottir, 2008). The Cronbach's α was .88 in the current study.

Procedure

The students were approached by teachers in scheduled classes and invited to participate in the survey. The participants were told that their answers would be anonymous and confidential. The questionnaire took up to 1 hr to complete, and on completion the students sealed them in a blank envelope and left it by the exit of the class room.

Statistical Analysis

Chi-square tests were used to analyze categorical differences between groups, Pearson correlations were used to determine the relationship between the continuous measures, and hierarchical multiple regressions were carried out (forced entry method) to investigate the relative contribution of the different predictors, entered in four different blocks, to the variance of delinquency and violent behavior.

Effect sizes were determined using Cohen's (1992) recommendations: (a) *t* tests between groups (Cohen's *d*: .30 = low; .50 = medium; .80 = large) and (b) correlation and regression coefficients for medium (accounts between 9% and 24% of the variance) and large (accounts for 25% or more of the variance) effect sizes.

Results

ADHD Screening and Medication Status

Of the total sample, 591 participants (5.2%) met screening diagnosis for ADHD on the Barkley Scale, the respective percentages for males and females being 5.5% and 5.0%. Of those participants, 358 (3.4%) claimed to be currently

on ADHD medication and there were significantly more males than females (4.4% and 2.6%, respectively; $\chi^2 = 22.6$, $df = 1$, $p < .001$).

Relationships of Predictors With Delinquency and Violent Behavior

Table 1 gives the mean scores and standard deviations of the nine predictor variables (ADHD current symptoms, emotional lability, anger, violent attitudes, self-esteem, CD, peer delinquency, illicit drug use during the past 30 days, lifetime use of illicit drugs) and the two outcome measures (nonviolent and violent delinquency). Table 1 also gives the correlations between the predictor variables with those of the two outcome measures. There was a significant correlation between the nonviolent and violent delinquency ($r = .59$, large effect size). Nonviolent delinquency and violent delinquency correlated significantly with all the predictor measures, with small to large effect sizes. For nonviolent delinquency, the largest correlation (large effect size) was with peer delinquency, with medium effect sizes being evident for CD, illicit drug use during the past 30 days, lifetime use of illicit drugs, and violent attitudes. For violent delinquency, the correlations with medium effect sizes were CD, peer delinquency, illicit drug use during the past 30 days, lifetime use of illicit drugs, and violent attitudes. There were small effect sizes between ADHD current symptoms and nonviolent delinquency ($r = .27$) and violent delinquency ($r = .27$).

Table 2 shows the correlations between the predictor variables. It is evident that ADHD symptoms correlate significantly with all the other predictor variables, the strongest correlations being with anger, emotional lability, and CD (all medium effect size). CD was strongly related to peer delinquency (large effect size), illicit drug taking, anger, and violent attitudes (all medium effect size).

Table 3 shows the relationship between the categorical ADHD medication status variable (i.e., those reporting as being currently on ADHD medication) and the nonviolent and violent delinquency outcome variables. The nonviolent and violent delinquency scores were significantly related to ADHD medication status with medium effect size (Cohen's $d = .54$ and $.61$, respectively).

Predictors of Nonviolent and Violent Delinquency

To investigate the impact of predictors on the two outcome variables, hierarchical multiple regressions were carried out in four blocks. Age and gender (male = 1, female = 2) were entered in Block 1, current ADHD status (*yes/no*) and ADHD current symptoms were added in Block 2, emotional lability, anger, violent attitudes and self-esteem were added in Block 3, and CD, peer delinquency, and current illicit

Table 1. Mean Scores on the Measures, Cronbach's Alpha, and Correlations With the Nonviolent and Violent Delinquency Scales.

Measures	M (SD)	n	Nonviolent delinquency	Violent delinquency
ADHD symptoms	10.3 (8.5)	10,950	.27***	.27***
Emotional lability	39.7 (12.8)	11,040	.14***	.12***
Anger	8.6 (3.4)	11,031	.23***	.29***
Violent attitudes	6.3 (2.7)	11,064	-.31***	-.44***
Self-esteem	18.4 (6.1)	10,937	.10***	.08***
Conduct disorder	7.9 (2.3)	11,021	.45***	.45***
Peer delinquency	6.6 (2.7)	11,045	.52***	.47***
Illicit drug use past 30 days	4.5 (2.2)	10,932	.49***	.46***
Lifetime use of illicit drugs	12.5 (7.2)	10,938	.40***	.35***
Nonviolent delinquency	4.8 (2.5)	10,676	—	.59***
Violent delinquency	11.9 (6.3)	10,607	.59***	—

*** $p < .001$.**Table 2.** Correlations Between the Predictor Variables.

	1	2	3	4	5	6	7	8	9
ADHD symptoms	—	.48***	.49***	-.22***	.32***	.47***	.33***	.20***	.23***
Emotional lability	—	—	.56***	-.01	.52***	.28***	.18***	.12***	.17***
Anger	—	—	—	-.22***	.38***	.40***	.32***	.17***	.19***
Violent attitudes	—	—	—	—	-.09***	-.37***	-.41***	-.25***	-.21***
Self-esteem	—	—	—	—	—	.19***	.14***	.11***	.11***
Conduct disorder	—	—	—	—	—	—	.51***	.38***	.40***
Peer delinquency	—	—	—	—	—	—	—	.40***	.35***
Illicit drug use past 30 days	—	—	—	—	—	—	—	—	.67***
Lifetime use of illicit drugs	—	—	—	—	—	—	—	—	—

*** $p < .001$.**Table 3.** Differences on the Nonviolent and Violent Delinquency Scales Between Those Currently on ADHD Medication Versus Not Currently on ADHD Medication.

	On medication for ADHD		No medication for ADHD		t	Cohen's d
	M (SD)	n	M (SD)	n		
Nonviolent delinquency	7.4 (6.7)	351	4.7 (2.2)	10,245	19.9***	.54
Violent delinquency	18.5 (15.0)	345	11.6 (5.6)	10,199	20.3***	.61

*** $p < .001$.

drug use were added in Block 4. The four blocks made it possible to study the effects of three different sets of factors after controlling for age and gender: (a) current ADHD symptoms and ADHD medication status, (b) emotional/psychological risk factors (i.e., variables related to unstable mood and anger, violent attitudes, and poor self-esteem), and (c) behavioral risk factors (i.e., variables related to CD, peer delinquency, and illicit drug use in past 30 days).

Tables 4 and 5 show the results with regard to the multiple regressions for nonviolent and violent delinquency, as the two outcome variables, respectively. The predictor variables explained 39.7% of the variance in nonviolent delinquency and 40.6% of the variance in violent delinquency, which represent large effect sizes.

For nonviolent delinquency, adding ADHD to the regression after age and gender increased the amount of variance explained by 8.2%, the emotional/psychological variables

Table 4. Hierarchical Regressions With the Nonviolent Delinquency Scale as the Dependent Measure.

General delinquency	Block 1		Block 2		Block 3		Block 4	
	β	<i>t</i>	β	<i>t</i>	β	<i>t</i>	β	<i>t</i>
Age	-.07	-7.46***	-.07	-7.03***	-.06	-5.93***	-.06	-7.68***
Gender	-.16	-16.41***	-.15	-16.17***	-.08	-7.54***	-.01	-1.06
On ADHD medication	—	—	.12	12.79***	.11	11.71***	.04	4.64***
ADHD symptoms	—	—	.24	24.74***	.14	12.47***	.01	1.44
Emotional lability	—	—	—	—	.05	3.50***	.01	0.96
Anger	—	—	—	—	.08	6.72***	.00	0.13
Violent attitudes	—	—	—	—	-.21	-19.83***	-.05	-4.84***
Self-esteem	—	—	—	—	-.02	-1.42	-.02	-2.51*
Conduct disorder	—	—	—	—	—	—	.17	16.53***
Peer delinquency	—	—	—	—	—	—	.28	28.67***
Illicit drug use in past 30 days	—	—	—	—	—	—	.30	33.74***
Adjusted R^2	.031		.113		.160		.397	
R^2 Change	.031***		.082***		.047***		.238***	
ANOVA (<i>F</i> value, <i>df</i>)	158.27 (2, 9990)***		318.18 (4, 9998)***		238.28 (8, 9984)***		600.13 (11, 9981)***	

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 5. Hierarchical Regressions With the Violent Delinquency Scale as the Dependent Measure.

Violent behavior	Block 1		Block 2		Block 3		Block 4	
	β	<i>t</i>	β	<i>t</i>	β	<i>t</i>	β	<i>t</i>
Age	-.12	-12.18***	-.11	-12.01***	-.09	-10.67***	-.10	-12.83***
Gender	.25	-25.98***	-.24	-26.26***	-.12	-11.491***	-.07	-7.05***
On ADHD medication	—	—	.14	14.43***	.12	13.20***	.06	7.68***
ADHD symptoms	—	—	.24	25.86***	.11	10.02***	.01	1.44
Emotional lability	—	—	—	—	.01	0.91	-.02	-1.33
Anger	—	—	—	—	.17	15.42***	.12	11.36***
Violent attitudes	—	—	—	—	-.32	-32.40***	-.20	-21.63***
Self-esteem	—	—	—	—	-.04	-4.23***	-.05	-5.46***
Conduct disorder	—	—	—	—	—	—	.14	13.39***
Peer delinquency	—	—	—	—	—	—	.16	16.66***
Illicit drug use in past 30 days	—	—	—	—	—	—	.25	28.36***
Adjusted R^2	.074		.163		.277		.406	
R^2 change	.074***		.088***		.114***		.130***	
ANOVA (<i>F</i> value, <i>df</i>)	400.76 (2, 9961)***		484.68 (4, 9959)***		477.63 (8, 9955)***		621.27 (11, 9952)***	

* $p < .05$. ** $p < .01$. *** $p < .001$.

added a further 4.7% to the variance, and the three behavioral measures added a further 23.8% to the variance. In the final block, current illicit drug use ($\beta = .30$), peer delinquency ($\beta = .28$), and CD ($\beta = .17$) were the strongest predictors of nonviolent delinquency followed by violent attitudes ($\beta = -.05$) and currently being on medication for ADHD ($\beta = .04$). There was also a significant (negative) contribution of age in the final block ($\beta = -.06$).

For violent delinquency, adding ADHD to the regression after age and gender increased the amount of variance explained in violent delinquency by 8.8%, the emotional/psychological variables added a further 11.4% to the variance, and the three behavioral measures added a further 13.0% to the variance. In the final block, current illicit drug use ($\beta = .25$), violent attitudes ($\beta = -.20$), peer delinquency ($\beta = .16$), CD ($\beta = .14$), and anger ($\beta = .12$) were the stron-

gest predictors of violent behavior followed by age ($\beta = -.10$), being a male ($\beta = -.07$), currently being on ADHD medication ($\beta = .06$), and low self-esteem ($\beta = -.05$).

To specifically test the comorbid problem mediation hypothesis, the two regression analyses were run again and with the two ADHD measures entered in Block 4 instead of Block 2. For both the nonviolent and violent delinquency measures, ADHD contributed significantly to the variance ($p < .001$), but this time the R^2 change to the overall variance was less than 1% in contrast to more than 8% when entered before the comorbid measures. These findings are consistent with the comorbid problem mediation hypothesis.

Discussion

The nonviolent and violent delinquency scales correlated significantly with all the predictor measures. CD, peer delinquency, and illicit drug use were most strongly associated with offending (medium to large effect size), whereas the lowest correlations were found for self-esteem and emotional lability (small effect size). Taken together, the predictor variables explained 39.7% of the variance in nonviolent delinquency and 40.6% of the variance in violent delinquency, which represent large effect sizes.

It was hypothesized that ADHD would contribute significantly to both nonviolent and violent delinquency but that this relationship would be substantially mediated by salient comorbid problems. Hierarchical multiple regressions gave strong support for the comorbid problems mediation hypothesis. After controlling for age and gender, ADHD contributed 8.2% to the variance in nonviolent delinquency and 8.8% in violent delinquency, but these effects were almost completely mediated by the comorbid measures. In fact, the incremental effect of adding ADHD current symptoms and ADHD medication status in Block 4, although significant in the model, was less than 1% for both nonviolent and violent delinquency. This suggests that in this age group (16-24 years), the relationship between ADHD and delinquency is almost completely indirect through associated problems, principally CD, peer delinquency, and illicit drug taking (i.e., behavioral risk factors).

As far as the relationship between ADHD symptoms and offending is concerned, the strong comorbid problems mediation effect shows that ADHD does not directly explain offending behavior, which corroborates the previous findings of Mordre et al. (2011) and Satterfield et al. (2007). With regard to predicting overall offending, there are likely to be both independent and joint (interaction) effects with regard to the four key predictors (ADHD, CD, peer delinquency, and illicit drug use). The large incremental effect of adding the three behavioral predictors in the final regression block suggests their strong independent effect above and beyond age, gender, ADHD, and dynamic emotional/

psychological risk factors. There may also be an important interaction effect, but this was not specifically investigated in the current study. For example, Sibley et al. (2011) found that children with a combination of ADHD and CD had the highest risk of earlier, variety, and severe offending.

The current findings highlight the important influence of the associations with peer delinquents on offending. Having delinquent friends strongly increases the likelihood of delinquent behavior by adolescents (Farrington et al., 2009). In the final regression models, this contributed more to the variance in offending than CD. This supports the findings of Keenan et al. (1995) on the importance of exposure to deviant peers for boys' engagement in disruptive and delinquent behavior. Keenan and colleagues found no significant moderating effects of ADHD on peer influence. This is unexpected because offenders who are symptomatic for ADHD are more compliant in their temperament than other offenders (Gudjonsson, Sigurdsson, Einarsson, Bragason, & Newton, 2008), which may make them particularly susceptible to peer influence. In the present study, ADHD symptoms correlated significantly with peer delinquency with a moderate effect size ($r = .33$).

The extent of current illicit drug use (i.e., past 30 days) was the single best predictor of nonviolent and violent delinquency. It suggests that drug use is an important pathway into both nonviolent and violent delinquency. The findings support the argument put forward by Retz and Rosler (2009) that substance use problems are influential in explaining offending behavior related to ADHD. Young et al. (2011) showed clear evidence of heroin use and ADHD symptoms in the persistence of offending among prisoners. They argued that there is an urgent need to treat the drug addiction and ADHD symptoms to reduce offending among the most persistent offenders. The present findings argue for early substance use intervention to prevent persistent offending. Further research also needs to be done on the role of peer delinquency to improve our understanding of the mechanisms involved and how these may be addressed to reduce offending. Importantly, CD, peer delinquency, illicit drug use, and offending are all correlated with medium to large effect sizes, and these are the factors that have the most direct effect on violent and nonviolent delinquency.

It was further hypothesized that ADHD and the dynamic emotional/psychological risk factors would contribute more to the variance in violent delinquency than general offending due to their more reactive nature (Retz & Rosler, 2010). The findings were not strongly supported for ADHD (i.e., its contribution to the variance was only marginally higher for violent than nonviolent offending after adjusting for age and gender), but multiple regressions showed that the relative contributions of the predictor variables were rather different for the two outcome measures. As expected, the emotional/psychological measures (particularly violent attitudes and anger) contributed more to the variance in the

violent than nonviolent delinquency outcome measures. The findings corroborate those of Unnever et al. (2006) who found that violent attitudes are relevant to both general offending and violent offending, but tend to be more strongly associated with violent crimes. More recently, Gudjonsson, Sigurdsson, Skapatdottir, & Helgadottir (2011) found that violent attitudes predicted self-reported offending above and beyond personality disorder. In the present study, it was assumed that the items making up the violent delinquency scale reflected reactive rather than proactive behavior. This may not necessarily be the case, because distinguishing reliably between reactive and proactive violent offending is a subtle process that probably requires independent rating scales (Retz & Rosler, 2010).

It was argued in the "Introduction" section that both the self-control theory of crime and social learning theory are important in explaining offending. How do these respective theories explain the current findings? Social learning theory seems to explain best the relationship of peer delinquency with nonviolent and violent delinquencies. Within social learning theory, peers are important because they function as powerful models of behavior (Spiropoulos, 2010). Warr (2010) argued that young persons may copy the delinquent behavior of their peers (e.g., smoking, drug taking, theft) through imitation, observation of how other people's behavior is rewarded (vicarious reinforcement), and financial and psychological reward (direct reinforcement). What about support for self-control theory? The impact of poor self-control on offending in the present study may be broader and more pervasive than social learning theory and include, for example, an aspect on maladaptive coping (Young, 2005). Unfortunately, there was no direct measure of self-control in the current study. However, the finding of Unnever et al. (2003) that the effect of ADHD on delinquency is largely mediated through low self-control suggests that the current ADHD symptoms may be largely mediated by aspects of low self-control, perhaps when combined with CD and anger problems. In addition, the association found in the current study between CD and offending is likely to be partly explained by low self-control (Gibson, 2010).

The findings show that current ADHD symptoms and being on medication for ADHD are significant predictors of both nonviolent and violent delinquency with low to medium effect sizes. The largest effect size was found for those currently on medication for ADHD (medium effect size). This most likely reflects that participants who were taking medication for ADHD have greater severity of symptoms and functional impairment. The results corroborate findings from the United Kingdom (Langley et al., 2010) and the United States (Barkley, Fisher, Smallish, & Fletcher, 2006; Biederman et al., 2006) suggesting that diagnosing and treating ADHD with medication may be insufficient to

prevent persistent functional impairments. However, it is not clear whether these findings reflect poor clinical practice rather than a lack of efficacy of the medication (i.e., it is possible that the treatment had not been optimized among the medicated participants). Irrespective of this, it is likely that psychological intervention is required, either in combination with ADHD medication or instead of medication, to address these issues (Emilsson et al., 2011; Young, Misch, et al., 2011; Young & Ross, 2007). Furthermore, the early identification of persistent disruptive behavior in school may suggest undiagnosed behavioral difficulty associated with ADHD and/or CD, and school exclusion could represent an important opportunity to detect such difficulties and manage them (O'Regan, 2010, Young, in press).

The strengths of the study are the large sample size, it being a highly representative sample for an entire country, using two offending measures that distinguish between nonviolent and violent delinquency, and using a range of salient predictor variables involving both behavioral and dynamic emotional/psychological risk factors. This is a very large national epidemiological risk study, and it is likely that the findings will generalize to other countries, including the United States and the United Kingdom. The findings are consistent with previous studies from other countries in terms of overall rate of ADHD screening symptoms (5.2%), associations between the outcome and predictor variables, and the important role of ADHD medication status as a vulnerability factor to the severity of their condition. Those on medication are likely to have a history of more severe symptoms and functional impairment than those identified by the screens.

The study has a number of limitations. First, there is caution warranted in that some of the findings may be exaggerated due to the exclusive reliance of self-report for all measures in the current study. Second, ADHD status was determined using current ADHD screening symptoms and ADHD medication status. Therefore, the effects of childhood symptoms that have fully remitted cannot be determined. Third, the effects of ADHD were investigated in a study of healthy students where only 5.2% of the participants self-reported ADHD, many of whom may have been subthreshold of a clinical diagnosis (Young & Gudjonsson, 2008). Compared with clinical samples, this relatively low rate of ADHD symptoms in an epidemiological sample may have weakened the relationship of ADHD with offending and substance use. It is possible that the direct effect of ADHD on offending would be stronger in a clinically diagnosed sample. Fourth, this is a cross-sectional study, and longitudinal research is needed to explore causative mechanisms.

What the current findings do not tell us is the early influence of ADHD in substance use, peer relationships, and offending. In spite of these limitations, the current findings

show powerful and robust effects and add substantially to the existing literature. The conclusion is that the effect of current ADHD on offending is primarily indirect via substance use, CD, peer delinquency, and violent attitudes. Future research needs to investigate to what extent the relationship between these predictors and offending, individually or in combination (interaction effects), is mediated by low self-control in accordance with general theory of crime (Gottfredson & Hirschi, 1990).

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References

- American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: Author.
- Barkley, R. A. (1998). *Attention deficit/hyperactivity disorder: A handbook for diagnosis and treatment* (2nd ed.). New York, NY: Guilford.
- Barkley, R. A., Fischer, M., Smallish, L., & Fletcher, K. (2004). Young adult follow-up of hyperactive children: Antisocial activities and drug use. *Journal of Child Psychology and Psychiatry*, *45*, 195-211.
- Barkley, R. A., Fischer, M., Smallish, L., & Fletcher, K. (2006). Young adult outcome in hyperactive children: Adaptive functioning in major life events. *Journal of the American Academy of Child & Adolescent Psychiatry*, *45*, 167-179.
- Barkley, R. A., Murphy, K. R., & Fischer, M. (2008). *ADHD in adults: What the science says*. New York, NY: Guilford.
- Biederman, J., Monuteaux, M., Mick, E., Wilens, T., Fontanella, J., Poetzl, K., . . . Faraone, S. (2006). Is cigarette smoking a gateway drug to subsequent alcohol and drug use disorders? A controlled study of youths with and without ADHD. *Biological Psychiatry*, *59*, 258-264.
- Biederman, J., Newcorn, J., & Sprich, S. (1991). Comorbidity of attention deficit hyperactivity disorder with conduct, depressive, anxiety and other disorders. *American Journal of Psychiatry*, *148*, 564-577.
- Brassett-Grundy, A., & Butler, N. (2004). *Prevalence and adult outcomes of attention-deficit/hyperactivity disorder: Evidence from a 30-year prospective longitudinal study* (Bedford Group for Life course & Statistical Studies Occasional Paper No. 2). London, England: University of London.
- Cohen, J. (1992). A power primer. *Psychological Bulletin*, *112*, 155-159.
- Derogatis, L. R., & Cleary, P. (1977). Confirmation of the dimensional structure of the SCL-90: A study in construct validation. *Journal of Clinical Psychology*, *33*, 981-989.
- Emilsson, B., Gudjonsson, G., Sigurdsson, J. F., Einarsson, E., Baldursson, G., Olafsdottir, H., & Young, S. (2011). R&R2 cognitive behaviour therapy in medication-treated adults with ADHD and persistent symptoms: A randomized controlled trial. *BMC Psychiatry*, *11*, 116. doi:10.1186/1471-244X-11-116
- Faraone, S. V. (2005). The scientific foundation for understanding attention deficit-hyperactivity disorder as a valid psychiatric disorder. *European Child Adolescent Psychiatry*, *14*, 1-10.
- Farrington, D. P. (1990). Implications of criminal career research for the prevention of offending. *Journal of Adolescence*, *13*, 93-113.
- Farrington, D. P., Ttofi, M. M., & Coid, J. W. (2009). Development of adolescence-limited, late-onset, and persistent offenders from age 8 to age 48. *Aggressive Behavior*, *35*, 150-163.
- Fite, P. J., & Colder, C. R. (2007). Proactive and reactive aggression and peer delinquency implications for prevention and intervention. *Journal of Early Adolescence*, *27*, 223-240.
- Gibson, C. L. (2010). Gotterredson, Michael, R., and Travis Hirschi: Self-control theory. In F. T. Cullen & P. K. Wilcox (Eds.), *Encyclopedia of criminological theory* (Vol. 1, pp. 392-399). London, England: SAGE.
- Gottfredson, M. R., & Hirschi, T. (1990). *A general theory of crime*. Stanford, CA: Stanford University Press.
- Gudjonsson, G. H., Einarsson, E., Bragason, O. O., & Sigurdsson, J. F. (2006). Personality predictors of self-reported offending in Icelandic students. *Psychology, Crime & Law*, *47*, 361-368.
- Gudjonsson, G. H., Sigurdsson, J. F., Adalsteinsson, T. F., & Young, S. (2011). The relationship between ADHD symptoms, mood instability, and self-reported offending. *Journal of Attention Disorders*. Retrieved from <http://jad.sagepub.com/content/early/2012/01/30/1087054711429791>
- Gudjonsson, G. H., Sigurdsson, J. F., Asgeirsdottir, B. B., & Sigfusdottir, I. D. (2007). Custodial interrogation: What are the background factors associated with claimed false confessions? *Journal of Forensic Psychiatry & Psychology*, *18*, 266-275.
- Gudjonsson, G. H., Sigurdsson, J. F., Einarsson, E., Bragason, O. O., & Newton, A. K. (2008). Interrogative suggestibility, compliance and false confessions among prisoners and their relationship with attention deficit hyperactivity disorder (ADHD) symptoms. *Psychological Medicine*, *38*, 1037-1044.
- Gudjonsson, G. H., Sigurdsson, J. F., Sigfusdottir, I. D., & Asgeirsdottir, B. B. (2008). False confessions and individual differences: The importance of victimization among youth. *Personality and Individual Differences*, *45*, 801-805.
- Gudjonsson, G. H., Sigurdsson, J. F., Skapatdottir, S. L., & Helgadóttir, Þ. (2011). The relationship of violent attitudes with self-reported offending and antisocial personality traits. *Journal of Forensic Psychiatry & Psychology*, *22*, 371-380.

- Gudjonsson, G. H., Wells, J., & Young, S. (2011). Motivation for offending among prisoners and the relationship with axis I and axis II disorders and ADHD symptoms. *Personality and Individual Differences, 50*, 64-68.
- Keenan, K., Loeber, R., Zhang, Q., Stouthamer-Loeber, M., & Van Kammen, W. (1995). The influence of deviant peers on the development of boys' disruptive and delinquent behavior: A temporal analysis. *Development and Psychopathology, 7*, 715-726.
- Langley, K., Fowler, T., Ford, T., Thaper, A. K., van den Bree, M., Harold, G., . . . Thaper, A. (2010). Adolescent clinical outcomes for young people with attention-deficit hyperactivity disorder. *British Journal of Psychiatry, 196*, 235-240.
- Lewinsohn, P. M., Rohde, P., & Farrington, D. P. (2000). The OADP-CDS: A brief screener for adolescent conduct disorder. *Journal of the American Academy of Child & Adolescent Psychology, 39*, 888-895.
- Lynam, D. R. (1996). Early identification of chronic offenders: Who is the fledgling psychopath? *Psychological Bulletin, 120*, 209-234.
- Magnusson, P., Smari, J., Sigurdardottir, D., Baldursson G., Sigmundsson, J., Kristjansson, K., . . . Sigurbjornsdottir, S. (2006). Validity of self-report and informant rating scales of adult ADHD symptoms in comparison with a semistructured diagnostic interview. *Journal of Attention Disorders, 9*, 494-503.
- Mordre, M., Groholt, B., Kjelsberg, E., Sandstad, B., & Myhre, A. M. (2011). The impact of ADHD and conduct disorder in childhood on adult delinquency: A 30 years follow-up study using official crime records. *BMC Psychiatry, 11*, 57.
- O'Regan, F. (2010). Exclusion from school and attention-deficit/hyperactivity disorder. *International Journal of Emotional Education, 2*, 3-18.
- Polanczyk, G., Silva de Lima, M., Horta, B. H., Biederman, J., & Rohde, L. A. (2007). The worldwide prevalence of ADHD: A systematic review and meta-regression analysis. *American Journal of Psychiatry, 164*, 942-948.
- Retz, W., & Rosler, M. (2009). The relation of ADHD and violent aggression: What can we learn from epidemiological and genetic studies? *International Journal of Law and Psychiatry, 32*, 235-243.
- Retz, W., & Rosler, M. (2010). Association of ADHD with reactive and proactive violent behavior in a forensic population. *ADHD Attention Deficit Hyperactivity Disorders, 2*, 195-202.
- Rosenberg, M. (1965). *Society and the adolescent child*. Princeton, NJ: Princeton University Press.
- Satterfield, J. H., Faller, K. J., Crinella, F. M., Schell, A. M., Swanson, J. M., & Homer, L. D. (2007). A 30-year prospective follow-up study of hyperactive boys with conduct problems: Adult criminality. *Journal of the American Academy of Child & Adolescent Psychiatry, 46*, 601-610.
- Sevecke, K., Kosson, D. S., & Krischer, M. K. (2009). The relationship between attention deficit hyperactivity disorder, conduct disorder, and psychopathy in adolescent male and females detainees. *Behavioral Sciences & the Law, 27*, 577-598.
- Sibley, M. H., Pelham, W. E., Molina, B. S. G., Gnagy, E. M., Waschbusch, D. A., Biswas, A., . . . Karch, K. M. (2011). The delinquency outcomes of boys with ADHD with and without comorbidity. *Journal of Abnormal Child Psychology, 39*, 21-32.
- Sigfusdottir, I. D., Farkas, G., & Silver, E. (2004). The role of depressed mood and anger in the relationship between family conflict and delinquent behaviour. *Journal of Youth and Adolescence, 33*, 509-522.
- Sigfusdottir, I. D., Gudjonsson, G. H., & Sigurdsson, J. F. (2010). Bullying and delinquency: The mediating role of anger. *Personality and Individual Differences, 48*, 391-396.
- Sourander, A., Elonheimo, H., Niemelä, S., Nuutila, A.-M., Helenius, H., Sillanmäki, L., . . . Almquist, F. (2006). Childhood predictors of male criminality: A prospective population-based follow-up study from age 8 to late adolescence. *Journal of the American Academy of Child & Adolescent Psychiatry, 45*, 578-586.
- Spiropoulos, G. V. (2010). Bandura, Albert: Social learning theory. In F. T. Cullen & P. K. Wilcox (Eds.), *Encyclopedia of criminological theory* (Vol. 2, pp. 67-72). London, England: SAGE.
- Unnever, J. D., Cullen, F. T., & Agnew, R. (2006). Why is "bad" parenting criminogenic? *Youth Violence and Juvenile Justice, 4*, 3-33.
- Unnever, J. D., Cullen, F. T., & Pratt, T. C. (2003). Parental management, ADHD, and delinquent involvement: Reassessing Gottfredson and Hirschi's general theory. *Justice Quarterly, 20*, 471-500.
- Warr, M. (2010). Peers and delinquency. In F. T. Cullen & P. K. Wilcox (Eds.), *Encyclopedia of criminological theory* (Vol. 2, pp. 694-699) London, England: SAGE.
- Young, S. (2005). Coping strategies used by ADHD adults. *Personality and Individual Differences, 38*, 809-816.
- Young, S. (in press). The 'RAPID' cognitive behavioral therapy program for inattentive children: Preliminary findings. *Journal of Attention Disorders*.
- Young, S., Adamou, M., Bolea, B., Müller, U., Pitts, M., Thome, J., & Asherson, P. (2011). The identification and management of ADHD offenders within the criminal justice system: A consensus statement from the UK Adult ADHD network and criminal justice agencies. *BMC Psychiatry, 11*, 32. doi:10.1186/1471-244X-11-32
- Young, S., & Gudjonsson, G. H. (2006). ADHD symptomatology and its relationship with emotional, social and delinquency problems. *Psychology, Crime & Law, 12*, 463-471.
- Young, S., & Gudjonsson, G. H. (2008). Growing out of ADHD: The relationship between functioning and symptoms. *Journal of Attention Disorders, 12*, 162-169.
- Young, S., Gudjonsson, G. H., Ball, S., & Lam, J. (2003). Attention Deficit Hyperactivity Disorder (ADHD) in personality disordered offenders and the association with disruptive

behavioural problems. *Journal of Forensic Psychiatry & Psychology*, 14, 491-505.

Young, S., Misch, P., Collins, P., & Gudjonsson, G. H. (2011). Predictors of institutional behavioural disturbance and offending in the community among young offenders. *Journal of Forensic Psychiatry & Psychology*, 22, 72-86.

Young, S., & Ross, R. R. (2007). *R&R2 for ADHD youths and adults with ADHD: A prosocial competence training program*. Ottawa, Ontario: Cognitive Centre of Canada. Retrieved from www.cognitivecentre.ca/

Young, S., Wells, J., & Gudjonsson, G. H. (2011). Predictors of offending among prisoners: The role of attention-deficit hyperactivity disorder and substance use. *Journal of Psychopharmacology*, 25, 1524-1532.

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